BLYMYER
ENGINEERS, INC.

July 14, 1995
BEI Job No. 94015

Ms. Jean Kawahara
Kawahara Nursery, Inc.
16550 Ashland Avenue
San Lorenzo, CA 94505

Subject: **Proposal for Additional Subsurface Investigation**
Kawahara Nursery
16550 Ashland Avenue
San Lorenzo, California

Dear Mr. Kawahara:

Blymyer Engineers, Inc. is pleased to submit this proposal to conduct additional subsurface investigation activities at the above referenced site. Blymyer Engineers completed a *Preliminary Site Assessment Phase I Subsurface Investigation* report, dated July 28, 1993 and a *Subsurface Investigation Status Report*, dated April 29, 1994. The completed reports detailed subsurface investigation activities conducted at the site following the removal of one 5,000-gallon diesel underground storage tank (UST) on December 1, 1992. The investigations completed at the site consisted of the installation of three groundwater monitoring wells (MW- 1 through MW-3), soil sample collection from the soil bores prior to well installation, collection of groundwater samples from the wells and the on-site irrigation well, and a thorough research of regulatory files relating to unauthorized releases of petroleum hydrocarbons in the vicinity of the site. The analytical results of the collected soil and groundwater samples indicated concentrations of petroleum hydrocarbons in the soil and groundwater at the site.

Blymyer Engineers also completed a *Subsurface Investigation Letter Report*, dated December 16, 1994, which detailed the results of a soil gas survey and the installation of two additional groundwater monitoring wells (MW-4 and MW-5) at the site. The results of the investigation indicated detectable concentrations of petroleum hydrocarbons in soil vapors and groundwater (MW-3) in the vicinity of the lath house located near the northwestern property line. Petroleum hydrocarbons were not detected in concentrations above analytical method reporting limits in the monitoring wells installed approximately 60 feet downgradient (MW-5) and 65 feet upgradient (MW-4) of the lath house area.

Blymyer Engineers has completed two consecutive quarters of groundwater sampling at the site which have indicated concentrations of petroleum hydrocarbons only slightly above analytical method reporting limits in monitoring well MW-5 installed downgradient of the lath house.

In a very recent discussions with you, it was revealed that there is a possibility that a gasoline UST may have been formerly located in the vicinity of the lath house. Records pertaining to the

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location and removal of the UST were not discovered during the historical record search completed for the site. However, you have indicated to us that you believe the UST has been removed.

A letter from the Alameda County Health Care Services Agency (ACHCSA), dated May 31, 1995, requested the submittal of a workplan addressing the identification of a potential source and deliniation of the extent of the petroleum hydrocarbon-contaminated groundwater detected at the site.

This proposal includes a proposed scope of work to locate a potential UST or UST backfill area and help to define the extent of the soil and groundwater petroleum hydrocarbon contamination in the vicinity of the lath house.

Scope of Work

1.0 Prepare a Workplan

A workplan detailing the proposed scope of work and Blymyer Engineers, Inc.'s Standard Operating Procedures will be prepared for submittal to the ACHCSA, as required by both the ACHCSA and the State UST Cleanup Fund Guidelines.

2.0 Update the site-specific health and safety plan

The health and safety plan formerly prepared for the site outlining the potentially hazardous work conditions and contingencies for an emergency will be updated to include the proposed additional investigation activities at the site.

3.0 Obtain permit

A permit will be obtained from the Alameda County Flood Control and Water District to drill the proposed Geoprobe® soil bores at the site.

4.0 Conduct a geophysical survey

A geophysical survey of an area approximatly 50 feet by 60 feet in the vicinity of the suspected gasoline UST will be coordinated by Blymyer Engineers. The survey will be performed by a contractor experienced in the location of USTs using magnetometer and ground penetrating radar (GPR) techniques. The GPR technique has the potential advantage of being able to locate a previously filled area, such as a backfilled UST

excavation, which could isolate the source of the subsurface petroleum hydrocarbon contamination at the site.

5.0 Drill approximately six Geoprobe® soil bores

Using a Geoprobe® sampling system, approximatly six soil bores will be advanced to approximately 20 feet below grade surface (bgs) in the vicinity of the lath house, or areas of suspected fill material noted during the GPR survey.

6.0 Field screen soil samples

Soil samples will be collected from each soil bore at encountered changes in soil lithology or at a minimum of 5-foot intervals, for field screening using a photoionization detector (PID) and for lithologic description.

7.0 Collect soil and grab groundwater samples from the soil bores for laboratory analysis

Two soil samples and one grab groundwater sample will be collected from each soil bore in accordance with Blymyer Engineers' *Standard Operating Procedure No. 4, Soil and Grab Groundwater Sampling Using Hydraulically-Driven Sampling Equipment, Revision No. 1.* Soil samples will be collected from the zone directly above the vadose/groundwater interface and from the interval displaying the highest field PID reading. The soil and grab groundwater samples will be submitted to a California-certified laboratory for analysis of Total Petroleum Hydrocarbons (TPH) as gasoline and TPH as diesel by modified EPA Method 8015 and benzene, toluene, ethylbenzene, and total xylenes (BTEX) by EPA Method 8020.

8.0 Prepare a final report

A final letter report will be prepared which will document all work performed, including a detailed summary of the soil and groundwater analytical data, a scaled map of the soil bore location with respect to existing features of the site, groundwater and soil contaminant concentration maps, soil bore logs including a detailed description of the geologic and hydrogeologic conditions at the site, investigation conclusions, and recommendations for future work at the site.

