Appendix B-12

Sampling and Analysis Plan

SAMPLING AND ANALYSIS PLAN

US ECOLOGY NEVADA

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GROUNDWATER SAMPLING AND ANALYSIS PLAN

1.1 PURPOSE

This plan details the sampling, maintenance, and analytical methodologies and procedures which assure consistent groundwater quality data from a representative network of monitoring wells at the US Ecology Nevada Facility (USEN) located near Beatty, Nevada. This document complies with the requirements of 40 CFR Part 264, Subpart F and 270.14(c)(6)(iv), and is in accord with procedures described in the 1992 RCRA Groundwater Monitoring Technical Enforcement Guidance (TEGD) published by U.S. EPA Office of Solid Waste. This plan also describes the procedures used to collect leachate samples once the leachate has been pumped from the landfill.

1.2 APPLICABILITY

This plan applies to ground water sampling at US Ecology Nevada.

1.3 REQUIREMENTS

Groundwater sampling is conducted in a manner to ensure that representative samples have been collected.

1.4 SAFETY

Groundwater sampling is conducted in a safe manner based on procedures reviewed and discussed prior to beginning the work.

1.5 EQUIPMENT AND MATERIALS

Sampling equipment and materials are decontaminated as described in the decontamination section of this document.

The following equipment is required to conduct groundwater sampling:

- Clean sample containers with required labels and preservatives. (These containers may be supplied by an independent laboratory).
- Devices for measuring water level, well depth, and for detection of immiscible layers.
- Portable pH, conductivity, turbidity and temperature meters, and applicable standards and buffer solutions for calibration.
- Field Log Book (information must be recorded in ink).
- Non-phosphate detergent and deionized water from facility laboratory for decontamination of equipment (deionized water should be replaced daily when using for decontamination).
- Portable air compressor to drive sampling pumps.
- Dedicated sampling discharge hose (composed of inert material, e.g., Teflon).
- Coolers and ice packs for transport to the laboratory.
- Containers for purge water storage (where necessary due to potential contamination).

- Purge water discharge hose.
- Disposable gloves and paper towels.
- Chain-of-Custody forms and security seals.

1.6 PRECAUTIONS

- Smoking is prohibited during well sampling.
- All monitoring will typically begin at the upgradient well; downgradient wells will typically not be sampled prior to the upgradient well unless dedicated equipment is used in downgradient wells.
- All instruments used for in-situ or field measurements are calibrated each day prior to use in the field according to the manufacturer's specifications. Each calibration and calibration check must be noted in the field log book or other record. Recalibration is required only when the calibration check shows drift outside of the manufacturer's specifications.
- A new pair of gloves must be worn when sampling each well.
- Water levels (see Section 2.3, 2.4, and 2.5) at all wells will be measured before any of the wells are purged or sampled.
- Place the generator or air compressor as far away downwind from the well opening as possible to prevent the potential for detection of hydrocarbons from the exhaust fumes.
- Recalibrate equipment if erratic readings are encountered during sampling (i.e., are not within the expected range as compared to the previous sampling event).

2. SAMPLING PROCEDURE

Activities that occur during groundwater sampling are summarized as follows:

- pre-arrangement with testing laboratory for sample bottles and coolers,
- inventory and check integrity of sample bottles
- assembly and preparation of equipment and supplies,
- well head inspection
- water-level measurements
- visual inspection of water
- purging and sampling equipment to well
- on-site measurement of parameters
- groundwater sampling,
- secure and package samples
- sample labeling
- completion of sample records
- completion of Chain-of-Custody records, and
- sample shipment

Detailed sampling and analysis procedures are presented in the following sections.

2.1 ARRANGEMENTS WITH ANALYTICAL LABORATORY

Prior to sampling, arrangements are made with an analytical laboratory that conducts the sample analyses. The requirements for the laboratory are included in the analytical procedures and Quality Control (QC) procedures included in this document.

The laboratory provides a sufficient number of sample containers for the wells to be sampled and the blanks to be included. The laboratory selects the proper type and size for the containers, based upon the analyses to be conducted. For samples requiring chemical preservation, preservatives are added to containers. Shipping containers, ice chests with adequate container padding are sent to the facility with the containers.

2.2 OBSERVATION OF WELL CONDITION

During groundwater sampling events, the integrity and operation of monitoring wells is checked if possible. The items to be observed include:

- weather conditions for each sampling date
- ground-surface conditions, with typical notations to include, but not limited to flooding, ground subsidence, and presence of desiccation cracks, and
- the surface casing and/or locking mechanism inspection for deterioration of casing or tampering, and
- the locking mechanism, if present, will be lubricated periodically with a graphite lubricant.

These comments are recorded in the Field Log Book.

2.3 PREPARATION FOR SAMPLING FOR MONITORING WELLS

Prior to the sampling episode, equipment is assembled, checked-out, and calibrated in accordance with the procedures included in this document. Equipment (e.g. water level indicator and non-dedicated pumps and sampling equipment) is cleaned prior to and after obtaining a sample in accordance with the decontamination procedures included in this document.

2.4 DECONTAMINATION PROCEDURES

Water used for equipment cleaning will be the distilled or de-ionized water from the site laboratory and non-potable water obtained from the site well. As practical, equipment cleaning fluids will be collected, stored, and disposed of in a manner consistent with local, state, or federal rules or regulations.

Portions of sampling and test equipment that contact the sample will be thoroughly cleaned before use for sampling. Equipment must be cleaned before and after a sample is taken. This includes water-level tapes or probes, non-dedicated pumps, tubing, and test equipment for field parameters. The procedure for cleaning pH, specific conductance, temperature, and turbidity field measurement equipment is a

thorough de-ionized or distilled water rinse between wells. The procedures for equipment cleaning are as follows, unless otherwise specified by the manufacturer:

- rinse with distilled or de-ionized water,
- air dry, and
- use equipment immediately, or pack equipment in plastic wrap or bags, or in aluminum foil.

Any necessary deviation from these procedures will be documented in the Field Log Book.

2.5 SAMPLING PROCEDURES

Special care is exercised to prevent water-quality changes to the groundwater and extracted samples during the sampling activities. The three primary ways in which such impacts can occur are:

- contamination of a sample through contact with improperly cleaned equipment; or
- cross-contamination of the groundwater through insufficient cleaning of equipment between wells, and
- impacts of purge and sampling procedures as observed through changes in turbidity.

Sampling equipment is cleaned before and after field use and between uses at different sampling locations according to the decontamination procedures in this document. In addition to the use of properly cleaned equipment, three further precautions are followed:

- a clean pair of new, disposable latex (or similar) gloves will be worn each time a different well is sampled, and
- sample collection activities will progress from the up-gradient to the down-gradient area. Wells described as "background" or "up-gradient" wells will be sampled first unless dedicated purging and sampling equipment is used.
- A minimum of one gallone of well water is discharged through the sample hose prior to filling samples bottles.

The following paragraphs present procedures for the several activities that comprise groundwater sample acquisition. These activities are performed in the order presented. Exceptions to this procedure are noted in the permanent sampling record.

2.5.1 Preparation of Location

Prior to starting the sampling procedure, the area around the well will be cleared of foreign materials such as brush, debris, etc to reduce the possibility of surface materials contaminating the sampling equipment or the well.

2.5.2 Water-Level Measurement

The first sampling operation is water-level measurement. An electrical probe is used to measure the depth to groundwater below the datum to the nearest 0.03 foot (0.01 meters). The datum, is the top of the

sounding tubes in most wells or the top of the pump support plate in wells with out sounding tubes. The measurement and datum used should be entered in the Field Log Book.

Water levels will be measured in all monitoring wells prior to any quarterly purging and sampling event. The water level-probe will be cleaned in accordance with the decontamination procedures described in this document with distilled or de-ionized water rinse between usage at different wells. For wells with extended sampling frequency (e.g., the 600-series wells), the water level measurements will be recorded prior to the sampling event, or during the total well depth measurement once every two years, if no other sampling is scheduled for the year.

2.5.3 Total Depth Measurement

USEN will measure the total depth of the monitoring wells once every two years. The water level will be measured as described above prior to the total depth measurement. Once the water level has been measured and recorded, the water-level probe or a weighted tape will be lowered slowly to the bottom of the well. The depth to the bottom will be measured and recorded in the Field Log Book to the nearest 0.1 foot. The probe or tape then will be withdrawn slowly from the well. The bottom of the probe or tape will be observed after withdrawal for evidence of any immiscible materials. Observations, and measurements if possible, of such materials will be made from observation of the probe or tape.

2.5.4 Immiscible Layer Observations and Measurements

Immiscible layers are reflective of gross contamination in the groundwater. Groundwater containing low concentrations of organic contamination would not be expected to exhibit immiscble layers. Personnel at USEN will monitor groundwater sampling results and conduct an immiscible layer check on any well having concentrations of organic contaminants greater than 1% of the constituents solubility in water if the organic contaminants presence are verified in the groundwater. Example threshold concentration limits for some common waste constituents are attached in Table 1.

Table 1 - Solubility Based Indicator of Possible LNAPL / DNAPL

Constituent	Solubility Limit (mg/L)	NAPL Threshold Limit (mg/L)
Carbon Tetrachloride	800	8
Chloroform	9300	8.22
Tetrachloroethene	150	1.5
Toluene	510	5.15
100	1	

Notes: Threshold limit based on 1% of solubility limit from "Estimating Potential for Occurrence of DNAPL at Superfund Sites."

In the event that an organic contaminant exceeds the limits in Table 1, the following procedure for checking for immiscible layers will be followed.

Prior to the next well sampling event a check for the presence of immiscible layers should be performed before well purging using an electronic interface meter. The meter shall be calibrated in the laboratory prior to the sampling event following manufacturer's instructions. The measuring device must be properly

decontaminated in accordance with the procedures included in this document with a nonphosphate detergent followed by tap water and deionized water rinses.

The interface meter must be lowered slowly into the well and the meter response monitored continuously (as detailed in the device's instruction manual). The probe shall respond with different warnings if immiscible layers are detected. The probe must be slowly raised and lowered to determine if the appropriate response is occurring at both the surface of the groundwater and at the bottom of the well. The results of the measurement of the top of the phase and the bottom of the phase for either LNAPL (Light Non-Aqueous Phase Liquid) or DNAPL (Dense Non-Aqueous Phase Liquid) must be recorded in the Field Log Book. If non-aqueous phase liquids are detected, the Facility Manager or designee must be contacted immediately. The Facility Manager or designee shall contact NDEP within seven days of confirmation of immiscible layers. If immiscible liquids are detected, obtain a sample using a bailer. If the immiscible layer is a LNAPL, slowly lower the bailer until contact is made with the surface of the LNAPL. The bailer should then be lowered to allow a sample of the LNAPL to be collected, but not to submerge the top of the bailer. The sample should be placed in a 40 ml VOA vial (see Appendix 1 for a description of sampling containers). A double check valve bailer may be necessary to sample a DNAPL. To collect a DNAPL sample, the bailer should be slowly lowered to the bottom of the well, and the fluid sample collected. Care must be taken to prevent loss of the fluid during recovery. The bailer should be recovered through the water column in a smooth, continuous fashion to prevent the check valves from releasing the liquid.

2.5.5 Visual Inspection of Well Water

At the start of well purging, a small quantity of water is collected in a clean container for visual inspection. The water is inspected for clarity and odor. These observations regarding clarity or are recorded in the Field Log Book.

2.5.6 Well Bore Purging

Water contained within, and adjacent to, the well casing potentially can reflect chemical interaction with the atmosphere (by diffusion of gases down the casing) or the well construction materials (through prolonged residence adjacent to the casing). This water is removed (purged) from the well prior to sampling.

The volume of water contained within the well bore at the time of sampling is calculated, and three times the calculated volume is removed from the well. Decontaminated bailers, decontaminated pumps, or dedicated pumps are used for well bore purging.

Calculation of the volume of water to be evacuated is done as follows:

Volume of water in well:

$$V_w = \frac{3.142\,(d_w^2)\,(L_w)\,(7.48)}{4}$$

3 casing volumes

for 6" diameter wells = 4.4 x L_w

for 4" diameter wells = 2.0 x L_w

where:

V_W = water volume in well (gallons)

d_W = inside diameter of well (ft)

L_W = length of water column in well (ft).

The calculated water volume is recorded in the Field Log Book.

Purge rates for wells have been calculated and are located in the Field Log Book. Purge wells at rates of 1.0 to 1.3 gallons per minute and record the rate in the Field Log Book for each sampling event. The directions in the pump operating manual must be followed in purging the calculated volume of water. Record any problems with the pump or equipment in the Field Log Book.

