APPENDIX A

MONITORING WELL PHOTOGRAPHS

photo 1

Wells W97-19A and W97-19B in background. Facing SW.

photo 2

Wells W97-19A and W97-19B. Facing SW.

Photolog

Photolog

A-1

photo 3

Well W98-20A. Facing W.

photo 4

Wells W85-7A and W85-7B. Facing N.

Photolog

WESTON SOLUTIONS

photo 5

Wells W98-21A and W98-21B. Facing W.

photo 6

Wells W85-6A and W85-6B. Facing SW.

Photolog

Photolog

A-3

photo 7

Wells W97-18A and W97-18 B. Facing E.

photo 8

Well B85-4. Facing W.

Photolog

photo 9


11. 19. 2003 16:39

Well B87-8. Facing E.

photo 10


11. 19. 2003 16:47

Wells W92-16A and W92-16B. Facing S.

Photolog

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photo 11

Well W85-2B. Facing NW.

photo 12

Wells W99-R5A & R5B.

Photolog

WESTON SOLUTIONS

Photolog

A-6

photo 13

Wells W85-3A & 3B looking west.

photo 14

Wells W85 -3A & 3B looking south.

Photolog

Photolog

A-7

photo 15

Well B85-3 looking south. Well in foreground with cover removed.

Photolog

APPENDIX B

STANDARD OPERATING PROCEDURES

RFW-R10-009	**Standard Operating Procedure for Low-flow Groundwater Sampling**
24618-00	**Operating Procedure for Hexavalent Chromium in Soil and Water Test Kit**
DR/2400 Method 8023	**Operating Procedure for Hexavalent Chromium in Water Test Kit #12710**

SOP Number: W/R10-009, Revision 0
Document Control Number: RFW153-2E-AOMY

FRONTIER HARD CHROME
STANDARD OPERATING PROCEDURE
FOR
LOW-FLOW GROUNDWATER
SAMPLING

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23 January 2004

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1.0 Scope and Applicability

The purpose of this standard operating procedure (SOP) is to describe the procedures for Weston Solutions, Inc. (Weston), Region X personnel will use for collecting groundwater samples using the low-flow (low stress) method. The purpose for the collection and analysis of groundwater samples by personnel will be detailed in site-specific Sampling and Quality Assurance Plans (SQAPs) and may include determining if concentrations of hazardous substances in groundwater exceed established action levels, confirming or identifying hazardous substances that may have impacted the environment, or determining if the concentrations of hazardous substances may present a risk to public health, welfare, or the environment.

2.0 Summary of Method

Groundwater samples collected by the low-flow method are indicative of mobile organic and inorganic substances (total and dissolved) at ambient flow conditions. This SOP emphasizes the need to minimize stress via low water-level draw downs, and low pumping rates (usually less than 0.5 liter/minute) in order to collect samples with minimal alterations to water chemistry. Drawdown within the well should also be kept to a minimal level (0.3 feet). This SOP is aimed at collecting samples from monitoring wells having a screen or open interval length of 10 feet or less by utilizing a submersible, inertial-lift, or peristaltic pump. However, this procedure is flexible and can be used in a variety of well construction and groundwater yield situations. Other groundwater sampling methods are presented in SOP No. RFW/R10-002, *Standard Operating Procedure for Groundwater and Drinking Water Sampling.* Groundwater sampling guidelines presented in EPA's publication *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers* should also be considered to assure quality samples are collected.

Samples thus obtained using the low-flow sampling procedure are suitable for analyses of groundwater contaminants [volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (pest/PCBs), metals, cyanide, and other inorganics], or other naturally occurring analytes. This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and/or DNAPLs).

3.0 Acronym List

cc	-	Cubic centimeters
CLP	-	Contract Laboratory Program
COC	-	Chain-of-custody
°C	-	Degrees Celsius
DAS	-	Delivery of Analytical Services
DNAPL	-	Dense non-aqueous phase liquids
DO	-	Dissolved oxygen
DOT	-	Department of Transportation
Dup	-	Duplicate
EPA	-	U.S. Environmental Protection Agency
ft	-	Feet
FID	-	Flame ionization detector
GPS	-	Global Positioning System

HASP	-	Health and Safety Plan
HCl	-	Hydrochloric Acid
HNO_3	-	Nitric Acid
IATA	-	International Air Transport Association
LNAPL	-	Light non-aqueous phase liquids
ml	-	Milliliter
MS/MSD	-	Matrix Spike/Matrix Spike Duplicate
NaOH	-	Sodium Hydroxide
NTU	-	Nephelometric Turbidity Unit
ORP	-	Oxidation reduction potential
OSHA	-	Occupational Safety and Health Administration
Pest/PCB	-	Pesticide/Polychlorinated Biphenyl
PE	-	Performance evaluation
PID	-	Photoionization detector
PPE	-	Personal Protective Equipment
ppm	-	Parts per million
PRP	-	Potentially Responsible Party
QA/QC	-	Quality Assurance/Quality Control
RFP	-	Request for Proposal
SDG	-	Sample Delivery Group
SOP	-	Standard Operating Procedure
SQAP	-	Sampling and Quality Assurance Plan
SVOC	-	Semivolatile Organic Compound
TDD	-	Technical Direction Document
TWP	-	Task Work Plan
µm	-	Micrometers
VOC	-	Volatile Organic Compound
Weston	-	Weston Solutions, Inc.
YSI Meter	-	Multi-Parameter Flow-Through Monitoring System Meter

4.0 Health and Safety Warnings

Personnel performing work on hazardous waste sites will follow Occupational Safety and Health (OSHA), U.S. Environmental Protection Agency (EPA), and project-specific health and safety procedures and protocols. Personnel conducting on-site low-flow groundwater sampling activities will also be performing tasks in accordance with EPA-approved site-specific SQAPs and Operating Practices.

In order to ensure the safety of personnel during sampling activities, the buddy system, periodic air monitoring (if deemed necessary in the site-specific HASP), and caution will be used throughout field activities. To minimize risks due to chemical exposure, dermal and respiratory protection may be required if air monitoring equipment (as per the site-specific HASP) indicates that the environment is unsafe. Field activities will follow the site health and safety plan (HASP), which further addresses the safety considerations of the property. Hazards identified in or around the site may include physical hazards (slips, trips, and falls). Additional potential hazards exist in association with the use of electrical generators; therefore, personnel will follow industry standards and protocols for all activities involving electrical devices.

5.0 Interferences

The primary goal of low-flow groundwater sampling is to obtain a representative sample of the groundwater at ambient flow conditions. Field personnel can compromise analysis in two primary ways: collecting a non-representative sample or cross-contamination of the sample.

When collecting groundwater samples using the low-flow method, stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. A non-representative sample can result from the collection of a sample prior to the stabilization of indicator field parameters. Cross-contamination of the sample can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary.

6.0 Personnel Qualifications

Only qualified personnel will conduct low-flow groundwater sampling. Training of field members will be provided to ensure that technical, operational, and quality requirements are understood. field personnel are trained in-house to conduct low-flow groundwater sampling activities. Training includes reviewing this SOP and other applicable SOPs and/or guidance documents, instrument calibration training, health and safety training, and “hands-on” experience conducting groundwater sampling activities with more experienced field personnel.

7.0 Apparatus and Materials

Equipment and materials used for collecting groundwater samples using the low-flow method include, but are not limited to, the following:

- Site-specific SQAP
- SOP for Low-Flow Groundwater Sampling
- Safety equipment specified in the site-specific HASP
- Field map of the site
- Monitoring well construction information (if available)
- Field logbook
- Field data sheets (for recording groundwater parameters)
- Tape measure
- Compass
- Camera and film
- Calculator
- Stop watch
- Barometer
- Keys for well cap locks
- Photoionization Detector (PID) or Flame Ionization Detector (FID) (if specified in the site-specific HASP)
- YSI 6-Series Multi-Parameter Flow-Through Monitoring System Meter (or similar instrument)
- Calibration fluids for YSI Meter

- Turbidity meter
- Calibration kit for turbidity meter
- Water level indicator
- Submersible pump (if applicable)
- Inertial-lift pump (if applicable)
- Peristaltic pump (if applicable)
- Generator
- Extension cords
- Polyethylene tubing
- Tygon tubing
- Peristaltic tubing
- In line filters
- Graduated cylinder (1 to 2 liters preferably)
- Plastic beakers (1 liter)
- Three way valves
- 5-Gallon buckets
- Decontamination fluids (supplies)/equipment (pump sprayers, brushes, etc.)
- Plastic sheeting
- Plastic tubs
- Sample containers
- pH paper
- Chain-of-custody (COC) forms and seals
- Sealable plastic bags
- Labels
- Trash bags
- Coolers and ice
- Vermiculite
- Tape (duct, packing, and strapping)

7.1 Sample Pump Selection

Submersible, inertial-lift, or peristaltic pumps with adjustable rate controls are applicable for low-flow sampling from groundwater monitoring wells. An exception is that peristaltic pumps may not be used for VOCs sampling due to possible volatiles loss due to the vacuum applied to lift the sample. Project-specific information (i.e.; data quality objectives, well construction, sampling constraints) will be evaluated during sample pump selection. Submersible pump types include pneumatic bladder or piston pumps and electric centrifugal pumps. Depending on equipment, submersible pumps are suitable for pumping at depths exceeding 200 feet. Inertial-lift pumps may be practically used to depths of 50 feet or more. The use of peristaltic pumps is generally limited to shallow depths (< 25 feet). Due to the small inside diameter, a peristaltic or small-diameter (typically ¼-inch I.D.) inertial-lift pump may be appropriate for use to sample groundwater from shallow push-probes or from small-diameter wells installed using a push-probe.

