

1788

QUALITY ASSURANCE AND QUALITY CONTROL PLAN
FOR
COLLECTING REPRESENTATIVE WATER SAMPLES
TYPE – B
LICENSE N7L1-1788

Prepared for

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1.0 INTRODUCTION

This protocol identifies: the types of sampling required; the location of sample collection; the frequency of sampling; proper sample handling methods and documentation; and the analytical parameters for laboratory analysis, to fulfill the requirements of Indian and Northern Affairs Canada Water Resources Division and the Northwest Territories Water Board Class B License N7L1-1788. This License is for the Nuna 2002/2003 Drilling Program, located in the area of Latitude 69° 05' – 69° 09' N, Longitude 133° 17' – 134° 20' W in the Northwest Territories. The maximum daily amount of water used for all purposes shall not exceed 1000-m³.

Included in Appendix A are basic definitions for terms used for sampling in this protocol.

2.0 SAMPLE COLLECTION

2.1 Location

Water sample collection for laboratory analysis will occur at sampling station 1788-1 (Discharge from the Sewage Treatment Facilities), 1788-2 (Drilling Waste Prior to Entering the Drilling Sump). Sign posting will be used to identify the sampling locations. Refer to Table 1.

2.2 Sampling Equipment

The collection of treated effluent at Stations 1788-1 and 1788-2 will require personal protective gear that should include: disposable latex or Nitril gloves, rubber boots (waterproof), Tyvek or other protective clothing, eye protection, and hardhat (if sampling near overhead equipment). For the protection and preservation of the collected water samples, equipment would include: labels for sample identification, packing tape to protect labels, laboratory cleaned sample containers (see Table 1 for types and quantity required), coolers, ice packs, bubble wrap for packing, chain of custody forms, and completed field notes (see section 3.1). Additional equipment that may be required includes a pH meter, electrical conductivity meter, and temperature probe. A general list of instructions for calibration of pH, DO, PID and Gastech meters is included as Appendix B. However, as the maintenance schedule and calibration is specific for each piece of analytical field equipment and for each manufacturer, please refer to manufacturer's instructions accompanying your equipment.

TABLE 1

STATIONS 1788-1 & 1788-2
SAMPLE COLLECTION

PARAMETER	CONTAINER TYPE	SAMPLE SIZE (ml)	PRESERVATION	MAXIMUM STORAGE TIME	FREQUENCY AND LOCATION
WEEKLY SAMPLING – STATION 1788-1					
BOD ₅	Sterile Polyethylene	1000	Refrigerate 4 °C	48 Hours	Weekly – Station # 1788-1
Total Suspended Solids	Polyethylene	500	Refrigerate 4 °C	28 Days	Weekly – Station # 1788-1
Faecal Coliforms	Sterile Polyethylene	300	Sodium Thiosulfate – Refrigerate 4 °C	24 Hours	Weekly – Station # 1788-1
Ammonia	Polyethylene	500 or 750	Refrigerate 4 °C	28 Days	Weekly – Station # 1788-1
Oil and Grease	Wide mouth Amber Glass	1000	2 ml 1:1 H ₂ SO ₄ - Refrigerate	28 Days	Weekly – Station # 1788-1
Total Residual Chlorine	Wide mouth Clear Glass	1000	Refrigerate 4 °C	Field Analyze (HACH)	Weekly – Station # 1788-1
pH	Polyethylene	500	Refrigerate 4 °C	Field Analyze (pH Probe)	Weekly – Station # 1788-1
MONTHLY SAMPLING – STATION 1788-2					
Total Sulphur	P.E.T.E Wide mouth	250	Refrigerate 4 °C - HNO ₃ 1:1	7 Days	Monthly – Station # 1788-2
Total Chlorine	Polyethylene	500	Refrigerate 4 °C – HNO ₃ 1:1	7 Days	Monthly – Station # 1788-2
Total Calcium	P.E.T.E Wide mouth	250	Refrigerate 4 °C – HNO ₃ 1:1	7 Days	Monthly – Station # 1788-2
Total Sodium	P.E.T.E Wide mouth	250	Refrigerate 4 °C – HNO ₃ 1:1	7 Days	Monthly – Station # 1788-2
Total Residual Chlorine	Wide mouth Clear Glass	1000	Refrigerate 4 °C	Field Analyze (HACH)	Monthly – Station # 1788-2

2.3 Sampling Methods

Two main categories of samples will be utilized for this program: Test Samples and Control Samples. The test sample method chosen to best characterize the site is Probability Sampling using the Simple Random Sampling method (see Appendix A). In addition to the test sampling, Quality Control (QC) sampling with field blanks, trip blanks, and duplicate samples should be performed periodically (monthly) to confirm the laboratory results.

All sampling, sample preservation, and analysis shall be conducted in accordance with method described in the current edition of “Standard Methods for the Examination of Water and Wastewater” (20th edition, 1998).

When sampling in lakes and ponds, the sample bottle is lowered to mid-depth and rinsed three times before collecting the sample on the fourth submersion. Ensure the sample container contains adequate room for mixing, preservative addition and thermal expansion.

When sampling stream water, the sample container is plunged into the current and rinsed three times before collecting the sample on the fourth submersion. As in lake and pond water sampling, ensure the sample container contains adequate room for mixing, preservative addition and thermal expansion.

Glass containers should be used when sampling for hydrocarbon (oil and grease) concentrations.

Deviating from the above sampling protocols, water collected for faecal coliforms, and oil and grease analysis is collected during the first submersion and not rinsed three times first.

For the sampling of Sump Fluids:

- Divide the Sump into a grid of six equal areas, take three samples in the vertical profile (surface, mid-depth, just above the mud/supernatant interface) at the centre of each area. Mix these eighteen samples together to form a single Composite Sample, from which as many sub-samples may be obtained as necessary for analysis. An additional sample must be taken from the surface of the sump.
- **Total Residual Chlorine must be field analyzed.** Using a product such as: HACH CL17 Chlorine Analyzer (5440002 – CL17 Total Residual Chlorine Analyzer) and the supplied reagents to determine concentrations. See Appendix B for product information, specifications, and ordering information of the HACH CL17 Chlorine Analyzer. **Please Note:** If taken back to the laboratory for this analysis, results would be invalid, as the residual chlorine degrades quickly.

TABLE 2

SUMP – STATION 1788-2
SAMPLE COLLECTION

PARAMETER	CONTAINER TYPE	SAMPLE SIZE (ml)	PRESERVATION	MAXIMUM STORAGE TIME	FREQUENCY AND LOCATION
COMPOSITE SAMPLING – STATION 1788-2					
Total & Dissolved Metals (Cu, Cd, Fe, Ni, Pb, Cr, & Zn)	Sterile Polyethylene	1000	Refrigerate 4 °C	48 Hours	Prior to Abandonment Station # 1788-2
Sulphate	Polyethylene	500	Refrigerate 4 °C	28 Days	Prior to Abandonment Station # 1788-2
Conductivity	Sterile Polyethylene	300	Sodium Thiosulfate – Refrigerate 4 °C	24 Hours	Prior to Abandonment Station # 1788-2
Total Suspended Solids	Polyethylene	500 or 750	Refrigerate 4 °C	28 Days	Prior to Abandonment Station # 1788-2
Oil and Grease	Wide mouth Amber Glass	1000	2 ml 1:1 H ₂ SO ₄ - Refrigerate	28 Days	Prior to Abandonment Station # 1788-2
Total Residual Chlorine	Wide mouth Clear Glass	1000	Refrigerate 4 °C	Field Analyze	Prior to Abandonment Station # 1788-2
pH	Polyethylene	500	Refrigerate 4 °C	Field Analyze	Prior to Abandonment Station # 1788-2
Potassium	Polyethylene	500	Refrigerate 4 °C	7 Days	Prior to Abandonment Station # 1788-2
Chlorine	Polyethylene	500	Refrigerate 4 °C	7 Days	Prior to Abandonment Station # 1788-2
Calcium	Polyethylene	500	Refrigerate 4 °C	7 Days	Prior to Abandonment Station # 1788-2
Sodium	Polyethylene	500	Refrigerate 4 °C	7 Days	Prior to Abandonment Station # 1788-2
Magnesium	Polyethylene	500	Refrigerate 4 °C	7 Days	Prior to Abandonment Station # 1788-2
Toxicity (96 hr LC50 – Rainbow Trout)	Sterile Plastic Pail	40 L	Refrigerate 4 °C	5 Days	Prior to Abandonment Station # 1788-2
SURFACE SAMPLING					
Oil and Grease	Wide mouth Amber Glass	1000	2 ml 1:1 H ₂ SO ₄ - Refrigerate	28 Days	Prior to Abandonment Station # 1788-2

In general, the protocol for sampling is as follows:

- Acquire all necessary equipment, including; personal protective equipment, sample labels, writing tool (pencil or waterproof ink should be used to avoid running), laboratory cleaned sample containers, sample documenting forms (field notes, field screening results (field pH, Electrical Conductivity (EC), and temp values, if required), chain of custody forms, weigh bill for transportation by commercial carrier), coolers and ice packs for sample refrigeration and transportation to the laboratory, bubble wrap for packing, clear packing tape to protect sample labels and seal cooler, camera to photo document sample collection, and any additional equipment required.
- Don personal protective equipment
- At sampling location, if required, perform field screening of pH, EC, and Temperature of treated effluent discharge and record values in field notes.
- Label sample containers with information described in Section 3.1.
- Place clear packing tape over label to protect information from “washing off”.
- Open control sample bottles of deionized (DI) water, and add analyte of known concentration (obtained from the Laboratory) and preservative if required, seal, label, and send with other samples for laboratory analysis. Note: if possible, it is preferable to fill control sample container with DI water at the site.
- Rinse sample containers with water to be sampled if necessary, do not rinse sample containers for faecal coliforms and oil and grease analysis.
- Collect sample in laboratory cleaned sample container (note: it is imperative that the collected samples be representative of the whole population (i.e. the effluent stream)). Qualitative observations of the sample should also be noted in the field notes at this time (i.e. sample colour, odour, clear-opaque, presence of particulates, etc.).
- **Total Residual Chlorine must be field analyzed.** Using a product such as: HACH CL17 Chlorine Analyzer (5440002 – CL17 Total Residual Chlorine Analyzer) and the supplied reagents to determine concentrations. See Appendix B for product information, specifications, and ordering information of the HACH CL17 Chlorine Analyzer. **Please Note:** If taken back to the laboratory for this analysis, results would be invalid, as the residual chlorine degrades quickly.
- Complete Chain of Custody form with required analysis listed for each collected sample.
- Carefully bubble wrap the sample containers and place in ice chilled cooler maintained at ~4 °C for transport directly to the laboratory for analysis. Note: this entire procedure, including the initial laboratory sample preparation, must be completed within the allowable holding time (Table 1) from the time of sampling (e.g. within 24 hours for faecal coliforms).
- Complete field notes and log samples. Retain paperwork for submission to the Board, if required.

