NYE COUNTY NUCLEAR WASTE REPOSITORY PROJECT OFFICE

TEST PLAN

TITLE: **Groundwater Sampling and Analysis of Early Warning Drilling Program (EWDP) Wells, August through November 2003**		REVISION: 0 DATE: 09-26-03 PAGE: 1 OF 12
TEST PLAN NUMBER: TPN-11.1	SUPERSEDES: New Document	
APPROVAL David Swanson 9-25-03 Project Manager Date	CONCURRENCE Dale Hammermeister 9/26/03 On-Site Geotechnical Representative Date Dale Hammermeister for John Walton 9/26/03 Principal Investigator Date Bill Metzger 9/26/03 Project Quality Assurance Officer Date Date	

1.0 INTRODUCTION

This test plan (TPN) provides detailed groundwater sampling and analysis instructions specific to a Nye County Nuclear Waste Repository Project Office (NWRPO) groundwater sample collection session planned for 21 Early Warning Drilling Program (EWDP) wells for August through November 2003. This TPN supplements work plan WP-11, *Groundwater Chemistry Sampling and Analysis* and technical procedure TP-8.1, *Field Collection and Handling of Water Samples*. This TPN identifies testing laboratories and provides detailed guidance for the maintenance and preparation of field measurement equipment and sample collection, preservation, storage, and shipping.

2.0 ANALYTICAL LABORATORIES

2.1 Desert Research Institute

Desert Research Institute (DRI) in Reno, Nevada, will analyze all groundwater samples, referred to in this plan as water samples, for indicator parameters, major anions and cations, trace metals, and nutrients (i.e., nitrate plus nitrite, phosphate, and ammonium). The DRI point of contact, mailing address, telephone number, and email address are listed below.

Mary Miller, Assistant Research Chemist
2215 Raggio Parkway
Reno, NV 89512
775-673-7451
Mary.Miller@dri.edu

2.2 Environmental Isotope Laboratory

The Environmental Isotope Laboratory (EIL) of the University of Waterloo in Waterloo, Canada, will analyze all water samples, except equipment rinsate and field blanks as defined in Section 5.0, for the following: stable isotope ratio analysis (SIRA) of oxygen and hydrogen in water, SIRA of nitrogen and oxygen in nitrate, SIRA of carbon in total dissolved inorganic carbon, tritium, and radiocarbon (Carbon-14). The EIL point of contact, mailing address, telephone number, and email address are listed below.

Robert J. Drimmie, Lab Manager
Environmental Isotope Laboratory
Department of Earth Sciences
University of Waterloo
200 University Avenue West
Waterloo ON N2L 3G1
Canada
519-888-4567 ext. 2580
rdrimmie@uwaterloo.ca

2.3 Radiation Safety Engineering Laboratory

The Radiation Safety Engineering Laboratory (RSE) in Chandler, Arizona, will analyze all water samples, except equipment rinsate and field blanks as defined in Section 5.0, for gross alpha and beta counts. The RSE points of contact, mailing address, telephone number, and email address are listed below.

Ariia Pike, Purchasing Agent
Bob Metzger, Lab Manager
Radiation Safety Engineering
3245 North Washington St.
Chandler, AZ 85225
480-897-9459
rmetzger@radsafe.com

3.0 PORTABLE FIELD MEASUREMENT EQUIPMENT MAINTENANCE AND PREPARATION

Instruments for measuring field indicator parameters include the YSI 650 handheld meter and 6820 sonde and the Hach handheld digital titrator. Manuals or manufacturers' instructions should be available at all times when using this equipment; specific references for the manuals are found in Section 6 of TP-8.1.

3.1 YSI Handheld Meter and Sonde

One month before the start of sampling, prepare the YSI handheld meter and sonde for use.

- Unpack the sonde and dry it.
- Remove all attached probes from the sonde housing.
- Check all probes for signs of wear and corrosion.
- Check the probe ports for signs of water, corrosion, or condensation. Clean any corrosion build-up in the ports or on the pins of the probes with a pipe cleaner, clean cloth, and compressed air. Wipe off excess water on the probe pins or in the sonde ports with a clean cloth, and dry the pins or port with compressed air.
- Check rubber probe O-rings for signs of wear, cracking, or deformation. Replace worn or damaged O-rings. Lubricate all O-rings with silicone grease and attach them to the sonde.
- Return the sonde to long-term storage.
- Check service kits for missing pieces; check standards to make sure that none have expired. If necessary, order new service kits, replacement probes, and standards.