Initially and approximately every 5 to 10 gallons (use larger intervals on high volume wells),obtain field readings for temperature, specific conductance, pH, and turbidity. A minimum of three readings will be obtained. Purging shall cease when the following equilibration/stabilization has occurred between successive readings:

- a minimum of 3 casing volumes
- pH plus, or minus, 0.1
- turbidity < 2.0 NTU plus, or minus, 10%
- conductivity, plus, or minus, 3%

For wells that have dedicated pumps, if, after three well volumes, the above parameters do not achieve the above equilibration, continue purging, taking readings every three minutes. For wells that are bailed, if, after three well volumes, the above parameters do not achieve the above equilibration, continue purging taking a sample from each new bail volume. If stabilization does not occur after a maximum of five well volumes is removed, purging will cease and the well will be sampled. Record all measurements in the Field Log Book including the notation that stabilization was not achieved. A maximum of five volumes is allowed for purging. Any additional purging will result in overdevelopment of the well.

For wells that can be evacuated to a dry state, the well is evacuated completely, and the sample taken as soon as sufficient water for sampling is present in the well within 24 hours. Wells incapable of yielding the calculated purge volume will be pumped to dryness, and so noted in the Field Log Book. Field samples are to be taken at each well volume obtained prior to the well going dry and one set must also be obtained

after the well sample has been obtained. Field samples should be recorded in the Field Log Book. Sample compositing, or sampling over a lengthy period by accumulating small volumes of water at different times to eventually obtain a sample of sufficient volume, is not allowed.

Purge water from wells will be collected and placed in the wash pad.

2.5.7 Sample Collection

Dedicated pumps and one non-dedicated pumps are used to collect water samples from the wells. Wells shall be sampled as soon as practical after purging. For low-yield wells (i.e., wells pumped to dryness), samples should be taken as soon as sufficient volume is available, if feasible. Purging and sampling of low-yield wells must be completed within a 24-hour period.

A down-hole, positive displacement pump is used in the wells where a dedicated pump is used for sampling. A non-dedicated pump is used for purging and sampling wells without dedicated pumps. In both situations the pump intake is positioned in the lower portion of the screened interval.

The procedures in the pump operating manual must be followed to avoid damage to the pump, however, the pump must be operated in a manner that does not compromise the samples (the pump fluctuation should be kept to a minimum). Handling of pump level controls and other fittings shall be minimized. Clean sampling gloves will be required before handling the lids of sampling containers if prolonged handling of controls, which require lubrication, is performed. All air hose quick-connections must be checked for a secure fit, and hoses must not be disconnected while still under pressure.

Appendix 1 describes the sample container and preservatives required for the parameters to be analyzed. Once sample containers have been filled they should be refridgerated as soon as possible. For shipment the samples shall be placed in a cooler with sufficient ice to ensure that the sample is kept chilled. Sample containers should not be allowed to remain in direct sunlight once they have been filled.

Prior to use, sampling containers received from the laboratory should be stored in a clean environment. Sampling containers should come from the laboratory that will be performing the analysis. Avoid using containers that have been cleaned on-site whenever possible (with the exception of field analysis containers).

The samples should be transferred directly from the pump discharge tube into the sample container, minimizing contact with the outside air. It is not an acceptable practice to pour samples into a wide-mouth container and then transfer to another sample container.

Samples shall not be obtained at a rate that exceeds the purge rate. When sampling for volatile organic compounds (VOCs), the pump should be reduced to the minimum sustainable rate.

Use caution when filling sampling containers that contain preservative to prevent sampler contact with the preservative and to possible loss of preservative. When sampling for VOCs, each vial should be filled until there is a meniscus over the lip of the vial. After tightening the lid, the vial should be inverted and

tapped to check for air bubbles. If any bubbles larger that 1 mm (based on visual estimation) are present, the vial must be refilled or sample added to minimize bubbles.

The samples collected by bailer should be collected in the order of volatilization sensitivity, as follows:

- Volatile Organic Compounds (Method 8240/8260)
- Semi-volatile Compounds (Method 8270)
- Organochlorine Pesticides and PCBs (Method 8082)
- Chlorinated Herbicides (Method 8150)
- Metals and Total Cyanide
- Major water quality cations and anions
- Radionuclides

Sample order is not significant when sampling by dedicated pumps. Each container must be capped securely and labeled. Labels should be legible and sufficiently durable even when wet. The label should be affixed to the sample container prior sampling, or use containers pre-labeled by the independent laboratory conducting the analysis. The following information must be recorded on the label:

- Sample identification number
- Date and time of sample collection
- Parameter(s) or analytical method(s) requested (if space permits)
- Preservatives used
- Place of Collection
- Name or initials of sampler

2.6 SAMPLE HANDLING

Samples are prepared, labeled, stored, and shipped in accordance with the procedures included in this document. Samples also are subject to the custody procedures included in this document.

The shipping container is sealed, so that it will be obvious if the seal has been tampered with or broken. The Chain-of-Custody documentation is placed on the inside of the container, so that it will be immediately apparent to the laboratory personnel receiving the container, but will not be damaged or lost during shipping.

Following sampling, the well cap will be locked and security sealed to assure its integrity for the next sampling. Record the new security seal in the Field Log Book. The Field Book Log will be reviewed for completeness before the sampler moves to another sample point.

All samples will be placed in shipping containers and transported to the dedicated sample refridgerator as soon as possible after sampling. In the event the sample refridgerator is inoperable or unavailable Ice packs or blue ice shall be used to ensure that samples are kept chilled until shipped to the laboratory.

Samples should be packed with sufficient packing material to minimize the potential for breakage during transport to the laboratory. Polyethylene overpack bags shall be used to contain the ice needed to keep the samples at 4 degrees C. As the samples are packed, all the required information shall be listed on the chain of custody form (Appendix 2). When all the samples have been packed, the shipping container will be sealed (See Section 3.2). The chain of custody shall be sealed in a zip lock plastic bag and placed inside the shipping container.

The samples will be analyzed per permit conditions.

Unless other instructions are given by the analytical laboratory, the sample containers will be completely filled. No air bubbles or headspace is allowed in samples collected for analysis for volatile organic compounds.

3. DOCUMENTATION OF FIELD ACTIVITIES

Identification and recordkeeping are as important as sound sampling techniques. This section addresses the documentation procedures required for field activities and transportation of the sample from the facility to the laboratory.

All information pertinent to field sampling must be documented, regardless of the type of sample. The Field Log Book should be a bound book, preferably with consecutively numbered pages. The following information must be documented and maintained in operational records.

- Sample location.
- Date.
- Depth to bottom of well (from surveyed measuring point), technique, and field meter used.
- Depth to water prior to purging (from surveyed measuring point), technique, and field meter used.
- Documentation of immiscible layer check, detection method, sample collected (if any), and field meter used.
- Time of purge, calculations for purge volume and actual volume purged, well yield, purged to dryness, any field changes in procedure made or deviations from the Sampling and Analysis Plan regarding purging, and purge pumping rate.
- Field measurements (pH, temperature, turbidity and specific conductance), method and field meter used.
- Purpose of sampling (i.e., RCRA, TSCA compliance).
- Field observations, includes general weather observations (air, temperature, wind direction, and strength), activity in sampling area, odor from the well, color and any other pertinent observations.
- Name of sample collector(s).
- Documentation of calibration of pH, and conductance meters, turbidity meter, well depth indicator (if separate from water level indicator), and immiscible layer meter used.

- The type of pump used for sampling will be entered in the log book at the beginning of the sampling event. If a sample is taken by equipment different from this pump, it shall be documented in the entry for that well.

Since sampling situations vary widely, no general rules are provided for the amount of information required. The best guideline is to record sufficient information so that anyone can reconstruct the sampling effort without reliance on the collector's memory. The Field Log Book(s) are filed chronologically when complete.

3.1 CHAIN OF CUSTODY RECORD

The Chain of Custody (COC) Record is the most important document in the entire process. When properly completed and signed, it is considered to be a suitable legal document in testimony regarding the validity of the sample. Each person who has the custody of the sample from the time it is collected until all analyses have been conducted should sign and date this document. Each signature acknowledges that the sample was secure from any outside forces (tampering) during the custody period. An example of a chain of custody form is included in Appendix B.

The COC Record also serves as official communication to the laboratory of the specific analyses required of each sample. After completing and signing the COC Record, the sample collector should file one copy and seal the original in the sample shipping container. When the samples are received at the laboratory, the individual taking possession of the samples should sign and date the COC form. The original COC Record will be returned to the facility with the analytical results.

3.1.1 Security Seals

Personnel from the delivery services employed to transport the samples to the laboratory are exempted from the Chain of Custody signatory requirements. As a protective measure, a security seal is affixed to the shipping container in such a way that the seal shall not come off and must be broken in order to access the container. The security seal is signed and dated by the sampling personnel. The integrity of the seal will be checked by the receiving laboratory's personnel before signing the Record. If the seal has been broken, the laboratory will inform the Environmental Manager or the Facility Manager.

3.2 SHIPMENTS

Groundwater monitoring samples should be forwarded to the analytical laboratory within 24 hours of sampling. If the sample cannot be shipped within 24 hours of sampling, or is to be held over night at the facility, it will be stored in the ground water laboratory refrigerator, along with the trip and field blanks, at about 4 degrees C until shipment.

Groundwater samples are shipped in containers maintaining temperatures at approximately 4^0C.

4. QUALITY ASSURANCE/QUALITY CONTROL

One equipment blank sample (distilled water) will be prepared for each sampling event. This sample will be obtained by collecting rinsate from the non-dedicated sampling equipment.

4.1 TRIP BLANKS

The independent laboratory shall provide trip blanks filled with deionized water. The blanks shall be transported to the sampling location and returned to the laboratory in a manner identical to the handling procedures used for the samples. The blank is not opened in the field. One trip blank shall be submitted to the laboratory each day that samples are taken, and analyzed at a minimum frequency of one per quarter. The trip blank shall be analyzed for volatile organics. The concentration levels of any contaminants found in the trip blank may not be used to correct the groundwater data. Comparison of trip blank contaminant levels to groundwater samples can form the basis for reassessing laboratory performance, discounting unreliable sample data, or deciding on well resampling requirements.

4.2 EQUIPMENT BLANKS

To ensure that any non-dedicated sampling devices have been properly cleaned between uses, the decontaminated device should be filled and or rinsed with deionized water and this water transferred to sample containers. The containers will be returned to the laboratory for the same analysis as the groundwater samples. If contaminants are found in the blanks, the source of contamination should be identified, and corrective action should be initiated, if appropriate. Equipment blanks will be submitted for analysis at the frequency of one per twenty samples for each type of non-dedicated sampling equipment and at a minimum frequency of once per quarter. Unless the equipment blank contains rinsate from all the above listed equipment, identification of which equipment rinsates were used should be included in the Field Log Book.

4.3 FIELD BLANKS

Field blanks are collected by pouring deionized water into labeled clean containers in the field. The blank is sent to the laboratory with the groundwater samples for analysis. Field blank samples are collected immediately after the well sample and at the well head with all equipment (air compressor and sample pump) operating. The intent is to fill the sample containers in the same manner and under the same environmental conditions as the ground water sample was collected. Field blanks shall be submitted at the minimum frequency of one per sampling event, not to exceed 20 wells. Field blanks will be analyzed for the most complete set of parameters for monitoring well samples collected.

4.4 LABORATORY QA/QC

USEN will only use a laboratory which exercises a proper QA/QC and data, management program, consistent or superior to SW-846 procedures. Upon receipt, the laboratory shall record the presence of headspace in VOA vials and the temperature of the sample.

4.5 REPORTING PROCEDURES

The Facility Manager or his desginee shall report data to NDEP on reporting sheets and/or electronically. The units of measure shall accompany each target analyte. The units of measure for a given target analyte shall be consistent throughout the report. The report shall include the value of the constituent determined by the laboratory, the date the sample was collected, the date the sample was received by the laboratory, the analytical method, and the detection limit. Data obtained from analysis of field and trip blanks shall also be submitted along with laboratory QA/QC data.

5. SAMPLING FREQUENCY

5.1.1 Detection Monitoring

The concentrations of the parameters listed in the permit will be determined for all detection monitoring wells during the active life and closure period of the facility quarterly.

The elevation of the groundwater surface and the total well depth must be determined at each monitoring well at least annually. Ground-water elevations are measured in wells prior to purging and sampling.

5.1.2 Compliance Monitoring

Compliance monitoring, if necessary, will be performed as specified in the permit. Compounds identified in Appendix IX Part 264 will be monitored at least every 2 years.

6. ANALYTICAL METHODS

Analytical methods are consistent with the intent and requirements of the latest edition of "Test Methods for Evaluating Solid Waste", U.S. EPA, SW-846. When an SW-846 method is not available or appropriate, alternative methods will be selected from sources such as "Standard Methods for the Examination of Water and Wastewater" and "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020 and submitted to NDEP as a permit modification.

Examples of specific methods are:

- Volatile Organic Compounds: SW-846 Method 8240/8260
- Organochloride Pesticides and PCBs: Method 8082
- Chlorinated Herbicides: Method 8150
- Semivolatile Organic Compounds: Method 8270

Examples of acceptable analytical methods are presented in Table 2.

7. MONITORING WELL AND EQUIPMENT INSPECTION

Monitoring wells and well monitoring equipment are inspected each time a sample is collected. The Facility Manager or designee will inspect for the following and record the results in the field log:

1. Inspect the protective well casings, locking cap and lock for cracks, damage, and any other signs of deterioration.
2. Inspect well pad for cracks or sign of deterioration.
3. Ensure that well identification number is legible.
4. Inspect pumping equipment for structural integrity and proper operation.