Treated effluent discharge samples will be collected on a *weekly* basis at *Station 1788-1* and sent for laboratory analysis to determine the concentrations of Biological Oxygen Demand (BOD₅), Total Suspended Solids (TSS), Faecal Coliforms, Ammonia, Oil and Grease, pH and Total Residual Chlorine.

Refer to Table 1 for a summary of parameters to be analyzed, container size, preservation methods, and holding times.

Drilling Waste prior to entering the Sump will be collected on a *monthly* basis at *Station 1788-2* and sent for laboratory analysis to determine the concentrations of Total Sulphur, Total Chlorine, Total Calcium, Total Sodium, and Total Residual Chlorine. Refer to Table 2 for a summary of parameters to be analyzed, container size, preservation methods, and holding times.

The quality controlled blank and duplicate samples will be statistically compared to laboratory QA/QC samples. The “Quality” of the samples and sampling procedures are evaluated from the results of this comparison. If field control samples fall out of the allowable statistical standard deviation, then the sample results are invalid, and the discharge must be sampled again. If upon re-sampling and re-submission to the laboratory, QC samples continue to be “out of range”, then complete review of the storage of containers prior to sampling, sampling procedures, and the storage and transport of the samples to the laboratory is warranted.

3.0 SAMPLE HANDLING

As sample-handling procedures are imperative to the integrity of the sample, lag times from the time of sample collection to the time of laboratory analysis must be kept to a minimum. Samples for Faecal Coliforms analysis, for example, have a holding time of 24 hours from the time of sample collection to the time of laboratory analysis. Beyond that time the analysis is not valid.

3.1 Documentation

Documentation is an important part of a Quality Assurance Program. The minimum documentation requirements (CCME 1993) for samples include:

- Sampling date
- Sampling time
- Identification number or code
- Sampler’s name
- Sampling site (including coordinate/depth where relevant)
- Sampling conditions
- Sample type
- Sampling equipment
- Storage and preservation methods
- Time of storage and of preservation
- Auxiliary information (topography, distance from source, field screening values of pH, EC, and temp, etc.)
- Deviations from the sampling protocols, if any, and
- Completion of the Chain of Custody (COC) for transport directly to the laboratory.

Additional information on the sample containers to aid in efficient handling includes:

- Analysis required (not just listed on the COC), and
- Label the sample container lid with sample identification number.

3.2 Preservation

This procedure is used to ensure the integrity of the collected sample until it is laboratory analyzed. Preservation methods include; refrigeration (refrigerated storage or ice packs), the addition of chemicals (acids, other preservatives, etc), and filtration.

Preservation methods can be parameter specific, such as the addition of Sodium Thiosulfate for BOD₅ analysis, or can be a universal method, such as refrigeration. Refer to Table 1 for the specific preservation method used for each parameter to be analyzed.

3.3 Transportation

The collected samples with complete documentation (sample identification and chain of custody form, as described in Section 3.1) are to be packed in bubble wrap and placed in coolers with ice packs or refrigerated. The packed samples are to be sent directly to the laboratory for analysis (Enviro-Test Laboratory in Calgary, AB) as soon as possible. Therefore, due to the remoteness of the site, sample collection times must be logistically organized with transportation schedules to the laboratory. This will ensure the samples arrive at the laboratory and are analyzed within the allowable holding time.

4.0 LABORATORY ANALYSIS

4.1 Lab Accreditation

Enviro-Test Laboratory in Calgary will be used to analyse samples for BOD₅ and pH. Samples analyzed for ammonia, TSS, faecal coliforms, oil and grease, total residual chlorine, total chlorine, total sulphur, total calcium, and total sodium will be analyzed at Enviro-Test Laboratory in Edmonton. ETL will arrange all transportation for all samples between their Calgary and Edmonton laboratories.

See Appendix C for Canadian Association for Environmental Analytical Laboratories (CAEAL) accreditation of Enviro-Test Laboratory.

4.2 Detection Limits

Refer to Table 2 in Section 4.3 for detection limits for each parameter.

4.3 Methodology

Refer to Table 2 for laboratory methods for each parameter.

TABLE 3

METHODS OF ANALYSIS AND DETECTION LIMITS

PARAMETER	ETL CODE	TEST METHOD ¹	DETECTION LIMIT
WEEKLY SAMPLING			
BOD ₅	BOD	APHA 5210 B - 5 Day incubation	2 mg/L
Total Suspended Solids	ROU+TSS	APHA 2540 D-Gravimetric	3 mg/L
Faecal Coliforms	FCC-MPN	A151.04 based on std method 9221A,B,C	MPNU/100mL
Ammonia	NH ₄	APHA 4500NH# Colorimetry	0.05 mg/L
Oil and Grease	OGG	APHA 5520 B-Gravimetric	1 mg/L
pH	ROU+TSS	APHA 4500-H-Electrode	0.01 Unit
Total Residual Chlorine	*	Field Analyzed	0.1 mg/L
MONTHLY SAMPLING			
Total Chlorine	CL2-TOT	APHA 4110 B-ion Chromotography	0.1 mg/L
Total Sulphur	S-TOT	APHA 3120 B-ICP-DES	0.5 mg/L
Total Calcium	CA-TOT	APHA 3120 B-ICP-DES	0.5 mg/L
Total Sodium	NA-TOT	APHA 3120 B-ICP-DES	1 mg/L
Total Residual Chlorine	*	Field Analyzed	0.1 mg/L
SUMP ABANDONMENT			
Total and Dissolved Metals (Cu, Cd, Fe, Ni, Pb, Cr, & Zn)	Metal-DIS Metal-TOT	APHA 3120 B-ICP OES	Varies for each metal
Sulphate	SO4-IND	APHA 4110 B-ION Chromotography	0.5 mg/L
Conductivity	EC	APHA 2510 B-Electrode	2 uS/cm
pH	ROU+TSS	APHA 4500-H-Electrode	0.01 Unit
Total Suspended Solids	ROU+TSS	APHA 2540 D-Gravimetric	3 mg/L
Total Reactive Chlorine	HydroQual	Environment Canada Approved Method	1 PPB
Chloride	CL	APHA 4110 B-ICP Chromotography	0.1 mg/L
Sodium	SAL-CL	APHA 3120 B-ICP OES	1 mg/L
Potassium			0.1 mg/L
Calcium			0.5 mg/L
Magnesium			0.1 mg/L
Oil & Grease			OGG
Toxicity (96 hr LC50 using Rainbow Trout)	HydroQual TR(D)	Environment Canada Approved Method	1 unit

¹Refer to Standard Methods for the Examination of Water and Wastewater 20th Edition (1998)

*Analysis performed in the field

4.4 Reporting Requirements

As indicated in the "Surveillance Network Program" appended to Petro-Canada's Class B Water License N7L1-1788:

"The Licensee Shall, within fifteen (15) days following the month being reported, submit to the Board all data and information required by the "Surveillance Network Program" including the results of the approved Quality Assurance Plan."

TABLE 4

MAXIMUM ALLOWABLE CONCENTRATIONS

SAMPLE PARAMETER	MAXIMUM ALLOWABLE CONCENTRATION	STATION
BOD ₅	80.0 mg/L	1788-1
Total Suspended Solids (TSS)	100.0 mg/L	1788-1
Faecal Coliforms	10E4 CFU/dL	1788-1
Oil and Grease	5.0 mg/L	1788-1
pH	6 to 9	1788-1
Chlorine	100,000 mg/L	1788-2

In addition to the monthly reporting of discharge quality, Petro-Canada shall file an **Annual Report** with the Board and an Inspector not later than **March 31** of the year following the calendar year reported.

This report shall contain:

- The total quantities in cubic metres of fresh water obtained from all sources;
- The total quantities in cubic metres of each and all waste discharged;
- An itemized list indicating the names and quantities of all drilling mud additives used;
- Details of work completed;
- Details on the restoration of any Sumps;
- The results of sampling carried out under the Surveillance Network Program;
- A summary of any modifications carried out on the Water Supply and Waste Disposal Facilities; including all associated structures;
- Results from monitoring programs;
- A list of any spills and unauthorized discharges; and
- Any other details on water use or waste disposal requested by the Board within forty-five (45) days before the annual report is due.

Definition of Terms

Act – Northwest Territories Waters Act.

Analyst – an Analyst designated by the Minister under Section 35(1) of the Northwest Territories Water Act.

Analyte – is a solution containing the parameter of interest in a known or unknown concentration.

