EPA Region 5 Records Ctr.
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ENVIRON

July 1, 2002

Mr. Matthew Ohl
USEPA, HSRW-6J
77 West Jackson Blvd.
Chicago, IL 60604-3590

Re: Work Plan for Augmentation of SVE System
ECC Superfund Site
Zionsville, Indiana

Dear Mr. Ohl:

Please find enclosed the document entitled, *Work Plan for Augmentation of SVE System*. As discussed during our April 29, 2002 meeting, the Trustees representing the Settling Defendants propose to augment the existing SVE system with additional wells and trenches. The enclosed document is a work plan for these proposed augmentations.

If you have any questions concerning this work plan, please do not hesitate to contact us.

Sincerely,

ENVIRON International Corporation

Scott Hayter, P.G.
Senior Associate

SCH:

cc: Mr. Michael Habeck – IDEM
Mr. Tim Harrison – CH2M Hill
Mr. Philip Smith – CH2M Hill
Dr. Roy Ball – ENVIRON International Corporation
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Enclosure

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WORK PLAN
for
AUGMENTATION OF SVE SYSTEM

ECC SITE
ZIONSVILLE, INDIANA

Submitted to:

U.S. Environmental Protection Agency, Region 5
and
Indiana Department of Environmental Management

Submitted by:

ENVIRON International Corporation
Deerfield, Illinois

On behalf of
The ECC Site Trustees

July 2002

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1.0 INTRODUCTION

As presently configured, the SVE system that has been installed at the Enviro-Chem (ECC) site has not achieved the subsurface water cleanup standards in the till set forth in Table 3-1 to Revised Exhibit A. U.S.EPA and IDEM are concerned that failure to achieve those cleanup standards may over time have an adverse effect on water quality in Unnamed Ditch which is located adjacent to the eastern portion of the site.

The Trustees representing the Settling Defendants propose to augment the existing SVE system with additional wells and trenches. Doing so along the alignment previously proposed in Revised Exhibit A for "Additional Work" will provide effective barrier protection to Unnamed Ditch. This SVE augmentation will be as protective of Unnamed Ditch as achieving subsurface cleanup standards. It also represents a more quickly effective and lower cost alternative to the Additional Work referred to in Section 3.3 of Revised Exhibit A. EPA is authorized to approve this work under Section VII of the Consent Decree.

2.0 AUGMENTATION OF SVE SYSTEM - REMEDIAL ACTIONS

The primary objective of the Augmented SVE System is to perform vapor extraction of the upper till and interbedded, discontinuous more permeable sands, silts and gravel lenses along the eastern, southern and southwestern boundaries of the ECC Site. The key elements of the Augmentation of SVE System are:

- Installation of soil vapor extraction trenches and vertical soil vapor extraction wells ("augmented SVE trench system") along the east, south, and southwest sides of the ECC Site.

- Installation of a slurry cutoff wall in the shallow till situated along the east, south, and southwest sides of the ECC Site, to facilitate and enhance the SVE treatment of soils.

- Installation of vertical SVE wells in the two Hot Spot areas.

The sequence of activities for implementing the Augmentation of SVE System are presented below.

- Abandonment of certain monitoring wells.

- Installation of a slurry cutoff wall in the shallow till situated along the east, south, and southwest sides of the ECC Site.

- Installation of vertical SVE wells in the two Hot Spot areas, and removal of till water[1] and vapors until attainment of Soil Vapor Standards.

[1] For the purposes of this Work Plan, the term till water means the saturated shallow unconsolidated glacial deposits composed predominantly of vertically heterogeneous clays and silts with occasional fine- to coarse-grained sand lenses.

- Installation of SVE trenches/wells along the east, south, and southwest sides of the ECC Site.

- Installation of vertical till water dewatering wells within the SVE trenches.

- Collection and treatment of till water and extraction of soil vapors *via* the augmented SVE trench system until attainment of Soil Vapor Standards.

- Monitoring of water in the augmented SVE trench system following attainment of the Soil Vapor Standards.

- Following completion of till water and surface water monitoring activities, the dewatering wells and extraction piping within the augment SVE trenches will be abandoned and till water will be diverted from the SVE trenches to a permeable reactive gate system.

In addition to the above list activities, monitoring of surface water quality in Unnamed Ditch will continue. The Augmentation of SVE System activities, including the monitoring of Unnamed Ditch, are discussed in more detail in the following sections.

2.1 Well Abandonment

Prior to the construction of the slurry cutoff wall and the augmented SVE trench system, all wells that are in the path of the SVE trenches and slurry cutoff wall will be abandoned. Any wells located within the Hot Spot Areas will also be abandoned so as to avoid short circuiting during operation of the SVE system in these area. In addition, the remaining till monitoring wells will be abandoned since their use as monitoring points will no longer be necessary. The wells that will be abandoned are:

gravel backfill in each excavation. Bentonite slurry or grout will be placed over the geotextile and the base of the remaining portion of the excavation to seal the vault to prevent leaks to the surface from the SVE trench. The vault will then be placed, and the annular space around the vault will then be backfilled and compacted as appropriate to maintain the integrity of the seal. Either hydraulic cement or silicon caulk will be used within the vault to seal the riser pipe from the well and the concrete vault. An appropriate well cap will be installed to prevent vacuum leaks through the well. A vacuum gauge will either be installed through the well cap or through the riser pipe in the vault. The surface of the vault will be installed approximately three inches above the surrounding grade to prevent water from ponding on the surface.

2.5 Permeable Reactive Gate System

A permeable reactive gate system will be installed during the SVE trench construction and will be activated once the Soil Vapor Standards (see Section 3.0) have been achieved. The reactive gate system is intended to act as a backup system. The reactive gate system will prevent the build-up of till water on the upgradient side of the slurry wall and will treat till water that is allowed to leave this area[11].

The permeable reactive gate system will utilize zero-valent granular iron to degrade chlorinated compounds to inorganic chloride and dehalogenated organic compounds. This system is appropriate for the ECC Site COCs since this treatment technology has been demonstrated during numerous bench scale studies, pilot studies and full-scale remediation projects for various chlorinated compounds in ground water and wastewater. The reaction mechanism for the degradation of chlorinated compounds with zero-valent iron has been the mostly widely studied to date. Based upon recent research, the predominant degradation pathways are expected to consist of: (1) oxidation of the iron due to the presence of dissolved oxygen (DO) in ground water entering the treatment system creating hydroxyl radicals that degrade the chlorinated compounds; and (2) further

[11] Due to the presence of the cap on the northern portion of the site, very little till water is expected to build-up along the upgradient side of the adjacent slurry wall.

degradation of chlorinated compounds during reducing reactions with iron, a strong reducing agent, through electron transfer. The chlorinated compounds are degraded to inorganic chloride, ethene and ethane, partially dechlorinated byproducts (e.g. 1,2-dichloroethene, 1,1 dichloroethene and vinyl chloride) and small-chained hydrocarbons (e.g. methane and propane). Treatment of these partially dechlorinated byproducts is achieved by the same reducing reactions with iron by providing sufficient retention time in the treatment system.

This reactive gate system will utilize the augmented SVE trench system to collect and convey till water by gravity to treatment gates containing iron filings. The discharge from the treatment gates will flow by gravity through pipe penetrations in the slurry cutoff wall to a subsurface infiltration trench located outside and parallel to the slurry cutoff wall. Presently, two (2) treatment gates are contemplated: one serving trench segments 1, 2 and 3; and one serving trench segments 4, 5, and 6. A schematic of the components of the augmented SVE trench system and permeable reactive gate system are depicted in Figure 16.

The vapor collection pipe in each trench segment will be extended horizontally using a solid (i.e. non-perforated) PVC pipe to manholes located between trench segments. During operation of the augmented SVE trench system, these horizontal connections from the trench will be capped inside the manhole. Following SVE treatment, the caps will be removed, thereby permitting gravity flow of till water from the connected trench segments to the treatment gate. The till water from the trenches will flow via gravity to and through the treatment gates filled with a mixture of iron filings and silica sand. The treatment gates will consist of a prefabricated concrete structure with two chambers separated by an under flow baffle. Both chambers will be filled with iron filings to the depth of the overflow pipe located in the second chamber. The hydraulic retention time in the treatment gate and the volume of iron filings will be designed to assure treatment/destruction of the contaminants remaining in the till water. The treated discharge from each treatment gate will flow by gravity through a pipe, which penetrates the slurry cutoff wall, to an infiltration trench.

3.0 REMEDIAL ACTION VERIFICATION SAMPLING AND MONITORING

Verification sampling and monitoring will be conducted at the ECC Site to determine the following:

1. The completeness of the vapor removal activities within Hot Spots 1/1A and 2.

2. The completeness of vapor removal activities within the augmented SVE trench system.

3. The adequacy of the augmented SVE system and the slurry wall in preventing migration of Site contaminants.

The means by which each of these determinations will be made are presented in the following subsections. Shutdown standards are discussed in Section 3.0 of this Work Plan.

3.1 Hot Spot Soil Vapor Removal

The Hot Spot dual-phase SVE system described herein is designed to achieve the Soil Vapor Standards presented in Section 3.2.3 below. The time required to attain the vapor standards is dependent upon the adequate removal of water, the initial concentrations of the contaminants of concern, the minimization of short-circuiting, the operating air flow rate and temperature, and the efficient diffusion of air through the soil pores. Based upon the previous SVE activities conducted on the Site, the attainment of Soil Vapor Standards is expected to occur within 3 to 6 months of operation of the SVE wells in the Hot Spots.

3.1.1 Hot Spot Sample Collection Frequency and Methodology

The SVE system will be installed to permit vapor samples to be collected from each individual SVE well and from the combined vapor stream from all

operating SVE wells within the Hot Spots. The combined vapor (i.e., the vapor from all SVE wells within both Hot Spots) will be sampled daily during the first week of operation, weekly for the following 4 weeks, and biweekly thereafter. Vapor samples will be collected in accordance with the sampling methodology previously agreed to by the U.S. EPA and IDEM, and as presented in the April 28, 1997 Field Sampling Plan. The collected combined vapor samples will be analyzed for total organics using an existing in-line Series 8800 Continuous Analyzer[12] and for the VOCs and SVOC presented in Section 3.0 below using NIOSH Methods 1500 and 1003 (modified), and OSHA Method 32, respectively. Also, the vapor flow rate will be monitored and recorded to provide sufficient data to calculate the mass of organics removed from the soils and the effectiveness of the system.

Vapor samples from individual SVE wells within the Hot Spots will be collected at the beginning of the SVE system operation to establish a baseline of organics removal per well/trench. These individual well vapor samples will be also analyzed for total organics using an existing in-line Series 8800 Continuous Analyzer and for the VOCs and SVOC presented in Section 3.0 below using NIOSH Methods 1500 and 1003 (modified), and OSHA Method 32, respectively. Additional vapor samples of individual wells and SVE trenches will be collected at least biweekly to determine when individual SVE wells can be initially shut down.

3.1.2 Hot Spot System Shutdown Methodology

The initial shutdown of individual SVE wells within the Hot Spots will occur when two consecutive air samples from an individual well show vapor concentrations to be less than or equal to the Soil Vapor Standards. When the vapor concentrations in each individual SVE well are less than or equal to the vapor shutdown standards, the "restart spike" method on the combined vapor flow will be used to demonstrate that the Soil Vapor Standards have been permanently achieved.

[12] Baseline Industries, Inc., Lyons, Colorado.

The "restart spike" method consists of periodically shutting down and restarting the SVE system. By shutting down the system, equilibrium conditions between the vapor space within the soil and any remaining organics amenable to vapor extraction within the soil matrix are reestablished. Therefore, when the SVE system is restarted, the initial organic compound concentrations in the extracted gas will be higher than under normal operation.

The restart spike procedure will include shutting down the SVE system for a period of 3 days. On restarting the SVE system, all Hot Spot SVE wells will be operated as during normal operations. A sample of the combined soil vapor will be collected over the time period (starting 30 minutes after restarting the SVE system) that is needed to exchange the air in one pore volume of soil to provide a representative sample of the soil vapor concentrations in equilibrium with the soil concentrations.

The Soil Vapor Standards will be met when analyses of soil vapor samples collected from two consecutive restart spikes (conducted once every 2 weeks) show that concentrations of each COC meet the vapor standards described herein in Section 3.2.3. Once the Soil Vapor Standards have been achieved, the Hot Spot SVE wells may be abandoned as described in Section 2.1[13].

3.2 Augmented SVE Trench System Vapor Removal

The augmented SVE trench system described herein is designed to achieve the Soil Vapor Standards described in Section 3.2.3 below. As with the Hot Spot SVE system, the time required to attain the Soil Vapor Standards is dependent upon the adequate removal of water, the initial concentrations of the COCs, the minimization of short-circuiting, the operating air flow rate and temperature, and the efficient diffusion of air through the soil pores. Based upon the previous SVE activities conducted on the Site, the attainment of shutdown standards is expected to occur within 3 to 6 months of operation of the dual-phase extraction systems in the augmented SVE trench system.

[13] The Hot Spot SVE wells may remain in place until the completion of 5 years of monitoring of the Unnamed Ditch, as described in Section 3.3.

3.2.1 Sample Collection Frequency and Methodology

The augmented SVE trench/system will be installed to permit vapor samples to be collected from each individual SVE trench/well and from the combined vapor stream from all operating SVE trenches and wells. The combined vapor from the trench system will be sampled daily during the first week of operation, weekly for the following 4 weeks, and biweekly thereafter. Vapor samples will be collected in accordance with the sample methodology previously agreed to by the U.S. EPA and IDEM, and as presented in the April 28, 1997 Field Sampling Plan. The collected vapor samples will be analyzed for total organics using an existing in-line Series 8800 Continuous Analyzer and for the VOCs and SVOC presented in Section 3.0 below using NIOSH Methods 1500 and 1003 (modified), and OSHA Method 32, respectively. Also, the vapor flow rate will be monitored and recorded to provide sufficient data to calculate the mass of organics removed from the soils and the effectiveness of the system.

Vapor samples from individual SVE trenches/wells will be collected at the beginning of the SVE system operation to establish a baseline of organics removal per trench/well. These samples will be also analyzed for total organics using an existing in-line Series 8800 Continuous Analyzer and for the VOCs and SVOC presented in Section 3.0 below using NIOSH Methods 1500 and 1003 (modified), and OSHA Method 32, respectively. Additional vapor samples of SVE trenches/wells will be collected at least biweekly to determine when individual SVE trenches/wells can be initially shut down.

3.2.2 Augmented SVE Trench System Shutdown Methodology

The initial shutdown of SVE systems at individual trenches/wells will occur when two consecutive air samples from an individual trench/well show vapor concentrations to be less than or equal to the Soil Vapor Standards. When the vapor concentrations in each individual SVE trench/well are less than the Soil Vapor

Standards, the restart spike method on the combined vapor flow will be used to demonstrate that the vapor standards have been achieved.

The restart spike procedure will include shutting down the entire trench/well vapor extraction system for a period of 3 days. On restarting the vapor extraction system, all SVE trenches/wells will be operated as during normal operations. A sample of the combined soil vapor will be collected over the time period (starting 30 minutes after restarting the SVE system) that is needed to exchange the air in one pore volume of soil to provide a representative sample of the soil vapor concentrations in equilibrium with the soil concentrations. If the combined sample exceeds the vapor standards, the system will be reactivated for a period of one week, and the shutdown process described above will again be implemented.

The remediation will be considered complete when results of analyses of the combined soil vapor sample collected from two consecutive restart spikes conducted once every 2 weeks show that concentrations of each COC meet the Soil Vapor Standards described herein in Section 3.0

Once the Soil Vapor Standards have been met, SVE trench system water samples will be collected on a semiannual basis for five years. If a trench system water sample exceeds the Applicable Stream Concentrations or Applicable Surface Water Background Concentration, then the SVE system will be restarted[14]. At the conclusion of the five year period, the gates to the permeable reactive gate system described in Section 2.6 will be opened and the reactive gate system will be made operational.

3.2.3 Soil Vapor Standards

The Soil Vapor Standards shown in Table 1 will be used, as described in previous sections, to determine the effectiveness and completeness of the Augmentation of SVE System. Table 1 represents a modification to Table 4-1 of Revised Exhibit A. The results of twelve vapor sampling events conducted by Versar between January 1999 and October 2000 were compared to the Table 4-1

[14] The SVE trench will be dewatered, if necessary, prior to restarting the SVE system.

standards. Those compounds that were previously detected in the vapor samples at concentrations above the Table 4-1 standards are shown on Table 1 herein, and the laboratory analysis of vapor samples collected as part of the ESD/QW will include all such compounds. Compounds not detected within any of the Versar vapor samples will not be analyzed.

3.3 Surface Water Monitoring

During operation of the augmented SVE trench system, the surface water within the Unnamed Ditch will be monitored on a semiannual basis. The surface water samples will be collected upstream and downstream of the ECC Site, as depicted on Figure 17. Additional samples may be collected at the discretion of the ECC Site Trustees.

Surface water samples will be collected as described in Section 6.4 of the Revised Remedial Action Field Sampling Plan (FSP); Revision 4 dated April 28, 1998. The surface water samples will be analyzed for those compounds of concern identified in Section 3.0 of this Work Plan, using U.S. EPA Methods 8260B and 8270C.
Once the Soil Vapor Standards have been achieved in both Hot Spots and the augmented SVE trench system, semiannual sampling of the Unnamed Ditch surface water will continue for 5 additional years.