Non-dedicated submersible pump equipment (pump, sample tubing, air supply line or electrical cable) must be decontaminated carefully between sample locations to avoid cross contamination. The sample tubing typically used for submersible, peristaltic, and inertial-lift pumps can be cost-effectively discarded between sample locations and does not require decontamination. Additional information on pumps is included in SOP No. RFW/R10-002.

Power supply requirements also need to be evaluated during sampling pump selection. Submersible pump operation typically requires a generator or air supply (compressed air tank or electric compressor) as a power source. Inertial-lift pumps can be operated manually or with an electric actuator (also requiring a generator). Peristaltic pumps generally operate using a 12-volt battery.

7.21 Reagents

Reagents used for the preservation of groundwater samples may include hydrochloric acid, nitric acid, and sodium hydroxide. Sampling preservation methods are further discussed in *Section 10.0, Sample Containers, Preservation, Handling, and Storage*.

8.0 Method Calibration

The following instructions are specific for use of the YSI 6-Series Multi-Parameter Flow-Through Monitoring System Meter (YSI Meter). Equivalent multi-parameter flow through systems are acceptable for use.

8.1 YSI Meter Set up

Remove the YSI Meter (sonde, flow-through cell, storage cup, hand-held field display, and stand) from the carrying case. Check all probes on the sonde to make sure they are intact. Check to ensure that the clear membrane covering the dissolved oxygen (DO) probe is not damaged and that no air is leaking into the system. Replace the membrane if damaged. Instructions for replacing the membrane are discussed in *Section 8.2, Replacing the DO Probe Membrane*. If all probes are intact, attach the sonde to the reel. Plug the hand-held field display into the sonde and begin calibration. Instructions for calibration of the YSI Meter are detailed in *Section 8.3, Calibrating the YSI Meter*.

After calibration of the YSI Meter is completed, attach the flow-through cell to the sonde. Attach Tygon tubing to the intake and outtake ports on the flow-through cell. Groundwater is pumped from the monitoring well and flows through tubing into the intake port (located at the bottom of the flow-through cell), into the flow-through cell, and out through the outtake port (located at the top of the flow-through cell). The flow-through cell should not contain any air bubbles once it is filled with water.

8.2 Replacing the DO Probe Membrane

If the membrane covering the DO probe is damaged, replace the membrane. A membrane replacement kit is included with the YSI Meter. The membrane can be replaced as follows:

- Remove the damaged membrane from the DO probe body.
- Prepare the potassium chloride electrolyte solution included in the kit. Dissolve the potassium chloride in the dropper bottle by filling it to the neck with deionized water and mixing it without shaking it until the solids are fully dissolved.
- Hold the sonde upside down in a vertical position. Apply a few drops of potassium chloride solution to the probe. The fluid should completely fill the small moat around the electrodes and form a convex meniscus on the tip of the sensor. No air bubbles should be present on the surface of the probe.
- Without touching the membrane surface to cover the probe, stretch a new membrane over the probe body and secure it with an O-ring. Make sure the membrane is pulled tightly and no air bubbles are trapped. If air bubbles are present, repeat the preceding step. Trim the membrane to approximately 1/8 inch from the O-ring.

8.3 Calibrating the YSI Meter

Once the sonde is attached to the reel and is hooked up to the hand-held display, the instrument is ready to be calibrated. Press **POWER** on the hand-held display. This will bring up the Main Menu display. Press **ESC** and then highlight Calibration Mode (using the arrow buttons) and press **ENTER**. This brings up a list of the several parameters including pH, specific conductivity, oxidation reduction potential (ORP), and DO to be calibrated. At this time, record the batch number and expiration dates of all calibration standard solutions used during calibration. [Note: Thoroughly rinse the probes with deionized water between calibrations].

8.3.1 Dissolved Oxygen (DO)

Calibration of DO requires a barometric pressure reading at the time of the sampling. A barometer should be available; however if it is unavailable, a default reading of 760 milliliters (ml) of mercury can be used. Thread the storage cup (with a damp piece of sponge in the bottom) loosely around the probes. Highlight DO and press **ENTER**. Highlight percent (%) and press **ENTER**. Enter 100% and press **ENTER**. Enter the appropriate barometric pressure (or 760 milliliters of mercury) and press **ENTER**. Once the DO stabilizes at (or around) 100%, record the DO value, and press **ENTER**. At this time, a message should appear indicating that calibration is successful. If a message indicating that calibration was unsuccessful appears, repeat the calibration until it is successful. Press **ESC** to return to the Main Menu screen.

8.3.2 Specific Conductivity

Highlight Specific Conductivity and press **ENTER**. Highlight 1 millisiemen (Note: the calibration standard solution is labeled as 1,000 <u>micro</u>siemens), submerge all probes in the specific conductivity 1 millisiemen calibration standard solution, and press **ENTER**. Once the specific conductivity stabilizes at (or around) 1,000 <u>micro</u>siemens, record the specific conductivity value, and press **ENTER**. At this time, a message should appear indicating that calibration was successful. If a message indicating that calibration was unsuccessful appears, repeat the calibration until it is successful. Press **ESC** to return to the screen listing the four parameters.

[Note: If during calibration, the specific conductivity value changes at four second intervals, the DO membrane is damaged and must be replaced. Instructions for replacing the membrane are discussed in *Section 8.2, Replacing the DO Probe Membrane*].

8.3.3 pH (4 and 7)

From the parameter screen, highlight pH (using the arrow buttons), press **ENTER**, and then highlight 2-Point Calibration (4 and 7) and press **ENTER**. Two pH levels (4 and 7) will be available. Highlight pH 4, submerge all probes into the pH 4 calibration standard solution, and press **ENTER**. Once the pH stabilizes at (or around) 4, record the pH value, and press **ENTER**. At this time, a message should appear indicating that calibration was successful. If a message indicating that calibration was unsuccessful appears, repeat the calibration until it is successful. Press **ESC** to return to the screen to choose which pH level to calibrate. Repeat the above steps for pH 7 using the appropriate calibration standard solution. After the pH calibration is complete, press **ESC** to return to the screen listing the four parameters. You can do a 3-Point Calibration with 4, 7 and 10 pH solutions if desired following the same procedures described above, depending upon pH range of field samples.

8.3.4 Oxidation Reduction Potential (ORP)

Calibration of ORP requires a temperature reading at the time of the sampling. To obtain a temperature reading, press **ESC** on the hand held-held display until you reach Run Mode. Press **ENTER** and record the current temperature. Refer to the temperature/ORP guide included with the YSI Meter to determine the appropriate ORP reading for the temperature. Press **ESC** to return to the Main Menu. Press **ESC** and then highlight calibration mode and press **ENTER** which will bring up the screen listing the four parameters. Highlight ORP, and press **ENTER**. Enter the appropriate ORP value (obtained from the temperature/ORP guide), submerge the ORP and temperature probes in the ORP calibration standard solution, and press **ENTER**. Once the ORP stabilizes at (or around) its specified value, record the ORP value, and press **ENTER**. At this time, a message should appear indicating that calibration was successful. If a message indicating that calibration was unsuccessful appears, repeat the calibration until it is successful. Press **ESC** to return to the screen listing the four parameters.

The YSI meter will be calibrated twice a day: after field personnel have arrived on site (prior to sampling) and prior to field personnel departing the site (after sampling).

9.0 Sample Collection

9.1 Preparation

Following EPA approval of the site-specific SQAP and prior to conducting sampling activities, a pre-sampling meeting will be held by field team members to discuss the proposed sampling strategy and site health and safety issues. Attendees of the pre-sampling meeting will include the Project Manager (as necessary), Site Leader, samplers, and the field Health and Safety Officer. During the pre-sampling meeting, the Site Leader discusses the site history, contaminants of concern, sampling methodology, individual responsibilities, sample shipment or delivery, health and safety issues, and lines of communication anticipated during the sampling event.

Prior to mobilizing to the site to conduct sampling activities, the Site Leader will fill out an equipment/supply list and transmit the list to the Weston Equipment Stores or technician one week prior to the sampling event. Necessary sampling equipment, sample containers, personnel protective equipment (PPE), and vehicles are therefore reserved. Equipment may also be rented from local suppliers when appropriate.