9.0 Drum soil cuttings and well development water

All soil cuttings will be stored on-site in labeled 5-gallon buckets and decontamination

water will be stored on-site in labeled Department of Transportation-approved, 55-gallon drums for later disposal by the owner. The cost for disposal of the drums is not included in this proposal. When analytical results for the contents of the drums are obtained, Blymyer Engineers can arrange for disposal on a time and materials basis. Blymyer Engineers estimates that approximately one 5-gallon bucket of soil and one 55-gallon drum of water will be generated during this phase of the investigation.

Remuneration

Blymyer Engineers will perform the above scope of work on a time and material basis, in accordance with the enclosed Hourly Fee Schedule and Field Log/Rate Sheet. All invoices shall be itemized and will include copies of invoices from subcontractors and suppliers pursuant to the UST Cleanup Fund Guideline. All invoices are due and payable within 15 days of issuance. A breakdown of the estimated project time and materials costs are as follows:

Outside Contractor Costs

GPR Survey (Terra Soft)	$ 960.00
Geoprobe Sampling (Kvilhaug Drilling)	$ 2,433.00
Laboratory (GTEL)	
Soil	$ 1,656.00
Groundwater	$ 828.00
Outside Contractor Subtotal	**$ 5,877.00**

Blymyer Engineers Costs

Expenses	$ 282.00
Workplan	$ 935.00
Project Administration	$ 280.00
Field Services	$ 1,040.00
Report Preparation	$ 1,657.00
Blymyer Engineers Subtotal	**$ 4,194.00**
4% communication Charge	$ 168.00
Total Estimated Cost	**$10,239.00**

Qualifications

All work will be conducted in accordance with the ACHCSA regulations, and the Regional Water Quality Control Board's *Tri Regional Board Staff Recommendation for Preliminary Evaluation and Investigation of Underground Tank Sites*, dated August 10, 1990 and the enclosed Blymyer Engineers' *Standard Provisions of Agreement*. Any additional work required after submittal of Blymyer Engineers' written report will be billed on a time and materials basis in accordance with the enclosed rate sheets. All work will be supervised and reviewed by a California State Certified Engineering Geologist.

If the proposed magnetometer and GPR survey detects the presence of a UST at the site, the ACHCSA will probably require the documented removal of the UST and sampling of the surrounding soil.

Assumptions

- All site work can be performed with Level D safety precautions
- The removal of a UST, if detected during the proposed magnetometer and GPR survey is not included in this proposal.

Blymyer Engineers appreciates the opportunity to present this proposal and looks forward to being of service to you. If you have any questions, please call me at (510) 521-3773.

Sincerely,

Blymyer Engineers, Inc.

By: _____
Laurie A. Buckman
Project Geologist

And: _____
Sue Black
VP, Environmental Services

Attachments:

Attachment A:	Blymyer Engineers' *Standard Operating Procedure No. 4, Soil and Grab Groundwater Sampling Using Hydraulically-Driven Sampling Equipment, Revision No. 1*
Attachment B:	Blymyer Engineers, Inc.'s Hourly Fee Schedule & Field Log/Rate Sheet
Attachment C:	Blymyer Engineers, Inc.'s *Standard Provisions of Agreement*

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FIELD LOG / RATE SCHEDULE

DATE _____ NAME _____

PROJECT NO. _____

EQUIPMENT AND MATERIALS:

Teflon Bailer	_____	Day(s)	@ 10.00	_____
Brass Tubes	_____	Tube(s)	@ 6.00	_____
Cassette PCM	_____	Cassette(s)	@ 5.00	_____
Cassette TEM	_____	Cassette(s)	@ 5.00	_____
Draeger Pump	_____	Day(s)	@ 35.00	_____
Draeger Tube-Carbon Dioxide	_____	Tube(s)	@ 15.00	_____
Draeger Tube-Carbon Monoxide	_____	Tube(s)	@ 15.00	_____
Draeger Tube-Oxygen	_____	Tube(s)	@ 25.00	_____
Drum-55 Gallon	_____	Drum(s)	@ 50.00	_____
Drum Pump/Drum Dolly	_____	Day(s)	@ 10.00	_____
Hand Auger/Hand Sampler	_____	Day(s)	@ 30.00	_____
PVC Hand Pump-1.7	_____	Day(s)	@ 30.00	_____
HEPA Cartridge	_____	Cartridge(s)	@ 15.00	_____
Hi-Flow Pump (includes calibration)	_____	Day(s)	@ 50.00	_____
Interface Probe	_____	Day(s)	@ 50.00	_____
LEL/H2S Meter	_____	Day(s)	@ 50.00	_____
Level C Protection Package (per person)	_____	Day(s)	@ 75.00	_____
Nitrile Gloves	_____	Pair	@ 5.00	_____
Organic Vapor Cartridge	_____	Cartridge(s)	@ 15.00	_____
Personal Air Sampling Pump (includes calibration)	_____	Day(s)	@ 50.00	_____
Photoionization Detector (includes calibration)	_____	Day(s)	@ 100.00	_____
Pipe and Cable Locator	_____	Day(s)	@ 50.00	_____
Radon Sample Kit	_____	Kit(s)	@ 30.00	_____
Respirator-Full Face	_____	Day(s)	@ 15.00	_____
Respirator-Half Face	_____	Day(s)	@ 5.00	_____
Survey Equipment	_____	Day(s)	@ 50.00	_____
Temp., pH, Cond. Meters	_____	Day(s)	@ 20.00	_____
Truck/Van	_____	Hour(s)	@ 8.00	_____
Tyvek Suit	_____	Suit(s)	@ 10.00	_____
Well I.D. Tags	_____	Tag(s)	@ 4.00	_____
Well Lock	_____	Lock(s)	@ 10.00	_____
Well Cap 2" (Locking)	_____	Cap(s)	@ 20.00	_____
Well Cap 4" (Locking)	_____	Cap(s)	@ 25.00	_____
Disposable Bailer	_____	Bailers(s)	@ 12.00	_____
Ground Water Filter (FF8200)	_____	Filter(s)	@ 25.00	_____
Flat Tape Water Meter	_____	Day(s)	@ 25.00	_____
Immunoassay Test-PCBs	_____	Sample(s)	@ 60.00	_____
Immunoassay Test-Petroleum Hydrocarbons	_____	Sample(s)	@ 50.00	_____
HazCat Field Screen	_____	Sample(s)	@ 15.00	_____