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[15] As used in this section, the term "confirmed" shall permit the Parties to demonstrate that an analytical result is not accurate as a result of errors in sampling, analysis, or evaluation or that it otherwise mischaracterizes the concentration of a parameter. The procedures used to obtain "confirmed" data shall include reanalysis, resampling, and the analysis of only undiluted samples if a concentration is qualified with a "J" (estimated concentration). If after reanalysis and/or resampling using an undiluted sample the concentration ~~of a compound is still qualified with "J," then~~ the result produced from undiluted samples will be used. Samples qualified with a "B" will be considered as "confirmed" data only if the concentrations in the sample exceed 10 times the maximum amount detected in any blank for the media being analyzed.

4.0 SCHEDULE

A preliminary schedule for the Augmentation of SVE System is presented as Figure 18. For the purposes of developing the preliminary schedule, it has been assumed that the duration of all reviews of draft and revised documents by the U.S. EPA will be completed within approximately 30 days of the submission date. The assumed Agency review period may be modified following discussions with Agency personnel.

- Wells in the path of the slurry cutoff wall and SVE trenches:
  T-6, T-7, T-8, T-9, S-2, S-3, ECC-MW-13 and piezometer P-1.

- Wells in the vicinity of the Hot Spots:
  HS-1, HS-1A, HS-2 and IW-5.

- Remaining On-Site[2] till wells:
  T-1, T-2, T-2A, T-3 and T-4A.

- Remaining Off-Site[3] till wells:
  T-5 and T-10.

In addition, a construction dewatering well located in the northeast portion of the former Southern Concrete Pad Area (SCPA) and monitoring well S-4A will be abandoned. Figure 1 shows the locations of the monitoring wells to be abandoned.

The abandonment of these 21 monitoring wells/piezometer will be conducted according to the requirements of 312 IAC 13-10-2. The outer, protective well casing will be removed and the inner, PVC well casing will be cut to a depth of at least two feet below ground surface (bgs). The well screen and casing will then be tremie-grouted with a bentonite/cement mixture to within six inches of the ground surface, and the surface will be filled with soil or gravel, as appropriate. Within 30 days of the completion of the abandonment, the Indiana Department of Natural Resources – Division of Water will be notified in writing of the identification and location of the wells, and the procedures followed during the abandonment. The U.S. EPA and IDEM will be copied on this notification.

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[2] Till water to be monitored via trench system samples described herein; therefore, till wells are no longer needed.
[3] Upgradient and side gradient, outside of remedial boundary.

2.2 Slurry Cutoff Wall

The results of the 1998 Versar Hot Spot pump test, as well as the 2002 cone penetration testing, indicate that the sand lenses intersected by the existing Hot Spot 2 well (HS-2) may be hydraulically connected to the Unnamed Ditch. As discussed below, a slurry cutoff wall will be installed along the east, south, and southeast sides of the ECC Site (see Figure 2). The slurry cutoff wall will eliminate, *inter alia*, any connection between the sand lenses located in the Hot Spots and the Unnamed Ditch, thus significantly decreasing the pumping rate needed for dewatering.

Geologic fence diagrams were prepared for the entire length of the slurry cutoff wall alignment using a three-dimensional kriging[4] program (EVS[5]). Those borings identified on Figure 3-A were used in completing the fence diagram. Figures 3-B and 3-C show the results of the kriging.

The slurry cutoff wall will be approximately 1,100 feet long, 4 inches wide, and of varying depth. A schematic of the profile view of the slurry cutoff wall is shown on Figure 4. It is presently contemplated that the slurry cutoff wall will be installed using the Vibrated Beam Method,[6] although conventional slurry wall trench construction methods will be considered. The vibrated beam installation technique utilizes a special crane-suspended I-beam connected to a powerful vibrator. The beam is locked in a guide frame for exact positioning and stabilized by a hydraulic foot that provides guidance and aids in keeping the wall vertical. Cement/bentonite slurry is injected under pressure through a set of nozzles located at the base of the vibrated beam. At the completion of each panel, the rig is moved along the direction of the wall, the previous insertion is overlapped to ensure continuity, and the entire process is repeated. The wall is installed with minimal soil excavation requirements.[7] The result is an approximately 4-inch thick wall made of a bentonite and cement mixture, with a resulting permeability of 1×10^{-8} cm/sec or less. A cross-section view of the slurry cutoff wall system is shown on Figure 5. The slurry

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[4] Kriging is a statistical interpolation method that selects the best linear unbiased estimate of the parameter in question.
[5] Environmental Visualization System (EVS), copyright – C Tech Development Corporation, Huntington Beach, California.
[6] Patent held by Slurry Systems, Inc. of Gary, Indiana.
[7] An approximately 2-foot deep excavation will be required along the length of the excavation trenches. The excavated soil will be placed on the former SCPA.

cutoff wall will provide a continuous low permeability boundary, thus blocking flow through the higher permeability sand and gravel lenses in the shallow till.

2.3 Hot Spot Dual-phase SVE Wells

Soil vapor extraction wells will be installed within each of the Hot Spots at the Site. The objective of the installation and operation of the Hot Spot dual-phase SVE system is to remove and destroy volatile organic compounds (VOCs) and selected semivolatile organic compounds (SVOCs) from the subsurface till and till water within Hot Spot 1/1A and Hot Spot 2. The locations of the Hot Spots are shown on Figure 6.

2.3.1 Hot Spot SVE Well Locations and Installation

EVS was used to analyze the geology in the Hot Spot areas and to determine the locations and depths of the SVE wells within the Hot Spots. The geological cross-sections are located as shown in Figure 7-A and presented in Figure 7-B (Hot Spots 1/1A) and Figure 7-C (Hot Spot 2).

The SVE system will include three dual-phase SVE wells within Hot Spot 1/1A and two dual-phase extraction wells within Hot Spot 2. The preliminary locations of these wells are shown on Figure 8. The SVE wells will be installed using standard hollow-stem auger drilling methods. The SVE wells will be constructed to intercept the shallow sand and gravel lenses within the shallow till, as shown on the schematic drawing included as Figure 9. As shown on Figures 10 and 11, each SVE well will consist of a 4-inch diameter, 10- to 20-foot long,[8] PVC well screen and sufficient schedule 40 PVC casing to reach the ground surface. A sand pack will be installed in the annular space around the well screen, from the bottom of the borehole to a depth of two feet above the top of the screen. Two feet of bentonite pellets will then be placed over the sand pack to create a seal, and cement/bentonite grout will be used to fill the remainder of the annular space to the ground surface.

[8] The screened lengths may vary based on placement. All screens will penetrate the shallow sand and gravel lenses within the shallow till but will be placed no less than two feet above the lower sand and gravel unit.

Continuous soil cores will be collected during the installation of each Hot Spot SVE well. The soil cores will be collected using 24-inch long, 2-inch outside diameter stainless steel split-spoon samplers. Standard split-barrel sampling procedures in accordance with the American Society for Testing and Materials (ASTM) Method D 1586 will be utilized. The split-spoon samplers will be opened in the field and screened for VOCs using a photoionization detector. All observations and readings will be recorded on a field log. The results of the field screening are not expected to alter the locations of the SVE wells; however, should any additional information result in a need for such considerations, the U.S. EPA and IDEM will be informed of any proposed modifications to the scope of work.

To minimize short-circuiting of the Hot Spot SVE system, all existing monitoring wells not used for extraction and within or immediately adjacent to the Hot Spots will be abandoned prior to testing and operation of the Hot Spot SVE system in accordance with the procedures described in Section 2.1 above.

2.3.2 Hot Spot Till Water and Soil Vapor Removal

Each SVE well will be constructed as either a single-pump or dual-pump extraction system. The single-pump extraction system utilizes a blower to generate high airflow to remove both the liquid and vapor phases from the well. The dual-phase pump system uses a submersible pump to remove the liquids from the well and a blower to extract the soil vapor. Figures 10 and 11 present schematics of typical single-pump and dual-pump SVE wells, respectively. A combination of single-pump and dual-pump systems will be installed in the Hot Spots, with at least one dual-pump system will be installed within each Hot Spot. The dual-pump wells will be used for the initial dewatering of the sand lenses within each of the Hot Spots. The dual-pump SVE wells will be connected to the existing treatment system with both a dual-phase line and a liquid extraction line.

Up to two single-pump SVE wells will be installed in Hot Spot 1/1A, and one single-pump SVE well will be installed in Hot Spot 2. Each of the single-pump SVE wells will be constructed so as to be readily converted to dual-pump systems, if necessary. The single-pump SVE wells will be connected to the existing on-Site treatment system using a single dual-phase line. The single-pump SVE wells can be pressurized, if needed, *via* the valve air inlet.

Till water extraction performance tests will be conducted within each Hot Spot following the installation of the Hot Spot SVE wells but prior to the installation of the single- and dual-phase extraction pump systems. The performance tests will be completed to estimate the volume of till water that must be removed to dewater the sand lenses within each Hot Spot as well as the required pumping rate to maintain the dewatered conditions. Appendix A contains the methodology to be used to perform the till water extraction tests.

The existing on-Site treatment system will be used to treat the extracted water and vapor. Appendix B contains a description of the existing treatment system. An auxiliary vacuum unit may be used to aid the existing treatment system blowers. If needed, the auxiliary vacuum unit will be skid-mounted and will likely be placed between the Hot Spot areas and the existing treatment system. The auxiliary vacuum unit may include a liquid pumping system that may be used to facilitate the transport of the water collected by the SVE wells to the 150,000-gallon storage tanks associated with the existing treatment system.

2.4 Augmented SVE Trench System

The augmented SVE trench system will be used for SVE treatment of the shallow till along the east, south, and southwest sides of the Site. Dewatering of the shallow till and associated sand lenses, using the augment SVE trenches, will permit the SVE treatment of the shallow till.

2.4.1 The SVE Process – SVE Trenches

The SVE process takes advantage of the volatility of the contaminants to allow the mass transfer of VOCs and SVOCs from adsorbed, dissolved, and free phases in the soil to the vapor phase, where it is removed under vacuum pressure. The basic operation for the ECC Site includes the extraction of air from the trench system using vacuum pumps. Free liquid entrained in the air will be removed by gravity in an entrainment separator. Periodically, water that accumulates in the entrainment separator will be pumped to an on-Site storage tank for subsequent treatment, as needed, and then to an on-Site discharge point in accordance with the substantive requirements of applicable federal and state laws. Vacuum pumps will also be used for the collection of contaminants *via* soil vapors. From the vacuum pumps, the collected vapor will pass through the existing carbon adsorption system, which consists of carbon columns connected in series. Appendix B contains a more detailed description of the on-site treatment system.

2.4.2 Augmented SVE Trench System

The preliminary augmented SVE trench system adds six segments (Segment 1 through Segment 6) to the existing SVE trench layout, each of varying length[9,10] (see Figures 12 and 13). Each of the augmented SVE trenches will be approximately 18 to 24 inches wide. The trenches will be situated to intercept permeable lenses in the till unit, above the sand and gravel unit (see Figure 14).

After the SVE trenches have been constructed, an initial dewatering of the trenches will be accomplished via pumps placed in vertical water collection wells situated at various low points within each trench segment. Each pump assembly will be housed in a pre-cast concrete vault with a locking cover. The concrete vault will be placed such that the top of the vault is slightly elevated above the final ground surface.

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[9] Configuration of the trench system may be modified based upon any additional soil characterization activities desired by the contractors prior to installation, observations made during construction of the slurry cutoff wall, and any unforeseen conditions identified during trench construction.

[10] The configuration presented herein does not represent a detailed or final design. Rather, the placement of the trenches has been presented to assist with the conceptual understanding of the intended construction theory.

Initial dewatering will occur in all six trench segments at the beginning of the SVE activities. Dewatering of the southern SVE trenches (Segment 4, Segment 5 and Segment 6) using dewatering wells may be necessary during SVE operation. In the northern segments (Segment 1, Segment 2 and Segment 3), it is anticipated that the SVE system will be sufficient to remove till water from these trenches, although dewatering wells will be used if necessary.

As shown on Figure 12, a 170-foot gap (approximate) will exist between the south end of the Segment 3 SVE trench and the north end of the Segment 4 SVE trench. A 50-foot gap (approximate) will also exist between the south end of the Segment 4 SVE trench and the east end of the Segment 5 SVE trench. Due to the irregular geology of these sections and the limited depth of clay between the shallow and deeper sand and gravel lenses, SVE trenches could not be extended to these areas. For this reason, four dual-pump SVE wells (as described in Section 2.3) will be installed between the Segment 3 and Segment 4 SVE trenches. In addition, two SVE wells proposed for the Hot Spot 2 area are in close proximity to the gap between Segment 4 and Segment 5.

The discharge pipes from the collection well pumps (for both the SVE trenches and the SVE wells) to the existing treatment system will run aboveground to an aboveground manifold, which leads to the existing ECC water treatment system. All discharge piping will be protected from freezing using either soil berms or heat trace lines. Appendix B contains a description of the existing treatment system.

2.4.3 SVE Trench Installation Methodology

The SVE trenches will be installed utilizing excavation equipment and a biopolymer slurry (guar gum). The approximate locations and depths of the trenches are depicted on Figures 12 and 13, respectively. The excavations will be performed through the biopolymer slurry to prevent the trench walls from collapsing during the excavation and to reduce the potential of the lower sand and gravel unit from heaving at the bottom of the excavation.

The biopolymer slurry will be added to the trenches, as necessary, as the excavations proceed to maintain slurry in the trench to within approximately two feet of the ground surface. Excavation spoils will be temporarily placed in staging areas adjacent to the trenches. As the spoils are stockpiled the biopolymer slurry will drain from the spoils and flow back into the excavation. Berms and/or silt fencing will be added along the Unnamed Ditch to preclude potential slurry solids or excavation spoils from entering the Ditch. Upon completion of the trench excavation activities, all stockpiled excavation spoils will be placed within the former SCPA.

The SVE trenches will be backfilled with pea gravel or similar granular material. The pea gravel backfill will be installed to within approximately two feet of the surface of each trench. As each trench is backfilled with pea gravel, a slotted four-inch diameter horizontal PVC pipe (SVE pipe) will be installed in the trench at an elevation of approximately 5 feet bgs (see Figure 14). The horizontal slotted pipe will be fabricated with solid vertical PVC riser pipes installed at three locations on each of the six excavation trenches. The riser pipes will either be connected to the SVE system or will be capped and equipped with a vacuum gauge above the final grade of the trench. The multiple risers will be installed to allow the installation of additional equipment/instrumentation, if necessary, to monitor the effectiveness of the SVE system, and for the addition of enzymes necessary to dissolve the biopolymer slurry after completing each trench.

In addition, a four-inch diameter PVC till water dewatering well(s) will be installed within each trench while backfilling is performed. The wells will be installed at the low point of each trench and will be used for initial dewatering and to remove the biopolymer slurry (see discussion below). The till water dewatering wells will be equipped with five or ten-foot sections of well screen, as appropriate, depending on the total depth of the trench at the respective location of the well. Solid PVC riser pipe will be used above the well screen to the surface of the trench (see Figure 15).

After each trench is backfilled with pea gravel and the SVE pipe and till water dewatering wells are installed, an appropriate enzyme will be added by the contractor to dissolve the biopolymer slurry. The enzyme will be added through the riser pipes and will be pumped out and re-circulated through the vertical till water dewatering wells. Temporary submersible pumps will be installed in the till water dewatering wells to circulate the enzyme. Biopolymer slurry displaced during the excavation or slurry removed from the till water extraction during the enzyme addition will be containerized and characterized. After assessment of the laboratory results to characterize the dissolved slurry is complete, the water will, if necessary, be treated in the on-Site treatment system and managed/disposed of in accordance with applicable standards.

Additional soil will be removed at the surface of each trench to allow for the installation of a seal that will prevent vacuum leaks from the SVE trenches to the ground surface. A high-density polyethylene (HDPE) liner will be installed at the base of this excavation over the gravel backfill in each trench and will be keyed into the surrounding soil. The seal will then be backfilled with clay material and will be suitably compacted. The backfill may consist of the soils excavated to construct the seal.

After the seal is completed, concrete vaults will be installed for each till water dewatering well. Excavations will be performed through the seal at each till water dewatering well location for the installation of the concrete vaults. A geotextile will be placed around the PVC riser for each well and across the pea

TABLES

Table 1

Augmentation of SVE System
Envirochem Superfund Site
Zionsville, Indiana

Compound	Soil Vapor Standard[1]	
	(mg/L)	(ppmv)
Methylene chloride	0.08	22
Methyl ethyl ketone	0.04	13
Trichloroethene	0.39	68
1,1,2-Trichloroethane	0.01	1
Tetrachloroethene	0.11	16
1,2-Dichloroethene (total)	3.7	880
Phenol	0.005	1.3

Notes:

[1] Soil Vapor Concentrations in Equilibrium with Acceptable Soil Concentration as presented in Revised Exhibit A, Table 4-1.

