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January 2, 2002
MFG Job No. 020255

Sharon Bell
Environmental Health Specialist I
Source Protection Programs
Tacoma-Pierce County Health Department
3629 South D Street
Tacoma, Washington 98418-6813

RE: Site Investigation Work Plan
Darling International, Inc. LUSTs Site
2041 Marc Avenue, Tacoma, Washington
Parcel Number: 0320031019

Dear Ms. Bell:

Please find enclosed a site investigation work plan for the Darling International, Inc. site located at 2041 Marc Avenue in Tacoma, Washington. The work plan was prepared in response to your request for the completion of additional investigative work at the site due to potential subsurface soil and groundwater contamination present in the vicinity of the two former underground storage tanks.

The site investigation will proceed once you have approved the proposed work plan. Please contact the undersigned at (425) 921-4000 with comments and/or questions regarding the enclosed document.

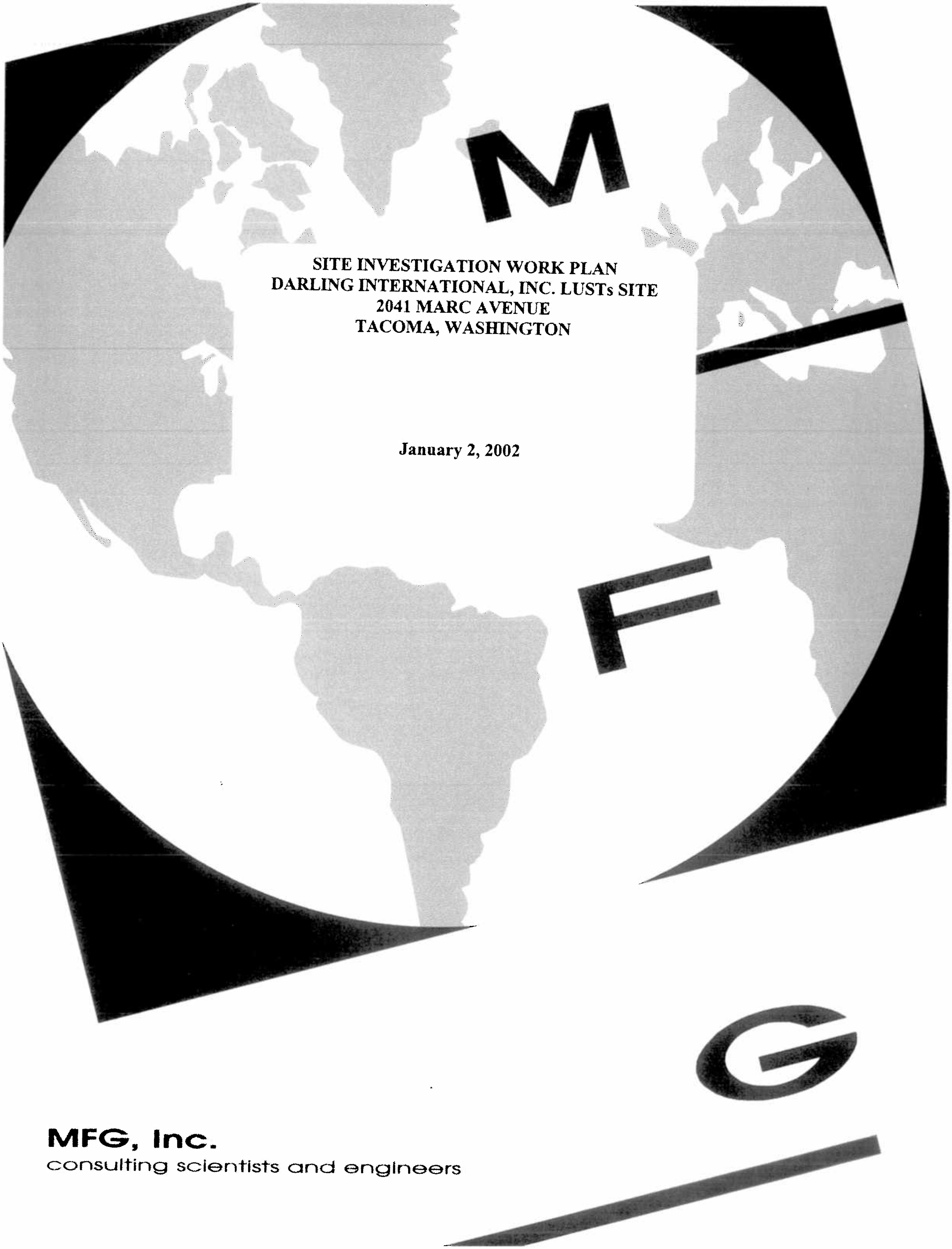
Sincerely,
MFG, INC.

Natalie J. Morrow, P.G., P.HG.
Senior Staff Hydrogeologist

NJM:bms

Enclosure

cc: Bill McMurtrey – Darling International, Inc.



SITE INVESTIGATION WORK PLAN
DARLING INTERNATIONAL, INC. LUSTs SITE
2041 MARC AVENUE
TACOMA, WASHINGTON

January 2, 2002

MFG, Inc.
consulting scientists and engineers

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

The following provides background information for the Site and a summary of previous field activities performed as a result of the removal of two underground storage tanks located at 2041 East Marc Street in Tacoma, Washington. In addition, site investigation activities are proposed to address concerns the Tacoma Pierce County Health Department (TPCHD) has with respect to possible petroleum hydrocarbons left in the subsurface after removal of the USTs at this address (see Section 2).

1.1 Site Location And Background

Darling International, Inc. (DII) owns and operates an animal by-products recycling facility (the "Site") located at 2041 East Marc Street in Tacoma, Washington (Figure 1). The DII facility, previously known as Puget Sound By-products, is located in a primarily heavy industrial area located on the Tacoma Tideflats, east of the Puyallup River and southeast of Commencement Bay of the Puget Sound. The Site is located in Township 20N, Range 3E, Section 3.

The former occupant at the Site was the Old Tacoma Tideflats Landfill (also known as the Lincoln Avenue Landfill). The landfill was constructed on top of dredged fill material. The landfill, operated by the City of Tacoma, was an unregulated dumping area for municipal waste for residents of Tacoma. It was used as a dumping area from the 1940's through approximately 1964. The recycling facility was constructed over top of the landfill. There are three buildings located at the Site. These include the office, the rendering plant, and a work shop. The Site is mostly asphalt paved with the exception of unpaved portions of the east and southeast areas of the Site where three wastewater treatments lagoons and a clarifier were previously located.

1.2 Underground Storage Tanks Removal

Two 10,000 gallon USTs were previously located at the Site. The tanks were located adjacent to the north-northeast side of the workshop (Figure 2). One tank held diesel fuel for use by company trucks and the other tank held Bunker C fuel oil for use in the facility's boiler. The two USTs and associated piping were removed on May 11, 1989 and properly disposed (WES, 1998).

Approximately 112 cubic yards of soil were excavated during the removal of the USTs (WES, 1998). The soil was stockpiled and sampled. The samples were analyzed for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylenes (BTEX). TPH results ranged from 4,672 to 8,370 mg/kg; ethybenzene was detected at 0.41 mg/kg, and xylenes at 1.93 mg/kg. No benzene or toluene was detected. The soil contained in the stockpiles was removed from the Site and properly disposed on May 23, 1989 (WES, 1998).

Soil samples were collected from the walls of the UST excavation and a grab sample was collected from groundwater in the excavation (WES, 1998). The samples were collected by the Washington Department of Ecology (Ecology). The soil samples were analyzed for TPH only and the groundwater sample was analyzed for TPH and BTEX. Soil TPH results ranged from 1,874 to 2,854 mg/kg. TPH in the groundwater sample was 4,565 mg/L and ethylbenzene and xylenes were detected at 0.5 mg/L and 0.44 mg/L, respectively. Benzene and toluene were not detected in the groundwater sample. The analytical results for soils and groundwater collected from the excavation exceeded the Washington MTCA Method A cleanup levels used at the time of the removal.

1.3 1989 Site Assessment

A subsurface investigation was performed at the Site in September 1989 by Rittenhouse-Zeman & Associates (WES, 1998). Three borings were installed during the site assessment and completed as groundwater monitoring wells in the shallow aquifer at the Site (Figure 2). Total depths of the borings ranged from 14 to 16.5 feet below ground surface (bgs) and groundwater was encountered approximately 9 feet bgs (WES, 1998). One well was completed to the south-southwest of the former USTs location (MW-4), a second to the north of the former USTs location (MW-5), and a third well was installed south of the former USTs location and on the eastern side of the workshop (MW-6).

Fill material was encountered to depths of 12 to 16.5 feet bgs during drilling. The fill material consisted of medium dense, gray to brown silty sand with some gravel followed by loose to medium dense black silty sand with wood chip waste, glass, metal, and organics. Soil material encountered below the fill material consisted of stiff to medium stiff gray silt. This soil material may be dredged fill material. The approximate groundwater flow direction in the upper groundwater zone at the Site, as inferred from these three wells, is to the west.

Soil samples were collected during drilling and analyzed for TPH. Results ranged from 141 to 645 mg/kg TPH (WES, 1998). Groundwater sampling was performed in September 1989 after completion of the wells. Initial results indicated no TPH above 10 mg/L. However continued sampling from 1990 through 1993 showed TPH concentrations in MW-4 ranged from less than 1.0 to 20 mg/L; concentrations in MW-5 ranged from less than 1.0 to 44 mg/L; and TPH concentrations in MW-6 ranged from 2.2 to 82 mg/L (WES, 1998).

Water table measurements were collected during sampling events. The groundwater flow direction in the shallow aquifer was inferred to be in a westward direction. All groundwater monitoring wells at the Site were abandoned in 1997 (WES, 1998).

Previously, three wells (MW-1, MW-2, and MW-3) were installed to monitor groundwater quality upgradient and downgradient of three wastewater treatment lagoons and one clarifier (Figure 2). The lagoons and clarifier are no longer present at the Site. The approximate groundwater flow direction of the lower groundwater zone at the Site, as inferred from these three wells, is to the south (Figure 2). These three wells, completed in the second aquifer beneath the site, have also been abandoned.

2.0 SITE INVESTIGATION

The following sections discuss the activities that will be performed to complete this site investigation.

2.1 Purpose of Investigation

The purpose of performing additional work at the Site is to: 1) evaluate the nature and extent of petroleum hydrocarbons in the subsurface soil and groundwater in the vicinity of the former USTs; 2) evaluate the direction of groundwater flow, 3) provide a final report presenting the findings of the investigation.