Revised 4/93swm

Total $_____

STANDARD PROVISIONS OF AGREEMENT

Client and consultant agree that the following provisions shall be part of their agreement:

1. This agreement shall be binding upon the heirs, executors, administrators, successors and assigns of client and consultant.

2. This agreement shall not be assigned by either client or consultant without the prior written consent of the other.

3. This agreement contains the entire agreement between client and consultant relating to the project and the provision of services to the project. Any prior agreements, promises, negotiations or representations not expressly set forth in this agreement are of no force or effect. Subsequent modifications to this agreement shall be in writing and signed by both client and consultant.

4. Consultant's waiver of any term, condition or covenant, or breach of any term, condition, or covenant, shall not constitute the waiver of any other term, condition, or covenant, or the breach of any other term, condition, or covenant.

5. If any term, condition, or covenant of this agreement is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions of this agreement shall be valid and binding on client and consultant.

6. Consultant is not responsible for delay caused by activities or factors beyond consultant's reasonable control, including but not limited to delays by reason of strikes, lockouts, work slowdowns or stoppages, accidents, acts of God, failure of client to furnish timely information or approve or disapprove consultants work promptly, faulty performance by client or other contractors or governmental agencies. When such delays beyond consultant's reasonable control occur, client agrees consultant is not responsible in damages nor shall consultant be deemed to be in default of this agreement.

7. Consultant shall not be liable for damages resulting from the actions or inactions of governmental agencies including, but not limited to, permit processing, environmental impact reports, dedications, general plans and amendments thereto, zoning matters, annexations or consolidations, use or conditional use permits, and building permits.

8. Consultant shall only act as an advisor in all governmental relations.

9. If client institutes a lawsuit against consultant for any alleged negligence, error, omission or other failure to perform, and if client fails to obtain a judgment in client's favor, or if the lawsuit is dismissed, or if judgment is rendered for consultant, client agrees to pay consultant all costs of defense, including attorneys' fees, expert witness fees, court costs and any and all other expenses of defense. Such payment shall be made immediately following dismissal of the case or upon entry of judgment.

10. If any action at law or equity, including an action for declaratory relief, is brought to enforce or interpret the provisions of this agreement, the prevailing party shall be entitled to reasonable attorney's fees, which fees may be set by the court in the same action or in a separate action brought for that purpose, in addition to any other relief to which he may be entitled.

11. Client agrees that in the event client institutes litigation to enforce or interpret the provisions of this agreement, such litigation is to be brought and adjudicated in the appropriate court in the county in which consultant's principal place of business is located, and client waives the right to bring, try or remove such litigation to any other county or judicial district.

12. All original papers, documents, drawings and other work product of consultant, and copies thereof, produced by consultant pursuant to this agreement, except documents which are required to be filed with public agencies, shall remain the property of consultant and may be used by consultant without the consent of client. Client's name will not be used in any way without prior approval.

13. All services provided pursuant to this agreement may be used by client only for the project described on the face hereof.

14. Client and consultant agree to cooperate with each other in every way on the project.

15. Upon written request, client and consultant shall execute and deliver, or cause to be executed and delivered, such additional instruments and documents which are necessary to perform the terms of the agreement.

16. This agreement shall not be construed to alter, affect or waive any lien or stop notice rights which consultant may have for the performance of services pursuant to this agreement.

17. If payment to consultant's services is to be made on behalf of client by a third party lender, client agrees that consultant shall not be required to indemnify the third party lender, in the form of an endorsement or otherwise, as a condition of receiving payment for services.

18. Consultant makes no representation concerning the estimated quantities and cost figures made in connection with maps, plans, specifications, or drawings other than that all such figures are estimates only and consultant shall not be responsible for fluctuations in cost factors.

19. Consultant makes no warranty, either express or implied, as to his findings, recommendations, specifications, or professional advice except that the work was performed pursuant to generally accepted standards of practice in effect at the time of performance.

20. Consultant makes no representations concerning soil conditions unless specifically included in writing in this agreement, and he is not responsible for any liability that may arise out of the making or failure to make soil surveys, or subsurface soil tests, or general soil testing.

