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Draft Final Phase II Additional Interim Actions Work Plan

Volume 1 – Soil Vapor Extraction System Upgrades and Start-up Testing with Monitoring Well Installation

Pasco Landfill Site
Pasco, Washington

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Tables

Figures

1.0 INTRODUCTION

This document presents the Phase II Additional Interim Actions (AIAs) Work Plan, Volume 1 for the Pasco Sanitary Landfill Site located in Pasco, Washington (Site). The location of the Site is indicated on Figure 1. This Work Plan has been prepared on behalf the Industrial Waste Area Generators Group II (IWAG) by Environmental Partners, Inc. (EPI) in continued fulfillment of the requirements of Agreed Order No. DE-00TCPER-1324 (Order).

An Agreement-in-Principle for the scope of the Phase II AIAs was provided by the IWAG to the Washington Department of Ecology (Ecology) and the Attorney General's Office (AG) in a letter dated August 31, 2009. In a letter dated September 18, 2009 and received on September 21, 2009 the Attorney General's Office subsequently provided the IWAG with initial approval to perform the Phase II AIAs under the Order.

Volume 1 of the Phase II AIAs Work Plan is focused on the planned actions for Soil Vapor Extraction (SVE) system upgrades and subsequent startup testing and monitoring well installation. Volume 1 also contains specific investigative tasks to be performed during the SVE system upgrades and monitoring well installation. A subsequent Volume 2 of the Phase II AIAs Work Plan will focus on remaining investigative tasks and the installation and monitoring of additional ground water wells. All of these actions are being performed in support of the negotiation of a new Agreed Order and performance of a Focused Feasibility Study (FFS) under the new Agreed Order.

The IWAG has previously completed Phase I of the AIAs. The Phase I AIA scope of work included a detailed evaluation of the existing SVE system and implemented changes to the flow regime of that system to optimize its current contaminant mass removal capacity. In addition, the Phase I AIA scope of work included an evaluation of the effectiveness and expected future performance of the current Zone A landfill cap system, and the NoVOCs ground water treatment component of the Interim Remedial Measures (IRMs) at the Site. The IWAG prepared an interim deliverable presenting the findings of the SVE evaluation in a Technical Memorandum titled *Phase I AIA Interim Findings and Conclusions, Soil Vapor Extraction System Testing*, dated February 20, 2009. Those findings and concurrent findings of ongoing data collection led the IWAG to the conclusion that additional upgrades to the SVE system would enable this IRM to be substantially more effective than the current system.

The IWAG subsequently presented to Ecology a Technical Memorandum titled *Proposed SVE Modifications and Upgrades,* dated March 20, 2009 that presented a technical rationale and conceptual design for a proposed upgraded SVE system. The intent of the proposed upgrades was to further increase the contaminant mass removal capacity of the existing IRM as well as increasing its level of protectiveness of ground water quality.

At the completion of Phase I of the AIAs the IWAG prepared a Combined 2008 Annual Report and Phase I AIA Report, dated May 20, 2009 presenting additional data and interpretation of the Phase I AIA findings. The Phase I AIA data strongly supported a conclusion that the optimized existing SVE system was serving to interrupt the contaminant migration pathway for VOCs within the effective radius of the system. Ongoing impacts to ground water suggest that contaminant migration to ground water may be ongoing in area outside of the current radius of capture. This finding was primarily supported by substantially improved ground water quality in response to the changes made in the operation of the existing SVE system. Ongoing ground water monitoring performed since the completion of the Phase I AIAs continues to support this conclusion in the form of progressively improving ground water quality at, and hydraulically downgradient of, the Industrial Waste Area and Zone A.

The findings of the Phase I AIAs and subsequently collected data continue to strongly support a conclusion that implementing SVE upgrades consistent with those proposed in the March 20, 2009 Technical Memorandum would provide substantial benefit to the site. The benefits include more focused contaminant mass recovery directly beneath Zone A and additional capacity to capture potential future transient changes in source strength, as well as providing additional source monitoring capability for soil and ground water.

The Phase I AIAs also resulted in a revised conceptual site model (CSM) for the Site and a more thorough understanding of the apparent modes and mechanisms of release from Zone A, the mechanisms for contaminant mass transfer between environmental media, and the nature and extent of impacts near and immediately downgradient of Zone A. During performance of the Phase I AIAs it was discovered that the NoVOCs ground water treatment component of the IRAs was not performing as originally designed and likely only providing marginal ground water treatment. As a result of this finding the NoVOCs system was deactivated during the Phase I AIAs and remains dormant. The Phase I AIAs also identified additional data gaps that, if filled, would likely provide the level of understanding necessary for performing an FFS and to develop a DCAP. The Phase II AIAs are intended, in part, to provide the data necessary to complete the FFS and ultimately to develop the DCAP.

This document presents a Work Plan for implementation of the SVE upgrades, start-up testing of those upgrades, developing an operational and management approach for the upgraded system, selected investigative tasks, and selected monitoring well installation and sampling. A subsequent Phase II AIA Work Plan, Volume II will address additional investigative tasks for the Site.

2.0 TECHNICAL BASIS AND RATIONALE

As noted above, the IWAG previously submitted a document presenting a conceptual design for upgrades and modifications to the SVE system. The conceptual design has been discussed with Ecology on several occasions and most recently on July 15, 2009 and again in a follow-up meeting on August 10, 2009. In July the IWAG and Ecology was generally agreed between that this Work Plan would be prepared with a detailed description of the installation and testing procedures involved.

This Work Plan presents three basic classes of actions. These actions include: 1) SVE upgrades and modifications and startup testing; 2) investigative tasks to be performed beneath Zone A in conjunction with SVE upgrade activities; and 3) additional monitoring well installation both proximal to, and downgradient of, Zone A.

The technical basis and rationale for performing upgrades and startup testing of the SVE system are:

- The Phase I AIAs and ongoing ground water monitoring have strongly indicated that SVE is capable of breaking the contaminant migration pathway between the Zone A wastes and ground water.
- Geophysical surveys suggest that reasonable access exists for vertical drilling through Zone A adjacent to the stacked drums.
- The vadose zone at the Site is well-suited to SVE.
- The placement of SVE wells more proximal to the Zone A wastes and beneath the geomembrane will focus induced airflow beneath the wastes and limit the dilution of the recovered vapors by unimpacted soil gas from areas outside the geomembrane cap.
- Increased contaminant mass removal rates and focused SVE proximal to the Zone A wastes will be more protective of ground water quality than the current system.
- Additional SVE capacity provides a method for addressing potential future transient changes in source strength at Zone A and improves the ability of the system to prevent the migration of contaminants to ground water.
- Data gathered during the SVE startup testing and subsequent operation will inform future evaluations and decisions on final remedial strategies and Site closure.

The technical basis and rationale for performing additional investigative tasks are:

- Additional data regarding soil conditions and contaminant distribution beneath Zone A will improve the understanding of past and current contaminant migration, including VOCs and other site-related contaminants.

- Monitoring wells in the area of mass transfer from the vadose zone to ground water will provide ongoing quantitative data regarding source term ground water quality and the effectiveness of SVE for protecting ground water quality.

The technical basis and rationale for additional downgradient monitoring well installation are:

- The Phase I AIAs and ongoing ground water monitoring have indicated an improvement in ground water quality as a result of changes to the existing SVE system.
- The Phase I AIAs suggest the presence of two relatively narrow and focused areas of dissolved-phase compound concentrations originating beneath Zone A.
- Monitoring areas downgradient of Zone A allows quantifiable evaluation of the effectiveness of the upgraded SVE system for protecting ground water quality.
- Monitoring ground water quality at appropriate downgradient locations can provide a quantifiable measurement of the attainment of cleanup levels at the limits of the property.

2.1 Objectives

The general objectives of the scope of work presented herein are to:

- Improve the effectiveness and protectiveness of the SVE component of the existing IRMs,
- Evaluate and measure the effectiveness of the upgraded SVE system and IRMs; and
- Provide necessary data to further the understanding of the site and inform the pending Focused Feasibility Study (FFS).

To satisfy these general objectives, the following specific objectives have been established:

- Installing SVE wells directly beneath the Zone A cap and immediately proximal to the Zone A wastes;
- Providing SVE capacity within the shallow, intermediate, and deeper portions of the vadose zone;
- Collecting additional chemical and soil quality data during well installation to better understand contaminant distribution and migration beneath Zone A;
- Providing sufficient monitoring capacity to accurately assess SVE area of capture and contaminant mass removal performance;
- Providing ground water monitoring and performance monitoring capacity to better assess the operation of the upgraded SVE system and its ability to break the contaminant migration pathway between the Zone A wastes and ground water;

- Providing ground water monitoring capacity to better assess ground water quality at the property boundary and the ability to assess concentration attenuation between Zone A and the property boundary;

- Providing sufficient ground water monitoring data to inform future decisions on additional downgradient monitoring well locations; and

- Collecting sufficient SVE operational data to assess the appropriate operational modes that will maximize contaminant mass removal and the effective radius of capture and in order to better protect ground water quality.

The following sections present the specific actions and components of the planned scope of work that will be used to achieve the objective stated above. Section 2.2 presents the elements of the upgraded SVE system design, Section 2.3 presents the elements of additional investigation to be performed during the SVE system upgrades and section 2.4 presents the elements of additional downgradient well installation.

Later sections of this document detail the installation and sampling procedures as well as provide information on baseline testing and SVE system startup testing.

2.2 SVE System Design

The following sections present design details for the upgrades to the SVE system. Additional design calculations and refinements will be a component of the final design documents that will be prepared upon acceptance of this Work Plan by Ecology. All final design drawings will be reviewed and stamped by a Professional Engineer licensed in the State of Washington.

The system is designed to have the capacity to:

- <u>Extract soil gas from beneath the geomembrane and immediately proximal to the area of stacked drums.</u> Testing conducted during the Phase I AIAs indicates that wells in the proposed locations are likely to have a sufficient radius of influence to capture vapors beneath Zone A encompassing the area of both stacked and randomly placed drums. It is currently believed that the stacked drums are the primary source of impacts. Operational data from the upgraded SVE system may help to clarify the apparent source of VOCs to soil and/or ground water.

- <u>Extract soil gas from differing depths within the vadose zone.</u> This will allow vapor extraction to be targeted to those depths where vapors are most abundant and most readily recoverable. Flows, vacuums, and extraction depths will be tested and evaluated during the startup and testing. The resulting data will be used to develop an operating protocol for the upgraded SVE system.

- <u>Provide vapor and vacuum monitoring capacity sufficient to guide SVE system operation.</u> The system contains elements that allow for monitoring the induced vacuum field and residual vapors immediately beneath the geomembrane and at varying depths throughout the vadose zone. The design objectives of these features are to allow for the collection of necessary data, and provide sufficient SVE system control to maximize both the radius of effective capture and contaminant mass removal.

- Balance and manage vapor flows. The proposed system is sufficiently valved and instrumented to allow for fine-tuning of vacuums and flows between varying depths and locations. The system flows can also be readily adjusted to allow a high degree of operational flexibility such as pulsed operation, time-variable flow rates, alternating between shallow and deeper flows, or focusing flow at one set of wells.

- Provide excess contaminant removal capacity. System components and piping are sufficiently sized to allow for additional contaminant mass removal if data indicate an apparent transient event or a transient change in recoverable vapors.

- Provide performance monitoring capabilities. In addition to SVE system performance data collected from active vapor recovery wells; both the vapor monitoring probes and ground water monitoring wells beneath the cap can be used to provide data for assessing and measuring the effectiveness of the system. Vapor monitoring points allow for an evaluation of the effectiveness of the system at providing sufficient lateral coverage to capture residual vapor. The monitoring wells will provide data to assess attainment of ground water cleanup criteria at the source area. Additional wells downgradient of Zone A will provide data regarding how improvements in ground water quality near the source of release are propagated to other portions of the Pasco Landfill Site property. Figure 2 depicts the property boundaries downgradient of Zone A and the proposed new well and probe locations.

It is possible that releases from Zone A have somewhat altered the original soil conditions in the immediate proximity of Zone A and immediately below the wastes. Such alterations would primarily be due to the presence of wastes within the soil matrix and could affect such soil properties as porosity and permeability. Such effects, if present, are likely to affect a relatively small volume of soil compared to the total thickness of the vadose zone and area of Zone A and are anticipated to be heterogeneously distributed. Such effects would not be readily discernable during operation of the current SVE system.

It is not anticipated that such effects on soil properties, if present, will adversely affect the operation and performance of the upgraded SVE system. As noted, only a relatively small volume of soil is potentially affected. The upgraded SVE system will be robust and flexible and will be subjected to ongoing testing and maintenance even after startup testing. Any changes to permeability and porosity that occur as a result of actual system operation will be observable in system flows, vacuums, and recovery rates. Adjustments to such changes can be made during normal operation and maintenance of the system. While it is not possible to anticipate all potential conditions beneath Zone A, now and in the future, it is our opinion that the planned SVE upgrades address the most likely changes and anticipate the ability to adjust the system in response to such changes.

2.2.1 Upgraded SVE System Elements

The proposed SVE upgrades consist of installing two sets of three SVE wells vertically staggered within the shallow, intermediate and deep portions of the vadose zone, one intermediate and one deep vapor monitoring probe, ten shallow monitoring probes, and three ground water monitoring wells. The planned locations of new SVE wells, intermediate and deep vapor monitoring probes, the shallow monitoring probes and the ground water monitoring wells within Zone A are indicated on Figure 3. As discussed in Section 2.5.2.1, the final locations may vary somewhat from the planned locations, depending on conditions encountered in the field.

This Work Plan presents the generally anticipated elements of the system and the methods and procedures of installation and testing. Upon acceptance of this Work Plan by Ecology, additional engineering will be performed to finalize the system design. That engineering and design will be consistent with the U.S. Army Corps of Engineers, *Engineer Manual, Engineering and Design, Soil Vapor Extraction and Bioventing* dated June 3, 2002. The final upgraded SVE system design will be presented in an Engineering Design Document prepared by the IWAG and to be submitted in the future under separate cover.

2.2.1.1 SVE Wells

The SVE well groupings will be denoted at VEW-06 and VEW-07, with the shallow, intermediate, and deep wells having the suffixes of S, I, and D. That is, the shallow SVE well at the VEW-07 grouping will be denoted as VEW-07S. This also includes the intermediate and deep SVE monitoring probes denoted VMW-51I and VMW-51D. These intermediate and deep SVE monitoring probes will be constructed in the same manner as the SVE wells, but it is not anticipated at this time that they will be used for vapor recovery.

Figure 3 illustrates the currently anticipated well locations within Zone A. Figures 4 and 5 detail the currently anticipated completion depths and screened intervals. Final well depths and screened intervals have yet to be established and will be based upon ongoing capture analysis modeling as part of system design.

2.2.1.1.1 Shallow SVE Wells

The shallow SVE wells will be installed with approximately 5 feet of screened interval extending from approximately 1 to 6 feet below the bottom of the Zone A high-density polyethylene (HDPE) geomembrane. The total length of these wells will depend on the depth of cover above the geomembrane. It is anticipated that these wells will be completed within historically disturbed soils used to construct the separation between the stacked and randomly placed drums. These soils are not thought to have been placed in an engineered manner and are likely to contain some amount of debris.

The shallow SVE wells are expected to exert a vacuum immediately beneath the geomembrane and to capture vapors that have accumulated beneath the HDPE geomembrane liner. Due to density-driven vapor migration, the vapors that have accumulated beneath the geomembrane may have a different chemical composition than those within deeper portions of the vadose zone. Probes and wells completed within differing depths will be sampled and analyzed for soil gas composition. An evaluation of compositional changes in the soil gas mixture will help to evaluation the degree to which density-driven migration may influence vapor migration and soil gas composition

It is currently expected that during startup and initial operation, these wells will have a high rate of mass recovery but that this rate of mass recovery will decrease relatively quickly over time. During testing and operation, the optimal induced airflow balance between the shallow and intermediate wells will be evaluated and operational system settings will be selected based on maximizing contaminant mass recovery and the lateral and vertical extent of the vacuum field. Data collected from the vacuum monitoring points (both vacuum and soil gas quality) will also be used to adjust the SVE system operating parameters.

2.2.1.1.2 Intermediate Depth SVE Wells

The intermediate depth SVE wells will be installed with approximately 10 feet of screened interval extending from approximately 5 to 10 feet below the bottom of Zone A, as determined during well drilling and soil logging. These wells will be installed within the Touchet Beds soils. The final depths of these wells are yet to be determined and will be based upon the subsurface conditions encountered, previous boring logs (e.g., MW-47D) and a capture zone analysis to be provided in the Engineering Design Document. The screened interval and depths for these wells will be designed to maximize the effective radius of capture and to limit potential short-circuiting of airflow through the bottom of the Touchet Beds from the more permeable underlying Upper Pasco Gravels.

The intermediate depth SVE wells are currently expected to have the largest radius of influence and the highest sustained rate and long-term recovery of contaminant mass. This expectation is based upon their proximity to the bottom of Zone A, the operating condition of the current SVE system, and the CSM. Actual mass recovery and operating conditions will be evaluated during the startup of the upgraded SVE system and system operation will take into account both radius of capture and contaminant mass removal rates.

2.2.1.1.3 Deep SVE Wells

The deep SVE wells will be installed with approximately 15 feet of screened interval extending from approximately 55 to 70 feet below grade, or approximately 10 feet above the water table. These wells will be installed within the Upper Pasco Gravels. The general purpose of these wells is to provide additional mass recovery capacity for the SVE system in the event that the shallow and intermediate SVE wells cannot fully break the contaminant migration pathway between Zone A and ground water. The deep wells will also provide excess recovery capacity in the event of a transient increase in source strength from Zone A and to monitor vacuum and vapors within the Upper Pasco Gravels.

2.2.1.2 Vacuum Monitoring Probes

Vapor monitoring probes will be denoted by a VMP prefix and will be numbered sequentially 1 through 10. These monitoring probes will be installed with 12-inch screened intervals placed about 6 to 8 inches beneath the HDPE liner and sealed at the surface. The purpose of these probes is to provide data regarding the induced vacuum field beneath the geomembrane and to allow sampling of the vapors that may accumulate beneath the geomembrane. These data will inform the IWAG regarding the effectiveness of the upgraded SVE system. The vapor monitoring probe data may also be used to make decisions regarding SVE system operation and flow balancing.

2.2.1.3 Near-Source Ground Water Monitoring Wells

Near source monitoring wells will be denoted with an MW prefix and will be named MW-52S and MW-53S since each well will be screened within the shallow portion of the aquifer. These wells will be constructed with

15 feet of screened interval, with about 10 feet below the static water level at the time of drilling and about 5 feet above.

Monitoring wells MW-52S and MW-53S will provide a monitoring capacity at the source of contaminant mass transfer from the vadose zone to ground water. Water quality information from these wells will provide data for a direct evaluation of the effectiveness of the SVE system at preventing contaminant mass transfer to ground water. It may be appropriate to compare the data from these wells with progressively downgradient monitoring wells. This would allow an evaluation of a rate of change in concentration versus distance and f concentration attenuation over time as the upgraded SVE system operates.

2.2.2 Upgraded SVE System Components

Figure 6 presents a plan view layout of the upgraded SVE system. Figure 7 presents the SVE system schematic providing additional detail on system components. Together these two figures illustrate the basic system components.

The major components of the extraction and treatment equipment currently exist at the Site. The existing SVE blower and equipment compound will continue to be used and it is anticipated that this regenerative type vacuum blower has sufficient operational capacity. The existing system will be retrofitted as a component of the upgraded system. If necessary, a different positive displacement (PD) vacuum blower, or additional PD blowers can be incorporated into the existing system with some modifications. Currently unused 10 horsepower and 30 horsepower PD blowers at the Site could be used for this purpose.

Treatment of the extracted vapor will continue to be performed by the Municipal Solid Waste Landfill flare using the existing piping alignment. The management and operation of the flare will continue to be performed by the Landfill Group. In the event of a flare shut down during startup testing, the extracted air stream will be treated using the existing granular activated carbon (GAC) vessel with about a 10,000-pound GAC capacity. This vessel will be refilled with new GAC prior to startup testing. The carbon vendor estimates that at 600 cubic feet/minute a 10,000-pound GAC vessel can provide about 10 days of treatment for the currently extracted air stream before the first compound breaks through. The flare has been modified to increase its dependability and, even prior to modifications the flare was typically off only about 1 day/month.

The layout indicates the planned general locations of SVE wells, intermediate and deep vapor monitoring wells, vapor monitoring probes, ground water monitoring wells and the orientation of piping. Final locations of these features will be presented in the detailed design drawings and some modification of system layout will be required in the field to adjust to actual conditions.

Conveyance piping will generally be above grade. SVE wells will be constructed of 4-inch diameter materials and each of the three wells at each of the two well grouping will be connected into a 6-inch diameter conveyance line. These two individual lines will be routed above ground across the top of the cap to the south and then to the east toward Dietrich Road. The pipes will then be placed below grade beneath Dietrich Road and trenched to near the equipment compound where they will be stubbed to the surface and connected to the vacuum blower.

Conveyance piping will be constructed of high-density polyethylene (HDPE), which is both highly chemically resistant and resistant to degradation from ultraviolet (UV) radiation. The moisture knockouts for existing wells VEW-01 and VMW-02D will be removed from those lines and will be modified to collect condensate from the two 6-inch SVE conveyance lines that originate from the northern and southern portions of Zone A. The conveyance lines will slope to the south along the top of the cap toward the moisture knockouts. The extended above grade travel time for extracted vapor between the SVE wells and the knockouts will allow additional time for moisture to cool, condense, and collect within the knockouts. The moisture knockouts will also be modified with additional internal baffles to facilitate condensation prior to the piping being routed below grade where condensate accumulation may affect system performance.

Figure 4 presents an east-west cross section through Zone A illustrating the proposed below grade features of the upgraded SVE system relative to the current understanding of the orientation of wastes, soil, and ground water conditions. The illustrated depths and lengths of screened intervals for the SVE wells may be refined based upon additional design and capture analysis. The final planned depths and screened intervals and the underlying calculations for that analysis will be presented in the detailed design documents to be submitted under separate cover.

Figures 4 and 5 illustrate how each of the three SVE wells in each grouping will be screened to recover vapors from varying depths. In the case of the intermediate and deep wells, the screens will be in different soil strata with differing pneumatic permeabilities. The intermediate depth wells will be screened within the Touchet Beds formation, which are generally finer grained, less pneumatically permeable and are assumed to have an appreciably higher horizontal permeability than vertical permeability. The deep wells will be screened within the Upper Pasco Gravels, which are generally coarser grained, have a higher permeability and are generally assumed to have less of a difference between horizontal and vertical permeabilities. The design analysis will focus on assessing the separation between screened intervals and the lithologic contact between the Touchet Beds and the Upper Pasco Gravels. The objective of this analysis will be to minimize, to the extent possible, the potential upward vapor flow through this lithologic contact as a result of vacuum extraction from the intermediate depth wells. The screened intervals and depths will be designed with the objectives of preventing the downward migration of soil vapors, maximizing lateral flow, achieving a large radius of capture, and maximizing mass removal.

Figure 6 presents a general piping routing diagram illustrating the general alignment of the above grade and below grade piping and piping connections. Additional detail on piping routing will be presented in the Engineering Design Document. However, some uncertainty will remain regarding actual routing and some field engineering may be required in order to successfully install the piping.

Figure 7 presents a general process and instrumentation diagram (P&ID) illustrating SVE system instrumentation and control logic. This diagram presents the SVE system components, how the system is instrumented and valved, and how basic controls interrelate with both manual and automatic controls.

2.3 Soil Sampling and Analysis

As noted above, one of the objectives of this portion of the Phase I AIAs is to continue to improve the understanding of the CSM, particularly with regard to contaminant migration through the vadose zone beneath Zone A and mass transfer from soil to ground water. One of the primary components of improving this understanding is through the collection of additional chemical and soil quality data beneath Zone A. These data, in conjunction with ground water quality immediately beneath Zone A, will significantly improve the current understanding of the mechanisms of mass transport from Zone A wastes to shallow ground water.

Soil samples will be collected and retained for physical and chemical analysis during SVE and monitoring well installation. Soil samples will be collected during the installation of five wells; each of the two deep SVE wells, each of the two monitoring wells within Zone A, and the single deep vapor monitoring well. The two deep SVE wells and the two monitoring wells will be located immediately west of the stacked drums in the berm area between the stacked and randomly placed drums. The intermediate and the deep vapor monitoring wells will be located immediately east of the stacked drums between the drums and the east detection basin. The locations of these wells are indicated on Figure 3.

During drilling, undisturbed soil samples will be collected at 5-foot vertical intervals. These samples will be collected by advancing a split spoon sampler into soils immediately below (ahead) of the tip of the drill stem. The split spoon sampler will be advanced using a standard drop hammer. These samples will be retained for chemical analyses of selected compounds. An additional sample of undisturbed soil will be collected at 10-foot vertical intervals for characterization of physical soil properties. These samples will be collected by advancing a Shelby tube, using a drop hammer or similar device.

Table 1 below presents the planned sampling depths and physical and chemical analyses that are anticipated at each of the five locations discussed above. The depth of the initial sample (i.e., 15 feet) will be targeted at the general observed depth of the original sub grade for the first tier of Zone A stacked drums. It is currently anticipated that the contact between previously disturbed and backfilled soils will be identifiable both on the basis of physical inspection and chemical impacts. Samples will then be retained for chemical and/or physical analysis at 5-foot intervals down to the depth of ground water. There may be necessary adjustments to sample depths and intervals based on the observed depth to the Zone A sub grade and the lithologic contacts between the Touchet Beds, Upper Pasco Gravels, and Lower Pasco Gravels.

Drilling will be performed using rotosonic methods and a continuous core of soil conditions will be retrieved and returned to the surface for inspection. Soil conditions will be visually inspected and logged and the soils will be subjected to field screening to assess the potential presence of impacts. Soil from selected locations throughout the soil core will be subjected to field screening using a photoionization detector (PID). Screening locations will be based upon field observations such as changes in soil grain size, apparent soil moisture, discoloration or other observed factors. Olfactory observations of soil conditions will be strictly prohibited and will not be used as a field indicator for health and safety reasons.

If field screening indicates that additional useful information may be gained through the collection of soils samples in addition to those indicated on Table 1, an additional targeted sample may be collected from the exposed soil core. These samples will be named with an additional “R” suffix to denote a field reconnaissance sample and to signify that they were collected from a disturbed soil core rather than undisturbed in situ soils.

Table 1
Summary of Planned Soil Sampling (a)

Depth(b)	Approx. Elevation	Lithologic Unit(c)	Chemical Analyses					Physical Properties			
			VOCs	SVOCs	Herb(d)	PCBs	Other(e)	Kv(f)	Kh(g)	TOC’(h)	Bulk Density
15	410	Touchet Beds	X	X	X	X	PPM(i)	X	X	X	X
20	405		X								
25	400		X	X	X	X	PPM			X	
30	395		X								
35	390		X	X	X		PPM	X	X	X	X
40	385		X								
45	380	Upper Pasco Gravel	X	X	X	X	PPM	X	X	X	X
50	375		X								
55	370		X	X	X	X	PPM	X	X	X	X
60	365		X								
65	360(j)	Lower Pasco Gravel	X	X	X	X		X	X	X	X

(a) Typical sampling depths and analyses at each location. Subject to adjustment based on field observations.
(b) Depth based upon assumed 15-foot depth to original starting subgrade for Zone A.
(c) Based upon current understanding of lithology beneath Zone A.
(d) Chlorophenoxy herbicides
(e) As indicated
(f) Vertical air permeability or hydraulic conductivity
(g) Horizontal air permeability or hydraulic conductivity
(h) Total organic carbon
(i) Priority Pollutant Metals
(j) Sample dependent upon depth to ground water. Saturated samples will not be retained for chemical analysis.