Any deficiencies noted will be brought to the attention of the Facility Manager or designee. Corrective actions will be taken, as expeditiously as possible, and will be noted in Field Log Book.

Table 2 - Sample Preparation and Analytical Methods

Parameter	Preparation Method	Analytical Method	Detection Limit
Volatile Organics	5030	8260	5 ug/L or PQL
Semi-volatile organics	3520	8270	PQL
Arsenic	3005,3010	7060	2 ug/L
Barium	3005,3010	6010	0.05 ug/L
Cadmium	3005,3010	6010, 7131	4 ug/L, 1 ug/L
Chloride		9250, 9251, 9252, 9553, 325.2	1 mg/L
Chromium	3005,3010	6010	0.05 mg/L
Fluoride		9200, 340.2	0.1 mg/L
Lead	3005,3010	9010, 7421	0.05 mg/L
Mercury	3005,3010	7470, 7471	0.004 mg/L
Nitrate		9200, 353.2, 353.1	0.05 mg/L
Sulfate		9036, 9038	1 mg/L
Sodium	3005,3010	7770, 6010	1 mg/L
Total Dissolved Solids		EPA 160.5, 160.1	1 mg/L
Selenium	3005,3010	6010, 7740	4 mg/L
Silver	3005,3010	6010	0.005 mg/L
Endrin	3510, 3520	8081, 8270	0.05 ug/L
Lindane	3510, 3520	8081, 8270	0.02 ug/L
Methoxyclor	3510, 3520	8081, 8270	0.2 ug/L
Toxaphene	3510, 3520	8081, 8270	0.5 ug/L
2,4-D	3510, 3520	8081, 8270	2ug/L
2,4,5-TP Silvex	3510, 3520	8081, 8270	2 ug/L
Radium		9315, 9320, SM704, SM705, 903, 904, 901.1M	Variable
Tritium		906.0	Variable
PCBs	3510, 3520	8082	0.5 ug/L
Cyanide		9010, 9012	0.005 mg/L

8. LEACHATE SAMPLING PROCEDURES

Leachate generated from the landfills are typically collected in 275 gallon plastic totes and always remain in the landfill area. Prior to sampling the totes will be moved to the outer edge of the landfill as to give the sampler better access to the totes. The method for extracting the leachate out of the totes is at the discretion of the sampler but several methods have been used in the past and are considered acceptable:

1. Use of a bottom feeding bailer with closure device
2. Disposable coliwasa
3. Dispenser valve at the bottom of the tote

Whatever method the sampler chooses to use to extract the leachate from the totes the removed leachate will be placed into a clean DI jug or container and then transferred into all the sampling containers. Once

the leachate samples have been collected they will be managed in a similar fashion as the other groundwater samples as described in Sections 2.6 to 3.2, 4.4, and 4.5 and analyzed using the methods outlined in Table 2.

Lastly, when filling out the Chain of Custody (COC) for the leachate samples it is a good idea to indicate "High Concentrations" in the comments section of the COC as to give the laboratory notice. This is not required but a courtesy to the laboratory analzing the samples.

APPENDIX A

SAMPLING AND PRESERVATION PROCEDURES

FOR DETECTION MONITORING

Appendix A

SAMPLING AND PRESERVATION PROCEDURES

FOR DETECTION MONITORING

Parameter	Container	Holding Time	Preservative
Volatiles	2 x 40 ml, glass vial with Teflon septum – no head space	14 days	HCl, pH<2; Cool 4° C
Arochlors, Semivolatiles, Pesticides/Herbicides	1 x 1 L, glass amber with lid lined with fluorocarbon resin	7/14 days (prep) 40 days (analysis)	Cool, 4° C
Metals (except mercury)	1 x 500 ml, plastic polyethylene bottle with polypropylene cap	6 months	HNO_3, Ph < 2
Cyanide	1 x 1 L, plastic polyethylene bottle with polypropylene cap	14 days	NaOH, pH >12
Radiochemistry	2 x 1 L, plastic polyethylene bottle with polypropylene cap	6 months	HNO_3, pH < 2
Nitrate and Sodium	1 x 1 L, glass amber bottle with a Teflon lined lid	28 days	H_2SO_4, pH < 2
Chloride, Fluoride, Sulfate	1 x 1 L, plastic polyethylene bottle with polypropylene cap	28 days	None
Total Dissolved Solids	1 x 1 L, plastic polyethylene bottle with polypropylene cap	7 days	None
Mercury	1 x 500 ml, plastic polyethylene bottle with polypropylene cap	28 days	HNO_3, pH < 2

Appendix 2

Sample Chain of Custody

CHAIN-OF-CUSTODY

WWW.ANALYSYSINC.COM

AnalySys Inc.
3512 Montopolis Drive, Austin, TX 78744
Phone: (512) 385-5886 Fax: (512) 385-7411
2209 N.P.I.D., Ste K, Corpus Christi, TX 78408
Phone: (361) 289-6384 Fax: (361) 289-0875

Send Reports To:
Company Name _____
Address _____
City _____ State ____ Zip _____
ATTN: _____
Phone _____ Fax _____

Bill to (if different):
Company Name _____
Address _____
City _____ State ____ Zip _____
ATTN: _____
Phone _____ Fax _____

Rush Status (must be confirmed with lab mgr.): _____
Project Name/PO#: _____ Sampler: _____

Analyses Requested (1)
Please attach explanatory information as required

Client Sample No. Description/Identification	Date Sampled	Time Sampled	No. of Containers	Soil	Water	Waste	Lab I.D. # (Lab only)										Comments

(1)Unless specifically requested otherwise on this Chain-of-custody and/or attached documentation, all analyses will be conducted using ASI's method of choice and all data will be reported to ASI's normal reporting limits (MDL/PQL). For GC/MS volatiles and extractables, unless specific analytical parameter lists are specified on this chain-of-custody or attached to this chain-of-custody, ASI will default to Priority Pollutants or ASI's HSL list at ASI's option. Specific compound lists must be supplied for all GC procedures.

Sample Relinquished By				Sample Received By			
Name	Affiliation	Date	Time	Name	Affiliation	Date	Time

[Tendering of above described samples to AnalySys, Inc. for analytical testing constitutes agreement by buyer/sampler to AnalySys, Inc.'s standard terms.]

Appendix 13 E

Statistical Analysis of Groundwater Monitoring Data

AquAeTer optimizing environmental resources | water, air, earth

7430 East Caley Avenue, Suite 310 • Centennial, CO 80111 • Phone (303) 771-9150 • Fax (303) 771-8776

February 19, 2010 093196

US Ecology Nevada, Inc.
PO Box 578
Beatty, Nevada 89003

Attention: Mr. Scott Wisniewski

RE: Assistance with Statistical Analysis of Groundwater Monitoring Data
US Ecology Nevada, Inc., Beatty, Nevada

Dear Mr. Wisniewski:

AquAeTer, Inc. has completed the statistical analysis of groundwater monitoring data at the US Ecology Nevada, Inc. (USEN) facility located in Beatty, Nevada. The scope of monitoring data analysis is described in **AquAeTer's** proposal #093196P, as authorized by USEN on August 11, 2009.

BACKGROUND

AquAeTer assisted USEN with statistical analysis of monitoring data for background well MW-313 in 2003. At the time of that previous statistical analysis, the USEPA statistical program GRITS/STAT was used. The GRITS/STAT program, which no longer is supported by USEPA, was determined to be of limited value for long-term data management and was not used for the present data analysis. **AquAeTer** recommended and received your approval to integrate USEN's groundwater sampling database into the electronic data management and statistical analyses program DUMPStat®. **AquAeTer** has used DUMPStat® as a data management tool for other landfill facilities, where we have evaluated monitoring data by the methods offered by the program (e.g., intrawell or up-to-down-gradient) and in a manner that is compliant with regulatory requirements.

STATISTICAL ANALYSIS METHOD

DUMPStat® is a program for the statistical analysis of groundwater monitoring data using methods described in Statistical Methods for Groundwater Monitoring by Dr. Robert D. Gibbons. The program allows direct importation of laboratory analytical data in Laboratory Information Management System (LIMS) format. The program provides the capacity for complete analysis of wells and monitored constituents; allows selecting the appropriate statistical method to accomplish the desired data analyses while minimizing false positive and false negative rates. The DUMPStat® statistical procedures are consistent with USEPA Subtitle C

and D regulations and guidance, and with ASTM D6312-98, "Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs."

DUMPStat® statistical methods include interwell (up-gradient to down-gradient) comparisons where up-gradient well data characterize the natural temporal and spatial variability that is observed in the down-gradient wells, as well as intrawell comparisons where the data history for individual wells is evaluated to identify evidence of potential impacts. The intrawell method is applicable at unimpacted wells with a sufficiently long historical database, usually at least eight measurements for each parameter. DUMPStat® uses Microsoft Access® as the database management software.

REGULATORY APPROVAL

AquAeTer notes that using DUMPStat® as the statistical analysis method for the Beatty facility will be a deviation from current RCRA Permit requirements that likely will require NDEP approval in order that the regulatory requirements are satisfied by the statistical analyses performed and the DUMPStat® reporting format.

Section 10.8.4 of the facility's RCRA Permit requires that USEN "determine whether there is a statistically significant increase over the Groundwater Protection Standards for each parameter identified in Table 4 each time groundwater quality is determined at the compliance point." Further, at 10.8.4.1, the Permit says that "a statistically significant increase is determined by comparing each groundwater monitoring result to the corresponding background limit." **AquAeTer** notes that the exceedence the Permit defines as a "statistically significant increase" actually is a non-statistical comparison of the observed groundwater quality at POC wells and the pre-determined background criterion listed in Permit Table 4. Although the background criterion might have been developed by a statistical method when the Permit was written, the Table 4 values do not consider temporal changes to background since that time and probably do not consider the spatial variability that would be represented by considering data from all up-gradient wells.

Organic constituents seldom result from natural causes, thus are appropriately considered to be potential facility-caused impacts that can be identified by comparison to criteria that are not site-specific, such as laboratory reporting limits or State or federal water quality standards (e.g., GWPS values). Many inorganic and indicator constituents potentially are naturally occurring and, as such, potential facility-caused impacts appropriately are identified using statistical methods to identify conditions that differ from natural occurrences. The DUMPStat® interwell method used by **AquAeTer** for the data comparison summarized in this letter is a statistical method that makes a site-specific data comparison for inorganic and indicator constituents. That is, the statistically determined constituent concentrations (i.e., control limits or prediction limits) derived for data from the three up-gradient wells are site-specific and event-specific values that probably will differ from the groundwater quality standards in Table 4 of the Permit.

DUMPStat® manages, reports, and displays the results of groundwater monitoring for organic constituents and will provide tabulated or graphical comparisons between observed concentrations in monitor wells and groundwater quality criteria. Though not a statistical data evaluation, the program manages these organic constituent data and identifies exceedences that can be simple detections or actual exceedences of water-quality criteria concentrations. Examples of tabular and graphical output for organics are attached.

SITE-SPECIFIC STATISTICAL DATA EVALUATION

The first task of the statistical analysis required **AquAeTer** to import USEN groundwater monitoring data from three up-gradient monitor wells and 15 down-gradient monitor wells (i.e., point of compliance, POC, wells). The data import covered all groundwater monitoring constituent data collected between 2002 and 2009, except for radiological analysis. Since monitor well MW-313 was designated the up-gradient well for previous statistical analysis, additional data for this well covering the time period from December 1988 to December 2001 also were imported. Data import also included leachate data and groundwater data for 600-series Supplemental Wells. The result of the data import process is the availability of a comprehensive electronic groundwater database for the USEN facility that covers sampling events for POC wells between 2002 and 2009, and historical groundwater data for several wells. Future groundwater analytical data can be added to the database, providing future users with access to the comprehensive data set.

In order to provide NDEP with a sample of the data evaluation generated by DUMPStat® and the proposed format of future groundwater data statistical analysis, **AquAeTer** performed the following statistical analyses.

- Up-to-down-gradient comparisons. Such comparisons were made for three up-gradient wells (MW-313, MW-318, and MW-319) and 15 down-gradient POC wells (MW-001, MW-002, MW-308, MW-309, MW-310, MW-311, MW-315A, MW-316, MW-317, MW-320, MW-322, MW-324, MW-325, MW-326, and MW-327).

- Changes in analytical methods. Considered whether inorganic and indicator constituent results done by different analytical methods can be grouped together (called 'aliasing' in DUMPStat®). Accomplished by grouping concentration data by various analytical methods as a single data set for each inorganic or indicator constituent. The initial conclusion is that inorganic and indicator data from the different analytical methods can be grouped to provide acceptable results.

- Reporting of statistical analyses. Analysis output consists of trend graphs of concentration versus time, up-gradient prediction limit, and the 2009 groundwater quality standard from USEN's RCRA Permit. In addition, summary statistics and prediction limit tables are generated. Example trend graphs for metals and indicators are attached.