To meet these goals, the following activities are proposed: 1) a site visit and document review will be performed; 2) four soil borings will be installed and completed as monitoring wells in the vicinity of the former USTs location; 3) soil and ground water sampling will be performed to evaluate petroleum hydrocarbons present in subsurface soil and groundwater; 4) the location and measuring point elevation for each monitoring well will be surveyed by a licensed surveyor; and 5) a final report will be prepared and submitted to the Tacoma-Pierce County Health Department for review. The following sections provide details of the proposed work

2.2 Site Visit and Document Review

A site visit will be performed prior to performing field work to identify the location of the former USTs; observe Site conditions, physical features, and the surrounding area; and evaluate placement of borings in the vicinity of the former USTs. In addition, available documents and information that pertain to the Site will be reviewed, including the Old Tacoma Landfill, the geology and hydrogeology of the Site and vicinity, and adjacent properties.

2.3 Boring and Monitoring Well Installation

Four new soil borings will be installed and completed as groundwater monitoring wells. The anticipated monitoring well locations are presented on Figure 2. However, the exact locations of the wells will be determined in the field. It is anticipated that each soil boring will be extended to a depth of no more than 20 feet bgs. Soil boring and monitoring well installation will be supervised by an MFG hydrogeologist.

Soil borings will be logged according to MFG Standard Operating Procedure (SOP) No. 4. A PID will be used in the field to screen for VOCs following MFG SOP No. 8. In addition, two soil samples will be collected from each soil boring. Soil samples will be collected from 1) the approximate water table/vadose zone boundary and 2) the soil interval where the highest PID value was recorded in the vadose zone. Samples will be analyzed according to Model Toxics Control Act (MTCA) requirements. Each soil sample will be analyzed for BTEX, carcinogenic polynuclear aromatic hydrocarbons (PAHs), naphthalene, NWTPH-Dx, and extractable petroleum hydrocarbons (EPH). Soil samples will be placed in a stainless steel bowl and thoroughly mixed prior to transfer to laboratory provided containers. Each sample will be preserved as required by the analytical laboratory. All samples will be shipped for overnight delivery or hand delivered to North Creek Analytical in Bothell, Washington.

A groundwater monitoring well will be completed in each soil boring. Each monitoring well will be constructed in accordance with the requirements of Chapter 173-160 WAC. Each monitoring well will be completed with a 2-inch diameter 10-foot screen. The screen will consist of 0.020 slot Schedule 40 polyvinylchloride (PVC) flush-threaded screen. The monitoring well riser will be constructed of 2-inch Schedule 40 PVC flush-treaded casing. Each well will be completed as a flush mount well.

2.4 Well Development and Sampling

The newly installed monitoring wells will be developed prior to sampling and according to MFG SOP No. 7. Thereafter, one round of groundwater sampling and analysis will be completed. Field parameters of pH, specific conductivity, and temperature will be monitored during well development and sampling. Sampling will be performed according to MFG SOP No. 11 and No. 12.

Samples will be analyzed according to MTCA requirements. Each groundwater sample will be analyzed for BTEX, carcinogenic PAHs, naphthalene, NWTPH-Dx, and EPH. Samples will be placed in laboratory provided containers and preserved in the field as required by the analytical laboratory. All samples will be shipped for overnight delivery or hand delivered to North Creek Analytical in Bothell, Washington.

2.5 Surveying

The locations and measuring points of each groundwater monitoring well installed during this investigation will be surveyed by a licensed surveyor. The survey information will be used to accurately locate the wells and evaluate the groundwater flow direction at the Site.

2.6 Decontamination and Sample Handling Procedures

All non-disposable equipment will be decontaminated prior to use at the Site, between borings, and after the collection of each sample. Decontamination procedures will follow those prescribed in MFG SOP No. 16. Disposable equipment will be disposed in waste receptacle for disposal in a sanitary landfill. Drill cuttings will be placed in 55-gallon drums and disposed in an approved landfill. Purged groundwater will be placed in 55-gallon drums and will be disposed in a wastewater disposal facility or discharged to the ground surface, depending on the groundwater analytical results.

Sample handling will follow MFG SOP No. 2. In general, after samples are collected they will be placed immediately into coolers containing doubled Ziploc™ bags, or similar, filled with ice. Chain-of-custody forms will be completed in the field.

2.7 Final Report

A final report that describes the field investigation activities and presents the results of the investigation will be completed and submitted to the Tacoma-Pierce County Health Department for review.

3.0 REFERENCES

Whitman Environmental Sciences (WES), 1998. Underground Storage Tank Closure Review, Darling International, Inc. Facility, 2041 Marc Avenue, Tacoma, Washington. Dated April 17, 1998.

FIGURES

Darling International, Inc. LUSTs Site
2041 Marc Avenue, Tacoma, WA

FIGURE 1
SITE LOCATION MAP

MFG Job# 020255 January 2002

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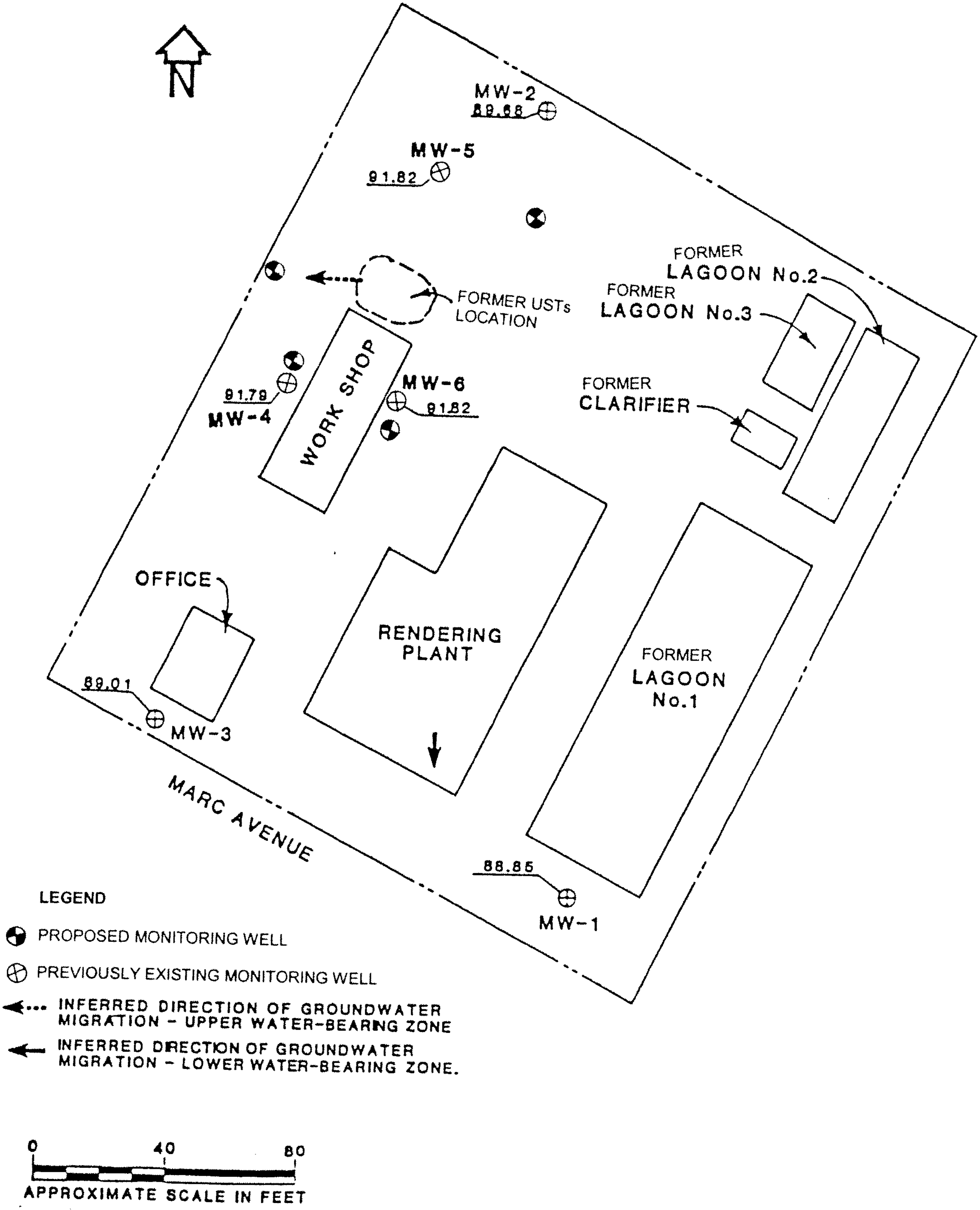
3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS 950 ft Scale: 1 : 24,000 Detail: 13-3 Datum: WGS84



GROUNDWATER ELEVATIONS BASED ON ARBITRARY DATUM.

Darling International, Inc. LUSTs Site 2041 Marc Avenue, Tacoma, WA	
FIGURE 2 **PROPOSED MONITORING WELL LOCATIONS**	
MFG Job# 020255	January 2002
MFG, Inc. consulting scientists and engineers	

APPENDIX A

MFG, Inc.

STANDARD OPERATING PROCEDURE No. 2

SAMPLE CUSTODY, PACKAGING AND SHIPMENT

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for sample custody, packaging and shipment. The procedures presented herein are intended to be general in nature. If warranted, appropriate revisions may be made when approved in writing by the MFG Project Manager.

This SOP applies to any liquid or solid sample that is being transported by the sampler, a courier or an overnight delivery service.

2.0 PROCEDURES

The objectives of this packaging and shipping SOP are: to minimize the potential for sample breakage, leakage or cross contamination; to provide for preservation at the proper temperature; and to provide a clear record of sample custody from collection to analysis.

2.1 Packaging Materials

The following is a list of materials that will be needed to facilitate proper sample packaging:

- Chain-of-Custody Record forms (see Figure SOP-2-1);
- Coolers (insulated ice chests) or other shipping containers as appropriate to sample type;
- Transparent packaging tape;
- Zip-lock type bags (note: this is used as a generic bag type, not a specific brand name);

- Protective wrapping and packaging material;
- Contained ice (packaged and sealed to prevent leakage when melted) or "Blue Ice"; and
- Chain-of-Custody seals.