One week before the start of sampling, remove the sonde from long-term storage and attach all probes. Replace the membrane of the dissolved oxygen (DO) probe before attaching it to the sonde; refer to the manual for more detail. Attach the probes to the sonde, beginning with the largest probe (i.e., the one that fits in the center optical port). Ensure that all pins are properly aligned in the ports before tightening the probes; do not over-tighten. The probes should be snugly seated against but not gouge the sonde housing.

Immediately after attaching the probes, calibrate the meter using the steps listed in TP-8.1, Appendix A, Instructions for the Use, Storage, and Calibration of Field Water Quality Parameter Measurement Equipment. If calibration is successful, place the sonde in short-term storage, as described in Appendix A. If calibration is not successful, contact the Principal Investigator (PI) or designee, and repeat the maintenance and calibration steps as directed. If calibration is still unsuccessful, contact YSI Technical Support by phone at 800-897-4151 or 937-767-7241, by fax at 937-767-1058, or by email at *environmental@ysi.com*.

3.2 Hach Handheld Titrator

One month before the start of sampling, check the acid cartridges of the Hach handheld titrator to ensure that they have not expired. Make sure that there are enough J-hook delivery tubes for the sample session. If the acid has expired or if more delivery tubes are needed, order new cartridges or tubes. Check the titrator for damage and wear. Wipe the exterior of the titrator to minimize contamination during sampling. Thoroughly clean the Erlenmeyer flasks and calibrated volumetric flasks. Calibrate the titrator to ensure accurate measurements of alkalinity, as described in TP-8.1, Appendix A. In general, titrator calibration problems will arise only if the titrator is dropped. If calibration problems are encountered, contact the PI or designee and repeat the above maintenance and calibration steps as directed. If calibration problems continue, contact Hach Technical Support at 800-227-4224.

4.0 LABORATORY AND FIELD ANALYSES

4.1 Laboratory Analyses

A summary of water chemistry analyses to be conducted on samples from the August to November 2003 sampling session is presented in Table 1. Analytes added for this sample session include cerium, lithium, rubidium, scandium, strontium, titanium, nitrate plus nitrite nitrogen, total dissolved phosphorus, and radiocarbon. Discontinued analytes include nitrate nitrogen, nitrite nitrogen, and orthophosphate.

4.2 Water Chemistry Monitoring and Data Collection

Calibrate all portable field indicator parameter measurement equipment on site before data collection. Following the instructions given in step 4 of Section 5.1.4 of TP-8.1, attach the flow-through cell to the discharge line of the pump, ensuring that the direction of flow is from the bottom to the top. Avoid direct water flow and excess bubble formation on the probes. Always check to make sure that bubbles have not built up on the probes before recording measurements. If the discharge water contains a large volume of air bubbles, it may be necessary to attach the sonde covering and place the sonde in a bucket containing well water. Note that this method is less accurate than that of the flow-through cell, especially for measurements of pH, DO, and oxidation reduction potential (ORP).

Monitor field water chemistry parameters and assess the stability of the measurements relative to the amount of water purged from the casing. Turbidity, electrical conductivity (EC), and pH should stabilize as the well is purged. DO, ORP, and temperature of the purged water may not stabilize, due to changes in air temperature, atmospheric pressure, or the sun’s radiant energy heating sampling equipment on the ground surface.

After purging is completed at each well screen, collect a sample for field or office measurement of alkalinity. Filter and collect the sample in a 1-L high density polyethylene (HDPE) bottle. Alkalinity tests using the Hach titrator will be conducted in the NWRPO office during August and in the field during September to November, if possible.

5.0 SAMPLE COLLECTION

The planned sample collection schedule for 21 EWDP wells, which include 36 well screens, is presented in Table 2. Post-purging samples will be collected from each of the well screens for the laboratory analyses listed in Table 1. In addition, quality assurance (QA) samples will be collected as follows: blind field duplicate samples from approximately every fifth well screen sampled and equipment rinsate and field blank samples from approximately every tenth equipment rinsing episode. The PI will determine the specific well screens to be sampled for QA samples. Detailed QA sample collection instructions will be given in the field by the PI and recorded in a scientific notebook.