AquAeTer ran statistic analyses for three groupings of inorganic and indicator constituents. The results of these DUMPStat® statistical analyses are as follow.

1. Water-quality constituents (including chloride, specific conductance, cyanide, fluoride, nitrate/nitrite-n, pH, sulfate, TOX, TOC) in groundwater.

    - When using the up-gradient groundwater data set from 2002 to 2009, DUMPStat® determined that there were only two exceedences in the down-gradient (POC) data set. These are for pH at well MW-310 and MW-315A.

    - After increasing the time period included in the up-gradient data set by adding up-gradient groundwater monitoring results from 1988 to 2009, DUMPStat® determined that there were no exceedences in down-gradient wells.

2. Metals constituents (Ag, As, Ba, Cd, Cr, Hg, Na, Pb, and Se) in groundwater.

    - Using background data from 2002 to 2009, DUMPStat® determined that there were no exceedences in the down-gradient (POC well) data set.

    - After including up-gradient data from 1988 through 2009, DUMPStat® again determined that there were no exceedences.

3. Radiological constituents (gross alpha, gross beta, radium-226, radium-228, tritium) in groundwater.

    - Using background data from 2002 to 2009, DUMPStat® found no exceedences; however, the statistical analysis of these data probably does not appropriately consider the uncertainty associated with reporting of radiological analyses.

An attached tabulation summarizes the results of up-gradient monitoring data evaluation by DUMPStat® as a comparison between the prediction limits determined by the program for up-gradient well data through 2009 with the groundwater protection standards contained in the RCRA Permit.

As discussed previously, the evaluation of the results of 2009 groundwater monitoring for organic constituents is a non-statistical comparison between the analytical results for POC wells and the groundwater protection standards listed in Table 10.5 of the RCRA Permit. For any other organic parameters for which groundwater samples are analyzed, the data evaluation process is based on laboratory reporting limits or practical quantitation limits (PQLs), where a reported concentration equal to or greater than the PQL is a "detection." Under RCRA Permit Section 10.8.4.1.1, such "detection" is subject to verification in the next scheduled sampling event. With regard to monitoring data for organic constituents, no statistical data evaluation is

necessary, but DUMPStat® does manage and report the monitoring data in tabular and graphical form. Examples of both are attached.

CLOSING REMARKS

We recognize that this statistical method for groundwater data evaluation differs from that established in the current RCRA Permit, and that a permit modification probably will be required to change to using DUMPStat® or similar software for data analyses. Accordingly, the next step should include obtaining NDEP concurrence with the suggested statistical approach for analyses of groundwater monitoring data for inorganic and indicator constituents and the future use of DUMPStat® as an acceptable tool for identification of groundwater impact at the USEN Beatty facility. To begin a dialog with NDEP, **AquAeTer** suggests providing this letter or a similar summary to NDEP for review and comment.

We appreciate the opportunity to work with USEN on this project. If you should have questions or comments concerning the groundwater statistics performed or the use of DUMPStat®, please contact us by telephone at (303) 771-9150, by FAX at (303) 771-8776, or by electronic mail at cbolin@aquaeter.com.

Sincerely,
AquAeTer, Inc.

Chris A. Bolin
Project Manager

Stephen L. Wampler
Director of Engineering

Attachments: Comparison of Groundwater Criteria
Examples of DUMPStat® trend graphs for metals and indicator parameters
Examples of DUMPStat® monitoring data presentation for organics

US Ecology Nevada, Inc.
Mr. Scott Wisniewski
February 19, 2010

COMPARISON OF GROUNDWATER CRITERIA

COMPARISON OF GROUNDWATER CRITERIA
USEN - BEATTY, NV

RCRA Permit Table 10.4 Constituent	Units	Permit GWQS	DUMPStat® 2009 Prediction Limit	USEPA MCL
Arsenic	ug/L	10	15.2	10
Barium	ug/L	100	240	2,000
Cadmium	ug/L	20	5.3	5
Chromium	ug/L	60	185	100
Lead	ug/L	50	29.7	15
Mercury	ug/L	2	2	2
Selenium	ug/L	40	33.9	50
Silver	ug/L	40	62.7	*100*
Cyanide	ug/L	20	10	200
Fluoride	ug/L	4,055	4,522	4,000
Sodium	ug/L	175,000	324,000	NA
Sulfate	ug/L	230,000	274,000	*250,000*
Chloride	ug/L	80,000	106,000	*250,000*
TOX	ug/L	10	7	NA
TOC	ug/L	2,100	7,460	NA
pH	s.u.	7 to 8.4	7 to 8.72	*6.5 to 8.5*
Specific Conductance	umhos	980 to 1240	1,398	NA
Nitrate-Nitrite as N	ug/L	1700	2,000	10,000

NOTES:

Groundwater Quality Standard (GQWS) from RCRA Permit, Revision 3, June 2009.

DUMPStat® Prediction Limits are based on up-gradient monitoring well data from 1988 to 2009.

MCL Italics indicates a Secondary MCL.

Fluoride GWQS value is 1.4 (Ln of concentration in mg/L) which converts to concentration = 4.055 mg/L = 4,055 ug/L

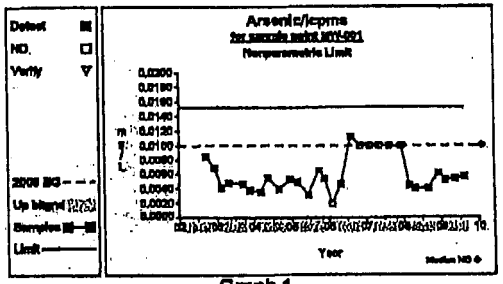
US Ecology Nevada, Inc.
Mr. Scott Wisniewski
February 19, 2010

EXAMPLE OF DUMPSTAT® TREND GRAPHS FOR METALS AND INDICATOR PARAMETERS

Beatty [mets_al]

Analysis prepared on: 12/30/2009

Up vs. Down Prediction Limits



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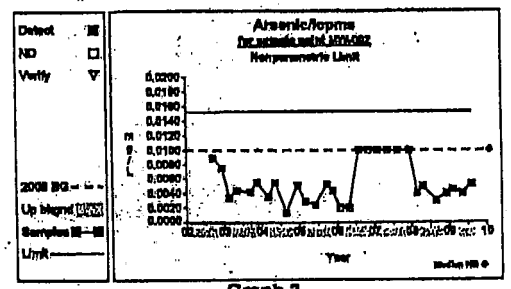

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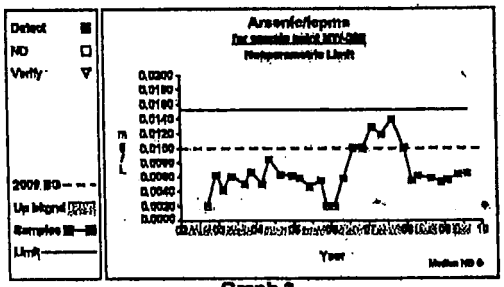

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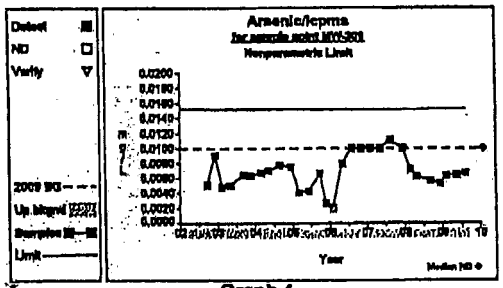
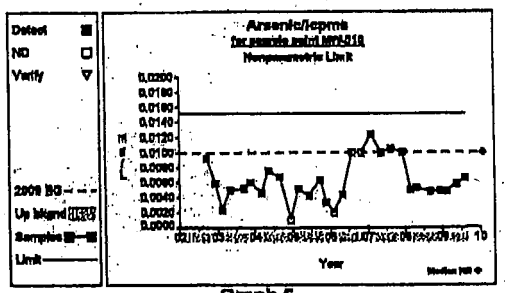


Graph 4



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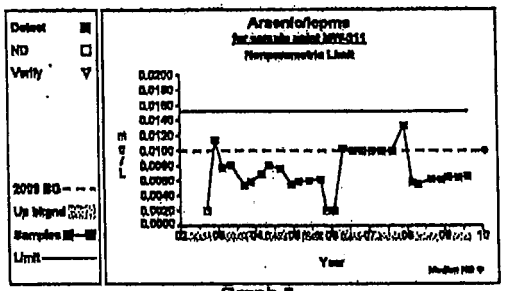

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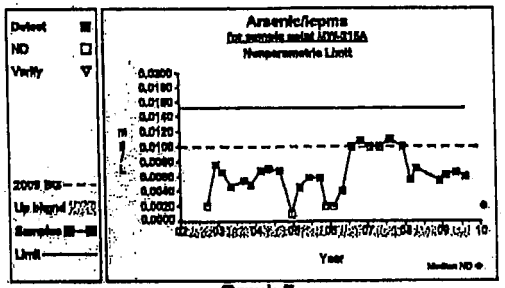

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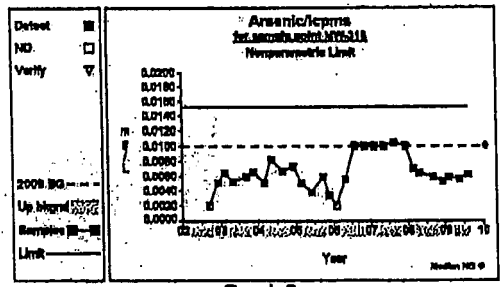

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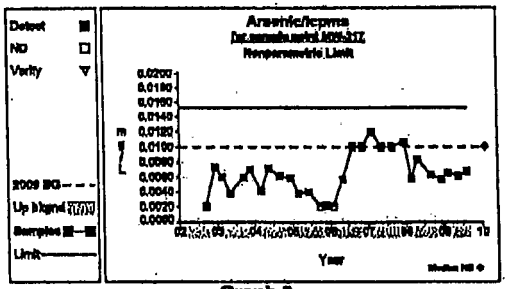
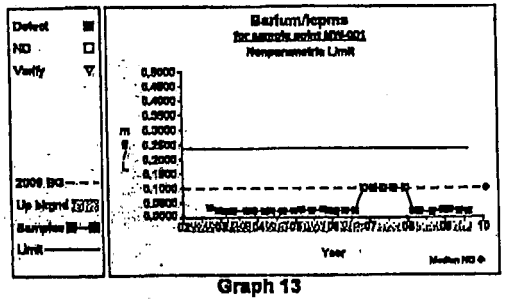


Graph 9

Prepared by: AquAeTer, Inc.

Up vs. Down Prediction Limits



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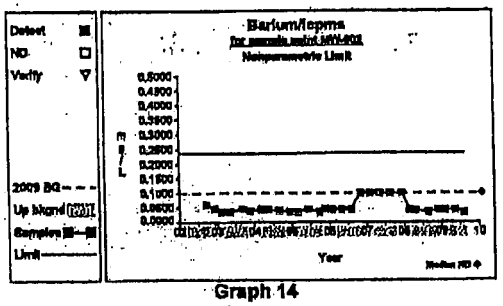

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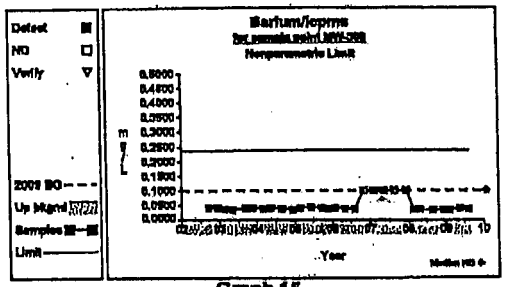

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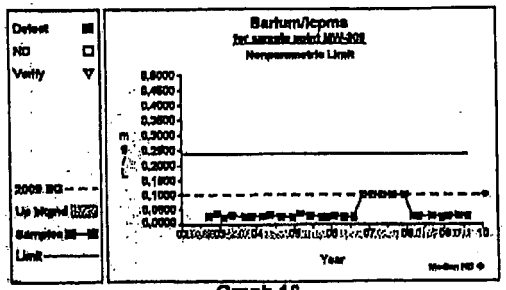

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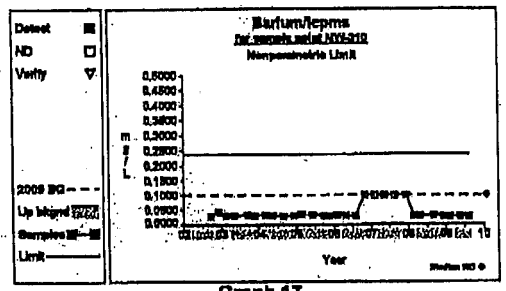

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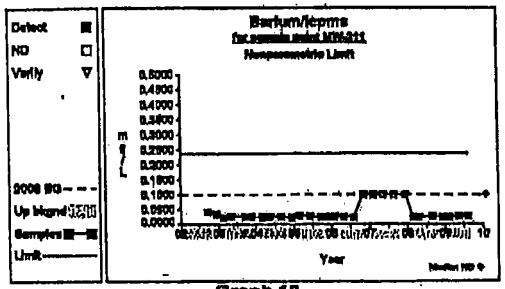

