ATK LAUNCH SYSTEMS
GROUND WATER SAMPLING AND ANALYSIS PLAN
FOR THE BACCHUS FACILITY

April 2009

TABLE OF CONTENTS

FIGURES

TABLES

ATK LAUNCH SYSTEMS
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1.0 PURPOSE AND SCOPE

This plan specifically addresses the sampling of ground water monitoring wells at ATK Launch Systems Bacchus, Utah-based Operations. The location, number, and description of each well have been submitted previously to the Utah DSHW. The plan addresses procedures for taking ground water samples, shipping the samples for analysis, and methods for analyzing samples. Groundwater in many areas throughout the Bacchus facility has historically contained elevated concentrations of various solvents and explosive constituents. The goal of this plan is to collect groundwater samples that are representative of in-situ groundwater conditions and to minimize changes in groundwater chemistry during sample collection and handling.

The purpose of this chapter is to present (1) techniques or procedures which are common to all sampling methods presented in this document; (2) chain of custody documentation requirements; (3) sample handling methods; (4) field quality control procedures; and (5) records management requirements. All of these topics are referred to throughout the document; thus, they are discussed here to avoid excessive repetition in each chapter.

1.1 DECONTAMINATION PROCEDURES

Decontamination of sampling equipment is a necessary and important portion of the sampling protocol. Decontamination of sampling equipment reduces the probability of cross-contaminating samples and sampling stations or monitoring wells. All equipment and instruments utilized in the sampling process must be properly decontaminated prior to collection of the first sample during a given sampling campaign, between subsequent samples, and following collection of the final sample of a given sampling campaign.

Proper decontamination can not be overemphasized. It is critical if representative samples are to be collected and if contamination or dilution of samples is to be avoided. Improper decontamination could result in costly re-collection and re-analysis of samples.

1.1.1 <u>Cleaning of Sensitive Equipment</u> The term “sensitive equipment” herein refers to scientific instruments used to measure field water quality parameters at monitoring wells. These instruments include pH and temperature meters and electrical conductivity meters. These instruments should be cleaned carefully due to their delicate construction and inability to withstand high-temperature steam cleaning.

Between samples, sensitive equipment will be cleaned using only distilled water as the rinse. A soft cloth and a soft-bristled plastic scrub brush can be used to remove resistant surface residues. Extreme caution will be used when cleaning scientific instruments to avoid abrasion, bending, or cracking of the instrument probes, cables, and moving parts. Any physical damage to the instruments could result in incorrect readings which may not be detected until after the sampling round has been completed, thus possibly requiring re-sampling of the station.

1.1.2 Cleaning of Non-Sensitive Equipment The term "non-sensitive equipment" herein refers to more rugged equipment used in the sampling process, such as the pumps and bailer. At the start of each day of sampling the non-sensitive equipment will be steam cleaned or thoroughly cleaned with a phosphate-free detergent and rinsed with distilled water. After sampling each well, the equipment will be cleansed using a solution of a phosphate-free detergent in water and then rinsed with distilled water.

Sampling personnel who steam clean the non-sensitive equipment will wear heavy duty water-proof gloves and eye protection to protect contact with steam and metal spray nozzle.

Preferably, the steam cleaner will be centrally located in a garage or service building which has ready access to standard culinary water taps and 110-volt electrical outlets. The building in which the steam cleaner is operated must have adequate ventilation during cleaning operations.

Prior to starting the steam cleaner on any given day, the fuel tank of the steam cleaner will be checked for sufficient fuel. Fuels must be handled in approved containers and stored in accordance with ATK safety procedures. If the system runs short of fuel, the fuel pump must be primed.

When daily cleaning operations commence, the steam cleaner will be located such that the hose will reach outside of the building to the equipment to be cleaned. The exhaust port of the steam cleaner must be well away from any flammable materials. The discharge hose of the steam cleaner will be positioned away from any materials that may melt.

The pump and bailer will then be steam cleaning and rinsed with distilled water. Both the pump and bailer are steam cleaned and rinsed inside and outside.

1.1.3 Cleaning of Filtration Equipment As will be discussed in subsequent sections, selected samples may be filtered in the field to remove particulate matter. All portions of equipment used in sample filtration which comes into contact with the sample water will be thoroughly cleaned prior to each sampling campaign. The silicone tubing on the peristaltic pump that drives the filtration unit will be cleaned by operating the peristaltic pump on the continuous forward setting while pumping the following sequence of cleaning fluids through the tubing:

- 500 ml of 20% hydrochloric acid solution (HC1)
- 2 quarts distilled water

In addition, after the collection of each filtered sample, the filter will be disconnected and discarded. The filtering system will be cleaned by repeating the above procedures. All cleaning fluids and residues will be collected and managed in accordance with the applicable rules and regulations.

1.2 MEASUREMENT OF FIELD WATER-QUALITY PARAMETERS

The measurement of field water-quality parameters will be performed at each monitoring well prior to sample collection. Field water-quality parameters to be measured include pH, temperature, and electrical conductivity.

These parameters are general indications of field water-quality conditions at the collection point. Since changes in these parameters occur with time, subsequent laboratory analyses are often not as accurate as properly performed field measurements. Therefore, it is critical that great care be taken when performing field measurements, to ensure that data are accurate.

Instruments used to measure pH, temperature, and electrical conductivity will be placed within an enclosed or covered area during periods of precipitation.

1.2.1 Electrical Conductivity The collection of electrical conductivity measurements will be performed by means of a portable electrical conductivity meter. Instrument calibration will be checked by measuring the specific conductance of potassium chloride solutions obtained commercially from a chemical supplier. Conductivity meters will be calibrated in accordance with the manufacturer's specifications.