Additional details regarding drilling and sampling techniques is presented in Section 2.5 – Installation Procedures. Additional details regarding planned sample depths and physical and chemical analyses are presented below in Section 4.0 – Sampling and Analysis Plan.

2.4 Additional Monitoring Well Installation

2.4.1 Sentinel Well

Wells at the Site that are located immediately downgradient of potential sources or are intended to provide an early indication of contaminant migration have been termed "sentinel" wells. Zone A currently has at least one sentinel well grouping, wells MW-47S/I/D, and an additional shallow well, MW-13S, which serves as a sentinel well. As a component of the proposed work an additional sentinel well (designated as MW-50S) will be installed in the shallow portion of the aquifer immediately downgradient of Zone A outside of the landfill cap and north of the MW-47 cluster.

Well MW-50S will serve as a sentinel well for the northern half of the stacked drums at Zone A while MW-47S will serve the same function for the southern portion of Zone A. The planned location of well MW-50S is indicated on Figures 2 and 3.

These sentinel wells will provide ground water quality data to assess contaminant concentrations near the downgradient edge of Zone A. This includes (by comparison to data from wells MW-52S and MW-53) an evaluation of the possible contaminant attenuation along possible preferential contaminant flow paths as suggested during Phase I of the AIAs.

2.4.2 Downgradient Monitoring Well

Data from the Phase I AIAs indicated the need for an additional well along the western boundary of the property in the area of the general ground water flow path extending from the northern portion of Zone A, through NVM-03 and MW-49S/I/D. The installation of an additional monitoring well in this location along the property boundary would serve to assess shallow ground water quality at this potential conditional point of compliance. These data will also be used to assess the likely orientation of the central axial core of the dissolved-phase plume at, and hydraulically downgradient of, the property boundary.

This monitoring well will be named MW-51S and will be located approximately 350 feet north of MW-11S, which is near the southwestern corner of the property. The planned location of well MW-51S is indicated on Figure 2.

Routine sampling at wells MW-10S, MW-11S and MW-51S will be used to plan the location of an additional intermediate depth monitoring well at the property boundary and to evaluate the potential locations of additional off-property shallow (if necessary) and intermediate depth wells. These locations and their technical basis and rationale will be presented in detail the Phase II AIA Volume 2 Work Plan.

2.5 Installation Procedures

The following sections discuss the materials, methods and procedures for SVE well, monitoring well, and vapor monitoring probe installation.

2.5.1 Site Preparation and Access

The first step in site preparation will be to retain a licensed surveyor to locate each of the proposed SVE well and monitoring well locations. A stake will be driven at each location and appropriately labeled. A handheld global positioning system (GPS) unit will then be used to set a way point at each stake in order to double check and confirm the location at the time of actual field work.

No site preparation is needed for installation of wells MW-50S and MW-51S because these locations are readily accessible with tire-mounted drilling equipment. An access agreement will be necessary for installation of MW-51S, which is located within a crop irrigation circle owned by Pasco Sanitary Landfill and farmed under contract to others. Existing wells MW-10S and MW-11S are also located within the crop irrigation circle and it is assumed that access for this work will not be problematic.

Access for the work on the Zone A cap will be through the double gate to on the north of the Zone A fence. This area of the cap has a generally gentle slope that allows vehicular access. Road preparation may be necessary to provide access onto the Zone A cap. It may be necessary to smooth the rise on the north end of the cap in order to allow equipment to cross this area without high centering. Figure 12 presents a plan view of segregated health and safety zones and access routes.

Drilling and well installation will generally be from south to north in the following order:

- MW-50S
- MW-51S
- MW-53S
- VEW-7D/I/S
- VMW-51I/D
- MW-52S
- VEW-6D/I/S

Well installation access routes and well locations are presented in detail on Figure 8.

Immediately prior to drilling in each area, a small skid steer (i.e., Bobcat) will be used to remove surface material from the cap and prepare a level work surface for the drill rig. Approximately 12 inches of material will be left between the tracks of the drill rig and the HDPE geomembrane to limit potential damage to the geomembrane, and provide a level work surface. The remaining soil in the immediate area of the boring will be excavated using hand equipment to expose the geomembrane.

As noted above, the drilling activities are generally from south to north so that previously installed wells are not damaged during drilling of the later wells. The cap repair procedures around each well are discussed below in the well installation sections.

General repair and top dressing of the Zone A cap can be completed following completion of well installations are completed. Additional maintenance of the Zone A cap will be performed after later components of the Phase II AIA scope of work is completed. While it is the goal of the IWAG to fully reestablish appropriate site grades and to address subsidence within Zone A, such actions are most effectively performed after all activities that could potentially impact the Zone A cap have been completed.

2.5.2 Well Drilling and Installation

A total of six SVE wells (i.e., VEW-6S/I/D and VEW-7S/I/D), one intermediate depth vapor monitoring well (i.e., VMW-51I), one deep vapor monitoring well (i.e., VMW-51D), and four shallow zone monitoring wells (i.e., MW-50S through MW-53S) will be installed during the first portion of the Phase II AIAs.

2.5.2.1 Drilling Methods

Prior to cutting the geomembrane liner, all engineering controls in support of health and safety provisions will be implemented and amended as appropriate to provide a sufficient level of protection to Site workers and the environment. Section 6 – Health and Safety Plan, of this document details these procedures in greater detail. Upon completion of site preparation as discussed above, following the removal of the 12" of soil on top of the geomembrane liner using hand tools, a 2-foot by 2-foot section of the geomembrane and geosynthetic clay liner (GCL) will be removed and set aside for later use in the geomembrane repair, if required. A vacuum truck and air knife will then be used to vacuum excavate to a depth of 10 to 15 feet below the geomembrane. The purpose of the vacuum excavation is to assess the potential presence of drummed waste or other materials that could obstruct drilling or exacerbate the release of wastes. The 10 to 15 foot depth equates to the general depth of three to four tiers of stacked drums and some surface cover. It is expected that 15 feet will be approximately the maximum depth possible for air-knifing, and the depth of vacuum excavation may be adjusted in the field based on observed conditions. Native soil conditions are expected beneath the bottom of the Zone A wastes.

It is also possible that the soil types within the berm area may not support an open hole for this depth and excessive sloughing may occur. Excessive sloughing could undermine the surrounding geomembrane. If this condition occurs, it will be necessary to make a field determination regarding terminating vacuum excavation and proceeding with drilling.

If general debris such as scattered metal, wood, or other material are encountered within the vacuum excavations, but which in the determination of the driller and the supervising field personnel will not obstruct drilling or cause additional waste releases, then drilling will proceed in that area. If an obstruction is encountered and it is not possible to determine the nature of the obstruction from the surface, a video camera will be lowered into the excavation for a better inspection of the obstruction. Borings are only likely to be relocated if either stacked or randomly placed drums are encountered or if large pieces of debris are evident. This will result in the boring being backfilled with the removed materials and the portion of the geomembrane replaced and temporarily sealed with butyl tape or other products specifically intended for landfill cap repairs. Any such temporary repairs will be permanently sealed when the boots surrounding the newly installed wells are sealed. The procedure for boot sealing and patch repair is discussed below.

The process described above will be repeated at each planned drilling location. The SVE well and monitoring well locations are based upon the previously performed geophysical investigations and it is our opinion that there is a reasonably high probability that it will be possible to install the wells in, or very near, the planned locations. If it is not possible to install wells within the planned locations based on the conditions observed within the vacuum excavation, then a secondary location will be selected based upon the prior geophysical testing. It is more likely that the well boring location will be moved 5 to 10 feet in any given direction in order to avoid an obstruction observed within the vacuum excavation. Additional vacuum excavation will again be performed at the new drilling location. These decisions are somewhat subjective and will be made by the supervising field personnel.

Well drilling will be performed using rotosonic drilling techniques. The IWAG currently anticipates using a low ground pressure drill rig mounted on rubber tracks. This smaller rig will be more mobile on the Zone A cap, is likely to result in less disturbance of the cap, and exerts less ground pressure. This rig is both significantly lighter than a truck mounted drill rig, the weight is distributed over a larger physical footprint (i.e., rubber tracks vs. tires) and it is less likely to exert heavy surface loads, which could affect the stability of the underlying drums.

Once the borehole has been cleared for drilling, the support truck and drill rig will be put in place. A piece of 1-inch plywood with a 2-foot by 2-foot hole will be placed over the drilling area to limit damage to the geomembrane, limit sloughing, and to provide a good working surface for site workers.

At the locations of the multiple depth SVE wells, the deep zone well will be drilled first and only that well boring will be logged and sampled unless radically different conditions are observed. The installation depths of the intermediate and shallow wells will be based upon the well log for the deep well. Soil conditions within the core for the shallow and intermediate wells will be compared to the log and core of the deeper boring. The cores will be visually compared for significant differences. PID readings of subsample headspace from all soil cores will be collected at about 5 foot vertical intervals and recorded. These comparisons of visual and field screening differences will be used for potential additional subsample selection from the shallow and intermediate soil cores and will be noted on the boring logs.

In the case of the shallow SVE well and depending upon observed conditions, it may not be appropriate to vacuum excavate that boring. The shallow SVE wells would generally be installed within the first 5 to 15 feet of soil and vacuum excavation could sufficiently compromise soil conditions within this zone that the resulting near surface seal could be compromised. This will be a field decision based upon the conditions encountered during the deep and intermediate depth SVE wells.

Drilling will generally be initiated at 10 to 15 feet below the surface of the landfill cap. The first action will be to collected a split-spoon sample from the undisturbed soils at the starting depth of drilling. The drill stem will then be advanced to a depth of 15 feet below grade, any resulting cuttings will be brought to the surface for logging and screening and an additional split spoon sample will be collected from the 15-foot to 16.5 foot depth interval. If required by the sampling and analysis plan a Shelby Tube sample will then be collected from 16.5 feet to 19.5 feet below the top of the landfill surface.

Drilling will then proceed in 5-foot intervals. At each 5-foot interval, drilling will be stopped, and the cuttings will be retrieved and set aside for inspection. A 1.5-foot split spoon sampler will then be advanced into undisturbed soil ahead of the drill stem and retrieved. This process will be repeated until the terminal depth of drilling is reached.

The split spoon sampler will be lined with three 6-inch stainless steel sleeves. Upon retrieval, the open ends of the upper two sleeves will be sealed with polytetrafluorethylene (PTFE) patches and plastic end caps.

These sleeves will then be labeled and placed in a chilled cooler. These two sleeve samples will be designated for analysis of non-volatile compounds. If no non-volatile compound analysis is planned for a specific target depth, the sleeves will be emptied for visual inspection of the soils present. No sleeves will be re-used.

The bottom sleeve will be retained for sample collection using EPA Method 5035 for volatile compounds. Samples for both low-range and high-range analysis will be collected and placed within the appropriate pre-preserved sample containers, labeled and placed in a chilled cooler. The contents of the cooler will periodically be transferred to the refrigerator located at the job trailer on-site.

Drilling cuttings will be placed in prefabricated wooden core boxes for visual inspection, logging, and field screening. The encountered soil conditions will be logged using the Unified Soil Classification System (USCS) with visual-manual procedures (ASTM 2488D). As a component of soil logging, each 5-foot section of drilling cuttings will also be photodocumented. The soil conditions will also be field screened for the potential presence of impacts using visual inspection and PID measurements. Along with the logged soil conditions, noteworthy visual observations and PID measurements will also be recorded. For health and safety reasons, olfactory observations of the soils will be prohibited.

2.5.2.2 Well Installation

At the terminal depth of drilling and following the completion of final sampling, the boring will be double checked for total depth using a weighted tape measure. Upon confirming the total depth, well installation will begin. In the case of monitoring wells, the depth to water will also be confirmed. The water level within the hollow casing of the drilling flights will be allowed to stabilize for up to 60 minutes to establish an equilibrated piezometric condition. The measured depth to water and surface elevation will be used to calculate a ground water elevation and this elevation will be compared to current piezometric conditions in surrounding monitoring wells such as MW-47S. The water level elevation will be used, in part, to determine the well installation depth.

A typical SVE well completion detail is indicated on Figure 9 and a typical monitoring well completion is indicated on Figure 10.

The downhole well materials will be lowered into the cased borehole using a winch on the drill rig. Well construction materials for all wells located within Zone A will be 316 stainless steel and wells located outside of Zone A (i.e., MW-50S and MW-51S) will be constructed of Schedule 40 PVC.

Stainless steel wells will have flush threaded, box-thread connections. The screened intervals will consist of 0.010-inch continuous wire wound screen with smooth curved inner surfaces. The wells will have threaded end caps. The stainless steel materials are expected to provide better longevity within Zone A and will have additional structural integrity under differential settlement conditions. The wire wound wells screens also provide a maximum amount of open area to facilitate induced air flow. The smoothness of the stainless steel surface is also less conducive to surface adherence of biological growth and will be easier to clean if biological growth does occur. Based upon observed conditions at VMW-50S, biological growth within the SVE wells is possible.

PVC wells will also have flush threaded, box-thread connections. The screened intervals will consist of 0.010-inch factory machine cut slots and the well screens will have threaded endcaps. Based on prior experience at the Site, PVC is an appropriate material for the planned locations of MW-50S and MW-51S.

Prior to setting the well screen into the cased borehole, approximately 1 foot of filterpack will be added to the bottom of the borehole. After setting the well screen and blank well casing within the cased borehole, the remainder of the filter pack media will be placed. The filterpack will consist of a #10/20 clean washed Colorado Silica Sand. The sand will be allowed to fall down the annulus of the drill stem between the well casing and the borehole casing. The depth of sand in the annulus will be measured periodically and the surrounding casing will be lifted or jacked out of the borehole as sand is placed. The objective of this is to maintain sand within the borehole casing as the casing is lifted to assure that native material does not come into direct physical contact with the well casing. The well seal and surface seals will be placed in a similar manner. Wells will be completed under the supervision of a licensed well driller and in accordance with Minimum Standards for Maintenance and Construction of Wells WAC 173-160.

In the case of wells through the Zone A geomembrane, where vacuum excavation was performed for the upper 10 to 15 feet of the borehole, the borehole sidewall may be irregular and the boring casing may not be in contact with the surrounding soil. If this is the case, and the borehole sidewalls appear stable, the drill casing may be removed and the final well seal material may be placed within the open borehole against the well casing. The borehole will be filled to the surface with well seal materials and allowed to remain in this configuration until a later time when the well monuments and boots are placed. The well casing will be cut to a height of approximately 2 to 3 feet above the final cap grade and sealed with a J-plug type compression cap.

Upon completion of SVE well and monitoring well drilling on the Zone A cap, the well casings will be fitted with HDPE) boots. Prior to boot placement, the mating surface between the boot and the existing HDPE geomembrane will be thoroughly cleaned. The boot will then be temporarily sealed with a butyl tape designed for this purpose. After placement of all HDPE boots, a person or persons certified in geomembrane sealing will permanently heat weld the boots into place. This will allow the well boot sealing to be performed in a single mobilization. The purpose of this action is to ensure a proper seal between the well casing and the geomembrane liner and to prevent the intrusion of clean air into the subsurface.

After boot sealing is completed, the area surrounding the well will be backfilled, and a stick-up type monument will be installed during the backfill placement. The annulus between the well casing and the monument will be sealed with a cement grout and the area surrounding the base of the monument will be backfilled with concrete to provide a stable base for the monument.

The surrounding cap soils that were disturbed for access will then be regraded to generally match the surrounding Zone A cap grade. This is a temporary repair until such time as Zone A subsidence repairs are completed. Those repairs, to be documented in a later report, will reestablish the necessary cap layers and geotextile in the areas where they were disturbed for well drilling and access for well drilling.

Monitoring well MW-50s (sentinel well) will be completed with a flush mounted monument due to its proximity to Dietrich Road. Monitoring well MW-51S (downgradient property boundary monitoring well) will be completed with a stick-up type monument. Monument placement will be completed either prior to or immediately after demobilization from the well location.

2.5.3 Vacuum Monitoring Probe Installation

A total of 10 shallow vapor monitoring probes will be installed on the Zone A cap during the first round of the Phase II AIAs. These probes will be installed after the well drilling equipment as been demobilized from the Zone A cap to minimize the potential disruption and damage to completed probes during drilling and equipment movement.

The 10 vacuum monitoring probes will be installed in locations across the Zone A cap. These vacuum monitoring probes are intended to monitor vacuum and soil vapor conditions immediately beneath the geomembrane and GCL. The vacuum monitoring probes will be generally uniformly distributed across the Zone A cap and the planned locations of these probes are indicated on Figures 2 and 3. These probes will allow an evaluation of the induced vacuum field immediately beneath the geomembrane and changes in residual VOC vapor concentrations over time and distance. The data from these probes will be an important part of the SVE system operation and maintenance and will be considered when evaluating operational changes intended to maximize SVE system effectiveness.

The vacuum monitoring probes will generally be installed using manual techniques. In each planned location, a test pit will be excavated down to the geomembrane liner. In order to allow sufficient space to work, these test pits will typically be approximately 3 feet by 3 feet a the bottom with sufficient sidewall slopes to allow a safe working environment and stable sidewalls. A minimum of 1:1 horizontal to vertical slope is anticipated. It is not anticipated that the excavations will be deeper than approximately 4 feet and shoring should not be required.

At the base of the excavation, the geomembrane will be cleaned and a 2-inch by 2-inch square will be cut through the HDPE and GCL. A vacuum probe will then be driven into the underlying soil using a slide hammer. Each probe will have approximately 12 inches of screened interval and the top of the screen will be driven to approximately 6 to 12 inches below the depth of the geomembrane. An HDPE boot will then be slipped over the top of probe piping and mated to the HDPE geomembrane. The boot will be temporarily sealed with butyl tape designed for this purpose. Upon placement of all HDPE boots, a person or persons certified in geomembrane sealing will permanently heat weld the boots into place. This will allow the vacuum monitoring probe boots to be sealed in a single mobilization.

After the boots are heat welded into place, the area surrounding each vacuum probe will be backfilled. A small diameter stick-up type monument will be installed at the time of backfilling. The annulus between the probe casing and the monument casing will be sealed with a cement grout and the area around the base of the monument will be backfilled with concrete to provide a stable base for the monument.

Figure 11 presents a schematic of a typical vapor monitoring probe installation. The probe casing will be constructed of 1-inch diameter 316 stainless steel. The screened interval will be pre-fabricated well screen suitable for being driven into the subsurface. It is currently anticipated that the screened interval will consist of a fine stainless steel mesh supported by outer stainless steel reinforcing bars and an integral drive point. It is anticipated that each probe will consist of a 12-inch screened section and about a 5 foot section of blank casing. The total length of casing will depend upon the amount of cap overburden on the geomembrane at each location. It is anticipated that about the casing will extend approximately 2 to 3 feet above grade and the protective monument will extend 2.5 to 3.5 feet above grade.

The vacuum probe casing will be sealed with a threaded screw cap fitted with an airtight swage lock type fitting. The swage lock will allow ready interchanges of both a vacuum gage as well as a connection for vacuum vapor sampling without opening the probe to the surrounding atmosphere. The protective casing will be constructed of at least 6-inch diameter mild steel fitted with a lockable cap and a padlock.

2.5.4 Well Surveying

After monument placement is complete, all newly installed monitoring wells, SVE wells, vapor monitoring wells, and vapor monitoring probes will be surveyed for both horizontal and vertical coordinates. The top of the well casing, top of the riser, and ground surface elevation at each well will be surveyed to the nearest 0.01-foot. Horizontal positions will be surveyed to the nearest 0.1-foot. A mark will be placed on the casing to indicate the location was surveyed. All locations will be surveyed by a licensed land surveyor and referenced to semi-permanent monuments set on-site during the Phase I AIAs and tied to the State Plane Coordinate System (NAD 1983-91) and the North American Vertical Datum (NAVD88).

2.5.5 IDW Management

Investigation-derived waste (IDW) will be generated during SVE and monitoring well drilling and during subsequent monitoring well sampling. The IDW includes:

- Bulk vacuum excavation soils
- Drilling cuttings and spoils
- Development and Purge Water

Vacuum excavated soils will be generated during initial boring clearance at the SVE and monitoring well locations on the Zone A cap. These soils will initially be captured within the vactor truck. When the truck is full, the soils will be transferred to an area near the north gate of the Zone A fenced enclosure and placed on a layer of heavy visqueen type plastic. The stockpile will then be covered with plastic and sandbagged into place. A composite sample of these soils will be collected and submitted for laboratory analysis of VOCs, SVOCs, chlorophenoxy herbicides, PCBs, organochlorine pesticides, and priority pollutant metals. These data will then be evaluated and a decision will be made regarding appropriate disposal of these soils based upon the requirements within Section 4.5 of this Work Plan. These soils will not leave the Zone A fenced enclosure until such time as a final determination has been made regarding their appropriate disposition.

Drilling cuttings from VEW-06D, VEW-07D, VMW-51D, MW-52S, and MW-53S will be logged continuously. In order to preserve a record of the soil conditions beneath the Zone A, these soil cores will be stored on-site. As discussed above, these soil cores will be extracted and placed in prefabricated wooden core boxes adjacent to the area of drilling. The core boxes will be placed on visqueen type plastic and appropriately labeled. The soil cuttings will then be used for logging and field screening and additional chemical or bulk samples may be collected from the cores at that time. Once drilling in a particular location is completed, the cores will be transported to the fenced equipment enclosure and placed on plastic sheeting and covered with plastic sheeting for future reference or inspection. Because of their potential value as a visual and technical reference for Zone A conditions, it is anticipated at this time that these soil cores will be retained as a resource for the Site. It is anticipated that, when disposal of these soil cores is necessary and appropriate, the cores will be bulked into 55-gallon drums and transported for appropriate disposal. Disposal of these soils will be based upon the analytical results for soil samples collected from various soil horizons during drilling (Table 1) and in accordance with Section 4.5 of this Work Plan.

Drill cuttings for the VEW-06S, VEW-06I, VEW-07S, VEW-07I, and VMW-51I will be placed into drums, labeled and sealed. The label will contain information on the depth interval from which the soils inside the drum originated. These drums will then be transported to an area inside the Zone A fenced enclosure for temporary storage. Disposal of these soils will be based upon the analytical results for soil samples from the deepest well in each cluster from the same interval as contained within a specific drum. The individual drums will be handled and managed appropriate to the analytical results and in accordance with Section 4.5 of this Work Plan.

It is anticipated that there is the potential for some of the soil cuttings generated during drilling beneath Zone A to be classified as hazardous waste based upon the Toxicity Characteristic Criteria. If the total concentration of a compound exceeds 20 times its Toxicity Characteristic threshold as identified in WAC 173-303-090, that sample will be submitted for follow-up analysis using the Toxicity Characteristic Leaching Procedure (TCLP) using EPA Method 1311 and appropriate analysis (e.g., VOCs, SVOCs, metals) of the leachate. The TCLP analysis threshold of a 20 times exceedance in the bulk soil concentration is based on the knowledge that the TCLP analysis uses a 20:1 water to soil dilution prior to extraction. This value remains conservative since even at 20 times the allowable leachate concentration in soil, complete mass transfer of a compound from soil to water would be necessary in order for the soil to designate as a hazardous waste. If the resulting TCLP evaluation yields data that indicate the soils are a Characteristic Hazardous Waste, they will be handled according to applicable regulations and requirements.

Drilling cuttings from the sentinel well MW-50S and the downgradient well MW-51S will be similarly managed as those discussed above. However, based upon prior findings during the installation of the well MW-47 cluster and the MW-49 cluster, it will not be necessary to retain the soil cuttings in a viewable condition. After field screening, logging, and photodocumentation are complete, these cuttings will be transferred into 55-gallon drums, sealed, labeled, and moved to within the fenced equipment enclosure. Prior to sealing the drums a composite sample of these soils will be collected for laboratory analysis of VOCs, SVOCs, and priority pollutant metals. Analytical results for this composite sample will be used to make decisions regarding ultimate disposal of these drill cuttings.

After installation, each of the new monitoring wells will be developed. Development water will be placed in 55-gallon drums, sealed, labeled, and transported to the fenced equipment enclosure. Similarly, purge water generated prior to ground water sampling will also be accumulated and retained within 55-gallon drums. Purge water from the monitoring wells MW-52S and MW-53S located on the Zone A cap will be accumulated in segregated 55-gallon drums. Purge water and development water will be handled and managed as described in Section 4.5.

2.6 Initial Testing

Upon completion of all SVE wells, monitoring wells, and vapor monitoring probes a round of baseline sampling will be performed. The objectives of this testing will be to assess soil gas and ground water conditions at Zone A prior to any additional perturbations to the subsurface. This work will be done with the current SVE system operating at its current operating parameters in order to determine subsurface conditions prior to startup of the upgraded SVE system.

2.6.1 Baseline Soil Vapor

Baseline soil vapor samples will be collected from each of the six new SVE wells, the intermediate and deep vapor monitoring wells, and from each of the 10 new vapor monitoring probes. Soil vapor samples will be collected from the SVE wells, vapor monitoring wells and probes by first evacuating the wells using a portable vacuum blower and then collecting a sample of the induced air stream in a Tedlar bag. Tedlar bags will be opaque to limit photolysis and stored at room temperature to limit internal condensation. During evacuation, the temperature and balance gas concentrations will be measured and recorded.

Soil vapor sampling from the probes will use a modified sampling technique. Prior to any sampling, a vacuum gage will be connected to the swage lock fitting to measure the current vacuum beneath the geomembrane. These readings will be recorded for each location. Due to the small diameter and low volume of the sampling probe, the probe will be evacuated with a hand pump and Tygon tubing connected to the swage lock fitting. The volume of air to be removed prior to sample collection will depend on the estimated volume of air within each probe depending on the specific construction details of each. The hand pump will be used to collect a sample of soil gas in a Tedlar bag.

Immediately upon collection the bag sample will be labeled and placed in a dark, un-chilled cooler to avoid photodegradation and condensation, pending submittal to the analytical laboratory.

Baseline soil vapor samples will be submitted for VOC analysis only.

2.6.2 Baseline Ground Water

Baseline ground water samples will be collected from the two new ground water monitoring wells in Zone A (i.e., MW-52S and MW-53S) as well as the two sentinel wells for Zone A (i.e., MW-47S and MW-50S). If reasonably possible, this sampling will be scheduled to coincide with an existing monthly, enhanced ground water sampling event, which will allow the baseline ground water data to be evaluated within the context of the wider ground water quality at the Site at the time of the baseline sampling.

Samples from the sentinel wells, MW-47S and MW-50S, and the downgradient monitoring well, MW-51S, will be collected using the standard operating procedures for the Site with dedicated Grundfos pumps and tubing. Samples from the wells within Zone A (MW-52S and MW-53S) will be collected with portable dedicated sampling equipment but it is not yet clear whether installation of fixed in-well dedicated equipment is appropriate within these wells. There are concerns that the water quality immediately beneath Zone A may significantly shorten the service life of pumps and tubing used at the Site. For this reason, the initial baseline sampling event will use portable equipment dedicated to each well but removed after each use. A dedicated pump may be installed in these wells at a future date if analytical data suggests a reasonable service life for the dedicated equipment.

The portable dedicated equipment will consist of a submersible PVC impeller driven pump powered by 12 volt DC power. The pump will be fitted with a stainless steel foot valve backflow preventer and dedicated tubing. The submersible pump will be used for purging prior to sampling. After purging is complete the pump will be removed and stored in a labeled polyethylene tub with a tight-fitting lid. Sampling will then be conducted with disposal polytetrafluorethylene bailers. Samples for VOC analysis will be collected with a bottom-emptying device to limit potential volatilization, and samples for non-volatile analytes will be collected by emptying the bailer directly into the sample container.