21. In the event that changes are made in the plans and specifications by client or by any other person other than consultant, which changes affect consultant's work, any and all liability arising out of or resulting from such changes is waived by client against consultant, and client assumes full responsibility and liability for such changes unless client gives consultant prior written notice of such changes and consultant consents in writing to such changes. Client agrees to indemnify consultant against any and all liability, loss, costs, damages, fees of attorneys and other expenses which consultant may sustain or incur as a result of such unconsented changes.

22. Client agrees not to use or permit any other person to use plans, drawings, or other documents prepared by consultant, which plans, drawings, or other documents are not signed by consultant. Client agrees to be liable and responsible for any such use of unsigned plans, drawings, or other documents not signed by consultant and waives liability against consultant for their use.

23. Consultant has a right to complete all services agrees to be rendered pursuant to this contract. In the event this agreement is terminated before the completion of all services, unless consultant is responsible for such early termination, client agrees to release consultant from all liability for work performed, to the extent that liability arises because of early termination.

24. If client fails to pay consultant within thirty (30) days after invoices are rendered, client agrees consultant shall have the right to consider such default in payment a material breach of this entire agreement, and, upon written notice, the duties, obligations, and responsibilities of consultant under this agreement are terminated. In such event, client shall promptly pay consultant for all fees, charges, and services provided by consultant.

25. This requirement shall be made to apply continuously and not be limited to normal working hours, and client further agrees to defend, indemnify and hold consultant harmless from any and all liability, real or alleged, in connection with the performance of work on this project, excepting liability caused by work done by the consultant.

26. Client agrees to limit consultant's liability to client and to all contractors and subcontractors on the project due to professional negligence, acts, errors or omissions of consultant, to the sum of $25,000 or consultant's fees, whichever is greater.

27. Consultant agrees to maintain its standard insurance throughout performance of the work.

28. All fees and other charges will be billed monthly and shall be due at the time of billing unless otherwise specified in this agreement.

29. Client agrees that the periodic billings from consultant to client are correct, conclusive, and binding on client unless client within ten (10) days from the date of receipt of such billing, notifies consultant in writing of alleged inaccuracies, discrepancies, or errors in the billing.

30. A late payment FINANCE CHARGE will be computed at the periodic rate of 1.00% per month, which is an ANNUAL PERCENTAGE RATE of 12%, and will be applied to any unpaid balance commencing 30 days after the date of the original invoice.

31. If consultant, pursuant to this agreement, produces plans, specifications, or other documents and or performs field work, and such plans, specifications, and other documents and/or field work are required by one or more governmental agency, and one or more such governmental agency changes its ordinances, policies, procedures or requirements after the date of this agreement, any additional office or field work thereby required shall be paid for by client as extra work.

32. In the event of any increase of costs due to the granting of wage increases and/or other employee benefits to field or office employees due to the terms of any labor agreement, or rise in the cost of living, during the lifetime of this agreement, such percentage increase shall be applied to all remaining compensation.

33. Client agrees that if client requests incidental services not specified on the front hereof, client agrees to pay for all such incidental services as extra work.

34. Client shall pay the costs of checking and inspection fees, zoning and annexation application fees, assessment fees, soils engineering fees, soils testing fees, aerial topography fees, and all other permits, bond premiums, title company charges, blueprints and reproductions, and all other charges not specifically covered by the terms of this agreement.

35. In the event all or any portion of the work prepared or partially prepared by consultants be suspended, abandoned, or terminated, client shall pay consultant for all fees, charges, and services provided for the project, not to exceed any contract limit specified herein.

36. This agreement shall be governed by and construed in accordance with the laws of the State of California.

37. In the event of any litigation, client agrees to pay to consultant interest on all past due balances at the rate of twelve percent (12%) per annum.

BLYMYER
ENGINEERS, INC.

Standard Operating Procedure No. 4

Soil and Grab Groundwater Sampling Using Hydraulically-Driven Sampling Equipment

Revision No. 1

Approved By:

Michael Lewis
Quality Assurance/Quality Control Officer
Blymyer Engineers, Inc.

9/1/94
Date

Table of Contents

Attachments:

Boring and Well Construction Log
Drum Inventory Sheet

1.0 Introduction and Summary

This Standard Operating Procedure (SOP) describes methods for drilling with the use of hydraulically-driven equipment, soil sampling with the use of split-spoon samplers, and grab groundwater sampling through an open borehole. Drilling activities covered by this SOP are conducted to obtain soil and grab groundwater samples. Soil samples may be obtained to log subsurface materials, to collect samples for chemical characterization, or to collect samples for physical parameter characterization.

The soil sampling techniques described in this SOP are generally suitable for chemical characterization and physical classification tests; because a driven split-spoon sampler is employed, the resulting soil samples should generally be considered "disturbed" with respect to physical structure and may not be suitable for measuring sensitive physical parameters, such as strength and compressibility. The techniques described in this SOP generally produce a borehole with a diameter corresponding to the outside diameter of the drill rods, a relatively small annulus of remolded soil surrounding the outside diameter of the drill rods, and limited capability for cross-contamination between subsurface strata as the leading drill rods pass from contaminated strata to uncontaminated underlying strata. However, should conditions require strict measures to help prevent cross-contamination or maintain the integrity of an aquitard, consideration should be given to augmenting the procedures of this SOP, for example, by using pre-drilled and grouted isolation casing.