Water to be used for conductivity measurements will be collected in a clean stainless steel, glass or Teflon™ container. The conductivity probe will be rinsed thoroughly with water from the sample container and then inserted vertically into the container. The water level within the container will be sufficient to immerse the probe to a depth at which sample water covers 2-inches above the bottom of the probe. The conductivity probe will not be immersed above the point at which the control wires enter the top of the instrument probe. The conductivity probe will be gently agitated after immersion into the water sample to release air trapped within the probe chamber. Failure to remove the air within the probe will result in incorrect instrument readings.

After inserting the probe into the sample water and displacing all air trapped within the probe chambers, the conductivity will be read and recorded directly onto the appropriate sampling form. The instrument probe will be rinsed with distilled water prior to returning the probe and meter to their storage area.

1.2.2 pH and Temperature The collection of pH and temperature data will be accomplished by means of a portable pH meter. The pH meter will be calibrated at the start of each sampling day. Calibration will be performed according to the manufacturer's specifications. The time of each calibration will be recorded on the field log for future reference. Buffer solution data recorded during calibration will include (1) the manufacturer, (2) the production lot number, (3) the pH, and (4) the expiration data.

Field measurements of pH and temperature will be taken by collecting a sample of water from the monitoring well in a reusable, clean container dedicated for that purpose. Bottles intended for sample storage will not be used for this purpose. A portion of the water from the sample cup will be used to rinse the temperature and pH probes, after which the probes will be placed vertically into the sample cup. The water in the sample cup will be of sufficient depth to immerse the probes to a depth of at least 2 inches. After immersing the instrument probes, the pH and temperature values of the sample will be determined. Measurements for pH will be read to the nearest 0.02 unit and temperature to the nearest 0.1°C. Values of pH and temperature will be recorded onto the appropriate sampling field log. Instrument probes will be rinsed with distilled water immediately after use at each well.

1.2.3 Flow Cell A flow cell may be used during sampling to facilitate accurate field water quality results while either low purge sampling or 3-volume purging a well. A flow cell or flow-through cell is designed to enables the user to "see" the physical condition of the purge water and obtain measurements of water quality parameters while the monitoring well is being purged. Field water quality parameters will be monitored continuously as the purge water passes through the flow cell where the instruments for pH, conductivity and temperature are submerged.

Prior to recording the first reading from the flow cell instrumentation, the sampler will ensure that all stagnant water has been removed from the tubing and hoses using the low flow procedure described in Section 2.3.4. Additional reading of the instrumentation will be taken at a frequency of not less than 1 minute apart. The sampling or reading frequency will be determined by the volume water flowing through the flow cell. To calculate the minimum frequency needed to ensure the flow cell has been completely evacuated between readings, the sampler will divide the volume of the flow cell by the flow rate used while purging the well. For example, if the flow cell holds 500 ml of water and the purge rate through the in-line flow cell is 0.1 GPM (379 ml/min), then a reading could be taken approximately every 80 seconds. Once the measurement frequency has been determined, additional measurements will be taken in accordance with the sampling frequency.

1.3 DOCUMENTATION OF CHAIN OF CUSTODY

Water-quality sampling, preservation, shipment, and documentation must comply with the appropriate protocol to ensure that data are representative of in-situ conditions. Therefore, detailed records need to be maintained to provide both quality assurance and quality control in the sampling program. The term "chain of custody" refers to the process of ensuring the integrity of a sample from the time of collection to the time of data reporting. This includes the ability to trace the possession and handling of the sample from the point of collection in the field to the analytical laboratory, and includes the analysis and final disposition of the sample.

A sample is considered to be in a person's custody if it is (1) in a person's physical possession, (2) in view of the person after he has taken possession, (3) secured by that person so that no one can tamper with the sample, or (4) secured by that person in an area which is restricted to authorized personnel. The components of chain of custody include analysis request forms, sample labels, chain of custody forms, field-log forms, and custody seals (commercial shipments only). The procedures for their use are described in the following sections.

1.3.1 Analysis Request Forms Prior to the start of each sampling campaign, an Analysis Request Form (ARF) will be prepared for each monitoring well. A typical ARF is shown in Figure 1-1. The ARF includes information on each specific bottle. Each bottle type corresponds to a given set of analyses as defined by the laboratory. The analyses to be performed may change between sampling campaigns as required.

The ARF will specify the quantity and type of bottles to be collected from each sampling site and the chemical preservative required (if any) in each bottle. The ARF will be used to ensure that the proper sample labels are present for each sampling site. Information on the ARF includes (1) the collector's signature, (2) field sample number, and (3) date sampled. The ARF will also dictate (1) the number of each bottle type included in the sample, (2) the preservative and field treatment used for each bottle, and (3) the requested analyses to be performed on the contents in each bottle.

Blind duplicates, equipment blanks, field blanks, and trip blanks will have individual ARFs.

Figure 1-1

SECOND QUARTER 2007

ATK LAUNCH SYSTEMS
Bacchus Facility, P.O. Box 98, Magna, UTAH 84044

ANALYSIS REQUEST FORM

SAMPLE NUMBER: GW-801 DATE: _____________ SAMPLER:______________________

ANALYTICAL LABORATORY: ATK Launch Systems Environmental Testing Laboratory

Bottle Number	No. of Containers	Preservative/ Treatment	Requested Analysis
1	1	4 degrees C	NITRATE/NITRITE (EPA 300)
3	1	4 degrees C	HMX/RDX (SW-846, 8330 Mod) NG/DING (SW-846, 8330 Mod)
9	1	4 degrees C	Perchlorate (EPA 314)
11	3	0.2 ml HCL	Volatile Organics (SW-846, 8260)

1.3.2 **Sample Labels** Sample labels are prepared in advance to prevent misidentification of samples to ensure correct bottles are filled. Gummed paper labels are adequate and will include spaces for recording (1) sample number, (2) bottle number, (3) preservative information, (4) date and time of collection, and (5) name of the collector. This information will be written with an indelible marker.

As the sample is collected the date, time, and collectors name will be recorded on the sample labels. Labels are then attached to sample bottles before leaving sample site.