In addition, Contract Laboratory Program (CLP) and/or commercial laboratories are procured or secured at least one week prior to the sampling event.

9.2 Low-Flow Groundwater Sampling

Prior to conducting any on-site activities, field members will review and sign the site-specific HASP. The field team will establish a command post upwind of suspected source areas, if possible. Field members will perform calibration checks of air monitoring instruments if these are specified in the HASP and document background ambient air monitoring levels. Field members will calibrate the YSI Meter (or equivalent). The samplers will decontaminate the sampling equipment (if appropriate). Decontamination will be conducted in accordance with the HASP and/or applicable SOPs. Decontamination generally consists of an alconox and water wash followed by a water rinse, followed by an isopropanol rinse, followed by a deionized water final rinse, and air drying. Equipment decontamination fluids, purge water from monitoring wells, and PPE generated during sampling activities will be containerized and disposed appropriately based on the results of laboratory analyses of samples collected.

The number of groundwater samples and the sample locations are described in the approved site-specific SQAP. Under the Removal Program, groundwater samples are generally collected to determine if hazardous substances have migrated from on-site sources to the groundwater, and have migrated off site and impacted private and public wells. Under the Site Assessment Program, groundwater samples are generally collected to evaluate the groundwater pathway and determine if hazardous substances attributable to on-site sources have migrated off site and have impacted private wells and public wells. Groundwater and drinking water samples are also used to identify Level I and/or Level II targets under the Hazard Ranking System.

9.2.1. Preliminary Well Observations

Prior to sampling a monitoring well, field personnel will check the well for security damage or evidence of tampering, and will record pertinent observations. Field personnel will remove the well cap and will immediately screen the headspace of the well for VOCs with a PID or FID, and record the reading in the field logbook if specified in the HASP. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), field personnel will make one and record the location and date of the mark in the logbook.

A synoptic water level measurement round should be performed (in the shortest possible time) before any sampling activities begin. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Proper well construction and development cannot be overemphasized, since the use of installation techniques that are appropriate to the hydrogeologic setting often prevents "problem well" situations from occurring. The screen, or open interval of the monitoring well should be optimally located (both laterally and vertically) to intercept existing contaminant plume(s) or along flow paths of potential contaminant releases. It is presumed that the analytes of interest move (or potentially move) primarily through the more permeable zones within the screen, or open interval. It is also recommended that as part of development, or redevelopment, the well should be tested to determine the appropriate pumping rate to obtain stabilization of field indicator parameters with minimal drawdown in the shortest amount of time. With this information, field crews can then conduct purging and sampling in a more expeditious manner.

The pump (or tubing) intake within the well should be positioned opposite the most contaminated zone within the well screen interval. If this zone is unknown, the mid-point of the saturated screen length (which should not exceed 10 feet) can be used by convention as the location of the pump (or tubing) intake. To enable reproducible sample results, the sample intake depth should be carefully measured and recorded for future reference. However, significant chemical or permeability contrast(s) within the screen may require additional field work to determine the optimum vertical location(s) for the intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permeability and/or high(er) chemical concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help ensure that the low-flow method will not underestimate contaminant concentrations. The SQAP must provide clear instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected.

Newly constructed wells will be checked for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent measurements with an interface probe are usually not needed unless analytical data or field headspace information signal a worsening situation. [Note: procedures for collection of LNAPL and DNAPL samples are not addressed in this SOP].

9.2.2. Purging Procedures

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (i.e.; peristaltic or inertial lift pump) and/or the use of dedicated sampling equipment.

For small-diameter sampling applications (such as small-diameter wells installed using a push-probe), using a combination of peristaltic and inertial-lift pumps is effective. In this case, it is more practical to purge the well using the peristaltic pump since the small-diameter inertial-lift pump is usually activated by hand. Once purging is complete and all applicable samples have been collected using the peristaltic pump, the inertial-lift pump can be lowered into the well for collection of the VOCs sample.

Lower the submersible pump or tubing slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. Criteria for the selection of the sample depth midpoint for each well are described in Section 9.2.1. If possible, keep the pump intake or tubing at least 2 feet above the bottom of the well, to minimize mobilization of particulates present in the well bottom.

Prior to starting pumping, measure the water level in the well. If possible, leave the water level meter in the well while purging in order to more effectively determine drawdown of the water column.

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check the water level and adjust the pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize. Monitor and record water level and pumping rate every 5 minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (e.g., 0.1 to 0.4 liter/minute) to ensure stabilization of indicator parameters. Adjustments are best made in the first 15 minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then “recover” as pump flow adjustments are made.

Purge volume calculations should utilize the stabilized drawdown value, not the initial drawdown. **Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the**

screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

9.2.3. Monitoring Parameters

All parameter measurements, except turbidity, must be obtained using a flow-through-cell. Transparent flow-through-cells will be used because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities.

The flow-through-cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off, water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through-cells are used in series, the one containing the DO probe should come first (this parameter is most susceptible to error if air leaks into the system).

During well purging, monitor indicator field parameters (turbidity, temperature, pH specific conductance, ORP, and DO) every 3 minutes (or less frequently, if appropriate). [Note: During the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments]. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at 3-minute intervals, are within the following limits:

- pH (± 0.1 unit).
- Specific conductance (3%).
- DO (10%).

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 Nephelometric Turbidity Units (NTU) and stable draw downs of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the remaining criteria in this procedure are met. If after 0.5 hours of purging, indicator field parameters have not stabilized, one of three optional courses of action may be taken:

- Continue purging until stabilization is achieved.

- Discontinue purging, do not collect any samples, and record in the logbook that stabilization could not be achieved (documentation must describe attempts to achieve stabilization).

- Discontinue purging, collect samples (as long as a minimum of 3 casing volumes have been removed), and provide full explanation of attempts to achieve stabilization. Document the volume of purge water removed and other pertinent information and observations in the sampling log including recommendations for actions to be taken for the next sampling round. (Note: There is a risk that the analytical data obtained, especially for metals and strongly hydrophobic organic analytes, may not meet the sampling objectives).

If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

9.2.4. Collection of Samples

Groundwater samples for laboratory analyses must be collected before the water has passed through the flow-through-cell (e.g., use a three-way valve prior to the flow-through-cell or remove flow-through-cell prior to sampling). VOC samples will be collected first, followed by SVOCs, PCBs/Pesticides, metals, and cyanide samples. An exception is when a peristaltic pump is used for purging and sampling prior to the use of and inertial-lift pump for VOCs sampling. In this case, the VOCs sample is collected last. Groundwater samples for the various analytical parameters listed below will be collected from the discharge end of the pump tubing.

<u>VOC Sampling</u> - The collection of VOC samples requires minimal disturbance of the sample to limit volatilization and therefore a loss of volatiles from the sample. The following procedures must be followed while collecting the VOC fraction of the sample.

- Open the vial, set the cap in a clean place, and collect the sample by allowing the water to flow gently down the inside of the container with minimal disturbance of the sample to limit volatilization and therefore prevent loss of volatile compounds from the sample. VOC samples shall not be collected and/or preserved near a running motor or any type of exhaust system due to possible contamination by discharges, fumes or vapors. Each container will be preserved with two (2) drops of 1:1 hydrochloric acid (HCl) per 40 ml of sample so that the pH is < 2. When collecting replicate samples, collect both samples at the same time. Fill the container to just overflowing until there is a convex meniscus on the top of the container. Check that the cap has not been contaminated (splashed) and carefully cap the container. Place the cap directly over the top and screw down firmly. Do not over tighten and break the cap. Invert the sealed container, tap gently on the side, and observe for the presence of air bubbles for 10 seconds. If an air bubble larger than 0.25-inches appears, the collection procedure should be repeated. Then mix the sample containers by shaking vigorously to mix the preservative; place them in a re-sealable plastic bag; and then into a cooler with ice. The holding time for preserved VOC samples is 14 days. Samples should be shipped or delivered to the laboratory daily so as not to exceed the holding time. Ensure that the samples remain at 4 degrees Celsius (°C), but do not allow them to freeze.

One trip blank sample (organic-free water) will be collected prior to the sampling event and will accompany the VOCs samples. Preparation of trip blanks is discussed in *Section 14.3, Trip Blanks*.

SVOC Sampling - Samples will be collected by allowing the water to flow gently down the inside of the appropriate size glass containers. Cap the sample container tightly and place pre-labeled sample container in a cooler with ice.

Pesticides/PCBs Sampling - Samples will be collected by allowing the water to flow gently down the inside of the appropriate size glass containers. Cap the sample container tightly and place pre-labeled sample container in a cooler with ice.

Metals Sampling - Samples will be collected by allowing the water to flow gently down the inside of the appropriate glass or plastic containers and preserving with nitric acid (HNO_3) to a pH of < 2. Cap the sample container tightly and place pre-labeled sample container in a cooler with ice.