Each well will be purged prior to sampling and measurements of stabilization parameters will be recorded. Samples will then be collecting and retained for analysis of VOCs, SVOCs, chlorophenoxy herbicides, PCBs, and priority pollutant metals.

Water samples will be placed in containers appropriate for the intended analyses, immediately labeled, and placed in an iced cooler or refrigerator until submittal to the analytical laboratory under standard chain of custody protocols.

2.7 System Infrastructure Installation

Upon completion of all well and probe installation and baseline testing, the necessary system infrastructure will be installed. This work will be performed in the intervening period between when the baseline data are collected, submitted for laboratory analysis, and evaluated and before any start-up testing.

Infrastructure construction will be performed by a qualified mechanical services subcontractor under the responsible charge of a Washington-licensed Professional Engineer from EPI. Infrastructure installation shall be consistent with the Engineering Design that is in preparation and to be submitted under separate cover. The final Engineering Design will have been reviewed and approved by Ecology prior to initiation of installation activities.

Figures 3, 6 and 7 illustrate the general system layout and the orientation of piping, fittings, controls, etc. The infrastructure installation may require some adjustment and field engineering to account for unanticipated or changed conditions but will, in all cases, be consistent with the requirements and intent of the approved Engineering Design. After installation is complete, a basic level of functionality testing will be performed. The purpose of the functionality testing is to assure that any safety shutdown controls or wiring are fully functional, gages and controls function and are leak free, and that the piping and moisture separators are free of leaks. No sustained system operation will occur until the start-up testing discussed below.

2.8 Initial System Testing

2.8.1 Objectives

Upon completion of the SVE wells, monitoring wells and vapor monitoring probes and after installation and functionality testing of the system components, the upgraded SVE system will undergo a period of initial testing. The objectives of this startup testing will be to:

- Ensure that adequate safety protocols are specifically addressed and corrected prior to startup;
- Assess the efficiency and performance of the SVE wells;
- Assess the actual performance of the upgraded system;
- Evaluate the response of the subsurface to a range of operating parameters; and
- Gather sufficient data to propose an appropriate approach for full-scale operation and management of the upgraded SVE system.

2.8.2 Procedures

Initial SVE system testing will consist of two phases; Step Testing and Startup Testing. The rationale and purpose of this testing is discussed below.

2.8.2.1 Step Testing

The Step Testing is initial short-term testing at each SVE well to confirm its anticipated performance. No SVE wells have been installed to date in disturbed Touchet Bed soils (i.e., berm materials) or native Touchet Beds soils and no larger diameter wells of the type planned herein have been installed and operated in the Upper Pasco Gravels. While it is assumed that these wells will operate at relatively low vacuums and high induced air flows, that assumption will be tested and confirmed during the Step Testing and prior to any longer term testing.

The step testing will include a progressive flow rate testing at each of the newly installed SVE wells. The tests will be conducted at flow rates of 50, 100, 200, and 300 cfm and each step will last for 15 to 30 minutes. During testing, measurements of wellhead vacuum and flow will be recorded on 5-minute intervals. This testing will be performed using the full system infrastructure and vacuum blower at the equipment shed.

2.8.2.2 Startup Testing

After completion of the step testing discussed above, the currently existing SVE system will be shut down for 24 hours before the Startup Testing is initiated. In previous meetings with Ecology it had been discussed that the existing system would remain in operation and flows from that system to the upgraded SVE system would be progressively transitioned to the new system. It is the IWAG's current opinion that transitioning SVE flows from one system to the other, while providing a marginal degree of protection to the environment also introduces substantial uncertainty into the data collected and does not allow for an optimal interpretation of the data to be collected from the upgraded system.

It is the IWAG's opinion that testing the performance of the upgraded SVE system in isolation from the existing system will provide the highest quality data and will facilitate the interpretation of the data that is collected during the Startup Testing. The primary advantage of this approach is that it eliminates competition for subsurface gases between the existing and planned SVE wells.

Past experience suggests that a 24-hour period of quiescence is sufficient for subsurface vapor conditions to essentially equilibrate and such a relatively short period of time represents relatively little risk to ground water quality. In essence, the substantial benefits of performing the Startup Testing in isolation from the existing system, in terms of data quality and interpretation, significantly outweigh the very minor potential risks to ground water posed by contaminant migration within that period of time.

The testing procedures proposed herein are subject to modification based upon the outcome of the baseline sampling data. However, based upon current knowledge, the basic procedures for startup testing have been developed using the primary assumption that the intermediate SVE wells screened within the Touchet Beds will provide both the highest level of protection for the aquifer and will yield the highest concentrations of vapor phase contaminants over the long term. It is possible that the shallow wells will also yield high concentrations during the baseline testing, but it is reasonable to conclude that this will be a short-lived effect and that the intermediate wells will provide the highest mass removal rates on a sustained basis. The testing does not include vapor extraction from the deeper SVE wells screened within the Upper Pasco Gravels. Such extraction could have the effect of inducing contaminant migration deeper into the vadose zone, which is not a desirable condition. It is acknowledged that the baseline testing may require modification and refinement and that such modifications will be discussed with Ecology prior to implementation. Nonetheless, the approach presented below is a reasonable starting point for discussions and illustrates the approach favored by the IWAG.

The influent airflow rate to the MSW flare from the current Zone A SVE system is generally limited to a maximum airflow of approximately 600 standard cubic feet per minute (scfm). That is approximately the total airflow from the current SVE system, although flow rates can vary over time. The start-up testing is intended to test the operation of the new SVE wells and, consequently, flow from the existing SVE wells will be terminated prior to the start of the testing program. The existing SVE wells will be incorporated into the monitoring program for the upgraded SVE system.

The Startup Testing will be performed in a sequence of five or six tests. The target airflows for the Startup Testing are summarized below in Table 2.

Table 2
SVE System Startup Testing
Target Airflows in cubic feet/minute (cfm)

Test	VEW-06			VEW-07		
	S	I	D	S	I	D
Baseline	0	0	0	0	0	0
Test No. 1	150	150	0	150	150	0
Test No. 2	100	200	0	100	200	0
Test No. 3	50	250	0	50	250	0
Test No. 4	0	250	0	0	250	0
Test No. 5	0	200	0	0	200	0
Test No. 6(a)	0	200	100	0	200	100

Test No. 1 will operate for a period of 14 days. Test Nos. 2 through 5 will each run for 7 days.
(a) – Test performance is to be determined. Target airflows are tentative values. Performance of test and operating parameters and durations will be based upon data review and discussions with Ecology prior to performance.

It is currently anticipated that at the completion of Test No. 5 the data will be quickly reviewed and discussed with Ecology. The objective of this discussion will be for the parties to jointly determine whether Test No. 6 should be performed and under what operating parameters and duration. The principal concern of the IWAG regarding performance of Test No. 6 is the potential to induce contaminant migration deeper into the vadose zone and into proximity with the water table. The primary purpose of Test No. 6 will be to assess vacuum and air flow performance within the Upper Pasco Gravels. It is currently anticipated that Test No. 6 will be designed to minimize the potential for contaminants to be pulled toward the water table. For this reason, it is anticipated that the configuration for Test No. 6 will include ongoing operation of the intermediate depth wells. As noted, the decision on performance of Test No. 6 and the operating parameters will be discussed and jointly made with Ecology.

At the completion of Startup Testing the system will be readjusted to the Test No. 4 configuration and will remain in this configuration until such time as the start-up testing data have been evaluated and Ecology and the IWAG have agreed upon an operational approach. If the data collected during the start-up testing clearly indicate that a different operating approach would result in significantly higher contaminant mass recovery or a higher level of environmental protection, operating parameters different from Test No 4 may be proposed to Ecology on an interim basis.

Day 1 of each test (e.g., typically Tuesday) will consist of initially setting airflows and performing initial measurement of PID readings, vacuums, and temperatures. On Day 2, the vacuum and airflows will be checked to confirm that they remain stable, PID and temperature measurements will be recorded, and a sample of vapor will be collected for laboratory analysis. Sampling vapor on the second day limits the potential to skew the data with the initial in-rush of captured vapor, which may not be indicative of a more steady-state operation. Vacuum, temperature and airflow will again be measured on Day 4 and Day 7, and an additional vapor sample will be collected on Day 7, just prior to changing the flow rates for the next test. For test No. 1, which has a two-week duration, the testing sequence will be repeated on Days 10 and 14.

In addition to the testing performed at the extraction wells, the following additional vacuum readings, vapor samples and ground water samples will be collected during the start-up testing:

- On Days 2 and 7 of each test, vacuum measurements will be recorded and vapor samples will be collected from VMW-50, VMW-51I and VMW-51D and from the 10 vapor monitoring probes. Vacuum measurements will also be recorded on Day 4 from these same locations.

- On Day 7 of each test, a ground water sample will be collected from wells MW-52S and MW-53S.

- Vacuum measurements will be recorded from wells VEW-01, VMW-02D, VEW-04 and VEW-05 on Days 2, 4, and 7 during each test.

- Vapor samples will be collected on from wells VEW-01, VMW-02D, VEW-04 and VEW-05 on Day 7 of each test.

For Test No. 1, the testing described above will be repeated on Days 10 and 14. Table 3 below summarizes the testing protocols.

Table 3
Summary of Startup Testing Sampling
By Day of Test[a,b]

Well	Parameter				
	Vacuum	Flow	Temperature	Balance Gas/PID	Sample[c]
VEW-06S	1,2,4,7	1,2,4,7	1,2,4,7	1,2,4,7	2,7
VEW-06I	1,2,4,7	1,2,4,7	1,2,4,7	1,2,4,7	2,7
VEW-06D	1,2,4,7				
VEW-07S	1,2,4,7	1,2,4,7	1,2,4,7	1,2,4,7	2,7
VEW-07I	1,2,4,7	1,2,4,7	1,2,4,7	1,2,4,7	2,7
VEW-07D	1,2,4,7				
VMW-50	2,7				2,7
VMW-51I	2,7				2,7
VMW-51D	2,7				2,7
VEW01	2,4,7				7
VMW-02D	2,4,7				7
VEW-04	2,4,7				7
VEW-05	2,4,7				7
VMP (x10)	2,7				2,7
MW-52S[d]					7 (water)
MW-53S[d]					7 (water)

(a) For Tests Nos. 2 through 5.
(b) During Test No. 1, sampling will be repeated on Days 10 and 14.
(c) Vapor sample collected in Tedlar bags. Analysis for VOCs using EPA Method 8260-Modified.
(d) During Test No. 1 sampling will be repeated on Day 14.

As noted above, it is currently assumed that at the completion of Test 5, the upgraded SVE system will be operated in the Test No. 4 flow configuration until such time as Ecology and the IWAG agree upon an appropriate long-term operational approach. During that interim operational status, the upgraded system will be monitored on a weekly basis in the same manner that the current system is monitored.

Samples will be collected from the monitoring wells and sentinel wells as a component of the ongoing enhanced ground water sampling on a monthly basis.

If these data suggest that modifications to the system operation may be appropriate, such modifications will be discussed with Ecology. Ecology approval shall be required before implementation of any such changes. The IWAG will also seek to develop a correlation between PID readings and laboratory analytical results in an effort to limit the high numbers of vapor samples submitted for analysis. Once such a correlation has been established, PID readings will provide more immediate data regarding system operation and operational decisions. Vapor samples will still be collected on a periodic basis, but with the objective of quantitatively assessing changes in the composition of extracted gases and contaminant mass loadings. Such operational issues will be discussed in the IWAG's proposed operational approach for the upgraded SVE system. This approach will be presented in the SVE Completion Report, which will combine the discussion of the completion activities, data evaluation, and proposed operation and maintenance approach for the system.

2.8.3 Data Evaluation and Interim Deliverable

The data generated during the soil and ground water sampling, the baseline testing, and the start-up testing will be evaluated while the system continues to operate under the Test No. 4 operating parameters.

The data evaluation will include, but may not be limited to, the following:

- An evaluation of the induced vacuum field;
- Induced flows and vacuums;
- Contaminant mass loading versus flow and vacuum as a measure of removal efficiency;
- Total concentrations of VOCs and potential changes in the concentrations of individual compounds compared to flow and time;
- Potential changes in contaminant distribution with depth over time;
- Change in ground water quality versus flow and time; and
- Other potential relationships that may exist within the dataset.

The purpose of the data evaluation will be to develop an efficient and effective operating scenario for the upgraded SVE system that offers a high level of protection for the environment and includes the capacity to quickly address potential future transient changes in Zone A source strength.

The data evaluation will be presented to Ecology as an interim deliverable in the form of a Technical Memorandum presenting a combined report of SVE completion details, startup testing data evaluation, and the proposed operation and maintenance approach for the upgraded system. This Technical Memorandum will be focused on the findings and interpretation of the data collected, and how those data suggest the upgraded SVE system should be operated and managed. The overall objectives of operating the upgraded SVE system will be to protect ground water quality by breaking the contaminant migration pathway between Zone A and ground water and doing so in as efficient a manner as possible.

The Technical Memorandum will not include an in-depth presentation of the procedures and methodologies used. That level of reporting will be reserved for the Phase II AIA Final Report, which is currently anticipated for completion in early 2011.

3.0 SCHEDULE

This section and Figure 13 (Phase II AIA General Schedule, Vol. I) present a detailed proposed schedule for major tasks and milestones included in scope of work presented herein.

The SVE upgrade work includes a number of major tasks and milestones that are summarized below:

- Submittal of the Draft Phase II AIA, Volume I Work Plan to Ecology
- Receipt of Ecology comments to the Draft Phase II AIA, Volume I Work Plan
- Addressing Ecology comments and submittal of Final Phase II AIA, Volume I Work Plan
- Ecology acceptance of Final Phase II AIA, Volume I Work Plan
- Preparation of 95 Percent Submittal of Engineering Design Document for SVE Upgrades
- Receipt of Ecology comments to 95 Percent Submittal
- Finalize Engineering Design Document for SVE Upgrades and 100 Percent Submittal
- Ecology acceptance of 100 Percent Submittal of Engineering Design Document for SVE Upgrades
- Sentinel Well and Property Boundary Monitoring Well Installation
- Public Comment Period
- State Environmental Policy Act (SEPA) Review
- Mobilization and surface preparation
- Zone A SVE and Monitoring Well drilling, installation, and associated soil sampling
- Soil vapor monitoring probe installation
- Well/geomembrane sealing
- Site restoration/top dressing
- Monument installation
- Piping and trenching
- Functionality testing/leak testing
- Baseline, Step Testing, and Start-up Testing
- Draft and Final Technical Memorandum of SVE Upgrade Completion, Data Evaluation, and O&M Plan(s)

This schedule is summarized in Figure 13, which sets forth the duration and completion date for the individual tasks and milestones.

3.1 Public Participation

Ecology has determined that public participation in the currently proposed interim action process is required under the Model Toxics Control Act (MTCA), specifically for the SVE system upgrades described in this Work Plan. Ecology has also determined that the proposed SVE system upgrades will require review under the State Environmental Policy Act (SEPA). This Work Plan therefore contains a formal public participation process consistent with MTCA public participation requirements (WAC 173-340-430(6) and WAC 173-340-600) and SEPA public commenting requirements (WAC Chap. 197-11, Part Five). The MTCA and SEPA public participation processes will run concurrently and consist of the following elements:

- Preparation by the IWAG Group of a SEPA Checklist for the planned actions at Zone A.

- Preparation by Ecology of a Fact Sheet summarizing the current conditions and planned actions described in this Work Plan. Ecology's Fact Sheet will also summarize an interim action planned by another party at Zone B of the Site. The Fact Sheet will identify a public repository where the Fact Sheet and other documents will be available for public review.

- Distribution of the Fact Sheet and public notice to the public and other interested parties, in accordance with the applicable procedures contained in MTCA and SEPA. The public comment period will last for 30 days with opportunity for interested parties to submit their comments in writing to Ecology.

- Completion by Ecology of a SEPA threshold determination pursuant to WAC 197-11, Part Three.

4.0 SAMPLING AND ANALYSIS PLAN

This Sampling and Analysis Plan (SAP) section discusses the sampling protocols to be used for collection of soil and ground water samples during installation of new vapor extraction, vapor monitoring and ground water monitoring wells, and collection of soil vapor and ground water samples after well installation. All SAP activities will be conducted in accordance with Model Toxics Control Act (Chapter 70.105D RCW) cleanup regulations (Chapter 173-340 WAC) and appropriate guidance.

4.1 Sampling Procedures

The following sections describe in detail the SVE Upgrade sampling procedures for soil, ground water, and soil gas, respectively. These are generally the same procedures presently used for interim measure monitoring.

4.1.1 Soil

Soil samples will be collected during installation of VEW-06D, VEW-07D, MW-52S, and MW-53S and VMW-51D. Soil samples will not be collected during installation of shallow and intermediate vapor extraction wells at well clusters based on the fact that their proximity to deep wells makes their sampling redundant.

4.1.1.1 Soil Sample Analysis

Soil samples from the five locations listed above will undergo chemical analysis for volatile organic compounds (VOCs) by EPA Method 8260C, semi-volatile organic compounds (SVOCs) by EPA Method 8270 and 8270 SIM (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene), chlorophenoxy herbicides by EPA Method 8151, Polychlorinated Biphenyls (PCBs) by EPA Method 8082, priority pollutant metals by ICP or ICP/MS, Mercury by CVAA, and total organic carbon (TOC).

Soil samples will undergo physical analysis for hydraulic conductivity and bulk density.

Table 1 summarizes samples and analyses to be performed at each depth. Table 5 summarizes the sample methods to be requested as well as sample containers, preservation and temperatures required, and holding times. Table 6 summarizes the method detection limits and reporting limits for each method of analysis.

4.1.1.2 Soil Sample Collection

As outlined in Section 2.3, soil samples will be collected and retained for physical and chemical analysis during SVE and monitoring well installation. Soil samples will be collected during the installation of five wells; each of the two deep SVE wells, each of the two monitoring wells within Zone A, and the single deep vapor monitoring well. The two deep SVE wells and the two monitoring wells will be located immediately west of the stacked drums in the berm area between the stacked and randomly placed drums. The intermediate and the deep vapor monitoring wells will be located immediately east of the stacked drums between the drums and the east detection basin. The locations of these wells are indicated on Figure 3.

During drilling, undisturbed soil samples will be collected at 5-foot vertical intervals. These samples will be collected by advancing a split spoon sampler into soils immediately below (ahead) of the tip of the drill stem. The split spoon sampler will be advanced using a standard drop hammer. These samples will be retained for chemical analyses of selected compounds. An additional sample of undisturbed soil will be collected at 10-foot vertical intervals for characterization of physical soil properties. These samples will be collected by advancing a Shelby tube using a drop hammer or similar device.

Table 1 below presents the planned sampling depths and physical and chemical analyses that are anticipated at each of the five locations discussed above. The depth of the initial sample (i.e., 15 feet) will be targeted at the general observed depth of the original sub grade for the first tier of Zone A stacked drums. It is currently anticipated that the contact between previously disturbed and backfilled soils will be identifiable both on the basis of physical inspection and chemical impacts. Samples will then be retained for chemical and/or physical analysis at 5-foot intervals down to the depth of ground water. There may be necessary adjustments to sample depths and intervals based on the observed depth to the Zone A sub grade and the lithologic contacts between the Touchet Beds, Upper Pasco Gravels, and Lower Pasco Gravels.

Drilling will be performed using rotosonic methods and a continuous core of soil conditions will be retrieved and returned to the surface for inspection. Soil conditions will be visually inspected and logged and the soils will be subjected to field screening to assess the potential presence of impacts. Soil from selected locations throughout the soil core will be subjected to field screening using a photoionization detector (PID). Screening locations will be based upon field observations such as changes in soil grain size, apparent soil moisture, discoloration or other observed factors. Olfactory observations of soil conditions will be strictly prohibited and will not be used as a field indicator for health and safety reasons.

If field screening indicates that additional useful information may be gained through the collection of soils samples in addition to those indicated on Table 1, an additional targeted sample may be collected from the exposed soil core. These samples will be named with an additional “R” suffix to denote a field reconnaissance sample and to signify that they were collected from a disturbed soil core rather than undisturbed in situ soils.

After collection, all soil samples will be placed in coolers with enough ice to maintain an internal temperature of 4°C for the duration of the sampling and transportation period.

4.1.2 Soil Vapor

Soil vapor samples will be collected from the 6 new vapor extraction wells (VEW-06S, VEW-06I, VEW-06D, VEW-07S, VEW-07I, VEW-07D), the two new vapor-monitoring wells (VMW-51I, VMW-51D) and the 10 new vapor-monitoring probes. The analysis of soil vapor samples will identify depth intervals with the greatest contaminant concentrations, which will allow vapor extraction to target the most productive depths for extraction. Air samples from these 18 locations will be analyzed for VOCs using EPA Method 8260. Table 5 summarizes the sample method to be requested as well as the sample container, preservation and temperature required, and the holding time. Table 6 summarizes the method detection limits and reporting limits for each analyte.

Soil vapor samples will be collected when the vapor extraction system is temporarily shut down. A vacuum extraction pump will be positively connected to the flow port assembly at the top of the vapor extraction or vapor monitoring well. The extraction pump will be run to purge gas from the well to the atmosphere for approximately three minutes. Following the purge, a 500-milliliter Tedlar bag will be attached to the vacuum pump and the sample collected. Laboratory specifications for analytical gas sample collection will be followed.

Soil vapor sampling from the probes will use a modified sampling technique. Prior to any sampling, a vacuum gauge will be connected to the swage lock fitting to measure the current vacuum beneath the geomembrane. These readings will be recorded for each location. Due to the small diameter and low volume of the sampling probe, the probe will be evacuated with a hand pump and Tygon tubing connected to the swage lock fitting. The volume of air to be removed prior to sample collection will depend on the estimated volume of air within each probe depending on the specific construction details of each. The hand pump will be used to collect a sample of soil gas in a Tedlar bag.

All soil vapor samples will be kept at room temperature and in a rigid cardboard box or non-iced cooler for the duration of the sampling and transportation period. If the Tedlar bags will be shipped by air, care will be taken to not overfill the bags to allow for expansion during flight.

4.1.3 Ground Water

The four new ground water monitoring wells will be developed and allowed to stabilize for a minimum of one week prior to purging and sampling. Following well development, ground water samples will be collected from the two sentinel wells (MW-47S and MW-50S), the two new Zone A ground water monitoring wells (MW-52S and MW-53S) and the new down-gradient property boundary well (MW-51S). Data from the analysis of these samples are expected to define source area ground water contaminant concentrations.

Ground water sampling procedures that will be followed include water level measurement, well purging, collection of field parameter data during purging, and sample collection for laboratory analysis.

Standard ground water parameters will be measured as part of the well purging process. Ground water samples will be analyzed for VOCs by EPA Methods 8260B and 8260 SIM (PCE, TCE, 1,1-DCE, VC, 1,2-DCA, and benzene), SVOCs by EPA Method 8270 and 8270 SIM (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and pentachlorophenol), chlorophenoxy herbicides by EPA Method 8151, PCBs by EPA Method 8082, Priority Pollutant Metals by ICP or ICP/MS, Mercury by CVAA, total and hexavalent chromium by EPA Method 200.8 and Standard Method (SM) 3500-Cr, respectively.

Table 5 summarizes the sample method to be requested as well as the sample container, preservation and temperature required, and the holding time. Table 6 summarizes the method detection limits and reporting limits for Method 8260 analysis and other analytes.

4.1.3.1 Water Level Measurement

Ground water level measurements to the nearest hundredth of a foot (0.01') will be obtained prior to sampling at each well using a decontaminated electronic water level indicator. The indicator tip will be decontaminated between wells according to standard decontamination procedures. All water level data, pertinent information, and any unusual conditions will be recorded in the field notebook and on any appropriate field forms.

4.1.3.2 Purging and Low Flow Sampling

Monitoring wells will be purged prior to sampling using dedicated pumps and tubing associated with each well. Purging will be performed using low-flow purging techniques. The purge rate will not exceed the well recovery rate and will not exceed four liters per minute. Purge water will be run through a water quality meter flow cell for field parameter measurements and will be discharged into a 5-gallon bucket or other container.

The water quality meter will measure temperature, DO, ORP, pH, specific conductance, and turbidity of the purged water. The meter will be calibrated prior to use following procedures outlined in the equipment manual. Purge stabilization criteria consist of pH (+/- 10%), DO (+/- 3%), ORP (+/- 10 mV), and turbidity (+/- 10% if greater than 10 NTUs), and conductivity (+/- 3%) for two consecutive readings.

When the stabilization criteria have been met, the flow cell will be disconnected and sample containers will be filled directly from the pump discharge tubing. The sampling will be performed at the same flow rate as the purge except for VOAs, which will be filled at a slow enough rate to avoid bubble formation (approximately 300 ml/minute).

4.1.3.3 Sample Collection

Ground water samples will be collected into laboratory-cleaned, pre-labeled sample bottles. Sample bottles can be filled in any order. Table 1 summarizes samples and analyses to be performed at each depth. Table 5 summarizes the sample method to be requested as well as the sample container, preservation and temperature required, and the holding time. Table 6 summarizes the method detection limits and reporting limits for Method 8260 analysis and other analytes.

One duplicate sample will be collected for every 20 samples and each sampling event containing VOC samples will include a trip blank. Samples will be shipped or transported with sufficient time for laboratory analysis within holding times. All ground water samples collected for metals analysis will be unfiltered.

After collection, all soil and ground water samples will be placed in coolers with enough ice to maintain an internal temperature of 4°C for the duration of the sampling and transportation period.

4.2 Decontamination Procedures

Equipment that is not dedicated to a certain well will be decontaminated between wells using the procedures listed below:

- Wash thoroughly with a non-phosphate detergent (like Alconox) using a brush to remove visible contaminants.
- Rinse with tap water followed by a distilled water rinse.
- Air-dry and store in a clean plastic bag.
- Contain decontamination water along with purge or drilling water for that well in 55-gallon drums.

See the Health and Safety Plan for additional information regarding decontamination.

4.3 Sample Handling

Each sample container will have a sample label permanently affixed to the surface of the container. Information to be supplied on the sample label includes the project number, sample ID, initials of sampler(s), date and time of sample collection, analysis requested and preservative used. Each sample will be assigned a unique alphanumeric identification code and this identification code will exactly match the identification printed on the chain-of-custody form and in the field notebook. The code will contain sufficient information to identify the sample location and depth or date.

4.3.1 Sample Identification

The identification code for soil sampling will consist of the well/probe identification (with no dash) followed by an “@” symbol, a number indicating the depth below surface at which the sample was collected, followed by a dash and six digits indicating the date of sample collection (MMDDYY). Examples of soil identification codes include the following: VEW06D@30-031610, VMW51I@15-031610 and MW50S@10-031610.

The identification code for ground water samples will consist of the well identification followed by a dash and six digits indicating the date of sample collection (MMDDYY). Examples of ground water identification codes include the following: MW50S-031610 and VEW07S-031610.

The identification code for soil vapor samples will consist of the well identification followed by a dash, the word “AIR”, another dash and six digits indicating the date of sample collection (MMDDYY). Examples of ground water identification codes include the following: MW50S-AIR-031610, VMW50S-AIR-031610 and VEW07S-AIR-031610.

Duplicate samples will be indicated by inserting the number 9 in front of the well number. For example: VEW906D@30-031610, MW950S-031610, and VEW907S-AIR-031610.