1.3.3 **Chain of Custody Forms** To establish the documentation necessary to trace sample possession from the time of collection, a chain of custody form will be filled out and accompany the samples recorded on the form. A typical chain of custody form is illustrated in Figure 1-2.

After the collected samples are recorded in the spaces provided on the chain of custody form, the collector will sign the form and place it with the samples to await transportation to the laboratory. Because the samples are in the custody of the collector, he will not leave the samples unattended at sampling sites or at other locations where the samples may be tampered with. When the samples are relinquished the collector will sign the appropriate relinquishment box on the form.

1.3.4 **Custody Seals** Custody seals are used to detect unauthorized tampering with the containers used to ship the samples commercially. The seal must be attached to the shipping container such that it is necessary to break the seal to open the shipping container. The custody seal must be affixed to the shipping container before the samples leave the custody of the sampling personnel. Shipping tape should be placed over the custody seal to prevent accidental breakage or removal during handling of the shipping containers. Figure 1-3 is an example of a typical custody seal.

1.3.5 **Sampling Log Forms** Field data (field parameters, water volumes, water depths, general observations, etc) will be recorded on sampling log forms. Figure 1-4 is an example of a groundwater sampling field form to be used each time sampling operations are performed. Information to be recorded on the groundwater sampling log will include, but not be limited to:

- Identification of monitoring well
- Signatures of sampling personnel
- General observations or unusual situations
- Date and time of sampling
- Water-level data
- Well depth
- Purge volume
- Water temperature, pH, and specific conductance

The Field Quality Control Sample Log documents collection of equipment blank (EB), field blank (FB), and trip blank (TB) (see Figure 1-5). A complete sampling log form will be produced for each sampling station or well.

Figure 1-2
Chain of Custody Record

Page ____ of _____

ATK LAUNCH SYSTEMS, Bacchus Facility, P.O. BOX 98, MAGNA, UTAH 84404

Collected by:	Project:
Contact:	Collection Location:
Telephone:	Work Order:

Turn Around Time: ________________

SAMPLE NUMBER	LAB	DATE SAMPLED	TIME SAMPLED	NUMBER OF BOTTLES	ANALYSIS REQUESTED

Relinquished by:	Received by:	Date/Time

Figure 1-3

Custody Seal

ATK

SAMPLED BY ______________________________________

____
SAMPLE NUMBER

DATE ______________________ TIME _________________

Figure 1-4

Groundwater Sampling Field Log
ATK Launch Systems
Bacchus Facility

Site ____________ Signature ______________________________
Date ____________ ______________________________
Time ____________ ______________________________

Calibration, pH

Instrument ________________________ Probe ______________
Time of two point calibration conducted today ________________ / ________________
Buffer pH 7.00 Source ________ Lot __________ Exp Date __________
pH 10.00 __________ __________ __________

Calibration, Conductivity

Instrument ____________________
Buffer conductivity __________ Source ______________ Lot ____________________
Exp Date ________________

Purge Volume

Well depth (WD) ____________________ Depth to water (DTW) ____________________

Volume = 0.653* (WD - DTW) = ____________________________

Purge volume = 3*Volume
= ______________________________

Field Parameters

Time	**pH**	**Temperature (°C)**	**Conductivity (μmhos/cm)**	**Purged Volume (gallons)**

Blind duplicate collected ________________________________

Comments

Figure 1-4 (Cont)

Groundwater Sampling Field Log (Page 2)

ATK Launch Systems
Bacchus Facility

Well Head Inspection

Well No. ______________________
Date ______________________ Depth to water (ft) ______________________
Time ______________________

	Yes	No
Cracks in the concrete apron	________	________
Well cover	________	________
Well No. on well cover or casing	________	________
Lock to secure cover to casing	________	________
Well cap (cap to cover PVC)	________	________

Signature: ______________________________________

____

Any of the above items needing repair/replacement should be noted below. What was repaired/ replaced, when it was repaired/replaced, and who made the repair/replacement should also be noted.

Comments: ____

Figure 1-5

Field Quality Control Sample Log

EB No. ________________ Date ___________________ Last sample location ___________________

Signature ____

Equipment to be tested ____

____

Time sampled __________

Distilled Water Quality Check

Gal No.	pH	Temp °C	EC* µmhos/cm	Remarks
1	________	_______	__________	*Note: EC must be less than 10 umhos/cm
2	________	_______	__________	
3	________	_______	__________	
4	________	_______	__________	
5	________	_______	__________	
6	________	_______	__________	
7	________	_______	__________	
8	________	_______	__________	
9	________	_______	__________	
10	________	_______	__________	
11	________	_______	__________	
12	________	_______	__________	
13	________	_______	__________	
14	________	_______	__________	
15	________	_______	__________	
16	________	_______	__________	
17	________	_______	__________	
18	________	_______	__________	
19	________	_______	__________	
20	________	_______	__________	
Field blank	________	_______	__________	

Time sampled __________

Trip blank __________

Time labeled __________

Taken to above well Yes ______________ No ______________

1.4 SAMPLE HANDLING PROCEDURES

When samples are collected, those requiring the removal of particulate matter and the addition of chemical preservatives will be treated as described in the following sections. Also discussed are methods pertaining to sample packaging and shipping.

1.4.1 Sample Filtration Samples requiring filtration will be filtered at the time of collection. Filtered samples are obtained by using an inline filter or external filtering equipment. The filtering equipment will always be assembled at the collection point. A clean filter will not be installed until filtering of samples is required.

When filtered samples are obtained using external filtering equipment the sample to be filtered will be collected in a clean disposable plastic bottle. These containers will be discarded after each use. Unfiltered groundwater sample will be collected immediately prior to filtering in a clean disposable bottle, using the appropriate methods outlined in Chapter 2. The intake end of the pump tubing will be placed directly into the bottle containing the unfiltered groundwater sample. The discharge end of the pump tubing will be pushed firmly onto the intake port of the filter. The pump control will then be switched to the on position and allowed to run until the tubing and filter have been flushed with filtered water. The sample collection bottle for the filtered sample will then be placed beneath the filter discharge port and filtered sample will be collected.