Table 2

Augmentation of SVE System Stream Standards

Envirochem Superfund Site
Zionsville, Indiana

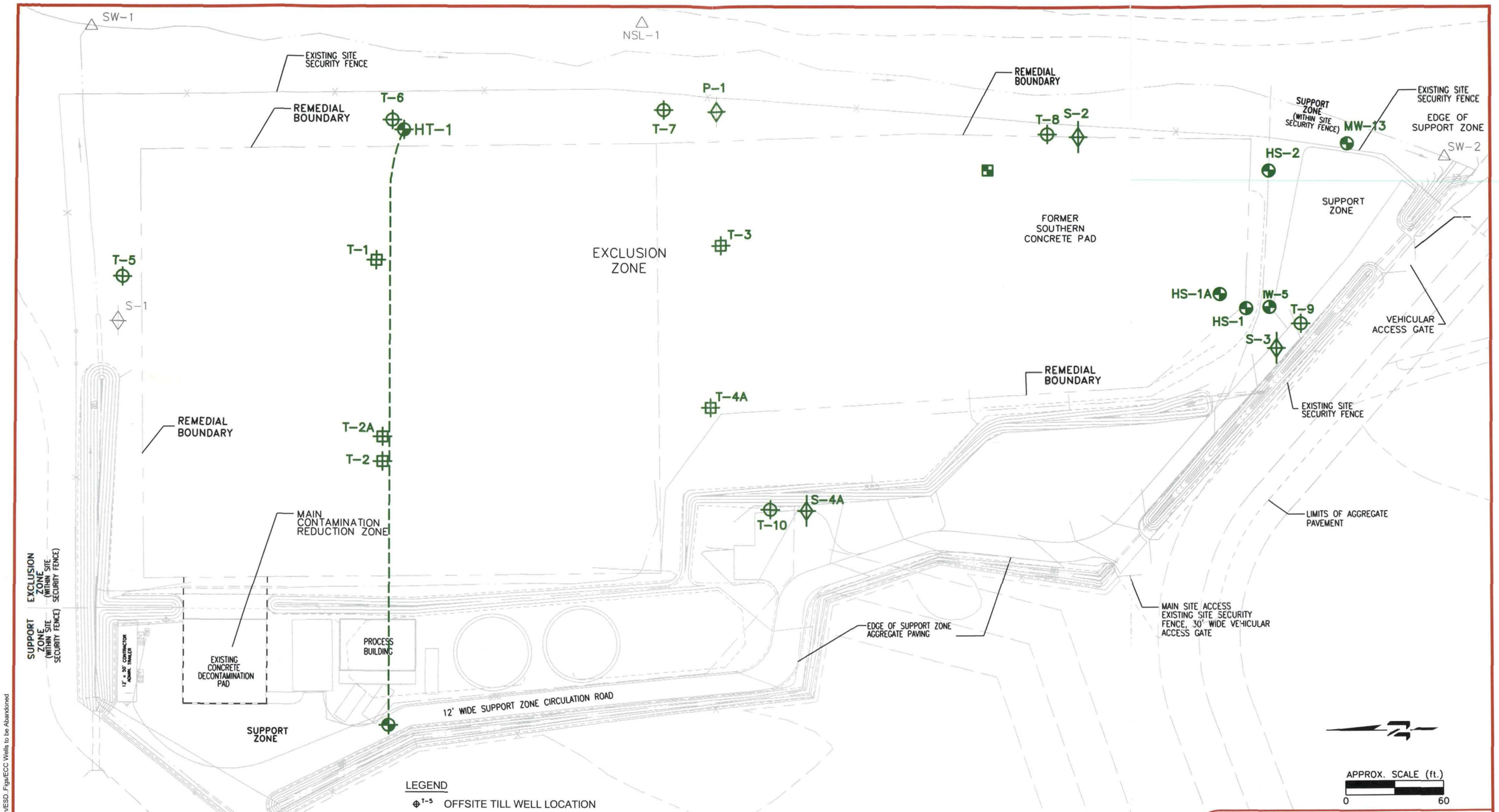
Compound	Stream Standard[1] (ug/L)
1,1-Dichloroethene	1.85
1,2-Dichloroethene (total)[2]	9.4
Methylene chloride	15.7
Tetrachloroethene	8.85
Toluene	3400
1,1,1-Trichloroethane	5280
1,1,2-Trichloroethane	41.8
Trichloroethene	80.7
Vinyl chloride	525
1,2-Dichlorobenzene	763
Phenol	570

Notes:

[1] Acceptable Stream Water Concentration as presented in Revised Exhibit A, Table 3-1.

[2] Revised Site-Specific Acceptable Stream Concentrations as determined in the Background Surface and Subsurface Water Monitoring Report dated December 22, 2000, Table 6 values.

FIGURES



LEGEND

- T-5 OFFSITE TILL WELL LOCATION
- T-2A ONSITE TILL WELL LOCATION
- S-2 SAND/GRAVEL WATER-BEARING ZONE WELL LOCATION
- P-1 SAND/GRAVEL WATER-BEARING ZONE PIEZOMETER
- SW-2 SURFACE WATER SAMPLING LOCATION
- MW-13 PREVIOUSLY INSTALLED MONITORING WELL
- HT-1 FLUTE HORIZONTAL TILL WELL
- FORMER SOUTHERN CONCRETE PAD DEWATERING WELL

NOTE: MONITORING WELLS TO BE ABANDONED SHOWN IN **GREEN**

CPFs/ECC/Additional Work.../Work Plan/ESD_Figs/ECC Wells to be Abandoned

ENVIRON

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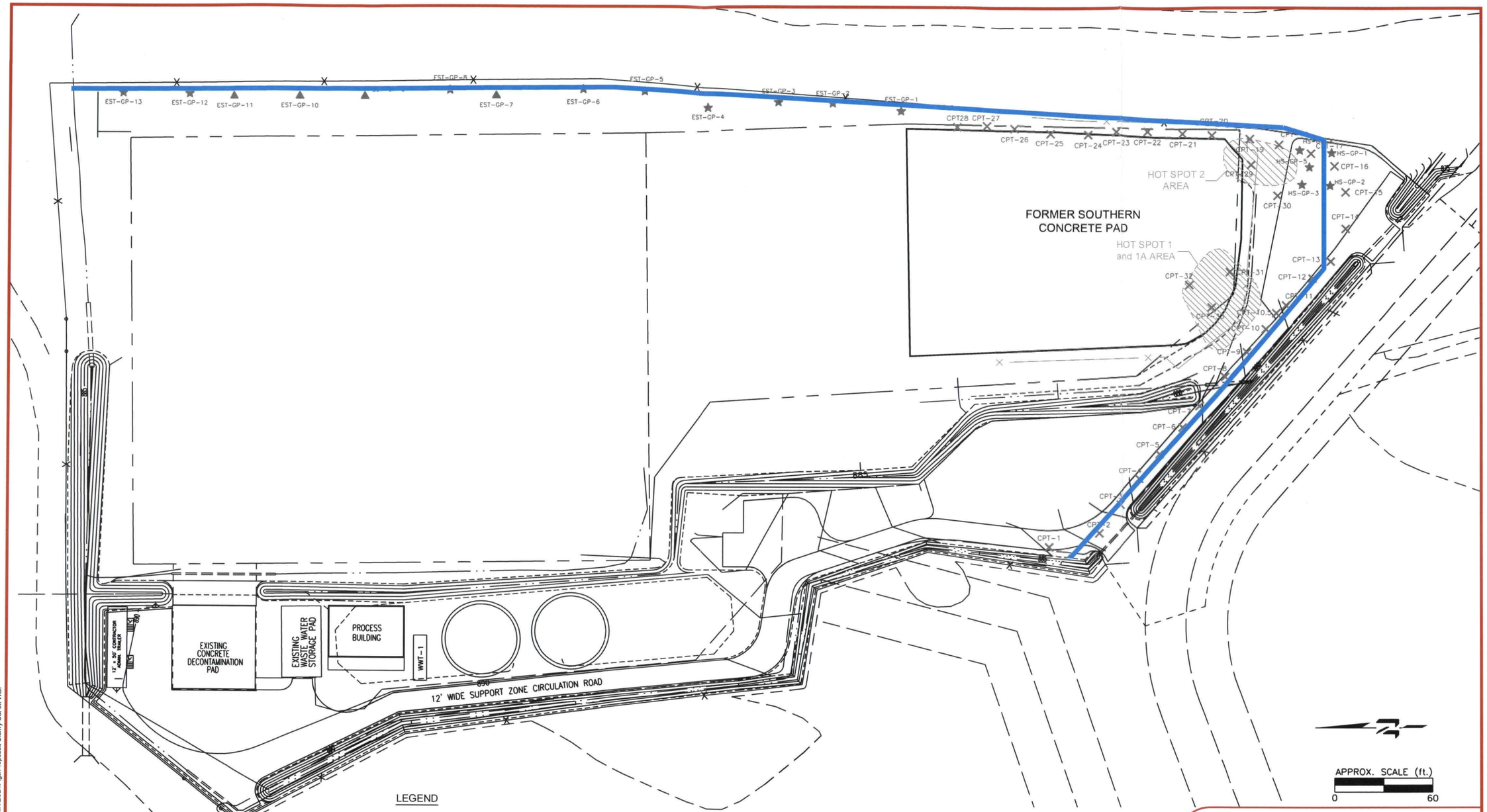
ECC Wells to be Abandoned
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE:
06/20/02	21-6585B		1
DRAFTER: APR	APPROVED: SCH	REVISED:	



LEGEND

- CPT BORING
- GEOPROBE STRATIGRAPHIC BORING
- PLANNED STRATIGRAPHIC BORING NOT COMPLETED
- APPROXIMATE AREA OF HOT SPOT
- PROPOSED SLURRY WALL LOCATION (APPROXIMATE)

NOTE:
Proposed slurry wall location based Additional Work, Subsurface Water Interceptor Trench location, as shown on Figure 3-1 of Revised Exhibit A, with the following exceptions:

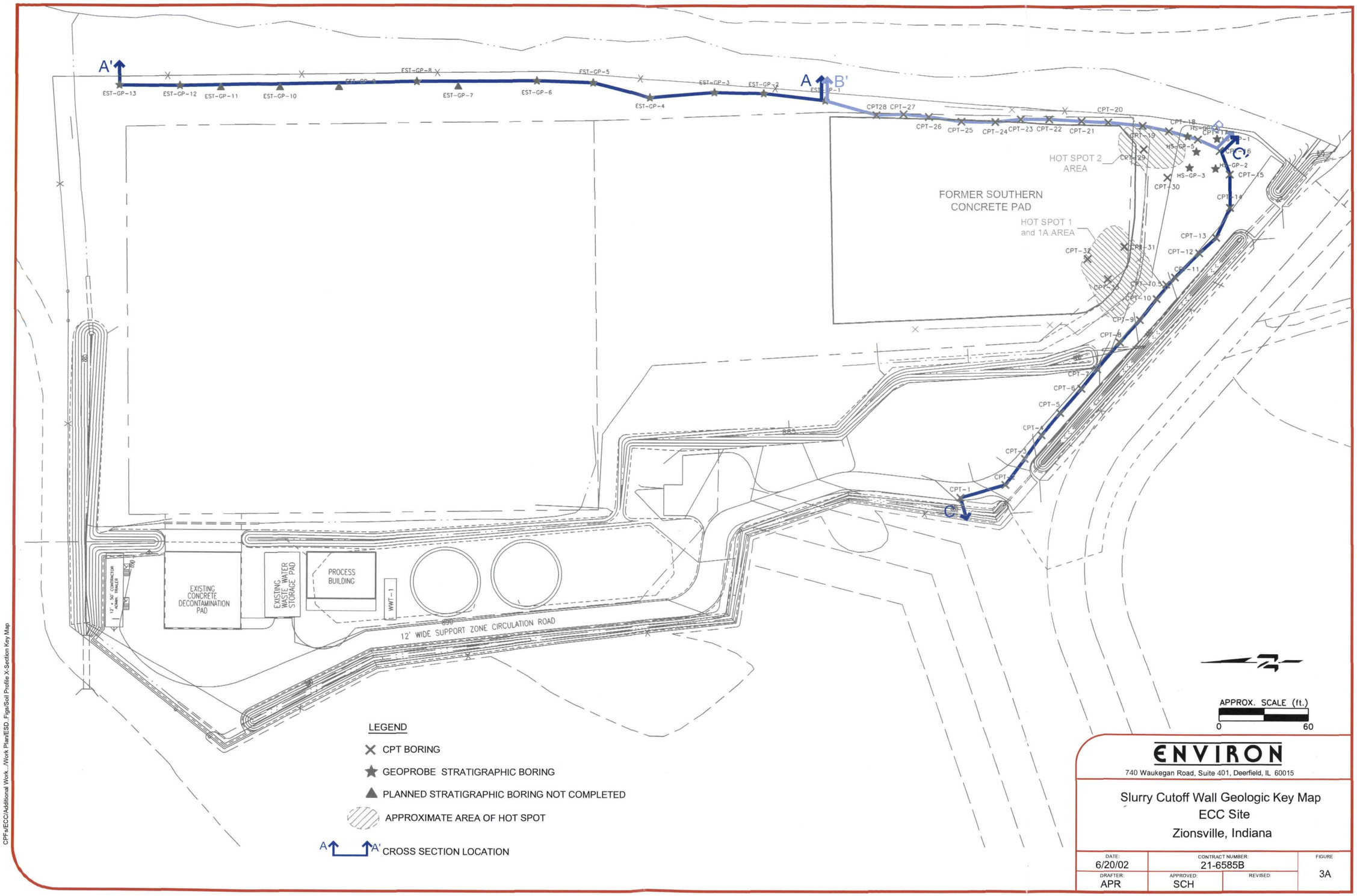
1. Proposed slurry wall has been extended south of Hot Spot 2 area
2. Proposed slurry wall location has been terminated at drainage swale near main access gate to maintain existing drainage swale and because access agreements do not extend beyond fence line.

ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Proposed Slurry Cutoff Wall Location - Plan View
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE
6/20/02	21-6585B		2
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/ECC/Additional Work.../Work Plan/ESD. Figs/Proposed Slurry Cut-off Wall



CPFs/ECC/Additional Work.../Work Plan/ESD_Figs/Soil Profile X-Section Key Map

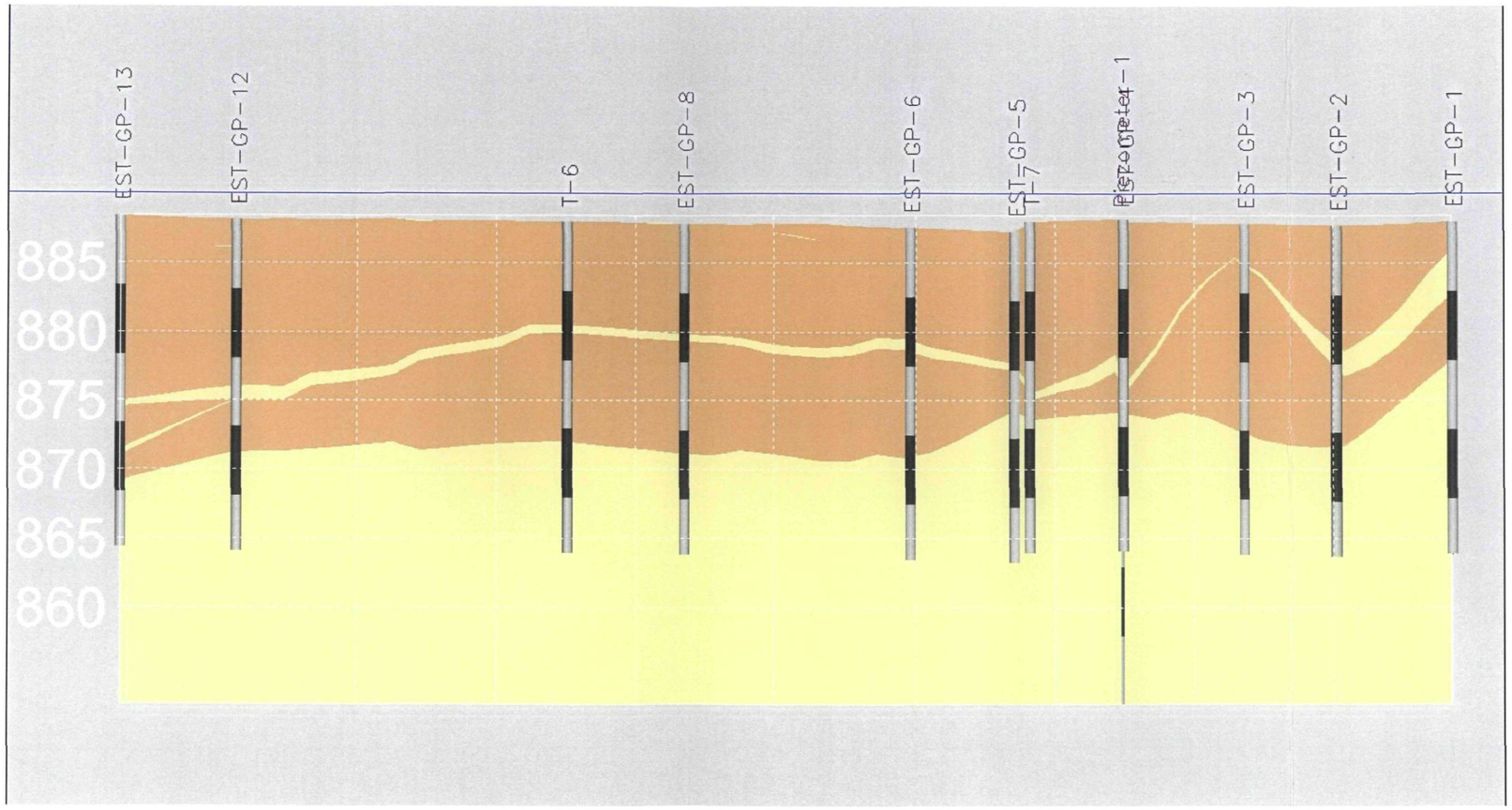
ENVIRON

740 Waukegan Road, Suite 401, Deerfield, IL 60015

Slurry Cutoff Wall Geologic Key Map
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE:
6/20/02	21-6585B		3A
DRAFTER: APR	APPROVED: SCH	REVISED:	

A-A'



Note:
Soil profile shown is a simplified presentation of field data from the boring locations shown on Figure 3A.