2.2 Sample Custody from Field Collection to Laboratory

After samples have been collected, they will be maintained under chain-of-custody procedures. These procedures are used to document the transfer of custody of the samples from the field to the designated analytical laboratory. The same chain-of-custody procedures will be used for the transfer of samples from one laboratory to another, if required.

The field sampling personnel will complete a Chain-of-Custody Record and Request for Analysis form (CC/RA form, Figure SOP-2-1) for each separate container of samples to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. Information contained on the triplicate, carbonless form will include:

1. Project identification;
2. Date and time of sampling;
3. Sample identification;
4. Sample matrix type;
5. Sample preservation method(s);
6. Number and types of sample containers;
7. Sample hazards (if any);
8. Requested analysis(es);
9. Requested sample turnaround time;
10. Method of shipment;
11. Carrier/waybill number (if any);

12. Signature of sampling personnel;
13. Name of MFG Project Manager;
14. Signature, name and company of the person relinquishing and the person receiving the samples when custody is being transferred;
15. Date and time of sample custody transfer; and
16. Condition of samples upon receipt by laboratory.

The sample collector will cross out any blank space on the CC/RA form below the last sample number listed on the part of the form where samples are listed. The samples will be carefully packaged into shipping containers/ice chests.

The sampling personnel whose signature appears on the CC/RA form is responsible for the custody of a sample from time of sample collection until the custody of the sample is transferred to a designated laboratory, a courier, or to another MFG employee for the purpose of transporting a sample to the designated laboratory. A sample is considered to be in their custody when the custodian: (1) has direct possession of it; (2) has plain view of it; or (3) has securely locked it in a restricted access area.

Custody is transferred when both parties to the transfer complete the portion of the CC/RA form under "Relinquished by" and "Received by." Signatures, printed names, company names, and date and time of custody transfer are required. Upon transfer of custody, the MFG sampling personnel who relinquished the samples will retain the third sheet (pink copy) of the CC/RA form. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the CC/RA form. Receipts of Bills of Lading will be retained as part of the permanent documentation in the MFG project file.

2.3 Sample Custody Within Laboratory

The designated laboratory will assume sample custody upon receipt of the samples and CC/RA form. Sample custody within the analytical laboratory will be the responsibility of designated laboratory personnel. The laboratory will document the transfer of sample custody and receipt by the laboratory by signing the correct portion of the CC/RA form. Upon receipt, the laboratory sample custodian will note the condition of the samples, by checking the following items:

1. Agreement of the number, identification and description of samples received by comparison with the information on the CC/RA form; and
2. Condition of samples (no air bubbles in VOA containers; any bottle breakage; leakage, cooler temperature, etc.).

If any problems are discovered, the laboratory sample custodian will note this information on the "Laboratory Comments/Condition of Samples" section of the CC/RA form, and will notify the MFG sampling personnel or Project Manager immediately. The MFG Project Manager will decide on the final disposition of the problem samples.

The laboratory will retain the second sheet (yellow copy) of the CC/RA form and return the first sheet (white original) to MFG with the final laboratory report of analytical results. The original of the CC/RA form will be retained as part of the permanent documentation in the MFG project file.

A record of the history of the sample within the laboratory containing sample status and storage location information will be maintained in a logbook, or a computer sample tracking system, at the laboratory. The following information will be recorded for every sample access event:

1. Sample identification;
2. Place of storage;
3. Date(s) and time(s) of sample removal and return to storage;
4. Accessor's name and title;
5. Reason for access; and

6. Comments/observations (if any).

The laboratory will provide MFG with a copy of the logbook or computer file information pertaining to a sample upon request.

2.4 Sample Custody During Inter-Laboratory Transfer

If samples must be transferred from one laboratory to another, the same sample custody procedures discussed above will be followed. The designated laboratory person (sample custodian) will complete a CC/RA Record (MFG form or similar) and sign as the originator. The laboratory relinquishing the sample custody will retain a copy of the completed form. The laboratory receiving sample custody will sign the form, indicating transfer of custody, retain a copy, and return the original record to MFG with the final laboratory report of analytical results. The CC/RA Record will be retained as part of the permanent documentation in the MFG project file.

2.5 Packaging and Shipping Procedure

Be sure that all sample containers are properly labeled and all samples have been logged on the Chain-of-Custody Request for Analysis form (CC/RA, SOP-2-1) in accordance with the procedures explained above and in the MFG SOPs entitled WATER QUALITY SAMPLING and SOIL/SEDIMENT SAMPLING FOR CHEMICAL ANALYSIS.

All samples should be packed in the cooler so as to minimize the possibility of breakage, cross-contamination and leakage. Before placing the sample containers into the cooler, be sure to check all sample bottle caps and tighten if necessary. Bottles made of breakable material (e.g., glass) should also be wrapped in protective material (e.g., bubble wrap, plastic gridding, or foam) prior to placement in the cooler. Place each bottle or soil liner into two zip-lock bags to protect from cross-contamination and to keep the sample labels dry. Place the sample containers upright in the cooler. Avoid stacking glass sample bottles directly on top of each other.

If required by the method, samples should be preserved to 4°C prior to the analysis. Water ice or "blue ice" will be used to keep the sample temperatures at 4°C. The ice will be placed in two zip-lock bags if the samples are to be transported by someone other than the MFG sampler (e.g., a courier or overnight delivery service). Place the zip-lock bags of ice in between and on top of the sample containers so as to maximize the contact between the containers and the bagged ice. If the MFG sampler is transporting the samples to the laboratory shortly after sample collection, the water ice may be poured over and between the sample bottles in the cooler.

If there is any remaining space at the top of the cooler, packing material (e.g., styrofoam pellets or bubble wrap) should be placed to fill the balance of the cooler. After filling the cooler, close the top and shake the cooler to verify that the contents are secure. Add additional packaging material if necessary.

When transport to the laboratory by the MFG sampler is not feasible, sample shipment should occur via courier or overnight express shipping service that guarantees shipment tracking and next morning delivery (e.g., Federal Express Priority Overnight). In this case, place the chain-of-custody records in a zip-lock bag and place the bag on top of the contents within the cooler. Tape the cooler shut with packaging tape. Packaging tape should completely encircle the cooler, and a chain-of-custody seal should be signed and placed across the packaging tape, and across at least one of the opening points of the container.

Retain copies of all shipment records provided by the courier or overnight delivery service and maintain in the project's file.

2.6 Documentation and Records Management

Daily Field Records or a field notebook with field notes will be kept describing the packaging procedures and the method of shipments. Copies of all shipping records and chain-of-custody records will be retained in the project files.

3.0 QUALITY ASSURANCE

The Project Manager or designated QA reviewer will check and verify that documentation has been completed and filed per this procedure.

MFG, Inc.

STANDARD OPERATING PROCEDURE No. 4

SUPERVISION OF EXPLORATORY BORINGS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during the drilling and logging of exploratory borings by MFG. Exploratory borings (pilot holes) may be drilled to obtain samples of the subsurface strata or to run borehole geophysical logs. Borings will be either backfilled with grout or completed as monitoring wells or piezometers.

The procedures presented herein are intended to be general in nature. As site-specific conditions become known, appropriate modifications to the procedures may be made when approved in writing by the MFG Project Manager.

2.0 PROCEDURES

2.1 Drilling

For any site or drilling location, the selection of drilling methods will be based on: (1) availability and cost of the method; (2) suitability for the type of geologic materials at the site (e.g., consolidated, unconsolidated); and (3) potential effects on sample integrity (influence by drilling fluids and potential for cross contamination between aquifers). Some commonly used drilling methods include hollow-stem auger method, cone penetrometer testing (CPT) method, direct-push geoprobe method, hydraulic rotary method, cable tool method, or casing-hammer air rotary method. Synthetic polymer drilling fluid additive should be used only if a boring: (1) will not be sampled for chemical analysis; (2) will not be completed as a monitoring well; or (3) if cuttings return and/or borehole integrity cannot be achieved by any other method.

Exploratory borings for monitoring wells and piezometers will be drilled in a manner that will minimize the potential for cross contamination between aquifers. The actual depth of each exploratory boring will be specified by the MFG field geologist assigned to the drill rig and will be based on the intended use of the boring. No solvents or petroleum-based products will be used for lubricating any drilling equipment (rods, bit, augers, mud pit, etc.) which will contact the borehole or the drilling fluid. For air rotary drilling, an air filter will be installed between the air compressor and the drill pipe to intercept oil droplets.

The drilling equipment in which fluid (including air) circulates, including drive samplers and bits, will be thoroughly steam cleaned before and after drilling of each exploratory boring. Only clean, potable water from a municipal supply will be used as makeup water for drilling fluid and for decontamination of drilling equipment. An acid rinse (e.g., 0.1 N HCl) or solvent rinse (e.g., methanol or hexane) may be used to supplement these procedures if tarry or oily deposits are encountered during drilling. Drilling equipment cleaned in this manner will be thoroughly steam cleaned prior to reuse or leaving the site.

To ensure that the specified equipment has been provided by the drilling contractor, prior to drilling the MFG field geologist will measure and record the outside diameter of the drill bit or augers and, when using the hollow stem auger method, the inside diameter of the augers.

During drilling, the MFG field geologist may choose to periodically measure and record the depth to water within the drill casing. The position of the lead drill casing will be recorded each time a water level measurement is taken. When the total depth of a boring is reached, the water level within the drill casing will be measured.

If the boring is to be completed as a monitoring well or a piezometer, the final borehole diameter will be sufficiently large to allow placement of a specified type and size of well casing, screen and filter pack. The MFG field geologist will measure and record the total depth of the final borehole at the completion of drilling.

The MFG field geologist shall specify to the driller the penetration rate, depth of soil sample collection, method of sample retrieval, and any other matters which pertain to the satisfactory completion of the exploratory borings.

Soil cuttings and drilling fluid generated during drilling should be temporarily stored in steel drums or other approved containers. Final disposal of the soil cuttings and drilling fluid will be conducted in accordance with all legal requirements and with procedures discussed in the MFG SOP entitled STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK.

2.2 Sampling and Logging

Representative samples of cores and/or drill cuttings may be obtained and evaluated. A detailed lithologic log of these samples should be made.

Selected samples may be retained for further physical analysis. Soil samples may also be obtained for chemical analysis. Sample collection and preservation for chemical analysis will be in accordance with the MFG SOP entitled SOIL/SEDIMENT SAMPLING FOR CHEMICAL ANALYSIS. Selected samples that illustrate specific geologic features may be retained and shall be labeled with boring number and appropriate sample interval.