After filling, the filtered sample will firmly capped, labeled and stored for analysis. The intake end of the pump tubing will be removed from the collection bottle and the pump will remain running until the pump tubing and filter have been purged of sample water. Intake will then be placed in a container of distilled water and thoroughly rinsed. After rinsing, the pump, tubing and filter mechanism will be decontaminated as described in Section 1.1.3.

Samples, from wells with dedicated pumps or collected from portable pumps, and requiring filtration will be collected after all other samples have been collected at that well. Samples will be filtered using an inline filter. The filter will be attached to the discharge end of the dedicated pump discharge tubing or portable pump discharge hose. The sample collection bottle for the filtered sample will then be place beneath the filter discharge port. After collecting the filtered sample the filter is removed and discarded.

1.4.2 Sample Preservation The Analysis Request Form (ARF) (Figure 1-1) indicates the types of preservatives required for each sample bottle. All samples will be cooled to 4°C upon collection regardless of their chemical preservation unless advised otherwise.

Chemical preservatives are listed on the ARF by type and amount of preservative required. Chemical preservatives include sulfuric acid (H_2SO_4, 50%), nitric acid (HNO_3, 50%), and hydrochloric acid (HC1, 50%). All of the chemical preservatives are corrosive and must be treated with caution. Sampling personnel will avoid skin or eye contact with the preservatives and wear safety glasses and disposable waterproof gloves for protection at all times during handling. Sample preservation will be performed in an area where large quantities of water are available for irrigation; should skin or eye contact occur. The sample preservation will be conducted in a well-ventilated area to prevent buildup of dangerous fumes produced by chemical reactions.

Chemical preservatives will be added to bottles prior to sample collection, if practical, to facilitate mixing of the preservative with the sample and to allow immediate “fixing” of the samples following collection. The sample collection bottles will have a minimum amount of preservative solutions as specified on the

ARF. Preservative solutions will be transferred from storage bottles to sample collection bottles by using dedicated pipettes. One pipette will be used for each type of liquid preservative and under no circumstances will they be used to transfer more than one type of compound. Only one preservative solution will be open at any given time during bottle preservation to prevent accidental mixing of preservative solutions.

1.4.3 Sample Shipping Procedures Immediately following the collection of samples, the bottles will be placed in ice chest or refrigerator for storage and subsequent transport to the analytical laboratory. Prior to shipment, bottles and shipping containers will be prepared in a manner which will enable sample bottles to arrive undamaged and suitable for accurate analysis. Sample bottles will be shipped to the analytical laboratory to ensure that holding times may be satisfied.

1.4.3.1 Sample Packing and Shipping Container Preparation Samples collected during each day's sampling operations will be placed in ice chest shipping containers with crushed ice and or ice packs assembled in a central area prior to shipment.

Glass bottles will be placed in protective foam sleeves and all bottles will be checked for cap tightness. Caps will be tightened as necessary to prevent any sample leakage during transport. Sampling personnel will inventory the sample bottles from each sampling site prior to shipment to ensure that all samples listed on the ARF are present.

1.4.3.2 Shipping Instructions Each shipping container will contain an ARF listing required analyses for each sample bottle within the container. After entering all required information on the form, sampling personnel will send the ARF to the laboratory along with samples.

A Chain of Custody form will accompany each shipment of samples. Sampling personnel will enter all necessary information on to the form. Sampling personnel will sign their name and the time relinquished in the proper location on the form. Following completion of the form, sampling personnel will obtain a copy of the Chain of Custody for subsequent filing.

The appropriate copies of the analysis request and chain of custody forms will be placed inside a waterproof plastic bag and then placed inside the shipping container prior to sealing of the container when shipping commercial. Care will be taken to ensure that the correct forms are included in each cooler.

An adhesive shipping label addressed to the analytical laboratory and containing the return address of the shipper will be securely affixed to the top center of the shipping container when shipping commercially. The container will be securely closed and latched, and an adhesive custody seal completed by the shipper with his signature and the date will be placed across the transition between the container body and lid in such a way that it cannot be opened without breaking the seal. This will notify the analytical laboratory if samples have been tampered with during shipment. After applying address and custody labels, clear plastic sealing tape will be applied liberally to the container to secure the lid to the body to prevent it from opening during shipment. Tape will also be used to secure the address label and custody seal to the shipping container.

1.5 FIELD QUALITY CONTROL

A fundamental part of a water-quality monitoring program is the establishment of quality control programs to ensure the reliability and validity of field data. Quality control procedures will include the collection of equipment blanks, field blanks, trip blanks, and blind duplicates. These samples are collected as an aid in determining sample biases introduced by equipment decontamination procedures, bottle handling, laboratory procedures, transportation procedures, and random errors.

The number of quality control samples to be collected during a groundwater sampling campaign will be equal to ten percent of the total number of monitoring wells (rounded to the nearest whole number). For example, if there are 73 monitoring wells, 7 quality control samples will be collected. The wells selected for quality control will be selected randomly. The random selection process will be accomplished by drawing numbers from a container or by using random number generator.

1.5.1 Equipment Blanks The purpose of equipment blanks is to verify the effectiveness of procedures for cleaning the sampling equipment between individual samples. Equipment blanks, therefore, aid in quantifying sample bias due to collection procedures.

Prior to collecting equipment blanks, the standard equipment cleaning procedures will be completed (see Section 1.1). A stainless steel cylinder will be steam cleaned and rinsed with distilled water. The cylinder will then be filled with distilled water and the pH, temperatures, and conductivity will be measured. The equipment (bailer) will be inserted in the cylinder and withdrawn. Samples will then be obtained from the cylinder and field parameters; pH, temperature, electrical conductivity measured and recorded. All data collected during the equipment blank process will be recorded on the field log (Figure 1-5). Equipment blanks will be labeled EB-1 for the first blank, EB-2 for the second blank, etc. Samples collected from the monitoring wells will be analyzed for the same parameters selected for the monitoring wells. Records will be kept which identify the well sampled immediately prior to collecting each equipment blank.