The procedures for hydraulically-driven soil sampling generally consist of initial decontamination, advancement of the drill rods, driving and recovery of the split-spoon sampler, logging and packaging of the soil samples, decontamination of the split-spoon and continued driving and sampling until the total depth of the borehole is reached. Withdrawal of the drill rods upon reaching the total depth requires completion of the borehole by grouting or other measures.

2.0 Equipment and Materials

- Drill rods and drive-weight assembly (hydraulic hammer or vibrator) for driving the drill rods and split-spoon sampler.

- Split-spoon sampler should conform to ASTM D 1586-Standard Method for Penetration Test and Split-Barrel Sampling of Soils, except: (1) split-spoon should be fitted with liners for collection of chemical characterization samples, and (2) allowable split-spoon diameters include nominal 1.5-inch inside diameter by nominal 2-inch outside diameter (Standard Penetration Test split-spoon), nominal 2-inch inside diameter by nominal

2.5-inch outside diameter (California Modified split-spoon), or nominal 2-1/2-inch inside diameter by nominal 3-inch outside diameter (Dames & Moore split-spoon). The split-spoon type and length of the split barrel portion of the sampler should be noted on the Boring and Well Construction Log (copy attached), as should the use of a sample catcher if employed.

- Liners should be 3- to 6-inch length, fitted with plastic end caps, brass or stainless steel, with a nominal diameter corresponding to that of the inside diameter of the split-spoon sampler. The Boring and Well Construction Log should note whether brass or stainless steel liners were used.

- Teflon® sheets, approximate 6-mil thickness, precut to a diameter or width of the liner diameter plus approximately 1 inch.

- Plastic end caps.

- Adhesiveless silicone tape.

- Disposable polyethylene bailer.

- Type I/Type II Portland cement.

- Groundwater sample containers (laboratory provided only).

- Kimwipes®, certified clean silica sand, or deionized water (for blank sample preparation).

- Sample labels, Boring and Well Construction Logs, chain-of-custody forms, drum labels, Drum Inventory Sheet (copy attached), and field notebook.

- Ziploc® plastic bags of size to accommodate a liner.

- Stainless steel spatula and knife.

- Cooler with ice or dry ice (do not use blue ice) and packing material.

- Field organic vapor monitor. The make, model, and calibration information for the field organic vapor monitor (including compound and concentration of calibration gas) should be noted in the field notebook.

- Pressure washer or steam cleaner.
- Large trough (such as a water tank for cattle), plastic-lined pit, or equivalent for decontamination of drill rod and end plug.
- Buckets and bristle brushes for decontamination of liners, split-spoon sampler, and other small gear.
- Low-residue, organic-free soap such as Liquinox® or Alconox®.
- Distilled water.
- Heavy plastic sheeting such as Visqueen.
- 55-gallon, open-top, DOT-approved, 17H drums
- 5-gallon open-top DOT-approved pails, if required.

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

3.0 Typical Procedures

The following typical procedures are intended to cover the majority of hydraulic drilling and sampling conditions. However, normal field practice requires re-evaluation of these procedures and implementation of alternate procedures upon encountering unusual or unexpected subsurface conditions. Deviations from the following typical procedures may be expected and should be noted on the Boring and Well Construction Log.

1. Investigate location of the proposed boreholes for buried utilities and obstructions. At least 48 hours before drilling, contact known or suspected utility services individually or through collective services such as "Underground Service Alert."

2. Decontaminate drill rods, split-spoon sampler, and other drilling equipment immediately prior to mobilization to the site.

3. Calibrate field organic vapor monitor equipment in accordance with the manufacturer's specifications. Note performance of the calibration in the geologist's field notebook.

4. Conduct "tail-gate" meeting and secure the work area in accordance with the Site Safety Plan.

5. Core concrete, if required.

6. Using hand-augering device, hand auger to a depth of 5 feet, if feasible, to clear underground utilities and structures not located by a utility service or on drawings. As appropriate, retain private buried utility location services or geophysical investigation services to search for buried utilities and obstructions. During initial advancement of each borehole, drill cautiously and have the driller pay particular attention to the "feel" of drilling conditions. The suspected presence of an obstruction, buried pipeline or cable, utility trench backfill, or similar may be cause for suspension of drilling, subject to further investigation.

7. Advance drill rods, or nested drill rods, to the desired sampling depth using hydraulic hammer or vibrator. Note depth interval, augering conditions, and driller's comments on Boring and Well Construction Log. Samples should be collected at intervals of 5 feet or less in homogeneous strata and at detectable changes of strata.

The sampling procedure varies depending on whether the drill rods are nesting-type. With nesting-type drill rods, the inner and outer drill rods are driven simultaneously. As they are driven, soil is forced into the lined inner drill rod. The outer drill rod is left in place and the inner drill rod is relined with sample sleeves and replaced for the next sampling segment. Where nesting-type drill rods are not used, a split-spoon sampler is used. The following sampling procedures cover sampling with a split-spoon sampler:

8. Remove drill rod and note presence of water mark on drill rod, if any. Also, monitor the top of hollow drill rods using field organic vapor monitor, as appropriate.

9. Decontaminate split-spoon sampler, liners, spatulas and knives, and other equipment that may directly contact the chemical characterization sample. Fit the split-spoon sampler with liners and attach to drill rod.