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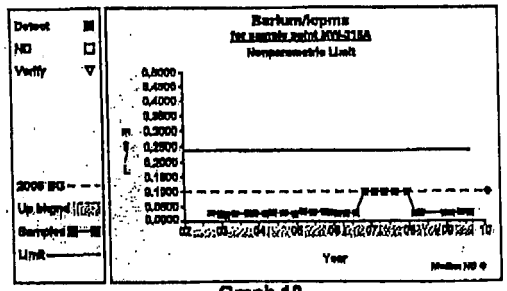

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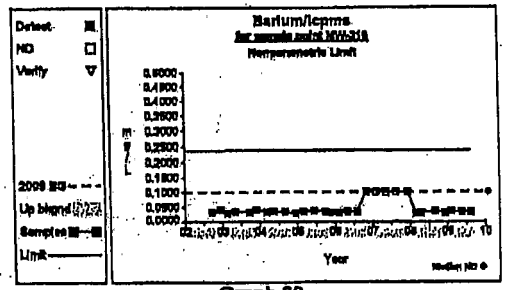

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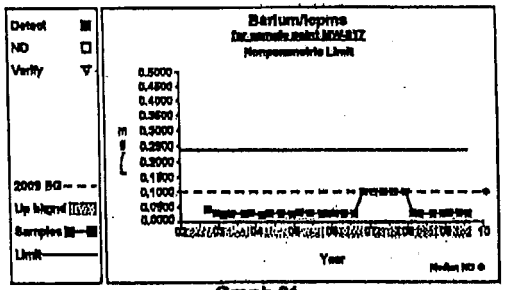
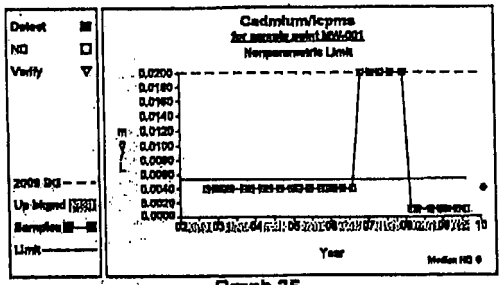


Graph 21

Up vs. Down Prediction Limits



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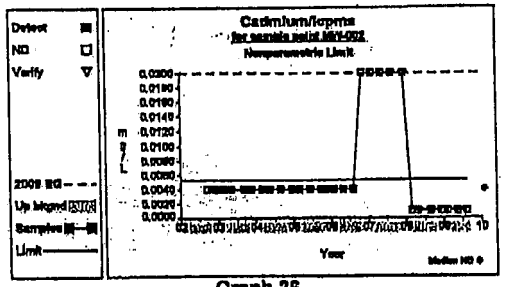

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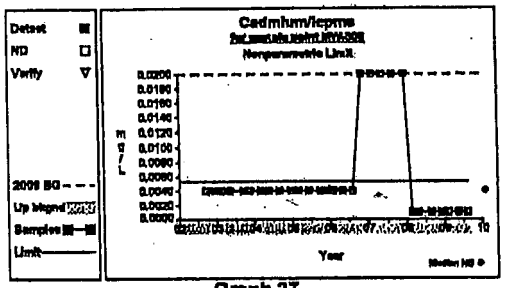

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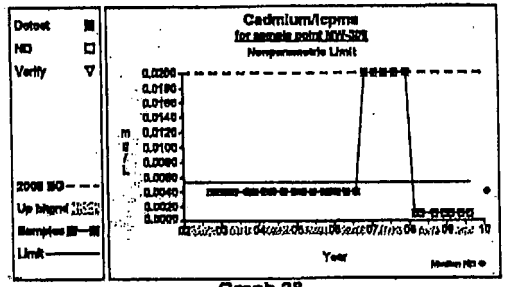

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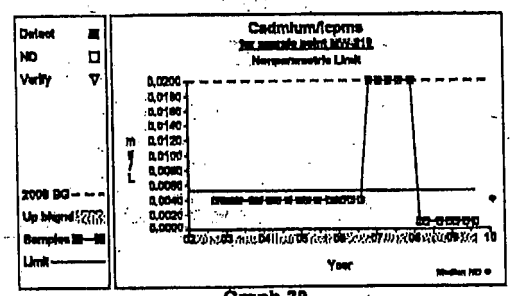

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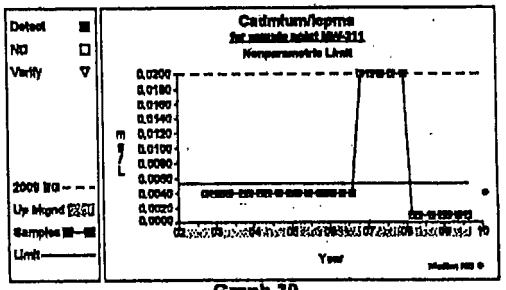

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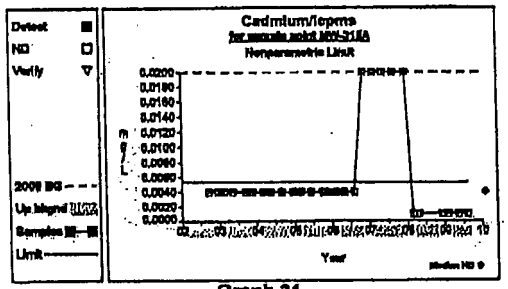
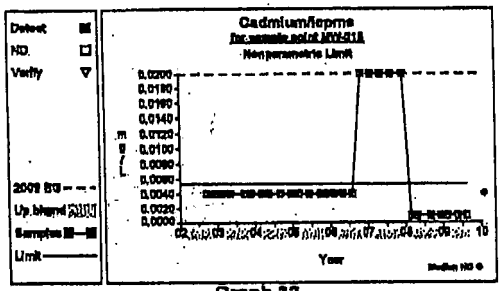
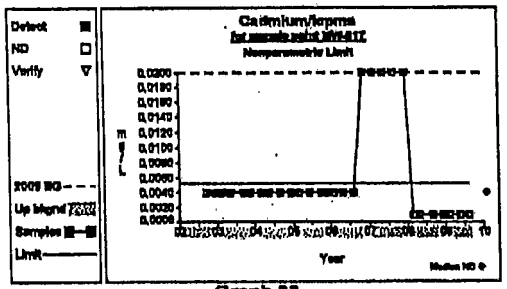


Graph 31



Graph 32

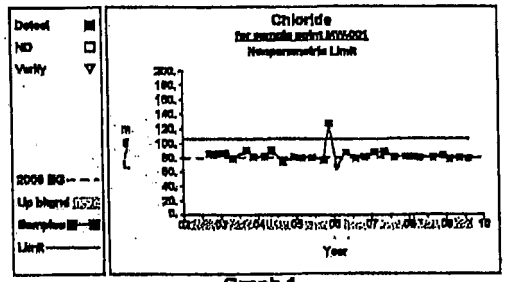


Graph 33

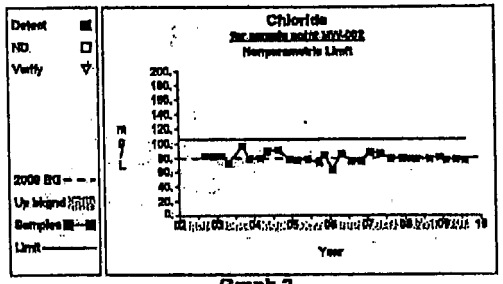
Beatty [wq]

Analysis prepared on: 12/30/2009

Up vs. Down Prediction Limits



Graph 1



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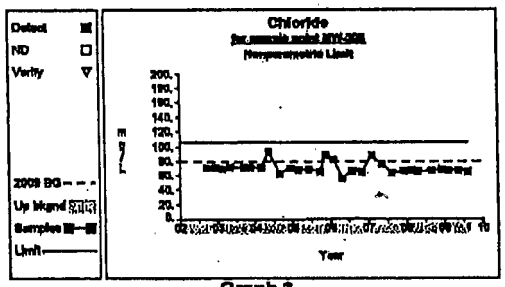

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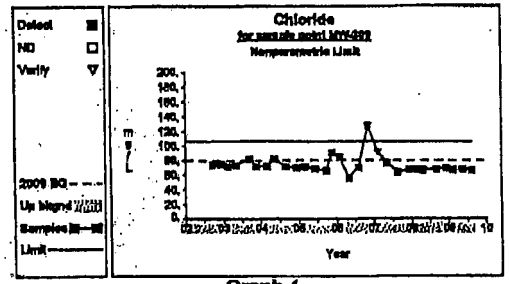

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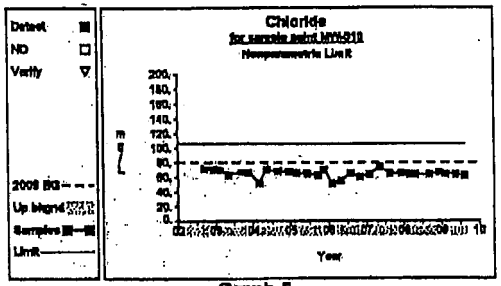

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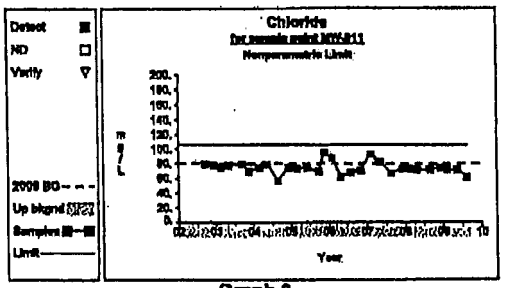

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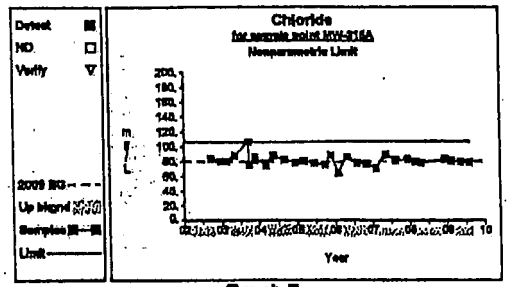

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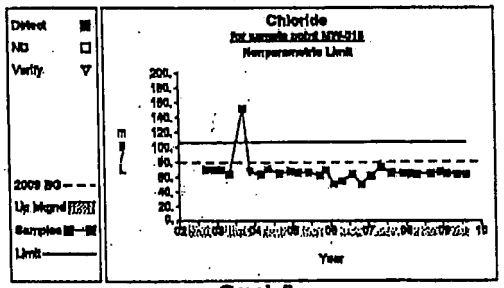

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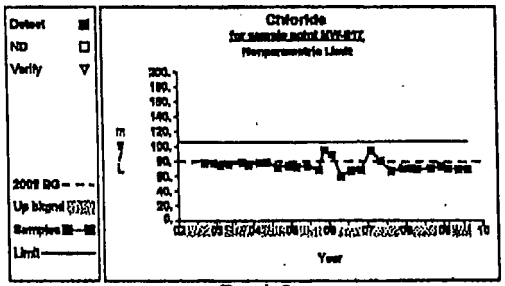
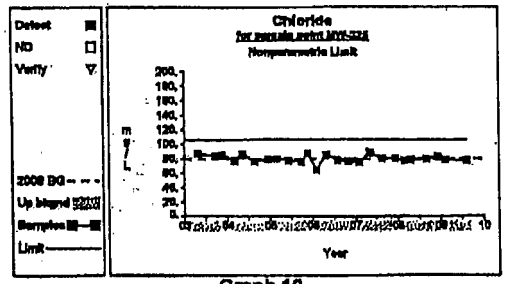


Graph 9

Prepared by: AquAeTer, Inc.