In the event that a random selection of wells includes a well that has a dedicated system, an equipment blank will not be collected from that well but the other quality control samples (field blank and trip blank) will be collected and recorded on the field log form.

1.5.2 Field Blanks Each time a quality control sample is collected, a field blank will also be collected. The field blank consists of distilled water collected directly from the distilled water containers. The field blank is submitted for analyses to confirm the purity of the commercially obtained distilled water and thus monitor the possibility of false positive results in the equipment blank. Distilled water for a field blank will be collected from the group of bottles of distilled water used for the equipment blank. The same types and number of sample bottles used for the equipment will be used for the field blank. Field blanks will be labeled FB-1 for the first blank, FB-2 for the second blank, etc. Field blank pH, electrical conductivity, and temperature will be recorded on the field log along with other information as appropriate.

1.5.3 Trip Blanks For each sampling campaign, a set of sample bottles of each type will be pre-filled with distilled or deionized water. A set of these bottles (referred to as trip blanks) will be transported to the sampling site that is sampled just prior to each equipment blank (i.e., one trip blank per quality control sample). The trip blank bottles will be handled identically to the handling procedures for bottles used for sample collection. The trip blanks will be subjected to the same analyses as the water sampled at the respective sampling sites. Trip blanks serve to indicate (1) if interaction between the sample and the container is occurring, (2) if a handling procedure alters the analytical results, and (3) if the sample bottles are being properly cleaned and rinsed before field use. Trip blanks will be labeled TB-1 for the first blank, TB-2 for the second blank, etc. Appropriate information will be recorded on the field log for each trip blank.

1.5.4 <u>Blind Duplicates</u> A blind duplicate consists of a duplicate sample collected from a monitoring well. This duplicate is provided with an arbitrary sample number and is, therefore, submitted “blind” to the laboratory without their knowledge of which station the sample was obtained from. The dual set of samples from the same sampling location allows detection of possible laboratory bias.

During each sampling campaign, ATK will randomly select ten percent of the monitoring wells for collection of blind duplicates. Each blind duplicate will be given a false identification number (e.g., GW-124) which will appear to correspond to an actual monitoring well. This method of numbering will be used to prevent laboratory personnel from knowing the source of the duplicate sample.

A suite of sample bottles identical to those used at the monitoring well being duplicated will be used for each blind duplicate. Both the blind duplicate and “real” sample bottles will be filled at the same time and in an identical manner according to standard sampling procedures. Both sets of sample bottles will be handled, packed, preserved, and shipped in the same manner and in the same or similar shipping container(s).

Blind duplicates will be labeled using a “GW” heading and a number which is greater than those used for “real” samples. Table 1 lists numbers historically used (through December 1986) for blind duplicates and corresponding “real” samples. Successively higher three-digit numbers will be used to denote blind duplicate collected at monitoring wells. Sampling personnel will document all blind duplicates collected and the “real” samples that they correspond to. This will allow subsequent correlation of the water chemistry data.

Table 1

Groundwater Blind Duplicate Summary

Blind Duplicate Number	Sample Number	Date (Mo/Yr)
GW-101	GW-11	12/85
GW-102	GW-36	12/85
GW-103	GW-37	12/85
GW-104	GW-28	12/85
GW-105	GW-09	01/86
GW-106	GW-13	02/86
GW-107	GW-04	02/86
GW-108	GW-14	03/86
GW-109	GW-06	03/86
GW-110	GW-24	03/86
GW-111	GW-33	03/86
GW-112	GW-07	06/86
GW-113	GW-12	06/86
GW-114	GW-25	06/86
GW-115	GW-34	06/86
GW-116	GW-14	09/86
GW-117	GW-15	09/86
GW-118	GW-36	09/86
GW-119	GW-05	09/86
GW-120	GW-10	12/86
GW-121	GW-35	12/86
GW-122	GW-38	12/86
GW-123	GW-26	12/86

1.6 ACQUISITION AND ORDERING OF SAMPLING SUPPLIES

Prior to beginning a sampling campaign, sampling personnel will check all equipment to ensure it is in proper working order. Personnel will also inventory all disposable sampling supplies and ensure that quantities required to complete the upcoming sampling campaign are available. Equipment will be maintained and repaired by sampling personnel in accordance with the manufacturer's instructions.

Disposable sampling supplies will be ordered in sufficient quantity to provide an excess of each item required to complete the sampling round. Disposable supplies include sample bottles, shipping containers and packing material, required forms and labels, chemical preservatives, buffer and calibrating solutions for pH and conductivity meters, filters, disposable gloves and other safety equipment, distilled water, and disposable paper towels. Sample bottles and supplies will be obtained in adequate time to ensure that the materials will be available, and stored in a secure location.

1.7 RECORDS MANAGEMENT

The original signed and dated sample logs, or an electronic equivalent logs are considered the legal sampling record for groundwater monitoring wells at the Bacchus Facility. All logs will be kept on file for future program auditing and analysis review. All monitoring data, field logs, and maintenance records, will be recorded and archived for future reference.

2.0 SAMPLE COLLECTION

2.1 WATER LEVEL MEASUREMENT

The protocol set forth in this chapter were prepared by means of guidelines present in the Utah Administrative Code (UAC) Section 315-3-8-6.8(f) and 40 CFR 264.97(f) as promulgated by the EPA, and the September 1992 edition of the RCRA TEGD. These regulations and guidance documents should be reviewed when updated to ensure that procedures are conducted in a manner that is in keeping with current regulatory requirements.

Static water levels will be collected from all monitoring wells and piezometers on an annual basis at the Bacchus Facility. This information will be used to determine possible changes in horizontal and vertical flow gradients on an annual basis. This chapter describes procedures used in collecting water-level measurements from the monitoring wells. A determination of the ground-water surface elevation will be conducted each time ground water is sampled as stipulated in 40 CFR 264.97(f).