Artesian Aquifer – a water-bearing rock stratum, which when encountered during drilling operations, produces a pressurized flow of groundwater that reaches an elevation above the water table or above the ground surface.

Board – the Northwest Territories Water Board established under section 10 of the Northwest Territories Water Act.

Detection Limit – refers to the minimum concentration of analyte that can be measured above the background noise of an instrument.

Drilling Fluids – any liquid mixture of clay, water or chemical additives pumped down-hole.

Inspector – an inspector designated by the Minister under Section 35(1) of the Northwest Territories Water Act.

Licensee – the holder of this License.

Minister – the Minister of Indian Affairs and Northern Development.

Maximum Average Concentration – the running average of any four consecutive analytical results, or if less than four analytical results collected, and submitted to the Inspector in accordance with the sampling and analysis requirements specified in the “Surveillance Network Program”.

Modification – an alteration to a physical work that introduces a new structure or eliminates an existing structure and does not alter the purpose or function of the work, but does include an expansion.

Permeability – the capacity to transmit water through a medium

Preservation – refers to control methods used to ensure the integrity of the collected sample until it is laboratory analyzed. Preservation methods include; refrigeration (refrigerated storage or ice packs), the addition of chemicals (acid, base, preservatives, etc), and filtration.

Project Description – refers to the description of the project submitted to Territorial Agencies for approval on the client’s behalf.

Quality Assurance – is the system of activities designed to better ensure that quality control is done effectively.

Quality Control – is the use of established procedures to achieve standards of measurement for the three principal components of quality; precision; accuracy; and reliability.

Regulations – Regulations proclaimed pursuant to Section 33 of the Northwest Territories Water Act.

Samples - There are two main categories of samples; Test Samples and Control Samples.

Test Samples – are basic samples used to characterize a site. The number of test samples depends on the degree of confidence required to characterize the site and on the number of samples needed for each analytical method. There are various approaches to collecting test samples:

- *Accessibility Sampling* - The sample is restricted to a part of a population that is readily accessible. It may be justified when resources of time, money or physical access, prevent any other type of sampling being taken, but there is little other justification.
- *Haphazard Sampling* - Taken when, although other samples may be accessible, there is no plan to control the probability of choosing a sample. It is really of value only if a very homogenous population over time and space is being sampled, which is generally unknown at the time of sampling (if it was known, samples would probably not be required). This is very difficult to justify and this method is not recommended.
- *Judgment (or Purposive) Sampling* - Taken when specific samples are selected for their unique value of interest, not for making inferences about the population. Judgment Samples may also be taken when the target population is well defined and homogenous, but the same concerns described for Haphazard Sampling apply. Since you are generally sampling because you do not know the population, this is not recommended.
- *Probability or Representative Sampling (suggested for this project)*. Probability or representative sampling is the most important type of sampling and is aimed at ensuring that valid conclusions can be drawn about a population from a sample. Various approaches to this include;
 - *Random Sampling* – the sample is selected by chance mechanism with known probability of selection. This method of sampling is also divided into Simple Random Sampling and Stratified Random Sampling.
 - *Simple Random Sampling* – When a population is large and homogeneous and every possible sample has an equal probability of being selected.
 - *Stratified Random Sampling* – When a population is large and heterogeneous, it can be subdivided, the subdivisions sampled and, if necessary, the results combined.
 - *Grid Sampling* – When systematic samples are taken in a specified pattern, usually a grid, with the samples collected at the grid nodes.
 - *Stratified Sampling* – When a specified number of random samples are taken in a specified pattern or within a cell, usually a grid.

Control samples / Quality Control (QC) samples, which may be simulated samples, are used to control the analytical process. They are often regarded as synonymous with QC check samples. The term is also used to describe samples taken outside the target area, in order to provide a “background” reading.

Sewage Treatment Facility – comprises the engineered structures that are designed to contain and treat sewage.

Sewage – all toilet waste and grey-water.

Sump – an excavation for the purpose of catching or storing fluids.

Waste – waste as defined by Section 2 of the Northwest Territories Water Act.

Waters – waters as defined by Section 2 of the Northwest Territories Water Act.

EC Meter

Introduction to Electrical Conductivity (EC)

Introduction

The conductivity of a water sample is the measure of its ability to carry an electrical current and the more dissolved solids in the water, the greater its electrical conductivity. In order to measure the amount of total dissolved solid, the sampler must first determine the conductivity of the water sample and then multiply that number by 0.67. The formula for this equation goes as follows: Total Dissolved Solids (TDS) in PPM = Electrical Conductivity (in micro-Siemens/cm) x 0.67. MicroSiemens/cm is the metric unit of measurement of conductivity.

Calibration

Before measuring the conductivity of a water sample, the sampler must first calibrate the conductivity meter. To calibrate the meter, the sampler must measure a "standardized solution" of known electrical conductivity. Turn the conductivity meter on. The sampler must rinse the electrode at the bottom of the probe with distilled water and afterwards blot the probe dry with a tissue. If the display on the conductivity meter does not read the standard solution value, then the sampler must adjust the instrument with a small screwdriver.

Sample Measurement

The sampler must first repeat the steps used to calibrate the instrument. After turn the instrument on, the sampler must rinse the probe with distilled water and blot dry. Immerse the EC probe in to the water sample and gently stir the sample for a few seconds to allow the display value to stabilize. Read and record the value displayed on the meter.

EC Meter General Maintenance

- Do not immerse the EC probe above the immersion level.
- When not in use, switch off the meter and replace the protective cap.
- To improve performance, clean the probe electrodes periodically by rinsing them in distilled water.
- Replace all batteries if the display become faint or disappears or if the reading are unstable or constant.

pH Meter

INTRODUCTION TO pH

Introduction

pH is a unit of measure which describes the degree of acidity or alkalinity of a solution. It is measured on a scale of 0 to 14. A pH of 7 is neutral, 0 is extremely acid and 14 is extremely alkaline (basic). pH values of some common substances are listed below.

0.35	battery acid
2.35	lemon juice
2.90	vinegar
4.30	orange juice
5.00	boric acid
6.20	corn
6.70	milk
7.00	distilled water
7.50	blood
8.00	sea water
8.40	baking soda
9.30	borax
10.25	milk of magnesia
11.40	ammonia
12.60	bleach
14.60	household lye

pH Measurement

A rough indication of pH can be obtained using pH papers or indicators, which change color as the pH level varies. These indicators have limitation on their accuracy, can be difficult to interpret correctly in colored or murky samples.

More accurate pH measurements are obtained with a pH meter. A pH measurement system consists of three parts:

1. A pH measurement electrode.
2. A measurement electrode.
3. A high input impedance meter.

The pH electrode can be thought of as a battery, with a voltage that varies with the pH of the measured solution. The pH measuring electrode is a hydrogen sensitive glass bulb, with a millivolt output that varies with the changes in the relative hydrogen ion concentration inside and outside of the bulb. The reference electrode output does not vary with the activity of the hydrogen ion.

The pH meter is basically a high impedance amplifier that accurately measures the minute electrode voltages and displays the results directly in pH units on either an analog or digital display.

Storage, Use and Maintenance

Over 80% of pH measurement difficulties are due to electrode problems. Proper storage, use and maintenance increase accuracy.

Storage: Electrodes should be stored so that the probe is kept moist and not allowed to dry out. Put a few drops of storage solution in the protective cap before putting the cap on. Never store the electrode in distilled or deionized water. Commercial soaking solutions are available or you can make your own by mixing a 1M KCl solution adjusted to pH 4.0.

Use and Maintenance: Electrodes should always be used in a vertical position.

- Electrodes should be rinsed between samples with distilled or deionized water.
- NEVER wipe an electrode to remove excess water, just blot the end of the electrode with a lint-free paper. Wiping electrode can cause spurious reading due to static charges.
- pH electrodes are fragile, care should always be taken when using the pH meter.

Calibration Method

1. For accurate results a pH meter should be calibrated each time it is turned on.
2. Pour a small amount of pH 7.01 calibration solution into a clean container labelled with the pH.
3. Pour a small amount of pH 4.01 (or pH 10.01) calibration solution into a clean container labelled with the pH.
4. Turn the pH meter on by pressing the "ON/OFF" button.
5. Remove the protective cap.
6. Rinse the electrode and temperature probe with distilled water or pH 7.01 solution.
7. Immerse the electrode into the fresh pH 7.01 solution. The electrode should be approximately 4 cm in the solution.
8. Gently stir the electrode and wait for the reading to stabilize.
9. When the reading stabilizes, press the "CAL" button.
10. Wait for the "pH" symbol to stop flashing and press the "CFM" button.
11. The symbol "E5" will flash.
12. Take the electrode and temperature probe out of the pH 7.01 solution and rinse with distilled water or pH 4.01 (or pH 10.01) solution.
13. Immerse the electrode and temperature probe into the fresh pH 4.01 (or pH 10.01) solution.
14. Gently stir the electrode and wait for the reading to stabilize.
15. The "E5" symbol will disappear and the pH reading will flash.
16. When the pH reading stops flashing press the "CMF" button.
17. Take the electrode and temperature out of the pH 4.01 (or pH 10.01) solution and rinse with distilled water.
18. The meter is now ready to take sample readings. Go to the "Sampling Method" section below.

Sampling Method

1. Make sure electrode and temperature probe are rinsed.
2. Submerge the electrode and temperature probe in the sample water.
3. Gently stir the electrode in the sample to supply fresh water to the probe.
4. Let the display reading stabilize.
5. Record temperature and pH readings.
6. Rinse the electrode and temperature probe with clean water.
7. Repeat steps 1 to 6 for each sample.
8. Turn meter off and rinse electrode and temperature probe.
9. Put a few drop of storage solution in protective cap.
10. Put protective cap on electrode.
11. Before storing the meter, make sure it is turned off.