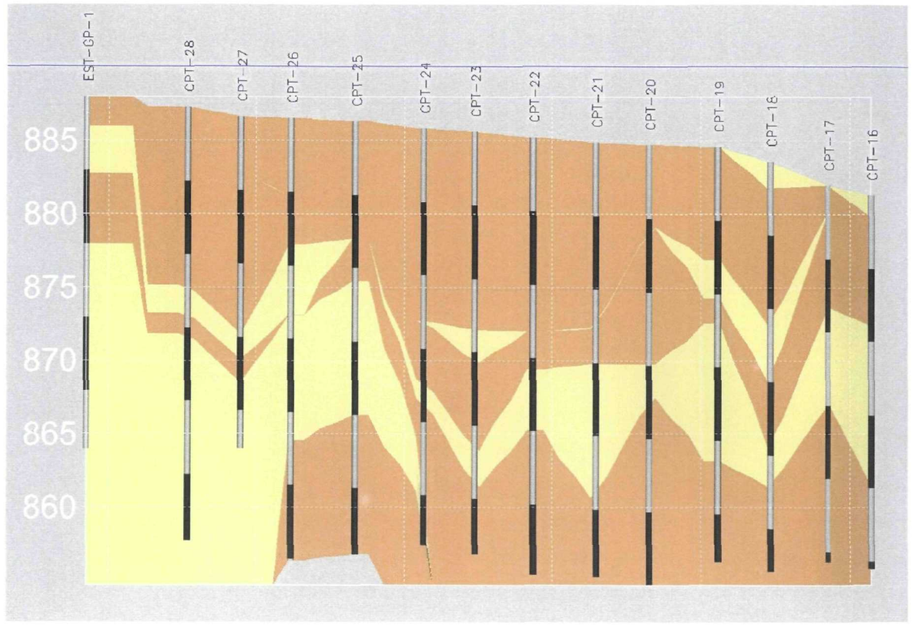
ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Slurry Cutoff Wall Geologic Cross Section A-A'
ECC Site
Zionsville, Indiana

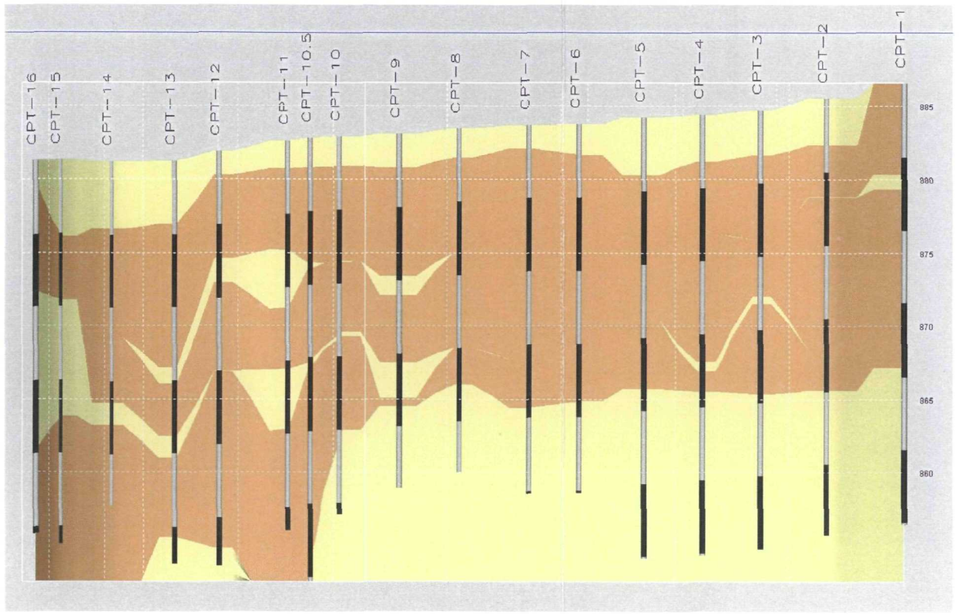
DATE:	CONTRACT NUMBER:		FIGURE
6/20/02	21-6585B		3B
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/Additional Work.../Work Plan/ESD.Figs/SL Geologic Cross Sections

B-B'



C-C'



Note:
Soil profile shown is a simplified presentation of field data from the boring locations shown on Figure 3A.

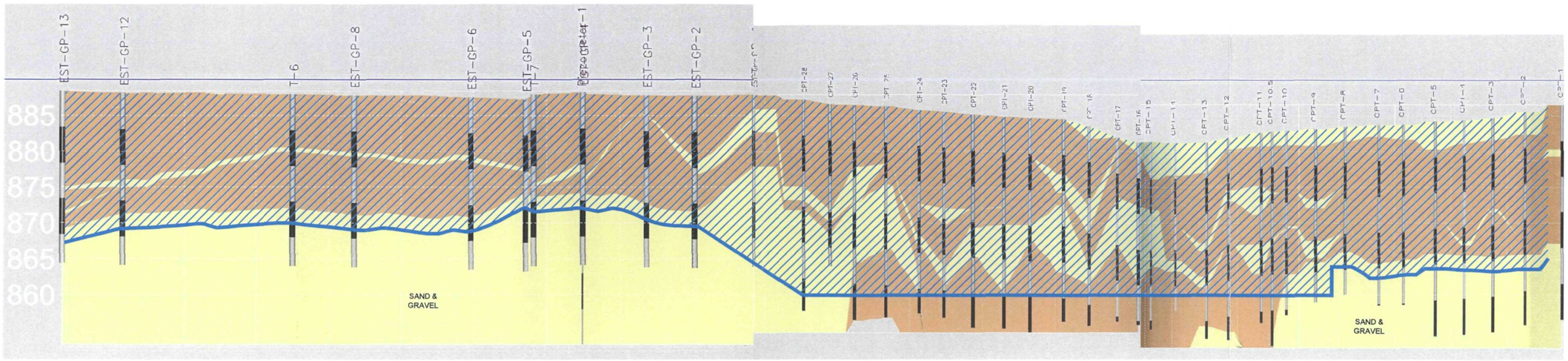
ENVIRON

740 Waukegan Road, Suite 401, Deerfield, IL 60015

Slurry Cutoff Wall Geologic Cross Sections
B-B' and C-C'
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE
6/20/02	21-6585B		3C
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/Additional Work.../Work Plan/ESD..Figs/SL Geologic Cross Sections



LEGEND

PROPOSED SLURRY WALL LOCATION
(2 FT INTO TOP OF LOWER SAND & GRAVEL STRATUM (EXCEPT WHERE SHOWN AT ELEVATION 860)).

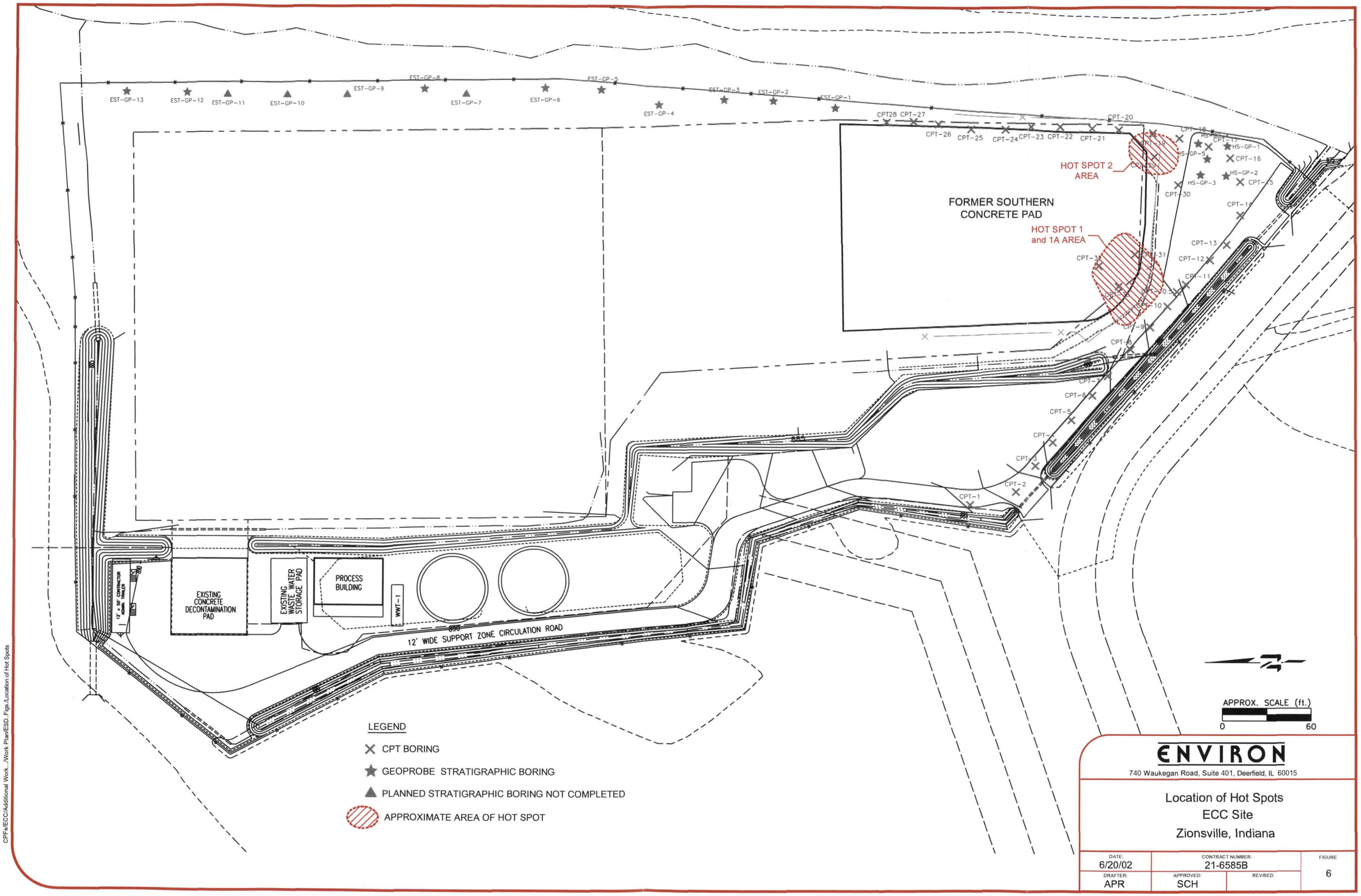
Note:
Soil profile shown is a simplified presentation of field data from the boring locations shown on Figure 2.

ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Slurry Cutoff Wall - Profile View
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE
6/20/02	21-6585B		4
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/Additional Work.../Work Plan/ESD_Figs/Trench &SL ProfileViews



ENVIRON

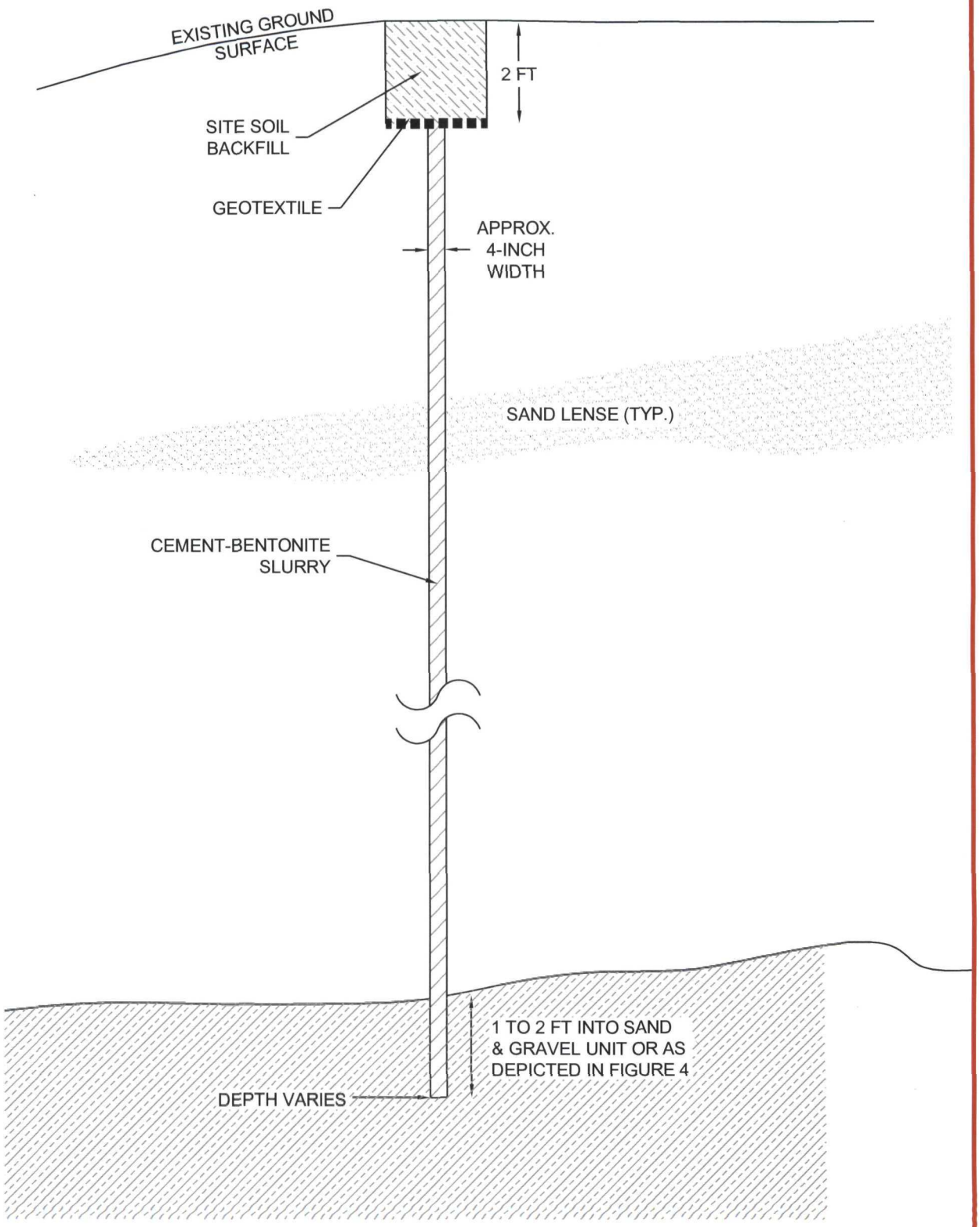
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Location of Hot Spots
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE
6/20/02	21-6585B		6
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/ECC/Additional Work.../Work Plan/ESD...Figs./Location of Hot Spots

SLURRY CUTOFF WALL



ENVIRON

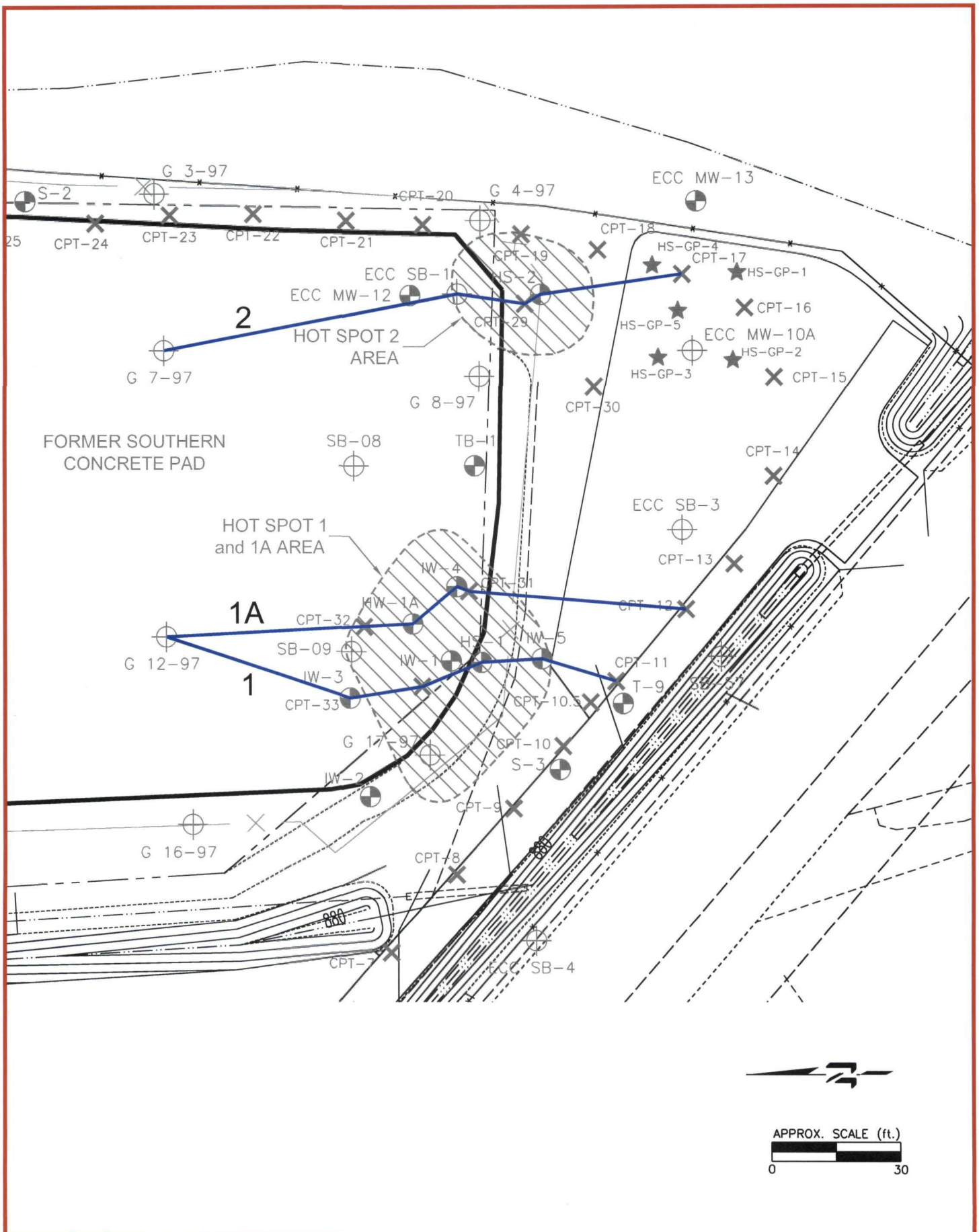
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Slurry Cutoff Wall Typical Section
ECC Site
Zionsville, Indiana