4.3.2 Chain-of-Custody

Sample possession will be traceable from the time of sample collection until receipt of samples at the analytical laboratory. Samples will be in the custody of the field sampler(s) from the time of sample collection until the samples are transferred to the laboratory or shipper/courier on a chain-of-custody (COC) form. Each sample ID will be listed on the chain along with the date and time of sample collection, analysis requested, and number of sample containers for each sample ID. When transferring custody of the sample coolers, the individuals relinquishing and receiving the coolers will sign, date, and note the time of transfer on the chain-of-custody record.

Samples that are shipped or sent by courier to the laboratory may use one chain for all the coolers delivered. Each sample cooler should be sealed with fiber tape and custody seals.

4.3.3 Sample Shipping Procedures

Samples will be either hand delivered the same day by a courier or be shipped by a next-day delivery service to the laboratory for chemical analysis. A COC form will accompany each batch of samples shipped. When a sample is shipped it will be packaged in a proper shipping container to avoid leakage and/or breakage. The shipping container will be labeled and packaged in accordance with Department of Transportation regulations. Each opening of the box or cooler will be taped with a custody seal. Air samples will be shipped either in a room temperature cooler or cardboard box. Soil and ground water samples will be shipped with sufficient ice to keep the samples cool until they reach the laboratory.

Packing and shipping of soil and water samples will conform to the following protocol:

- Tape the cooler drain plug.
- Line the cooler with a large sturdy garbage bag or package all samples so they cannot leak or spill from the cooler.
- Approximately two to three inches of inert cushioning material will be placed in the bottom of the cooler.
- Ice in double plastic bags will be used to cool samples.
- Sufficient packing material shall be used to prevent breakage.
- The chain-of-custody will be sealed in a plastic bag and taped to the inside lid of the cooler.
- The cooler will be taped with two strands of tape and sealed with custody seal(s) for shipment.

When received by the laboratory, the COC will be verified, signed, and returned by the laboratory. Copies of the shipping documentation and signed chain-of-custody forms will be retained in the project files.

4.4 Quality Assurance/Quality Control

This section presents information about sample custody procedures, analytical laboratory requirements, and collection of QA/QC samples.

4.4.1 Field Instrument Calibration

The water quality meter will be calibrated once per day prior to sampling for pH, DO, ORP, conductivity, and temperature parameters. The turbidity meter will be calibrated at the beginning of each day and recalibrated as needed.

4.4.2 Sample Custody

A chain-of-custody form documenting each sample collected and tracing each person in possession of the samples will accompany each batch of samples shipped or delivered to the laboratory for analysis. A custody seal will be signed and dated and placed across the opening point(s) of each cooler or box of samples. A minimum of one custody seal will be used per cooler; more may be used. After the custody seal is affixed the cooler it will be secured with two bands of packaging tape for delivery or shipment.

Copies of all delivery service or shipping company papers will be retained for the project files. A copy of the COC, signed by the laboratory receiving the samples, will also be retained in the project files.

4.4.3 Analytical Laboratories

Only laboratories accredited by the Department of Ecology will be utilized. The laboratory will follow all required analytical equipment calibration and tuning procedures. Internal quality control checks such as method blanks, laboratory control samples, surrogate spikes, internal standards and duplicates will be followed as required. The QC results will be included in the analytical data package along with sample results.

The laboratory will analyze all samples within method-specified holding times. All data reductions will be performed by the laboratory according to procedures specified by the appropriate analytical method.

4.4.4 QA/QC Samples

Quality control (QC) measures will be taken to evaluate laboratory precision, potential matrix interferences, and potential contamination from the ambient air.

Field duplicate samples, trip blank samples, and matrix spike/matrix spike duplicate (MS/MSD) samples will be the QC samples collected as part of the field QC program. Equipment blanks will be not obtained because all sampling equipment will be either dedicated or disposable single-use devices.

Duplicate Samples: Laboratory and field sampling precision will be evaluated by collecting blind field duplicate samples. One field duplicate sample will be collected per every 5% (1 per 20 samples) or fraction thereof, of the total number of samples per sampling event. Field duplicate samples will be collected under conditions as nearly identical as possible to the original sample. Field duplicate samples will be labeled like standard samples. The field duplicate sample will be distinguished as a duplicate with a number 9 before the well or boring number and will be analyzed for the same constituent list as the original sample. Duplicate samples will be noted in the field notebook.

Trip Blank Samples: The potential for contamination from the ambient air will be evaluated using trip blank samples. The trip blank will originate at the contract laboratory and be re-labeled upon arrival at the site. One set of trip blanks will accompany each cooler of samples submitted for VOC analysis. Trip blanks will be listed on the chain-of-custody and analyzed for VOCs only.

Matrix Spike/Matrix Spike Duplicate Samples: Potential interferences from the sample matrix will be evaluated with MS/MSD samples. Triplicate volumes of ground water and soil samples will be collected. One MS/MSD sample will be obtained for every 5% or fraction thereof, of the total number of samples collected per event. MS/MSD samples will be given sample names identical to the original field sample but will have "MS/MSD" written next to the analysis requested on the sample bottle label and will also be noted on the chain-of-custody. MS/MSD samples will be analyzed for the same constituent groups as the original sample. MS/MSD samples will not be collected for soil vapor. MS/MSD analysis will be noted in the field notebook.

It is anticipated that soil samples will be designated for MS/MSD analysis based on varying degrees of apparent impact (based on field screening) and on varying soil types and depths. Water samples will be designated for MS/MSD analysis on the basis of varying proximity to Zone A. A sample from MW-52S or MW-53S will be designated for analysis as a near-source location and a sample from MW-11S, or similarly downgradient well, will also be designated for MS/MSD analysis. The need for such specific MS/MSD analysis in future sampling events will be discussed in the Operations and Maintenance Manual to be prepared for the upgraded SVE system.

4.4.5 Data Validation

Level III Data Validation will be performed on the EPA Method 8151 chlorophenoxy herbicide analysis only.

4.5 Investigation-Derived Waste Management Procedures

To comply with the Model Toxics Control Act (MTCA), the management of investigation-derived wastes (IDW) must ensure protection of human health and the environment and comply with applicable or relevant and appropriate requirements (ARARs). The procedures outlined below will be followed when handling wastes generated during the additional interim actions implementation. Disposal certificates will be produced and provided to Ecology upon final treatment or disposal of all dangerous and hazardous wastes.

Depending on the type of waste, drums will be sampled by either grab or composite methods and the sample sent to an approved laboratory for analysis. If sufficient data exists, the analytical results collected from in situ sampling during waste generation may be used for waste characterization. Analytes requested will be representative of the investigation program. Upon receipt of results decisions will be made regarding disposal.

Steps will be taken to limit on-site storage of confirmed hazardous or dangerous wastes to within regulatory established storage time limitations (e.g. 90 days). A hazardous or dangerous waste designation will be attached to the waste upon receipt of analytical data indicating such a waste status.

4.5.1 Soil Wastes

Soil cuttings from the installation of new wells and Zone A soil berm characterization will be drummed or containerized and staged on-site. All waste soil produced will be stored on a boring-by-boring basis. Each container will be labeled with the following information:

- Monitoring well designation or other location identification,
- Medium contained in container (i.e. soil or water)
- Depth interval of the contained soils
- Date collected, and

- Other appropriate information.

As discussed in Section 2.5.5, soil will be sampled during drilling and analyzed for a variety of analytes including VOCs, SVOCs, chlorophenoxy herbicides, PCBs, organochlorine pesticides, and priority pollutant metals. The IWAG does not anticipate proposing on-site placement of any IDW soils.

Stockpiled soils and drums will be staged on-site until the results of the analytical testing have been reviewed at which point the soils will be appropriately handled and disposed. Analytical results for soil wastes will typically be compared to the following standards:

- MTCA Method A and Method B table values,
- Dangerous Waste Regulations for the Toxicity Characteristic (WAC 173-303-090), and
- Dangerous Waste Regulations for the Toxic and Persistent Dangerous Wastes (WAC 173-303-100).

If none of the detected compounds are present at a concentration that exceeds MTCA Method A or B cleanup levels those soils will be disposed off-site as a non-regulated waste. Disposal will be subject to acceptance by the receiving facility and may require additional facility-specific analyses.

If the total concentration of a compound exceeds a MTCA Method A or B value, and is less than 20 times the Dangerous Waste Toxicity Characteristic List maximum concentrations, as identified in WAC 173-303-090, and is less than the Toxic and Persistent criteria in WAC 173-303-100 the waste will be disposed of off-site as a non-hazardous waste and non-dangerous waste. If certain compounds are present, this may require a “Contained In” determination from Ecology to facilitate disposal as non-hazardous waste. Disposal will be subject to acceptance by the receiving facility and may require additional facility-specific analyses.

If a concentration is greater than 20 times the Toxicity Characteristic Criteria the sample will be submitted for follow up extraction by EPA SW-846 Method 1311, Toxicity Characteristic Leaching Procedure (TCLP) and appropriate analysis of the leachate (VOC, SVOC, metals) to determine appropriate disposal.

If the analytical results for the TCLP leachate are below the Toxicity Characteristic List limits and are less than the Toxic and Persistent criteria, the soil will be disposed off-site as a non-hazardous and non-dangerous waste.

If the analytical results for the TCLP leachate exceed the maximum concentrations of the Toxic Characteristic List (WAC 173-303-090) or exceed the Toxic or Persistent criteria in WAC 173-303-100 the soil will be managed as Dangerous Waste and sent off-site for disposal with profiling and manifesting documentation appropriate to the accepting facility.

For drums determined to be dangerous or hazardous waste, a Waste Material Profile Sheet will be completed. Separate profile forms will be completed for each waste stream as required by the accepting facility. Wastes will be transported using a Uniform Hazardous Waste Manifest and will comply with the requirements of the Resource Conservation and Recovery Act (RCRA) and the requirements of the receiving facility. If required by the receiving facility, a representative sample may be collected for each different waste stream and submitted to a permitted waste disposal or treatment facility along with the corresponding profiles. The receiving facility may require analyses in addition to those discussed herein.

Personnel at the disposal or treatment facility will verify that the waste stream samples are consistent with the information on the completed profiles. Following profile approval, the transportation, treatment, and disposal methods will be finalized. Applicable state and federal hazardous and dangerous waste regulations will be followed during the actual waste transport, treatment, and disposal (40 CFR 261, 49 CFR 170-178, and WAC 173-303). Following final waste treatment or disposal, a certification will be provided that specifies the treatment or disposal method used.

4.5.2 Well Installation, Development and Purge Water

All water from well installation (i.e., decontamination water), well development, and pre-sample purging will be drummed or containerized on a well-by-well basis. Each drum will be labeled with the following information:

- Monitoring well designation,
- Description of the water, and
- Date collected.

Drums will be staged on-site until the results of the analytical testing have been reviewed.

If the analytical results indicate that contained water meets the Ground Water Quality Criteria in Table 1 of WAC 173-200-040 and the Site draft ground water cleanup levels and MTCA Method A or B ground water cleanup levels, it will be discharged at the ground surface on-site following consultation with Ecology and agreement over the methods and location(s) deemed most appropriate.

Drums with water that contains compounds at concentrations exceeding WAC 173-200-040, Table 1 values or Site draft ground water cleanup levels or MTCA Method A or B ground water cleanup levels, but which are below the Toxicity Characteristic values contained in WAC 173-303-090 and the Toxic and Persistent criteria in WAC 173-303-100 will be disposed off-site as non-hazardous and non-dangerous. Disposal will be subject to acceptance by the receiving facility and may require additional facility-specific analyses.

Drums with water that contains compound concentrations that exceed the Toxicity Characteristic values in WAC-173-303-090 or Toxic or Persistent criteria in WAC 173-303-100 will be managed and disposed as dangerous waste in accordance with applicable regulations at an appropriate facility. Disposal will be subject to acceptance by the receiving facility and may require additional facility-specific analyses.

4.5.3 Condensate from SVE System

Condensate produced in the SVE system during testing will be drummed or containerized and held on-site until the results of the analytical testing have been reviewed. If the analytical results indicate that the SVE condensate is not a dangerous waste according to the Toxicity Characteristics in WAC-173-090 and Toxic and Persistent Dangerous Waste criteria in WAC 173-303-100, it will either be thermally treated at the flare or transported to the local Publically-Owned Treatment Works (POTW). Disposal will be subject to acceptance by the receiving facility and may require additional facility-specific analyses.

SVE condensate that is found to be hazardous or dangerous waste will be disposed of off-site at a hazardous waste treatment or disposal facility. Disposal will be subject to acceptance by the receiving facility and may require additional facility-specific analyses.

The IWAG Group reserves the opportunity to revisit the practices and techniques of on-site handling, management and/or treatment of SVE condensate generated during subsequent full-time SVE operation as additional data and information become available.

4.5.4 References

Operations and Maintenance Manual - SVE, NoVOCs™, and Groundwater Monitoring. Pasco Landfill Site. Pasco, Washington. Prepared by Environmental Partners, Inc. January 31, 2007 with February 23, 2007 and May 25, 2007 revisions.

Addendum No. 1 – Operations and Maintenance Manual – SVE, NoVOCs™, and Ground Water Monitoring. Pasco Landfill Site, Pasco, Washington. Prepared by Environmental Partners, Inc. May 22, 2008.

REVISED FINAL Work Plan for Additional Interim Actions – Phase I. Pasco Landfill Site. Pasco, Washington. Prepared by Environmental Partners, Inc. May 5, 2008.

Groundwater and Interim Action Systems Design and Monitoring Plan. Pasco Landfill Site. Pasco, Washington. Prepared by Phillip Services Corporation, June 20, 2001.

Interim Action Implementation. Pasco Landfill. Pasco, Washington. *Investigative Waste Management Plan*. Prepared by Phillip Services Corporation, April 2001.

5.0 HEALTH AND SAFETY PLAN

IWAG GROUP II CONTACTS

Richard Elliott:	**425-649-6140**
Richard DuBey:	**206-682-3333**

EPI CONTACTS

Adam Morine:	**425-677-5727**
Thom Morin:	**206-954-6957**

EMERGENCY CONTACTS AND EMERGENCY INFORMATION

POLICE:	**911**
FIRE:	**911**
FIRST AID:	**911**

In the event of an emergency, be prepared to give the following information:

- Location of Emergency

Site Location:	**Pasco Sanitary Landfill** **1901 Dietrich Road** **Pasco, Washington 99301**
Landmarks:	**Basin Disposal, Inc. Transfer Station**
Nearest Cross Street:	**N. Commercial Avenue**

- Phone Number That You Are Calling From: .... **Cell Phone Number of Person Calling**

- What Happened?
  - * Type of Accident
  - * Type(s) of Injuries
- How Many People Need Help?

Additional Emergency Information:

Hospital Name:	**Lourdes Medical Center**
Address:	**520 N. 4th Avenue**
City, State, Zip Code:	**Pasco, Washington 99301**
Phone Number:	**509-547-7704**

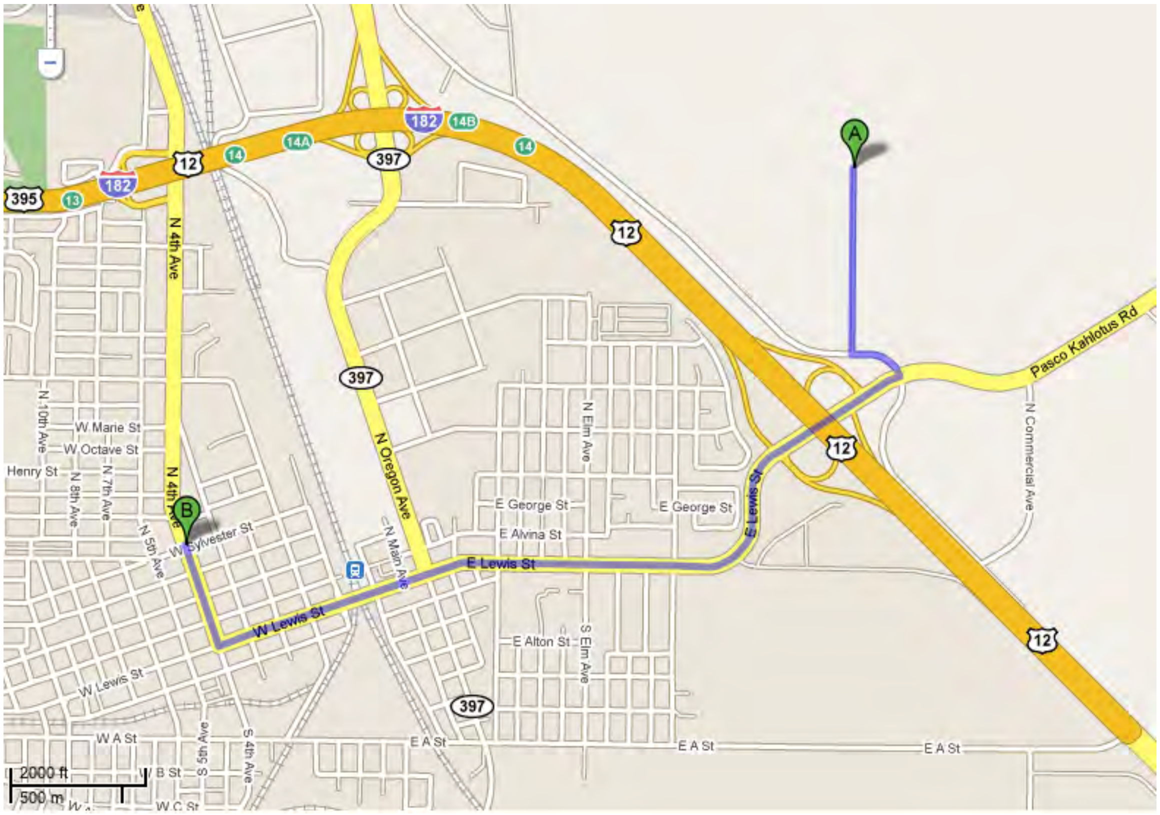
- Note: Contact a Principal at Environmental Partners, Inc. after Emergency Services have been called.

Environmental Partners, Inc.	**425-395-0010**
Thom Morin (Principal)	**206-342-6957 (cell)**
Doug Kunkel (Principal)	**425-241-8170 (cell)**

HOSPITAL ROUTE DESCRIPTION AND MAP

To Lourdes Medical Center:

From the Pasco Landfill, head south on Dietrich Road and turn left onto N Commercial Ave. Turn right onto Pasco Kahlotus Rd, cross over the highway and follow the right lane onto E Lewis St. Drive west on E Lewis Street for 2.1 miles, driving underneath the railroad tracks through a short tunnel until arriving at the intersection of 4th Avenue. Take a right on 4th Avenue and drive north four blocks through the intersection of 4th Avenue and Sylvester. Take the first left and drive to the entrance of Lourdes Medical Center.



5.1 Plan Objectives and Applicability

This Health and Safety Plan (HASP) has been written to comply with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act (WISHA).

The purpose of this Health and Safety Plan is to establish protection standards and mandatory safe practices and procedures for all personnel involved with field activities at the site. This plan assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may occur during field activities. The plan consists of site and task descriptions, a summary of work activities, identification and evaluation of chemical and physical hazards, monitoring procedures, personnel responsibilities, descriptions of site zones, decontamination and disposal practices, emergency procedures, and administrative requirements.

Mr. Adam Morine of Environmental Partners, Inc. (EPI) is currently the designated Site Health and Safety Officer. This duty may be assigned to another EPI employee or IWAG Group-employed subcontractor if deemed appropriate. As Site Health and Safety Officer, Mr. Morine has total responsibility for ensuring that the provisions outlined herein adequately protect worker health and safety and that the procedures outlined by this Health and Safety Plan are properly implemented. In this capacity, Mr. Morine will conduct regular Site inspections to ensure that this Health and Safety Plan remains current with potentially changing site conditions. Mr. Morine has the authority to make health and safety decisions that may not be specifically outlined in this plan, should Site conditions warrant such actions. In the event that Mr. Morine leaves the Site while work is in progress, an alternate Site Health and Safety Officer will be designated.

The provisions and procedures outlined by this Health and Safety Plan apply to all contractors, subcontractors, owner's representatives, oversight personnel, and any other persons involved with the field activities described herein. All such persons are required to read this Health and Safety Plan and indicate that they understand its contents by signing the Site Health and Safety Officer's copy of the Plan. Copies of this Health and Safety Plan have been distributed to a designated representative of the following companies and /or organizations:

- Eric Jensen – Site Operations Manager

It is possible that additional hazards that are not specifically addressed by this Health and Safety Plan may exist at the Site, or may be created as a result of on-Site activities. It is EPI's firm belief that active participation in health and safety procedures and acute awareness of on-Site conditions by all Site workers is crucial to the health and safety of everyone involved. If a real or suspected unsafe Site condition arises that is not addressed in this Health and Safety Plan, or if any participant in site work has questions or concerns about Site conditions or this Plan, it is the individual’s obligation to immediately notify the Site Health and Safety Officer.

5.2 Background Information

The Site is located at: Pasco Sanitary Landfill
1901 Dietrich Road
Pasco, Washington 99301

Contaminants of Potential Concern (COPCs) were defined in the Site Risk Assessment/Cleanup Analysis Report prepared by Philip Environmental Services in September 1998 and were based upon the occurrence and quantification of contaminants found in ground water during the Remedial Investigation (RI). Data collected from subsequent investigational activities have caused additional COPCs to be added at the request of the Washington State Department of Ecology. The listed COPCs are defined as follows:

- Soil – acetone and methylene chloride; and

- Ground water – acetone, benzene, chloroform, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene (PCE), toluene, trans-1,2-dichloroethene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene (TCE), and vinyl chloride.

The work to complete the SVE Upgrades involves intrusive digging and drilling activities on and beneath the Zone A landfill cap. It is possible that additional COPCs not listed above, may exist in soil, ground water, and soil vapor at the project Site.

5.3 Scope of Work

Following is a brief description of the SVE Upgrade work activities that are covered by this Health and Safety Plan. These activities were described in detail in the previous sections of the Work Plan.

5.3.1 Site Preparation

Site preparation will consist of developing the north-south access route and the small southeast spur across the surface of the landfill cap. All equipment and the drill rig that will be used in later tasks will maintain access, as appropriate to all points on the cap via these routes. The access routes are shown in Figure 8 of the Work Plan.

Steps involved in this task will include establishing work zones such as a safety (cold) zone, a contamination reduction area (warm zone), and active work areas (hot zones), widening portions of the Site fence surrounding the landfill if necessary to accompany the equipment, a small amount of grading and leveling of surface soil to make it suitable for vehicle travel, and the establishment of an equipment staging area for drill pipe and other supplies. This task will also involve the staging of temporary sanitary facilities, the erection of mobile job trailers, eyewash stations, and other necessary OSHA requirements for work of this type.

5.3.2 Probe and Vacuum Monitoring Well Installation

Hand methods will be used to install the ten shallow vacuum probes following excavation of the soils above the cap to expose the geomembrane, cutting and repairing the geomembrane, and restoration of the landfill cap after probe completion at the surface. The ten shallow probes can be installed without substantially intrusive work.

At VMW-51 (Figure 3 of Work Plan), air knife and/or vacuum excavation of soil beneath the geomembrane will be conducted, followed by track-mounted rotosonic drilling methods to install the intermediate and deep-screened intervals.

5.3.3 SVE and Monitoring Well Installation

Well installation will begin with positioning of the drill rig on the landfill cap. The landfill cap will be excavated to expose the geomembrane and the geomembrane will be cut. Air knife and/or vacuum excavation of soil beneath the geomembrane will be conducted, followed by rotosonic drilling, and casing installation. During drilling, soil cuttings will be logged and sampled. After well completion at the surface, the geomembrane will be repaired and the cap will be restored.

5.3.4 Sampling and Monitoring

Soils will be sampled during well installation in accordance with the Site-specific Sampling and Analysis Plan. Following completion of well and probe installation, ground water and soil vapor will be sampled periodically from these locations.

5.3.5 Waste Material Management

During and following the completion of the wells, wastes will be encountered and will either be segregated and drummed for disposal, or segregated and sampled for characterization purposes. Exposure to the wastes during this process is likely.

5.4 Hazard Evaluation and Risk Analysis

In general, there are three broad hazard categories that may be encountered during site work; Chemical Exposure Hazards, Fire/Explosion Hazards, and Physical Hazards. Subsections 5.4.1 through 5.4.3 deal with specific hazards falling within each of these broad categories.

5.4.1 Chemical Exposure Hazards

Table 4 presents chemical-specific data regarding permissible exposure levels, likely pathways of exposure, target organs that will likely be affected by exposure, and likely symptoms of exposure for hazardous substances that are potentially present at the site. Table 4 data was compiled from the *NIOSH Pocket Guide to Chemical Hazards*, February 2004 edition.

Table 4
Chemical Exposure Hazard Data

Chemical Name	PEL*	STEL*	IDLH*	Exposure Route	Target Organs	Symptoms	Ionization Potential
Acetone	1,000 ppm	None	2,500 ppm	Inhalation, ingestion, skin/eye contact	Eyes, skin, respiratory system, central nervous system (CNS)	Irritation of eyes, nose, and throat; headaches; dizziness; CNS depression; dermatitis	9.69 eV
1,1-Dichloroethane	100 ppm	None	3,000 ppm	Inhalation, ingestion, skin/eye contact	Skin, liver, kidneys, lungs, CNS	Irritation of skin; CNS depression; liver, kidney, and lung damage	11.06 eV
1,2-Dichloroethane	50 ppm	2 ppm	50 ppm Carcinogen	Inhalation, absorption, ingestion, skin/eye contact	Eyes, skin, kidneys, liver, CNS, cardiovascular system (CVS)	Irritation of eyes; corneal opacity; CNS depression; nausea; vomiting; dermatitis; liver, kidney, and CVS damage (carc.)	11.05 eV
1,1-Dichloroethene (Vinylidene Chloride)	None	None	Carcinogen	Inhalation, absorption, ingestion, skin/eye contact	Eyes, skin, respiratory system, CNS, liver, kidneys	Irritation of eyes, skin, and throat; dizziness; headaches; nausea; dyspnea; liver and kidney dysfunction; pneumonitis	10.00 eV
1,2-Dichloroethene	200 ppm	None	1,000 ppm	Inhalation, ingestion, skin/eye contact	Eyes, respiratory system, CNS	Irritation of eyes and respiratory system; CNS depression	9.65 eV
Benzene	1 ppm	5 ppm	500 ppm Carcinogen	Inhalation, absorption, ingestion, skin/eye contact	Blood, central nervous system, skin, bone marrow (leukemia), eyes, respiratory system	Irritation of eyes, nose, skin, and respiratory system; dizziness; headache; nausea; staggered gait; fatigue; anorexia; lassitude; dermatitis; bone marrow depression (carc.)	9.24 eV
Chloroform	50 ppm (ceiling value)	2 ppm	500 ppm Carcinogen	Inhalation, absorption, ingestion, skin/eye contact	Liver, kidneys, heart, eyes, skin, CNS	Irritated eyes and skin; dizziness; mental dullness; nausea; confusion; headaches; fatigue; anesthesia; enlarged liver (carc.)	11.42 eV
Methylene Chloride	25 ppm (TWA)	125 ppm	2300 ppm Carcinogen	Inhalation, absorption, ingestion, skin/eye contact	Eyes, skin, CNS, respiratory system	Irritation of eyes, skin, and respiratory system; dizziness, drowsiness, lassitude, numbness, tingling of limbs, nausea (carc.)	11.32 eV
Tetrachloroethene	100 ppm	None	150 ppm Carcinogen	Inhalation, absorption, ingestion, skin/eye contact	Eyes, skin, respiratory system, liver, kidneys, CNS	Irritation of eyes, nose, skin, throat, and resp. system; nausea; flush face and neck; dizziness; incoherence; headaches; drowsiness; skin erythema; liver damage (carc.)	9.32 eV
Toluene	100 ppm	150 ppm	500 ppm	Inhalation, absorption, ingestion, skin/eye contact	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Irritation of eyes and nose; fatigue; confusion, euphoria, dizziness, headache; dilated pupils; lacrimation; anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver and kidney damage	8.82 eV

Chemical Name	PEL*	STEL*	IDLH*	Exposure Route	Target Organs	Symptoms	Ionization Potential
Trichloroethene	100 ppm	None	1,000 ppm Carcinogen	Inhalation, absorption, ingestion, skin/eye contact	Eyes, skin, respiratory system, heart, liver, kidneys, CNS	Irritation of eyes and skin; headache; visual disturbance; fatigue; dizziness; tremor; drowsiness; nausea; vomiting; dermatitis; cardiac arrhythmia; paresthesia; liver injury (carc.)	9.45 eV
1,1,1-Trichloroethane (Methyl Chloroform)	350 ppm	None	700 ppm	Inhalation, ingestion, skin/eye contact	Eyes, skin, CNS, CVS, liver	Irritation of eyes and skin; headaches; fatigue; CNS depression; poor equilibrium; dermatitis; cardiac arrhythmia; liver damage	11.00 eV
1,1,2-Trichloroethane (Vinyl Trichloride)	10 ppm	None	100 ppm Carcinogen	Inhalation, absorption, ingestion, skin/eye contact	Eyes, nose, skin, CNS, respiratory system, liver, kidneys	Irritation of eyes, skin; nose, CNS depression; kidney damage, liver damage	11.00 eV
Vinyl chloride	1 ppm	None	Carcinogen	Inhalation, skin/eye contact	Liver, CNS, blood, respiratory system, lymphatic system	Fatigue; abdominal pain; gastro-intestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid frostbite (carc.)	9.99 eV

* PEL – Permissible Exposure Limit
* STEL – Short Term Exposure Limit
* IDLH – Immediately Dangerous to Life or Health

To help minimize chemical exposure, appropriate personal protective equipment (PPE) will be worn during drilling and sampling activities. Expected PPE use will include hard hats, Tyvek coveralls, work boots, appropriate gloves, and protective eyewear and ear protection, as necessary. Variations of PPE use may be made dependent on work activity and approval by the Site Health and Safety Officer. Section 5.4.4 provides complete PPE requirements for site work activities. Additionally, breathing zone air monitoring will be conducted on a regular basis to check for the presence of volatile organic compounds. A PID will be used to perform the monitoring. Air monitoring details are presented in Section 5.5.