Up vs. Down Prediction Limits



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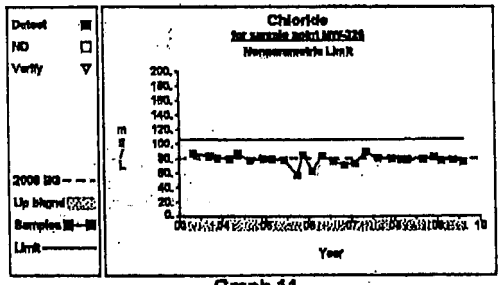
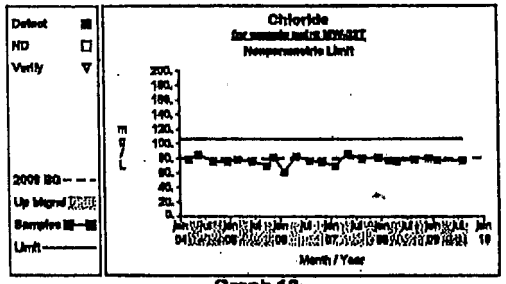
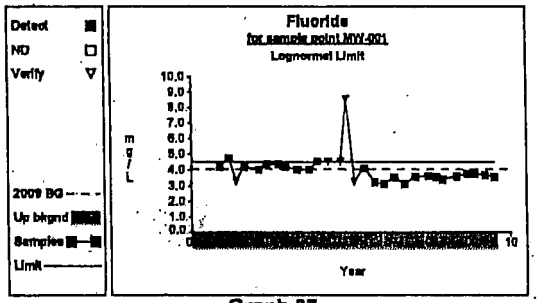


Graph 11



Graph 12

Up vs. Down Prediction Limits



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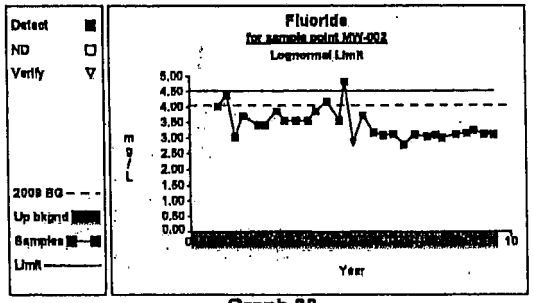

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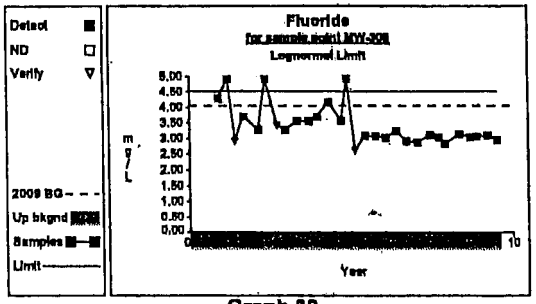

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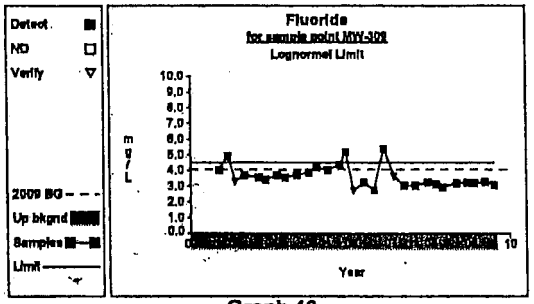

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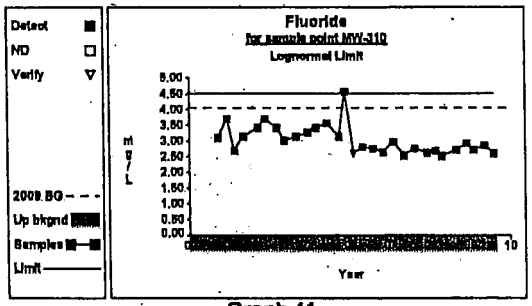

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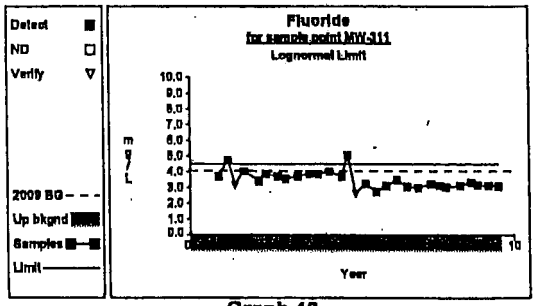

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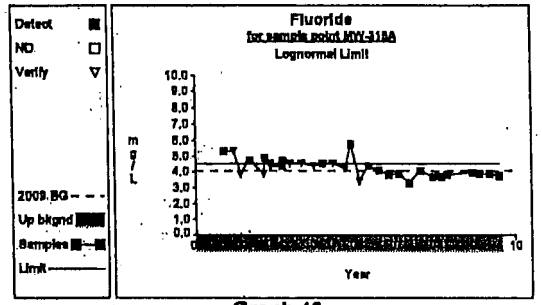

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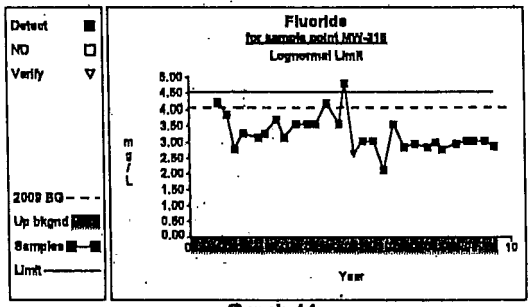

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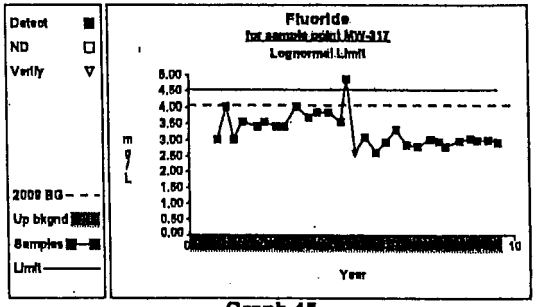
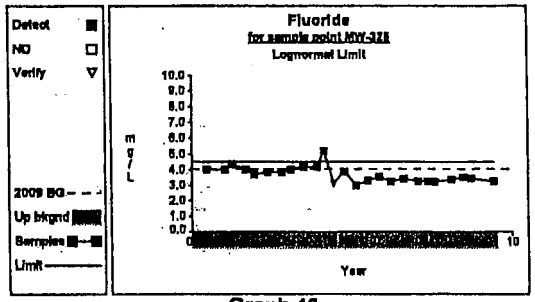


Graph 45

Up vs. Down Prediction Limits



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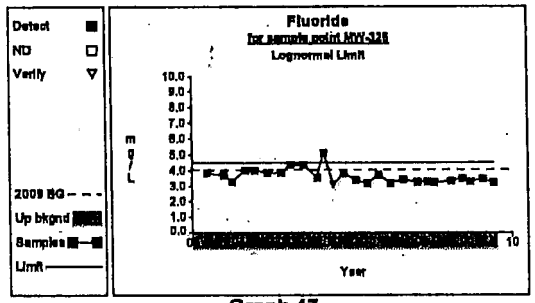

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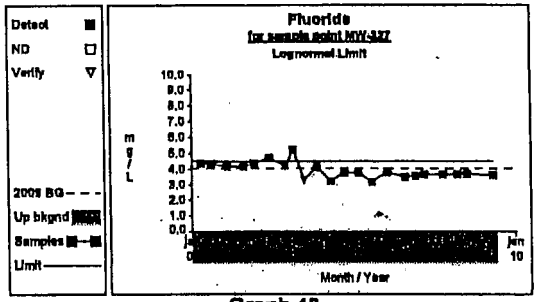
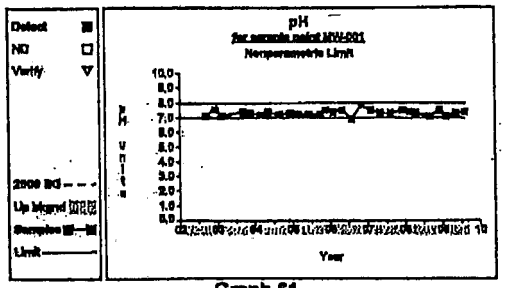


Graph 48

Up vs. Down Prediction Limits



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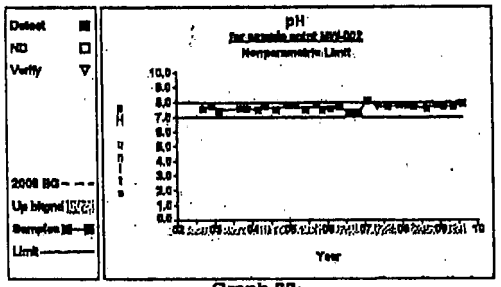

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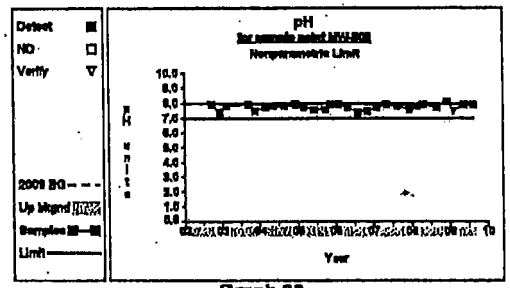

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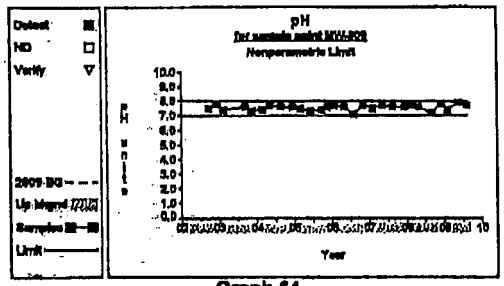

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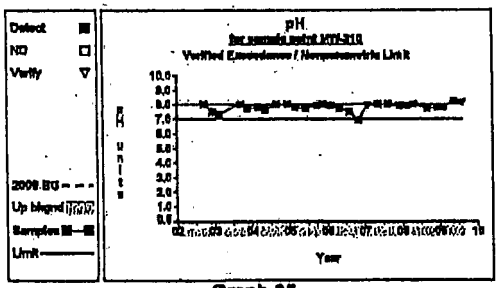

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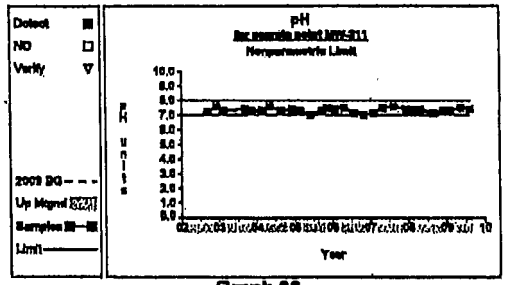

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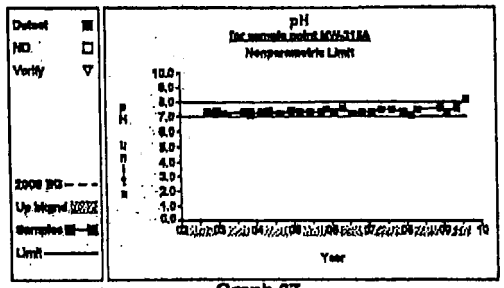

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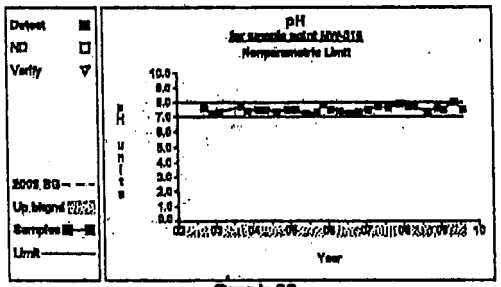

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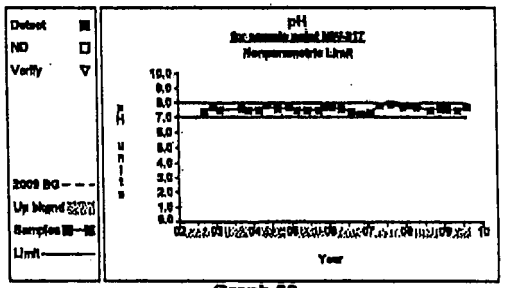
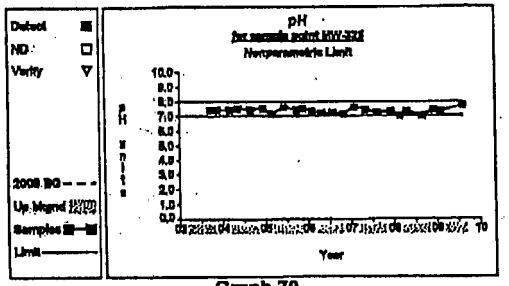


Graph 69

Up vs. Down Prediction Limits



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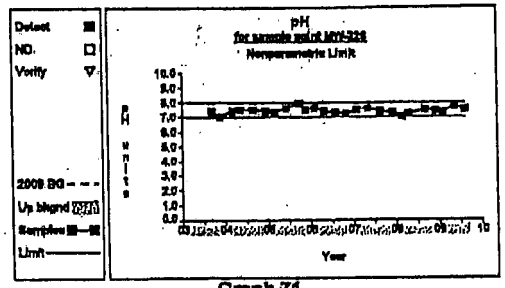
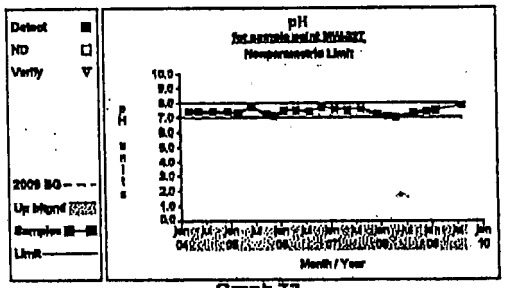