2.1.1 Equipment Water-level measurements will be obtained by means of an electronic water level indicator. The water level indicator consists of a probe sheathed in plastic, 300 feet of plastic-coated transmitting cable, and a light/buzzer. The system operates by means of an open electronic circuit which is closed upon contact with the water surface in the well casing. The light and buzzer at the ground surface indicates when the electrical circuit is closed.

2.1.2 Quality Control Upon arrival at each well site, proceed to complete the checklist shown on page 12 of Figure 1-5. The locking cover of the protective outer well casing will be carefully removed and visually inspected for cleanliness. To avoid contamination during the measurement process, or cross-contamination between wells, the probe and cable of the measuring unit will not be allowed to contact the ground surface or other potential sources of contaminants. The immersed portioned will be thoroughly rinsed with distilled water after measurements are completed at each well. The probe and cable will be visibly inspected during each use for foreign materials (e.g., soil, oil, etc). If present, these materials will be removed to reduce the chance of anthropogenic contamination of the wells.

2.1.3 <u>Measurement Procedure</u> The water-level indicator will be checked in accordance with manufacturer's instructions to ensure that it is working properly prior to measuring the wells. Care will be taken to lower the cable of the water level indicator such that the cable does not rub on the edge of the well casing and thus damage footage markers on the cable which are used for measurement.

The sampling personnel will consult the log book in which previous water-level measurements were recorded to define an approximate depth to the water surface. Knowledge of previous water levels allows the sampling personnel to anticipate the approximate depth at which the probe will encounter the water surface. The cable can then be lowered into the well at an efficient rate and the rate can be reduced near the depth of anticipated contact.

As soon as the probe contacts the water surface, the circuit will be completed and the light and buzzer flash and beep. The sampling personnel will then carefully raise and lower the cable in reference to the top of the protective outer casing to precisely determine the depth to water. The cable will then be read directly to the nearest 0.01 foot and recorded on the appropriate field data sheet.

After the probe is retrieved from the well the probe will be rinsed with distilled water. The protective cap will then be carefully replaced on the inner well casing. Care will be taken to ensure that the locking cap of the protective outer well casing is secured to preclude unauthorized access to the inner well casing.

2.2 SAMPLING ORDER OF MONITORING WELLS

The specific hose and pump used to purge a well is a function of whether the well has a dedicated pumping system or is purged with a portable pump and reel. In general, contaminated wells will be sampled after non-contaminated wells. Groundwater monitoring wells will be sampled during the course of any given day starting with the least contaminated well first and ending with the most contaminated wells to avoid cross contamination. Although specific purge and sample systems are described below, other methods may be employed if they meet guidelines approved by the USEPA and Utah DSHW.

2.3 WELL PURGING AND SAMPLE COLLECTION

2.3.1 Pre-sampling Operations Prior to the use of equipment at a well, the equipment will be cleaned as specified in Section 1.1. All bottles will be prepared for sampling, and the paperwork will be prepared so that paperwork effort in the field can be minimized.

2.3.2 <u>Purge Operation</u> The purging operation will consist of a dedicated stainless steel submersible pump or a portable stainless steel submersible pump connected to a Teflon™ coated hose on a reel. Various combinations of pump sizes and hose sizes will be required to purge wells depending on the depth and size of the well. A stainless steel, Teflon™, or disposable polyethylene bailer may also be used for purging the well.

2.3.3 <u>3-Volume Purging Procedures</u> Prior to the commencement of purging operations instruments used to monitor the chemistry of the discharged water will be calibrated according to manufacturers specifications.

The cap and cover of the well will be removed. The pump will be lowered into the well until it is submersed in or near the screened interval. The discharge hose will be connected and placed in a container. The pump will be started and the well will be pumped until the three well volumes have been removed. This volume may be measured by filling buckets, drums or a tank to a calibrated mark or by measuring the flow rate for the purging the well and calculating the purge volume for a period of time.

Wells may be purged by a dedicated pump system or portable pump with a hose reel system. For dedicated systems a hose is attached to fitting on top of well where water is discharged. The discharge hose can be placed into a measuring bucket, 55 gallon drum or tank. The pump then will be plugged into the generator and the well will be pumped until the required purge volume has been removed. This volume will be measured by filling buckets, drums or a tanks to a calibrated mark or by measuring the flow rate for the purging the well and calculating the purge volume for a period of time.

Wells may also be purged using a stainless steel, Teflon™, or disposable polyethylene bailer. The bailer will be connected to the cable and positioned directly above the well. The bailer will be lowered until it is completely immersed, if possible, and permitted to fill with water. The bailer will be raised and emptied. This procedure will be repeated until the appropriate purge volume has been removed.

Purge water will be managed in accordance with the procedures described in Section 2.3.11.

Samples of the discharging water will be collected in a cup dedicated for measurement of pH, specific conductance, and temperature. All field measurements will be performed on samples collected in the sample cup (i.e., probes will <u>not</u> be inserted into sample bottles which will be shipped to the laboratory). All field data and the time at which they were collected will be recorded on the sampling log form (Figure 1-4).

Wells will be purged until pH values stabilize. This parameter will be considered stable when readings from three successive samples lie within plus or minus 0.1 pH units.

2.3.4 <u>Low Flow Purging</u> The objective of low-flow purging is to pump in a manner that minimizes stress (drawdown) or disturbance to the ground-water flow system to the extent practical. Low flow purging will follow the procedures outlined below.

In situations where a well is screened or open across a single zone of interest, and that zone is comprised of nearly homogeneous geologic materials, the pump intake should be positioned at or near the mid-point of the well screen. In this type of situation, the water that is withdrawn will likely represent the water quality of the entire screened zone, even at low-flow pumping rates. In situations in which the geology of the screened zone consists of heterogeneous materials with layers of contrasting hydraulic conductivity, the pump intake should be positioned adjacent to the zone of highest hydraulic conductivity (as defined by geologic samples).