If (dissolved) metal concentrations are a sampling objective, then filtered water samples will be collected using the same low-flow method. The use of an in-line filter is required, and the filter size [0.45 micrometers (µm) is commonly used] should be based on the sampling objective. Pre-rinse the filter with approximately 25 to 50 ml of groundwater prior to sample collection. Preserve the filtered water sample immediately. [Note: Filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in groundwater for human health risk calculations].

Cyanide (Total and Amenable) Sampling - Samples will be collected by allowing the water to flow gently down the inside of the appropriate glass or plastic containers and preserved with sodium hydroxide (NaOH) to a pH of > 12. Cap the sample container tightly and place pre-labeled sample container in a cooler with ice.

After collection of the samples, the pump tubing may be dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Secure the well by installing the riser cap, and placing a padlock on the protective casing cap.

10.0 Handling and Preservation

The type of analysis for which a sample is being collected determines the type of bottle, preservative, holding time, and filtering requirements. Ideally, sample containers will be labeled appropriately prior to sample collection; however, if this is not possible, sample containers will be labeled immediately after sample collection.

Trip blanks are used to assess the degree of contamination introduced into samples during sample handling, shipment, and analysis. Contamination may be introduced from the sample bottle, the preservatives used, cross-contamination (in the case of VOCs), or from shipping and handling, both in the field and in the laboratory. Samples are shipped to analytical laboratories expeditiously to ensure that holding times are not exceeded. Chemical preservatives used during groundwater sampling activities include HCl, HNO_3, and NaOH.

Preservative will be added, as required by analytical methods, to samples after they are collected, if the sample containers are not pre-preserved. VOC samples (collected in 40-ml vials) are pre-preserved with 2 drops of HCl. HNO_3 will be added (following sample collection) to samples collected for metals (total or dissolved) analyses until a pH of less than 2 is obtained. NaOH will be added (following sample collection) to samples collected for cyanide analyses until a pH of greater than 12 is obtained.

Following preservation, sample information will be recorded on the appropriate chain of custody form, and samples will be placed in a cooler to be maintained at 4°C. Samples must be shipped before the holding time is over, ideally within 24 hours of sample collection. It is imperative that these samples be shipped or delivered daily to the analytical laboratory in order to maximize the time available for the laboratory to perform the analysis. The bottles should be shipped with adequate packing and cooling material to ensure that they arrive intact and at 4° C.

11.0 Sample Preparation and Analysis

This section is not applicable to this SOP.

12.0 Troubleshooting

All field screening instrumentation (PID and/or FID, and YSI meter) and pumps must be calibrated and operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the site-specific SQAPs. Equipment checkout and calibration activities must occur prior to and following sampling activities, and they must be documented.

13.0 Data Acquisition, Calculations, and Data Reduction

Field observations made during the sampling event will be recorded in a site logbook and/or field data sheets, including description of sampling locations and any deviations from the site-specific SQAPs. Chain-of-custody will be maintained until samples are relinquished to a courier or to the laboratories assigned to perform the analyses. Photographs may be taken to document site conditions. The location and direction from which photographs are taken will be noted in the field logbook, in accordance with the scope of work. Reports, site file memoranda, figures, tables, boring logs, etc. will be saved in site-specific Technical Direction Document (TDD) directories.

14.0 Quality Assurance and Quality Control Section

All observations and field parameters must be documented on field data sheets, field member's logbooks, or in site-specific logbooks. All instrumentation must be operated in accordance with operating instructions as specified by the manufacturer, unless otherwise specified in the site-specific SQAP. Instruments shall be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be recalibrated so that all measurements fall within the calibration range. At the end of each day, instruments should be recalibrated to verify that instruments remained in calibration.

This section describes quality assurance/quality control (QA/QC) pertinent to low-flow groundwater samples, and the types and uses of the QA/QC samples that are collected in the field. Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared identically to regular investigation samples with regard to sample volume, containers, and preservation. QA/QC samples provide information on the variability and usability of environmental sample results. They assist in identifying the origin of analytical discrepancies to help determine how the analytical results should be used. They are used mostly to validate analytical results.

A data quality review of the laboratory sample analyses will be conducted by U.S. EPA. As part of this validation process, a memorandum is prepared with tables qualifying the data.

Field replicates, matrix spike/matrix spike duplicate (MS/MSD), trip blanks, rinsate (equipment) blanks, and temperature blanks are discussed below. QA/QC results may suggest the need for modifying sample collection, preparation, handling, or analytical procedures if the resultant data do not meet quality assurance objectives.

14.1 Field Replicates

Field replicates are used to assess the degree of sample heterogeneity, and the reproducibility of the sample collection procedure and the laboratory analysis. Field replicates are typically collected with groundwater samples which are submitted for Site Assessment scoring activities. For this procedure, replicates will be collected for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

If split samples are to be collected, the split for each analyte group will be collected in consecutive order (VOC original, VOC split, etc.). Split samples should be as identical as possible to the original sample.

14.2 Laboratory Matrix Spike and Matrix Spike Duplicate

MS and MSD samples are used to monitor laboratory performance. MS/MSD samples are spiked in the laboratory with a known concentration of a target analyte(s) to verify percent recoveries. It may be necessary to provide extra volume of a sample to the laboratory for spiking analyses. Extra volume for MS/MSD or MS/Duplicate (Dup) analyses is collected for every 20 samples of groundwater for each requested analytical parameter.

14.3 Trip Blanks

Trip blanks are typically collected for VOC analysis. Trip blanks are used to assess the degree of contamination introduced into samples during sample handling, shipment. Contamination may be introduced from the sample bottle, the preservatives used, cross-contamination (in the case of VOCs), or from shipping and handling, both in the field and in the laboratory. Trip blanks (organic-free water) will be collected prior to the groundwater sampling event. Each bottle of the trip blank sample will be preserved with two drops of 1:1 HCl per 40 ml of sample to achieve a pH < 2. Trip blanks are handled, transported, and analyzed in the same manner as the other samples collected for that analysis that day. One set of trip blanks is collected for VOCs analysis for each cooler in which VOCs samples are shipped.

14.4 Rinsate (Equipment) Blanks

Dedicated or decontaminated sampling equipment will be used at each groundwater sample location to minimize cross-contamination. Groundwater sampling equipment must be decontaminated prior to the start of sampling activities as well as between sample locations, unless the sampling activity is dedicated to one sample location. Rinsate blanks are used to assess contamination (typically, cross-contamination) brought about by improper decontamination procedures between sampling stations. Rinsate blanks are not required for dedicated, disposable sampling implements. If a submersible pump is used, then a rinsate blank must be collected from the pump and its associated tubing. If tubing is dedicated to the well, the rinsate blank will only include the pump (if using a submersible pump) in subsequent sampling rounds. If tubing is dedicated to the well and a peristaltic pump or inertial-lift pump is used, an equipment blank is not required.

Rinsate blanks are obtained by running (or pumping) analyte-free water through decontaminated sampling equipment to test for residual contamination. The water is collected into the appropriate sample containers, which are handled (e.g., preserved), shipped, and analyzed identical to the samples collected that day. Where non-dedicated sampling equipment is used, rinsate blanks must be collected at the rate of one per 20 stations for each parameter for which groundwater samples are collected.

14.5 Temperature Blanks

Temperature blanks provide information on the preservation (temperature) of the samples during shipment to the laboratories. Temperature blanks are obtained by pouring tap water into a 40-ml glass vial and placing one temperature blank per cooler of samples.

15.0 Reference Section

Weston Solutions, Inc. December 1999. Manual of Procedures for Shipping and Transporting Dangerous Goods.

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U.S. Environmental Protection Agency. 2000. *U.S. EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration.* Document Number ILM04.1.

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U.S. Environmental Protection Agency. February 1998. *EPA Guidance for Quality Assurance Project Plans*. Office of Research and Development, Washington, D.C. EPA/600/R-98/018. OSWER Directive 9360.4-01.

U.S. Environmental Protection Agency. 1998. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*. 3rd Edition, Revision 5.

U.S. Environmental Protection Agency. May 1993. *Subsurface Characterization and Monitoring Techniques, a Desk Reference Guide*. Office of Research and Development. Washington D.C. EPA/625/R-93/003a.

U.S. Environmental Protection Agency. January 1991. *Compendium of ERT Soil Sampling and Surface Geophysics Procedures* Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9360.4-02. EPA/540/P-91/006.

U.S. Environmental Protection Agency. 1982. *Test Method: Purgeables - Method 624.* Environmental Monitoring and Support Laboratory, Office of Research and Development, Cincinnati, OH.

Hexavalent Chromium in Soil and Water Kit

Range: 0.5-10,000 mg/kg (soil)
0-750 mg/L (water)
Cat. No. 24618-00

TO ENSURE ACCURATE RESULTS PLEASE READ CAREFULLY BEFORE PROCEEDING

Introduction

Hexavalent chromium (Cr^{6+}) in soil at levels greater than 100 ppb (100 mg/kg) indicate contamination and is hazardous because Cr^{6+} and its compounds are toxic and carcinogenic. Environmental soil contamination sources include corroding chromium-plated objects and effluent from plating operations, tanneries, and municipal wastewater plants.