Graph 71



Graph 72

US Ecology Nevada, Inc.
Mr. Scott Wisniewski
February 19, 2010

EXAMPLES OF DUMPSTAT® MONITORING DATA PRESENTATION FOR ORGANICS

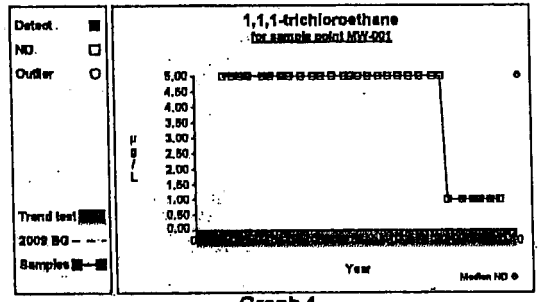
Table 1

Leachate Parameter Detections

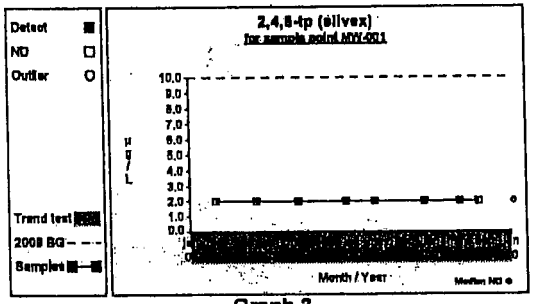
Constituent	Units	Well	Date	Result	Limit
Acetone	µg/L	MW-310	9/02/2008	14.3000	10.0000
Tetrachloroethene	µg/L	MW-310	4/20/2008	1.9300	1.0000
Tetrachloroethene	µg/L	MW-310	9/02/2008	2.4900	1.0000
Tetrachloroethene	µg/L	MW-310	12/05/2008	1.9900	1.0000
Tetrachloroethene	µg/L	MW-310	2/07/2009	1.8700	1.0000
Tetrachloroethene	µg/L	MW-310	5/16/2009	2.3500	1.0000
Tetrachloroethene	µg/L	MW-310	8/08/2009	1.7700	1.0000
Acetone	µg/L	MW-313	8/27/2008	10.6000	10.0000
Acetone	µg/L	MW-315A	12/10/2007	889.0000	100.0000
Chloroform	µg/L	MW-315A	9/22/2003	6.4700	5.0000
Chloroform	µg/L	MW-315A	11/14/2003	78.1000	5.0000
Chloroform	µg/L	MW-315A	11/17/2003	10.7000	5.0000
Chloroform	µg/L	MW-315A	2/28/2004	8.5400	5.0000
Chloroform	µg/L	MW-315A	3/01/2005	14.0000	5.0000
Chloroform	µg/L	MW-315A	6/08/2005	7.9700	5.0000
Chloroform	µg/L	MW-315A	9/27/2005	21.1000	5.0000
Pcb, total	µg/L	MW-315A	4/28/2006	.6880	.5000
Acetone	µg/L	MW-318	4/25/2003	586.0000	500.0000
Acetone	µg/L	MW-325	4/25/2003	107.0000	100.0000
Acetone	µg/L	MW-326	4/28/2003	6540.0000	2500.0000
Lindane	µg/L	MW-326	4/19/2008	.0290	.0200
Pcb, total	µg/L	MW-326	9/03/2008	2.5500	.5000
Pcb, total	µg/L	MW-327	8/15/2007	.7430	.5000

Detections are shown for constituents selected in the VOC list and all selected wells
The Limit column refers to the laboratory reporting limit

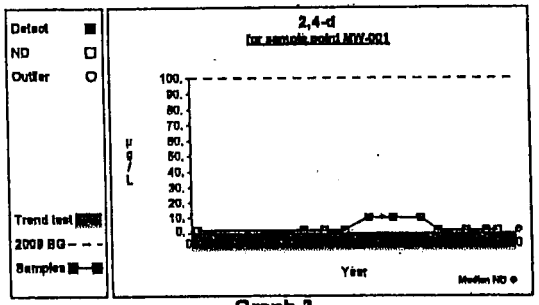
Time Series



Graph 1



Graph 2



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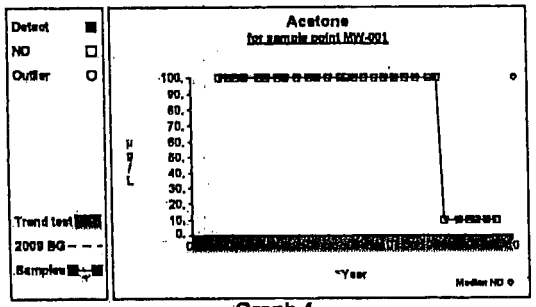
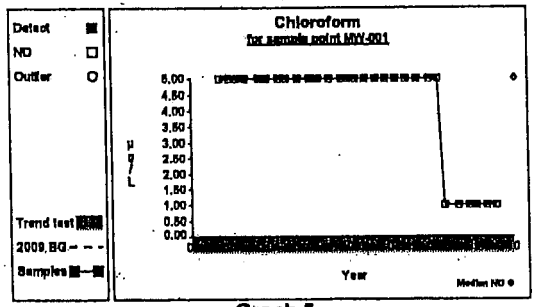
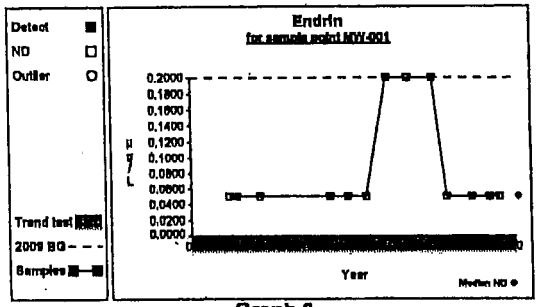


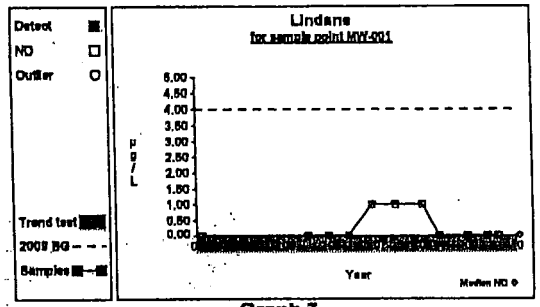
Graph 4



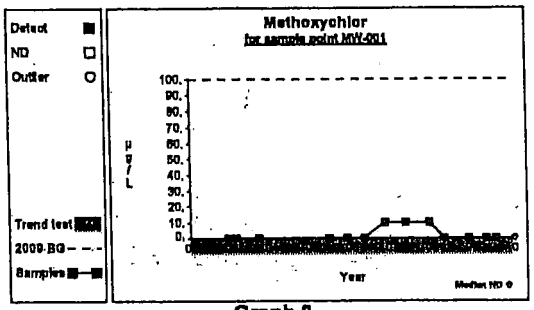
Graph 5



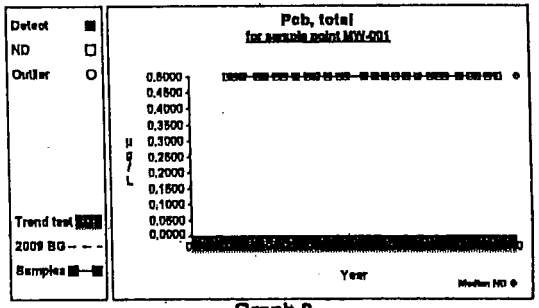
Graph 6



Graph 7

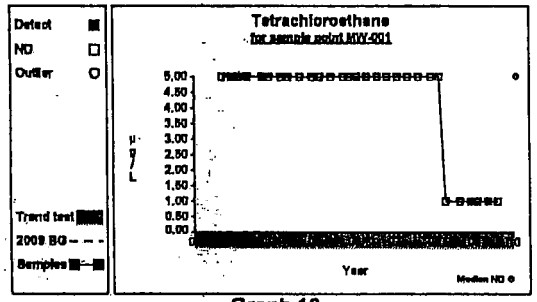


Graph 8

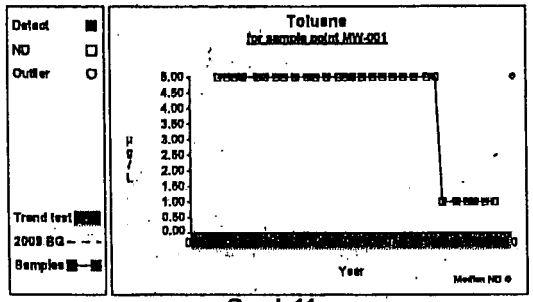


Graph 9

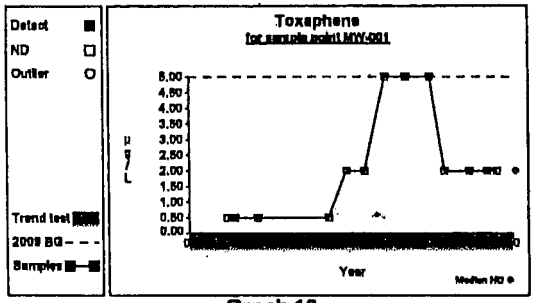
Time Series



Graph 10



Graph 11



Graph 12

Appendix 13 F

Corrective Measures Study Work Plan

Appendix Not Included with TSCA Application

Appendix 13 G

Justification for Elimination of Monitoring Requirements for the 600-series Wells

AquAeTer

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7430 East Caley Avenue, Suite 310 ◦ Centennial, CO 80111 ◦ Phone (303) 771-9150 ◦ Fax (303) 771-8776

August 25, 2010 093205

US Ecology Nevada, Inc.
P.O. Box 578
Beatty, Nevada 89003

Attention: Mr. Scott Wisniewski

RE: Justification for Elimination of Monitoring Requirements at 600-series Wells US Ecology Nevada, Inc., Beatty, Nevada

Dear Mr. Wisniewski:

AquAeTer, Inc. has completed a review of groundwater conditions at the US Ecology Nevada, Inc. (USEN) facility located in Beatty, Nevada in support of justification for elimination of monitoring and reporting for 600-series monitoring wells. The scope of this review of monitoring well data and water bearing zone characteristics was initially proposed in **AquAeTer's** proposal #093205P, as authorized by USEN on October 6, 2009 and refined in recent telephone conversations between you and Mr. Chris Bolin.

BACKGROUND

Natural subsurface materials at the USEN facility include about 300 feet of unsaturated strata above groundwater (the Vadose Zone) that consist of primarily of interbedded sandy gravels and gravelly sands, with some layers of fine-grained materials (i.e., silt and clay). Typically, individual layers of fine-grained in the Vadose Zone are not continuous beneath the entire Facility area, but the sequence of discontinuous fine-grained sediment layers in the Vadose Zone impedes downward movement of infiltrating water or contaminants. Further, downward movement of infiltrating water is significantly impeded by the extremely low moisture content of Vadoze Zone sediments. Research conducted at the Amargosa Desert Research Site (ADRS), located adjacent to the Facility, indicates that the dominant direction of moisture movement within the Vadose Zone is upward[1].

Groundwater occurs below the Vadose Zone in two zones. The Upper Water-Bearing Zone occurs between about 326 and 340 feet deep, and the Lower Water-Bearing Zone occurs at about 350 feet deep. A continuous fine-grained stratum separates the Upper Water-Bearing Zone and

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[1] Stonestrom, D.A., Abraham, J.D., Andraski, B.J., Baker, R.J., Mayers, C.J., Michel, R.L., Prudic, D.E., Striegl, R.G., and Walvoord, M.A., 2004, Monitoring Radionuclide Contamination in the Unsaturated Zone--Lessons Learned at the Amargosa Desert Research Site, Nye County, Nevada: Proceedings, Workshop on Long-Term Performance Monitoring of Metals and Radionuclides in the Subsurface, Reston, VA, April 20-22.

Lower Water-Bearing Zone. The Upper Water-Bearing Zone is considered to be semi-confined to confined and is monitored by the 300-series groundwater monitoring wells. The Lower Water-Bearing Zone is confined and is composed of thin interbedded sand and gravel layers. It occurs at depths of about 350 feet and greater below the ground surface, and is monitored by the 600-series monitoring wells.

AquAeTer assisted USEN with groundwater monitoring reporting in the past and recently assisted USEN with statistical analyses of groundwater data. Recently, we were made aware of Facility RCRA Permit modifications being done as part of your Permit renewal. Also, we understand that a notice of deficiency (NOD) was issued by the State for failure to address sampling at 600-series wells in the Permit renewal.

It is **AquAeTer**'s understanding that the current RCRA Permit (NVT330010000) specifies wells to be sampled, parameters to be analyzed, and schedule for sampling. The 600-series wells include MW-600, 601, 603, 604, and 605. The wells are identified in the Permit as supplemental lower aquifer monitoring wells. Samples from the supplemental wells are analyzed for constituents included in Tables 10.4, 10.5, and 10.6 (in accordance with Section 10.7.1.1). 600-series well monitoring is scheduled to occur once every five quarters.

USEN has monitored both the 300-series and 600-series wells as a condition of the RCRA Permit. Recent updates to the Permit include a re-evaluation of the applicability of sampling the 600-series wells. Based on **AquAeTer**'s review of data collected from the 600-series wells and assessment of the water bearing zone characteristics we provide the following justification for their elimination from the groundwater monitoring plan.