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DO Meter

INTRODUCTION TO DISSOLVED OXYGEN (DO)

Introduction

Dissolved oxygen (DO) is the amount of molecular oxygen dissolved in water. Because oxygen is required for most aquatic life and many microorganisms, DO is one of the most important criteria in determining the quality of a natural water. The air we breathe is approximately 20% oxygen and the water fish "breathe" is less than 10mg/L (or 0.001%).

The amount of DO decreases with increasing water temperature. So cold water can contain more dissolved oxygen than warm water. The saturation dissolved oxygen at given temperatures is given below (the maximum DO in water at given temperatures):

0°C	14.6 mg/L
5°C	12.8 mg/L
10°C	11.3 mg/L
15°C	10.1 mg/L
20°C	9.1 mg/L
25°C	8.3 mg/L
30°C	7.6 mg/L

DO Measurement

DO can be measured using chemicals or with a DO meter. In the field a DO meter is always used. DO measurements for meters are typically given in mg/L.

For a DO meter, a thin semi-permeable membrane, stretched over a sensor, isolates the sensor elements from the environment, but allows oxygen and certain other gases to enter (pass through the membrane). When a polarizing voltage is applied across the sensor, oxygen that has passed through the membrane reacts at the cathode, causing a current to flow. Oxygen diffuses through the membrane at a rate proportional to the pressure difference across it. Since oxygen is rapidly consumed at the cathode, it can be assumed that the oxygen pressure inside the membrane is zero. Hence, the amount of oxygen diffusing through the membrane is proportional to the absolute pressure of oxygen outside the membrane. If the oxygen pressure increases, more oxygen diffuses through the membrane and more current flows through the sensor, giving a higher DO reading. A lower pressure results in less current, giving a lower DO reading.

Storage, Use and Maintenance

Storage: The protective cap should be kept on the probe when the probe is not in use to protect against damage and dirt.

Use and Maintenance: The platinum cathode (is seen when replacing the membrane) should also be bright and untarnished. If it is tarnished or stained the cathode should be cleaned.

- To clean the cathode, use a clean lint-free cardboard or cloth. Rub the cathode very gently side to side 4 to 5 times. Take care not to damage the platinum tip.
- After cleaning the cathode, rinse the probe with deionized or distilled water and install a new membrane using instruction below.
- In order to have accurate and stable measurements, the surface of the membrane should be in perfect condition.
- If any dirt is observed on the membrane, rinse carefully with distilled or deionized water. If any imperfection still exists, or any damage is evident (such as wrinkles, tears or holes) the membrane should be replaced.
- Make sure that the O-ring is properly seated in the membrane cap.

Changing the Membrane: To replace the membrane or refill with electrolyte, proceed as follows:

1. Remove the protective cap by gently twisting and pulling it off the body of the probe.
2. Unscrew the membrane by turning it counter-clock-wise with the other hand.
3. Wet the sensor by soaking the bottom 2.5cm of the probe in electrolyte for 5 minutes.
4. Rinse the new membrane with electrolyte while shaking it gently. Refill with clean electrolyte.
5. Gently tap the sides of the membrane with your fingertip to ensure that no air bubbles remain trapped. Do not directly tap the bottom with your finger as this will damage the membrane.
6. Make sure that the rubber O-ring is seated properly inside the membrane cap.
7. With the sensor facing down, screw the membrane cap clock-wise. Some electrolyte will overflow.

Calibration Method

1. For accurate results a DO meter should be calibrated each time it is turned on.
2. Turn the DO meter on by pressing the "ON/OFF" button.
3. It can take as long as 15 minutes for the DO probe to stabilize, therefore meter calibration should be performed after a 15 minute "warm-up" period.
4. The meter is generally left on throughout the working day, since it takes so long to stabilize.
5. Remove the protective cap from the DO probe.
6. Dip the probe into zero oxygen solution.
7. Stir gently for 2 to 3 minutes.
8. Allow another 2 minutes for reading to stabilize.
9. Adjust the zero DO calibration trimmer until the display reads "0.0".
10. Rinse the probe in a large amount of clean water to remove any residual zero oxygen solution.
11. Dry the probe tip.
12. Allow a few minutes for the readout to stabilize.
13. Press and hold the "CAL" button.
14. Adjust the slope trimmer on the top of the meter to read "100%" on the display (while still holding the "CAL" button).
15. Release the "CAL" button and the display will give the value of oxygen in mg/L.

16. Steps 6 to 10 only need to be performed after the membrane or electrolyte are changed. When the membrane or electrolyte have not been changed steps 6 to 10 can be skipped.
17. The meter is now ready to take sample readings. Go to the "*Sampling Method*" section below.

Sampling Method

1. Make sure your probe is rinsed.
2. Immerse the tip of the probe in the water sample.
3. Make sure temperature sensor is also immersed.
4. Gently stir the probe in sample to supply fresh water to the probe.
5. Let the display reading stabilize.
6. Record temperature and DO readings.
7. Rinse the probe with clean water.
8. Repeat steps 1 to 7 for each sample.
9. Put protective cap on electrode.
10. Before storing the meter, make sure it is turned off.

Gastech 1238 ME

INTRODUCTION TO GASTECH MODEL 1238 ME HYDROCARBON SURVEYOR

General Description

The Gastech Model 1238ME is a battery powered, portable instrument designed to detect and measure concentrations of combustible gases in the atmosphere. It is equipped with two ranges of measurements, reading concentrations in the parts per million (0-500 ppm) range or in percent lower explosive limit (0-100% LEL). LEL is a measure of the explosibility of the atmosphere with 100% being the minimum concentration of gas required for ignition.

The meter is also equipped with alarms to warn the operator should the concentration of gas reach preset limits. The two alarms, one for each range, are factory set, but can be changed. The meter will also sound an alarm if an internal malfunction is detected or when the battery power begins to run down.

A unique feature of this meter is its ability to eliminate response from methane. This feature is especially useful when the meter is used to detect soil contamination in areas where methane occurs naturally and its response on gas detection equipment is undesirable.

The air sample enters the sensor chamber from the front, flows over the sensor and is then drawn out the exhaust by an electric pump. Within the sensor is an electrically heated platinum filament. When a combustible gas comes into contact with the filament, the gas oxidizes causing a temperature increase in the filament. This temperature increase is directly proportional to the concentration of combustible gas at the sensor. The temperature increase in the filament produces an increase in the resistance which is used by the electronic circuitry to generate a meter reading.

The filaments are enclosed within a flame arrestor which prevents any outward propagation of flame, should an explosive environment be sampled. The methane elimination option works by reducing the temperature of the filament to below that of the ignition temperature of methane. Doing this prevents methane from oxidizing, however, other combustible gasses which have lower ignition temperatures will still react.

Controls and Indicators

The five controls used in the normal operation of this instrument are arranged on the left side of the meter as viewed from the rear. These include:

1. Power switch
2. Batt.ck switch (changes instrument meter to volt meter to check battery condition)
3. LEL/PPM switch (changes between LEL and PPM units)
4. Zero control (zero instrument when in fresh air environment)
5. Methane elimination switch

Calibration

Calibration consists of exposing the instrument to a known gas sample and adjusting the electronic circuitry to generate a display equal to the concentration of the calibrating gas. All this has been already done in the factory prior to taking the instrument out into the field.

Sampling Procedure

1. Connect the hose and probe to the instrument.
2. Place the LEL/PPM switch into the LEL position ("out" position) with the black indicator showing.
3. Press the power switch to turn the instrument on. The orange indicator dot will be showing and the hum of the pump will be heard. Allow the instrument to warm up until the meter stabilizes (about 10 minutes).
4. Press the BATT CK button and note the meter reading. IF the reading is on or below the BATT CK mark, the battery pack must be recharged.
5. Ensure the Methane elimination switch is in the desired position. Pressing the switch in (orange indicator dot showing) places the instrument in the no methane response mode.
6. With the instrument drawing in a known gas free air sample, adjust the ZERO control to bring the needle to the zero mark. If it is not possible to bring the needle to zero.
7. The meter is now ready to read gas concentrations in the 0-100% LEL range.
8. To read gas concentrations on the 0-500 PPM range, push the range selection switch into the PPM position. Allow an additional 5 minutes for the instrument to thoroughly warm up and the meter to stabilize at this more sensitive range.
9. With the instrument drawing a known gas free sample, re zero the meter needle using the zero control.
10. The instrument is now ready to read gas concentrations in the 0-500 PPM range.

Alarms

1. The LEL alarm is factory preset at 10% LEL. This gives a safety factor of 10, or one tenth of the concentration required to produce and explosion. When the gas concentration exceeds the preset alarm level, the buzzer will sound a pulsing tone.
2. The PPM alarm is factory preset at 100 PPM. When the gas concentration exceeds the preset levels an alarm will sound.
3. The trouble alarm will sound if there is a problem with the sensor or if the battery pack becomes discharged. The trouble alarms is signaled by a continuous tone from the buzzer.