Determining Cr^{6+} levels in soils is important during decontaminating of soils containing Cr^{6+}. These analyses also provide valuable information for preventing groundwater pollution near the contaminated site. Evaluating and decontaminating polluted locations involves screening large numbers of soil samples to determine the size and severity of the contamination at the site.

HACH COMPANY, P.O. BOX 389, LOVELAND, COLORADO 80359
TELEPHONE: WITHIN U.S. 800-227-4224, OUTSIDE U.S. 970-669-3050, TELEX: 160840

Current Cr^{6+} soil analyses require laboratory instruments, experienced operators, and cumbersome extraction techniques which may require samples be sent to laboratories, making the analysis lengthy and expensive. Hach chemists have developed a simple, reliable, portable testing procedure based on EPA-approved methods. The method measures Cr^{6+} in soil down to 500 ppb in less than 30 minutes.

TEST INSTRUCTIONS

Determination of Cr^{6+} in Soil

1. Using the soil scoop, measure out the required sample size based on anticipated Cr^{6+} levels (Table 1). Place soil sample in whirl-pak bag.

Table 1. Soil Sample Size

Expected Cr^{6+} Concentration	Sample Size
500–5000 ppb	20 grams
1.0–10 ppm	20 grams
2.50–50 ppm	20 grams
50–1000 ppm	1 gram
500–10,000 ppm	1 gram

2. Use the shears to open one Hexavalent Chromium Extractant Pillow. Pour the pillow contents into a 50-mL graduated cylinder. Add 40 mL of deionized water. Swirl to dissolve the powder.
3. Add the extraction solution (from Step 2) to the soil in the whirl-pak bag and close tightly. Invert and shake several times to ensure the soil is completely suspended.

4. Shake the soil/soil extractant mixture for 15 seconds at 2 minute intervals for a period of 15 minutes.
5. Set the funnel in the 50-ml graduated cylinder. Open a piece of filter paper and place it into the funnel. Pour the soil/soil extractant mixture into the funnel.
6. Determine the required filtrate aliquot size from Table 2. Transfer the required aliquot from the 50-mL graduated cylinder to each of the two 25-ml graduated cylinders.

Table 2. Required Aliquot Size

Expected Cr^{6+} Concentration	Aliquot Size
500–5000 ppb	10 mL
1–10 ppm	5 mL
2.5–50 ppm	1 mL
50–1000 ppm	1 mL
500–10,000 ppm	0.1 mL

7. To both 25-mL graduated cylinders add deionized water to the 25-mL mark.
8. Pour the contents of one 25-mL graduated cylinder to the top mark of a plastic Color Viewing Tube. Set aside and use this as the blank. Do not cap if the long path adapter is used.

9. Use the shears to open a ChromaVer 3 Chromium Reagent Powder Pillow. Pour the pillow contents into the other 25-mL graduated cylinder. Swirl to mix. This is the prepared sample.

10. Allow a 10-minute reaction period. If the solution becomes cloudy following reagent addition and does not clear up after 10 minutes, the aliquot size must be reduced until the turbidity is no longer present after the 10-minute reaction period.

11. Pour the prepared sample to the top mark of another plastic Color Viewing Tube. Do not cap if the long path adapter is used.

12. Place the long path viewing adapter and color disk into the viewing box and close (See Figure 1).

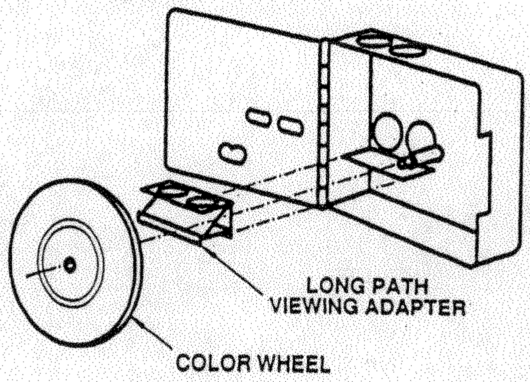


FIGURE 1

13. Place the blank tube into the blank position of the comparator (See Figure 2). Place the viewing tube with the prepared sample into the sample position. Orient the comparator with the tube tops pointing to a window or light source as in Figure 3. Use care not to spill the sample from unstoppered tubes. Turn the color wheel until the color on the wheel matches the color in the prepared sample tube. Read the mg/L on the color disk scale and convert to actual mg/L using the chart below.

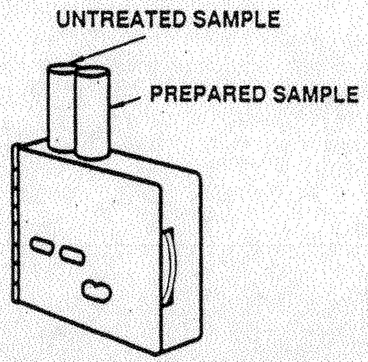


FIGURE 2

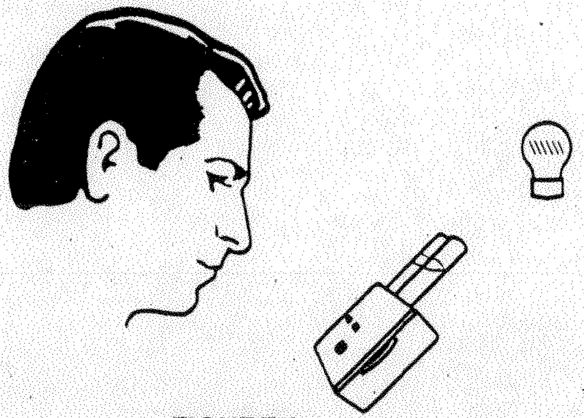


FIGURE 3

Note: If the reading is off-scale (sample is darker than darkest color on wheel), remove the long path viewing adapter and re-read the color using the standard scale. Read the number in mg/L directly off the color disk scale. Do not convert the scale reading.

Conversion Chart
Disk Range

	High (mg/L)	Low (mg/L)	
	0.0	0.0	
D	0.1	0.020	A
I	0.2	0.040	C
S	0.3	0.060	T
K	0.4	0.080	U
	0.5	0.100	A
R	0.6	0.120	L
E	0.7	0.140	
A	0.8	0.160	R
D	0.9	0.180	E
I	1.0	0.200	A
N	1.1	0.220	D
G	1.2	0.240	I
	1.3	0.260	N
	1.4	0.280	G
	1.5	0.300	

Example: Using the long path adapter, you read 0.8 mg/L from the color disk scale. On the chart, convert the color disk reading on the left (or high scale) to the actual reading of 0.160 mg/L on the right (or low scale). This is the actual reading if you're using the long path adapter. Use this number in calculating the Cr^{6+} concentration in the soil.

If you don't use the long path adapter, the correct result is 0.8 mg/L.

14. Calculate the Cr^{6+} concentration in the soil with the following formula:

$$Cr^{6+}\ \text{ppm} = \frac{\text{Disk Reading (mg/L)} \times 1000}{\text{Aliquot Volume (mL)} \times \text{Sample Size (grams)}}$$

SAMPLING NOTES

Obtain a soil sample representative of the area being tested. If the soil is moist or taken at a depth, air dry before sampling with the soil scoop(s). High levels of hexavalent chromium (> 100 ppm) do not require very rigorous sampling treatment procedures.

ACCURACY CHECK

1. Using a Tensette Pipet or a fixed volume pipetter, add 0.2 mL of a 50-mg/L Cr^{6+} standard solution to 20 grams of soil. The soil must not contain any Cr^{6+}.

2. Analyze the sample as described in the procedure, using the long path adapter and a 10-mL aliquot. A reading between 0.4 to 0.6 mg/L should be obtained. The disk reading will correlate with a 0.080-0.120 mg/L actual reading. The calculation should give a result of 400-600 ppb (the true value is 500 ppb).

INTERFERENCES

The following do not interfere up to the concentration listed in the 25-mL liquid sample:

Mercurous/Mercuric ions	Interferes slightly
Vanadium	1 mg/L
Iron	See below

Vanadium interference can be overcome by waiting 10 minutes before reading.

Iron interference levels depend on the volume of the extract aliquot. To avoid iron interference, use the smallest sample and aliquot volume possible. Iron interference prevents color formation. If you get a Cr^{6+} concentration of nearly 0, check the sample for iron interference by adding 0.1 mL of a 50-mg/L Cr^{6+} standard to the sample and allow an additional 10 minute reaction period. If a pink color develops, iron is not interfering and the sample does not contain hexavalent chromium. If no color develops, interference is occurring and the aliquot and/or sample size should be decreased until the interferences stops.

SUMMARY OF METHOD

Hexavalent chromium in soil is measured by extracting it using a concentrated alkaline extracting reagent. Color development with the 1,5 diphenylcarbohydrazide method uses a single dry powder formulation called ChromaVer 3 Chromium Reagent. This reagent contains a buffer and 1,5 diphenylcarbohydrazide, which gives a purple color when hexavalent chromium is present.