Figure 5

Drafter: APR | Date: 6/20/02 | Contract Number: 21-6585B | Approved: SCH | Revised:

CPFs/Additional Work.../Work Plan/ESD..Figs/ Typ Secs



CPFs/Additional Work.../Work Plan/ESD..Figs/HS Geological X-Section Key Map

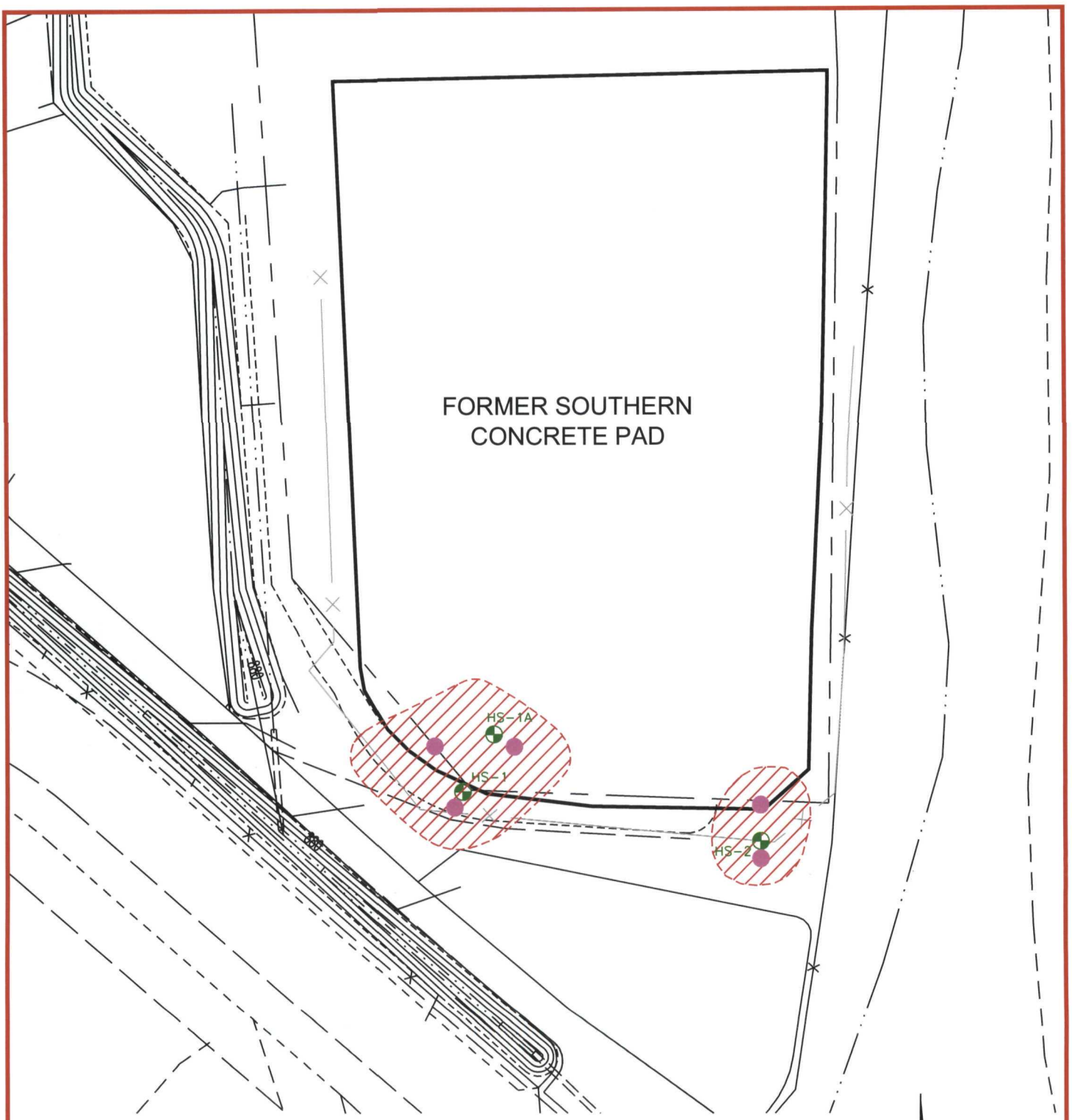
ENVIRON

740 Waukegan Road, Suite 401, Deerfield, IL 60015

Hot Spot Geological Cross Section Key Map
ECC Site
Zionsville, Indiana

Figure
7A

Drafter: APR	Date: 6/20/02	Contract Number: 21-6585B	Approved: SCH	Revised:



LEGEND

- MONITORING WELLS (EXISTING) - TO BE ABANDONED
- PROPOSED DUAL-PHASE SVE WELLS - APPROXIMATE LOCATIONS
- APPROXIMATE AREA OF HOT SPOT

APPROX. SCALE (ft.)
0 40

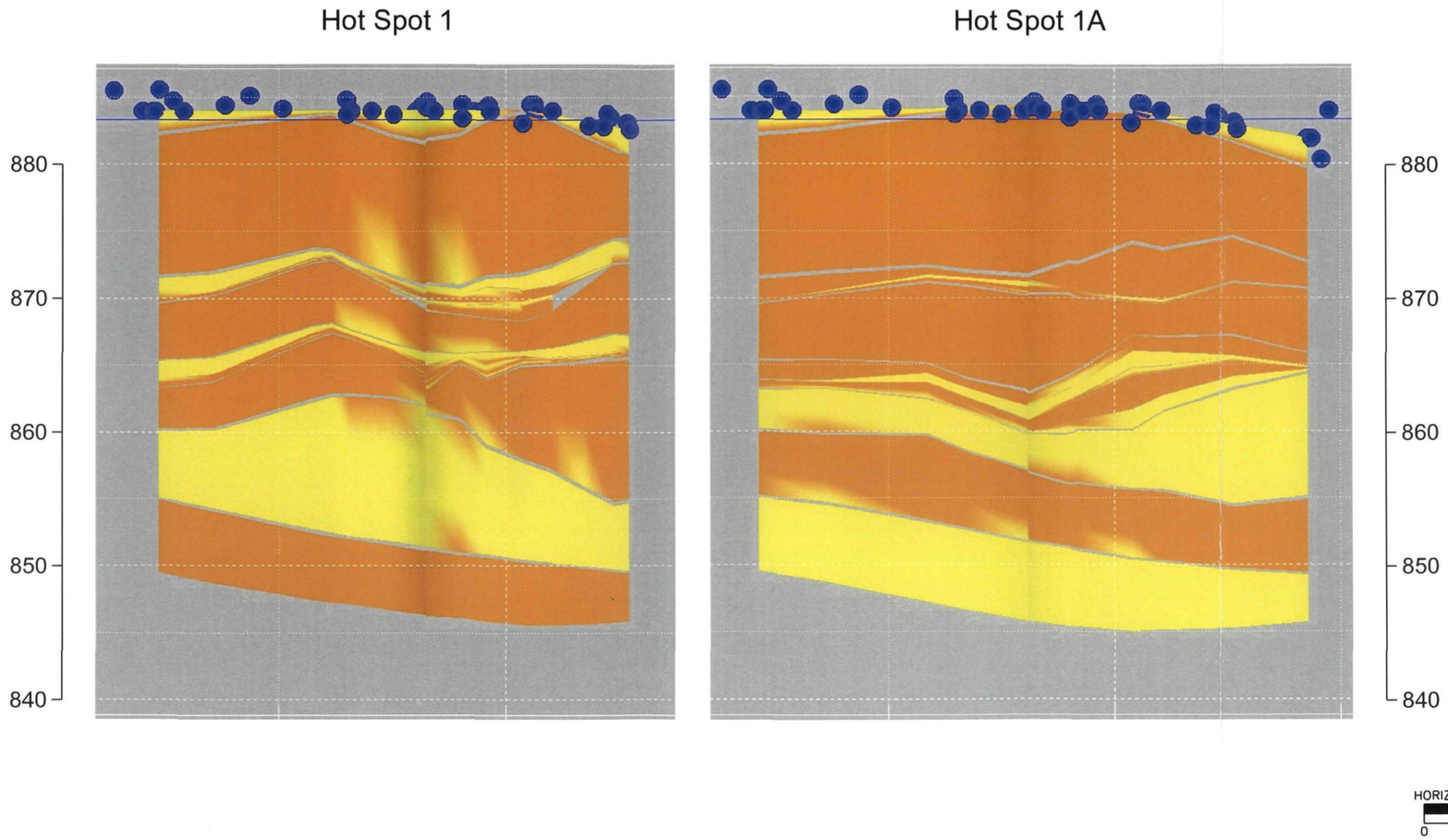
ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Preliminary Hot Spot SVE Well Locations
ECC Site
Zionsville, Indiana

Figure
8

Drafter: APR | Date: 06/20/02 | Contract Number: 21-6585B | Approved: SCH | Revised:

CPFs/ECC/Additional Work/Work Plan/ESD_Figs/Prelim. HS SVE Well Locs



Note:
Soil profile shown is a simplified presentation of field data from the boring locations shown on Figure 7A.

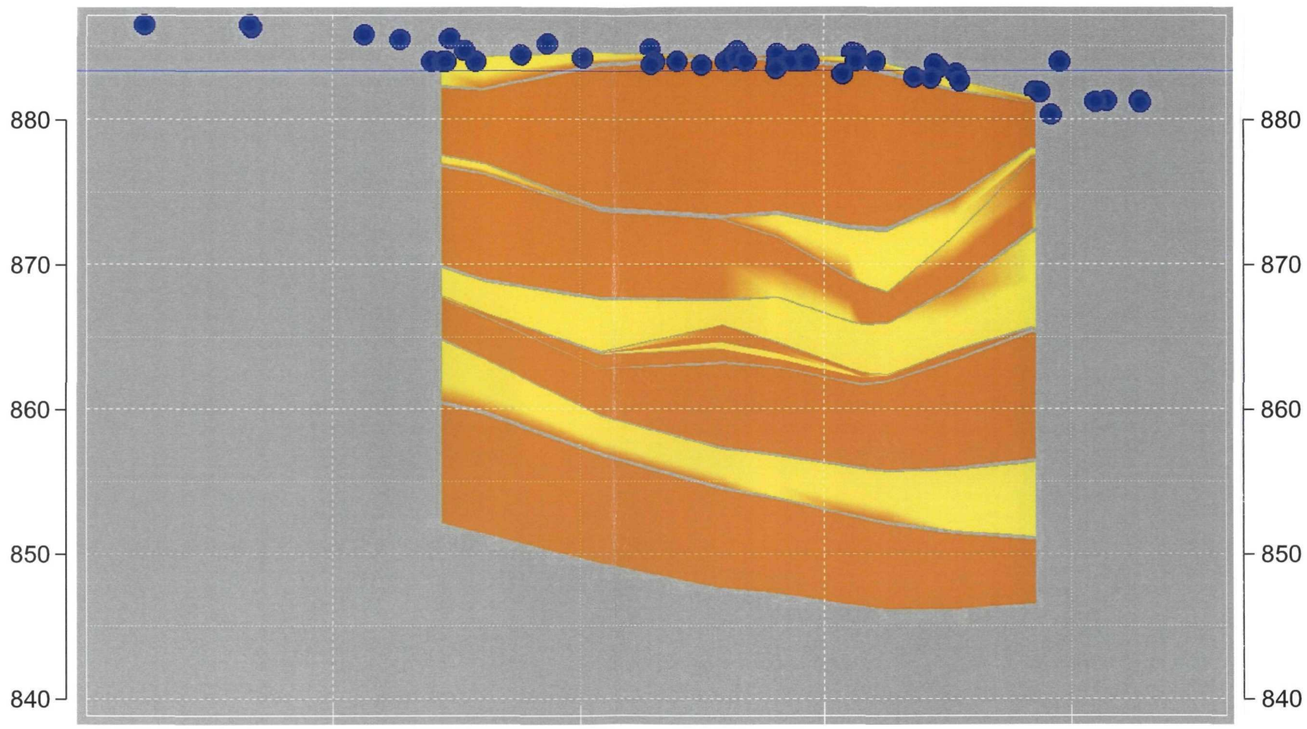
ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Hot Spot 1 & 1A Geologic Cross Sections
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE
6/20/02	21-6585B		7B
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/Additional Work.../Work Plan/ESD Figs/HS Geologic X-Sections

Hot Spot 2



HORIZONTAL SCALE (ft.)
0 30

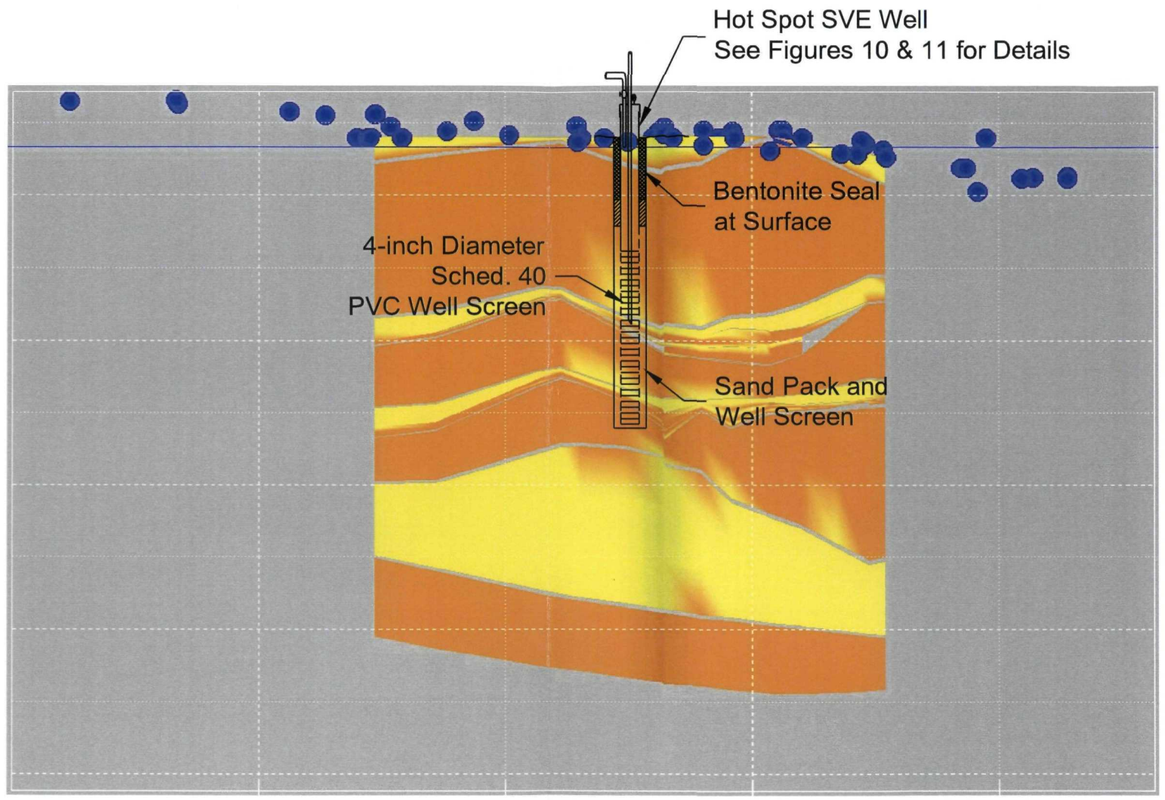
Note:
Soil profile shown is a simplified presentation of field data from the boring locations shown on Figure 7A.

ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Hot Spot 2 Geologic Cross Section
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE
6/20/02	21-6585B		7C
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/Additional Work.../Work Plan/ESD...Figs/HS Cross Sections



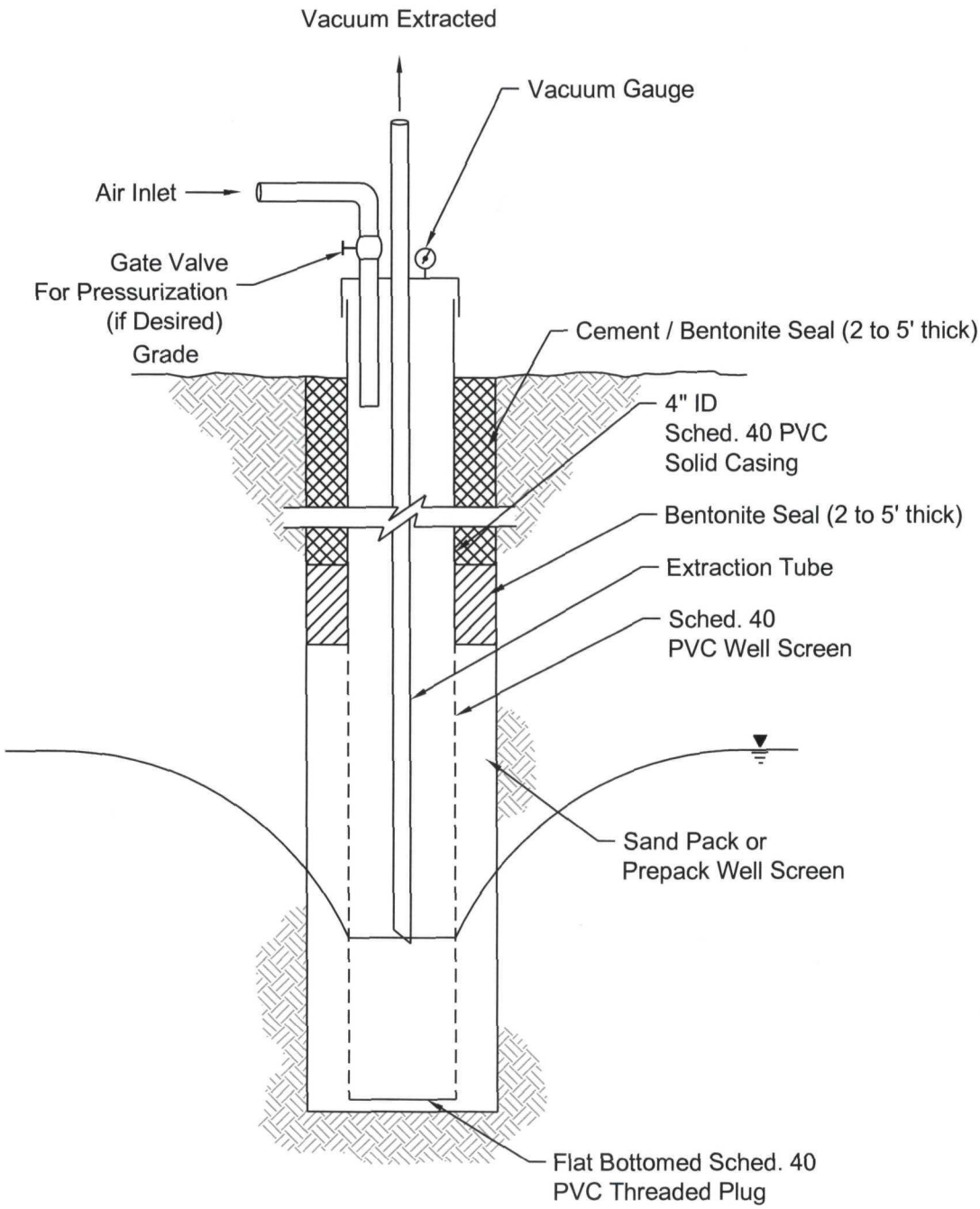
Note:
The screened lengths vary based on placement. *All screens will fully penetrate the upper sand and gravel* lenses in the shallow till but will be placed no less than two feet above the lower sand and gravel unit.
Soil profile shown is a simplified presentation of field data from the boring locations shown on Figure 7A.

ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Hot Spot SVE Well Profile Schematic
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE
6/20/02	21-6585B		9
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/Additional Work.../Work Plan/ESD_Figs/HS SVE Well Profile Schematic



CPFs/ECC/Additional Work.../Work Plan/ESD...Figs/Typical Single-Pump

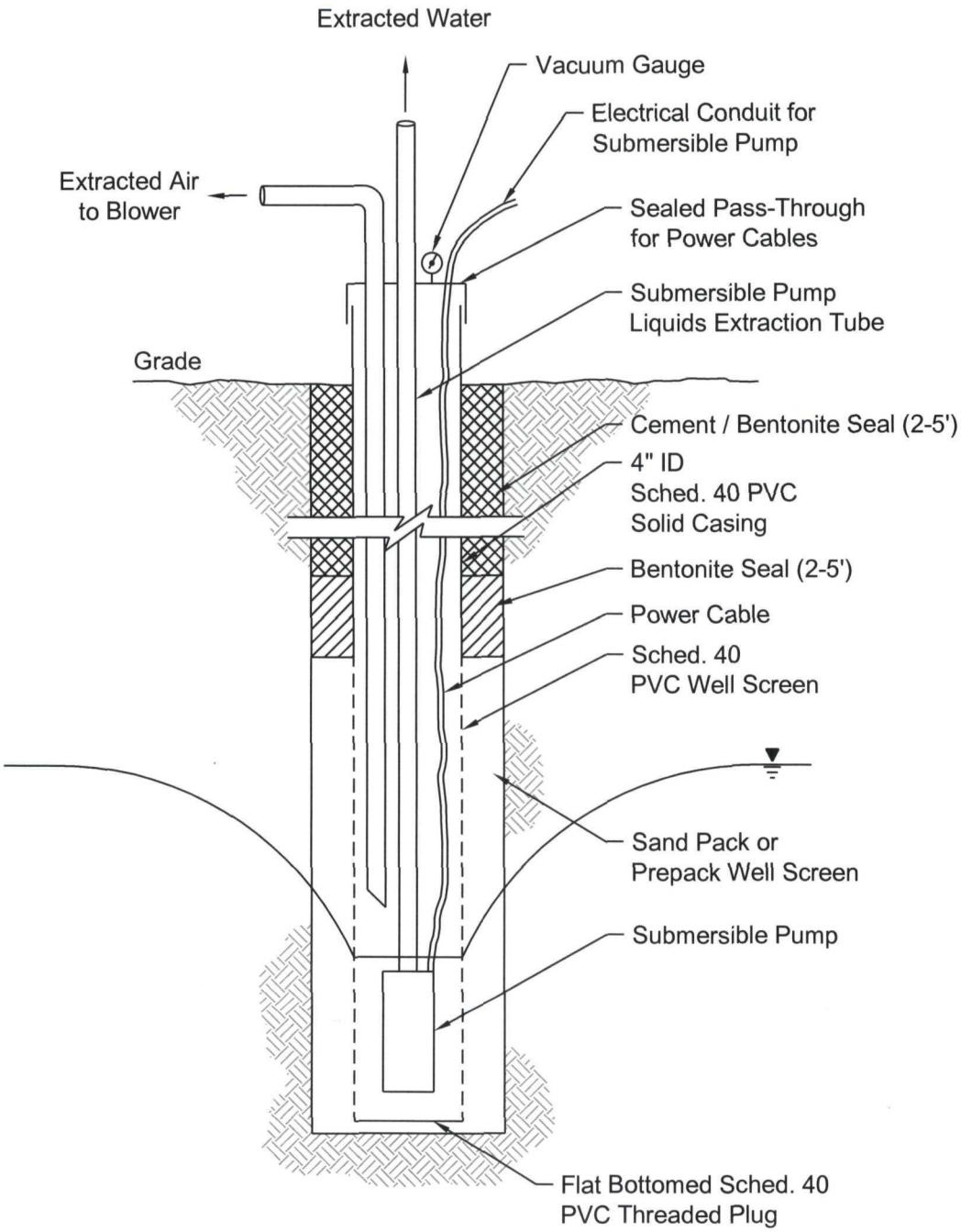
ENVIRON

740 Waukegan Road, Suite 401, Deerfield, IL 60015

Typical Single-Pump SVE Well
ECC Site
Zionsville, Indiana

Figure
10

Drafter: APR | Date: 6/20/02 | Contract Number: 21-6585B | Approved: SCH | Revised:



ENVIRON

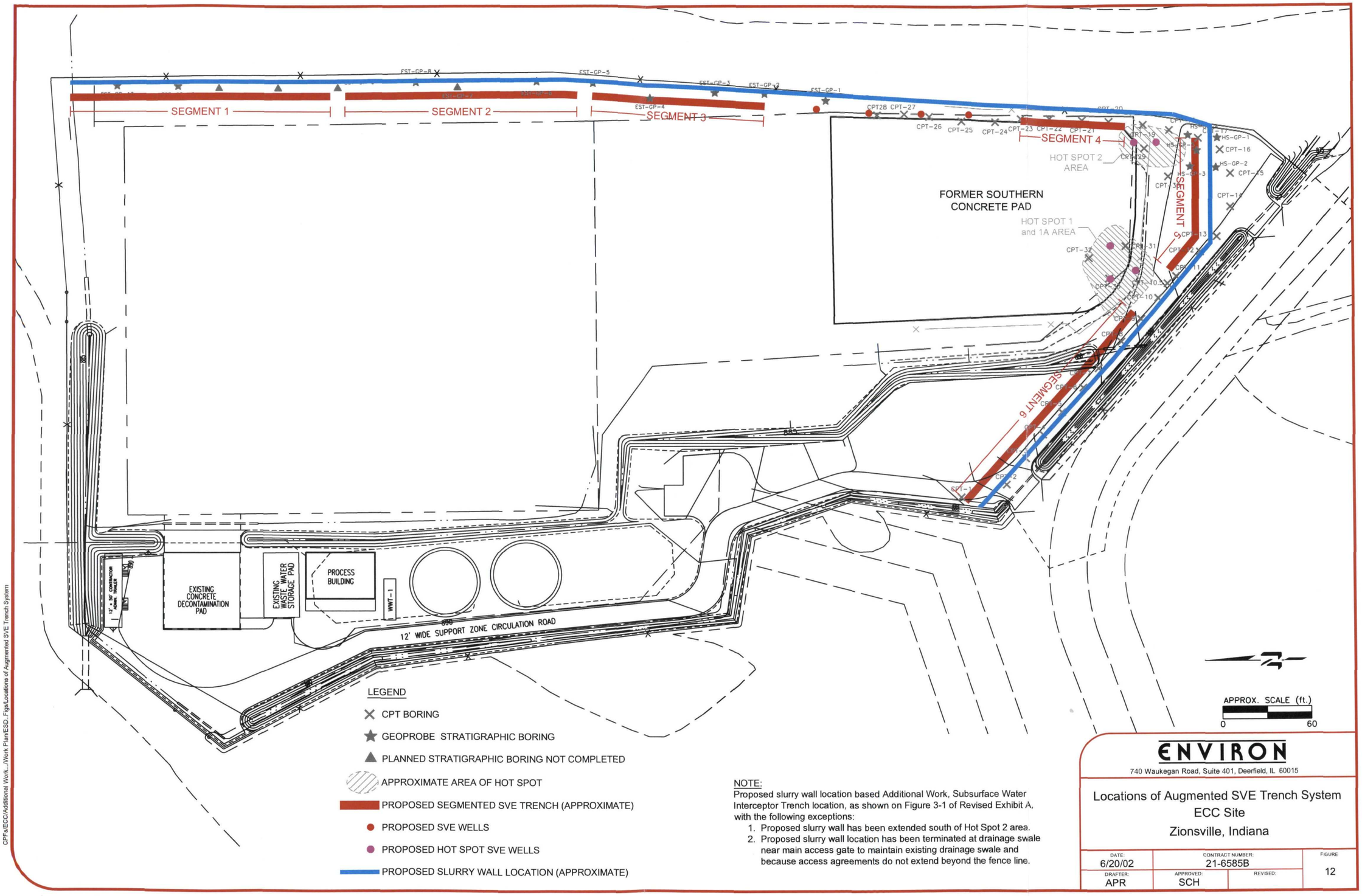
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Typical Dual-Pump SVE Well
ECC Site
Zionsville, Indiana

Figure
11

Drafter: APR | Date: 06/20/02 | Contract Number: 21-6585B | Approved: SCH | Revised:

CPFs/ECC/Additional Work/Work Plan/ESD..Figs/Typical Dual-Pump



NOTE:
Proposed slurry wall location based Additional Work, Subsurface Water Interceptor Trench location, as shown on Figure 3-1 of Revised Exhibit A, with the following exceptions:

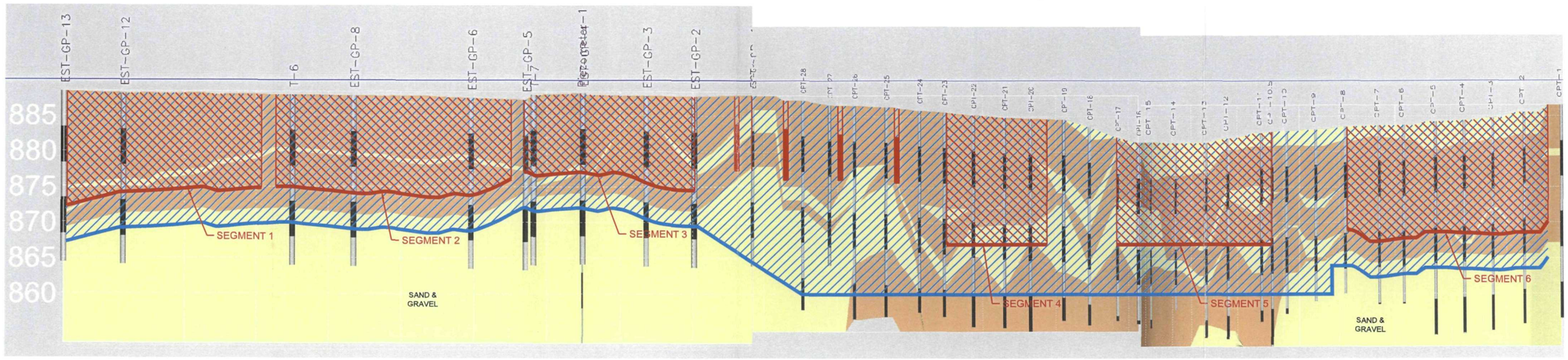
1. Proposed slurry wall has been extended south of Hot Spot 2 area.
2. Proposed slurry wall location has been terminated at drainage swale near main access gate to maintain existing drainage swale and because access agreements do not extend beyond the fence line.

ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Locations of Augmented SVE Trench System
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE:
6/20/02	21-6585B		12
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/ECC/Additional Work.../Work Plan/ESD...Figs/Locations of Augmented SVE Trench System



LEGEND

PROPOSED BOTTOM DEPTH OF SEGMENTED EXTRACTION TRENCH (3 FT ABOVE TOP OF LOWER SAND & GRAVEL STRATUM (EXCEPT WHERE SHOWN AT ELEV. 868)).

PROPOSED SVE WELL LOCATION (BOTTOM OF WELL LOCATED 1FT ABOVE TOP OF LOWER SAND & GRAVEL STRATUM)

PROPOSED SLURRY WALL LOCATION (2 FT INTO TOP OF LOWER SAND & GRAVEL STRATUM (EXCEPT WHERE SHOWN AT ELEVATION 860)).

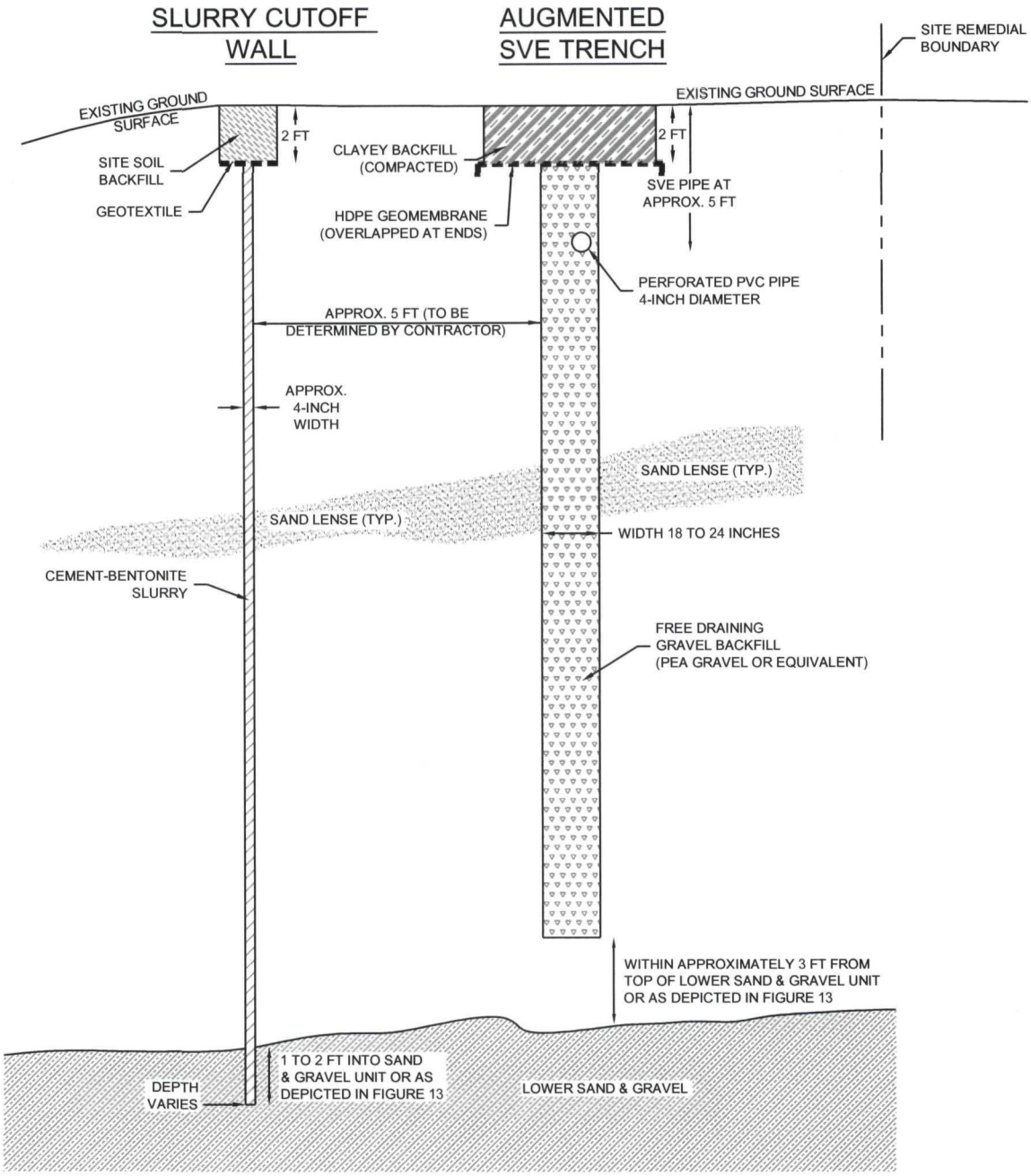
Note:
Soil profile shown is a simplified presentation of field data from the boring locations shown on Figure 7A.