All site workers will have current hazardous waste operation certification and medical clearance to wear a respirator equipped with either organic vapor or combination particulate matter/organic vapor cartridges. The use of respirators will be based on PID measurements of breathing zone air monitoring results. The Site Health and Safety Officer will specify when respirators must be used.

Explosion-proof fans will be used during intrusive work to ventilate the area and disperse potential organic vapors from worker breathing zones. The fans will be set-up as near to the intrusive work activity as possible for their most effective operation.

5.4.2 Fire and Explosion Hazards

It is unlikely that volatile organic vapors from well installation or other tasks will be present at concentrations sufficient to create an explosion and/or fire hazard. It should be noted, however, that the 1996 Emergency Response Guidebook, published by the United States Department of Transportation, identifies the following explosion and/or fire hazards associated with volatile organic vapors.

- Volatile compounds may produce vapors.
- Vapors may be ignited by heat, sparks, or flames.
- Vapors may travel to a source of ignition and flash back.
- Containers may explode in heat or fire.
- Vapor explosion hazards indoors, outdoors, or in sewers.

A Combustible Gas Indicator (CGI) will be used during field work to assess the presence of potentially explosive atmospheres. The CGI will be used in various locations around the work site including near and immediately above the drilling casing.

In most cases it is anticipated that the engineering controls used to protect workers from potential volatile chemical exposures will also dissipate potentially explosive atmospheres. In the event that engineering controls are not initially required to address chemical exposures, but the CGI indicates a potentially explosive atmosphere at 10 percent of the lower explosive limit (LEL), the engineering controls discussed in Section 5.4.5 will be implemented, regardless of the potential for chemical exposure.

5.4.3 Physical Hazards

Listed below is a summary of a variety of physical hazards that may be encountered on the job-site. For convenience, these hazards have been categorized into several general groupings and suggested preventative measures are also included.

Category	Cause	Prevention
Head Hazards	Falling and/or sharp objects, bumping hazards.	All personnel will wear hard hats at all times.
Foot/Ankle Hazards	Sharp objects, dropped objects, uneven and/or slippery surfaces, chemical exposure	Chemical resistant, steel-toed boots must be worn at all times on-site.
Eye Hazards	Dirt and dust in air, sharp objects, bright lights (welding equipment), exposure due to splashes	Safety glasses/face shields will be worn when appropriate. Shaded welding protection will be worn when appropriate.
Electrical Hazards	Use of generators for temporary electrical power.	Follow good electrical practice, replace damaged wires and connectors, GFI outlets/explosion-proof equipment when appropriate, visual inspection of work area prior to starting work.
Work around Heavy Equipment	Heavy equipment such as drill rigs, service trucks, excavation equipment, saws, drills, etc.	Competent operators, backup alarms, regular maintenance, daily mechanical checks, proper guards, orange safety vest, non-verbal communication with operator.
Noise Hazards	Machinery creating >85 decibels TWA, >115 decibels continuous noise, or peak at >140 decibels	Wear earplugs or protective ear muffs.
Fall Hazards	Elevated, slippery, or uneven surfaces; open excavations; trips caused by poor "house keeping" practices	Exercise caution; place barriers, traffic cones, and caution tape around open excavations; maintain good "house keeping". Use retrieval system for work near open excavations.
Lifting Hazards	Injury due to improper lifting techniques, overreaching/overextending, heavy objects	Use proper lifting techniques, mechanical assist devices where appropriate.
Lighting Accidents	Due to improper illumination	Work will proceed during daylight hours only or under sufficient artificial illumination.
Animal Hazards	Spiders, scorpions, snakes and animals encountered during site preparation, well installation, and sampling activities.	Be aware of hazard. Look for spider webs, check well monument for signs of animal habitation. Look where you are walking or reaching.

The most important physical hazard at the site will be personnel working around heavy equipment. This is especially important because of confined conditions created by work activity being limited to the narrow access route. Workers should be especially aware of work around excavators and drill rigs. Non-verbal communication between ground-workers and equipment operators shall be discussed prior to entering work zones. Hand signs identifying actions such as shutting off equipment, stopping the equipment, or donning respirators must be clearly understood by all parties. Ground-workers shall not stand behind or in the “blind spot” of heavy operating equipment.

Workers performing air knife and/or vacuum excavation work after the geomembrane has been cut will wear a retrieval harness attached to a safety/retrieval line. This is necessary due to the expected depth of the excavation. The safety/retrieval line will be tied-off at an appropriate anchor point such that the line will prevent the worker from falling into the excavation and will enable quick retrieval of a worker who may fall. After the excavation is completed, the opening will be covered with a sheet of sufficiently thick plywood with a hole cut in it for and during drilling.

Additional physical hazards of concern are heat stress and exposure to cold. This Site undergoes extreme temperature fluctuations, and workers must be properly dressed to work in the given environment. Changes in worker clothing must be compatible with necessary PPE requirements. Workers are expected to understand and recognize behavioral or physical signs of heat or cold stress in other Site workers and they have an obligation to report or address these concerns if encountered.

5.4.4 Personal Protective Equipment (PPE)

It is anticipated that most field tasks will be performed in Level D PPE unless additional PPE is required because of task or site-specific upgrades. Level D PPE includes the following items:

- Nitrile inner and outer gloves for sampling activities
- Work gloves (appropriate type) for excavation and equipment operation
- Steel toe, steel shank work boots
- Neoprene steel-toe, steel shank boots for ground water sampling
- Hard hat
- Tyvek coveralls for excavation and drilling
- Ear protection as necessary
- Safety glasses as necessary

Level C PPE includes all Level D items plus the following:

- Full-face or half-face respirator equipped with organic vapor/HEPA combination cartridges
- Tyvek or Saranex coveralls
- Neoprene steel-toe, steel shank boots

In addition, workers performing the air knife and/or vacuum excavation below the geomembrane will wear a safety harness and safety/retrieval line appropriately anchored.

5.4.5 Engineering Controls

Work activity engineering controls will consist of explosion-proof fans that will be used during well and probe installation to ventilate and disperse potential organic vapors from worker breathing zones. Fans will be used to remove vapors from the source area and will exhaust the vapors downwind and sufficiently distant from work zones through caterpillar-type exhaust hoses. To be most effective, the fans will be set-up as near to the work activity as possible. Use of the fans will be dependent on air monitoring results. If deemed necessary, additional fans will be set up to force clean, ambient air into the Site worker vicinity. The Site Health and Safety Officer will decide when and how the ventilation fans will be used.

Additional engineering controls during well drilling and landfill cap work will include limiting the exposure routes for vapors to generate within work areas. As necessary, drillers will cap boring stems to limit vapor migration from down-hole points to the ground surface. Work on and below the landfill cap will be conducted in a way so as to not leave open portions of the liner for extended periods.

Avoiding physical injuries may be addressed through good housekeeping practices, and through the use of correct, well-maintained equipment. Upon finishing tasks in certain areas, work zones shall be kept in an orderly fashion. Tripping hazards may be avoided if loose tools are put away following use. Additionally, using the correct equipment for the specific job tasks is a crucial component to the health and safety of Site workers. Drums shall be moved with mechanical equipment whenever possible to avoid physical strains to workers. Equipment should be well maintained and in good working order to ensure its intended function and avoid accidents due to wear and tear.

5.5 Air Monitoring

The following section describes monitoring procedures and equipment that will be used during site work. The Site Health and Safety Officer, or a designated alternate, is responsible for performing all monitoring activities. Air monitoring will be used to determine the level of protection that is required for work to proceed safely.

5.5.1 Protection Monitoring

Protection monitoring is intended to confirm that human health and the environment are protected during implementation of the remedial action [WAC 173-340-410(a)]. Protection monitoring will be performed through the implementation of this Health and Safety Plan (HASP) prepared in accordance with the requirements of the Occupational Safety and Health Administration (OSHA) and the WISHA standards for hazardous waste site operations (29 CFR 1910.120 and WAC 296-62 Part P). The HASP will pertain only to those activities relating to the installation of wells and monitoring probes, and handling and management of contaminated soils and ground water and related hazards, and will have no relation to any other phases of the project.

This HASP will establish the general health and safety practices for EPI personnel performing these actions and will be provided to the on-site contractors for their information. EPI will not be responsible for the health and safety of other on-site personnel, however EPI will be available to advise other on-site workers on the health and safety measures that EPI personnel will be using, will share all of its monitoring data, and will advise other workers when EPI personnel are upgrading or modifying their level of personal protective equipment. The HASP will also be provided to subcontractor personnel for informational purposes. Implementation of this level of on-site health and safety monitoring is considered to meet the requirements of WAC 173-340-410(1)(2)(a) for the following reasons:

- Site access will be limited to authorized personnel;

- The field monitoring and mitigation measures called for in the HASP are protective of on-site worker health and should, therefore, also be adequate to protect the health of workers in nearby areas. The nearest potential exposure points for off-site workers are considerable distances from the affected soil investigation and handling areas;

- Conditions imposed on the well installation contractors by applicable federal and state regulations and laws require that specific measures be taken to prevent the occurrence of exposure that may pose a threat to human health or the environment (e.g., surface water runoff, earth moving equipment dragout, wind-blown dust emissions). Work will be conducted in accordance with applicable OSHA and WISHA regulations. Contractors on this project will be required to develop and implement their own health and safety procedures in accordance with applicable laws and regulations; and

- Soil investigation activities associated with this project will be of a relatively short duration (i.e., 2-4 weeks) and health risks associated with long-term exposures to on-site contaminants are not of a concern. Considering the protection measures and monitoring called for during soil investigation activities, the risk of non-workers being subjected to appreciable short-term chemical exposure will be negligible.

Real-time evaluations of vapor concentrations will be performed using a photo-ionization detector (PID) calibrated to isobutylene. The readings from this PID will be the basis for upgrading personal protective equipment (PPE) to include half or full-face respirators and for establishing exclusion zones. If a PID reading exceeds 1 ppm for 15-minutes, additional monitoring using compound specific methods such as colorimetric tubes will be used to assess chemical-specific exposure levels.

5.5.2 Air Monitoring Equipment

All monitoring equipment used during this project will be inspected and calibrated prior to use to ensure that it is in proper working condition. If any piece of required monitoring equipment does not work properly, work in the monitored area will stop and will not continue until the monitoring equipment is repaired. Because exposure to airborne contaminants is expected to be limited to volatile organic compounds (VOCs), air monitoring will be performed with a Photoionization Detector (PID). The range of contaminants expected to be present require that the PID be equipped with a *10.6 eV* detector lamp.

The PID must be "zeroed" and calibrated according to manufacturer instructions at least daily. Initial monitoring will be performed approximately every 30 minutes, unless odors, tastes, or a PID response indicate the presence of airborne contaminants above background levels. If airborne contaminants are detected, air monitoring will be performed continuously.

Additional air sampling for compound-specific components of the air will be performed with a GasTec® GV-100S gas-sampling pump. Colorimetric tubes will be used to determine compound-specific levels of gases in the breathing zones as defined below. The hand-held gas-sampling pump is equipped with chemically reactive colorimetric tubes that change color in the presence of the compound being sampled. Small aliquots of 50 or 100 ml of air are drawn through the tubes by the pump, and direct readings of concentrations of the specific compound by volume may be recorded.

5.5.3 Action Levels

The action level for this Site is 25 ppm. This action level will be used when PID detections reach or exceed 25 ppm for a sustained period in excess of 15 minutes. The most likely airborne constituents include TCE and toluene, however, compounds with lower exposure limits dictate the need for providing additional air sampling for specific compounds at concentrations less than the action level. Because the site action level for VOCs is set at 25 ppm and the PEL for vinyl chloride is 1.0 ppm, it must be determined if the total VOCs detected in the air contain greater than 1.0 ppm of vinyl chloride. This determination will be made using colorimetric tubes specifically designed to detect and quantify vinyl chloride concentrations in the air. If total VOC concentrations are greater than 1.0 ppm over background (sustained for >15 minutes) EPI will use colorimetric tubes to evaluate the vinyl chloride concentration. If vinyl chloride is detected at concentrations greater than 1.0 ppm in the breathing zone, additional engineering controls will be implemented and the breathing zone will be re-tested to determine if Level C PPE shall be donned. If total VOC concentrations are greater than 5.0 ppm over background (sustained for >15 minutes) EPI will additionally use colorimetric tubes to evaluate benzene concentrations. If benzene is detected at concentrations greater than 5.0 ppm in the breathing zone, additional engineering controls will be implemented and the breathing zone will be re-tested to determine if Level C PPE shall be donned.

If at any time PID concentrations are in excess of 25 ppm over background (sustained for >15 minutes), all Site workers will immediately be notified, Level C PPE will be donned, and engineering controls will be sufficiently implemented to address these concerns.

Procedures for air monitoring and action levels are presented in the list below.

Response	Length of Time	Protective Measure
>1 ppm over background	15 minute average	Level D Personal Protective Equipment (PPE); Evaluate vinyl chloride concentrations relative to total VOCs using colorimetric tubes
1 to 5 ppm	15 minute average	Level D PPE; Evaluate benzene concentrations relative to total VOCs using colorimetric tubes
5 to 25 ppm	15 minute average	Allow work area to vent. If persistent go to Level C
25 to 50 ppm	Sustained over 15 minutes	Level C PPE, High-efficiency organic vapor cartridges in respirators
> 50 ppm	One (1) minute average	Vacate work area, notify Site Health and Safety Officer immediately; Re-test air after 15 minutes

It should be noted that these action levels are based on the presence of vinyl chloride and benzene which have some of the lowest exposure levels of the compounds listed in the Chemical Hazard Exposure Data table, and which can be directly measured in the field with hand-held equipment.

5.5.4 Changed Conditions

The Site Health and Safety Officer will periodically and routinely visually inspect the work site to assess whether any new potential hazards have arisen. Whenever possible, immediate measures will be taken to eliminate or reduce the risks associated with new hazards or changed conditions.

5.6 Hazard Analysis by Task

The following section identifies potential hazards associated with each task listed in Section 2.3 of this Health and Safety Plan. Unless otherwise noted, work will begin and proceed in Level D personal protective equipment. The level of protection will be upgraded accordingly by the Site Health and Safety Officer whenever warranted by conditions present in the work area.

Task 1 – Site Preparation
Hazards due to work around heavy equipment; physical hazards such as head, foot/ankle, eye, noise, fall, and lifting hazards; a potential for animal hazards.

Task 2 – Probe Installation
Exposure to volatile organic compounds; working around heavy equipment; other physical hazards include head, foot/ankle, eye, noise, fall, lifting hazards, and heat and cold stress; a potential for animal hazards.

Task 3 – Well Installation
Exposure to volatile organic compounds; working around heavy equipment; other physical hazards include head, foot/ankle, eye, noise, fall, lifting hazards, and heat and cold stress; a potential for animal hazards.

Task 4 – Sampling and Monitoring
Exposure to volatile organic compounds; physical hazards include head, foot/ankle, eye, noise, fall, and lifting hazards; a potential for animal hazards.

5.7 Site Control

The following section identifies work zones located at the work site. Access to some of these work zones (i.e., the exclusion zone and contamination reduction zone) will be restricted to designated personnel. Figure 12 details the locations of these zones.

The Pasco Zone A landfill cap site is secured by a fence with locked gates. Unauthorized personnel will not be allowed to enter the landfill cap site. Additionally, there are other fenced and secure areas for the remediation equipment near the Zone A landfill cap.

5.7.1 Exclusion Zone (Hot Zone)

Exclusion Zones for this project shall be considered the area within the fence immediately surrounding the landfill cap (except for a small contaminant reduction zone) where active work is being performed, and any area within a 50-foot radius of any active work. Only authorized personnel will be allowed within this zone. All site workers entering an Exclusion Zone must have current hazardous waste operations training and must be wearing the prescribed PPE for the work activity being performed. As a general rule, all parties whom are within the Contamination Reduction Zone shall remain a minimum of 50 feet from an active Exclusion Zone. Parties are to remain upwind of the Exclusion Zone during active work beneath the HDPE liner.

5.7.2 Contamination Reduction Zone (Warm Zone)

A decontamination area will be established inside the fence, immediately adjacent to the gate and the access route. In addition, any area within the fenced portions of the Zone A landfill, and at a distance greater than 50 feet from any exclusion zone shall be considered the Contamination Reduction Zone. All equipment and personnel will pass through the decontamination area as they exit the contamination reduction or exclusion zones and before exiting through the gate. The purpose of the contamination reduction zone is to prevent site contaminants from leaving the work site.

5.7.3 Safety Zone (Cold Zone)

The safety zone at the Site will be considered any areas outside of the exclusion or contamination reduction zones. This area will function as a staging area for support vehicles, supplies, and will function as an area where work may be performed in preparation for the work to be done in the exclusion and contamination reduction zones. It is safe practice to remain upwind of any Site work beneath the HDPE liner, even if in the Safety Zone.

5.7.2.1 Decontamination Procedures – Equipment

All equipment that has been exposed to soil and/or ground water from beneath the landfill cap geomembrane must be inspected and decontaminated in the Contamination Reduction Zone before leaving the site. Equipment and tools will be either water washed or dry brushed to remove soil and dirt.

Water washing will use Alconox (or equivalent) detergent to remove contamination. The cleaning will be done with a dedicated scrub brush that remains in the decontamination area. Small equipment and tools will be washed in an open basin or tub. Following washing, the small equipment and tools will be rinsed in a second open basin or tub. After washing and rinsing, the equipment may exit the site.

Large equipment will be washed and rinsed on a water-impervious tarp or heavy plastic sheet. The tarp or sheet will be set up to contain and collect the wash and rinse water. Water washing will use Alconox or an equivalent detergent to remove contamination. The cleaning will be done with dedicated equipment that will remain in the decontamination area. Washing and rinsing of large equipment will use the minimum amount of water to accomplish decontamination.

Drill rigs and other heavy equipment commonly used at contaminated sites may use their own steam or pressure washing apparatus for decontamination. Decontamination water must be properly contained, profiled and disposed.

All wash and rinse water will be collected in 55-gallon drums, which will be stored until sampled for characterization, and profiled for ultimate disposal. The water will be sampled and analyzed for applicable constituents and disposed of according to applicable regulations.

5.7.2.2 Decontamination Procedures – Personnel

Personnel that have been exposed to soil and/or ground water from beneath the landfill cap geomembrane will also pass through the Contamination Reduction Zone before exiting the work site. Workers will dispose of gloves, coveralls, and any other disposable contaminated PPE in 55-gallon drums. Work boots will be dry brushed to remove visual dust and dirt. Excessively dirty work boots must be scrubbed with an Alconox (or equivalent) detergent solution and rinsed so that no contamination leaves the work site. Wash and rinse water will be contained in an open tub or basin, and containerized in 55-gallon drums as appropriate.

5.8 Emergency Response and Contingency Plan

This section defines procedures and specific responsibilities that are to be followed in the event that a chemical spill or release, a fire or explosion, or an accident involving injuries occurs. The Site Health and Safety Officer, or a designated alternate, will determine when emergency and/or regulatory agencies should be contacted and which agencies are appropriate to contact. It should be noted that if injuries have occurred, all site workers have the responsibility to secure medical help for the affected worker(s). **Medical and other emergency help can be contacted at the appropriate phone numbers listed on the introductory pages of this Plan.**

In all emergency situations, the rule is SAFETY FIRST! Do not, under any circumstances, attempt to rescue a fallen co-worker unless proper safety measures for the rescue have been carefully considered and executed.

In case of injury: call 911.

5.9 Administrative

Because the site contains hazardous wastes, all personal must be Hazardous Waste Operations and Emergency Response (HAZWOPER) trained. In addition, annual refresher training must be current.

5.9.1 Medical Surveillance

Personnel involved with field activities must be covered under their employer's medical surveillance program that includes annual physical examinations and certification to wear respiratory protective equipment. These medical monitoring programs must be in compliance with all applicable worker health and safety regulations.

5.9.2 Record Keeping

The Site Health and Safety Officer, or a designated alternate, will be responsible for keeping daily logs of workers and visitors present at the work site, attendance lists of personnel present at site health and safety meetings, accident reports, air monitoring results, and signatures of all personnel who have read this Health and Safety Plan.

Signature Page

I have read this Health and Safety Plan and understand its contents. I agree to abide by its provisions and will immediately notify the Site Health and Safety Officer if site conditions or hazards not specifically designated herein are encountered.

Name (Print)	Signature	Date	Company/Affiliation

Tables

TABLE 5
Sampling Methods and Specifications

Matrix	Method	Parameter	Container	Preservation and Handling	Holding Time
Soil Gas	EPA 8260	VOCs	500-ml Tedlar bag	Store in dark box or cooler at room temperature	72 hours
Soil	EPA 8260C (collect via EPA 5035A)	VOCs	2 - 40-ml VOA vials with preweighed magnetic stir bars	Cool to 4°C	48 hrs until frozen or analzed
			40-ml VOA vial	5 ml methanol, Cool to 4°C	14 day
			4 ounce wide mouth glass jar	Cool to 4°C	48 hrs until frozen or analzed
	EPA 8151	Chlorophenoxy Herbicides	8 ounce jar	Cool to 4°C	14 day
	EPA 8270 and 8270 SIM	SVOCs	3 - 4 ounce wide mouth glass jars	Cool to 4°C	14 day
	EPA 8082	Polychlorinated Biphenyls (PCBs)			
	EPA 6020 and 200.8 (ICP-MS)	Prioirty Pollutant Metals			
	EPA 7471A (CVAA)	Mercury			
	EPA 415.1	TOC			
	TCLP	All above parameters	3 - 4 ounce wide mouth glass jars	Cool to 4°C	14 day
			8 ounce jar		
	To be determined upon laboratory selection	Vertical Hydraulic Conductivity	Conductivity and bulk density samples will be collected and handled according to laboratory specifications once a laboratory is selected.		
		Horizontal Hydraulic Conductivity			
		Bulk Density			
Ground Water	EPA 8260B and SIM	VOCs	2 - 40-ml VOA vials	HCl, Cool to 4°C	14 days
	EPA 8270 and 8270 SIM	SVOCs	1 L amber glass	Cool to 4°C	7 days to extract
	EPA 8151	Chlorophenoxy Herbicides	1 L amber glass	Cool to 4°C	7 days to extract
	EPA 8082	PCBs	1 L amber glass	Cool to 4°C	7 days to extract
	EPA 6020 and 200.8 (ICP-MS)	Prioirty Pollutant Metals	500 mL HDPE bottle	HNO_3 to pH<2, cool to 4°C	6 months
	EPA 7471A (CVAA)	Mercury			28 days
	SM 3500Cr	Hexavalent Chromium	1 L HDPE	Cool to 4°C	24 hours

TABLE 6
Method Detection Limits and Reporting Limits

Air Analysis

Analyte	Method Detection Limit	Reporting Limit	Units
EPA Method 8260 - Limits provided by ALS Laboratory Group			
Dichlorodifluoromethane	0.0285	0.2	µg/L
Ethanol	0.2	1	µg/L
Chloromethane	0.0209	0.2	µg/L
tert-Butanol	0.2	0.2	µg/L
Vinyl Chloride	0.0177	0.02	µg/L
Diisopropyl Ether	0.2	0.2	µg/L
Bromomethane	0.0248	0.2	µg/L
Ethyl T-Butyl Ether	0.2	0.2	µg/L
Chloroethane	0.0127	0.2	µg/L
tert-Amyl Methyl Ether	0.2	0.2	µg/L
Trichlorofluoromethane	0.0147	0.2	µg/L
Carbon Tetrachloride	0.0165	0.2	µg/L
Carbon Disulfide	0.2	0.2	µg/L
Acetone	0.0582	2.5	µg/L
1,1-Dichloroethene	0.0283	0.2	µg/L
Methylene Chloride	0.045	0.5	µg/L
Acrylonitrile	0.0157	1	µg/L
Methyl T-Butyl Ether	0.0132	0.2	µg/L
Trans-1,2-Dichloroethene	0.0241	0.2	µg/L
1,1-Dichloroethane	0.021	0.2	µg/L
2-Butanone	0.0373	1	µg/L
Cis-1,2-Dichloroethene	0.0238	0.2	µg/L
2,2-Dichloropropane	0.029	0.2	µg/L
Bromochloromethane	0.0172	0.2	µg/L
Chloroform	0.016	0.2	µg/L
1,1,1-Trichloroethane	0.0212	0.2	µg/L
1,1-Dichloropropene	0.018	0.2	µg/L
1,2-Dichloroethane	0.0268	0.2	µg/L
Benzene	0.0116	0.2	µg/L
Trichloroethene	0.0221	0.2	µg/L
1,2-Dichloropropane	0.0256	0.2	µg/L
Dibromomethane	0.0361	0.2	µg/L
Bromodichloromethane	0.0221	0.2	µg/L
Trans-1,3-Dichloropropene	0.0153	0.2	µg/L
4-Methyl-2-Pentanone	0.0228	1	µg/L
Toluene	0.0199	0.2	µg/L
Cis-1,3-Dichloropropene	0.0278	0.2	µg/L
1,1,2-Trichloroethane	0.0249	0.2	µg/L
2-Hexanone	0.0366	1	µg/L
1,3-Dichloropropane	0.0169	0.2	µg/L
Tetrachloroethylene	0.0497	0.2	µg/L
Dibromochloromethane	0.026	0.2	µg/L
1,2-Dibromoethane	0.0241	0.2	µg/L
Chlorobenzene	0.0084	0.2	µg/L
1,1,1,2-Tetrachloroethane	0.0158	0.2	µg/L
Ethylbenzene	0.0105	0.2	µg/L
m,p-Xylene	0.0319	0.4	µg/L
Styrene	0.0154	0.2	µg/L
o-Xylene	0.0131	0.2	µg/L
Bromoform	0.0379	0.2	µg/L
Isopropylbenzene	0.0065	0.2	µg/L