2.2.1 Obtaining Samples

When samples are collected, they should be obtained by one or both of the following methods described below.

A. Coring -- Cores will be collected from selected intervals of the exploratory borings. Core barrels, Pitcher tubes, modified California drive samplers or other split-spoon drive samplers will be used to obtain the soil cores. The MFG field geologist will carefully record on a boring log information which applies to the coring, such as rate of penetration, coring smoothness, core recovery, intervals of core loss, zones of lost circulation of drilling fluid, hammer weight, drop length and blow counts, as appropriate to the drilling method.

Cores may be retained for future examination and/or preserved for chemical or geotechnical analysis. If they are retained, the cores will be stored and labeled to show project, boring number, date, and cored interval.

B. Collecting Cuttings -- The MFG field geologist may collect cuttings from the drilling return fluid, air return from a cyclone separator, or the auger blade for every five-foot (or more frequent) increment of the exploratory boreholes. Sampling and logging should be performed in accordance with the following procedures (Note: Items 2 through 6 do not apply to drilling methods that do not use a drilling fluid, e.g., hollow stem auger, push point sampler, etc.):

1. The height of the drilling table above ground surface, lengths of the drill bit, sub and drill collars, and length of drill rods or augers should be taken into account in calculating the depth of penetration.

2. A small-diameter, fine-mesh hand screen or a shovel may be used to obtain a sample of the cuttings from the boring by holding the sampling device directly in the flow of the drilling return fluid or cyclone separator.

3. A sample will be obtained from the drilling return fluid or cyclone separator by leaving the sampling device in place only for the brief period required to collect an adequate sampling volume.

4. The most representative cuttings samples are usually obtained whenever the driller stops advancing the hole and circulates drilling fluid or air prior to adding another joint of drill rod.

5. Keep in mind that the deeper the hole, the longer cuttings at the drill bit take to reach the surface. The travel time for cuttings to reach the surface may be estimated each time the driller adds a new length of drill rod by timing the first arrival of cuttings after fluid or air circulation is resumed. This travel time should be used along with the depth of penetration to estimate the start and finish of each sampling interval.

6. In hydraulic rotary drilling, carefully wash the cutting sample in a bucket of fresh water by slowly shaking the screen while the sample is submerged, to wash away the drilling fluid.

7. For all drilling methods, place the cutting samples on a sampling table, labeled in consecutive order. If the sample is to be retained, place the sample in a plastic or cloth sample bag labeled with the boring number and sample interval. The retained samples will later be used during preparation of a detailed lithologic log.

2.3 Logging of Boreholes

The drill-rig operator and the MFG field geologist should discuss significant changes in material penetrated by the drill bit, changes in drilling conditions, hydraulic pressure, drilling action, and drilling fluid circulation rate. The MFG field geologist will be present during drilling of exploratory borings and will observe and record such changes by time and depth. When using a drilling method that does not involve the use of a wet drilling fluid, the MFG field geologist will evaluate the relative moisture content of the samples and note zones that produce water. The MFG field geologist will record such field notes to use later in preparing a detailed lithologic log.

Core samples and selected cuttings that are collected and retained during the drilling of the exploratory borings shall be examined to evaluate the lithologic properties. A detailed lithologic log for the exploratory borings shall be completed using MFG's Log of Boring by Cuttings (Figure SOP-4-1) or Field Log of Borehole by Coring (Figure SOP-4-2). The lithologic description of the log should include soil or rock type, color, grain size, texture, hardness, degree of induration, calcareous content, indications of contamination, and other pertinent information. Color should be described using the Munsell Color Chart. Soil type should be described using the Unified Soil Classification System. When the Field Log of Borehole by Coring form is used, it shall include the method of sample collection (coring, cuttings) and the sample collection interval (Figure SOP-4-2), if any samples are collected.

2.4 Geophysical Logs

The MFG SOP entitled GEOPHYSICAL LOGGING discusses in detail the steps to be followed when performing geophysical logs of exploratory borings. Geophysical logging will be performed generally in uncased, fluid-filled boreholes. Following completion of the drilling, spontaneous potential, single-point resistance, lateral resistivity, natural gamma or other logs may be made for each exploratory boring immediately after the drilling fluid has been circulated to remove all of the cuttings. When performed, geophysical logging shall be done as quickly and efficiently as possible, while the wall of the borehole is in good condition, to minimize the possibility of trapping or entangling the downhole probes. Instruments on the logging unit should be adjusted to give the maximum definition of strata boundaries.

2.5 Sealing and Abandonment

For borings (pilot holes) not used to install a monitoring well and/or piezometer, the exploratory borings will be abandoned by sealing the hole with cement grout or other approved sealing agents. The MFG field geologist shall inspect the grout for adequate mixing prior to placement in the borehole.

If the borehole is dry and is less than 10-feet deep, the grout or other approved sealant may be poured slowly from the ground surface into the borehole. The grout should be added in one continuous pour before its initial set. If the borehole is greater than 10-feet deep, or if more than 2-feet of water is present in the borehole, the grout should be placed in one continuous pour by pumping through a tremie hose or pipe. The tremie hose or pipe initially shall be placed near the bottom of the bore hole and shall remain submerged in the grout during the entire grouting operation. Grout will continue to be pumped until return of fresh grout (uncontaminated by drilling fluid) is witnessed at the ground surface.

The preferred grout mix is one (1) sack of Type I-II Portland cement, five (5) percent by weight of powdered bentonite, per 8.5 gallons of water. If a high-yield bentonite grout (trade names Quik-Gel, Super Gel X, etc.) is used, the powdered bentonite percentage should be reduced to two (2) percent. The grout mixture may be modified to meet local regulations or site-specific conditions or specifications.

2.6 Documentation and Records Management

Field notes recorded by the MFG field geologist during the drilling of each exploratory boring shall be transferred to the log forms (Figures SOP-4-1 and SOP-4-2). The original logs shall be sent to the MFG office and placed in the MFG project file. A copy of the logs will be retained in the field file for the project. For preparation of the report, data from the field boring logs may also be transferred to another format.

3.0 QUALITY ASSURANCE

Field notes and field forms completed by the field geologist shall be reviewed by the field supervisor and the MFG Project Manager or other designated QA officer before they are placed into project files. Deviation from this SOP or a project-specific work plan shall be identified and described in field notes. The QA review will be recorded on the reviewed originals by initials of reviewer and date.

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LOG OF BORING

BORING NO.:

PAGE ____ OF ____

SITE NAME	PROJECT NO	BORING LOCATION
DRILLING CONTRACTOR	DATE STARTED	
DRILLING METHOD	DATE COMPLETED	SURFACE ELEVATION
DRILL RIG & BIT TYPE	LOGGED BY	NORTHING COORDINATE
SAMPLER TYPE	REVIEWED BY	EASTING COORDINATE

Depth (Ft)	DESCRIPTION	USCS Class	Depth (Ft)	Sampling Run (Recov.)	Sampling Blows\ Ft	PID (v-ppm)	REMARKS

WELL CONSTRUCTION SUMMARY

SITE: ______________________
PROJECT NO.: ______________________

MFG, Inc.

LOCATION: ______________
SUPERVISOR: ______________
PROJECT: ______________
STAFF: ______________

WELL: ______________________ COORDINATES: N: ________ E: ________
ELEVATION: GS: ________ TOC: ________ SEC.: ________ T: ________ R: ________

DRILLING SUMMARY:

TOTAL DEPTH: ______________________

BOREHOLE DIAMETER: ______________________

DRILLER: ______________________

RIG: ______________________

BIT(S): ______________________

DRILLING FLUID: ______________________

CONSTRUCTION TIME LOG:

	START		FINISH	
DRILLING:	DATE	TIME	DATE	TIME
GEOPHYS.LOG:				
CASING:				
FILTER PACK:				
BENTONITE:				
CEMENTING:				
OTHER:				

WELL DESIGN:

BASIS: GEOLOGIC LOG ___ GEOPHYSICAL LOG ___

CASING STRING(S):
C=CASING S=SCREEN
SND=SAND

MATERIAL(S):
CEM=CEMENT
BENT= BENTONITE

_______ - _______ _______
_______ - _______ _______ - _______
_______ - _______ _______ - _______
_______ - _______ _______ - _______
_______ - _______ _______ - _______
_______ - _______ _______ - _______

CASING: C1: ______________________
C2: ______________________
C3: ______________________
C4: ______________________

SCREEN: S1: ______________________
S2: ______________________
S3: ______________________

CENTRALIZERS: ______________________

FILTER MATERIAL: ______________________

CEMENT: ______________________

BENTONITE: ______________________

DECONTAMINATION:

COMMENTS:

MFG, Inc.

STANDARD OPERATING PROCEDURE No. 7

MONITORING WELL DEVELOPMENT

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during the development of groundwater monitoring wells. Monitoring wells must be developed before they are used to collect groundwater samples. The procedures presented are intended to be general in nature. As site-specific conditions become known, appropriate modifications of the procedures may be made when approved in writing by the MFG Project Manager.

2.0 PROCEDURES

2.1 Development Procedure

After construction of the monitoring well is complete, the well will be developed by surging, bailing and/or pumping (e.g., positive displacement hand pump, electric pump or pneumatic pump). At least 24 hours must pass between completion of grouting of the monitoring well and development to allow sufficient curing of the grout.

The total depth of the well will be measured in accordance with the procedures described in the MFG SOP entitled WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT. The presence of sediment at the bottom of the well will be checked using a stainless steel bailer or positive displacement hand pump. Water and sediment will first be removed from the bottom of the well to ensure that the entire screened interval is open for water to flow into the well. The well should be bailed or pumped until the water removed from the bottom of the well is relatively free of sediment. If a bailer is used, care must be taken to avoid breaking the bottom cap on the well casing.

After most of the sediment has been removed from the bottom of the well, a well development pump (positive displacement hand pump, electric pump or pneumatic pump) should be used to remove water from the well. Initially, the intake of the pump should be at the bottom of the well. The pump intake should be raised in two- to three-foot increments to the top of the water column after approximately one-half of a casing volume of water has been removed from each interval.

Next, a surge block constructed of non-reactive material (usually stainless steel or PVC) should be used to develop the well screen by forcing water in and out of the screened area. The surge block should be moved up and down in one-to two-foot increments creating a suction action on the upstroke and a pressure action on the downstroke. Development should begin at the top of the water column and move progressively downward to prevent the surge block from becoming sand locked. After surging to the bottom of the well, the surge block should be moved progressively upward to the top of the water column.