Blind field duplicates will be analyzed for all analytes listed in Table 1; equipment rinsate and field blank samples will be analyzed only for nutrients (i.e., nitrate plus nitrite, phosphate, and ammonium), trace metals, major anions and cations, and indicator parameters.

6.0 SAMPLE FILTERING, BOTTLING, AND PRESERVATION

Table 3 summarizes sample filtering, bottling, and preservation requirements for major analyte groups. Filtering and bottle labeling methods are described in TP-8.1. Specific bottle type, size, and numbers are listed in Table 3. Sample bottles are to be filled to neck level to allow for expansion and contraction during storage and shipping, with the exception of analyte group 6 bottles, which are to be filled only 85 percent to allow for expansion during sample freezing.

The sampling work area (i.e., table or bench tops) should be thoroughly cleaned before sampling and kept as clean as possible during sample collection to minimize sample contamination. When filling sample bottles, note sources of contamination and minimize these sources when possible. Use new, clean tubing to fill sample bottles for each well or zone in the well to minimize contamination.

Rinse bottles with the water sample several times, fill the bottle the required amount, and add preservatives, ensuring that all preservative is added. Adding preservatives as a last step helps to ensure that the work area is not contaminated with acids and that the sample is preserved properly. Process samples requiring preservatives last to minimize the chance of contaminating gross chemistry and nutrient samples with acids. Have one person add preservatives and put on new gloves before changing preservative types. It is important to handle preservatives carefully to ensure that they are not spilled in the work area. Preservatives pose a potential safety risk and can easily contaminate samples with nitrate, sulfate, or other ions. If acid preservatives are spilled on the work area, neutralize the acid with a water solution of sodium bicarbonate, rinse with bottled tap water, and wipe the area dry with paper towels.

Attachment 1 presents information from Table 3 in checklist form. Analyte groups are listed according to collection order and further grouped into three larger groups, each requiring a clean set of gloves to minimize possible cross-contamination problems. Attachment 1 is designed to provide informal guidance and is not a required QA form.

7.0 SAMPLE STORAGE

In the field, minimize the exposure of samples to heat and direct sunlight, and transport samples to the NWRPO office at the end of each sampling day. When possible, store analyte groups 3, 6, and 7 in the field in coolers with ice packs.

In the NWRPO office, store samples from analyte groups 1, 2, 4, 5, and 8 in a cool, dry place out of the sun. Samples from analyte groups 3 and 7 (i.e., nutrient and SIRA carbon samples) should be refrigerated as soon as possible and kept refrigerated until they are shipped; samples from analyte group 6 (i.e., SIRA of nitrogen and oxygen in nitrate) should be frozen as soon as possible and kept frozen until shipped. Attachment 2 presents these sample storage procedures in checklist form. This checklist is designed to provide informal guidance and is not a required QA form.

8.0 SAMPLE SHIPPING

Ship all samples to the appropriate testing laboratory within 7 days of sampling in coolers with NWRPO chain-of-custody forms. Place all samples in the coolers with the caps up; do not place them on their sides. Wrap all glass bottles in bubble wrap. Pad the sides of the cooler with bubble wrap and pack samples so that they are held snugly in place. Use additional bubble wrap and ice packs to prevent the samples from moving during shipping; pack the top of the cooler with bubble wrap so that samples cannot move vertically. Samples from analyte groups 3, 6, and 7 require cold packs in the coolers and groups 6 and 7 also require a completed customs form.

Pack all frozen or refrigerated samples with blue ice or some form of cold pack. If possible, pack all frozen or refrigerated samples together to ensure a longer cold period. Do not use free ice in the coolers; the water from melted ice can wash labels off, contaminate samples, and remove labeling tape. Do not tape the tops of the bottles with Parafilm®. Make sure that coolers are securely closed and will not open during shipping.

Ship coolers containing samples from analyte groups 1 through 4 to DRI. To minimize the chance of contamination if a bottle breaks open, place samples into separate coolers, to the extent reasonably possible, as follows: metal samples by themselves; anion, indicator parameter, and TDS samples together; and nutrient samples together. Ship samples from analyte groups 5 through 7 to EIL with completed customs forms; label the contents as water samples and list the cost of the bottles as the value on the shipping label. Ship samples from analyte group 8 to RSE. Ship all samples by Federal Express to the addresses listed below. Do not ship samples on Friday.