GASTECH MODEL 1238ME INSTRUCTION MANUAL

GASTECH INSTRUMENTS CANADA CALIBRATION FORM

MODEL 1238ME SERIAL NUMBER _____

DATE	METH ELIM MODE (Y/N)	CAL GAS USED		READING BEFORE ADJUST.		MAX. READING W/ ADJ.		FINAL ADJUSTED VALUE		COMMENTS
		LEL	PPM	LEL	PPM	LEL	PPM	LEL	PPM	

GASTECH MODEL 1238ME INSTRUCTION MANUAL

IX. GASTECH INSTRUMENTS CANADA CALIBRATION FORM

MODEL 1238ME SERIAL NUMBER _____

DATE	METH ELIM MODE (Y/N)	CAL GAS USED		READING BEFORE ADJUST.		MAX. READING W/ ADJ.		FINAL ADJUSTED VALUE		COMMENTS
		LEL	PPM	LEL	PPM	LEL	PPM	LEL	PPM	



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Accreditation
 Offices/Labs
 Personnel Directory

About Us

Accrediting agency:

1. *Standards Council of Canada (SCC) in cooperation with the Canadian Association for Environmental Analytical Laboratories (CAEAL)*

2. *American Industrial Hygiene Association (AIHA)*

3. *Standards Council of Canada (SCC)*

4. *Standards Council of Canada (SCC) in cooperation with the Canadian Association for Environmental Analytical Laboratories (CAEAL)*

5. *(Scc/CAEL- Sask.)*

Accredited analyses:

Air: metals,
Biological: Mercury by AA, Metals
Oil: PCB
Soil/Sediment: BTEX, TEH, Grain Size, Hydride Metal Mercury by AA, ICPMS Metals, Oil and Grease, PAH, Sodium Absorption Ratio
Waste: Flashpoint
Water: Alkalinity, Ammonia, Hydride Metals, BOD, COI Chlorate/Chlorite, Hex Cr, Colour, Conductivity, Dissolved Metals, Fluoride, Major Ions, Mercury, Nitrate/Nitrite, Oil and Grease (SPE, Shake), pH, Phosphorus, Solids, Sulphide, TOC/TIC/DOC/DIC, TKM Tannin and Lignin, Ultra Trace Metals, AOX, BTEX, Chlorinated Phenolics, Resin and Fatty Acids, Dioxins and Furans, TEH, PAH, PCB, Phenol, Pesticides (HPLC/UV, HPLC/Fluorescence, GC/MS, GC/ECD, LC/MS/MS), Volatiles (Edmonton Laboratory)

Organic Solvents, Silica, Metals, Asbestos PCM, Asbestos PLM, Diffusive Samples (Edmonton Laboratory)

Recognized as a GLP Compliant Facility. Areas of Expertise: Physical-Chemical Testing, Studies on Behaviour in Water, Soil, and Air; Bioaccumulation, and Analytical Testing. Product Preliminary Analysis, Residue and/or Environmental

Air Filters: Hi Vol Particulates
Air Impingers: Acidic Stack Gases, Mercury, Solids
Soil/Sediment: BTEX (Mobile Lab), BTEX, Conductivity Flashpoint, Hydrocarbons (C11-C60), Metals, pH, CCM Petroleum Hydrocarbons, Phenols, Cations/SAR, TEH (Mobile Lab), TEH
Water: Alkalinity, Anions, BOD, Cations, Conductivity, Fluoride, Inorganic/Organic Carbon, Metals, pH, Phenols, Solids, BTEX, TEH (Calgary Laboratory)

Soil/Sediment: Available Boron, Chloride, Potassium, Nitrogen and Phosphorus, BTEX, Hydrocarbons (C11-C30, C3-C10), Saturated Soil Extract (Ca, Mg, Na, K, C

NO3, SO4), Cation Exchange Capacity, Conductivity, Hand Texture, Inorganic Carbon, Metals, Ammonia, Oil and Grease, Organic Matter, pH, Particle Size, Total Carbon, Total Nitrogen

Water: Alkalinity, Conductivity, Major Ions, Metals, pH, Total Suspended Solids, Oil and Grease (Saskatoon Laboratory)

6.(SCC/CFIA)

Standards Council of Canada (SCC) in cooperation with the Canadian Food Inspection Agency (CFIA)

(under "accredited analysis") Feed and Fertilizer Testin

Environmental Tests

Air: Biocontaminants

7. Standards Council of Canada (SCC) in cooperation with the Canadian Association, for Environmental Analytical Laboratories (CAEAL)

Oil: PCB

Soil: CCME, BTEX, TVH, TEH, Oil & Grease, Total Metals, PAH, PCB, Hg

Animal Tissue: Total Metals

Plant Tissue: Total Metals

Water: Alkalinity, Ammonia, BOD, cBOD, COD, Hexavalent Chromium, Conductivity, pH, Chloride, Sulfate, Fluoride, Nitrate + Nitrite, Metals (Total, Dissolved & Extractable), Hg, Reactive Silica, TKN, Phosphorus, Solids (Total, Dissolved & Suspended), C (SAD), CN (WAD), Carbon, Turbidity, Color, Coliforms · E. coli (MF, MPN, Quantitray & Presence/Absence), HPC, Cryptosporidium, Giardia, Staphylococcus aureus pesticides, PCB, VOC, PAH, BTEX, TVH, THE, Daphni Bioassay, Trout Bioassay, Microtox, Phytoplankton, Zooplankton. (Winnipeg Lab)

Food and Medical Tests

Microbiological in Foods: Total & Fecal Coliforms, E. coli, Staphylococcus aureus, Salmonella, HPC, Listeria monocytogenes

8. Standards Council of Canada (SCC) in cooperation with the Canadian Food Inspection Agency (CFIA)

Medical: Metals in Hair, Blood and Urine (Winnipeg La

Industrial Hygiene Tests

Air: Asbestos, Metals

Bulk: Asbestos

9. American Industrial Hygiene Association (AIHA)

Environmental Microbiology: Fungi

(Winnipeg Lab)

10. *Standards Council of Canada (SCC) in cooperation with the Canadian Association, for Environmental Analytical Laboratories (CAEAL)*

Water: Acidity, Alkalinity, Conductivity, pH, Ammonia, Anions, BOD, COD, Cations, Chlorine, Cyanide, Fluoride, Metal Hydrides, Metals, Oil and Grease, Phenolics, Potassium, Solids, Sulphide, TOC/DOC, TK Thiocyanate, TKN, Total Phosphorus, True Colour, Turbidity, Coliforms, Heterotrophic Plate Count, Presence/Absence
(Thunder Bay Laboratory)

11. *Standards Council of Canada (SCC) in cooperation with the Canadian Association, for Environmental Analytical Laboratories (CAEAL)*

Soil/Sediment: Base/ Neutral/ Acid Semi-Volatiles, Metals, OC Pesticides, PCB, Solids, Extractable Petroleum Hydrocarbons (C10-C24), Oil and Grease, Volatiles
Water: Alkalinity, Ammonia, Anions, BOD, Colour, Dissolved Metals, pH, Solids, TKN, Total Metals, Phenolics, Total Phosphorus, Total Sulphide, Total and Free Cyanide, Turbidity, Coliform Bacteria, HPC, Coliform Background Counts, Escherichia Coli, Total ar Fecal Coliforms, Base/ Neutral/ Acid Semi-Volatiles, OC Pesticides, PCB, Pesticides (GC/MS), Extractable Petroleum Hydrocarbons (C10-C24), Oil and Grease, Volatiles
(Waterloo Laboratory)

NORTHWEST TERRITORIES WATER BOARD

Pursuant to the *Northwest Territories Waters Act* and Regulations the Northwest Territories Water Board, hereinafter referred to as the Board, hereby grants to

PETRO-CANADA

(Licensee)

150 - 6 Avenue S.W.

of

CALGARY, ALBERTA T2P 3E3

(Mailing Address)

hereinafter called the Licensee, the right to alter, divert or otherwise use water subject to the restrictions and conditions contained in the *Northwest Territories Waters Act* and Regulations made thereunder and subject to and in accordance with the conditions specified in this Licence.

Licence Number

N7L1-1788

Licence Type

"B"

Water Management Area

NORTHWEST TERRITORIES 07

Location

Mackenzie Delta approximately located at
Latitude 69°05' - 69°09' N. and
Longitude 133°17' - 134°20' W.
NORTHWEST TERRITORIES

Purpose

TO USE WATER AND DISPOSE OF
WASTE FOR MUNICIPAL AND
INDUSTRIAL UNDERTAKINGS

Description

OIL AND GAS

Quantity of Water Not to be Exceeded

1000 CUBIC METRES DAILY

Effective Date of Licence

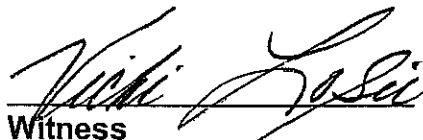
OCTOBER 11, 2002

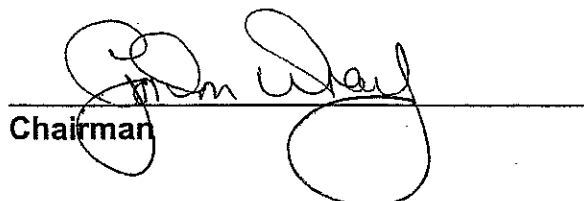
Expiry Date of Licence

SEPTEMBER 30, 2007

This Licence issued and recorded at Yellowknife includes and is subject to the annexed conditions.

NORTHWEST TERRITORIES WATER BOARD


Witness


Chairman

PART A: SCOPE AND DEFINITIONS

1. Scope

- a) This Licence entitles Petro-Canada to use water and dispose of waste for municipal and industrial undertakings in the Mackenzie Delta for the Nuna Winter 2002/2003 Drilling Program located in the area of: maximum Latitude 69°09' N., minimum Latitude 69°05' N., maximum Longitude 134°20' W. and minimum Longitude 133°17' W., Northwest Territories, which entails the drilling of up to two (2) wells and associated camp(s);
- b) This Licence is issued subject to the conditions contained herein with respect to the taking of water and the depositing of waste of any type in any waters or in any place under any conditions where such waste or any other waste that results from the deposits of such waste may enter any waters. Whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the *Northwest Territories Waters Act*, or other statutes imposing more stringent conditions relating to the quantity or type of waste that may be so deposited or under which any such waste may be so deposited this Licence shall be deemed, upon promulgation of such Regulations, to be automatically amended to conform with such Regulations; and
- c) Compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with the requirements of all applicable Federal, Territorial and Municipal legislation.