REPLACEMENTS

Cat. No.	Description
12066-66	ChromaVer 3 Chromium Reagent Powder Pillows, 50/pkg
810-14	Hexavalent Chromium Standard Solution, 50 mg/L Cr^{6+}
24497-99	Hexavalent Chromium Soil Extractant Powder Pillows, 100/pkg
22331-99	Bags, Whirl-Pak, 100/pkg
23694-00	Clippers, large (shears)
1732-00	Color Comparator Box
2172-40	Cylinder, graduated, 25 mL, polypentene
2172-41	Cylinder, graduated, 50 mL, polypentene
21846-00	Demineralizer bottle, 473 mL
22275-10	Droppers, polyethylene, 4 mL, 10/pkg
692-58	Filter Paper, folded, 15 cm, 100/pkg
1083-67	Funnel, analytical
24122-01	Long Path Viewing Adapter
22753-00	Pipetter, fixed volume, 100 µL
22754-10	Pipetter Replacement Tips, 10/pkg
22628-01	Scoop, soil, 1 gram
22628-10	Scoop, soil, 10 grams
46600-00	Viewing Tubes, plastic
46600-10	Viewing Tube Caps

Determination of Cr^{6+} in Water

With undiluted samples, the range of this test is 0-1.5 mg/L. By diluting samples with deionized water, the range can be expanded to 750 mg/L Cr^{6+}. Determine the correct sample size by using Table 3.

Table 3. Sample Volumes

Estimated Cr^{6+} Level	Sample Volume	Multiplication Factor
0–1.5 mg/L	50 mL	1
1.0–75 mg/L	1 mL	50
0.0–750 mg/L	0.1 mL	500

1. Transfer the correct sample volume determined in Table 3 to a 50-mL graduated cylinder.
2. Add deionized water to bring the total to 50 mL. Swirl the cylinder to thoroughly mix the solution.
3. Transfer 25 mL of this solution to a 25-mL graduated cylinder. The solution remaining in the 50-mL cylinder is the blank.

4. Using the shears, open a ChromaVer 3 Reagent Powder Pillow. Add the contents of the pillow to the 25-mL cylinder. Mix to dissolve the reagent. Allow a 5-minute reaction period. This is the prepared sample.

5. Fill a viewing tube to the top mark (about 16 mL) with the solution from the 50-mL cylinder and set aside. This is the blank. Do not cap if the long path viewing adaptor is used.

6. After the reaction period, fill a second viewing tube to the top mark with the contents of the 25-mL cylinder. This is the sample tube.

7. Place the long path viewing adaptor and color disk into the viewing box and close. (See Figure 1.)

8. Place the blank tube into the blank position of the comparator (See Figure 2). Place the viewing tube with the prepared sample into the sample position. Orient the comparator with the tube tops pointing to a window or light source as in Figure 3. Use care not to spill the sample from unstoppered tubes. Turn the color wheel until the color on the wheel matches the color in the prepared sample tube. Read the mg/L on the color disk scale and convert to actual mg/L using the chart below.

Note: If the reading is off-scale (sample is darker than darkest color on wheel), remove the long path viewing adapter and re-read the color using the standard scale. Read the number in mg/L directly off the color disk scale. Do not convert the scale reading.

Conversion Chart

	Disk Range		
	High (mg/L)	Low (mg/L)	
	0.0	0.0	
D	0.1	0.020	A
I	0.2	0.040	C
S	0.3	0.060	T
K	0.4	0.080	U
	0.5	0.100	A
R	0.6	0.120	L
E	0.7	0.140	
A	0.8	0.160	R
D	0.9	0.180	E
I	1.0	0.200	A
N	1.1	0.220	D
G	1.2	0.240	I
	1.3	0.260	N
	1.4	0.280	G
	1.5	0.300	

Example: Using the long path adapter, you read 0.8 mg/L from the color disk scale. On the chart, convert the color disk reading on the left (or high scale) to the actual reading of 0.160 mg/L on the right (or low scale). This is the actual reading if you're using the long path adapter. Use this number in calculating the Cr^{6+} concentration in the soil.

If you don't use the long path adapter, the correct result is 0.8 mg/L.

9. Multiply the Cr^{6+} concentration obtained in Step 8 by the correct multiplication factor in Table 3 to determine the actual Cr^{6+} concentration in the water sample (in mg/L).

SAMPLING AND STORAGE

For best results, analyze the sample immediately. If this is not possible, collect samples in clean glass or plastic containers. Adjust the pH to 2 or less with nitric acid (about 2 mL per liter). Preserved samples can be stored for at least six months at room temperature. Before analysis, adjust the pH to 4 with 5.0 N sodium hydroxide. Correct the test result for volume additions.

ACCURACY CHECK

1. Use a TenSette Pipet or fixed volume pipetter to add 0.1 mL of a 50-mg/L Cr^{6+} standard to a 50-mL graduated cylinder. Dilute to 50 mL.
2. Analyze each sample as described in the procedure for water samples. Using the long path adapter and a 25-mL aliquot, a reading between 0.4 to 0.6 mg/L should be obtained. The disc reading correlates with an actual reading of 0.080 to 0.120 mg/L, the true value being 0.100 mg/L.

INTERFERENCES

The following do not interfere with the test up to the following concentrations:

Mercurous/Mercuric Ions	Interfere slightly
Iron	1 mg/L
Vanadium	1 mg/L

Vanadium interference can be overcome by waiting ten minutes before reading.

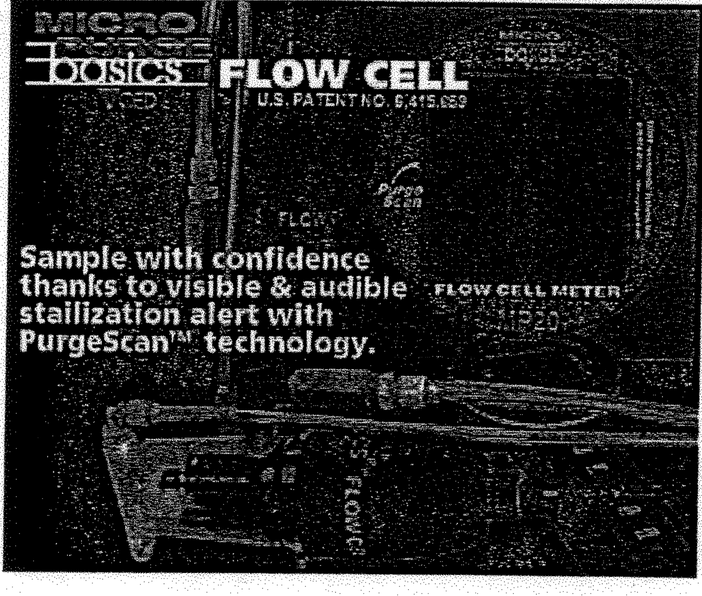
Highly buffered sample or extreme sample pH may exceed the buffering capacity of the reagent and require sample pretreatment.

SUMMARY OF METHOD

Hexavalent chromium is determined by the 1,5-diphenylcarbohydrazide method using a single powder formulation called ChromaVer 3 Chromium Reagent. This reagent contains a buffer combined with 1,5-diphenylcarbohydrazide, which reacts to give a purple color when hexavalent chromium is present.

REPLACEMENTS

Cat. No.	Description
12066-66	ChromaVer 3 Chromium Reagent Powder Pillows, 50/pkg
810-14	Hexavalent Chromium Standard Solution, 50 mg/L Cr^{6+}
23694-00	Clippers, large (shears)
1732-00	Color Comparator Box
2172-40	Cylinder, graduated, 25 mL, polypentene
2172-41	Cylinder, graduated, 50 mL, polypentene
24122-01	Long Path Viewing Adapter
22753-00	Pipetter, fixed volume, 100 µL
22754-10	Pipetter Replacement Tips, 10/pkg
46600-00	Viewing Tubes, plastic
46600-10	Viewing Tube Caps



MicroPurge® basics™ MP20 Flow Cell Advantages

- Exclusive PurgeScan™ technology (U.S. Patent No. 6,415,659) gives the OK to sample when selected purge water quality parameters remain steady over successive readings at user-defined intervals.
- Now, optional upgrades deliver twice the data storage with fast PC download capability and automatic date/time stamping, plus a new, revolutionary sensor array including turbidity.
- Transparent, molded flow cell effectively vents bubbles, even in the horizontal position; low internal volume (175 ml), designed flow distribution and stirrer give fast response, even at low rates.
- Rugged, waterproof case doubles as a measurement and calibration workbench.
- Waterproof MP20 meter displays all readings automatically: pH, ORP, temperature, conductivity, DO, and (optional) turbidity.
- The compact sonde attaches with a quick bayonet-type mount to the flow cell, calibration and storage cups.
- Three Year Warranty.