10. Lower split-spoon sampler until sampler is resting on soil. If more than 6 inches of slough exists inside the borehole, consider the conditions unsuitable and re-advance the drill rods and sampler to a new sampling depth.

11. Drive and recover split-spoon sampler. Record depth interval and sample recovery on Boring and Well Construction Log. Monitor the recovered split-spoon sampler with the field organic vapor monitor, as appropriate.

12. Remove either bottom-most or second-from-bottom liner (or both) from split-spoon sampler for purposes of chemical characterization and physical parameter testing. Observe soil at each end of liner(s) for purposes of completing sample description. Place Teflon® sheet at each end of liner, cover with plastic caps, and tape plastic caps with adhesiveless silicone tape (do not use electrical or duct tape) to further minimize potential loss of moisture or volatile compounds. Label liner(s) and place in Ziploc® bag on ice or dry ice inside cooler.

13. Extrude soil from remaining liner(s) and subsample representative 1-inch cube (approximate dimensions). Place subsample in Ziploc® bag and seal. Allow bag to equilibrate at ambient conditions for approximately 5 minutes and screen for organic vapors by inserting the probe of the field organic vapor monitor into the bag. Record depth interval, observed sample reading, and ambient (background) reading on the Boring and Well Construction Log. Discard bag and sample after use in the solid waste stockpile.

14. Classify soil sample in approximate accordance with ASTM D 2488-Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and in accordance with the Unified Soil Classification System (USCS). Description should include moisture content, color, textural information, group symbol, group name, and odor. Optional descriptions, especially if classification is performed with protective gloves, include particle angularity and shape, clast composition, plasticity, dilatancy, dry strength, toughness, and reaction with HCl. Add notes on geologic structure of sample, as appropriate. Record depth interval, field organic vapor monitor reading, USCS classification, and other notes on the Boring and Well Construction Log.

15. Repeat steps 7 through 14 until total depth of borehole is reached.

16. If a grab groundwater sample is to be collected, slowly lower bailer through the open borehole to minimize agitation and aeration of the sampled water. Transfer the grab groundwater sample into sample container(s). Label sample container(s), place packing materials around containers, and place on ice inside cooler.

17. After drill rods are removed, complete borehole according to the requirements specified elsewhere or by abandonment in accordance with section 8.0.

18. Decontaminate drill rods between boreholes and after finishing last borehole prior to drill rig leaving site.

19. Change decontamination solutions and clean decontamination trough, buckets, and brushes between boreholes.

20. Containerize decontamination liquids in 17H steel drums. Affix completed "Caution - Analysis Pending" labels to the drums.

21. Store any excess soil sample on and cover with heavy plastic sheeting. If required by local regulations or due to site constraints, store excess soil sample in 5-gallon pails. Affix completed "Caution - Analysis Pending" labels to drums.

22. Complete Drum Inventory Sheet.

23. Complete pertinent portion of the chain-of-custody form and enter descriptions of field work performed in the field notebook.

4.0 Quality Assurance and Quality Control (QA/QC)

Optional quality control sampling consists of sequential replicates, collected at an approximate frequency of one sequential replicate for every 10 collected soil samples. Sequential replicates are collected by packaging two adjacent liners of soil from a selected split-spoon drive. Each sample is labeled according to normal requirements. The replicate samples obtained in such a manner are suitable for assessing the reproducibility of both chemical and physical parameters. Interpretations of data reproducibility should recognize the potential for significant changes in soil type, even over 6-inch intervals. Accordingly, sequential replicates do not supply the same information as normally encountered in duplicate or split samples. Duplicate or split samples are better represented by the laboratory performing replicate analyses on adjacent subsamples of soil from the same liner.

Optional quality control samples may be collected to check for cross-contamination using field blanks. Field blanks may be prepared by (1) wipe sampling decontaminated liners and split-spoon with Kimwipes®, (2) pouring clean silica sand into a decontaminated split-spoon sampler that has been fitted with liners, or (3) pouring deionized water over the decontaminated liners and split-spoon sampler and collecting the water that contacts the sampling implements for aqueous analysis. Field blanks may be prepared at the discretion of the field staff given reasonable doubt regarding the efficacy of the decontamination procedures.

The comparability of the field soil classification may be checked by conducting laboratory classification tests. Requests for laboratory testing verification of the field classification should be left to the discretion of the field staff.

Field decisions that may also affect the quality of collected data include the frequency of sampling and the thoroughness of documentation. Subject to reasonable limitations of budget and schedule, the completeness, comparability, and representativeness of data obtained using this SOP will be enhanced by decreasing the sampling interval (including collecting continuous samples with depth) and increasing the level of detail for sample classification and description of drilling conditions. More frequent sampling and more detailed documentation may be appropriate in zones of chemical concentration or in areas of critical geology (for example, zones of changing strata or cross-correlation of confining strata).

As required, rinse or wipe samples may be collected from the sampling equipment before the initial sampling is conducted to establish a baseline level of contamination present on the sampling equipment. Rinse or wipe samples may also be collected at intervals of decontamination wash and rinse events or after the final decontamination wash and rinse event.

5.0 Documentation

Observations, measurements, and other documentation of the drilling and soil sampling effort should be recorded on the following:

- Sample label
- Boring and Well Construction Log
- Field notebook
- Chain-of-custody form
- Drum Inventory Sheet

Documentation should include any deviations from this SOP, notations of unusual or unexpected conditions, and documentation of the containerization and disposal of investigation-derived waste. Information to be documented on the sample label and Boring and Well Construction Log is listed below.