2. Definitions

In this Licence: **N7L1-1788**

"Act" means the *Northwest Territories Waters Act*;

"Analyst" means an Analyst designated by the Minister under Section 35(1) of the *Northwest Territories Waters Act*;

"Artesian Aquifer" means a water-bearing rock stratum, which when encountered during drilling operations, produces a pressurized flow of groundwater that reaches an elevation above the water table or above the ground surface;

"Board" means the Northwest Territories Water Board established under Section 10 of the *Northwest Territories Waters Act*;

"Drilling Fluids" mean any liquid mixture of clay, water or chemical additives pumped downhole;

"Inspector" means an Inspector designated by the Minister under Section 35(1) of the *Northwest Territories Waters Act*;

"Licensee" means the holder of this Licence;

"Minister" means the Minister of Indian Affairs and Northern Development;

"Maximum Average Concentration" means the running average of any four consecutive analytical results, or if less than four analytical results collected, and submitted to the Inspector in accordance with the sampling and analysis requirements specified in the "Surveillance Network Program";

"Modification" means an alteration to a physical work that introduces a new structure or eliminates an existing structure and does not alter the purpose or function of the work, but does not include an expansion;

"Permeability" means the capacity to transmit water through a medium;

"Project Description" refers to the report titled "Project Description for the Proposed Petro-Canada Nuna Winter 2002/2003 Drilling Program", dated July 2002, prepared by Inuvialuit Environmental & Geotechnical Inc.;

"Regulations" mean Regulations proclaimed pursuant to Section 33 of the *Northwest Territories Waters Act*;

"Sewage Treatment Facility" comprises the engineered structures that are designed to contain and treat sewage;

"Sewage" means all toilet waste and greywater;

"Sump" means an excavation for the purpose of catching or storing fluids;

"Waste" means waste as defined by Section 2 of the *Northwest Territories Waters Act*; and

"Waters" means waters as defined by Section 2 of the *Northwest Territories Waters Act*.

PART B: GENERAL CONDITIONS

1. The Licensee shall file an Annual Report with the Board and an Inspector not later than March 31st of the year following the calendar year reported which shall contain the following information:
 - a) the total quantity in cubic metres of fresh Water obtained from all sources;
 - b) the total quantities in cubic metres of each and all Waste discharged;
 - c) an itemized list indicating the names and quantities of all drilling mud additives used;
 - d) details of work completed;
 - e) details on the restoration of any Sumps;
 - f) a list of spills and unauthorized discharges;
 - g) results from monitoring programs; and
 - h) any other details on water use or waste disposal requested by the Board within forty-five (45) days before the annual report is due.

2. Meters, devices or other such methods used for measuring the volumes of water used and waste discharged shall be installed, operated and maintained by the Licensee to the satisfaction of an Inspector.

3. The Licensee shall comply with the "Surveillance Network Program" annexed to this Licence, and any amendment to the said "Surveillance Network Program" as may be made from time to time, pursuant to the conditions of this Licence.

4. The "Surveillance Network Program" and compliance dates specified in the Licence may be modified at the discretion of the Board.

5. All monitoring data shall be submitted in printed form and electronically in spreadsheet format on a diskette or other electronic forms acceptable to the Board.

6. All reports shall be submitted to the Board in printed format accompanied by an electronic copy in a common word processing format on diskette or other electronic forms acceptable to the Board.
7. Prior to the use of water for municipal undertakings or the disposal of waste and pursuant to Section 17(1) of the *Act* and Section 12 of the Regulations, the Licensee shall have posted and shall maintain a security deposit of Eight Hundred Thousand (\$800,000.00) Dollars in a form suitable to the Minister.
8. Thirty (30) days prior to the commencement of drilling, the Licensee shall notify the Board of the exact wellsite location(s) that have been selected for drilling.
9. The Licensee shall ensure a copy of this Licence is maintained at the site of operation at all times.

PART C: CONDITIONS APPLYING TO WATER USE

1. The Licensee shall obtain Water from the Mackenzie River and unnamed lakes as indicated in the Project Description or as otherwise approved by an Inspector.
2. The daily quantity of water used for all purposes shall not exceed 1000 cubic metres.
3. The water intake hose used on the water pumps shall be equipped with a screen with a mesh size sufficient to ensure no entrainment of fish.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. All sewage shall be directed to the Sewage Treatment Facility as indicated in the Project Description or as otherwise approved by an Inspector.
2. All Waste discharged from the Sewage Treatment Facility shall be directed to the land surface at a location approved by an Inspector.

3. All Waste discharged from the Sewage Disposal Facility shall meet the following effluent quality requirements:

Sample Parameter	Maximum Average Concentration
Biological Oxygen Demand (BOD ₅)	80.0 mg/L
Total Suspended Solids (TSS)	100.0 mg/L
Faecal Coliforms	10E4 CFU/dL
Oil and Grease	5.0 mg/L
Total Residual Chlorine (TRC)	<0.01 mg/L

The Waste discharged shall have a pH between 6 and 9.

4. The Licensee shall contain all wastes that do not meet the requirements in Part D, Item 3 in a sewage sump at a location approved by an Inspector.
5. All Waste discharged from the sewage sump shall meet the requirements in Part D, Item 3.
6. Introduction of water to Waste for the purpose of achieving effluent quality requirements in Part D, Item 3 is prohibited.
7. The Licensee shall, to the satisfaction of an Inspector, contain all drilling Waste in a drilling Sump near the drill site, or at an alternate Sump location as approved by an Inspector.
8. Sumps shall be constructed of materials that normally exhibit low Permeability and in a manner that prevents intrusion of runoff Water.
9. All drilling Waste shall be contained in the drill Waste Sump a minimum of one (1) metre below the active layer.
10. In the event the initial Sumps do not consist of low permeability materials, the Licensee shall construct offsite Sumps to the satisfaction of an Inspector.

11. The Licensee shall construct and maintain the Sumps to the satisfaction of an Inspector.
12. There shall be no disposal of Drilling Fluids from the Sumps into any Waters or onto any land surface.
13. The Licensee shall ensure that Chloride concentrations at SNP Station 1788-2 do not exceed 100,000 mg/L.
14. The Licensee shall, prior to abandonment of a Sump, obtain a representative sample from the Sump using the information requirements outlined in the "Sampling and Analytical Requirements for Characterization of Sump Supernatant Fluids" (Appendix A).
15. If during the drilling, an Artesian Aquifer is encountered producing water flowing at the surface, the Licensee shall notify an Inspector immediately. A sample of not less than ten (10) litres shall be collected from the flowing source at the point of discharge from the well. Five (5) litres shall be made available to an Inspector for analysis, and the Licensee shall have the remaining five (5) litres analysed.
16. Any fluids generated to surface, including those produced from an Artesian Aquifer, shall be contained and shall not be disposed of without approval of an Inspector.
17. All analyses shall be conducted in accordance with methods prescribed in the current edition of "Standard Methods for the Examination of Water and Wastewater" or by such other methods as may be approved by an Analyst.
18. No oil-based Waste products are to be disposed of on-site. Oil-based additives and drill cuttings associated with these additives are to be disposed of at an approved offsite location to the satisfaction of an Inspector.
19. Any on-site treatment of oil-based Waste products must be done with the approval of an Inspector.
20. Lost circulation that may contaminate groundwater must be immediately reported to an Inspector.

21. The Licensee shall dispose of all solid Waste in a manner acceptable to an Inspector.

PART E: CONDITIONS APPLYING TO MODIFICATIONS

1. The Licensee may, without written approval from the Board, carry out Modifications to the planned undertakings provided that such Modifications are consistent with the terms of this Licence and the following requirements are met:
 - a) the Licensee has notified an Inspector in writing of such proposed Modifications at least five (5) days prior to beginning the Modifications;
 - b) such Modifications do not place the Licensee in contravention of either this Licence or the *Act*;
 - c) an Inspector has not, during the five (5) days following notification of the proposed Modifications, informed the Licensee that review of the proposal will require more than five (5) days; and
 - d) an Inspector has not rejected the proposed Modifications.
2. Modifications for which all of the conditions referred to in Part E, Item 1 have not been met may be carried out only with written approval from an Inspector.
3. The Licensee shall provide to the Board as-built plans and drawings of the modifications referred to in this Licence within ninety (90) days of completion of the modifications.

PART F: CONDITIONS APPLYING TO STREAM AND WATER BODY CROSSINGS

1. The Licensee shall ensure that only clean snow is used on all stream or water body crossings and that no debris is left on the surface of the crossings.
2. Stream or water body crossings shall be notched or removed before spring break-up to facilitate natural flow.

3. The removal of naturally occurring material from the bed or banks of any stream or water body below the ordinary high water mark is not permitted.

PART G: CONDITIONS APPLYING TO CONTINGENCY PLANNING

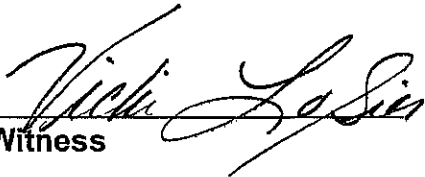
1. The Licensee will maintain a copy of the approved Emergency Response Plan onsite in a readily available location, to the satisfaction of an Inspector.
2. The Licensee shall ensure that petroleum products, hazardous material and other wastes associated with the project do not enter any waters.
3. The Licensee shall ensure that all containment berms are constructed of an impermeable material, to the satisfaction of an Inspector.
4. If, during the period of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:
 - a) report the incident immediately via the 24 Hour Spill Report Line (867) 920-130; and
 - b) submit to an Inspector a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.