DRI: Desert Research Institute
Analytical Chemistry Laboratory
c/o Mary Miller
2215 Raggio Parkway
Reno, NV 89512

EIL: Environmental Isotope Laboratory
c/o Chemistry Stores
University of Waterloo
200 University Avenue West
Waterloo ON N2L 3G1
Canada

RSE: Radiation Safety Engineering
Sample Receiving
3245 North Washington St.
Chandler, AZ 85225

Table 1
Water Chemistry Analyses

Analyte	Method Detection Limit	Detection Method
Alkalinity	0.5 mg/l[a]	Titration
Aluminum	0.002 mg/l	ICP-MS[b]
Ammonium	0.010 mg/l	Colorimetry
Antimony	0.002 mg/l	ICP-MS
Arsenic	0.002 mg/l	ICP-MS
Barium	0.002 mg/l	ICP-MS
Beryllium	0.002 mg/l	ICP-MS
Boron	0.1 mg/l	ICP-OES[c]
Bromide	0.02 mg/l	Ion Chromatography
SIRA[d] of carbon in TDIC[e]	0.2 permil	McCrea, 1950
Cadmium	0.002 mg/l	ICP-MS
Calcium	0.035 mg/l	Atomic Absorption
Cerium	0.002 mg/l	ICP-MS
Chloride	0.092 mg/l	Ion Chromatography
Chromium	0.002 mg/l	ICP-MS
Cobalt	0.002 mg/l	ICP-MS
Copper	0.002 mg/l	ICP-MS
SIRA of oxygen and hydrogen in water	2.0 permil	Coleman, et al., 1982 and Fritz et al., 1987
Enriched Tritium	0.8 Tritium units	Liquid Scintillation
Fluoride	0.029 mg/l	Ion Specific Electrode
Gross Alpha	0.4 pCi/l[f]	Co-precipitation
Gross Beta	0.1 pCi/l	Co-precipitation
Iodide, as I	0.008 mg/l	Ion Specific Electrode
Iron	0.01 mg/l	Atomic Absorption
Lead	0.002 mg/l	ICP-MS
Lithium	0.002 mg/l	ICP-MS
Magnesium	0.015 mg/l	Atomic Absorption
Manganese	0.002 mg/l	ICP-MS
Molybdenum	0.002 mg/l	ICP-MS
SIRA of nitrogen and oxygen in nitrate	0.2 permil	To be determined
Nickel	0.002 mg/l	ICP-MS
Nitrate plus Nitrite, as N	0.010 mg/l	Colorimetry
pH	pH units	Titration
Potassium	0.072 mg/l	Atomic Absorption
Radiocarbon (i.e., C-14)	0.3 pmC[g]	Liquid Scintillation
Rubidium	0.002 mg/l	ICP-MS
Scandium	0.002 mg/l	ICP-MS
Selenium	0.01 mg/l	ICP-MS
Silver	0.002 mg/l	ICP-MS
Sodium	0.075 mg/l	Atomic Absorption
Specific Conductivity	3.12 μS/cm[h]	Probe
Strontium	0.002 mg/l	ICP-MS
Sulfate	0.076 mg/l	Ion Chromatography
Thallium	0.002 mg/l	ICP-MS
Titanium	0.002 mg/l	ICP-MS
Total Dissolved Solids	0.1 mg/l	Sample Reduction
Total Dissolved Phosphorous	0.010 mg/l	Digestion, Colorimetry
Vanadium	0.002 mg/l	ICP-MS
Zinc	0.002 mg/l	ICP-MS

[a] Milligrams per liter.
[b] Inductively Coupled Plasma – Mass Spectrometry.
[c] Inductively Coupled Plasma – Optical Emission Spectroscopy.
[d] Stable isotope ratio analysis.
[e] Total dissolved inorganic carbon.
[f] Picocuries per liter.
[g] Percent modern carbon.
[h] Microsiemens per centimeter.