5.1 Sample Label

- Project name and project number
- Borehole number
- Sample depth interval (feet below ground surface), record the depth interval using notation similar to "19.2-19.7;" generally do not record just one depth "19.2" because of uncertainty regarding the location such depth corresponds to (midpoint, top, etc.)
- Sample date and sample time
- Name of on-site geologist
- Optional designation of orientation of sample within the subsurface, for example, an arrow with "up" or "top" designated

5.2 Boring Log

- Project name, project number, and name of on-site geologist
- Borehole number
- Description of borehole location, including taped or paced measurements to noticeable topographic features (a location sketch should be considered)
- Date and time drilling started and completed
- Name of drilling company and name of drilling supervisor, optional names and responsibilities of driller's helpers
- Name of manufacturer and model number of sampling rig
- Type and size of sampler, optional description of the size of drill rod
- USCS classification
- Sampling interval and total depth of borehole

- Depth at which groundwater was first encountered with the notation "initial" and any other noted changes in groundwater movement or stabilized water level
- Field organic vapor monitor readings
- Method of boring completion
- Other notations and recordings described previously in section 2.0, Equipment and Materials, and section 3.0, Typical Procedures

6.0 Decontamination

Prior to entering the site, the sampling rig and appurtenant items (drill rods, split-spoon sampler, shovels, troughs and buckets, driller's stand, etc.) should be decontaminated by steam cleaning or pressure washing. Between each borehole, appurtenant items that contacted downhole soil (essentially all appurtenant items including drill rod, split-spoon sampler, shovels, troughs, and buckets, etc.) should be decontaminated by steam cleaning or pressure washing. The sampling rig should be steam cleaned or pressured washed as a final decontamination event. On-site decontamination should be conducted within the confines of a trough or lined pit to temporarily contain the wastewater. Between each borehole and prior to demobilization, the trough or lined pit should be decontaminated by steam cleaning or pressure washing. If a rack or other support is used to suspend appurtenant items over the trough or lined pit during decontamination, only the rack or other support needs to be decontaminated between boreholes.

Prior to collection of each sample, the split-spoon sampler, liners, sample catcher, spatulas and knives, and other equipment or materials that may directly contact the sample should be decontaminated. Decontamination for these items should consist of a soap wash (Alconox®, Liquinox®, or other organic-free, low-residue soap), followed by a clean water rinse. If testing for metals, a final rinse of deionized water should be conducted. Wastewater should be temporarily contained.

Between each borehole, buckets and brushes should be decontaminated by steam cleaning or pressure washing. Before installation of each borehole is begun, fresh decontamination solutions should be prepared. Decontaminated equipment should be kept off of the ground surface. Cleaned equipment should be placed on top of plastic sheeting, which is replaced after completion of each borehole, or on storage racks.

More rigorous decontamination procedures may be employed if necessary to meet sampling or QA/QC requirements.

7.0 Investigation-Derived Waste

Wastes resulting from the activities of this SOP may include excess soil samples, decontamination liquids, and miscellaneous waste (paper, plastic, gloves, bags, etc.).

Solid waste from each borehole should be placed on and covered with heavy plastic sheeting or containerized in DOT-approved 5-gallon pails. Solids from multiple boreholes may be combined within a single stockpile if field observations (presence or absence of chemical staining and field organic vapor monitoring) indicate the solids are similarly uncontaminated or similarly contaminated. Given sufficient space and reasonable doubt, separate stockpiles should be used for solid waste from each borehole.

Decontamination liquids for each borehole should be placed in individual 17H steel drums with completed "Caution - Analysis Pending" labels affixed. Liquids from multiple boreholes may be combined, subject to the same limitations as solids.

8.0 Borehole Abandonment

Each borehole should be completely filled with neat cement (5.5 gallons of water in proportion to one 94-pound bag of Type I/Type II Portland cement, ASTM C-150) from the bottom of the bore to grade surface. Water used to hydrate cement should be free of contaminants and organic material. Bentonite may be added to reduce shrinkage and improve fluidity. Add 3 to 5 pounds of bentonite with 6.5 gallons of water and one 94-pound bag of Type I/Type II Portland cement. The water and bentonite should be mixed first before adding the cement. The borehole should be filled from the bottom first to grade surface. A tremie pipe should be used in small diameter boreholes or in formations prone to bridging or collapse. The tremie pipe should be lifted as the cement grout is poured, but should never be lifted above the surface of the neat cement. In boreholes deeper than 50 feet, the neat cement may need to be applied with pressure.

9.0 References

Aller, L., Bennett T.W., Hackett G., Petty R.J., Lehr J.H., Sedoris H., and Nielson D.M., 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH, 1989.

American Society for Testing and Materials, 1992. ASTM Standards On Ground Water and Vadose Zone Investigations. ASTM, Philadelphia, PA, 1992.

Driscoll, F.G., 1986. Groundwater and Wells. Johnson Filtration Systems Inc., St. Paul, MN, 1986.

Neilson, D.M., 1991. Practical Handbook of Ground-Water Monitoring. Lewis Publishers, Chelsea, MI, 1991.

United States Environmental Protection Agency, 1992. RCRA Ground-Water Monitoring: Draft Guidance Document. U.S. EPA, 1992.