Automated purge stabilization alert with powerful new capabilities

The MicroPurge® **basics™** MP20 Flow Cell – from the leaders in low-flow ground water sampling – sets new standards in performance, size and price for purge water quality monitors. QED-exclusive PurgeScanTM technology (U.S. Patent No. 6,415,659) signals when stabilization has been achieved for selected water quality parameters, with automatic storage of key data points.

Two upgrades enhance performance even further. One option offers fast PC download capability. The other option also adds a technology breakthrough turbidity sensor in addition to pH, ORP, DO, temperature, and conductivity.

The lightweight, waterproof MP20 meter is simple to field calibrate. It displays all readings automatically. The sonde is a compact, low-profile design with rugged, easy-to-service probes. The flow cell is designed to collect and vent gas bubbles effectively, and to distribute purge flow evenly for quick measurement response and more accurate readings.

The whole package is protected by a 3-year warranty, backed by service and support from QED, the leader in low-flow sampling.

QED PurgeScan™ technology assures stabilization

Successful, consistent low-flow sampling is based on knowing when purge water indicator parameters stabilize. This allows sampling to begin only when the pump discharges samples representative of the formation water.

Until now, deciding when stabilization had been achieved was complex, requiring you to monitor multiple parameters and make repeated calculations. The MP20 Flow Cell simplifies this process. Microprocessor-based PurgeScan™ technology performs the monitoring and calculation, clearly signaling when stabilization has occurred.

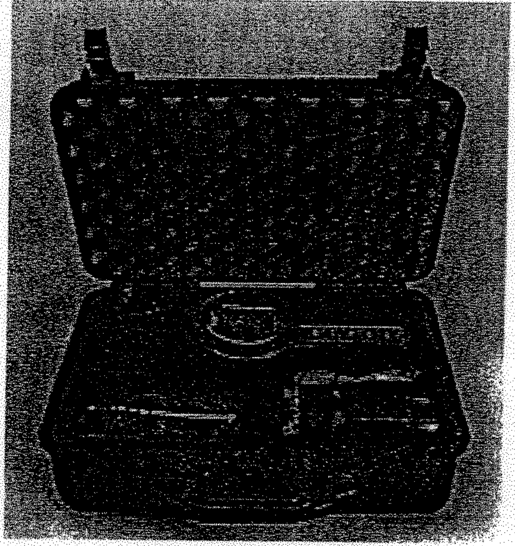
This makes low-flow sampling easy. You can do it the right way, collecting the most accurate samples, and saving time and money.

Engineered for performance and field readiness

The MP20 flow cell is engineered to allow the probe to make rapid, accurate responses to changes in purge water parameters. The flow cell is 100% transparent for observation. The low-volume, fast-response cell couples to the sonde with a quick, bayonet attachment, and can be used in either a horizontal or vertical position.

The incoming flow is directed in a tangential path around the flow cell to provide fast, thorough mixing with no "dead spots" that could affect the accuracy of purge parameter measurements. Bubbles in the flow stream are vented out of the cell and away from the probe so they don't interfere with purge water analysis.

The multiparameter probe has a special sensor with built-in stirring for highly stable dissolved oxygen readings. All sensors are easy to calibrate and the reference electrode is fully field-serviceable.



The complete MP20 kit, with sonde, flow cell, meter, and calibration and storage materials, in field-ready case.

OPTIONAL ENHANCEMENTS

- **PC Data Dump / Real Time Clock**
  Fast, easy download to PC with automatic date/time stamp

- **Turbidity Sensor**
  Patented 4-beam infrared sensor for accurate readings, easy calibration

Options available on new units or as retrofits on existing models

The large display screen makes it easy to see your purging status. Power by standard C cells keeps you on top of the job all day with no energy supply worries.

System Specifications:

Model No.	MP20 (Standard) MP20D (w/ Real Time Clock/Data Download) MP20DT (w/ RTC/Data Download/Turbidity)
Dimensions	18.5"x15"x6.5" (47 x 38 x 17 cm)
Weight	14 lbs (6.4 kg)
Storage	100 Data Points (200 opt.)
Stabilization	Purge Scan™ Technology (U.S. Patent #6,415,659)
Case Material	Structural Resin
Keypad	5 Keys

Meter Specifications:

Display	3.5" (9 cm)
Weight	2.1 lbs (1 kg)
Memory	100 Data Frames (200 opt.)
Rating	Waterproof NEMA 6 [IP67]
Power	3 "C" batteries
Battery Life	12 Hours
Temperature	23 - 122°F (-5 - 50°C)

Cable	6 foot (1.83 m)

Flow Cell Specifications:

Volume	175 ml
Material	Rigid urethane
Fitting Type	Soft-tube "clamp-free"
Fitting Size(s)	Inlet: 1/4" I.D. x 3/8" O.D. Outlet: 3/8" I.D. x 1/2" O.D.
Venting Modes	Horizontal and Vertical
Sonde Connection	Bayonet-style Twist Mount

Sonde Specifications:

Size	3" x 9" (8 x 23 cm)
Weight	1.3 lbs (0.6 kg)

Typical Sensor Performance Specifications:

	Range	**Accuracy**	**Resolution**
Temperature	-5 - 50°C (23 - 122°F)	± 0.2°C (0.36°F)	0.01°C (0.018°F)
DO	0 to 20 mg/l	± 0.2 mg/l	0.01 mg/l
Specific Cond.	0 to 100 mS/cm	±1% of reading ± 1 count	4 Digits
pH	2 to 12 units	± 0.2 units	0.01 units
ORP	-999 to 999 mV	± 20 mV	1 mV
Turbidity	0 to 1,000 NTU	± 5% of reading ± 1 NTU	1 NTU
Salinity*	0 to 70 PSS	± 1% of reading ± 1count	0.01 PSS

***Calculated**

PurgeScan™ Specifications:

Parameter Stabilization range criteria*	pH	± .2 units
	DO	± 0.2 mg/l
	Conductivity	± 0.020 mS/cm
	ORP	± 20 millivolts
	Turbidity	± 1 NTU

*NOTE: These are default ranges; settings are adjustable to meet site specifications.

Stabilization basis 3 consecutive readings of selected parameters (one or more of above 5) within above limits, at time interval selected, from 1 to 9 minutes. For example, if 2 minutes is selected, then stabilization would be signaled when 3 consecutive 2-minute intervals showed in-range readings at the end of each interval, requiring 6 minutes.

Elapsed time since Purge Scan initiated shows at the bottom of the screen.

Full data sets are stored at time 0, every 5 minutes, and the 3 consecutive readings which satisfy the stabilization criteria.

More information on Dedicated Ground Water Sampling

Need Help?
Call 1-800-624-2026
Product Specifications
Rental Information

APPENDIX C

SUPPLEMENTAL FORMS

USEPA Contract Laboratory Program
Inorganic Traffic Report & Chain of Custody Record

1. Case No.:
DAS No.:
SDG No.:

L

2. Date Shipped:
Carrier Name:
Airbill:
Shipped To:

3. Chain of Custody Record		**Sampler Signature:**	
Relinquished By:	**(Date/Time)**	**Received By:**	**(Date/Time)**
1)			
2)			
3)			
4)			

4. For Lab Use Only

Lab Contract No: ____
Unit Price: ____
Transfer To: ____
Lab Contract No: ____
Unit Price: ____

5. INORGANIC SAMPLE No.	6. MATRIX/ SAMPLER	7. TYPE	8. ANALYSIS/ TURNAROUND	9. TAG No./ PRESERVATIVE/Bottles	10. STATION LOCATION	11. SAMPLE COLLECT DATE/TIME	12. ORGANIC SAMPLE No.	13. FOR LAB USE ONLY Sample Condition On Receipt

14. Shipment for Case Complete?
15. Sample(s) to be used for laboratory QC:
16. Additional Sampler Signature(s):
17. Cooler Temperature Upon Receipt:
18. Chain of Custody Seal Number:
19. Analysis Key:
Type: Comp, Grab (from Box 7)
20. Custody Seal Intact? ____
21. Shipment Iced? ____

22. TR Number:

PR provides preliminary results. Requests for preliminary results will increase analytical costs.
Send Copy to: Sample Management Office, 2000 Edmund Halley Dr., Reston, VA 20191-3400 Phone 703/264-9348 Fax 703/264-9222

LABORATORY COPY

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EPA

USEPA Contract Laboratory Program
Inorganic Traffic Report & Chain of Custody Record

1. Case No.:
DAS No.:

R

2. Region:
Project Code:
Account Code:
CERCLIS ID:
Spill ID:
Site Name/State:
Project Leader:
Action:
Sampling Co.:

3. Date Shipped:
Carrier Name:
Airbill:
Shipped To:

4. Chain of Custody Record

Sampler Signature:

Relinquished By: (Date/Time)	**Received By: (Date/Time)**
1)	
2)	
3)	
4)	