Analyte	**Method Detection Limit**	**Reporting Limit**	**Units**
1,1,2,2-Tetrachloroethane	0.0422	0.2	µg/L
1,2,3-Trichloropropane	0.0154	0.2	µg/L
Bromobenzene	0.0241	0.2	µg/L
N-Propyl Benzene	0.0121	0.2	µg/L
2-Chlorotoluene	0.0141	0.2	µg/L
1,3,5-Trimethylbenzene	0.0175	0.2	µg/L
4-Chlorotoluene	0.0145	0.2	µg/L
T-Butyl Benzene	0.2	0.2	µg/L
1,2,4-Trimethylbenzene	0.0078	0.2	µg/L
S-Butyl Benzene	0.0168	0.2	µg/L
P-Isopropyltoluene	0.0196	0.2	µg/L
1,3 Dichlorobenzene	0.0154	0.2	µg/L
1,4-Dichlorobenzene	0.0105	0.2	µg/L
N-Butylbenzene	0.0106	0.2	µg/L
1,2-Dichlorobenzene	0.0139	0.2	µg/L
1,2-Dibromo 3-Chloropropane	0.0467	1	µg/L
1,2,4-Trichlorobenzene	0.0313	0.2	µg/L
Hexachlorobutadiene	0.0356	0.2	µg/L
Naphthalene	0.0354	0.2	µg/L
1,2,3-Trichlorobenzene	0.0351	0.2	µg/L

Soil Analysis

Analyte	**Method Detection Limit**	**Reporting Limit**	**Units**
EPA Method 8260 - Limits provided by ALS Laboratory Group			
Dichlorodifluoromethane	0.054092476	10	µg/kg
Ethanol	7.036231109	10	µg/kg
Chloromethane	0.102020723	10	µg/kg
tert-Butanol	0.055933971	10	µg/kg
Vinyl Chloride	0.075534728	10	µg/kg
Diisopropyl Ether	0.228209795	10	µg/kg
Bromomethane	0.068318333	10	µg/kg
Ethyl T-Butyl Ether	0.109899149	10	µg/kg
Chloroethane	0.147502735	10	µg/kg
tert-Amyl Methyl Ether	0.829181742	10	µg/kg
Trichlorofluoromethane	0.095851823	10	µg/kg
Carbon Tetrachloride	0.212994629	10	µg/kg
Acetone	1.021928159	50	µg/kg
1,1-Dichloroethene	0.110115279	10	µg/kg
Methylene chloride	0.851929639	10	µg/kg
Acrylonitrile	0.12311695	50	µg/kg
Methyl T-Butyl Ether	0.128810893	10	µg/kg
Trans-1,2-Dichloroethene	0.151761523	10	µg/kg
1,1-Dichloroethane	0.095549361	10	µg/kg
2-Butanone	0.471403972	50	µg/kg
Cis-1,2-Dichloroethene	0.154318535	10	µg/kg
2,2-Dichloropropane	0.100558747	10	µg/kg
Bromochloromethane	0.154983378	10	µg/kg
Chloroform	0.271835136	10	µg/kg
1,1,1-Trichloroethane	0.10124017	10	µg/kg
1,1-Dichloropropene	0.102167049	10	µg/kg
1,2-Dichloroethane	0.195789377	10	µg/kg
Benzene	0.085438086	10	µg/kg

Analyte	**Method Detection Limit**	**Reporting Limit**	**Units**
Trichloroethene	0.11896593	10	µg/kg
1,2-Dichloropropane	0.101454187	10	µg/kg
Dibromomethane	0.100373217	10	µg/kg
Bromodichloromethane	0.131164564	10	µg/kg
Trans-1,3-Dichloropropene	0.105266665	10	µg/kg
4-Methyl-2-Pentanone	0.161025131	50	µg/kg
Toluene	0.231437749	10	µg/kg
Cis-1,3-Dichloropropene	0.066972847	10	µg/kg
1,1,2-Trichloroethane	0.195760878	10	µg/kg
2-Hexanone	0.52856694	50	µg/kg
1,3-Dichloropropane	0.118221487	10	µg/kg
Tetrachloroethylene	0.023956516	10	µg/kg
Dibromochloromethane	0.094517355	10	µg/kg
1,2-Dibromoethane	0.180923864	5	µg/kg
Chlorobenzene	0.067814777	10	µg/kg
1,1,1,2-Tetrachloroethane	0.138498415	10	µg/kg
Ethylbenzene	0.325169031	10	µg/kg
m,p-Xylene	0.159550237	20	µg/kg
Styrene	0.065670707	10	µg/kg
o-Xylene	0.110207469	10	µg/kg
Bromoform	0.141716843	10	µg/kg
Isopropylbenzene	0.072376802	10	µg/kg
1,1,2,2-Tetrachloroethane	0.131854292	10	µg/kg
1,2,3-Trichloropropane	0.127773785	10	µg/kg
Bromobenzene	0.084895738	10	µg/kg
N-Propyl Benzene	0.086876312	10	µg/kg
2-Chlorotoluene	0.142153499	10	µg/kg
1,3,5-Trimethylbenzene	0.084278083	10	µg/kg
4-Chlorotoluene	0.069232921	10	µg/kg
T-Butyl Benzene	0.237914721	10	µg/kg
1,2,4-Trimethylbenzene	0.056384514	10	µg/kg
S-Butyl Benzene	0.054298265	10	µg/kg
P-Isopropyltoluene	0.075075769	10	µg/kg
1,3 Dichlorobenzene	0.1001724	10	µg/kg
1,4-Dichlorobenzene	0.049909914	10	µg/kg
N-Butylbenzene	0.101690634	10	µg/kg
1,2-Dichlorobenzene	0.078470151	10	µg/kg
1,2-Dibromo 3-Chloropropane	0.427090868	50	µg/kg
1,2,4-Trichlorobenzene	0.074700976	10	µg/kg
Hexachlorobutadiene	0.134162268	10	µg/kg
Naphthalene	0.052558291	10	µg/kg
1,2,3-Trichlorobenzene	0.072023974	10	µg/kg
EPA Method 8270 SIM - Limits provided by ALS Laboratory Group			
Benzo[A]Anthracene	0.000943	0.02	mg/kg
Benzo[A]Pyrene	0.00149	0.02	mg/kg
Benzo[B]Fluoranthene	0.001712	0.02	mg/kg
Benzo[K]Fluoranthene	0.001841	0.02	mg/kg
Chrysene	0.001038	0.02	mg/kg
Dibenz[A,H]Anthracene	0.000899	0.02	mg/kg
Indeno[1,2,3-Cd]Pyrene	0.001075	0.02	mg/kg
EPA Method 8270 - Limits provided by ALS Laboratory Group			
1-Methylnaphthalene	8.6	100	µg/kg
1,2-Dichlorobenzene	4.3	100	µg/kg

TABLE 6
Method Detection Limits and Reporting Limits

Analyte	**Method Detection Limit**	**Reporting Limit**	**Units**
1,2,4-Trichlorobenzene	7.6	100	µg/kg
1,3-Dichlorobenzene	4.4	100	µg/kg
1,4-Dichlorobenzene	3.9	100	µg/kg
2-Chloronaphthalene	4.4	100	µg/kg
2-Chlorophenol	12	100	µg/kg
2-Methylnaphthalene	10.4	100	µg/kg
2-Methylphenol	12.4	100	µg/kg
2-Nitroaniline	6.4	250	µg/kg
2-Nitrophenol	9.8	250	µg/kg
2,3,4,6-Tetrachlorophenol	8.4	250	µg/kg
2,4-Dichlorophenol	9.5	100	µg/kg
2,4-Dimethylphenol	12.8	100	µg/kg
2,4-Dinitrophenol	19.7	500	µg/kg
2,4-Dinitrotoluene	10.7	250	µg/kg
2,4,5-Trichlorophenol	12.2	100	µg/kg
2,4,6-Trichlorophenol	8.3	100	µg/kg
2,6-Dichlorophenol	11.3	100	µg/kg
2,6-Dinitrotoluene	14.9	250	µg/kg
3-Nitroaniline	11.6	250	µg/kg
3&4-Methylphenol	14.2	100	µg/kg
4-Bromophenyl-Phenylether	10.2	100	µg/kg
4-Chloro-3-Methylphenol	11.5	100	µg/kg
4-Chloroaniline	4.6	100	µg/kg
4-Chlorophenyl-Phenylether	9.5	100	µg/kg
4-Nitroaniline	14.1	250	µg/kg
4-Nitrophenol	38.7	500	µg/kg
4,6-Dinitro-2-Methylphenol	17.5	100	µg/kg
Acenaphthene	7	100	µg/kg
Acenaphthylene	10.1	100	µg/kg
Aniline	4.7	100	µg/kg
Anthracene	10.2	100	µg/kg
Azobenzene	10.7	100	µg/kg
Benzo[A]Anthracene	28.2	100	µg/kg
Benzo[A]Pyrene	14.6	100	µg/kg
Benzo[B]Fluoranthene	8.7	100	µg/kg
Benzo[G,H,I]Perylene	13.4	100	µg/kg
Benzo[K]Fluoranthene	5.9	100	µg/kg
Benzoic Acid	25	1000	µg/kg
Benzyl Alcohol	10.6	100	µg/kg
Bis(2-Chloroethoxy)Methane	12.1	100	µg/kg
Bis(2-Chloroethyl)Ether	6.3	100	µg/kg
Bis(2-Chloroisopropyl)Ether	7.7	100	µg/kg
Bis(2-Ethylhexyl)Phthalate	4.9	130	µg/kg
Butylbenzylphthalate	8.2	100	µg/kg
Carbazole	10.8	100	µg/kg
Chrysene	7.1	100	µg/kg
Di-N-Butylphthalate	6.5	130	µg/kg
Di-N-Octylphthalate	15.1	100	µg/kg
Dibenz[A,H]Anthracene	14.1	100	µg/kg
Dibenzofuran	7.3	100	µg/kg
Diethylphthalate	8.4	100	µg/kg
Dimethylphthalate	6.9	100	µg/kg
Fluoranthene	10.1	100	µg/kg
Fluorene	6.4	100	µg/kg

Analyte	Method Detection Limit	Reporting Limit	Units
Hexachlorobenzene	10.1	100	µg/kg
Hexachlorobutadiene	5.9	100	µg/kg
Hexachlorocyclopentadiene	31.6	500	µg/kg
Hexachloroethane	5.7	100	µg/kg
Indeno[1,2,3-Cd]Pyrene	9.1	100	µg/kg
Isophorone	14	100	µg/kg
N-Nitroso-Di-N-Propylamine	10.2	100	µg/kg
N-Nitrosodimethylamine	6.5	100	µg/kg
N-Nitrosodiphenylamine	12.5	100	µg/kg
Naphthalene	6.4	100	µg/kg
Nitrobenzene	9.6	100	µg/kg
Pentachlorophenol	26.4	500	µg/kg
Phenanthrene	9.3	100	µg/kg
Phenol	12.1	100	µg/kg
Pyrene	11.1	100	µg/kg
Pyridine	8.8	200	µg/kg
EPA Method 8082 - Limits provided by ALS Laboratory Group			
PCB-1016	0.0027	0.1	mg/kg
PCB-1221	0.0027	0.1	mg/kg
PCB-1232	0.0027	0.1	mg/kg
PCB-1242	0.0027	0.1	mg/kg
PCB-1248	0.0027	0.1	mg/kg
PCB-1254	0.0027	0.1	mg/kg
PCB-1260	0.0027	0.1	mg/kg
PCB-1268	0.0027	0.1	mg/kg
Chlordane	0.0022	0.5	mg/kg
EPA Method 8151 - Limits provided by TestAmerica			
2,4-D	0.413	1.33	µg/kg
2,4-DB	0.34	1.33	µg/kg
2,4,5-T	0.258	1.33	µg/kg
4-Nitrophenol	0.403	1.33	µg/kg
Benzonitrile,3,5-dibromo-4-hydroxy	0.570	6.67	µg/kg
Dalapon	1.466	5	µg/kg
Dicamba	0.846	3.33	µg/kg
Dichlorprop	0.377	1.33	µg/kg
Dinoseb	0.464	3.33	µg/kg
MCPA	0.359	1.33	µg/kg
MCPP	0.512	1.33	µg/kg
Pentachlorophenol	0.599	3.33	µg/kg
Silvex	0.381	1.33	µg/kg
EPA Method 6020 and 200.8 (ICP-MS) - Limits provided by Analytical Resources, Inc.			
Antimony	0.008	0.2	mg/kg
Arsenic	0.090	0.5	mg/kg
Beryllium	0.022	0.2	mg/kg
Cadmium	0.011	0.2	mg/kg
Chromium	0.101	0.5	mg/kg
Copper	0.127	0.5	mg/kg
Lead	0.263	1	mg/kg
Nickel	0.208	0.5	mg/kg
Selenium	0.365	2	mg/kg
Silver	0.009	0.2	mg/kg

Analyte	Method Detection Limit	Reporting Limit	Units
Thallium	0.005	0.2	mg/kg
Zinc	0.637	4	mg/kg
EPA Method 7471A (CVAA) - Limits provided by Analytical Resources, Inc.			
Mercury	0.0053	0.05	mg/kg

Ground Water Analysis			
EPA Method 8260 SIM - Limits provided by ALS Laboratory Group			
Vinyl Chloride	0.00351	0.02	µg/L
1,1-Dichloroethene	0.006199	0.02	µg/L
1,2-Dichloroethane	0.001926	0.01	µg/L
Benzene	0.004468	0.02	µg/L
Trichloroethene	0.01695	0.05	µg/L
Tetrachloroethylene	0.01033	0.05	µg/L
EPA Method 8260 - Limits provided by ALS Laboratory Group			
Dichlorodifluoromethane	0.285	2	µg/L
Ethanol	10	10	µg/L
Chloromethane	0.209	2	µg/L
tert-Butanol	2	2	µg/L
Vinyl Chloride	0.177	0.2	µg/L
Diisopropyl Ether	2	2	µg/L
Bromomethane	0.248	2	µg/L
Ethyl T-Butyl Ether	2	2	µg/L
Chloroethane	0.127	2	µg/L
tert-Amyl Methyl Ether	2	2	µg/L
Trichlorofluoromethane	0.147	2	µg/L
Carbon Tetrachloride	0.165	2	µg/L
Carbon Disulfide	0.261	2	µg/L
Acetone	0.582	25	µg/L
1,1-Dichloroethene	0.283	2	µg/L
Methylene Chloride	0.45	5	µg/L
Acrylonitrile	0.157	10	µg/L
Methyl T-Butyl Ether	0.132	2	µg/L
Trans-1,2-Dichloroethene	0.241	2	µg/L
1,1-Dichloroethane	0.21	2	µg/L
2-Butanone	0.373	10	µg/L
Cis-1,2-Dichloroethene	0.238	2	µg/L
2,2-Dichloropropane	0.29	2	µg/L
Bromochloromethane	0.172	2	µg/L
Chloroform	0.16	2	µg/L
1,1,1-Trichloroethane	0.212	2	µg/L
1,1-Dichloropropene	0.18	2	µg/L
1,2-Dichloroethane	0.268	2	µg/L
Benzene	0.116	2	µg/L
Trichloroethene	0.221	2	µg/L
1,2-Dichloropropane	0.256	2	µg/L
Dibromomethane	0.361	2	µg/L
Bromodichloromethane	0.221	2	µg/L
Trans-1,3-Dichloropropene	0.153	2	µg/L
4-Methyl-2-Pentanone	0.228	10	µg/L
Toluene	0.199	2	µg/L
Cis-1,3-Dichloropropene	0.278	2	µg/L
1,1,2-Trichloroethane	0.249	2	µg/L

Analyte	**Method Detection Limit**	**Reporting Limit**	**Units**
2-Hexanone	0.366	10	µg/L
1,3-Dichloropropane	0.169	2	µg/L
Tetrachloroethylene	0.497	2	µg/L
Dibromochloromethane	0.26	2	µg/L
1,2-Dibromoethane	0.241	2	µg/L
Chlorobenzene	0.084	2	µg/L
1,1,1,2-Tetrachloroethane	0.158	2	µg/L
Ethylbenzene	0.105	2	µg/L
m,p-Xylene	0.319	4	µg/L
Styrene	0.154	2	µg/L
o-Xylene	0.131	2	µg/L
Bromoform	0.379	2	µg/L
Isopropylbenzene	0.065	2	µg/L
1,1,2,2-Tetrachloroethane	0.422	2	µg/L
1,2,3-Trichloropropane	0.154	2	µg/L
Bromobenzene	0.241	2	µg/L
N-Propyl Benzene	0.121	2	µg/L
2-Chlorotoluene	0.141	2	µg/L
1,3,5-Trimethylbenzene	0.175	2	µg/L
4-Chlorotoluene	0.145	2	µg/L
T-Butyl Benzene	0.15	2	µg/L
1,2,4-Trimethylbenzene	0.078	2	µg/L
S-Butyl Benzene	0.168	2	µg/L
P-Isopropyltoluene	0.196	2	µg/L
1,3 Dichlorobenzene	0.154	2	µg/L
1,4-Dichlorobenzene	0.105	2	µg/L
N-Butylbenzene	0.106	2	µg/L
1,2-Dichlorobenzene	0.139	2	µg/L
1,2-Dibromo 3-Chloropropane	0.467	10	µg/L
1,2,4-Trichlorobenzene	0.313	2	µg/L
Hexachlorobutadiene	0.356	2	µg/L
Naphthalene	0.354	2	µg/L
1,2,3-Trichlorobenzene	0.351	2	µg/L
EPA Method 8270 SIM - Limits provided by ALS Laboratory Group			
Benzo[A]Anthracene	0.00445	0.02	µg/L
Benzo[A]Pyrene	0.00852	0.02	µg/L
Benzo[B]Fluoranthene	0.00736	0.02	µg/L
Benzo[K]Fluoranthene	0.00493	0.02	µg/L
Chrysene	0.0057	0.02	µg/L
Dibenz[A,H]Anthracene	0.00786	0.02	µg/L
Indeno[1,2,3-Cd]Pyrene	0.00774	0.02	µg/L
Pentachlorophenol	0.08112	0.5	µg/L
EPA Method 8270 - Limits provided by ALS Laboratory Group			
1-Methylnaphthalene	1.0384	2	µg/L
1,2-Dichlorobenzene	0.7603	2	µg/L
1,2,4-Trichlorobenzene	0.5491	2	µg/L
1,3-Dichlorobenzene	1.0166	2	µg/L
1,4-Dichlorobenzene	1.046	2	µg/L
2-Chloronaphthalene	0.796	2	µg/L
2-Chlorophenol	0.4352	2	µg/L
2-Methylnaphthalene	0.8253	2	µg/L
2-Methylphenol	0.5687	2	µg/L
2-Nitroaniline	0.8618	2	µg/L

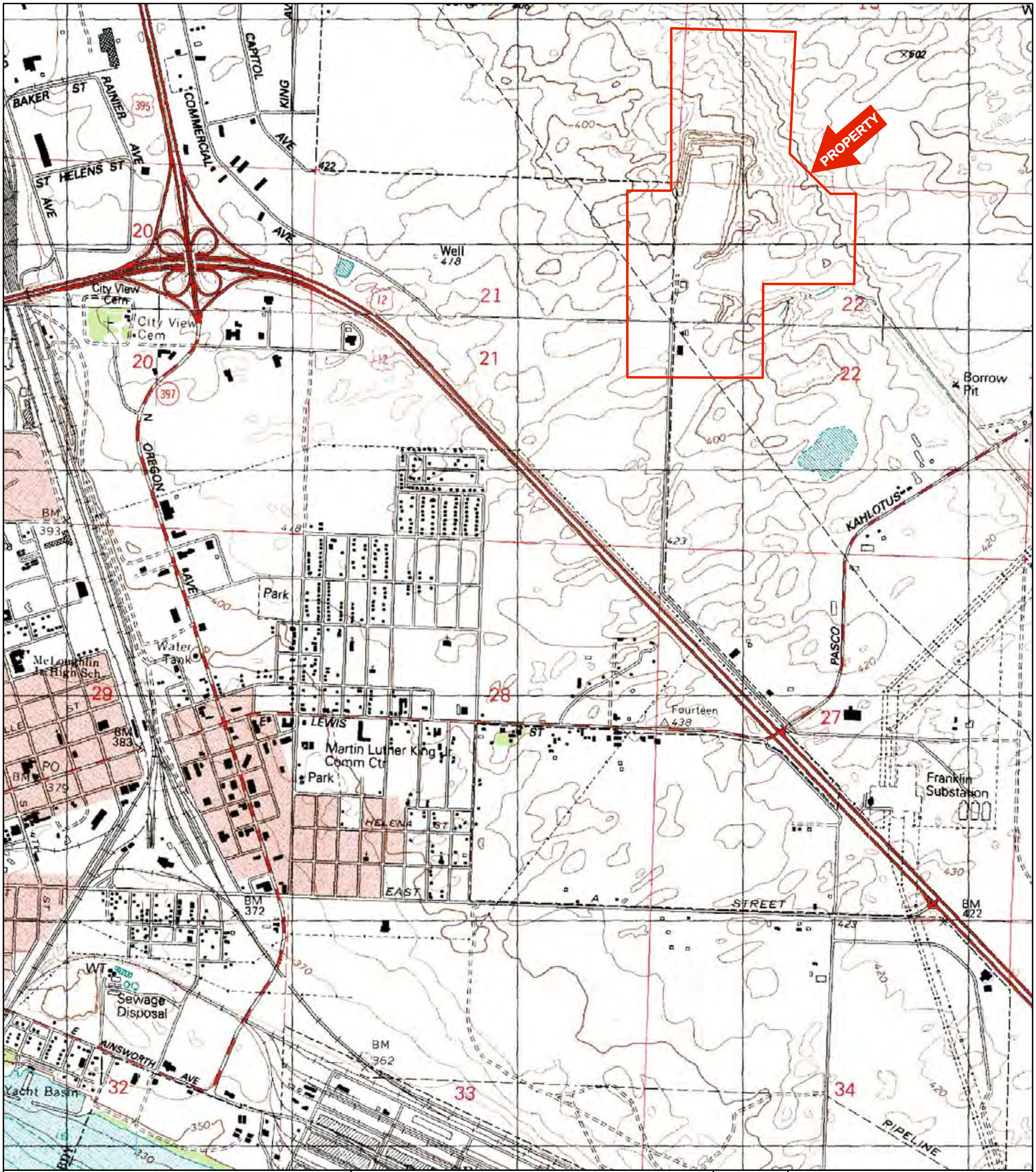
TABLE 6
Method Detection Limits and Reporting Limits

Analyte	**Method Detection Limit**	**Reporting Limit**	**Units**
2-Nitrophenol	0.9159	2	µg/L
2,3,4,6-Tetrachlorophenol	1.2394	2	µg/L
2,4-Dichlorophenol	0.5936	2	µg/L
2,4-Dimethylphenol	0.9118	2	µg/L
2,4-Dinitrophenol	4.1875	10	µg/L
2,4-Dinitrotoluene	0.9238	2	µg/L
2,4,5-Trichlorophenol	1.4881	2	µg/L
2,4,6-Trichlorophenol	1.6559	2	µg/L
2,6-Dichlorophenol	0.8238	2	µg/L
2,6-Dinitrotoluene	1.0806	2	µg/L
3-Nitroaniline	0.5466	5	µg/L
3&4-Methylphenol	1.0284	2	µg/L
4-Bromophenyl-Phenylether	1.2992	2	µg/L
4-Chloro-3-Methylphenol	1.1426	2	µg/L
4-Chloroaniline	0.393	2	µg/L
4-Chlorophenyl-Phenylether	0.737	2	µg/L
4-Nitroaniline	1.6	2	µg/L
4-Nitrophenol	1.7124	2	µg/L
4,6-Dinitro-2-Methylphenol	1.6082	2	µg/L
Acenaphthene	0.4844	2	µg/L
Acenaphthylene	0.7725	2	µg/L
Aniline	0.376	2	µg/L
Anthracene	0.3882	2	µg/L
Azobenzene	0.6945	2	µg/L
Benzo[A]Anthracene	0.466	2	µg/L
Benzo[A]Pyrene	0.3139	2	µg/L
Benzo[B]Fluoranthene	1.1605	2	µg/L
Benzo[G,H,I]Perylene	0.4981	2	µg/L
Benzo[K]Fluoranthene	0.5263	2	µg/L
Benzoic Acid	0.8756	10	µg/L
Benzyl Alcohol	0.4869	2	µg/L
Bis(2-Chloroethoxy)Methane	0.7278	2	µg/L
Bis(2-Chloroethyl)Ether	0.5839	2	µg/L
Bis(2-Chloroisopropyl)Ether	0.5987	2	µg/L
Bis(2-Ethylhexyl)Phthalate	0.4053	2	µg/L
Butylbenzylphthalate	0.5804	2	µg/L
Carbazole	0.6927	2	µg/L
Chrysene	0.4809	2	µg/L
Di-N-Butylphthalate	0.578	2	µg/L
Di-N-Octylphthalate	0.8795	2	µg/L
Dibenz[A,H]Anthracene	0.4825	2	µg/L
Dibenzofuran	0.4421	2	µg/L
Diethylphthalate	0.9463	2	µg/L
Dimethylphthalate	0.2464	2	µg/L
Fluoranthene	0.5603	2	µg/L
Fluorene	0.6519	2	µg/L
Hexachlorobenzene	0.5883	2	µg/L
Hexachlorobutadiene	1.1315	2	µg/L
Hexachlorocyclopentadiene	0.9804	2	µg/L
Hexachloroethane	1.5637	2	µg/L
Indeno[1,2,3-Cd]Pyrene	0.4338	2	µg/L
Isophorone	0.458	2	µg/L
N-Nitroso-Di-N-Propylamine	0.7645	2	µg/L
N-Nitrosodimethylamine	0.7166	2	µg/L