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BORE/WELL CONSTRUCTION LOG

BORE/WELL NO.:

ocation:	Client:	Drilling Company:
	Project Site Address:	
	BEI Job No:	Driller:
	Logged By:	License No.:
	Sampling Method:	Drilling Method:
	Started Time:	Date:
Scale: Elevation (msl):	Completed Time:	Date:

Total Bore Depth/Diameter:	Water Depth:	Initial: (▽):		Stabilized: (▽):
Total Well Depth/Diameter:	Time:			
Surface Seal Type/Completion:	Date:			

Annular Seal Type/Interval:

Seal Type/Interval:

Sand Type/Interval:

Blank Casing Type/Diameter/Interval:

Screened Casing Type/Diameter/Interval:

LITHOLOGIC DESCRIPTION	U.S. Classification/ Contact Type	Depth (ft.)	Sample Intervals (symbols)	Sample Number	Blows/6 in.	Inches Driven	Inches Recovered	PID Readings (ppm)	Screened/Blank Casing Intervals	Sand/Seal Intervals
		1								
		2								
		3								
		4								
		5								
		6								
		7								
		8								
		9								
		10								
		11								
		12								
		13								
		14								
		15								

BLYMYER ENGINEERS, INC.

BORE/WELL CONSTRUCTION LOG (continued)

BORE/WELL NO.:

Notes:

LITHOLOGIC DESCRIPTION	U.S.C. Contact Type	Depth (ft.)	Sample Interval	Sample Number	Blows/6 in.	Inches Driven	Inches Recovered	PID Readings (ppm)	Casing Intervals	Sand/Seal Intervals

KEY TO BORE/WELL CONSTRUCTION LOGS

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN NO. 200 SIEVE)	GRAVEL (MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE)	CLEAN GRAVEL WITH LESS THAN 5% FINES	GW	WELL GRADED GRAVEL, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVEL, GRAVEL-SAND MIXTURES
		GRAVEL WITH OVER 12% FINES	GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVEL, GRAVEL-SAND-CLAY MIXTURES
	SAND (MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE)	CLEAN SAND WITH LESS THAN 5% FINES	SW	WELL GRADED SAND, GRAVELLY SAND
			SP	POORLY GRADED SAND, GRAVELLY SAND
		SAND WITH OVER 12% FINES	SM	SILTY SAND, SAND-SILT MIXTURES
			SC	CLAYEY SAND, SAND-CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN NO. 200 SIEVE)	SILT AND CLAY (LIQUID LIMIT LESS THAN 50)		ML	INORGANIC SILT, ROCK FLOUR, SANDY OR CLAYEY SILT OF LOW PLASTICITY
			CL	INORGANIC CLAY OF LOW TO MEDIUM PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAY (LEAN)
			OL	ORGANIC SILT AND ORGANIC SILTY CLAY OF LOW PLASTICITY
	SILT AND CLAY (LIQUID LIMIT GREATER THAN 50)		MH	INORGANIC SILT, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOIL, ELASTIC SILT
			CH	INORGANIC CLAY OF HIGH PLASTICITY, GRAVELLY, SANDY OR SILTY CLAY (FAT)
			OH	ORGANIC CLAY, ORGANIC SILT OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

FILL MATERIALS

C		CONCRETE
F		FILL
A		ASPHALT

WELL CONSTRUCTION MATERIALS

CEMENT GROUT	
BENTONITE	
FILTER SAND	SEE ABOVE FOR CONCRETE SYMBOL

SOIL CONSISTENCY FROM DRIVE SAMPLER

NON-COHESIVE SOILS*		COHESIVE SOILS*		UNCONFINED COMPRESSIVE STRENGTH
SANDS & GRAVELS	BLOWS PER FOOT	SILTS AND CLAYS	BLOWS PER FOOT	STRENGTH TONS/SQ. FT.
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 1/4
LOOSE	4 - 10	SOFT	2 - 4	1/4 - 1/2
MED. DENSE	10 - 30	MEDIUM STIFF	4 - 8	1/2 - 1
DENSE	30 - 50	STIFF	8 - 16	1 - 2
VERY DENSE	OVER 50	VERY STIFF	16 - 32	2 - 4
		HARD	OVER 32	OVER 4

* = STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2-INCH O.D. (1-3/8-INCH I.D.) SPLIT BARREL SAMPLER 12 INCHES USING A 140-POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES AND THE NUMBER OF BLOWS ARE RECORDED FOR EACH 6-INCH INTERVAL. THE SUMMATION OF THE FINAL TWO INTERVALS IS THE STANDARD PENETRATION RESISTANCE.

SAMPLE INTERVAL SYMBOLS

	CORED/RECOVERED		CORED/RECOVERED/SAMPLED/ANALYZED
	CORED/ NO RECOVERY	N/A	NON APPLICABLE/NOT AVAILABLE
	CORED/RECOVERED/SAMPLED		

BLYMYER ENGINEERS DRUM INVENTORY FORM

Number of Drums	Date Generated	Person on-site when generated	Soil or Groundwater	Contents (Cuttings, Purge Water, Development Water, Decon Water, PPE)	% Full	Bore or Monitoring Well ID	Do Lab Results Exist for Contents?

:mon\drm\drum.inv

te Client informed? _____ All drums labeled? _____