In general, the pumping rate used during low-flow purging and sampling must be low enough to minimize mobilization and entrainment of particulate matter and to minimize hydraulic stress on the well and the formation (for example, to minimize drawdown and to eliminate inclusion of stagnant water from the casing in the sample).

Prior to the beginning of the purging process, the sampler will calculate the minimum amount of water that must be removed from the tubing to ensure that no stagnant water is present. This volume will be determined by taking the total well depth minus the water level and then multiplying that number by the volume of water contained in one foot of hose or tubing used to purge the well. The formula for this calculation if as follows:

[Total Well Depth – Water Level (ft)] X [Volume of water in one foot of hose (gal/ft)]
= Amt of water to be removed

This calculation determines the potential volume of stagnant water present in the tubing or hose used to extract the groundwater and ensures that all of the field measurements taken during purging and sampling operations are taken from formation waters.

After the pump intake is properly set in the well, the pump will be started at a low pumping rate, 1 gpm or less. From the time the pump is started, the water level in the well will be measured to determine the amount of drawdown caused by pumping. If drawdown is rapid and continuous, the pumping rate will be lowered until drawdown decreases and stabilizes. The pumping rate may be slowly adjusted to the point at which drawdown stabilizes. The maximum pumping rate will not exceed a pumping rate of 1 gpm during purging.

During purging, the water level in the well should not decrease significantly and should stabilize after purging for a few minutes. Water quality parameters will be collected and measured during purging until pH, conductivity (or specific conductance), and temperature have stabilized. Stable conditions will be when the pH, conductance and temperature have stabilized, and the readings vary no more than 10% over at least three measurements. The 10% variation will be calculated using the following formula:

[(Max – Min of last 3 reading)/last reading] X 100%

Once readings have stabilized and are recorded, groundwater samples will be collected from the discharge hose at a rate equal to or less than 1 gpm.

2.3.5 **<u>Low Yield Monitoring Wells</u>** Low yield monitoring wells will occasionally purge dry before 3-volumes are purged from the well. In the event that the well purges dry, the water level in the well will be allowed to recover to within 80% of the pre-pumping level or within 24 hours of purging. Once recovered, the well will be sampled without additional purging.

2.3.6 **<u>Sample Withdrawal</u>** After the well has stabilized, the groundwater will be withdrawn for samples using either a stainless steel, Teflon™, or disposable bailer or taken directly from the pump discharge hose. Dedicated wells may be sampled using a bladder pump and controller or a Grundfos RediFlo pump and controller. The controller will be adjusted to maintain a steady flow rate while sampling. The bailer will be used as described above to collect water. Water-proof disposable gloves will be worn during sampling. These gloves will be disposed of after sampling activities are completed at each well. All bottles will be appropriate to the sample and EPA analytical method. At dedicated wells, sample bottles will be filled from the end of the Teflon™ or polyethylene discharge tubing.

Bottles will be filled in the following order:

1. Volatile organics (VOA);
2. Explosives (e.g. NG, HMX);
3. Perchlorate;
4. Nitrate/Nitrite;

Bottles used for the collection of volatile organic compounds, will be collected first and filled gently from the bottom up and immediately capped so that no free air remains in the headspace of the bottle. To check for free air in the headspace, the bottle will be turned up-side-down after it is capped. If bubbles appear at the bottom of the bottle, the bottle must be uncapped and additional liquid must be added to eliminate all free air from the bottle.

After collection of each sample, the time of collection will be recorded in the field log, on the sample label, and on the chain of custody form (Figure 1-2). The collector will then initial or sign all the forms, labels, and field logs as appropriate to certify that sampling of that particular well is complete. Each sample bottle will be affixed with a sample label after sample collection (see Section 1.3.2 of Chapter 1 for discussion).

2.3.7 New Monitoring Wells ATK periodically installs new monitoring wells to refine the understanding of contaminant migration on and offsite of the Bacchus Facility. In the event that a new monitoring well is installed, ATK proposes to collect four sets of quarterly groundwater samples for the constituents listed in Table 2. This list of analytes has been used for the previous baseline chemistry at the Bacchus Facility. Once the four quarterly sampling events have been accomplished, the new monitoring well will revert to annual sampling unless otherwise agreed upon with the Division.

2.3.8 Sample Handling Refer to Section 1.4 of Chapter 1 for discussion of sample preservation and sample shipping procedures.

2.3.9 Field Quality Control Refer to Section 1.5 of Chapter 1 for discussion of sample blanks and duplicates.

2.3.10 Records Refer to Sections 1.7.

2.3.11 Purge Water Management Purge water containing contaminants of concern will be collected at the well head in either drums or a mobile tank, and managed as hazardous waste in accordance with R315-5 of the UAC. All applicable requirements of R315-5 of the UAC including label, container management and accumulation time requirements will be implemented at the well head. Contaminated purge water that meets the Wastewater Treatment Unit Exemption, must be stored in a tank or tank system that is directly connected to the wastewater treatment unit, or it must be collected in a mobile tank and discharged to the wastewater treatment unit within 72 hours or three working days of being collected.

2.4 SAMPLE COLLECTION SCHEDULE

The ground water monitoring wells will be sampled in accordance with the sampling protocol identified in Table 3.

3.0 ANALYSIS OF GROUNDWATER SAMPLES

All samples will be analyzed by a Utah certified laboratory, using EPA or State approved analytical methods. If there is not an established EPA or State approved analytical method, the Utah DSHW will be notified of the proposed analytical method.

If the laboratory does not have Utah certification for a specific analysis, the laboratory will subcontract a qualified Utah certified laboratory to do the analysis. Table 3 lists the wells to be sampled and sampling frequency for each well at the Bacchus Facility. All samples will be analyzed for the field water quality parameters pH, temperature, and conductance.