If necessary, water may be added to the well to facilitate surging. This water should be distilled deionized or "clean" potable municipal water. The volume of de-ionized water added to the well should be noted on the Well Development Record form (Figure SOP-7-1).

After surging, the surge block should be removed and replaced with the pump or bailer. The intake of the pump or bailer should be at the bottom of the well to remove any sediment that may have collected in the bottom of the well. The pump intake should again be raised in two- to three-foot increments to the top of the water column after approximately one-half of a casing volume of water has been removed from each interval.

During development, the pH, specific conductance and temperature of the purge water should be periodically measured and documented on a Well Development Record form. Parameter readings should be collected and noted for every casing volume of water removed from the well.

The well should be alternately surged and pumped until the field water quality parameters have stabilized to within 10% for specific conductance, 0.05 pH units for pH, and 1 °C for temperature, and the water is relatively clear and free of sediment.

Water removed during well development should be temporarily stored in steel drums, a portable storage tank or other approved storage container. Final disposal of all water generated during development procedures will be conducted in accordance with all legal requirements and with procedures discussed in the MFG SOP entitled STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK.

2.2 Documentation and Records Management

A Well Development Record will be filled out by the MFG Field Geologist for each well developed. The Well Development Record will be submitted to the MFG Project Manager. Also, the daily events and other items not covered in the Well Development Record will be entered on a Daily Field Record form in accordance with the procedures contained in the MFG SOP entitled FIELD DOCUMENTATION.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Equipment Cleaning

All reusable equipment used in developing the monitoring well should be cleaned prior to and following use. Cleaning shall be accomplished by either (1) washing with a laboratory-grade detergent/water solution, rinsing with clean, potable, municipal water, then rinsing with distilled or deionized water; or (2) steam cleaning followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with water. After final cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminant when not in use.

3.2 Records Review

The Project Manager or designated QA reviewer will check and verify that documentation has been completed and filed per this procedure.

WELL DEVELOPMENT RECORD

WELL NUMBER:

Project No: ____ Project Name: ____ PAGE ____ of ____

Date(s): ____

Developed by: ____

Measuring Point (MP) of Well: ____

Screened Interval (ft. BGL): ____

Filter Pack Interval (ft. BGL): ____

Casing Stick-Up/Down (ft.): ____

Starting Water Level (ft. BMP): ____

Total Depth (ft. BMP): ____ Water Column Height (ft.): ____

Casing Diameter (in. ID): ____ Multiplication Factor: ____

Casing Volume (gal.): ____

Water Level (ft. BMP) at End of Development: ____

Total Depth (ft. BMP) at End of Development: ____

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment:

Development:

Disposal of Discharged Water:

INSTRUMENTS (indicate make, model, i.d.):

Water Level: ____ Thermometer: ____

pH Meter: ____ Field Calibration: ____

Conductivity Meter: ____ Field Calibration: ____

Other: Field Calibration:

DEVELOPMENT MEASUREMENTS

	Purge Characteristics		Water Quality Data				Appearance			
					Specific Conductance (μmhos/cm)					
Date/ Time	Cumul.Vol. (gal)	Water Level (ft. BGL)	Temp. (□C)	pH	@ Field Temp.	@ 25□ C	Color	Turbidity & Sediment	Intake Depth (ft. BMP)	Remarks

Total Discharge (gallons): ____ Casing Volumes Removed: ____

Observations/Comments:

ABBREVIATIONS:

BMP - below measuring point	C - Celsius
BGL - below ground level	gal. - gallons
Cumul. Vol. - Cumulative volume removed	gpm - gallons per minutes
ID - Inside Diameter	in. – inches

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Well Development Form Revision 8/00

FIGURE SOP-7-1. WELL DEVELOPMENT RECORD

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STANDARD OPERATING PROCEDURE No. 8

FIELD ORGANIC VAPOR SCREENING METHODOLOGY FOR SOIL SAMPLES

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during field screening of soil samples for organic vapors using portable organic vapor meters (OVMs), such as a photoionization detector (PID) or a flame ionization detector (FID). Personnel responsible for the use of these instruments must be familiar with the manufacturer's use, calibration and maintenance instructions. The procedures presented herein are intended to be general in nature and, when warranted, appropriate revisions may be made when approved in writing by the MFG Project Manager.

2.0 PROCEDURES

2.1 Equipment List

- OVM(s) (PID and/or FID);
- OVM calibration kit (refer to instrument manufacturer's instructions; may include calibration gas, tedlar bag, regulator, connectors);
- Indelible marker (SANFORD Sharpie®, space pen, or equivalent);
- Grease Pencil; and
- One-quart, zip-lock plastic bags.

2.2 Operational Factors

Common OVM operational factors which may affect performance during field vapor screening may include, but are not limited to, the following:

2.2.1 PID

A. Photoionization lamp requires periodic cleaning/changing.

B. Moist atmospheric conditions (i.e., rain) and high relative humidity (>90%) in the sample or ambient air can "quench" the signal resulting in high readings. If the ambient temperature is less than the soil temperature, water vapor can condense in the PID ion chamber. Ideal conditions for conducting PID analyses are dry weather and ambient air temperatures greater than 50 degrees Fahrenheit (10 degrees Centigrade).

C. Dust particles may absorb ultraviolet light, which reduces the energy emitted. Constituents in the dust may ionize and cause erratic responses in PID's that do not have filters. Note that the ThermoEnvironmental Instruments Models 580A and 580B do have particulate filters.

D. Sampling from a source of limited air volume will restrict the instrument air flow and provide anomalously low instrument readings.

E. Responses may be affected by interference from nearby AC or DC power lines, transformers, high voltage equipment, or radio wave transmitters.

F. The PID does not detect methane or other alkanes, thus eliminating anomalous methane contributions to total concentration readings.

2.2.2 FID

A. Low oxygen levels can influence the instrument response or cause the flame to be extinguished.

B. Recommended ambient air temperature is greater than 40 degrees Fahrenheit (4 degrees Centigrade).

C. High winds may extinguish the flame.

D. The FID requires a relatively high sample flow rate for reliable readings. Restricting the flow rate can yield inaccurate results, erratic responses, and may extinguish the flame.

E. The FID detects the total concentration of many organic vapors and gases (methane, other alkanes and aromatics). It may yield anomalously high readings (false positives) when evaluating potential hydrocarbon contamination in situations where methane is present (i.e., wetlands, sewers, septic leach fields, decaying organic matter, etc.).

F. Hydrogen gas is required for operation.

2.3 Field Operations

OVM(s) shall be calibrated and operated according to the manufacturer's specifications to yield total organic vapors (TOV) in parts per million (ppm) by volume.

2.3.1 Calibration and Testing

Use ambient air (background) where "zero" air is called for in the calibration procedure. Calibration should be performed at least once at the beginning of each work day and in accordance with the instrument manufacturer's instructions.

1. If using a PID with a filter, verify that the particulate filter is properly inserted, and that the filter is not dirty or clogged.
2. Measure concentration of TOV in background air in vicinity of location where screening will be done. If ambient air was used as the "zero" air in the calibration procedure, the background concentration should be approximately zero.
3. Measure concentration of TOV within empty plastic zip-lock bags.
    - A. Remove three plastic zip-lock bags at random from their packaging;
    - B. For each bag: 1) open top of bag completely; 2) immediately insert OVM probe to middle of bag; and 3) record highest reading;
    - C. The average value of the TOV readings should be noted on the appropriate Field Logs.

4. Check operation of OVM(s) by holding the tip of an indelible marker, or other organic vapor source, approximately one-half inch away from the end of the OVM probe and observing for meter deflection. Any positive deflection of OVM is indicative of proper function. Verify that OVM(s) returns to background levels. This procedure should be performed periodically during the work day. Be careful not to get ink on the OVM probe.

5. Record the calibration procedure, background air readings and periodic checks of OVM operation in the Daily Field Record. The Daily Field Record is presented in the MFG SOP entitled FIELD DOCUMENTATION.

2.3.2 Operation

1. Label each plastic zip-lock bag with a grease pencil before the bag is used (it is much easier to write on the bag when it is empty and flat). Do not use an indelible marker to label the bag, as the marker ink may contain volatile organic compounds. Information written on the bag should include: 1) sample identification (including depth, if appropriate); and 2) sample collection time.

2. Fill bag one-half full with the soil sample. Seal bag immediately under ambient conditions. Do not attempt to inflate or evacuate bag while closing. Crush the sample by squeezing sample through the bag with fingers to provide greater surface area for vapor outgassing. Agitate the sample for 15 seconds. The agitation period should be consistent for all samples collected at the site in the same time period.

3. Allow headspace development for approximately 10 minutes at ambient air temperature. Where ambient temperatures are below 32 degrees Fahrenheit, the headspace development step should be performed within a heated vehicle or building. The headspace development period should be consistent for all samples collected from the site in the same time period.

4. Subsequent to headspace development, agitate the sample again for 15 seconds. While holding top of plastic zip-lock bag, press end of OVM probe into corner of zip-lock closure and hold the remainder of zip-lock area closed around probe. Keep the end of the probe at approximately the center of the airspace within the bag. Exercise care to avoid uptake of water droplets or soil particulates into the OVM probe.

5. Record the highest reading obtained with the OVM. If using a ThermoEnvironmental Instruments Models 580A or 580B PID, the response time should be less than 2 seconds. If using different instrument(s), the manufacturer's specifications should be checked for the expected response time(s).

6. After screening each sample, verify that the OVM returns to previous background ambient air levels and/or record any changes. Record OVM

measurements on a Field Log of Borehole Cuttings or Field Log of Borehole Coring or in a field notebook.

7. Discard the contents of the plastic zip-lock bag into container with other soil cuttings. Discard the zip-lock bag appropriately with other wastes.

2.4 Documentation and Record Management

Instrument calibration will be recorded with date, time and calibration results. OVM measurements for soil samples or borehole cuttings/cores will also be recorded with date, time and TOV results. This information may be included on the Daily Field Record form, Field Logs of Boreholes or in a field notebook.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

Instrument calibration results must demonstrate that the OVM is in good working condition and can provide TOV measurements within the range expected for soils at the designated sample locations. If the instrument operation is not confirmed through the calibration and testing procedure described in Section 2.3.1 then the instrument should be tagged as "Non-Operational/Defective" and repaired or replaced immediately.

MFG, Inc.

STANDARD OPERATING PROCEDURE No. 11

WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT

1.0 SCOPE AND APPLICABILTIY

This Standard Operating Procedure (SOP) describes the protocol to be followed during measurement of water levels, immiscible layer levels and depths of monitoring wells and piezometers. The procedures presented herein are intended to be general in nature and, as the work progresses and when warranted, appropriate revisions may be made when approved in writing by the MFG Project Manager.

2.0 PROCEDURES

Prior to performing water level, immiscible layer and well depth measurements, the construction details and previous measurements for each well or piezometer shall be reviewed by the MFG field geologist so any anomalous measurements may be identified. Well construction details and previous measurements shall be available in the field for review.

In general, water-level and immiscible-layer depth measurements shall be performed before groundwater is removed from the well by purging or sampling.

2.1 Equipment

Equipment that may be necessary to perform measurements (depending on measurements to be performed):

- Well/piezometer construction details
- Water-level meter
- Water Level Monitoring Record Sheet

- Inteface probe/gas-finding paste/water-finding paste
- Weighted steel surveyor's tape measuring to the nearest 1/10 foot.

2.2 Measuring Point

A measuring point (MP) shall be selected and marked for each monitoring well and piezometer in which water level measurements will be made. Generally, the MP will be the top of the well casing on the north side. The MP will be permanently marked using an indelible marker or a notch cut into the PVC casing. When the top-of-casing elevation of a monitoring well or piezometer is surveyed, the licensed surveyor shall measure the MP elevation and reference this measurement to an appropriate datum (such as feet above mean sea level).

2.3 Water Level Measurements

When water levels are measured to describe the groundwater potentionmetric surface, the water level will be measured prior to purging. All water level measurements will be recorded to the nearest hundredth of one foot. Note the instrument used for each measurement on the Water Level Monitoring Record (Figure SOP-11-1). The measurement procedures to be followed when an immiscible layer is present or suspected in a well are discussed in Section 2.3. Water levels are measured using the electric probe method, as discussed below.

An electric probe consists of a contact electrode attached to the end of an insulated electric cable, and a reel which houses an ammeter, a buzzer, or other closed circuit indicator. The indicator shows a closed circuit and flow of current when the electrode touches the water surface. The electric probes used shall be calibrated periodically by comparing the depth-to-water readings between the electric probe and a steel surveyors' tape. Calibration procedures are discussed in Part B of this section.

The procedure for measuring water levels with an electric probe is as follows:

1. Switch on.
2. Lower the electric cable into the well until the ammeter or buzzer indicates a closed circuit. Raise and lower the electric cable slightly until the shortest length of cable that gives the maximum response on the indicator is found.
3. With the cable in this fixed position, note the depth to water from the Measuring Point (MP).
4. Repeat as necessary until at least two identical duplicate measurements are obtained.

Calibration of the electric probe will be checked at regular intervals as part of regular maintenance measuring the position of the electrode to check that the calibration marks on the electric probe correspond to those on the steel surveyors tape.

2.4 Immiscible Layer Measurement and Sampling

2.4.1 Immiscible Layer Measurement

The thickness of non-aqueous phase liquid (NAPL) in a well may be measured by using (A) an interface probe, (B) gas-finding paste with a water-level meter or (C) water-finding paste with a steel surveyor's tape.

A. Use an interface probe in a similar fashion as an electric water-level probe. An interface probe may be used to measure the thickness of both a light-phase NAPL (LNAPL) and a dense-phase NAPL (sinker). Measure a light-phase NAPL prior to measuring a dense-phase NAPL.

B. Gasoline gauging paste is used for measuring LNAPL (floaters) only. Gasoline gauging paste can be used to detect petroleum hydrocarbons and other LNAPL chemicals. Using a graduated electronic water-level probe, apply a thin layer of gasoline gauging paste (Kolor-kut brand or equivalent) to the amount of tape greater than the anticipated LNAPL thickness. Make a depth to water measurement; probe buzzer/light will activate when it contacts the water (not the LNAPL). Record the depth to water from the MP then quickly reel up the tape. Record level of the LNAPL on the tape by noting where the gasoline gauging paste has changed color. This level will be the thickness of the LNAPL layer.

C. Water-finding paste is used only for LNAPLs . Using a steel surveyor's tape coated with chalk on the bottom foot, take a depth to "liquid" measurement from the measuring point (MP) of the well, as described in Section 2.2. Record the depth to "liquid" measurement. Clean and dry the steel tape and recoat the bottom calibrated foot with fresh chalk. Along one edge of the bottom calibrated foot of the steel tape, apply a thin layer of the yellow water-finding paste (Kolor-Kut brand or equivalent). Take another "depth to liquid" measurement from the MP of the well. Upon retrieving the steel tape, quickly note the depth to "liquid" marked by the wet/dry chalk interface along one edge, and the depth to water marked by the yellow/red paste interface along the other edge. Record the chalk measurement as the depth to "liquid" and the paste measurement as the depth to water. The thickness of the NAPL is the difference between these two measurements. If the two readings are identical, then there is no measurable NAPL in the well.

Record the thickness of the NAPL in the "Remarks" column of the Water Level Monitoring Record (Figure SOP-11-1). To calculate the corrected water level elevation in the presence of LNAPL, use the worksheet provided as Figure SOP-11-2.

If a light-phase NAPL (floater) is not detected using the water-finding paste, gasoline gauging paste or interface probe, but the presence of light-phase NAPL is suspected, the presence of a very thin layer or sheen (too thin to be measured) may also be checked using a bottom-filling transparent bailer. The presence of a light-phase layer is checked by lowering the bailer into the well. Care must be taken to not completely submerge the bailer. Retrieve the bailer and visually examine the air/liquid interface for the presence of an immiscible light-phase layer or sheen. Note that the transparent bailer is not to be used to measure the thickness of light-phase NAPL in a well.

The presence of a dense-phase NAPL (sinker) may also be checked next by lowering the bailer to the base of the well. Retrieve the bailer and visually examine for the presence of an immiscible, dense-phase layer. Note that the transparent bailer is not to be used to measure the thickness of dense-phase NAPL in a well.

2.4.2 Immiscible Layer Sampling

Samples of immiscible layers may be obtained with a bailer (A) or a peristaltic pump (B), if the well is shallow (i.e., depths of about 20 feet or less, depending upon the liquid).

A. Bailer Method -- A appropriate sampling bailer with a ball check valve is submerged to the desired sample depth, either directly or by suspending the bailer on a rope from a pole.

B. Peristaltic Pump Method -- The sample is collected through a section of clean, flexible Tygon (polyvinyl chloride) tubing which will not be reused. The tubing intake will be secured manually or by attaching weights. This procedure may be modified to collect the sample through a Teflon tube into a sample flask by running the pump on a vacuum.

Sample containers prepared specifically for the required analyses by the analytical laboratory or their supplier will be used for sample collection. To collect a sample in a volatile organic analysis (VOA) vial, remove the cap with Teflon-lined septum, then fill slowly (avoiding agitation) until a miniscus of NAPL (held by surface tension) extends above the top of the vial. Carefully replace the cap, then turn the vial upside down and tap gently while checking to ensure that no headspace (air bubbles) is present in the vial.

2.4.3 Sample Handling

Care should be taken to thoroughly clean the outside of the sample bottles that contain the immiscible liquids. To avoid potential cross-contamination, these samples will be kept in a designated ice chest, separate from other groundwater samples. Equipment used in immiscible layer measurement and sampling must be thoroughly decontaminated in accordance with the procedure described in Section 4.0 of this SOP. Samples will be handled in accordance with the procedures described in the MFG SOP entitled SAMPLE CUSTODY.

2.5 Well Depth Measurements

The total depth of a well shall be measured by sounding with a weighted steel surveyors' tape or other steel or fiberglass measuring tape, weighted as needed. For shallow wells, the electronic water-level probe may also be used as a measuring device. Procedures to be followed are specified below.

A. For calibration, measure the distance between the zero mark on the end of the measuring tape and the bottom of the weight to the nearest 1/10 foot at the beginning of each well depth measurement activity day, and whenever the apparatus is altered.

B. Lower a weighted tape into the well until the tape becomes slack or there is a noticeable decrease in weight, which indicates the bottom of the well. Care should be taken to lower the tape slowly to avoid damage to the bottom of the well by the weight. Raise the tape slowly until it just becomes taut, and with the tape in this fixed position, note the tape reading opposite the Measuring Point to the nearest 1/10 foot. Add the values from the distance from the end of the tape to the end of the weight together, round this number to nearest 1/10 foot, and record the resulting value as "well depth below MP" in the "Remarks" column of the Water Level Monitoring Record form.

2.6 DOCUMENTATION AND RECORDS MANAGEMENT

Water levels observed in wells selected for the groundwater level monitoring program will be tabulated on a Water Level Monitoring Record form during each monitoring period (Figure SOP-11-1). The date and time of each measurement will also be recorded on the Water Level Monitoring Record. All water level measurements shall be recorded to the nearest 1/100 foot, and all depth measurements shall be noted to the nearest 1/10 foot.

Water level data will be recorded as feet below measuring point so that water level elevations may be calculated from the depth-to-water measurement (from measuring point) and the surveyed elevation of the measuring point at each well or piezometer.

Well depth measurements may be recorded in the “Remarks” column of the Water Level Monitoring Record.

If free product is encountered during water level measurement, the measured thickness or observation shall be recorded in the "Remarks" column. Each form or, as appropriate, individual measurement data, shall be signed to indicate the originator. If LNAPL is encountered, the corrected water level elevation may be calculated using the procedures included on Figure SOP-11-2.

3.0 QUALITY CONTROL

3.1 Equipment Decontamination/Cleaning

Steel surveyors' tapes, electric well probes, and other measuring tapes shall be cleaned prior to use and after measurements in each well are completed. Cleaning shall be accomplished by either (1) washing with a laboratory-grade detergent/water solution, rinsing with clean, potable, municipal water, then rinsing with distilled or deionized water, or (2) steam cleaning followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with municipal water and then with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

3.2 Technical and Records Reviews

The project manager or designated QA reviewer will check and verify that documentation has been completed and filed per this procedure.

In addition, all calculations of water-level elevations and NAPL correction to water-level elevations must be reviewed before they are submitted to the project file and used to describe site conditions. The calculation review should be performed by technical personnel familiar with this procedure. Evidence of the completed review and any necessary corrections to calculations should also be submitted to the project file.

MFG, Inc.