ENVIRON
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Augmented SVE Trench System Profile View
ECC Site
Zionsville, Indiana

DATE:	CONTRACT NUMBER:		FIGURE
6/20/02	21-6585B		13
DRAFTER: APR	APPROVED: SCH	REVISED:	

CPFs/Additional Work.../Work Plan/ESD. Figs/Trench & SL Profile Views



ENVIRON

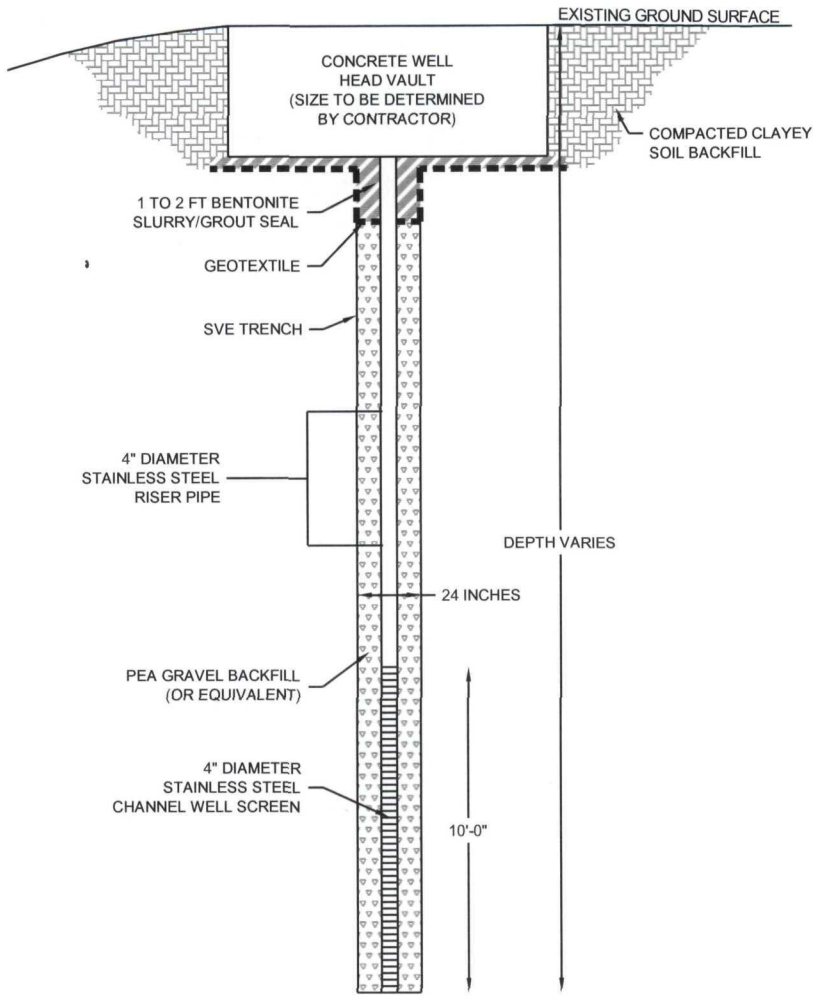
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Augmented SVE Trench Typical Section
ECC Site
Zionsville, Indiana

Figure 14

Drafter: APR | Date: 6/20/02 | Contract Number: 21/6585B | Approved: SCH | Revised:

CPFs/Additional Work.../Work Plan/ESD...Figs/Typ Secs



TYPICAL SVE TRENCH WATER DEWATERING WELL

SCALE: 1" =6'

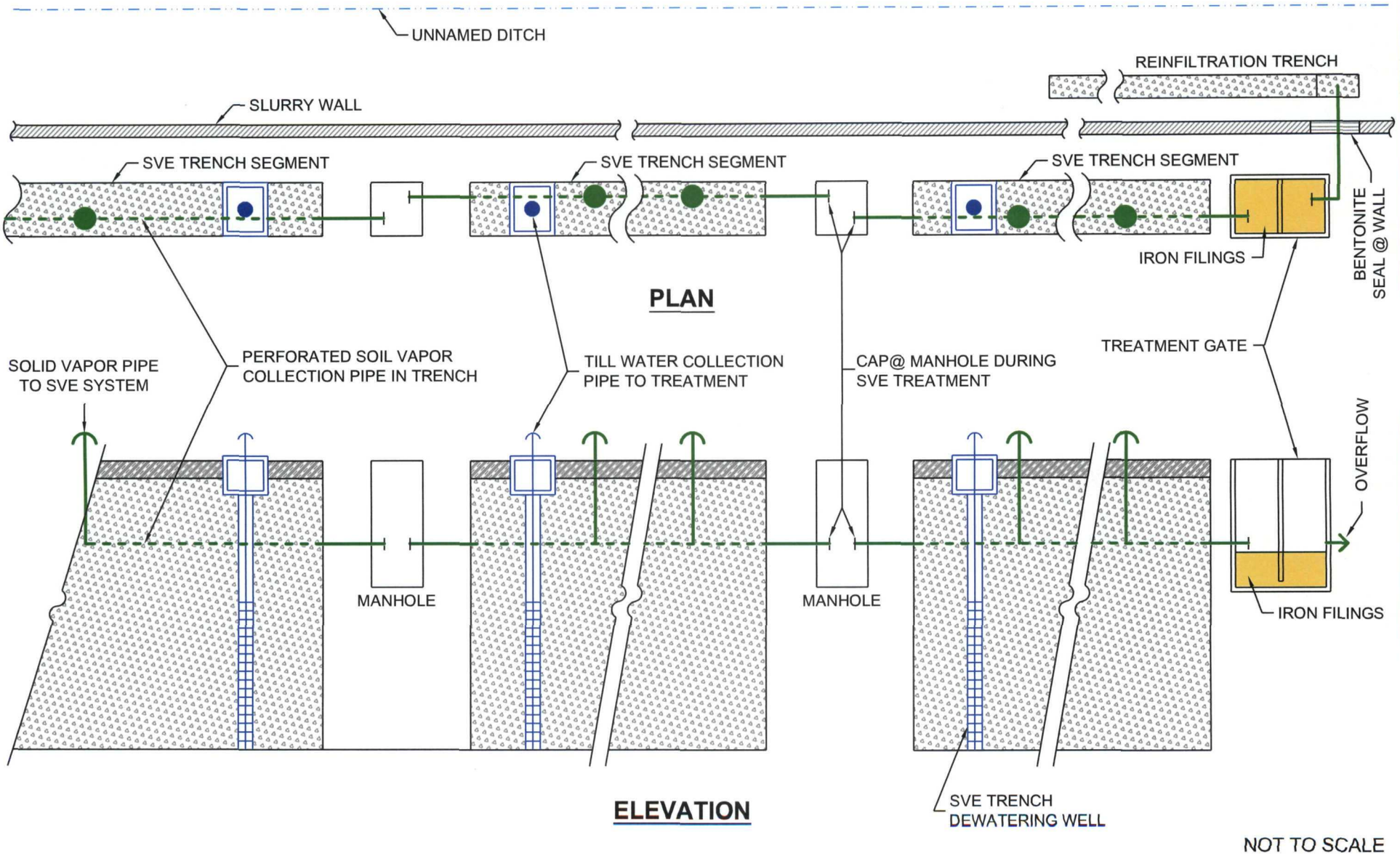
NOTES:

1. DEWATERING WELL LOCATIONS TO BE DETERMINED
2. *INSTALLATION DURING TRENCH CONSTRUCTION*
3. WELL SCREENS AVAILABLE FROM USF JOHNSON SCREENS, ST. PAUL, MN (4" PS SS304 SS SCREEN)

CPFs/Additional Work.../Work Plan/ESD..Figs/Typ Secs

ENVIRON 740 Waukegan Road, Suite 401, Deerfield, IL 60015	Typical Till Water Dewatering Well- Augmented SVE Trench ECC Site Zionsville, Indiana	Figure 15

Drafter: APR Date: 6/20/02 Contract Number: 21-6585B Approved: SCH Revised:



ENVIRON

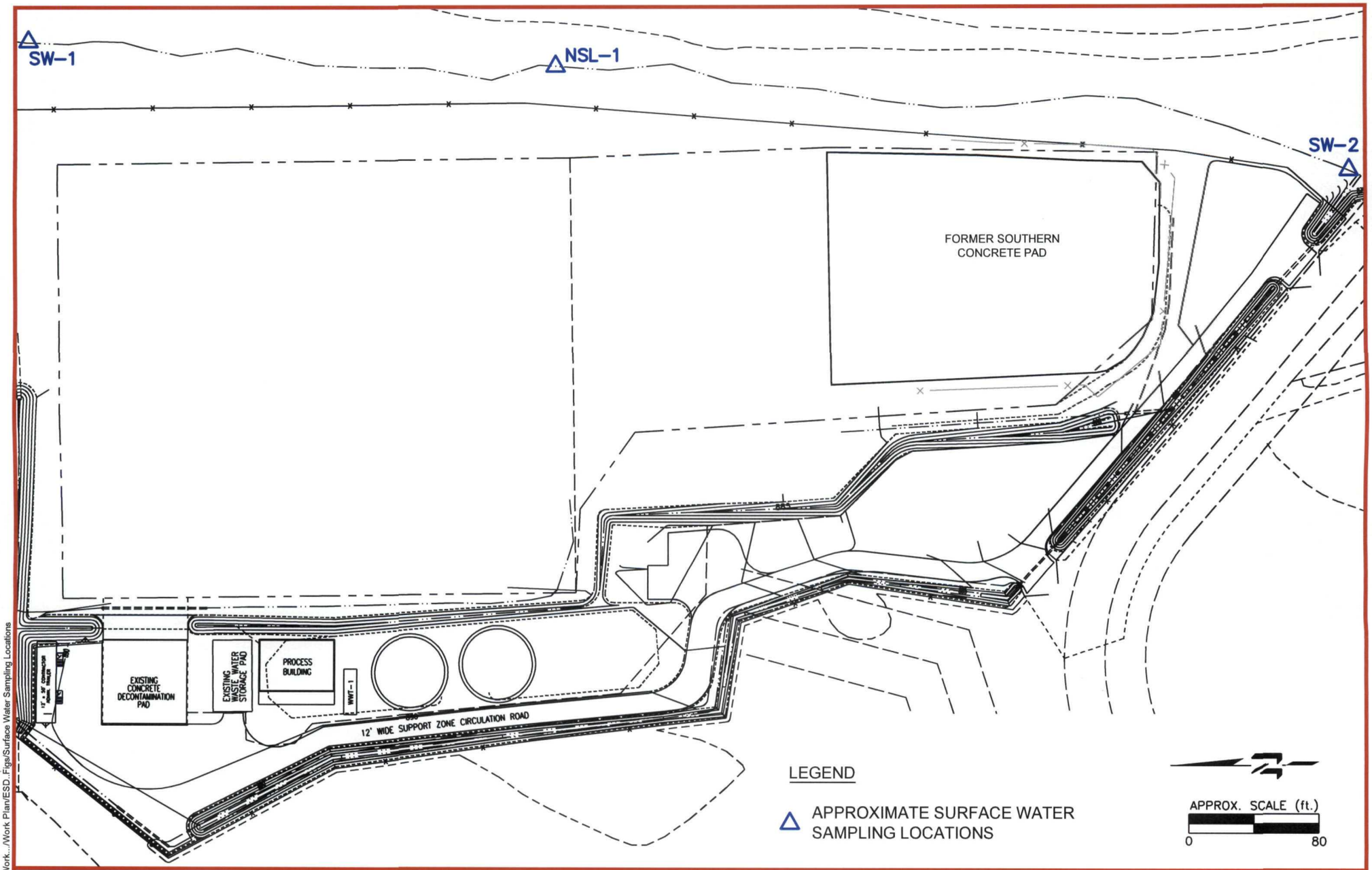
740 Waukegan Road, Suite 401, Deerfield, IL 60015

Schematic of Augmented SVE Trench/Permeable Reactive Gate System
ECC Site
Zionsville, Indiana

Figure 16

Drafter: APR | Date: 6/28/02 | Contract Number: 21-6585B | Approved: SCH | Revised:

CPFs/ECC/Additional Work.../Work Plan/ESD..Figs/Schematic of Augmented SVE Trench



CPFs/ECC/Additional Work.../Work Plan/ESD..Figs/Surface Water Sampling Locations

ENVIRON

740 Waukegan Road, Suite 401, Deerfield, IL 60015

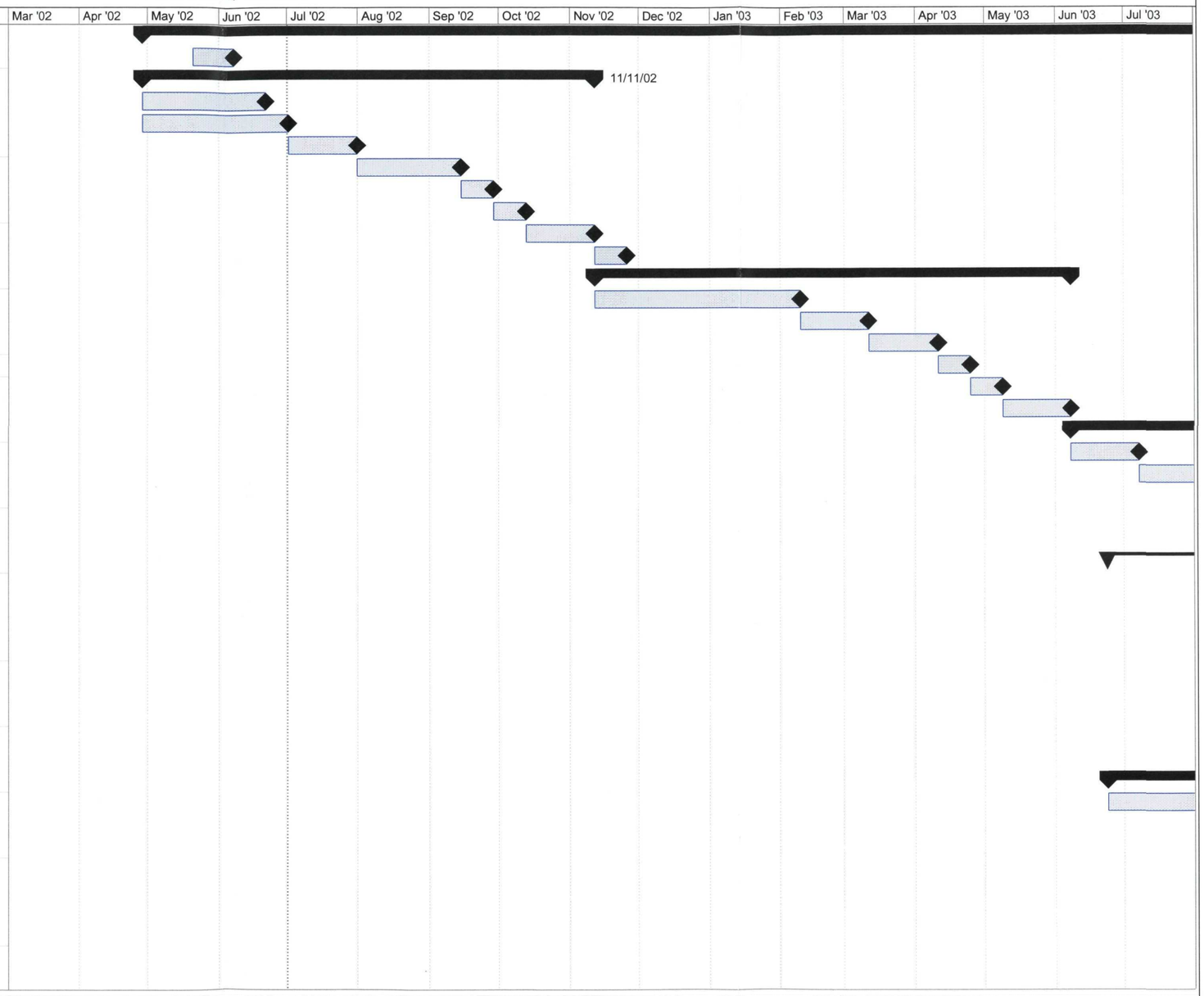
Surface Water Sampling Locations
ECC Site
Zionsville, Indiana