TABLE 6
Method Detection Limits and Reporting Limits

Analyte	Method Detection Limit	Reporting Limit	Units
N-Nitrosodiphenylamine	1.0374	2	µg/L
Naphthalene	0.7214	2	µg/L
Nitrobenzene	0.9449	2	µg/L
Pentachlorophenol	1.6874	5	µg/L
Phenanthrene	0.6688	2	µg/L
Phenol	0.4075	2	µg/L
Pyrene	0.7221	2	µg/L
Pyridine	0.3756	2	µg/L
EPA Method 8082 - Limits provided by ALS Laboratory Group			
PCB-1016	0.0222	0.1	µg/L
PCB-1221	0.0222	0.1	µg/L
PCB-1232	0.0222	0.1	µg/L
PCB-1242	0.0222	0.1	µg/L
PCB-1248	0.0222	0.1	µg/L
PCB-1254	0.0222	0.1	µg/L
PCB-1260	0.0222	0.1	µg/L
PCB-1268	0.0222	0.1	µg/L
EPA Method 8151 (GC/MS) - Limits provided by TestAmerica			
2,4-D	0.0019	0.025	ug/L
2,4-DB	0.0024	0.025	ug/L
2,4,5-T	0.0044	0.025	ug/L
4-Nitrophenol	0.0068	0.025	ug/L
Benzonitrile,3,5-dibromo-4-hydroxy	0.0100	0.030	ug/L
Dalapon	0.0100	0.05	ug/L
Dicamba	0.0042	0.025	ug/L
Dichlorprop	0.0044	0.025	ug/L
Dinoseb	0.0034	0.025	ug/L
MCPA	0.0035	0.025	ug/L
Mecoprop (MCPP)	0.0023	0.025	ug/L
Pentachlorophenol	0.0028	0.025	ug/L
Silvex (2,4,5-TP)	0.0049	0.025	ug/L
EPA Method 6020 and 200.8 (ICP-MS) - Limits provided by Analytical Resources, Inc.			
Antimony	0.010	0.2	µg/L
Arsenic	0.179	0.5	µg/L
Beryllium	0.022	0.2	µg/L
Cadmium	0.008	0.2	µg/L
Chromium	0.086	0.5	µg/L
Copper	0.065	0.5	µg/L
Lead	0.127	1	µg/L
Nickel	0.150	0.5	µg/L
Selenium	0.814	2	µg/L
Silver	0.008	0.2	µg/L
Thallium	0.003	0.2	µg/L
Zinc	0.470	4	µg/L
EPA Method 7470A (CVAA) - Limits provided by Analytical Resources, Inc.			
Mercury	0.011	0.1	µg/L
Mercury - Low RL	0.0029	0.02	µg/L
Method SM3500Cr - Limits provided by Analytical Resources, Inc.			
Hexavalent Chromium	0.003	0.01	µg/L

Figures



KEY:

SOURCE: USGS 7.5 MINUTE QUADRANGLE (TOPOGRAPHIC)

GLADE, WASHINGTON - 1992
PASCO, WASHINGTON - 1992

SCALE = 1:24,000

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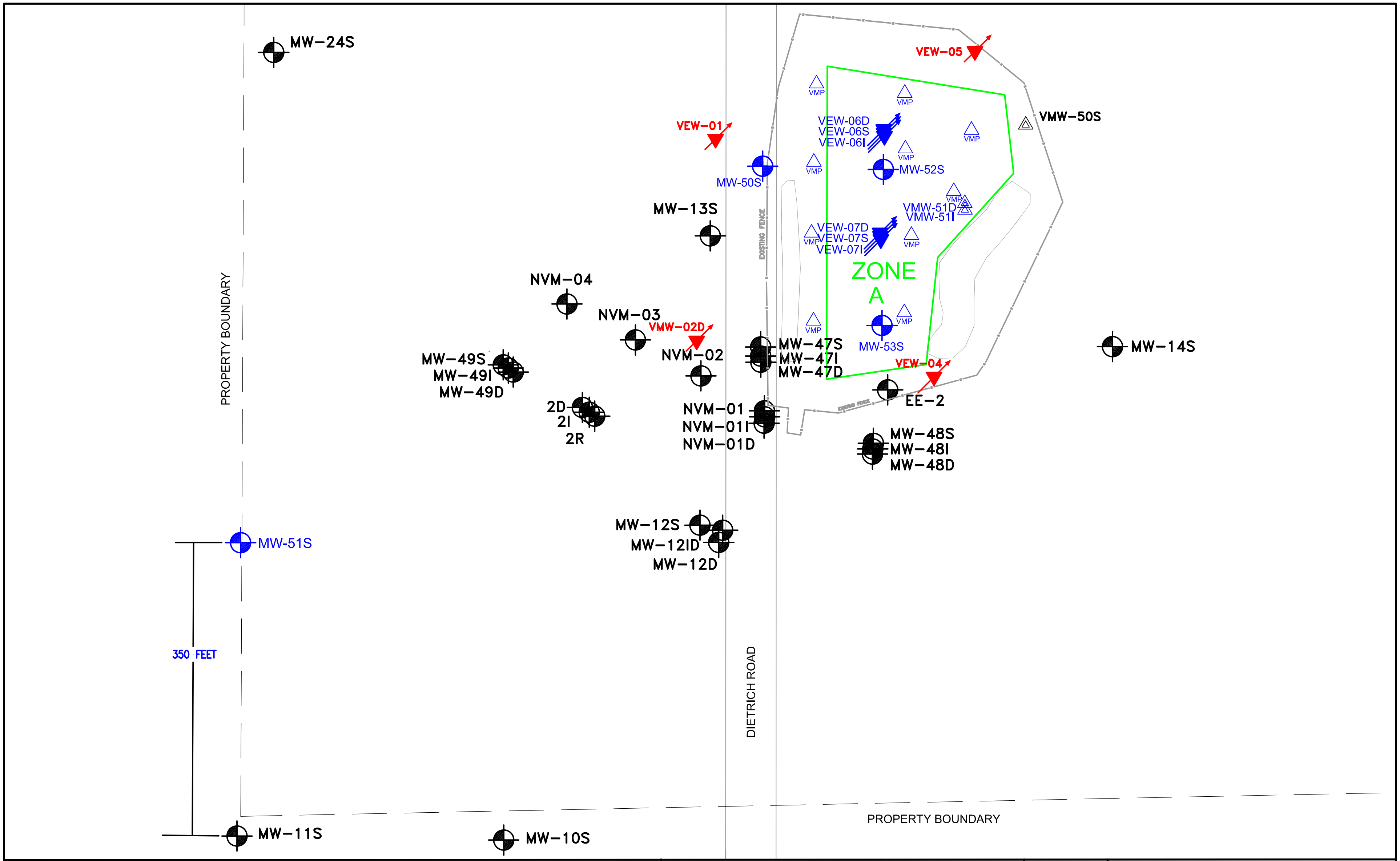
295 NE Gilman Boulevard, Suite 201
Issaquah, Washington 98027

FIGURE 1

GENERAL VICINITY MAP

PROJECT	PASCO LANDFILL
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	***DRAWN BY***	***REVIEWED BY***	***DATE***
1 of 1	*ARM*	*TCM*	*09/25/09*



KEY:

N

MW-50S		PROPOSED GROUND WATER MONITORING WELL
VEW-07S		PROPOSED SOIL VAPOR EXTRACTION (SVE) WELL
VMW-51D		PROPOSED VAPOR MONITORING WELL
	VMP	PROPOSED VAPOR MONITORING PROBE

0 42 84 166

SCALE: 1" = 166'

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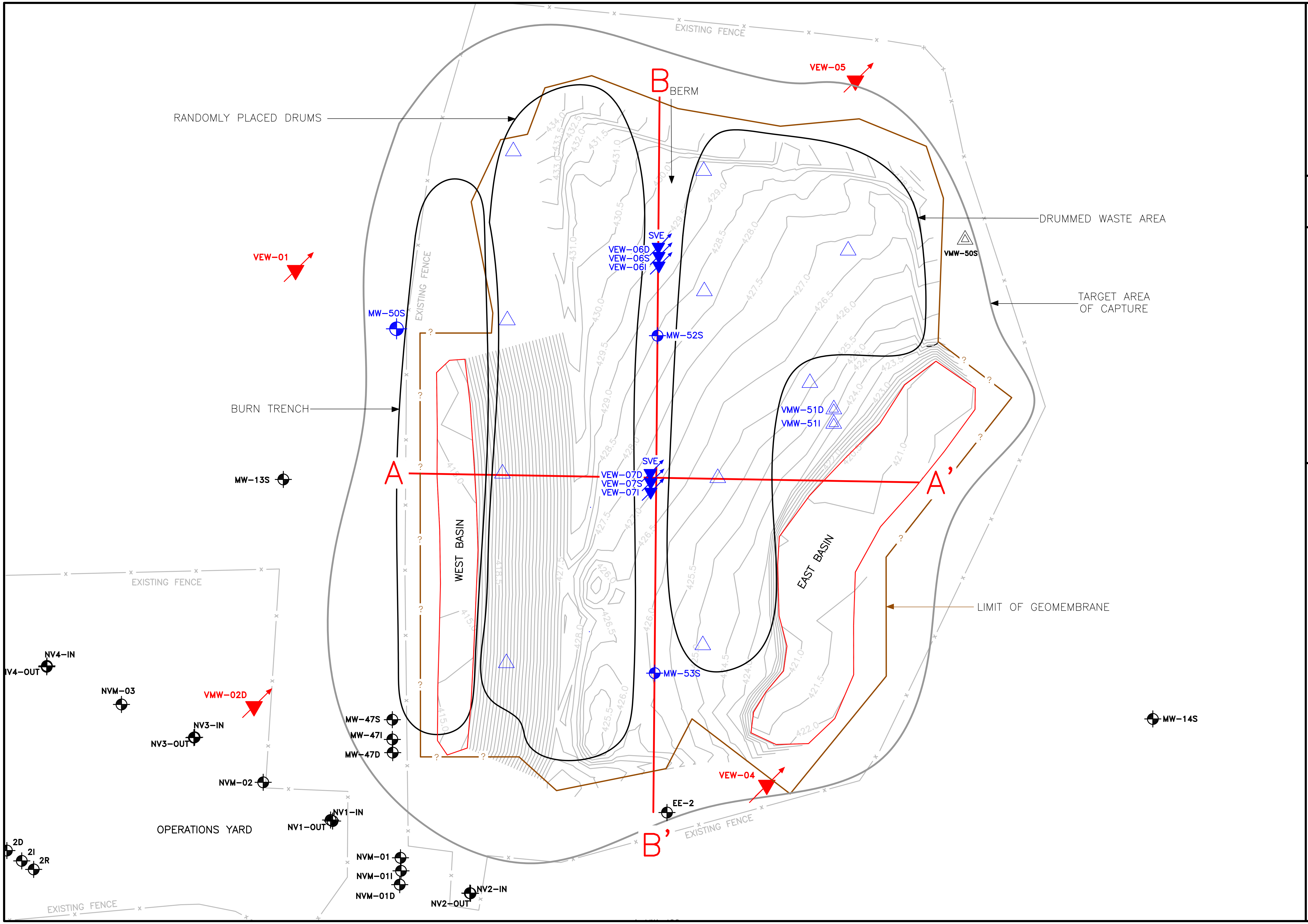
FIGURE 2

DOWNGRADIENT PROPERTY BOUNDARIES AND LOCATIONS OF PROPOSED NEW WELLS AND PROBES

PROJECT	PASCO LANDFILL
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	***DRAWN BY***	***REVIEWED BY***	***DATE***
1 of 1	MMH	TCM	10/07/09



PROJECT	03908.5
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	DRAWN BY	REVIEWED BY	DATE
1 of 1	MMH	TCM	10/07/09

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FIGURE 3

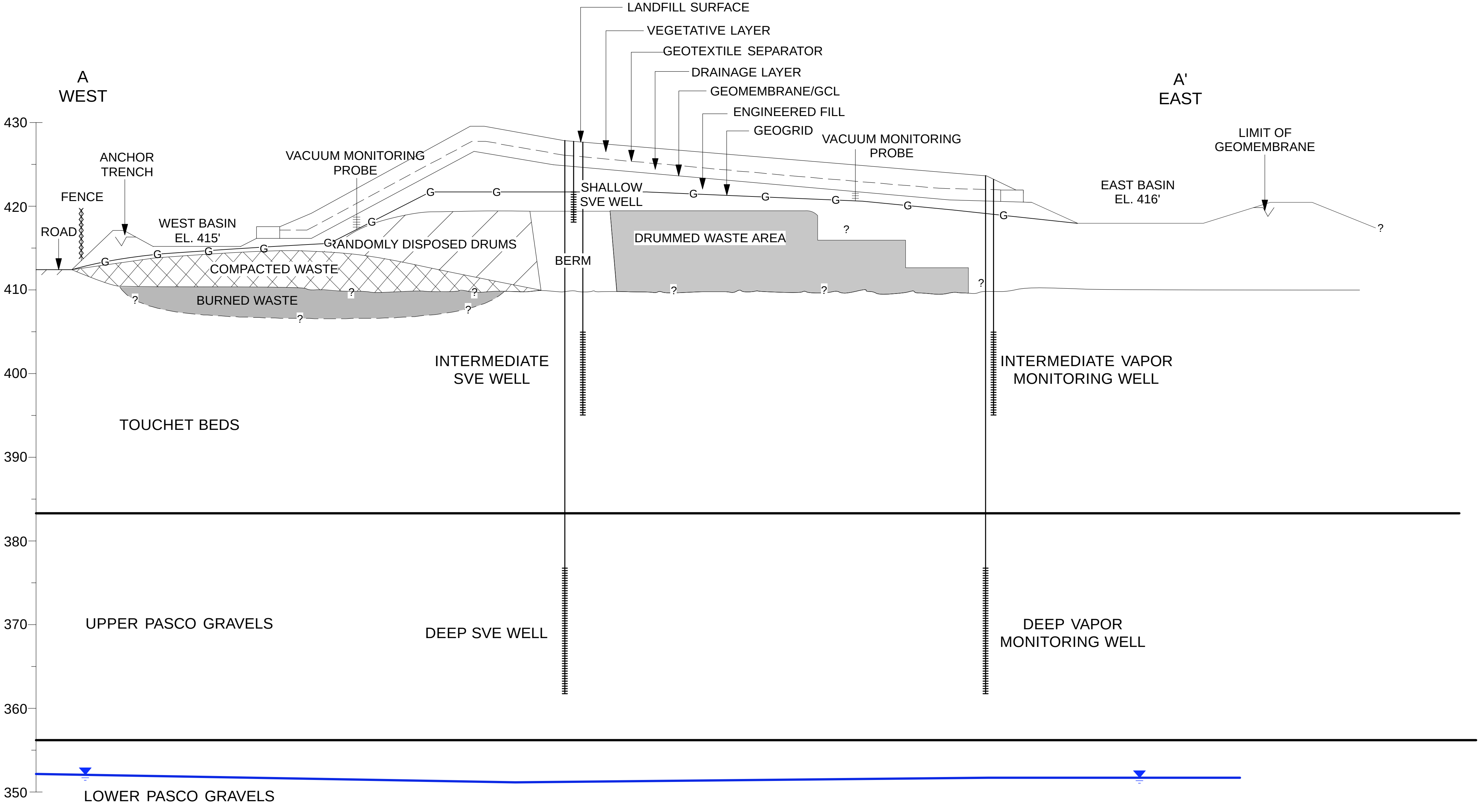
PLAN VIEW OF PROPOSED WELL LOCATIONS,
LIMIT OF GEOMEMBRANE
AND TARGET AREA OF CAPTURE

KEY:

- D – DEEP SOIL VAPOR EXTRACTION WELL
- S – SHALLOW SOIL VAPOR EXTRACTION WELL
- I – INTERMEDIATE SOIL VAPOR EXTRACTION WELL
- ⊕ – GROUND WATER MONITORING WELL
- △ – SHALLOW VAPOR MONITORING PROBE
- ◬ – INTERMEDIATE AND DEEP VAPOR MONITORING WELL
- ▼ – EXISTING SVE WELL

0 12.5 25 50

SCALE: 1" = 50'



PROJECT 03908.5

PREPARED FOR IWAG GROUP II

LOCATION 1901 DIETRICH ROAD
PASCO, WASHINGTON

SHEET 1 of 1

DRAWN BY ARM

REVIEWED BY ARM

DATE 11/19/09

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FIGURE 4

EAST/WEST CROSS SECTION OF LANDFILL PROFILE

NOTE:

LOCATIONS, NUMBER OF SVE WELLS AND SCREEN INTERVALS TO BE DETERMINED DURING DESIGN. UP TO FOUR TIERS OF STACKED DRUMS MAY BE PRESENT IN THE DRUMMED WASTE AREA.

KEY:

0 7.5 15 30
HORIZONTAL SCALE 1" = 30'

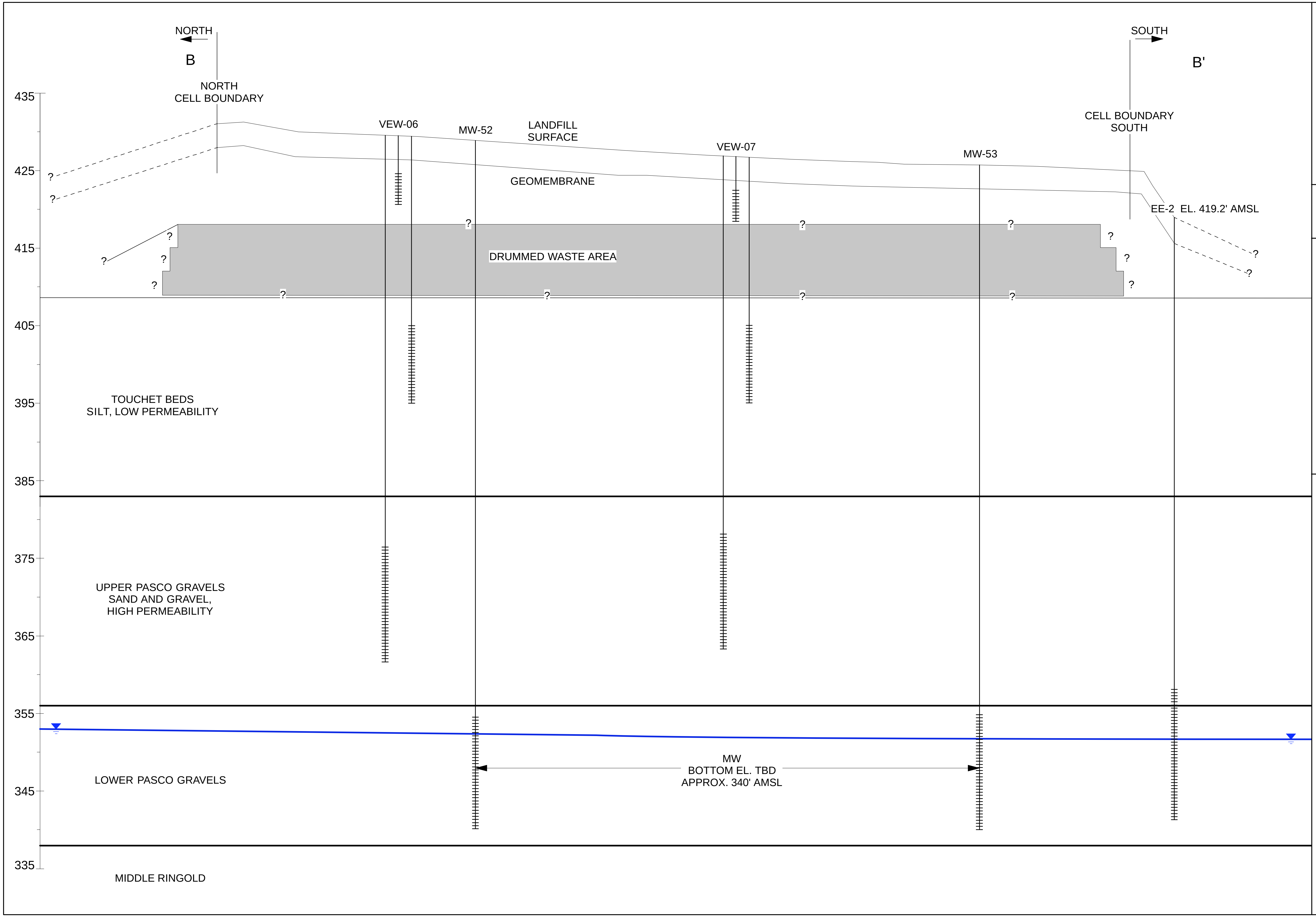

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FIGURE 5

NORTH/SOUTH CROSS SECTION
OF PROPOSED WELL LOCATIONS

PROJECT	03908.5
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	***DRAWN BY***	***REVIEWED BY***	***DATE***
1 of 1	*ARM*	*ARM*	*11/19/09*

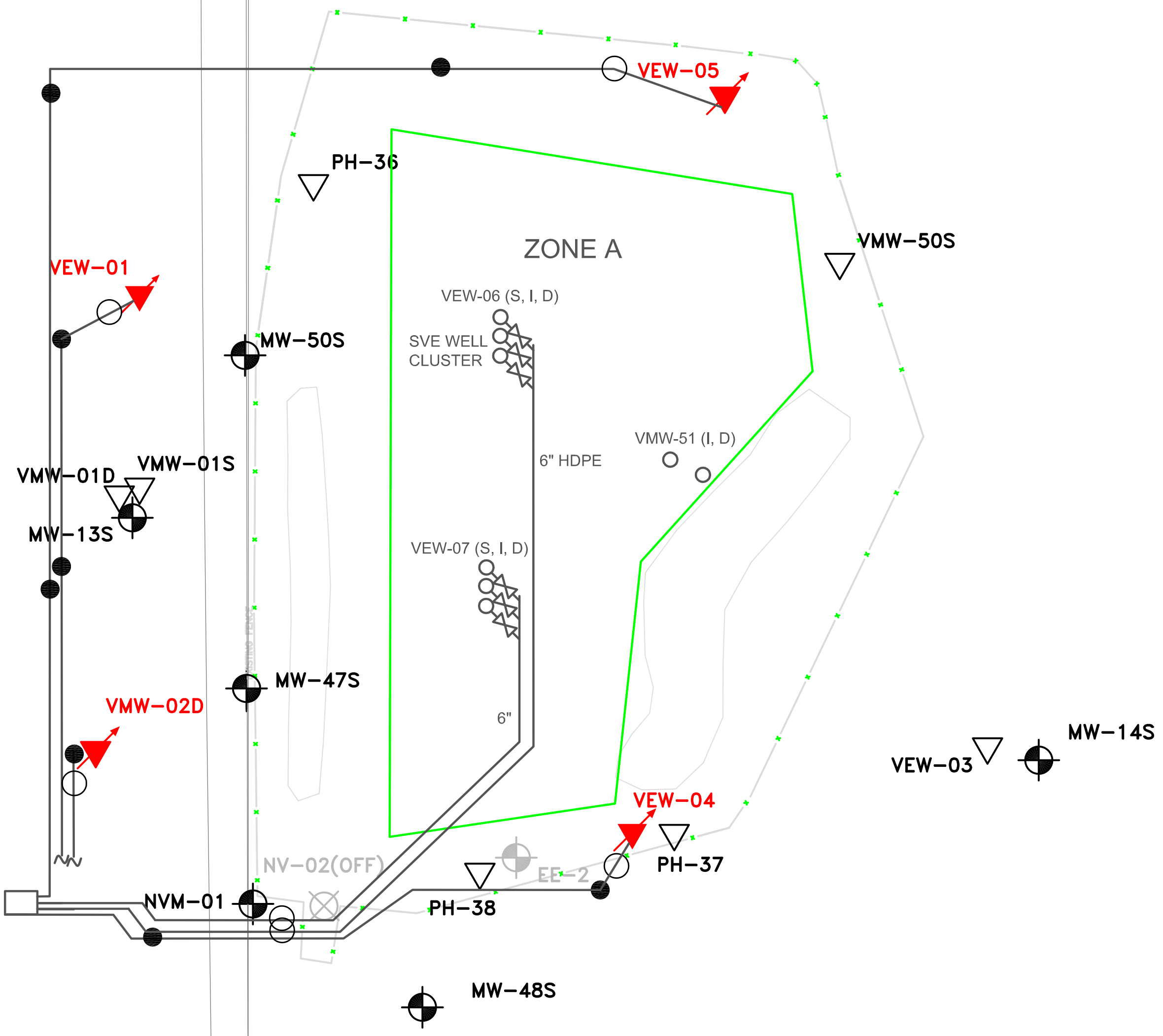
NOTE:

LOCATIONS, NUMBER OF SVE WELLS AND SCREEN INTERVALS TO BE DETERMINED DURING DESIGN. UP TO FOUR TIERS OF STACKED DRUMS MAY BE PRESENT IN THE DRUMMED WASTE AREA.