STANDARD OPERATING PROCEDURE No. 12

WATER QUALITY SAMPLING

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during sampling of surface water, groundwater, stormwater or waste water. Note that the protocol for collection of non-aqueous phase liquid (NAPL) samples from monitoring wells is provided in the MFG, Inc. (MFG) SOP entitled WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT. The procedures presented herein are intended to be general in nature. Appropriate revisions may be made to accommodate site-specific conditions or project-specific protocols when they are approved in writing by the MFG Project Manager or detailed in a project work plan, sampling plan or quality assurance project plan.

2.0 PROCEDURES

2.1 Groundwater Sample Collection

Individual samples from wells will be collected as follows:

A. The depth to water, the thickness or presence of a Non-Aqueous Phase Liquid (NAPL) in a well and the total depth will be measured using the procedures discussed in the MFG SOP entitled WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT.

B. A positive displacement pump, submersible pump, and/or bailer will be used for removing the groundwater in the monitoring wells (purging). Equipment used for purging and sampling may be permanently installed (dedicated) in the monitoring wells. Care must be taken that bailers and/or tubing are constructed from materials that will not affect the sample analyses.

C. Wells will be pumped or bailed at least until the volume of water removed is equal to three casing volumes (volume of standing water in the well based upon total depth of well, the depth to water, and the well casing diameter). The purge rate must not reach a point where the recharge water is entering the well in an agitated manner. To assure that the water samples are representative of the water-yielding zone, periodic measurements of the temperature, pH, and specific conductance will be made. The sample will be collected only when the temperature, pH and specific conductance reach a relatively constant value (see Section 2.8) or after five well volumes have been removed. If the yield of the well is low such that it can be bailed or pumped dry, then the recharged groundwater in the well will be considered representative regardless of the number of casing volumes of groundwater removed, since all standing water in the well has been replaced by recharge from the water-yielding zone. If a well is purged dry, the well can be sampled upon 90% recovery or after two hours, whichever occurs first.

D. For specific projects, a low-flow purge method or "micopurge" method may be used for sample collection. Wells will be purged at a low pumping rate to minimize agitation of water in the well and minimize drawdown. The goal is to limit drawdown in the well to less than 10 percent of the length of the saturated well screen. If the initial water level is above the top of the screen, then the goal is to limit drawdown due to purging so that the water level in the well does not drop below the top of the screened interval. Wells will be purged by pumping water at a rate less than 250 mL per minute. Bailers will not be used for purging of sampling wells.

E. A sample drawn from plumbing on municipal or domestic wells will be taken at the access valve closest to the well and upstream of any water softening or chlorination input.

F. Prior to collecting samples from a well, a clean plastic apron will be placed adjacent to or around the well to prevent equipment and sample containers from coming into contact with surface materials. Alternatively, a clean field table may be set up near the well. If used, the table will be cleaned (Section 6.0) before and after use at each well.

G. Sample containers prepared specifically for the required analyses by the analytical laboratory or their supplier will be used for sample collection. Samples for volatile organic compound analyses will be collected first. To collect a sample in a volatile organic analysis (VOA) vial, remove the cap with Teflon-lined septum, then fill slowly (avoiding agitation) until a miniscus of sample water (held by surface tension) extends above the top of the vial. Carefully replace the cap, then turn the vial upside down and tap gently while checking to ensure that no headspace (air bubbles) is present in the vial.

Other glass sample bottles for semi- and non-volatile analyses should be filled to near the top. To account for slight expansion due to temperature changes, leave headspace approximately equivalent to the volume of liquid which would fill the bottle's cap. Plastic sample bottles should be filled completely. Splashing of the water in the sample container and exposure to the atmosphere shall be minimized during sampling. The container cap will be screwed on tightly immediately after filling the sample container. Sample filtration, if necessary, is discussed in Section 2.4 of this SOP.

Sample bottles that do not contain preservative should be rinsed with the sample water prior to filling.

H. Where more than one well within a specific field or site is to be sampled, the sampling sequence should begin with the well having the lowest suspected level of contamination. Successive samples should be obtained from wells with increasing suspected contamination. If the relative degree of suspected contamination at each well cannot be reasonably assumed, sampling should proceed from the perimeter of the site towards the center of the site. The sampling sequence should be arranged such that wells are sampled in order of increasing proximity to the suspected source of contamination, starting from the wells up-gradient of the suspected source.

I. Sampling activity for each monitoring well will be recorded on a Groundwater Sampling Record (example attached).

2.2 Surface Water Sample Collection

Individual samples from surface water sampling stations will be collected as follows:

A. Where multiple sampling stations exist along a moving water source (i.e., a creek or drainage channel), the downstream station will be sampled first. A moving water sample will be taken from the portion of the water with maximum flow at any given sampling station unless otherwise specified. If the sampling point is inaccessible from shore, the sampling personnel will enter the water from a point downstream of the sampling point, taking care not to disturb the water.

B. A standing water sample will be taken at a point in the body of water at least three feet from the shore, if possible, or unless otherwise specified.

C. A surface water sample will be collected according to one of the following, or similar, techniques.

   1. Direct Method -- Sample bottle is inverted, submerged to the specified depth, turned upright, removed from the water, and then capped. Add preservative, if any, after sample collection.

   2. Dipper Method -- Sample bottle or container attached to a pole is dipped in the water, raised above the water, and then capped (if actual sample bottle used).

3. Bailer Method -- A appropriate sampling bailer with a ball check valve is submerged to the desired sample depth, either directly or by suspending the bailer on a rope from a pole.

4. Syringe Method (for very shallow water) -- A disposable plastic filtering syringe may be used to collect very shallow surface water without disturbing the sediment. The syringe will be disposed of after each use.

5. Peristaltic Pump Method -- The sample is collected through a section of new, clean, flexible Tygon (polyvinylchloride) tubing. The tubing intake will be secured manually or by attaching weights. This procedure may be modified to collect the sample through a Teflon tube into a sample flask by running the pump on a vacuum.

D. The first collected water will be used to rinse the sampling equipment. Sample bottles that <u>do not</u> contain preservative should be rinsed with the sample water prior to filling. Subsequent water collected will be used to fill the analytical sample bottles until all bottles are filled. Field measurement of parameters will be taken once for each sampling station. Field parameters (pH, specific conductance, temperature, odor, turbidity, and/or sediment) will be measured from a separate container (instruments will not contact the analytical samples).

E. A stake or pole identifying the sampling station should be placed at or near the sampling station for future identification of the location. MFG personnel will record a brief description of the stake or pole location in relation to permanent landmarks, and the sampling location in relation to the stake or pole (example: stake is approximately 100 feet west along Markley Creek from Somersville Road, on north-side shore. Sampling point is 25 feet south of stake, in middle of Markley Creek). MFG personnel will include a sketch map of the sampling station in the Surface Water Sampling Record (example attached).

2.3 Sample Filtration

When required, a field-filtered water sample will be collected using a disposable, in-line 0.45 μm filter. The water sample will be pumped through the filter using a peristaltic pump and a section of Tygon (polyvinylchloride) tubing or other appropriate method. An aliquot of approximately 100 ml of sample will be run through the tubing and filter prior to collection into the sampling containers. Both the filter and tubing will be disposed of between samples.

2.4 Sample Containers and Volumes

The sample containers will be appropriate to the analytical method and will be obtained from the water analysis laboratory or other approved source. Different containers will be required for specific groups of analytes in accordance with U.S. EPA Methods, project-specific requirements, and/or other local jurisdictional guidance. The MFG sampler will confirm with the laboratory performing the analyses that appropriate bottleware and preservatives are used and ensure that a sufficient volume of sample is collected.

2.5 Sample Labeling

Sample containers will be labeled with self-adhesive tags. Each sample will be labeled with the following information using waterproof ink.

A. Project identification;

B. Sample identification;

C. Date and time samples were obtained;

D. Requested analyses and method;

E. Treatment (preservative added, filtered, etc.); and

F. Initials of sample collector(s).

2.6 Sample Preservation and Storage

If required by the project or analytical method, water samples submitted for chemical analysis will be stored at 4°C in ice-cooled, insulated containers immediately after collection. Preservation and storage methods depend on the chemical constituents to be analyzed and should be discussed with the water analysis laboratory prior to sample collection. EPA and/or other local jurisdictional requirements and/or the requirements of a project-specific plan (e.g., sampling and analysis plan, work plan, quality assurance project plan, etc.) shall be adhered to in preservation and storage of water samples.

2.7 Sample Custody

Samples shall be handled and transported according to the sample custody procedures discussed in the MFG SOP entitled SAMPLE CUSTODY. The sample collector shall document each sample on the Chain-of-Custody and Request for Analysis form (Figure SOP-2-1).

2.8 Field Measurements

Specific conductance, pH, and temperature measurements may be performed on water samples at the time of sample collection. Data obtained from these (or other) field water quality measurements will be recorded on the appropriate sampling records. Separate aliquots of water shall be used to make field measurements (i.e., sample containers for laboratory analysis shall not be reopened).

For groundwater samples, field measurement intervals will be calculated based upon the casing volume of the monitoring well so that at least four readings will be taken during the course of purging the target volume from the well (at least three casing volumes). Note that the target volume criteria does not apply if the well is purged dry. If the parameters have not stabilized after the target volume is removed from the well, field measurements and purging will continue until two consecutive readings have stabilized to within the following limits or until five casing volumes have been removed:

- Specific conductance+/-10%
- pH +/-0.05 pH units
- temperature+/-1 °C

For surface water sampling, the parameters will be measured once and recorded.

2.8.1 Temperature Measurement

Temperature will be measured directly from the water source or from a separate sample aliquot. Temperature measurements will be made with a mercury-filled thermometer, bimetallic-element thermometer, or electronic thermistor. All measurements will be recorded in degrees Celsius (°C).

2.8.2 pH Measurement

A pH measurement will be made by dipping the probe directly into the water source or into a separate sample aliquot. Prior to measurement, the container in which the field parameter sample will be collected will be acclimated to the approximate temperature of the sample. This can be accomplished by immersing the container in water removed from a well during the purging process. The pH measurement will be made as soon as possible after collection of the field parameter sample, preferably within a few minutes, using a pH electrode. The value displayed on the calibrated instrument will be recorded after the reading has stabilized. If the value falls outside of the calibrated range, then the pH meter will be recalibrated using the appropriate buffer solutions.