Figure 17

Drafter:	APR	Date:	6/26/02	Contract Number:	21-6585B	Approved:	SCH	Revised:

Figure 18
Preliminary Schedule
Augmentation of SVE System
Enviro-Chem Superfund Site
Zionsville, Indiana

ID	Task Name	Start	Finish	Duration	Predecessors
1	**ECC Additional Work**	**Mon 4/29/02**	**Sun 12/12/04**	**959 days**	
2	**CPT and Geoprobe Study**	**Tue 5/21/02**	**Fri 6/7/02**	**18 days**	
3	**Work Plan**	**Mon 4/29/02**	**Mon 11/11/02**	**197 days**	
4	Draft Work Plan to Trustees	Mon 4/29/02	Fri 6/21/02	54 days	
5	Work Plan to Agency	Mon 4/29/02	Mon 7/1/02	64 days	
6	Agency review of Work Plan	Tue 7/2/02	Wed 7/31/02	30 days	5
7	Meetings and discussions with Agency	Thu 8/1/02	Sat 9/14/02	45 days	6
8	Incorporation of Agency comments	Sun 9/15/02	Sat 9/28/02	14 days	7
9	Trustee review of revised Work Plan	Sun 9/29/02	Sat 10/12/02	14 days	8
10	Agency Approval of Work Plan	Sun 10/13/02	Mon 11/11/02	30 days	9
11	**Till Well Abandonment**	**Tue 11/12/02**	**Mon 11/25/02**	**14 days**	**10**
12	**100% Design Report**	**Tue 11/12/02**	**Sat 6/7/03**	**208 days**	
13	Draft Design Report to Trustees	Tue 11/12/02	Sun 2/9/03	90 days	10
14	Design Report to Agency	Mon 2/10/03	Tue 3/11/03	30 days	13
15	Agency Review of Design Report	Wed 3/12/03	Thu 4/10/03	30 days	14
16	Incorporation of Agency comments	Fri 4/11/03	Thu 4/24/03	14 days	15
17	Trustee Review of revised Design Report	Fri 4/25/03	Thu 5/8/03	14 days	16
18	Agency Approval of Design Report	Fri 5/9/03	Sat 6/7/03	30 days	17
19	**Bid Specifications and Contractor Procurement**	**Sun 6/8/03**	**Tue 11/18/03**	**164 days**	
20	Obtain SOQs and financial information	Sun 6/8/03	Mon 7/7/03	30 days	18
21	Preparation of Bid Specifications	Tue 7/8/03	Thu 8/21/03	45 days	20
22	Contractor Bidding	Fri 8/22/03	Sun 10/5/03	45 days	21
23	Trustee meeting/review	Mon 10/6/03	Sun 10/19/03	14 days	22
24	Contract Preparation/Award Contract	Mon 10/20/03	Tue 11/18/03	30 days	23
25	**Additional Work**	**Tue 6/24/03**	**Sun 12/12/04**	**538 days**	
26	**Slurry Wall**	Wed 11/19/03	Sat 1/17/04	60 days	24
27	Construction	Wed 11/19/03	Sat 1/17/04	60 days	
28	**Vertical SVE Well System**	Sun 1/18/04	Sun 5/16/04	120 days	27
29	Construction	Sun 1/18/04	Mon 2/16/04	30 days	27
30	Operation	Tue 2/17/04	Sun 5/16/04	90 days	29
31	**Augmented SVE Trench System**	Tue 2/17/04	Sun 12/12/04	300 days	
32	Construction - East Side	Tue 2/17/04	Sun 5/16/04	90 days	29
33	Construction - South Side	Sat 4/17/04	Tue 6/15/04	60 days	29FS+60 days
34	Operation	Wed 6/16/04	Sun 12/12/04	180 days	33
35	**Permeable Reactive Gates System**	Tue 6/24/03	Mon 10/6/03	105 days	
36	Construction	Tue 6/24/03	Mon 10/6/03	105 days	29
37	**Construction Completion Report**	**Tue 10/7/03**	**Wed 3/17/04**	**163 days**	**36**
38	Draft Report to Trustees	Tue 10/7/03	Thu 11/20/03	45 days	36
39	Construction Completion Report to Agency	Fri 11/21/03	Sat 12/20/03	30 days	38
40	Agency review of Report	Sun 12/21/03	Mon 1/19/04	30 days	39
41	Incorporation of Agency comments	Tue 1/20/04	Mon 2/2/04	14 days	40
42	Trustee review of revised Report	Tue 2/3/04	Mon 2/16/04	14 days	41
43	Agency Approval of Report	Tue 2/17/04	Wed 3/17/04	30 days	42
44	***Trench & Ditch Monitoring (5 years)***	***Tue 6/15/04***	***Tue 6/15/04***	***0 days***	***33***



Project: ECC Schedule rev 6
Date: Mon 7/1/02

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline | Monthly Progress Reports

Figure 18
Preliminary Schedule
Augmentation of SVE System
Enviro-Chem Superfund Site
Zionsville, Indiana

ID	Task Name	Start	Finish	Duration
1	**ECC Additional Work**	**Mon 4/29/02**	**Sun 12/12/04**	**959 days**
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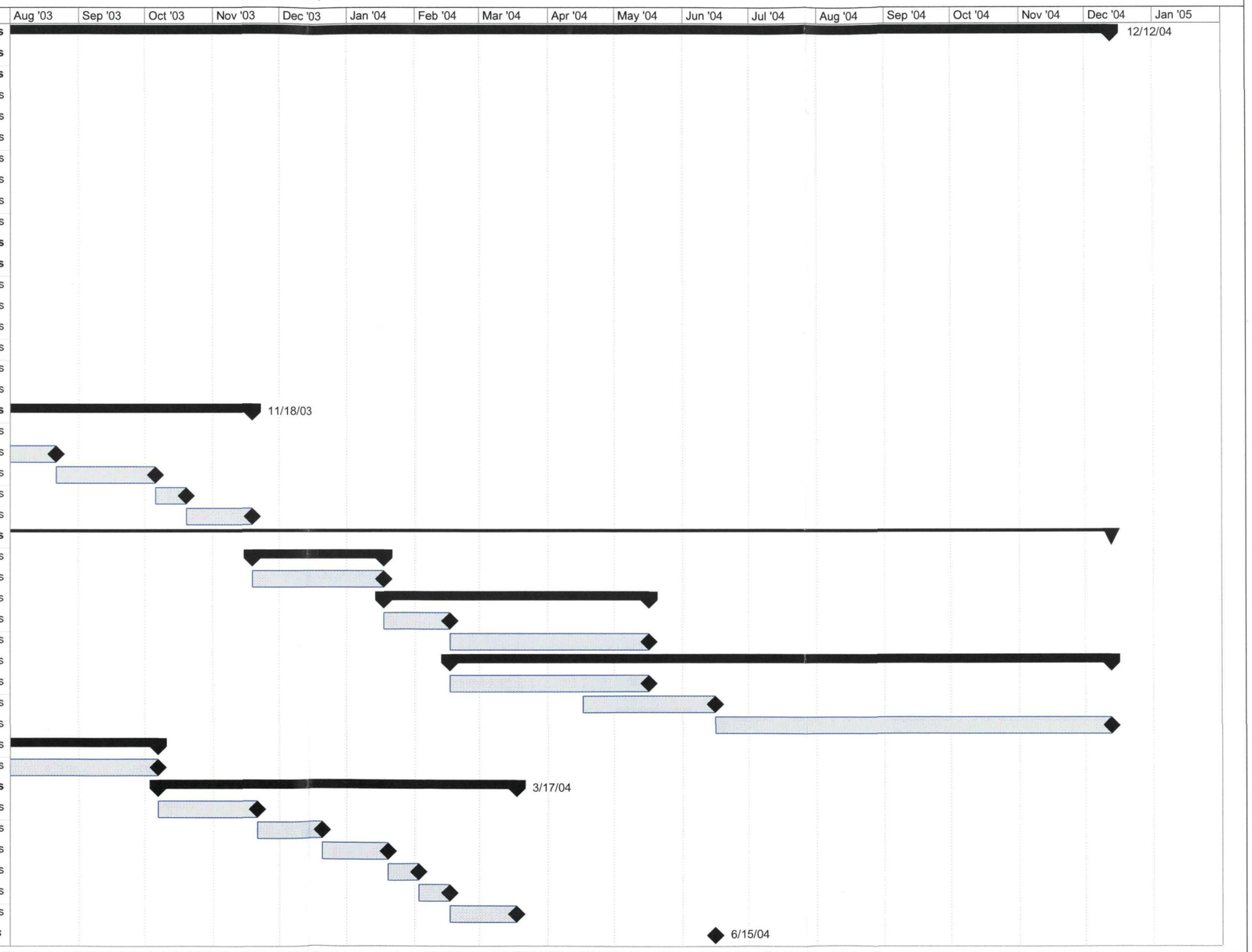
44	***Trench & Ditch Monitoring (5 years)***	***Tue 6/15/04***	***Tue 6/15/04***	***0 days***



Project: ECC Schedule rev 6
Date: Mon 7/1/02

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone | Monthly Progress Reports

APPENDIX A

Hot Spot SVE Well Performance Test

HOT SPOT SVE WELL PERFORMANCE TEST

Till water extraction performance tests will be conducted within each Hot Spot following the installation of the Hot Spot SVE wells but prior to the installation of the single- and dual-phase extraction pump systems. The performance tests will be completed to estimate the volume of till water that must be removed to dewater the sand lenses within each Hot Spot as well as the required pumping rate to maintain the dewatered conditions. The tests within each Hot Spot will be conducted at a well designated for a dual-pump extraction system.

The first part of the performance test (Test 1) within each Hot Spot will consist of pumping one well at a sufficient rate to initially cause the water level within that well to drop by several feet. The water levels within the surrounding wells located within that Hot Spot area will be monitored to determine the extent of dewatering. The second part of the performance test (Test 2) will include the pumping of till water until the water level in the pumping well is within one foot of the bottom of the well and the water levels within the other Hot Spot wells have stabilized. The pumping rate required to dewater the well (Test 1), the pumping rate required to maintain the dewatered condition (Test 2), the volume of water removed from the SVE well, and the time needed to dewater the well will be recorded.

If Test 2 cannot be completed due to an inability of the pumping well to dewater the well within one foot of the bottom of the well, a step drawdown test will be conducted within the well. The step drawdown test will be conducted by pumping the well at three or more successive rates, while allowing the water level within the pumping well to stabilize for each pumping rate. The step drawdown test is an alternative method to determine the pumping rate required for dewatering the Hot Spots.

The results of the performance tests will be used to verify the number of SVE wells needed, to identify the specifications for the submersible pumps for the dual-pump extraction wells, and to verify the adequacy of the existing on-Site treatment systems. Following analysis of the results, a performance test report will be prepared and submitted to the U.S. EPA and IDEM. The report will provide descriptions of the

performance test methodologies, test observations and results, and recommendations for the final SVE well configuration and components.

APPENDIX B

Soil Vapor and Water Treatment System

SOIL VAPOR AND WATER TREATMENT SYSTEM

The objective of the SVE activity is to remove VOCs and selected SVOCs (as provided herein) from the shallow till along the east, south, and southwest sides of the Site, and from the Hot Spot areas.

The SVE system consists of two 60-horse power vacuum pumps with a design vacuum of 10-inches of mercury and a design backpressure of 1.25-inches of mercury. The design airflow is 1,175 cubic feet per minute (cfm) and the design discharge temperature is less than 175° Fahrenheit (F). Prior to treatment, the vapor is cooled to increase effectiveness of the carbon units. The heat exchanger has a normal airflow of 2,400 cfm and a normal water flow of 0.75 to 7 gallons per minute (gpm).

The potential effectiveness of SVE for organics removal from the ECC soils was demonstrated during a pilot test conducted by Terra Vac in June 1988. The description of the pilot test, including the results obtained, was previously submitted to the U.S. EPA and the State of Indiana. The test showed an initial high organics extraction rate of 1.9 pounds per day per foot of SVE trench that decreased over the course of the pilot test to a steady state rate of approximately 0.25 pounds per day per foot of SVE trench.

The full-scale effectiveness of SVE has been demonstrated by the nine-foot-deep horizontal SVE trenches and by the vertical SVE well T-2. With respect to the nine-foot-deep horizontal SVE trenches, all trenches achieved compliance with the vapor standards within 25 months as verified by restart spikes over a 2-month period. With respect to T-2, the former testing well found to contain DNAPL, the extracted vapors met the vapor standards presented in Revised Exhibit A within a two-month period. Given that the augmented SVE system vapor is outside the remedial boundary, the only source of contaminants to be extracted is associated with till water and the subsequent equilibrium with the soils in contact with the granular lenses – similar to the conditions at T-2. Therefore, the time required to attain the Soil Vapor Standards for the augmented SVE system is anticipated to be, at most, three to six months once the granular lenses containing contaminated till water have been drained.

The SVE process at the ECC Site is intended to operate continuously. However, automatic shutdown of the system will occur in the event of an operating problem or malfunction. As noted above, the air extracted from the system will be continuously monitored by in-line instrumentation. The system will allow for the collection of samples from the individual wells and SVE trenches or the combined air stream. Sample taps will also be provided to collect vapor samples for detailed chemical analysis. The existing on-line instrumentation includes a PID and moisture analyzer. The following are conditions that will prompt a shutdown of the normal operating sequence of the SVE system:

- High vapor temperatures above the estimated acceptable range of 150°F to 180°F prior to activated carbon treatment,

- Low vapor temperatures below the estimated acceptable range of 75°F to 85°F prior to activated carbon treatment indicating relative humidity above the estimated acceptable range,

- A high water level in the water entrainment separator indicating operating problems with the liquid transfer operation,

- A high water level in water storage tank,

- High or low pressure conditions on vacuum or injection pumps under normal operating conditions, and

- Power interruptions at the Site.

During normal operation, vapor extraction may be temporarily halted to facilitate carbon vessel change out and during transfer of water from the entrainment separator to the on-Site water storage tank, or to conduct restart spike tests.

The vacuum vapor extraction system will be capable of removing water that accumulates in the SVE wells and trenches. Also, any free liquid in the extracted vapor will be separated by gravity in an entrainment separator. A level control system will be utilized to control the removal of water that accumulates in the entrainment separator as required. The existing separator tank is equipped with a vacuum breaker system which will open the tank to the atmosphere to permit water to be transferred by pump from the separator to an on-Site water storage tank as necessary.

The two existing 150,000-gallon storage tanks are sufficient to store the liquids for a period of time compatible with the selected water handling/treatment method. Periodically, the contents of the water storage tank will be removed for treatment and discharged on-Site in accordance with the substantive requirements of applicable federal and state laws or, if there is any off-Site disposal, in accordance with all requirements of federal and state laws for off-Site disposal, if any.

The exhaust from the soil vapor vacuum pump system is connected to a two-stage carbon adsorption system (primary and secondary). This system consists of two vessels in series containing granular activated carbon. The organics contained in the extracted air will be adsorbed on the activated carbon. The moisture content of the air stream will be less than 50% relative humidity, and temperatures will be maintained below 150° F by a cooling system – both conditions that allow for efficient operation of the carbon adsorption unit.

The vapor from the primary carbon vessel will be monitored frequently by an existing on-line organic analyzer. When the organic analyzer detects organic vapor in the air stream between the primary and secondary carbon vessels, the SVE system will shut down automatically to permit the removal and replacement of the "spent" primary carbon vessel. An operator will be alerted to this condition by the shut-down alarm, and will disconnect the primary carbon bed from service. The spent carbon vessel will be removed and replaced by a carbon vessel containing fresh activated carbon. The unit previously serving as the secondary carbon bed will become the primary carbon bed and the unit just placed in operation will be the secondary carbon bed. Once this switch is complete, the SVE system (i.e., vacuum pump and injection pump) will be restarted and

the system operation resumed. The arrangement of two activated carbon vessels in series (i.e., primary and secondary) will permit optimal utilization of the activated carbon, and efficient capture of the organics. The spent carbon vessels will be stored on-Site. The inlet and outlet connections to each carbon vessel will be capped and sealed appropriately. Periodically when a truckload quantity of vessels has accumulated, and at the conclusion of the SVE program, the vessels containing the spent carbon will be transported in accordance with the requirements of the applicable federal and state laws to an off-Site facility where the carbon will be regenerated by high temperature incineration, and in the process, the organics adsorbed on the carbon will be destroyed.

If the SVE system is shut down due to a combination of (a) the need to shut down the water treatment system and (b) exceedance of on-Site water storage capacity, and the shutdown of the SVE system for that reason continues for more than 5 days in any one month or for more than an average of 3 days per month (using a rolling average and for this purpose an assumed SVE operation time of 1 year), then water generated by the SVE system will be disposed of off-Site so as to allow resumption of SVE system operation. Off-Site water disposal, if any, will be performed in accordance with all requirements of federal and state laws and regulations. Off-Site water disposal will terminate as soon as practicable once the on-Site treatment system operation and storage capacity allow for resumption of on-Site water management.[16] Wastewater discharges and vapor emissions from the existing treatment systems will be monitored to ensure attainment of the standards presented in February 1997 Briefing Memorandum on ARAR Effluent Limits.

[16] Work Plans for the adjacent Third Site Superfund Site are currently being prepared and some of the activities to be conducted on that site will include the collection of ground water. It is anticipated that waters collected from Third Site will also be sent to the existing water treatment plant. The ECC Site Trustees and the Third Site Trustees will ensure that the schedules for the activities at both sites are such that treatment system capacity exceedances will not occur.