Table 2
August to November 2003 Sampling Schedule

Well (Zone)	Date	Travel and Set Up	Run Pump	Purge 3 Volumes	Sample
22S (1)	8/5/03	TBD[a]	TBD	TBD	TBD
22S (2)	8/12/03	TBD	TBD	TBD	TBD
22S (3)	9/9/03	TBD	TBD	TBD	TBD
22S (4)	9/25/03	TBD	TBD	TBD	TBD
27P	9/29/03	6:00 - 8:00	8:00 - 9:00	9:00 - 10:00	10:00 - 11:30
16P	9/29/03	11:30 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:30
28P	9/30/03	6:00 - 8:00	8:00 - 9:00	9:00 - 10:20	10:20 -11:30
24P	9/30/03	11:30 - 13:30	13:30 - 14:00	14:00 - 15:30	15:30 - 17:00
29P	10/1/03	6:00 - 8:00	8:00 - 9:00	9:00 - 10:30	10:30 -12:00
19P	10/1/03	12:00 - 14:00	14:00 - 15:00		
	10/2/03			7:00 - 8:00	8:00 - 9:30
4PB	10/2/03	9:30 - 11:30	11:30 - 12:30	12:30 -17:00	17:00 - 18:30
Wash 1X (d)[b]	10/3/03	6:00 - 8:00	8:00 - 9:00	9:00 - 10:40	10:40 - 12:30
18P	10/6/03	6:00 - 9:00	9:00 - 10:00	10:00 - 11:50	11:50 -13:00
10P (s)[c]	10/6/03	13:00 to 14:00	14:00 - 14:30	14:30 - 16:40	16:40 - 17:30
10P (d)	10/7/03	6:00 - 7:00	7:00 -7:30	7:30 - 12:00	12:00 - 13:00
22PA (s)	10/7/03	13:00 - 14:00	14:00 - 14:30	14:30 - 16:30	16:30 - 17:30
22PA (d)	10/8/03	6:00 - 7:00	7:00 -7:30	7:30 - 12:00	12:00 - 13:00
22PB (s)	10/8/03	13:00 - 14:00	14:00 - 14:30	14:30 - 18:00	
	10/9/03			5:00 - 12:00	12:00 - 13:00
22PB (d)	10/9/03	13:00 - 13:30	13:30 - 14:00	14:00 - 18:00	
	10/10/03			5:00 - 9:00	9:00 - 10:00
23P (s)	10/13/03	10:00 - 11:00	11:00 -11:30	11:30 - 13:00	13:00 - 14:00
23P (d)	10/14/03	6:00 - 7:00	7:00 - 8:00	8:00 - 12:30	12:30 - 14:00
7SC (4)	10/15/03	6:00 - 9:00	9:00 - 10:00	10:00 - 13:30	13:30-15:00
10S (1)	10/20/03	6:00 - 8:00	8:00 - 9:00	9:00 - 10:20	10:30 - 12:00
10S (2)	10/20/03		12:00 - 13:00	13:00 - 15:00	15:00 - 16:30
7SC (1)	10/21/03	6:00 - 8:00	8:00 - 9:00	9:00 - 9:10	9:10 - 10:00
7SC (2)	10/21/03		10:00 - 11:30	11:30 - 11:45	11:45 - 12:30
7SC (3)	10/22/03		12:30 - 14:00	14:00 -16:00	16:00 - 18:00
3S (1)	10/23/03	6:00 - 8:00	8:00 - 9:00	9:00 - 9:30	10:30 - 12:00
3S (2)	10/24/03	12:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:30
19IM1 (1)	10/27/03	6:00 - 8:30	8:30 - 10:00	10:00 - 12:30	12:30 - 14:30
19IM1 (2)	10/27/03		14:30 - 16:00		
	10/28/03			6:00 - 8:00	8:00 - 9:00
19IM1 (3)	10/28/03		9:00 - 10:00	10:00 - 12:30	12:30 - 14:30
19IM1 (4)	10/28/03		14:30 - 16:00		
	10/29/03			7:00 - 7:30	7:30 - 9:00
19IM1 (5)	10/29/03		9:00 - 10:00	10:00 - 10:30	10:30 - 12:30
19IM2	10/30/03	8:00 - 9:00			
	10/31/03			4:00 - 14:00	14:00 - 16:00
19D	11/3/03	8:00 - 9:00		9:00 - 18:00	
	11/3/03			5:00 - 14:00	14:00 - 16:00

[a] To be determined.
[b] Deep string.
[c] Shallow string.