KEY:

0 8.75 17.5 35

HORIZONTAL SCALE: 1" = 35'



KEY:

0 25 50 100

SCALE: 1" = 100'

SVE WELL

POTENTIAL MONITORING LOCATIONS
(GRAY LOCATIONS NOT INCLUDED):

- ▽ VAPOR MONITORING WELL
- ⊕ MONITORING WELL
- ☒ NOVOCS WELL (OUT PIEZOMETER)
- ○ MOISTURE SEPARATOR
- ● CLEANOUT
- ○⊳⊲ NEW SVE WELLS

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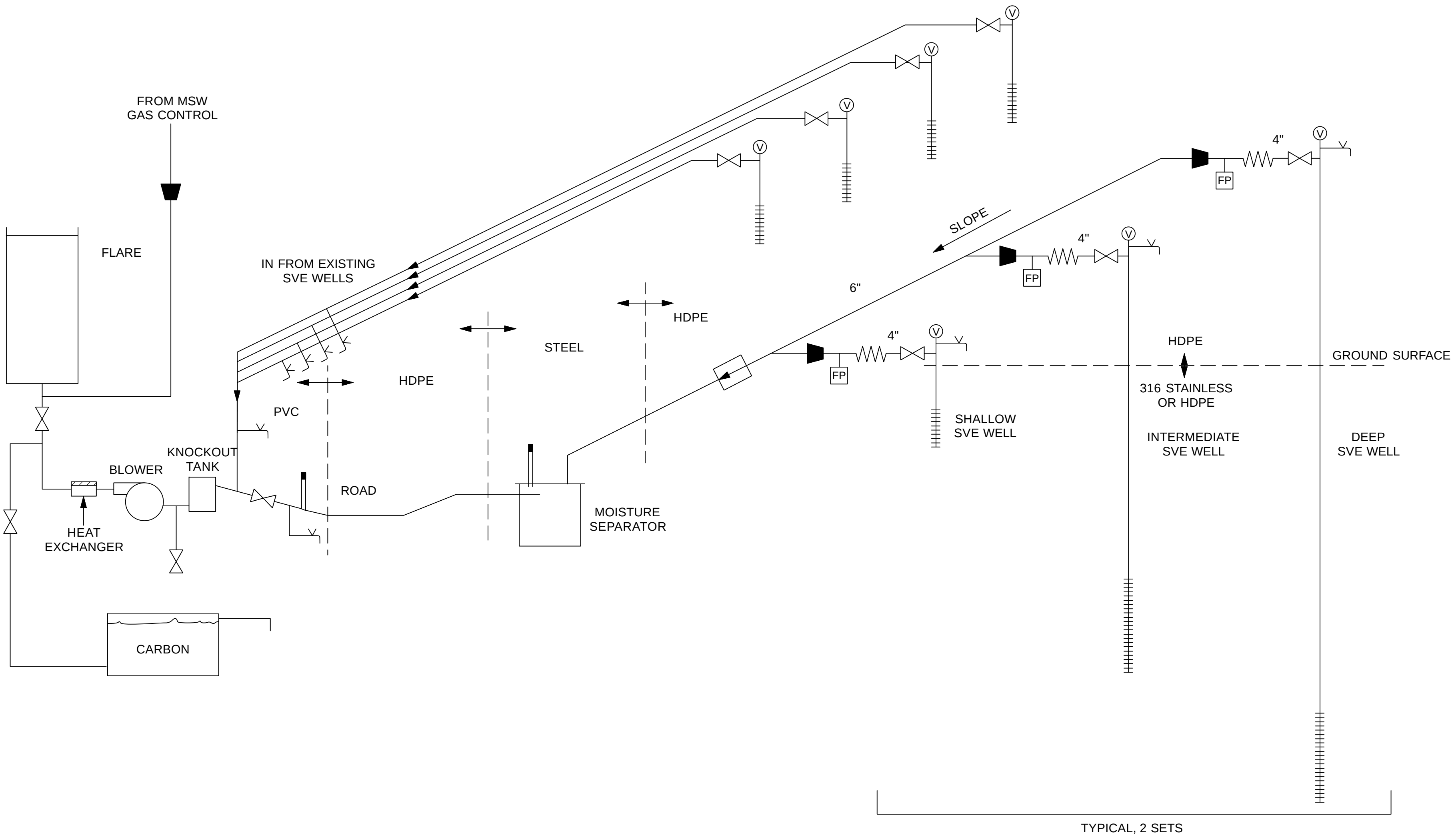
FIGURE 6

PIPING DETAIL

PROJECT	03908.5
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	***DRAWN BY***	***REVIEWED BY***	***DATE***
1 of 1	*ARM*	*ARM*	*09/30/09*



KEY:

	CLEAN OUT
	CHECK-VALVE
FP	FLOW PORT
▶	REDUCER BUSHING
⋈	GATE VALVE
Ⓥ	VACUUM GAUGE
	TEMP/GAS COLLECTION PORT
	FLEX HOSE

NOT TO SCALE

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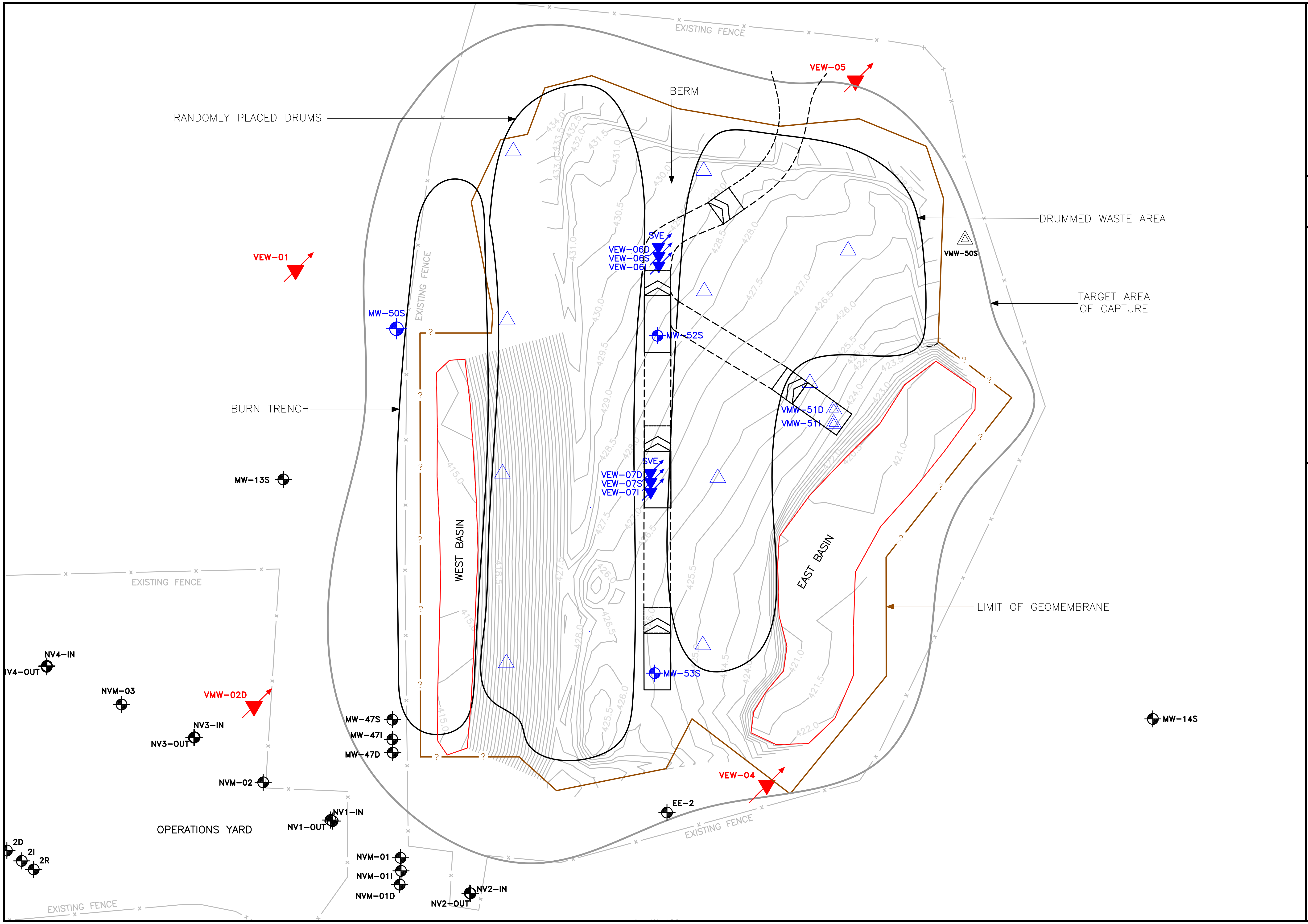
FIGURE 7

OPERATIONAL SCHEMATIC

PROJECT	03908.5
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	***DRAWN BY***	***REVIEWED BY***	***DATE***
1 of 1	*ARM*	*ARM*	*09/30/09*



KEY:

- ▭ – DRILL RIG WORKING DECK (1 FOOT ABOVE HDPE LINER)
- ¦ ¦ – DRILL RIG ACCESS ROUTE
- ⋙ – 3 TO 1 SLOPED SOIL RAMP
- ▼ – SOIL VAPOR EXTRACTION WELL
- ⊗ – GROUND WATER MONITORING WELL
- △ – SHALLOW VAPOR MONITORING PROBE
- ◬ – SHALLOW AND INTERMEDIATE VAPOR MONITORING WELL
- ▼ – EXISTING SVE WELL

0 12.5 25 50

SCALE: 1" = 50'

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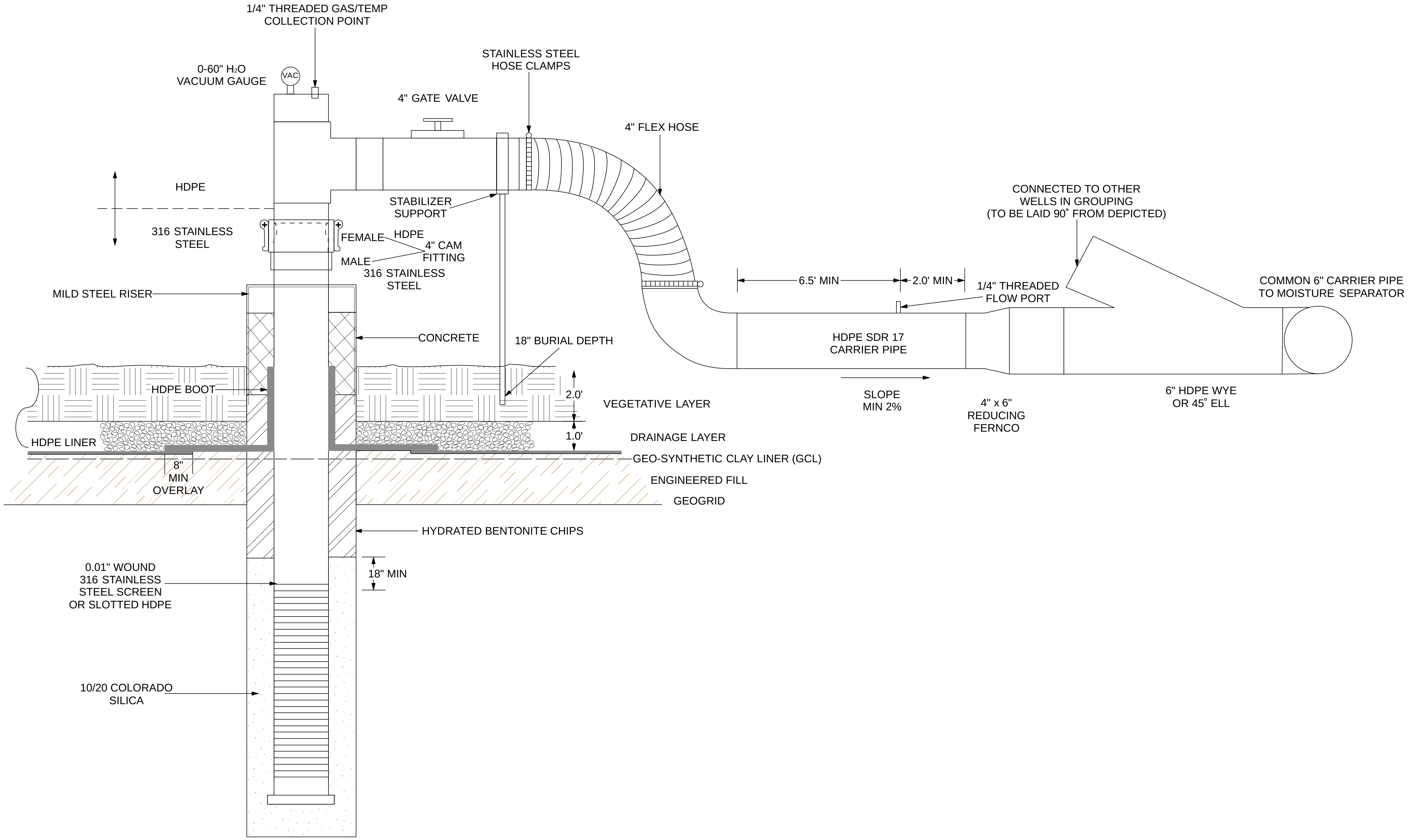
FIGURE 8

PLAN VIEW OF PROPOSED WELL LOCATIONS,
INSTALLATION SEQUENCE,
AND ACCESS ROUTES

PROJECT	03908.5
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	DRAWN BY	REVIEWED BY	DATE
1 of 1	MMH	TCM	10/07/09



PROJECT
03908.5

PREPARED FOR
IWAG GROUP II

LOCATION
1901 DIETRICH ROAD
PASCO, WASHINGTON

SHEET
1 of 1

DRAWN BY
ARM

REVIEWED BY
ARM

DATE
11/17/09

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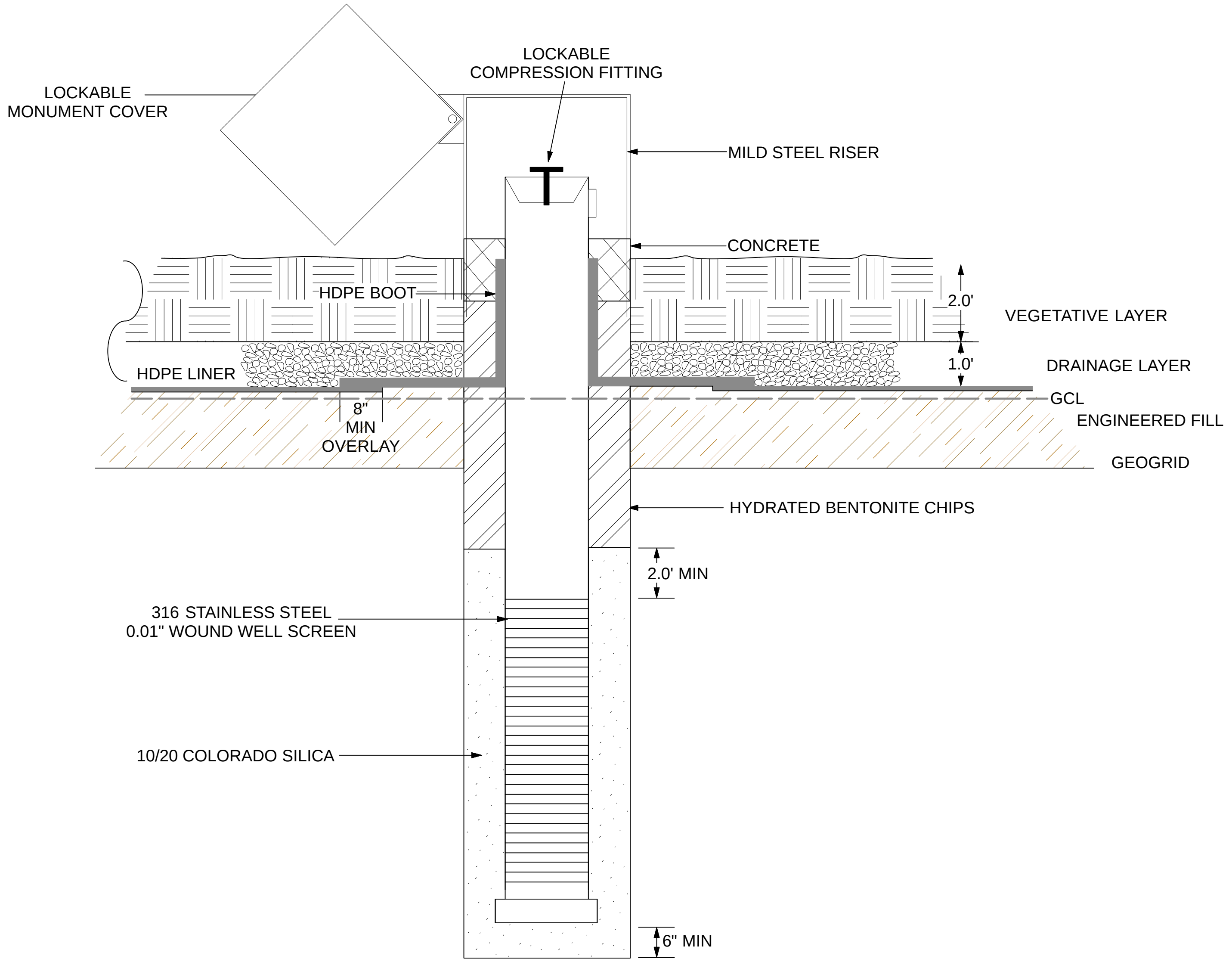
295 NE Gilman Boulevard, Suite 201
Issaquah, Washington 98027

FIGURE 9

COMPLETED SVE WELL

KEY:



KEY:

ENVIRONMENTAL PARTNERS INC

295 NE Gilman Boulevard, Suite 201
Issaquah, Washington 98027

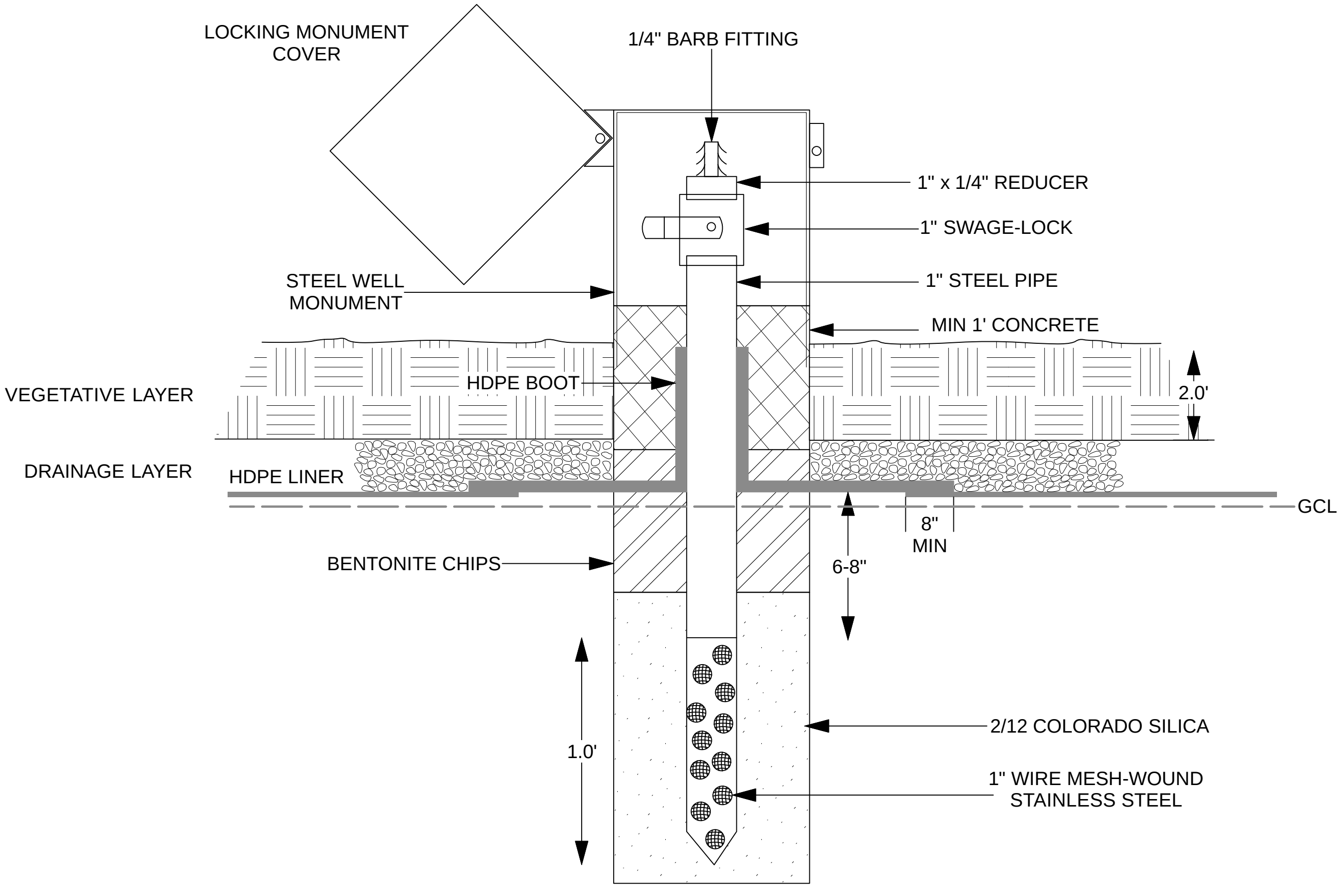
FIGURE 10

MONITORING WELL DETAIL

NOT TO SCALE

PROJECT	03908.5
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	***DRAWN BY***	***REVIEWED BY***	***DATE***
1 of 1	*ARM*	*ARM*	*11/19/09*



KEY:

NOT TO SCALE

ENVIRONMENTAL PARTNERS INC

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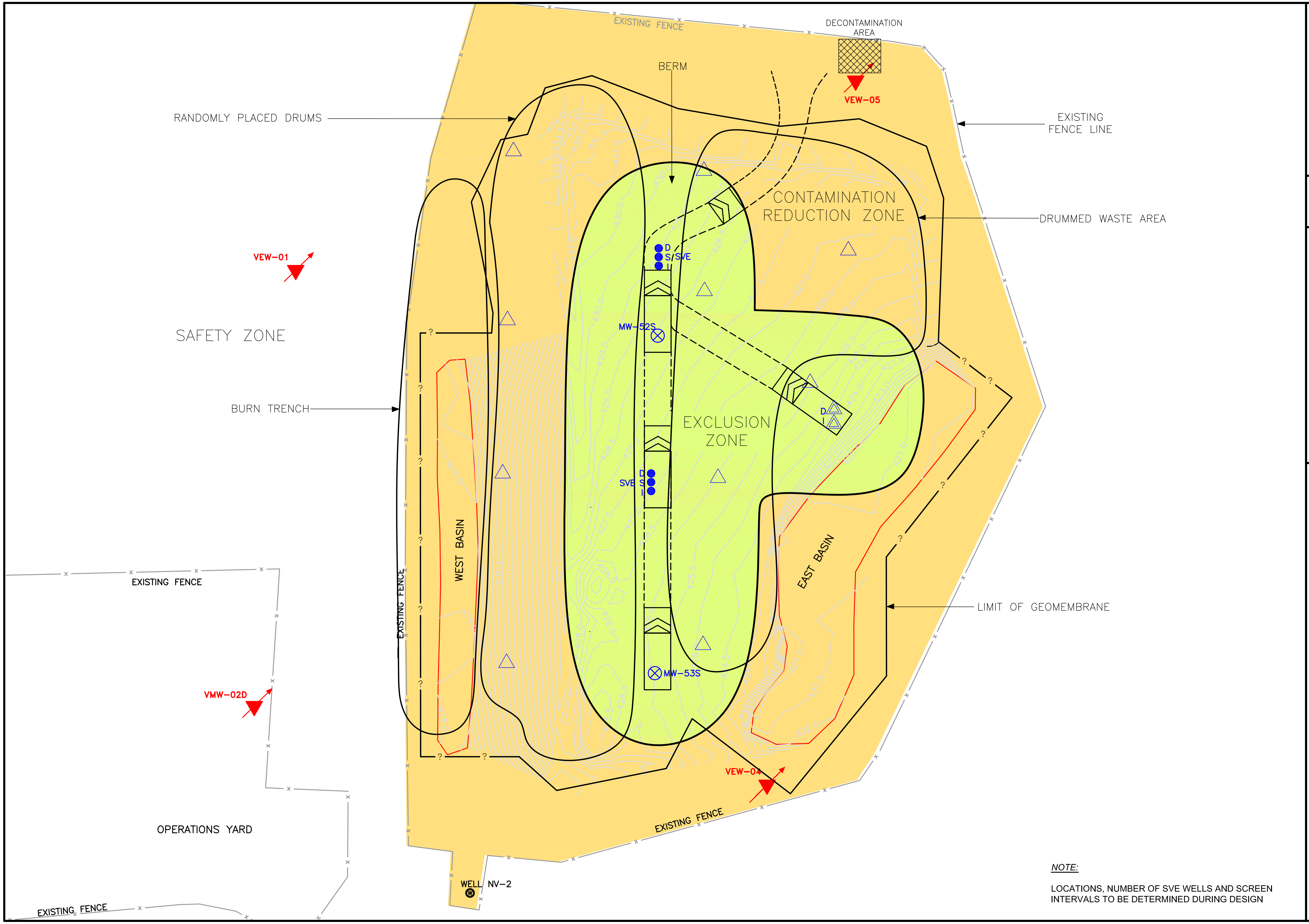
FIGURE 11

COMPLETED VACUUM/VAPOR
PROBE DETAIL

PROJECT	03908.5
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	**DRAWN BY**	**REVIEWED BY**	**DATE**
1 of 1	*ARM*	*ARM*	*11/19/09*



NOTE:

LOCATIONS, NUMBER OF SVE WELLS AND SCREEN INTERVALS TO BE DETERMINED DURING DESIGN

KEY:

▭ – DRILL RIG WORKING DECK (1 FOOT ABOVE HDPE LINER)
- - – DRILL RIG ACCESS ROUTE
⋘ – 3 TO 1 SLOPED SOIL RAMP
● D – DEEP SOIL VAPOR EXTRACTION WELL
● S – SHALLOW SOIL VAPOR EXTRACTION WELL
● I – INTERMEDIATE SOIL VAPOR EXTRACTION WELL
⊗ – MONITORING WELL
△ – SHALLOW VACUUM MONITORING PROBE
⟁ – SHALLOW AND INTERMEDIATE VACUUM MONITORING WELL
▼ – SVE WELL

0 12.5 25 50

SCALE: 1" = 50'

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Issaquah, Washington 98027

FIGURE 12

PLAN VIEW OF SEGREGATED HEALTH
AND SAFETY ZONES AND ACCESS ROUTES

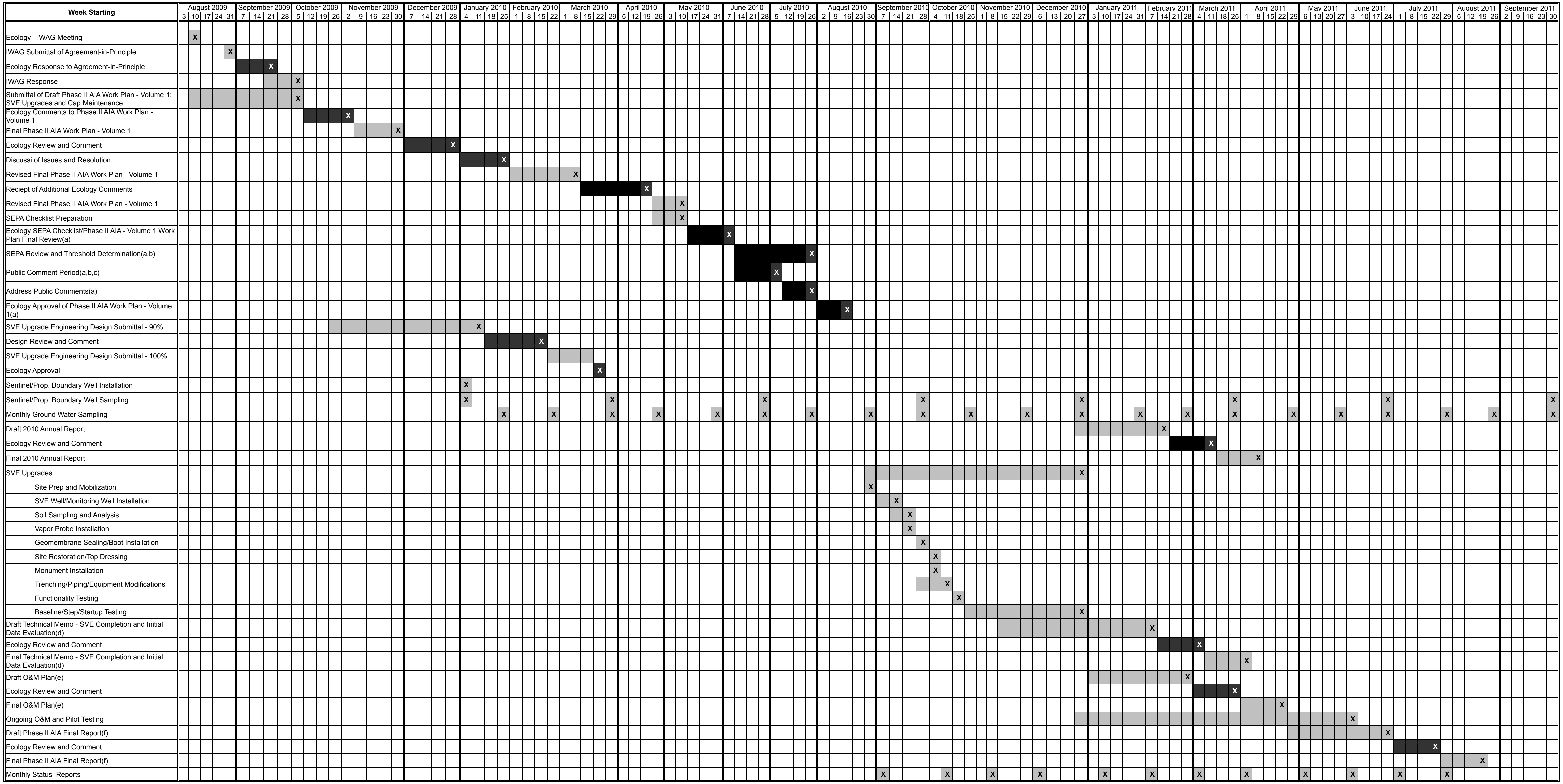
PROJECT	03908.5
PREPARED FOR	IWAG GROUP II
LOCATION	1901 DIETRICH ROAD PASCO, WASHINGTON

SHEET	**DRAWN BY**	**REVIEWED BY**	**DATE**
1 of 1	*ARM*	*ARM*	*10/08/09*

Figure 13

Phase II AIA Work Plan - Volume I

Project Schedule



▨ - Indicates timing and duration of IWAG Group II activity
■ - Indicates timing and assumed duration of Ecology activity
X - Indicates timing of submittal or decision and or task milestone

(a) - Duration and timeframe presented by Ecology and task completion is under the control of Ecology. Project schedule may be modified if actual timeframes vary from those presented.
(b) SEPA Checklist review and Public comment period are concurrent
(c) Schedule based on Ecology beginning public comment period on June 14, 2010.
(d) Report to include results of SVE installation and initial startup testing
(e) Report to propose O&M methodologies and/or additional testing.
(f) Culminating Report for Phase II AIAs.