Table 2

NEW MONITORING WELL ANALYTE LIST

Bottle Number	No. of Containers	Preservative/ Treatment	Analysis
1	2	4 degrees C	General Parameters Alkalinity, Aluminum, Calcium, Chloride Fluoride, Iron, Magnesium Potassium, Sodium, Sulfate, TDS TSS, Zinc
1	1	4 degrees C	NITRATE/NITRITE (EPA 300)
3	1	4 degrees C	HMX/RDX (SW-846, 8330 Mod) NG/DING (SW-846, 8330 Mod)
4d	1	5 ml HNO3	METALS (EPA 6010)
9	1	4 degrees C	Perchlorate (EPA 314)
11	3	0.2 ml HCL	Volatile Organics (SW-846, 8260)

Table 3
Groundwater Analytes and Sampling Frequency

Well	Volatiles	Field Parameters	Nitrate/ Nitrite	Perchlorate	HMX/RDX	NG
GW-1	Semi-Annual	Semi-Annual		Semi-Annual		
GW-2		Semi-Annual		Semi-Annual		
GW-3		Annual		Annual		
GW-4	Annual	Annual		Annual		
GW-5	Annual	Annual		Annual		
GW-6	Annual	Annual		Annual		
GW-7		Annual		Annual		
GW-8		Annual		Annual		
GW-9		Annual		Annual		
GW-10	Annual	Annual	Annual	Annual	Annual	
GW-11		Annual		Annual		
GW-12	Annual	Annual		Annual	Annual	
GW-13	Semi-Annual	Semi-Annual	Semi-Annual	Semi-Annual		
GW-14	Semi-Annual	Semi-Annual		Semi-Annual		
GW-15	Annual	Annual		Annual		
GW-16		Annual		Annual		
GW-17		Annual		Annual	Annual	
GW-18		Annual		Annual	Annual	
GW-19	Annual	Annual		Annual	Annual	
GW-20	Semi-Annual	Semi-Annual		Semi-Annual	Semi-Annual	
GW-21		Semi-Annual		Semi-Annual	Semi-Annual	
GW-22						
GW-23						
GW-24		Annual		Annual	Annual	
GW-25		Semi-Annual		Semi-Annual	Semi-Annual	Semi-Annual
GW-26	Annual	Annual		Annual		
GW-27						
GW-28	Annual	Annual		Annual		
GW-29	Annual	Annual		Annual		
GW-30	Annual	Annual		Annual	Annual	
GW-31		Annual		Annual	Annual	
GW-32		Annual		Annual		
GW-33	Annual	Annual		Annual		
GW-34	Annual	Annual		Annual		
GW-35	Annual	Annual		Annual		
GW-36		Annual		Annual		
GW-37		Semi-Annual		Semi-Annual		
GW-38		Semi-Annual		Semi-Annual	Semi-Annual	
GW-39		Semi-Annual		Semi-Annual	Semi-Annual	

Table 3 (Continued)

Well	Volatiles	Field Parameters	Nitrate/ Nitrite	Perchlorate	HMX/RDX	NG
GW-40		Semi-Annual		Semi-Annual	Semi-Annual	
GW-41		Annual		Annual		
GW-42		Semi-Annual		Semi-Annual	Semi-Annual	
GW-43	Annual	Annual		Annual		
GW-44		Annual		Annual	Annual	
GW-45		Semi-Annual		Semi-Annual		
GW-46		Semi-Annual		Semi-Annual	Semi-Annual	
GW-47		Semi-Annual		Semi-Annual	Semi-Annual	
GW-48		Annual		Annual		
GW-49	Annual	Annual		Annual		
GW-50	Annual	Annual		Annual		
GW-51	Annual	Annual		Annual		
GW-52						
GW-53		Annual	Annual	Annual		
GW-54	Annual	Annual		Annual		
GW-55						
GW-56	Annual	Annual		Annual		
GW-57	Annual	Annual		Annual		
GW-58	Annual	Annual				
GW-59		Annual		Annual		
GW-60	Annual	Annual		Annual		
GW-61	Semi-Annual	Semi-Annual		Semi-Annual		
GW-62	Semi-Annual	Semi-Annual		Semi-Annual	Semi-Annual	
GW-63	Semi-Annual	Semi-Annual		Semi-Annual	Semi-Annual	
GW-64	Semi-Annual	Semi-Annual		Semi-Annual	Semi-Annual	
GW-65	Semi-Annual	Semi-Annual		Semi-Annual	Semi-Annual	
GW-66	Annual	Annual	Annual	Annual	Annual	
GW-67	Annual	Annual		Annual	Annual	
GW-68	Annual	Annual		Annual	Annual	
GW-69	Annual	Annual		Annual	Annual	
GW-70	Annual	Annual		Annual	Annual	
GW-71		Annual		Annual		
GW-72	Annual	Annual		Annual		
GW-73		Annual	Annual	Annual		
GW-74		Semi-Annual		Semi-Annual		
GW-75		Semi-Annual	Annual	Semi-Annual		
GW-76	Semi-Annual	Semi-Annual		Semi-Annual		
GW-77		Annual		Annual	Annual	
GW-78		Semi-Annual		Semi-Annual		

Table 3 (Continued)

Well	Volatiles	Field Parameters	Nitrate/ Nitrite	Perchlorate	HMX/RDX	NG
GW-791	Semi-Annual	Semi-Annual		Semi-Annual		
GW-792	Semi-Annual	Semi-Annual		Semi-Annual		
GW-801	Semi-Annual	Semi-Annual		Semi-Annual		
GW-802	Semi-Annual	Semi-Annual		Semi-Annual		
GW-803	Semi-Annual	Semi-Annual		Semi-Annual		
GW-811	Semi-Annual	Semi-Annual		Semi-Annual		
GW-812	Semi-Annual	Semi-Annual		Semi-Annual		
GW-082	Semi-Annual	Semi-Annual		Semi-Annual		
GW-083		Semi-Annual		Semi-Annual		