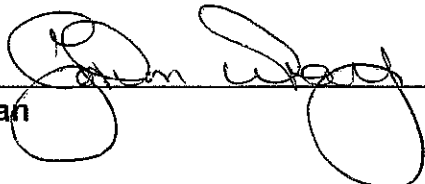
PART H: CONDITIONS APPLYING TO ABANDONMENT AND RESTORATION

1. Upon completion of all activities, the Licensee shall ensure that all equipment and materials are removed from the site. Other final restoration activities as outlined in the Project Description should be implemented to the satisfaction of an Inspector.
2. The Licensee shall monitor the drilling Waste sump after closure for a period of three (3) years during the thaw season consisting of the following measures:
 - a) install subsurface monitoring systems designed to detect thawing of the drilling waste;
 - b) monitor for salinity migration using electromagnetic induction; and

- c) conduct an annual inspection of the site during the thaw season, and submit a written report of the inspection, including photographs of the site, to the Board by October 1st of the year the inspection is conducted.

NORTHWEST TERRITORIES WATER BOARD


Witness


Chairman

JAN 24 03 00:40PM FROM 1-168 002/002 4-461

APPENDIX A - SAMPLING AND ANALYTICAL REQUIREMENTS FOR CHARACTERIZATION OF SUMP SUPERNATANT FLUIDS

Prior to abandoning a drilling Waste Sump, the Licensee shall sample the Sump using the following method:

Divide the Sump into a grid of six equal areas, take three samples in the vertical profile (surface, mid-depth, just above the mud/supernatant interface) at the centre of each area. Mix these eighteen samples together to form a single Composite Sample, from which as many sub-samples may be obtained as necessary for analysis. An additional sample must be taken from the surface of the Sump.

The Licensee shall have the Composite Sample analysed for the following parameters:

- Total and Dissolved Metals:
 - Copper
 - Cadmium
 - Iron
 - Nickel
 - Lead
 - Chromium
 - Zinc
- Sulphate
- Conductivity
- pH
- Total Suspended Solids
- Total Residual Chlorine
- Chloride
- Sodium
- Potassium
- Calcium
- Magnesium
- Oil and Grease
- Toxicity (96 hour LC50 using rainbow trout)

The Licensee shall have the Surface Sample analysed for the following parameters:

- Oil and Grease

NORTHWEST TERRITORIES WATER BOARD

LICENSEE: Petro Canada
LICENCE NUMBER: N7L1- 1788
EFFECTIVE DATE OF LICENCE: OCTOBER 11, 2002
EFFECTIVE DATE OF SURVEILLANCE NETWORK PROGRAM: OCTOBER 11, 2002

SURVEILLANCE NETWORK PROGRAM

A. Location of Sampling Stations

<u>Station Number</u>	<u>Description</u>
1788 - 1	Discharge from the Sewage Treatment Facilities
1788 - 2	Drilling Waste Prior to Entering the Drilling Sump

B. Sampling and Analysis Requirements

1. Water at Station Number 1788 -1, shall be sampled every week during decant, and analysed for the following parameters:

BOD ₅	Total Suspended Solids
Oil and Grease	Faecal Coliforms
Ammonia	pH
Total Residual Chlorine	

2. Waste Water at Station 1788-2, shall be sampled monthly, and analysed for the following parameter:

Total Sulphur	Total Calcium
Total Chloride	Total Sodium
Total Residual Chlorine	

3. More frequent sample collection maybe required at the request of an Inspector.
4. All sampling, sample preservation, and analyses shall be conducted in accordance with methods prescribed in the current edition of "Standard Methods for the Examination of Water and Wastewater", or by such other methods approved by an Analyst.
5. All analysis shall be performed in a laboratory approved by an Analyst.
6. The Licensee shall, by November 15, 2002, submit to an Analyst for approval a Quality Assurance/Quality Control Plan.
7. The Plan referred to in Part B, Item 6 shall be implemented as approved by an Analyst.

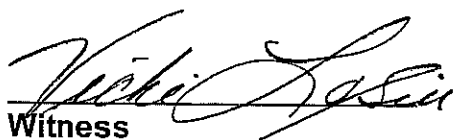
C. **Flow and Volume Measurement Requirements**

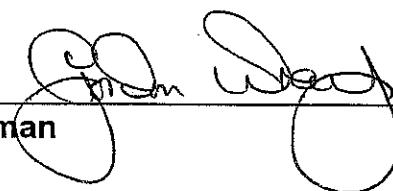
1. The daily and monthly quantities of water obtained from the Mackenzie River and unnamed lakes as indicated in the Project Description shall be measured and recorded in cubic metres.

D. Reports

1. The Licensee shall, within fifteen (15) days following the month being reported, submit to the Board and an Inspector all data and information required by the "Surveillance Network Program" including the results of the approved Quality Assurance Plan.

NORTHWEST TERRITORIES WATER BOARD


Witness


Chairman

NORTHWEST
TERRITORIES
WATER BOARD



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WATER REGISTER: N7-1-1788

October 10, 2002



Mr. John Kerkhoven
Supervisor Surface Land
Petro-Canada
150 - 6 Avenue S.W.
CALGARY, AB T2P 3E3

Dear Mr. Kerkhoven:

LEVEL 1 ENVIRONMENTAL SCREENING

Pursuant to Section 5 of the *Canadian Environmental Assessment Act (1992)*, Indian and Northern Affairs Canada (INAC), on behalf of the Northwest Territories Water Board, has conducted an environmental assessment and screening of the undertakings as directed in your Licence application submitted to the Board on August 9, 2002.

The Board has decided that the environmental and directly related socio-economic concerns are considered known and mitigable with existing technology and the project may proceed through the licensing process.

Sincerely,

A handwritten signature in black ink, appearing to read "Gordon Wray".

Gordon Wray
Chair
N.W.T. Water Board

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NORTHWEST
TERRITORIES
WATER BOARD



PETRO-CANADA

OCT 21 2002

LAND SERVICES
SURFACE

WATER REGISTER: N7-1-1788

October 10, 2002

Mr. John Kerkhoven
Supervisor, Surface Land and Community Affairs
Petro-Canada
P.O. Box 2844
150 - 6 Avenue S.W.
CALGARY, AB T2P 3E3

Dear Mr. Kerkhoven:

EMERGENCY RESPONSE PLAN - NUNA WINTER 2002/2003 DRILLING PROGRAM

The Northwest Territories Water Board has reviewed the Emergency Response Plan as contained within the August 9, 2002 Water Licence Application. The Board approves this Emergency Response Plan for the Nuna Winter 2002/2003 Drilling Program.

If you require further assistance, please contact this office. For enquiries of a technical nature, contact Ms. Sarah Aho at (867) 669-2402 or Mr. David Milburn at 669-2650 of the Water Resources Division.

Sincerely,

Gordon Wray
Chair
N.W.T. Water Board

WATER SAMPLING

SURFACE WATER SAMPLING METHODOLOGY

Sampling Notes

Sampling from Rivers and Streams

- Be prepared for various sampling situations.
- Wear long rubber boots if sampling will be directly from the river. Check the depth and bottom type of the river with a long wooden or metal stick.
- If sampling from a bridge or high river bank attach sufficient length of string to the sampling device.
- Rinse sampling device (bailer, bucket, container) with water from the river at least twice.
- Homogeneous river: grab sample from one vertical profile starting from the bottom to the top of the river.
- Nonhomogeneous river: collect composite sample from different points along river cross section. Usually three to five locations are sufficient. Collect equal volumes of subsamples.
- Always sample upstream.
- Rinse bottles from the laboratory a few times with the water from the river, then add necessary preservative.
- Measure air temperature. Measure water temperature by lowering thermometer directly into the river. Measure pH of water with field pH meter immediately after sample collection. Measure conductivity and turbidity.
- Collect samples directly into the bottles (if they are not containing preservatives) or collect water into separate container and pour into the bottles.
- In places with visible contamination (wastes inflow) collect separate samples. Take separate samples of any visible waste floating on the water surface (LNAPL) by skimming it from the water body. Make notes about what you are sampling.
- Avoid adding leaves and detritus to the sample. Avoid touching the bottom of the river. Do not mix river sediments with water. If you cause suspension of sediments from the bottom of the river, wait until water is clear.
- Collect sufficient volume of water. Always take a duplicate sample and trip blank. If using the same sampling device for different sampling locations, prepare field blank (after cleaning, make sample of water used for the last rinse).
- Make notes about sampling location, water colour and odour, sampling procedure.

Sampling from Lakes

- Boat is always recommended.
- When sampling for general water quality, choose a sample location close to the lake's central part, at the greatest depths, to avoid shoreline effects.
- Measure the depth to the bottom of the lake (if possible) with a measuring tape equipped with heavy weight.
- Sample from different depths intervals.
- Do not mix bottom sediments with water. Avoid touching bottom of the lake. Avoid adding leaves and detritus to the sample.
- Use special designed samplers for water collecting at a specific depths (Van Dom or Kemmerer samplers or a WaTerra pump)

- Rinse sampling equipment a few times prior to sampling. Wash sampling equipment after each sampling event and rinse with tap water. Rinse bottles from the laboratory a few times with water from the lake.
- Measure air temperature. Measure water temperature by lowering thermometer in the lake. Choose various depths in vertical profile. Measure pH of water immediately after sampling. Measure conductivity and turgidity.
- Collect sufficient volume of water. Always take a duplicate sample and trip blank.
- Make notes about sampling location, water colour and odour, sampling procedure.