5. INORGANIC SAMPLE No.	6. MATRIX/ SAMPLER	7. TYPE	8. ANALYSIS/ TURNAROUND	9. TAG No./ PRESERVATIVE/Bottles	10. STATION LOCATION	11. SAMPLE COLLECT DATE/TIME	12. ORGANIC SAMPLE No.	13. QC Type

14. Shipment for Case Complete?

15. Sample(s) to be used for laboratory QC:

16. Additional Sampler Signature(s):

17. Chain of Custody Seal Number:

18. Analysis Key:

Type: Comp, Grab (from Box 7)

19. Shipment Iced?

20. TR Number:

PR provides preliminary results. Requests for preliminary results will increase analytical costs.
Send Copy to: Sample Management Office, 2000 Edmund Halley Dr., Reston, VA 20191-3400 Phone 703/264-9348 Fax 703/264-9222

REGION COPY

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GEOLOGIC LOG OF BORING

Boring No.________

Sheet _____ of _____

Project Name: Rainier Court Area 3 TBA
Project Location: Rainier Ave. S., Seattle, WA
Project No.: 12644.001.003.0113.00
Logged By:

Start Date ________ Hour ______
Finish Date ________ Hour ______
Driller ________
Drill Type/Method ________
Sampling Method ________
Boring Diameter ________
Total Depth
Depth to Water Date/Hour

	PID Reading	Grain Size (%)			Sample Number	Sample Recovery	Depth	Penetration Resistance	**Description** Lithology, (USCS classification), color, constituents, density, moisture, other features, (interpretation)	**Summary Log**
		G	S	F						
							0			
							1			
							2			
							3			
							4			
							5			
							6			
							7			
							8			
							9			
							0			
							1			
							2			
							3			
							4			
							5			
							6			
							7			
							8			
							9			
							0			

MONITORING WELL INSTALLATION REPORT

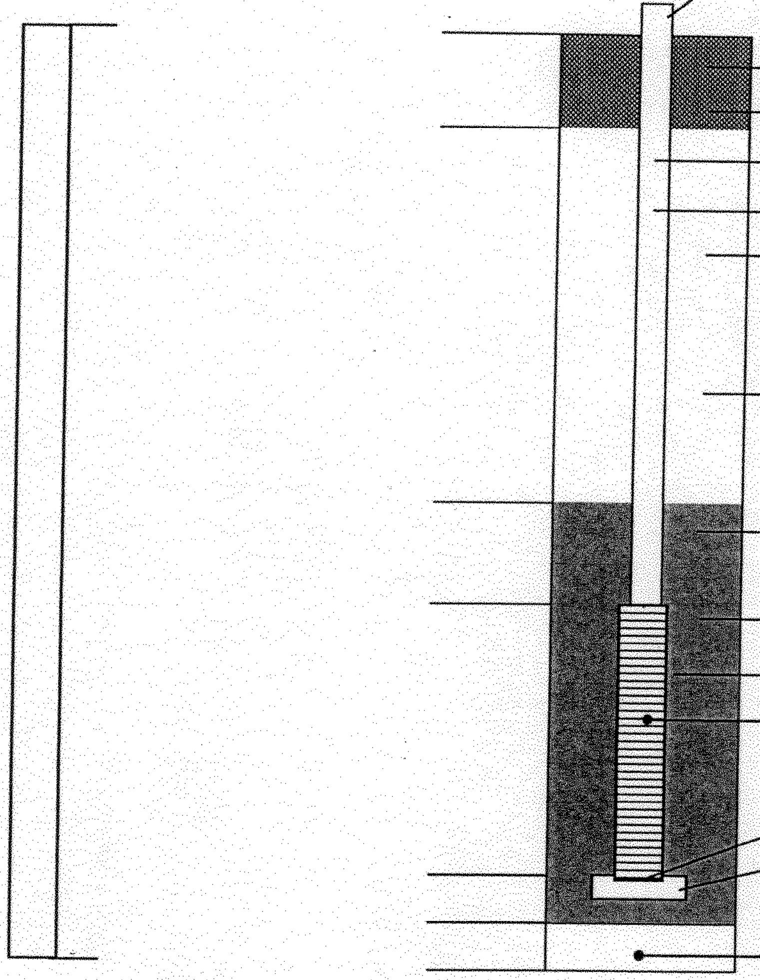
Project Name: ______________________ Well No.: ______________________

Project No.: ______________________ Observer: ______________________

Date/Time: ______________________ Drilling Method: ______________________

Soil Log

Depth of Components in feet



Stick up (feet) ____________

Approximate ground surface elevation (feet) ____________

Diameter of borehole (inches) ____________

Type of surface seal ____________

I.D. of riser pipe (inches) ____________

Type of riser pipe ____________

Type of backfill around riser ____________

Type of well seal ____________

Type of sand ____________

Length of top screen blank ____________

Screen size and type ____________

Water level ____________

Length of bottom screen blank ____________

Length of end cap ____________

Type of backfill material ____________

Remarks: ____

Amount of Materials:

Sand ____________ Monument ____________

Cement ____________ Riser ____________

Bentonite pellets ____________ Screen ____________

Bentonite/Volclay ____________ Other ____________

U:\Projects\EPA START 10\EPA Forms\Field Forms\Monitoring Well Installation Form.doc

WESTON SOLUTIONS

Groundwater Sampling Record

Project Name:

Project Location:

Project Number:

Date/Time:

Well ID:

Sample No.:

Sampler(s):

Weather:

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
	☐ Meas. ☐ Hist.	Initial		

Water Level Measurement Method: ☐ Electric Tape ☐ Other:

Well Evacuation Method: ☐ Peristaltic Pump ☐ Submersible Pump ☐ Bailer ☐ Other:

Purge Rate:

Begin Purge: Time: Total Volume Purged:

End Purge: Time: Well Volumes Purged:

Purge Water Disposed: ☐ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquibin ☐ Other:

Sample Collection Method & Analysis

Sample Type: ☐ Groundwater ☐ Surface Water ☐ Other:

Sample Time:

Sample Collection Method: ☐ Pump Type: Dedicated ☐ Y ☐ N ☐ Bailer ☐ Other:

Decon Procedure: ☐ N/A ☐ Alconox Wash ☐ Tap Rinse ☐ DI Water ☐ Other:

Sample Description (color, turbidity, odor, sheen, etc.):

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	

Notes:

Sampler Signature:

Date: ____________________ Well ID: ____________________

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity

Notes :

Well Development Log

PROJECT: ______________________
SITE: ______________________
WELL ID: ______________________
DATE: ______________________

MEASURED BY: ______________________
DEVELOPMENT METHOD: ______________________
COMMENTS: ______________________

ONE WELL VOLUME: __________ gallons
WELL TD: __________ ft TOC
Well Volume (gallons/foot): 2-inch = 0.16, 4-inch = 0.65, 6-inch = 1.47, 8-inch = 2.51

TIME	WELL DEV. CODE	DEPTH TO WATER (ft)	PURGE RATE (gpm)	PURGE VOLUME (gal)	FIELD MEASUREMENTS				TURBIDITY	COMMENTS
	FINAL									

WELL DEVELOPMENT CODES

DOB – Begin Overpumping
DOE – End Overpumping
DRB – Begin Rawhiding
DRE – End Rawhiding
DSB – Begin Surge Blocking
DSE – End Surge Blocking
DJB – Begin Hydraulic Jetting
DJE – End Hydraulic Jetting
DFM – Field Measurements
DAB – Begin Air Surging
DAE – End Air Surging
DCB – Begin Recirculation
DCE – End Recirculation
DBB – Begin Bailing
DBE – End Bailing
DXB – Begin Other
DXE – End Other
Other: ______________

FIELD MEASUREMENT CODES

MTP – Temperature
MSC – Specific Conductance
MPD – Photoionizer (eg., HNu)
MFD – Flame Ionizer (eg., OVA)
MDO – Dissolved Oxygen
MPH – pH
MEH – eH
MOT – Other: ______________

TURBIDITY

Enter Turbidity Meter Reading
(Final should be < 5 NTU)
OR
Enter Qualitative Observations

H – High: Muddy/Silty
M – Medium: Cloudy/Translucent
L – Low: Transparent
N – None: Clear/No Sediment

CORRECTIVE ACTION CHECKLIST

Project Name and Number:

Sample Dates Involved:

Measurement Parameter(s):

Acceptable Data Range:

Problem Areas Requiring Corrective Action:

Measures Required to Correct Problems:

Means of Detecting Problems and Verifying Correction:

Initiators Name: ______________________ Date:

Project Approval: ____________________ Date:

QA Officer/Reviewer: ________________ Date:

SAMPLE PLAN ALTERATION FORM

Project Name and Number:

Material to be sampled:

Measurement Parameter:

Standard Procedure for Field collection and Laboratory Analysis (cite references):

Reason for change in Field Procedure or Analytical Variance:

Variance from Field or Analytical Procedure:

Special Equipment, Materials, or Personnel Required:

Initiators Name: Date:

Project Approval: Date:

QA Officer/Reviewer: Date: