QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC) PLAN FOR THE COLLECTION OF EFFLUENT SAMPLES AT THE **CAM-5 (MACKAR INLET)** DEW LINE SITE

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for
DEFENCE CONSTRUCTION CANADA
&
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1. Introduction

During the clean-up of the CAM-5 DEW Line site at Mackar Inlet, Nunavut the collection of sewage effluent samples was undertaken as required by the Water use License. The collection of wastewater samples is similar to the collection of other types of water samples.

As stated in the Water Use License, the contents of the Sewage Disposal Facility shall be analyzed once at 30 days after its establishment and a second time prior to discharge. All waste discharged from this Facility will be analyzed for the following parameters:

- Oil and grease (observations of presence/absence of sheen will be made – no samples will be collected or analyzed);
- Total suspended solids (TSS);
- Biological oxygen demand (BOD_5);
- Faecal coliforms; and
- pH.

2. Sample Collection

2.1. Location

GPS coordinates of sample locations are collected and recorded. Photographs of the sample location are also taken.

2.2. Sampling Equipment

The following table summarizes the equipment and storage requirements for each water sample type collected. New bottles were used in all cases for the collection of the water samples.

Contaminant	**Container**	**Amount**	**Rinse**	**Storage**	**Special Treatment**
TSS, pH	1L Plastic Bottle	Full	No	Cool	Do not filter
BOD_5	250 mL amber glass bottle	Full – no headspace	No	Cool	Do not filter
Bacteria and coliforms	Bacti bottles (Accutest)	Full	No	Cool	Analyze within 48 hours of collection

2.3. Sampling Methods

Sample bottles will be filled completely at the time of sampling. Bottles are not to be filled progressively over the course of days. If there is not sufficient water to completely fill the bottle(s), then no water sample will be collected. The bottles are to be filled with no headspace remaining to guard against volatilization of dissolved phases. Generally, the samples will be collected immediately prior to departure from the site and submitted for analysis within 48 hours.

3. Sample Handling

3.1. Preservation

The water samples will be kept cool (approximately 4^0 C) prior to and during shipping. In general, water samples will be collected when transportation from the site will be available almost immediately after, as many types of the required analyses should be performed as quickly as possible after collection.

Ideally, samples collected for inorganic analyses should be acidified in the field, at the time of collection. However, regulations concerning the transportation of dangerous goods make supplying concentrated nitric acid in the field difficult. Where samples can not be acidified in the field, it will be requested that the samples are acidified immediately upon receipt in the lab, *prior* to decanting or sample extraction. When acidifying in the lab, the container will be rinsed with 35% HNO_3 and included with the sample.

Samples are not to be filtered at any time. If samples contain excessive sediment, the samples will simply be decanted in the southern laboratory (*following* acidification, for metal analyses) prior to analysis.

3.2. Sample Identification

Each water sample will be given a blind number that was the only number provided on the labels of samples submitted for analysis. This sample number corresponds to the number assigned to that specific sample location which will be recorded on a map and in the field notebook.

3.3. Transportation

Samples are to be shipped by guaranteed airfreight in coolers from the site to their respective accredited laboratory for analysis. Chain-of-custody forms will be filled out and checked for each sample before shipment from the North, and the contents of shipments will be verified upon receipt in the laboratory.

4. Lab Analysis

4.1. Lab Accreditation

All laboratory analysis is carried out at accredited labs. The following laboratories are the ones primarily responsible for the analysis of water samples collected at CAM-5 (Mackar Inlet):

1) Analytical Services Unit, Queen's University, Kingston ON; and
2) Analytical Sciences Group, Royal Military College of Canada, Kingston ON.

Proof of accreditation from these laboratories is located in Appendix A. The standard methods used by the laboratories for each of these analyses are listed in the laboratory's scope of accreditation.

4.2. Detection Limits

The following table provides a summary of the detection limits for the analysis to be performed on water samples collected at CAM-5 (Mackar Inlet).

Parameter	Detection Limit
Biological oxygen demand (BOD_5)	3 mg/L
Total suspended solids (TSS)	1 mg/L
Faecal coliforms	0 counts/100 mL

4.3. Methodology

The following is a summary of the methods to be used in the analysis of the water samples collected from CAM-5 (Mackar Inlet).

4.3.1. Total Suspended Solids

Analyses were conducted by the Analytical Services Group, Royal Military College, Kingston, Ontario. Each sample was clearly labelled and stored at low temperatures in a secured area before and after analysis.

Total suspended solids (TSS) in water were determined by filtering a sample through a 0.45-micron glass fibre filter. The filter was first dried in an oven at 105 ^{o}C for 4 hours, allowed to cool, and weighed. A measured volume of water (usually 500 mL) was poured through the filter, which was then oven-dried for 12-18 hours, cooled, and reweighed. The TSS were reported as the weight of suspended material divided by the volume of water (units of mg/L).

4.3.2. Biological Oxygen Demand (BOD_5)

Analyses were conducted by the Analytical Services Group, Royal Military College, Kingston, Ontario. Each sample was clearly labeled and stored at low temperatures in a secured area before and after analysis.

The dissolved O_2 consumed over a five-day period was used as a measure of organic matter oxidizable by biological means. Nutrients were added to each sample solution. Dissolved oxygen was determined using a probe while stirring each solution. Samples were diluted if necessary. The difference in the dissolved oxygen measured in a sample upon receipt and after five days was taken as the measure of its biological oxygen demand (BOD).

4.3.3. Analysis of Faecal Coliforms in Water

Analyses were conducted by the Analytical Services Group, Royal Military College, Kingston, Ontario. Each sample was tested for storage temperature and checked for holding time in receipt. All samples were clearly labeled and stored at low temperatures in a secured area before and after analysis. Drinking water analyses were conducted in accordance with Canadian Drinking Water Quality Guidelines and according to procedures appropriate to Ontario Reg. 169/03 (Safe Drinking Water Act, 2002).

A vacuum filtration apparatus was used to filter 100 mL of sample onto a 47 mm diameter, 0.45 μm pore size cellulose ester membrane filter. The membrane filter was then placed on a fecal coliform (FC) agar plate and incubated at 44.5 ± 0.2 °C for 24 ± 2 hours. After the incubation period, fecal coliform colony-forming units (CFU) appeared as blue colonies on the membrane filter.

The presence of any fecal coliform bacteria per 100 mL in drinking water samples is considered adverse (Table 1, Microbiological Standards of Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (MOE 2003) according to the Safe Drinking Water Act O. Reg. 169/03. Coliforms are not necessarily pathogenic, but the presence of coliforms in water samples, especially *E. coli*, is indicative of recent fecal contamination and hence the possibility of contamination by the pathogenic organisms commonly associated with fecal waste.

4.3.4. pH Measurement

Measurements on water and soil samples were conducted by the Analytical Services Group, Royal Military College, Kingston, Ontario.

Water samples were measured directly using a 50-mL sample; the pH of soil was determined by mixing 10 g of soil with 10 mL of distilled water, allowing the mixture to settle, and measuring the pH of the supernatant. The pH was measured with a Denver Instruments model 220/300729.1 pH meter and probe, relative to buffered reference standards and control.

4.4. Reporting Requirements

The following types of QA/QC samples will also be collected as part of the water sampling program. Note that if more than one type of bottle is used for each water sample, QA/QC samples will be submitted in each type of bottle used for the collection of the samples.

Field duplicates*:* Approximately 10% of the samples were collected as field duplicates. That is, two samples were collected from one sample location. These samples were handled in the same way and submitted blindly to the laboratories for analysis.

Field blanks: Field blanks consisted of distilled water and were collected to ensure that there is no corruption of samples from the sampling method. The distilled water was poured from its container into the sample container at the same time and using the same techniques as used to collect the regular water samples.

Travel blanks: The purpose of travel blanks is to ensure that there is no corruption of the sample or sample container during travel. Ideally, a full set of travel blanks should accompany each shipment of water samples. However, in cases where very few samples are shipped at a time, this guideline can be extended to a more reasonable number. Travel blanks were filled at ESG prior to leaving for the field. They were shipped with the

sample bottles, stored with the sample bottles on site, brought out to the sampling location in the field, returned to the lab, and shipped to the labs with the water samples. They should not be opened unless the other bottles or water samples are opened for some reason during shipping.

Appendix A: Proof of Laboratory Accreditation

CAEAL Directory of Laboratories

Membership Number: 2709
Laboratory Name: Queen's Analytical Services Unit
Parent Institution: Queen's University
Address: Environmental Studies Biosciences Complex Kingston ON K7L 3N6
Contact: Dr. Allison Rutter
Phone: (613) 533-2642
Fax: (613) 533-2897
Email: ruttera@queensu.ca; kettlewb@queensu.ca

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served:
Revised On: August 11, 2008
Valid To: September 18, 2009

Scope of Accreditation

Oil
PCB - Oil (004)
ASU 04; based on EPA 8081

GC/ECD - EXTRACTION	RDL Range
Total PCB	1 - 5 µg/g

Soil (Inorganic)
Mercury - Soil (014)
ASU012; based on MILESTENE METHODS

COLD VAPOUR AA	RDL Range
Mercury	5 - 25 ng/g

Soil (Inorganic)
Metals - Soil (007)
ASU007; based on EPA 200.7

ICP/OES - DIGESTION	RDL Range
Aluminum	50 - 250 µg/g
Antimony	10 - 50 µg/g
Arsenic	1 - 5 µg/g
Barium	5 - 25 µg/g
Beryllium	1 - 5 µg/g
Boron	10 - 50 µg/g
Cadmium	1 - 5 µg/g
Calcium	
Chromium	10 - 50 µg/g
Cobalt	5 - 25 µg/g
Copper	5 - 25 µg/g
Iron	50 - 250 µg/g
Lead	10 - 50 µg/g
Magnesium	
Manganese	1 - 5 µg/g

† "OSDWA" indicates the appendix is used for the analysis of Ontario drinking water samples, which is subject to the rules and related regulations under the Ontario "Safe Drinking Water Act" (2002).

Molybdenum	
Nickel	5 - 25 µg/g
Phosphorus	
Potassium	
Selenium	
Silver	
Sodium	
Strontium	5 - 25 µg/g
Sulphur	
Thallium	
Tin	1 - 5 µg/g
Titanium	10 - 50 µg/g
Uranium	10 - 50 µg/g
Vanadium	10 - 50 µg/g
Zinc	10 - 50 µg/g

Solids

Metals - Solids (015)

ASU015; based on MOE TCLP-LEACH E9002

ICP/AES - TCLP	RDL Range
Arsenic	
Barium	
Boron	
Cadmium	
Chromium	
Lead	
Mercury	
Selenium	
Silver	
Uranium	

Water (Inorganic)

Ammonia - Water (009)

ASU09; based on TECHNICON METHOD

AUTO COLOR	RDL Range
Ammonia	.1 - .5 mg/L

Water (Inorganic)

Dissolved Metals - Water (008)

ASU08; based on EPA 200.7

ICP/AES	RDL Range
Aluminum (High)	.1 - .5 mg/L
Antimony	
Arsenic	
Barium (High)	.05 - .25 mg/L
Beryllium	
Boron (High)	.1 - .5 mg/L
Cadmium	
Calcium	
Chromium (High)	.01 - .05 mg/L
Cobalt (High)	.01 - .05 mg/L
Copper (High)	.1 - .5 mg/L
Iron (High)	.05 - .25 mg/L
Lead (High)	.01 - .05 mg/L
Magnesium	
Manganese (High)	.05 - .25 mg/L
Molybdenum (High)	.05 - .25 mg/L
Nickel (High)	.1 - .5 mg/L

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Phosphorus	
Potassium	
Selenium	
Silver	
Sodium	
Strontium (High)	.01 - .05 mg/L
Sulphur	
Thallium (High)	.01 - .05 mg/L
Tin	
Titanium (High)	.01 - .05 mg/L
Uranium	
Vanadium (High)	.01 - .05 mg/L
Zinc (High)	.01 - .05 mg/L

Water (Inorganic)
Major Ions - Water (003)
ASU 03; based on DIONEX MANUAL

ION CHROMATOGRAPHY	RDL Range
Bromate	
Bromide	.1 - .5 mg/L
Chloride	.05 - .25 mg/L
Fluoride	.05 - .25 mg/L
Fluoride	
Nitrate	.05 - .25 mg/L
Nitrite	.05 - .25 mg/L
Phosphate	.1 - .5 mg/L
Sulfate	.1 - .5 mg/L

Water (Inorganic)
Mercury - Water (013)
ASU015; based on MILESTONE METHODS

COLD VAPOUR AA	RDL Range
Mercury	.005 - .025 µg/L

Water (Inorganic)
Oil and Grease - Water (010)
ASU10; based on SM 5520 (20TH EDITION)

GRAVIMETRIC - EXTRACTION	RDL Range
Total Oil and Grease	1 - 5 mg/L

Water (Inorganic)
Total Metals - Water (012)
ASU08; based on EPA 200.7

ICP/AES	RDL Range
Aluminum	.1 - .5 mg/L
Antimony	
Arsenic	
Barium	.05 - .25 mg/L
Beryllium	
Boron	.1 - .5 mg/L
Cadmium	
Calcium	
Chromium	.01 - .05 mg/L
Cobalt	.01 - .05 mg/L
Copper	.1 - .5 mg/L
Iron	.05 - .25 mg/L
Lead	.01 - .05 mg/L

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Magnesium	
Manganese	.05 - .25 mg/L
Molybdenum	.05 - .25 mg/L
Nickel	.1 - .5 mg/L
Potassium	
Selenium	
Silver	
Sodium	
Strontium	.01 - .05 mg/L
Sulphur	
Thallium	.01 - .05 mg/L
Tin	
Titanium	.01 - .05 mg/L
Uranium	
Vanadium	.01 - .05 mg/L
Zinc	.01 - .05 mg/L

Water (Inorganic)

Total Phosphorus (TP) - Water (016)
ASU06; based on TECHNICON METHOD

AUTO COLOR	RDL Range
Total Phosphorus	.01 - .05 mg/L

Water (Organic)

Biphenyl - Water (005)
ASU 05; based on EPA 3510 C

GC/FID - EXTRACTION	RDL Range
Biphenyl	
Biphenyl Ether	

Water (Organic)

Phenols - Water (001)
ASU 01; based on MOE METHOD 1983

AUTO COLOR	RDL Range
Total Phenolics	.001 - .005 mg/L

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CAEAL Directory of Laboratories

Membership Number: 2965
Laboratory Name: RMC Analytical Sciences Group
Parent Institution: The Royal Military College of Canada
Address: Dept. of Chemistry & Chemical Engineering RMC, PO Box 17000 Stn. Forces Kingston ON
Contact: Dr. David Kelly
Phone: (613) 541-6000
Fax: (613) 545-8341
Email: david.kelly@rmc.ca; curtis.mcdonald@rmc.ca

Standard: Conforms with requirements of ISO/IEC 17025
Clients Served: Specified Clients
Revised On: August 11, 2008
Valid To: October 10, 2009

Scope of Accreditation

Oil
Total Chlorine - Oil (003)
ASG003; based on J. RADIONAL CHEM., 50, 229-234 (1979), ANAL. CHIM. ACTA., 108, 137-147 (1979).

NAA	RDL Range
Total Chlorine	

Soil (Inorganic)
Mercury - Soil (026)
ASG014; based on EPA 7470 A

COLD VAPOUR AA - MICROWAVE DIGESTION	RDL Range
Mercury	

Soil (Organic)
BTEX - Soil (039)
ASG016; based on EPA 624, EPA 8260 B

GC/MS - EXTRACTION		RDL Range
Benzene		
Ethylbenzene		
m/p-xylene	(Parameter suspended on 8/11/2008)	
o-xylene	(Parameter suspended on 8/11/2008)	
Toluene		

Soil (Organic)
Petroluem Hydrocarbons (PHC) - Soil (025)
ASG053; CCME REFERENCE METHOD FOR THE CANADA-WIDE STANDARD FOR PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD, 2001

GC/FID - EXTRACTION	RDL Range
F2: C10-C16	
F3: C16-C34	
F4: C34-C50	

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Soil (Organic)
Petroluem Hydrocarbons (PHC) - Soil (038)
ASG053; CCME REFERENCE METHOD FOR THE CANADA-WIDE STANDARD FOR PETROLEUM HYDROCARBONS IN SOIL - TIER 1 METHOD, 2001

GC/FID - PURGE AND TRAP	RDL Range
F1: C6-C10	

Soil/Sediment
Polycyclic Aromatic Hydrocarbons (PAH) - Soil (001)
ASG002; based on EPA 8100

GC/MS - EXTRACTION	RDL Range
Acenaphthene	
Acenaphthylene	
Anthracene	
Benzo (a) anthracene	
Benzo (a) pyrene	
Benzo (b) fluoranthene	
Benzo (g,h,i) perylene	
Benzo (k) fluoranthene	
Chrysene	
Dibenzo (a,h) anthracene	
Fluoranthene	
Fluorene	
Indeno (1,2,3 - cd) pyrene	
Naphthalene	
Phenanthrene	
Pyrene	

Soil/Sediment
Total Petroleum Hydrocarbons (C8-C34) - Soil (010)
ASG010/ASG 064/ ASG 065; based on EPA 3550B, EPA 8015C

GC/FID - EXTRACTION	RDL Range
Total Petroleum Hydrocarbons (C8-C34)	

Soil/Sediment
Trace Elements - Soil (030)
ASG057; based on EPA 6020

ICP/MS	RDL Range
Antimony	.1 - .5 µg/g
Arsenic	
Beryllium	
Cadmium	
Chromium	
Cobalt	
Copper	
Lead	
Nickel	
Uranium	
Uranium-235	
Uranium-238	
Zinc	

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Soil/Sediment (Radiochemistry)

Radionuclide Activity- Soil (007)

ASG030; based on SM 7120 and EPA 901.1.

GAMMA SPECTROSCOPY	RDL Range
Barium-140	
Cerium-144	
Cesium-134	
Cesium-136	
Cesium-137	
Cesium-138	
Iodine-131	
Iodine-132	
Iodine-133	
Iodine-134	
Iodine-135	
Lanthanum-140	
Molybdenum-99	
Niobium-95	
Rubidium-86	
Rubidium-88	
Ruthenium-103	
Ruthenium/Rhodium-106	
Strontium-91	
Tellurium-129m	
Tellurium-131m	
Tellurium-132	
Uranium - 235	
Uranium - 238	
Yttrium-90m	
Yttrium-91m	
Zirconium-95	

Tissue (Radiochemistry)

Radionuclide Activity - Biota (008)

ASG031; based on SM 7120 and EPA 901.1.

GAMMA SPECTROSCOPY	RDL Range
Barium-140	
Cerium-144	
Cesium-134	
Cesium-136	
Cesium-137	
Cesium-138	
Cobalt-60	
Iodine-131	
Iodine-132	
Iodine-133	
Iodine-134	
Iodine-135	
Lanthanum-140	
Molybdenum-99	
Niobium-95	
Rubidium-86	
Rubidium-88	
Ruthenium-103	
Ruthenium/Rhodium-106	
Strontium-91	
Tellurium-129m	
Tellurium-131m	
Tellurium-132	
Yttrium-90m	
Yttrium-91m	

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Zirconium-95

Urine and Water

Alpha/Beta Radiation - Urine and Water (035)
ASG 069; based on RMC-CMR LSC PROCEDURES MANUAL VEC 1.0 (IN-HOUSE)

LIQUID SCINTILLATION COUNTING	RDL Range
Alpha radiation	
Beta radiation	

Water (Inorganic)

Biochemical Oxygen Demand (BOD) - Water (Surface/Sewage/Ground) (019)
ASG042; based on NAQUADAT NO. 08201, EPA 405.1, SM 5210

D.O. METER	RDL Range
BOD (5 day)	

Water (Inorganic)

Conductivity - Water (Drinking/Surface/Sewage/Ground) (016)
ASG038; based on SM 2510, EPA 120.1

CONDUCTIVITY METER	RDL Range
Conductivity (25°C)	

Water (Inorganic)

Dissolved and Extractable Mercury - Water (Ground/Surface/Drinking) (011)
ASG021; based on EPA 7470A

COLD VAPOUR AA - MICROWAVE DIGESTION	RDL Range
Mercury	.1 - .5 µg/L

Water (Inorganic)

Dissolved and Extractable Metals - Water (024)
ASG049; based on EPA 200.8, SM 3125 D

ICP/MS-MICROWAVE EXTRACTION	RDL Range
Aluminum	
Antimony	
Arsenic	
Beryllium	
Boron	
Cadmium	
Chromium	
Cobalt	
Copper	
Lead	
Manganese	
Molybdenum	
Nickel	
Silver	
Strontium	
Thallium	
Tin	
Uranium	
Vanadium	

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Water (Inorganic)
pH - Water (Drinking/Surface/Sewage/Ground) (015)
ASG037; based on SM 4500-H+ B, EPA 150.1

pH METER	RDL Range
pH	

Water (Inorganic)
Solids - Water (Drinking/Surface/Sewage/Ground) (017)
ASG039; based on EPA 160.2, SM 2540D

GRAVIMETRIC	RDL Range
Total Dissolved Solids	
Total Suspended Solids	

Water (Microbiology)
Coliforms - Water (Drinking/Surface/Sewage/Ground) (014)
ASG036; based on MOE MICROMEFDC-E3407, SM 9225

MEMBRANE FILTRATION (DC)	RDL Range
Escherichia coli (E. coli)	
Total Coliforms	

Water (Microbiology)
Fecal Coliforms - Water (Drinking/Surface/Sewage/Ground) (022)
ASG044; based on MOE MICROMEFDC-E3407, SM 9222D

MEMBRANE FILTRATION (m FC)	RDL Range
Fecal (Thermotolerant) Coliforms	

Water (Microbiology)
Heterotrophic Plate Count (HPC) - Water (Drinking/Surface/Sewage/Ground) (023)
ASG041; based on SM 9215D

MEMBRANE FILTRATION	RDL Range
Heterotrophic Plate Count (HPC)	

Water (Organic)
Total PCB - Water (021)
ASG006; based on EPA 8082, EPA 617, FRAME, ET. AL. J. HIGH RESOL. CHROMATOGR., 19: 657-668, 1996.

GC/ECD - EXTRACTION	RDL Range
Total PCB	

Water (Organic)
Total PCB - Water (Surface/Sewage/Ground) (009)
ASG015, ASG022; based on EPA 8082, EPA 617, FRAME, ET. AL. J. HIGH RESOL. CHROMATOGR., 19: 657-668, 1996

GC/MS - EXTRACTION	RDL Range
Total PCB	

Water (Organic)
Volatile Organic Compounds (VOC) - Water (Drinking/Surface/Ground) (012)
ASG023; based on EPA 624, EPA 8260B

GC/MS - PURGE AND TRAP	RDL Range
1,1-Dichloroethane	
1,1-dichloroethylene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane	

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1,1,2,2-Tetrachloroethane
1,2-dichlorobenzene
1,2-dichloroethane
1,2-Dichloropropane
1,3-Dichloropropane
1,3,5-Trimethylbenzene
1,4-dichlorobenzene
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon Tetrachloride
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
Dichloromethane
Ethylbenzene
Ethylene Dibromide
m/p-xylene
o-xylene
Tetrachloroethylene
Toluene
trans-1,2-Dichloroethylene
trans-1,3-Dichloropropene
Trichloroethylene
Trichlorofluoromethane
Vinyl Chloride

Water (Radiochemistry)

Alpha/Beta Radiation (Swab) (004)
ASG004; RMC-CMR LSC PROCEDURES MANUAL VER. 1.0

LIQUID SCINTILLATION COUNTING	RDL Range
Alpha radiation	
Beta radiation	

Water (Radiochemistry)

Radionuclide Activity - Water (006)
ASG024; based on SM 7120, and EPA 901.1.

GAMMA SPECTROSCOPY	RDL Range
Barium-140	
Cerium-144	
Cesium-134	(Parameter suspended on 7/3/2008)
Cesium-136	
Cesium-137	(Parameter suspended on 7/3/2008)
Cesium-138	
Cobalt-60	(Parameter suspended on 7/3/2008)
Iodine-131	
Iodine-132	
Iodine-133	
Iodine-134	
Iodine-135	
Lanthanum-140	
Molybdenum-99	
Niobium-95	
Rubidium-86	
Rubidium-88	

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Ruthenium-103
Ruthenium/Rhodium-106
Strontium-91
Tellurium-129m
Tellurium-131m
Tellurium-132
Uranium - 235
Uranium - 238
Yttrium-90m
Yttrium-91m
Zirconium-95

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