Table 3
Sample Bottles and Preservatives for Major Analyte Groups

Analyte Group	Sample Type	Filter (Yes/No)	Preserve with HNO_3[a] (Yes/No)	Preserve with H_2SO_4[b] (Yes/No)	Bottle Type	Bottle Size (milliliters)	Bottles per Sample	Samples per Analyte Group	Bottles per Analyte Group
1	Anions, cations, and indicator parameters	Yes	No	No	HDPE[c]	500	1	49	49
2	Metals	Yes	Yes	No	HDPE	500	1	49	49
3	Nutrients (i.e., nitrate plus nitrite, phosphate, and ammonium)	Yes	No	Yes	HDPE	250	1	49	49
4	Total dissolved solids	No	No	No	HDPE	500	1	49	49
5	SIRA[d] of oxygen and hydrogen in water; tritium	No	No	No	HDPE	1000	1	46	46
6	SIRA of nitrogen and oxygen in nitrate	No	No	No	HDPE	1000	4	46	184
7	SIRA of carbon in total dissolved inorganic carbon; radiocarbon (C-14)	No	No	No	Glass Septa	500	1	46	46
8	Gross alpha and beta	Yes	Yes	No	HDPE	1000	4	46	184
								Total number of bottles	656

[a] Nitric acid.
[b] Sulfuric acid.
[c] High density polyethylene.
[d] Stable isotope ratio analysis.

Attachment 1
Sample Filtering, Bottling, and Preservation Checklist

This form is intended for guidance only. It is not a required QA form.

Well:	NC-EWDP-
Zone:	

Analyte Group	Sample Type	Filter (Yes/No)	Fill Level	Preserve with HNO_3[a] (Yes/No)	Preserve with H_2SO_4[b] (Yes/No)	Bottle Type	Bottle Size (milliliter)	Bottles per Sample	Date	Initials
4	Total dissolved solids	No	To the neck	No	No	HDPE[c]	500	1		
5	SIRA[d] of oxygen and hydrogen in water; tritium	No	To the neck	No	No	HDPE	1000	1		
6	SIRA of nitrogen and oxygen in nitrate	No	85%	No	No	HDPE	1000	4		
7	SIRA of carbon in total dissolved inorganic carbon, radiocarbon (C-14)	No	To the neck	No	No	Glass Septa	500	1		
1	Anions, cations, and indicator parameters	Yes	To the neck	No	No	HDPE	500	1		
Change gloves										
3	Nutrients (i.e., nitrate plus nitrite, phosphate, ammonium)	Yes	To the neck	No	Yes	HDPE	250	1		
Change gloves										
8	Gross alpha and beta	Yes	To the neck	Yes	No	HDPE	1000	4		
2	Metals	Yes	To the neck	Yes	No	HDPE	500	1		

[a] Nitric acid.
[b] Sulfuric acid.
[c] High density polyethylene.
[d] Stable isotope ratio analysis.

Attachment 2
Sample Storage Checklist

This form is intended for guidance only. It is not a required QA form.

Well:	NC-EWDP-
Zone:	

Type of Storage	Sample Type	Analyte Group	Date	Time	Initials
Cool, dry, and unexposed to sunlight	Anions, cations, and indicator parameters	1			
	Metals	2			
	Total dissolved solids	4			
	SIRA[a] of oxygen and hydrogen in water; tritium	5			
	Gross alpha and beta	8			
Refrigerated	Nutrients (i.e., nitrate plus nitrite, phosphate, and ammonium)	3			
	SIRA of carbon in total dissolved inorganic carbon; radiocarbon (C-14)	7			
Frozen	SIRA of nitrogen and oxygen in nitrate	6			

[a] Stable isotope ratio analysis.

Attachment 3
Sample Shipping Checklist

This form is intended for guidance only. It is not a required QA form.

Laboratory	Sample Type	Analyte Group[a]	Special Shipping[b]	Date	Initials
DRI	Anions, cations, and indicator parameters	1	None		
	Total dissolved solids	4			
	Metals	2			
	Nutrients (i.e., nitrate plus nitrite, phosphate, and ammonium)	3	Cold packs		
EIL	SIRA[c] of oxygen and hydrogen in water; tritium	5	Cold packs and a completed customs form		
	SIRA of carbon in total dissolved inorganic carbon; radiocarbon (C-14)	7			
	SIRA of nitrogen and oxygen in nitrate	6			
RSE	Gross alpha and beta	8	None		

[a] Sample types are grouped by shipping container to avoid contamination and when feasible should be shipped in this manner.
[b] Bubble wrap should used to snugly pack all sample bottles and to wrap glass bottles.
[c] Stable isotope ratio analysis.