2.8.3 Specific Conductance Measurement

Specific conductance will be measured by dipping the probe directly into the water source or into a separate sample aliquot. The probe must be immersed to the manufacturer's recommended depth. Specific conductance will be reported in micromhos/cm at 25°C. If the meter is not equipped with an automatic temperature compensation function, then the field value will be adjusted at a later time using the temperature data and the following formula:

$SC_{25} = SC_T / [1 + \{(T - 25) \times 0.025\}]$

where: SC_{25} = specific conductance at 25°C
SC_T = specific conductance measured at temperature T (°C)
T = sample temperature (°C)

The value displayed on the calibrated instrument will be recorded after the reading has stabilized. If the value falls outside of the calibrated "range" set by the range dial on the instrument, then the range setting will be changed to a position which gives maximum definition. If the specific conductance value falls outside of the calibrated range of the conductivity standard solution, then the instrument will be recalibrated using the appropriate standard prior to measurement.

2.8.4 Equipment Calibration

Equipment used to measure field parameters will be calibrated by MFG personnel according to manufacturer's instructions. Calibration checks will be performed at least once prior to and at least once following each day of instrument use in the field and the results will be documented on the Sampling Record for each sampling station.

2.9 DOCUMENTATION

2.9.1 Groundwater Sampling Record

Each sampling event for each monitoring well will be recorded on a separate Groundwater Sampling Record form. The documentation should include the following:

A. Project identification;

B. Location identification;

C. Sample identification(s) (including quality control samples);

D. Date and time of sampling;

E. Purging and sampling methods;

F. Sampling depth;

G. Name(s) of sample collector(s);

H. Inventory of sample bottles collected including sample preservation (if any), number, and types of sample bottles;

I. Total volume of water purged;

J. Results of field measurements and observations (time and cumulative purge volume, temperature, pH, specific conductance, turbidity, sediment, color, purge rate);

K. Equipment cleaning record;

L. Description and identification of field instruments and equipment; and

M. Equipment calibration record.

When the sampling activity is completed, the Groundwater Sampling Record will be checked by the MFG Project Manager or his/her designee, and the original record will be placed in the MFG project file.

2.9.2 Surface Water Sampling Record

Each sampling event for each surface water sampling station will be recorded on a separate Surface Water Sampling Record form (Figure SOP-12-2). The documentation should include the following:

A. Project identification;

B. Location identification (sampling station);

C. Sample identification(s) (including quality control samples);

D. Date and time of sampling;

E. Description of sampling location;

F. Sampling depth below water surface;

G. Sampling method;

H. Condition of water (standing or moving);

I. Description of flow measurement method, if applicable, and any flow data;

J. Instrument calibration and cleaning record;

K. Results of field measurements and observations (time, temperature, pH, specific conductance, turbidity, sediment, color);

L. Name(s) of sample collector(s); and

M. Sketch map showing location of sampling station and permanent landmarks.

When the sampling activity is completed, the Surface Water Sampling Record will be checked by the MFG Project Manager or his/her designee, and the original record will be placed in the MFG project file.

3.0 QUALITY CONTROL

3.1 Chain-of-Custody and Request for Analysis Form

A Chain-of-Custody and Request for Analysis form (CC/RA form) will be filled out as described in the MFG SOP entitled SAMPLE CUSTODY. Sample custody procedures are discussed and the CC/RA form presented in the MFG SOP entitled SAMPLE CUSTODY, PACKAGING AND SHIPMENT.

3.2 Equipment Cleaning

Sample bottles and bottle caps will be cleaned and prepared by the analytical laboratory or their supplier using standard EPA-approved protocols. Sample bottles and bottle caps will be protected from dust or other contamination between time of receipt by MFG and time of actual usage at the sampling site.

Groundwater sampling equipment may be dedicated to a particular well at a project site. Prior to installation of this equipment, all equipment surfaces that will be placed in the well or may come in contact with groundwater will be cleaned to prevent the introduction of contaminants (refer to the MFG SOP entitled EQUIPMENT DECONTAMINATION).

Sampling equipment that will be used at multiple wells or sampling locations will be cleaned after sampling at each location is completed in accordance with the MFG SOP entitled EQUIPMENT DECONTAMINATION.

Equipment such as submersible electric pumps, which cannot be disassembled for cleaning, will be cleaned by circulating a laboratory-grade, detergent and potable water solution through the assembly, followed by clean potable water from a municipal supply, and then by distilled or deionized water. Equipment cleaning methods will be recorded on the Groundwater Sampling Record and Surface Water Sampling Record.

3.3 Records Review

The MFG Project Manager or designated QA reviewer will check and verify that documentation has been completed and filed per this procedure.

GROUNDWATER SAMPLING RECORD

WELL NUMBER:

PAGE: ____ of ____

Project No.: ____________ Project Name: ________________________________ Date: ____________

Sampling Location (well ID, etc.): ____________________

Sampled by: ____________________

Measuring Point (MP) of Well: ____________________

Screened Interval (ft. BGL): ____________________

Filter Pack Interval (ft. BGL): ____________________

Casing Stick-Up/Down (ft.): ____________________

Starting Water Level (ft. BMP): ____________________

Total Depth (ft. BMP): ________ Water Column Height (ft.): ________

Casing Diameter (in. ID): ________ Multiplication Factor: ________

Casing Volume (gal.): ______ 2X ______ 3X ______ 4X ______

Water Level (ft. BMP) at End of Purge: ____________________

Total Depth (ft. BMP) at End of Purge: ____________________

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: ________________________________

Purging: ____________________ Sampling: ____________________

Disposal of Discharged Water: ________________________________

INSTRUMENTS (indicate make, model, i.d.):

Water Level: ____________________ Thermometer: ____________________

pH Meter: ____________________ Field Calibration: ____________________

Conductivity Meter: ____________________ Field Calibration: ____________________

Other: Field Calibration:

SAMPLING MEASURMENTS

	Purge Characteristics		Water Quality Data				Appearance			
					Specific Conductance (μmhos/cm)					
Date/ Time	Cumul.Vol. (gal)	Purge Rate (gpm)	Temp (°C)	pH	@ Field Temp.	@ 25 °C	Color	Turbidity & Sediment	Intake Depth (ft. BMP)	Remarks

SAMPLE INVENTORY

Water Level (ft. BMP) Before Sampling: ____________ Recovery %: ____________ Sample Intake Depth (ft. BMP): ____________

Bottles Collected							
Date/ Time	Sample ID	Container (glass, plastic)	Quantity/ Vol.	Filtered (Y/N)	Preserved (type)	Analysis	Remarks (natural, dups, blanks, QC)

Chain-of-Custody Record No. ____________________________

ABBREVIATIONS:
BMP = below measuring point
BGL = below ground level
Cumul.Vol. = Cumulative volume removed
ID = Inside Diameter
C = Celsius
gal = gallons
gpm = gallons per minute
in. = inches

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FIGURE SOP-12-1. GROUNDWATER SAMPLING RECORD

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MFG, Inc.

STANDARD OPERATING PROCEDURE No. 16

EQUIPMENT DECONTAMINATION

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the methods to be used for the decontamination of all reusable field equipment which could become contaminated during use or during sampling. The equipment may include split spoons, bailers, trowels, shovels, hand augers or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross contamination between samples and also helps to maintain a clean working environment.

Decontamination is achieved mainly by rinsing with liquids which may include: soap and/or detergent solutions, tap water, distilled weak acid solution, and/or methanol or other solvent. Equipment may be allowed to air dry after being cleaned or may be wiped dry with chemical-free towels or paper towels if immediate re-use is necessary.

At most project sites, decontamination of equipment that is re-used between sampling locations will be accomplished between each sample collection point. Waste produced by decontamination procedures, including waste liquids, solids, rags, gloves, etc., should be collected and disposed of properly, based upon the nature of contamination. Specific details for the handling of decontamination wastes are addressed in the MFG SOP entitled STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS AND WATER GENERATED DURING FIELD WORK or may be specified by a project plan.

2.0 PROCEDURES

2.1 Responsibilities

It is the responsibility of the field sampling coordinator to ensure that proper decontamination procedures are followed and that all waste materials produced by decontamination are properly managed. It is the responsibility of the project safety officer to draft and enforce safety measures which provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of any subcontractors (i.e., drilling contractors) to follow the proper, designated decontamination procedures that are stated in their contracts and outlined in the Site-Specific Health and Safety Plan. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and ensure that any contaminants are not negligently introduced to the environment.

2.2 Supporting Materials

1. Cleaning liquids: soap and/or detergent solutions (Alconox, etc.), tap water, distilled water, methanol, weak nitric acid solution, etc.
2. Personal protective safety gear as defined in the Site-Specific Health and Safety Plan.
3. Chemical-free towels or paper towels.
4. Disposable, nitrile gloves.
5. Waste storage containers: drums, boxes, plastic bags, etc.
6. Cleaning containers: plastic and/or stainless steel pans and buckets.
7. Cleaning brushes.
8. Aluminum foil.

2.3 Methods

The extent of known contamination will determine the degree of decontamination required. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated. Decontamination procedures should account for the types of contaminants known or suspected to be present. In general, high levels of organic contaminants should include an organic solvent wash step, and high levels of metals contamination should include a weak acid rinse step.

The procedures listed below constitute the full field decontamination procedure. If different or more elaborate procedures are required for a specific project, they may be specified in sampling and analysis or work plan. Such variations in decontamination protocols may include all, part or an expanded scope of the decontamination procedure stated herein.

1. Remove gross contamination from the equipment by dry brushing, and rinse with tap water.
2. Wash with soap or laboratory-grade detergent solution.
3. Rinse with tap water.
4. Rinse with methanol (optional, for equipment potentially contaminated by organic compounds).
5. Rinse with acid solution (optional, for equipment potentially contaminated by metals).
6. Rinse with distilled or deionized water.
7. Repeat entire procedure or any parts of the procedure as necessary.
8. Air dry.

Decontaminated equipment should be stored in sealable containers, such as Ziplock-type plastic bags or cases or boxes with lids.

2.4 DOCUMENTATION

Field notes will be kept describing the decontamination procedures followed. The field notes will be recorded according to procedures described in the MFG SOP entitled FIELD DOCUMENTATION.

3.0 QUALITY CONTROL

To assess the adequacy of decontamination procedures, field rinsate blanks may be collected. The specific number of rinsate blanks will be defined in a sampling and analysis or work plan or by the MFG project manager. In general, at least one field rinsate blank should be collected per sampling event or per day.

Rinsate blanks with elevated or detected contaminants will be evaluated by the Project Manager, who will relay the results to the site workers. Such results may be indicative of inadequate decontamination procedures that require corrective actions (e.g., retraining).