QA/QC

- All equipment, apparatus and instruments should be kept clean and in good working condition.
- Standardized and approved methodologies should be used by field personnel.
- Protect samples from contamination. Keep them away from dust and fumes. Store them in a clean and cool place (4C). Do not keep bottles in the sun.
- Make field measurements (pH, conductivity) on separate sub-samples. Do not use this water for laboratory analyses.
- Prepare field blank – one bottle for every five used. Fill the bottle with distilled water in the field, close the bottle tightly and store it in the same manner as the water samples. Prepare field blank for same parameters. If using the same sampling device for different sampling locations, prepare field blank from water used for the last rinse.
- Prepare trip blank – one bottle for every ten used. Fill the bottle with distilled water before leaving for the field, preserve as others and store in the same manner as all samples. Prepare trip blank for same parameters.
- Prepare duplicate samples by dividing one sample into two sub-samples.

Sampling Equipment

The following is a list of equipment that may be necessary:

- 5 gallon buckets
- Bailers
- Boat and life jackets
- Camera
- Coolers with ice
- Decontamination soap
- De-ionized water
- Disposable gloves
- Field DO meter
- Field notebook, pen and permanent marker
- Field pH meter
- Filters
- Garden spray cans for wash fluids
- Hand pump for water filtering
- Harness and rope
- Large plastic sheet
- Paper towel
- Rinse water
- Rubber boots

- Safety equipment(steel toes, safety glasses, nomex coveralls, hard hat)
- Sample containers with required preservatives
- String
- Tape measure
- Thermometer

Field Preparation

1. Define objective, number of samples and parameters to be analyzed.
2. Define sampling method, location and prepare maps.
3. Order necessary sampling containers and equipment from the laboratory.
4. Obtain specific instructions on sampling procedure from the laboratory.
5. Prepare or get laboratory to prepare trip blanks.
6. All safety issues should be discussed to ensure safe working conditions for the samplers.
7. Organize necessary equipment.
8. Package sampling containers with care so they will not break during transport.

Field Sampling Procedures

1. Find sampling locations and determine if changes in sampling location will be required due to accessibility.
2. If a site map is available, mark approximate locations of the samples. If a site map is not available, sketch a site map and mark approximate locations of the samples.
3. Label sample containers and put sample information in your field notebook for each sample. Label the sample containers with a permanent marker. The sample label and your field notebook at a minimum should contain the following information:
 - a. Sample ID
 - b. Depth sample was taken
 - c. Date/Time of sampling
 - d. Name of person sampling
 - e. Sample location
 - f. Preservative used or not
 - g. Analysis to be performed
4. Put on disposable gloves.
5. Measure air temperature and record results.
6. Measure dissolved oxygen of the water with DO meter (described in another section) and record results.
7. Measure water temperature (DO meter may have temperature measurements) and record results.
8. Measure pH of the water with pH meter (described in another section) and record results.
9. Measure electrical conductivity of the water with EC meter (described in another section) and record results.
10. Rinse sample bottle 2 to 3 times with sample water, unless preservative is already in the container.
11. Composite water sample if necessary (mix a number of water samples until homogeneous).
12. If a preservative is needed, add to container after it has been rinsed.
13. If a preservative is used, collect water in a separate container that has been rinse 4 times with sample water, then pour water into sampling container. Take care not to get any sediment in the

water sample.

14. Use the lid to make sure there is no headspace (when the sample container is almost full, fill lid with sample water then pour into sample container).
15. If a preservative is not used, collect water directly into the sampling container. Take care not to get any sediment in the water sample.
16. Use the lid to make sure there is no headspace (when the sample container is almost full, fill lid with sample water then pour into sample container).
17. Make sure the sample is labeled correctly.
18. Dispose of gloves.
19. Package the sample carefully in the cooler with ice.
20. Complete the chain of custody for the sample taken.
21. Take notes on the water sample in your field notebook. The notes should include a description of the following:
 - a. Odor
 - b. Water color
 - c. Parameter measured with meters
 - d. Sampling procedure used
 - e. If sample is a composite of more than one location, describe each location, and what locations were composite.
22. Clean all tools used in the collection of the sample. First wash with a decontamination soap, then rinse with water.
23. Repeat steps 3 to 22 for each additional sample.
24. Make sure you prepare any duplicate samples or field blanks.
25. When sampling is complete, prepare samples for transport. Make sure all chain of custody forms are complete and pack samples carefully to ensure no damage will occur during transport. Make sure that the sample will stay at the appropriate temperature during transport.

GROUNDWATER SAMPLING METHODOLOGY

Sampling Notes

- Measure depth to the water table and to the bottom of the well from the top of casing.
- If any LNAPL is present on the water surface, measure thickness with interface probe. Next take off the oil and collect it in a glass bottle. Be sure to keep it away from other water samples.
- Check heavy solvents deposited at the bottom of the well. Measure thickness with interface probe.
- Take off all remaining oil from the well. Do not throw the oil on the surface. Collect it in a separate container. Purge water from the well using hand bailer or pump. Purge the volume of water at least equal 3 volumes of water standing in the well.
- Measure parameters in the field, temperature (air and water, pH and electric conductivity).
- Sample ground water with a bailer or a pump. Pour water into the bottles. For samples that need preservatives, add the preservative first. Take duplicates and trip blank as well as a field blank.

QA/QC

- All equipment, apparatus and instruments should be kept clean and in good working condition.
- Standardized and approved methodologies should be used by field personnel.
- Protect samples from contamination. Keep them away from dust and fumes. Store them in a clean and cool place (4C). Do not keep bottles in the sun.
- Make field measurements (pH, conductivity) on separate sub-samples. Do not use this water for laboratory analyses.
- Prepare field blank – one bottle for every five used. Fill the bottle with distilled water in the field, close the bottle tightly and store it in the same manner as the water samples. Prepare field blank for same parameters. If using the same sampling device for different sampling locations, prepare field blank from water used for the last rinse.
- Prepare trip blank – one bottle for every ten used. Fill the bottle with distilled water before leaving for the field, preserve as others and store in the same manner as all samples. Prepare trip blank for same parameters.
- Prepare duplicate samples by dividing one sample into two sub-samples.

Sampling Equipment

The following is a list of equipment that may be necessary:

- 5 gallon buckets
- Bailers
- Camera
- Coolers with ice
- Decontamination soap
- De-ionized water
- Disposable gloves
- Field DO meter
- Field notebook, pen and permanent marker
- Field pH meter
- Filters

- Garden spray cans for wash fluids
- Groundwater level indicator
- Hand pump for water filtering
- Interface probe (if LNAPL are expected)
- Large plastic sheet
- Paper towel
- Rinse water
- Safety equipment(steel toes, safety glasses, nomex coveralls, hard hat)
- Sample containers with required preservatives
- String
- Tape measure
- Thermometer

Field Preparation

1. Define objective, number of samples and parameters to be analyzed.
2. Define sampling method, location and prepare maps.
3. Order necessary sampling containers and equipment from the laboratory.
4. Obtain specific instructions on sampling procedure from the laboratory.
5. Prepare or get laboratory to prepare trip blanks.
6. All safety issues should be discussed to ensure safe working conditions for the samplers.
7. Organize necessary equipment.
8. Package sampling containers with care so they will not break during transport.

Field Sampling Procedures

1. Find sampling locations and determine if changes in sampling location will be required due to accessibility.
2. If a site map is available, mark approximate locations of the samples. If a site map is not available, sketch a site map and mark approximate locations of the samples.
3. Label sample containers and put sample information in your field notebook for each sample. Label the sample containers with a permanent marker. The sample label and your field notebook at a minimum should contain the following information:
 - a. Sample ID
 - b. Depth sample was taken
 - c. Date/Time of sampling
 - d. Name of person sampling
 - e. Sample location
 - f. Preservative used or not
 - g. Analysis to be performed
4. Put on disposable gloves.
5. Measure depth to the water table and to the bottom of the well from the top of casing and record results.
6. If any LNAPL is present on the water surface, measure thickness with interface probe and record results.
7. Next take off the oil and collect it in a glass bottle. Be sure to keep it away from other water samples record approximate volume taken off.

8. Check heavy solvents deposited at the bottom of the well. Measure thickness with interface probe and record results.
9. Purge water from the well using hand bailer or pump. Purge the volume of water at least equal 3 volumes of water standing in the well. Record approximate volume purged.
10. Let the well recover if necessary and record time required to recover.
11. Measure air temperature and record results.
12. Measure dissolved oxygen of the water with DO meter (described in another section) and record results.
13. Measure water temperature (DO meter may have temperature measurements) and record results.
14. Measure pH of the water with pH meter (described in another section) and record results.
15. Measure electrical conductivity of the water with EC meter (described in another section) and record results.
16. Composite water sample if necessary (mix a number of water samples until homogeneous).
17. Add preservative to the sampling container if needed.
18. Sample groundwater with a bailer or a pump.
19. Use the lid to make sure there is no headspace (when the sample container is almost full, fill lid with sample water then pour into sample container).
20. Make sure the sample is labeled correctly.
21. Dispose of gloves.
22. Package the sample carefully in the cooler with ice.
23. Complete the chain of custody for the sample taken.
24. Take notes on the water sample in your field notebook. The notes should include a description of the following:
 - a. Water and oil levels
 - b. Heavy solvent thickness
 - c. Volume of oil removed
 - d. Volume of water purged
 - e. Recovery time of groundwater
 - f. Odor
 - g. Water color
 - h. Parameter measured with meters
 - i. Sampling procedure used
 - j. If sample is a composite of more than one location, describe each location, and what locations were composite.
25. Clean all tools used in the collection of the sample. First wash with a decontamination soap, then rinse with water.
26. Repeat steps 3 to 25 for each additional sample.
27. Make sure you prepare any duplicate samples or field blanks.
28. When sampling is complete, prepare samples for transport. Make sure all chain of custody forms are complete and pack samples carefully to ensure no damage will occur during transport. Make sure that the sample will stay at the appropriate temperature during transport.