WELL PAIRS

The USEN groundwater monitoring system includes wells located in the Upper Water-Bearing Zone and Lower Water-Bearing Zone. Wells in close proximity to each other, but screened in separate water bearing zones are considered to be "well pairs" in this justification, for the purpose of comparing their hydrologic and chemical properties. Well pairs include the following:

1. MW-313/MW-600
2. MW-327/MW-601
3. MW-315A/MW-603
4. MW-311/MW-604
5. MW-317/MW-605

INDICATOR PARAMETER AND METALS CONSTITUENT CONCENTRATION COMPARISONS

AquAeTer has imported USEN groundwater data into the statistical database program, DUMPStat™. The database program allows the query or inorganic and indicator parameters in 300 and 600-series wells including:

1. Water-quality constituents (including chloride, specific conductance, cyanide, fluoride, nitrate/nitrite-n, pH, sulfate, TOX, TOC); and

2. Metals (Ag, As, Ba, Cd, Cr, Hg, Na, Pb, and Se).

DUMPStat™ query outputs consist of trend graphs of concentration versus time, and up-gradient prediction limits. The trend graphs are used to compare indicator parameter and metals concentrations at respective well pairs and to determine if variances in concentrations support a justification that these are separate groundwater bearing zones. The graphical displays included in Attachment 1 summarize the results for 300-series and 600-series wells. Representative parameter concentrations are summarized in Table 1. Comparison of constituent concentration at 300-series wells and their respective 600-series well pair confirms the similarity of water quality and metals concentrations. Although some variations exist, they appear to be minimal and indicate the waters likely are of similar origin and that the water-bearing strata are of similar composition and chemical makeup. Given the similarity of the geologic origins of the water-bearing strata, this physical and chemical similarity is expected. However, the similarity of the indicators of basic water quality should not be considered to be evidence that the two zones are not hydraulically separated beneath the Facility. The two zones, though possibly interconnected at an up-gradient (off-site) location, are hydraulically separated beneath the Facility. Other data and interpretations supportive of this separation are presented below.

CROSS SECTIONS

AquAeTer reviewed cross-sections and monitor well installation logs to evaluate subsurface media. The pertinent cross-sections are included as Attachment 2. The two water-bearing zones are shown to be separated by a confining layer that is made up of several feet of low to high plasticity silts and clays. The hydraulic conductivity of the fine-grained confining layer, though not confirmed by site-specific testing, is likely to be several orders of magnitude lower than that of the coarser-grained materials comprising the matrix of the two water-bearing zones. Based on our evaluation, it appears to be unlikely that the two zones are hydraulically connected beneath the USEN Facility and contaminant impacts to the Upper Water-Bearing Zone are unlikely to impact the Lower Water-Bearing Zone within the area monitored by 300 and 600-series wells. .

GROUNDWATER ELEVATIONS

Historic groundwater elevation data was examined to determine if variability exists between the 300 and 600-series well pairs. As shown on Figure 1 and included in Attachment 3, variations do exist at the well pairs. All well pairs except MW-327/MW-601 show approximately 20 feet of vertical difference with the 300 series wells being the upper potentiometric surface.

MW-327 is about 200 feet from MW-601. Based on the February 2009 potentiometric map, the groundwater elevation in the Upper Water-Bearing Zone, at a location equivalent to MW-601, is approximately 2452 ft msl or approximately 8 feet higher than the Lower Water-Bearing Zone The actual and theoretical differences in groundwater elevation for this well pair are shown on Figure 1.

The variations in groundwater elevation data provide an additional line of evidence that the two zones are not hydraulically connected.

WATER-BEARING ZONE CHARACTERISTICS

Historic groundwater flow directions have minor variations as illustrated on potentiometric maps included in Attachment 3. The Upper Water-Bearing Zone has a localized flow direction that varies across the site, a hydraulic conductivity of 61 feet per day and a hydraulic gradient of approximately 0.03 to 0.04 feet per foot. The Lower Water-Bearing Zone has a localized flow direction towards the south-southwest, a hydraulic conductivity of 2 feet per day and a hydraulic gradient of approximately 0.01 feet per foot. The differences, particularly the differences in groundwater flow direction, are indications of hydraulic separation. More closely comparable flow directions and rates would be expected if the two zones were hydraulically connected.

The facility water production well is located in close proximity to MW-313 and MW-600 and is completed in the Lower Water-Bearing Zone. The hydrograph of this well pair (included on Figure 1) shows significant fluctuations in groundwater levels in MW-600, believed to be the result of pumping from the facility production well. These same fluctuations are not observed in MW-313, evidence that the two zones are not hydraulically connected.

DETECTIONS OF VOCS

Volatile organics are not naturally occurring constituents of water-bearing zones and, where present, indicate impact that is attributable to the history of waste disposal at the Facility. Within the USEN monitoring system, some 300-series wells have been impacted by VOCs in the past. Those detections have occurred at wells located in close proximity to the disposal cells and are generally thought to be the result of the presence of soil gas containing volatile constituents in the Vadose Zone and migration of soil gas within the vadose zone and diffusion into the groundwater of the Upper Water-Bearing Zone. Further, it is believed that vertical migration of soil gas (and VOCs) in the Vadose Zone might be associated with monitor well borings, allowing gas to move vertically along preferential pathways associated with the borings. Where gas contacts groundwater (or interstitial water) in the vadose zone, VOCs can partition from the gas into the water. The low concentration detections of some VOCs in USEN wells offer confirmation of the influence of vadose zone gas on groundwater.

Gas-related VOC movement is limited by the presence of groundwater. That is, the groundwater surface provides a distinct lower boundary to gas movement. Thus, the migration mechanism that is suspected of being the primary cause for VOC impact to the upper zone cannot affect the lower zone.

VOC impacts are not observed in the Lower Water-Bearing Zone. The absence of such impacts in the lower zone is an indication of the effectiveness of the fine-grained stratum separating the upper and lower zones, and the absence of hydraulic connectivity between the zones.

CONCLUSIONS

The Upper and Lower Water-Bearing Zones located at the USEN facility have distinctive characteristics that support the conclusion that the two zones are not hydraulically connected. The geologic makeup of the two zones are similar and they exhibit similar historic water quality (indicator parameters and metals) suggesting that the water within each zone originated from a similar source, such as the surrounding zones of higher elevation. However, at the USEN Facility they are separate units.

Consideration of historic groundwater levels indicates the head pressures are different at the paired wells. Connected water-bearing zones would be expected to have the similar head pressures at similar locations. In addition, the characteristics of the water-bearing zones are different, including different groundwater flow directions, different hydraulic conductivities, and variations in potentiometric gradient. Finally, VOCs have been detected in the Upper Water-Bearing Zone, but not in the Lower Water-Bearing Zone.

Based on the findings of this assessment, it is concluded that the Upper and Lower Water-Bearing Zones are separated by a less permeable (lower hydraulic conductivity) stratum that is continuous beneath the Facility. With the intervening stratum limiting hydraulic connection between the water-bearing zones, the potential for vertical contaminant migration from the upper to lower zones is unlikely. The absence of impact and the poor hydraulic connectivity between the zones provides justification for the conclusion that monitoring of the 600-series wells is unnecessary. **AquAeTer** recommends that the 600-series wells be eliminated from the requirement for groundwater monitoring through the RCRA Permit modification process.

CLOSING REMARKS

We recognize that this groundwater monitoring recommendation differs from the requirements established in the current RCRA Permit, and that a Permit modification probably will be required to make the requested change. Accordingly, the next step should include obtaining NDEP concurrence with the suggested approach for monitoring of groundwater impact at the USEN Beatty facility. To begin a dialog with NDEP, **AquAeTer** suggests providing this letter or a similar summary to NDEP for review and comment.

We appreciate the opportunity to work with USEN on this project. If you should have questions or comments concerning this justification, please contact us by telephone at (303) 771-9150, by FAX at (303) 771-8776, or by electronic mail at cbolin@aquaeter.com.

Sincerely,
AquAeTer, Inc.

Chris A. Bolin
Project Manager

Stephen L. Wampler
Director of Engineering

Attachments: as stated

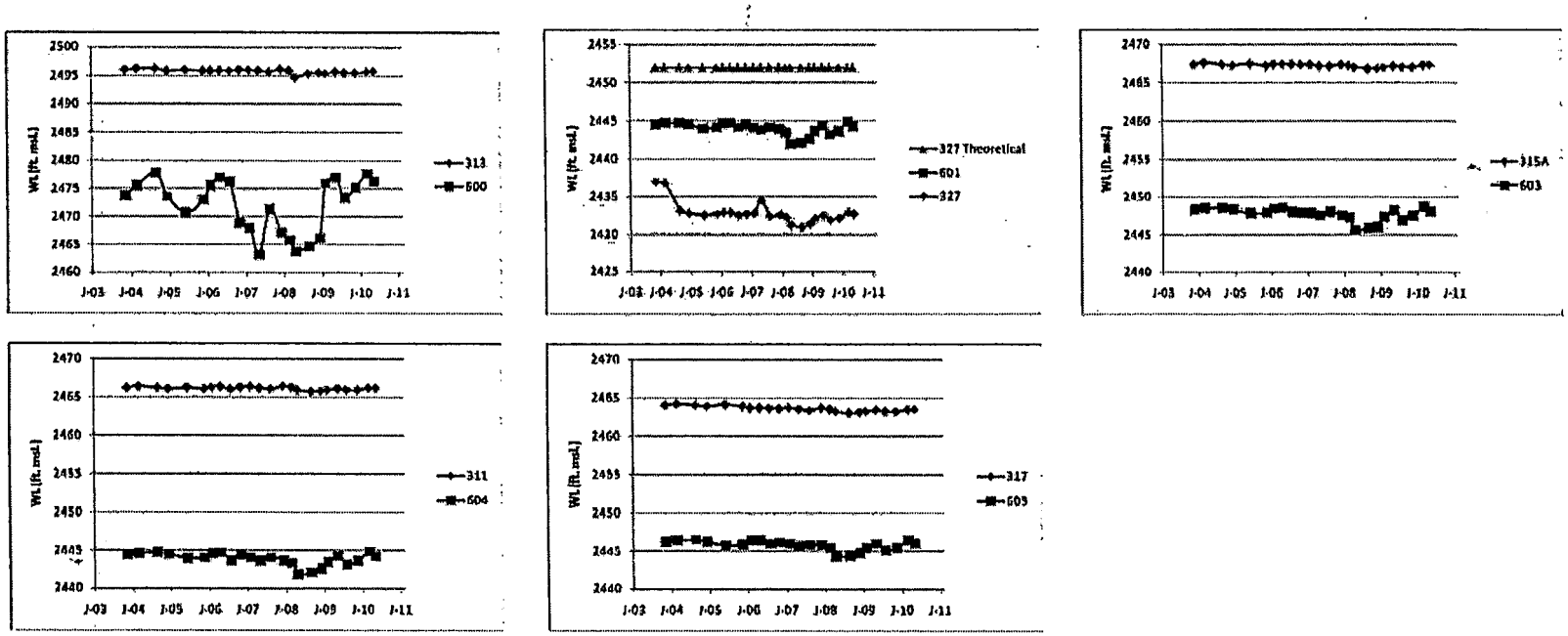
US Ecology Nevada, Inc.
Mr. Scott Wisniewski
August 25, 2010

Table 1 Summary of Indicator Parameter and Metals Constituent Concentration Comparisons

Parameter	Well Pair									
	MW-313/MW-600		MW-327/MW-601		MW-315A/MW-603		MW-311/MW-604		MW-317/MW-605	
	MW-313	MW-600	MW-327	MW-601	MW-315A	MW-603	MW-311	MW-604	MW-317	MW-605
Water Quality										
Chloride	75	75	80	80	80	80	75	80	75	75
Specific Conductance	1100	1000	1100	1050	1100	1000	1100	1000	1050	1000
Cyanide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoride	3.5	3.5	3.5	3.0	4.0	3.0	3.0	3.0	3.0	3.0
Nitrate/Nitrite	0.25	0.2	0.2 t 0.4	0.2	0.2 to 0.6	0.2	0.3 to 0.8	0.2	0.1 to 0.7	0.2
pH	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Sulfate	200	160	175	190	190	175	175	175	190	175
TOX	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals										
Arsenic	0.005 to 0.010	0.0150 to 0.020	0.001	0.01	0.007	0.01	0.006	0.01	0.007	0.01
Barium	0.025	0.02	0.025	0.02	0.025	0.03	0.025	0.02	0.025	0.04
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	0.020	0.020	0.030	0.040	0.020	0.010	0.025	0.020	0.020	0.020
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	175	175	175	175	175	175	160	175	150	175

US Ecology Nevada, Inc.
Mr. Scott Wisniewski
August 25, 2010

Figure 1 Groundwater Elevation Data (Presentation by Well Pairs)



Note: MW-327 is about 200 feet from MW-601. Based on the February 2009 potentiometric map, the groundwater elevation in the Upper Water-Bearing Zone, at a location equivalent to MW-601, is approximately 2452 ft msl or approximately 8 feet higher than the Lower Water-Bearing Zone (as shown on the above figure as "327 Theoretical").