

## IV. BARRELS

### A. General

This year the cleanup of barrels and their contents continued. All areas where barrel caches were present have been completely cleared. There are however still barrels at the site but nearly all are thought to be empty; the largest collection is at the toe of the airstrip dump. This year, 67 barrels were sampled and their contents analyzed. This chapter describes the activities undertaken and the data that resulted. The results are presented in Tables IV-1 to IV-2. Quality control data is given in Tables IV-3 and IV-4.

### B. Barrel Sampling Methodology

In order to sample barrels, they were first set in the upright position unless it caused the barrel to leak in that position. The lids on the barrels were opened by using a bung wrench. This was carefully done to ensure that all of the excess pressure was slowly released. The samples were taken by inserting a 25 mL glass sampling tube (drum thief) into the barrel. Protective gear including white suit, goggles and gloves must be worn. Generally a sample of 20 mL is obtained from the barrel and deposited into a 30 mL glass vial with a teflon lid. Barrels were numbered with white spray paint using a letter number code and the same codes were used on the vials.

#### *1. Analysis of Barrel Contents*

Chemical analyses were carried out on the samples obtained from the barrels in order to establish the identity of the contents (e.g., fuel oil, lubricating oil and grease, antifreeze, etc.) and to determine the PCB, chlorine, cadmium, chromium and lead concentrations. Samples were initially characterized as one phase, two phase or one phase with a trace (if the top layer was very thin). If required, one phase samples were mixed with methyl isobutyl ketone (MIBK) or hexane to determine if they were organic or aqueous. PCB, chlorine, cadmium, chromium and lead concentrations were not determined on the aqueous layer if two phases were present or if the sample was one phase and was determined to be water. Single phase aqueous samples which contained greater than 20% ethylene glycol were analyzed for metals and PCBs as described below.

The infra-red spectra of all aqueous phases or samples were recorded and, if applicable, identified as water, ethylene glycol or other organic compound or mixture. All organic liquids were diluted with carbon disulfide and run on a gas chromatograph with

an FID detector and a SPB-1 30 m capillary column. This enabled the petroleum product mixtures to be classified as either gasoline, fuel oil or lubricating oil and grease. To confirm identities, particularly for chlorinated compounds, some organic liquids were analyzed by GC/FID using either a 3 m 60/80 Carbopack B / 1% SP-1000 or a 6 m 100/120 Supelcoport / 10% FFAP column. GC/MS was also used for identification of unknowns and confirmation.

The PCB content of organic samples was determined by weighing approximately 0.2 g of material on to a LC-Florisil solid phase extraction tube and eluting with hexane. The resultant solutions were run on an gas chromatograph with ECD detector to determine the concentration of PCBs present; further cleanup was required in some cases. Aqueous samples were treated in the same manner but sodium sulphate was added to the top of the Florisil tube before adding the 0.2 g sample.

The concentration of chlorine in samples was determined by neutron activation analysis (NAA) using the Slowpoke reactor at the Royal Military College, Kingston, Ontario. Samples were weighed (0.3 g approximately) into a polyethylene vial and heat sealed. They were then irradiated with neutrons ( $5 \times 10^{11} \text{ n cm}^{-2} \text{ s}^{-1}$ ) for 1.0 minutes. After a delay time of 2.0 minutes the resulting gamma ray activity was counted for 5.0 minutes. The chlorine content was determined by comparing the peak area due to the chlorine-38 isotope with known standards. The gamma ray spectra was also checked to determine if bromine was present; none was found in any samples.

Samples were analyzed for cadmium, lead and chromium by AAS. All samples were diluted with MIBK and run along with standards prepared in MIBK. Aqueous samples were diluted 1 in 100 in water and analyzed by AAS.

### **C. Work Carried Out in 2002**

This year at Resolution Island, 67 barrel samples were taken and analyzed. The contents of all except three could be incinerated or contained water that could be discharged to the land. The three samples were all paint products. Many samples were from barrels belonging to DND.

### **D. Quality Assurance/Quality Control (QA/QC)**

Blanks and controls were run for all analysis sets (Table IV-3). The results given in Table IV-4 show that good agreement was obtained in the analysis of duplicates.

**Table IV-1: Description of Barrels and Description and Identity of Barrel Contents**

Barrel No Prefix RI02-	Amount	Description of Contents	Identity of Barrel Contents
F001	full	clear colourless liquid	fuel oil
F003	full	clear colourless liquid	fuel oil
F004	2/3 full	clear colourless liquid	water
F005	full	clear colourless liquid	fuel oil
F006	composite of 3 barrels (1/8 full)	2 phases: top clear yellowish liquid; bottom brown liquid (1:2)	top: gasoline, fuel oil (1:1); bottom: water
F007	full	2 phases: top clear colourless liquid; bottom clear yellowish liquid (1:1)	top: fuel oil; bottom: 20% diethylene glycol methyl ether
F008	1/3 full	2 phases: top clear colourless liquid; bottom sandy opaque liquid (1:1)	top: gasoline, fuel oil (1:1); bottom: water
F009	full	clear colourless liquid	fuel oil
F010	full	clear colourless liquid	gasoline, fuel oil (1:1)
F011	full	clear colourless liquid	fuel
F012	full	2 phases: top clear colourless liquid; bottom rusty orange liquid (4:1)	top: fuel; bottom: 5% diethylene glycol methyl ether
F013	full	clear colourless liquid	fuel
F014	full	clear colourless liquid	fuel
F015	full	clear colourless liquid	fuel
F016	full	clear colourless liquid	fuel
F017	full	clear colourless liquid	fuel
F018	full	clear colourless liquid	gasoline: fuel (1:9)
F019	¾ full	clear colourless liquid	fuel
F020	full	clear colourless liquid	fuel
F021	full	clear colourless liquid	fuel
F022	composite of 4	2 phase: top clear colourless; bottom clear yellowish liquid	top: gasoline, fuel (1:2); bottom: water

Barrel No Prefix RI02-	Amount	Description of Contents	Identity of Barrel Contents
	barrels all ¼ full	(1:1)	
F023	1/3 full	2 phase: top clear colourless; bottom clear colourless liquid (1:2)	top: gasoline, fuel (1:4); bottom: water
F024	1/3 full	2 phase: top clear colourless; bottom clear colourless liquid (1:1)	top: gasoline, fuel (1:1); bottom: water
F025	composite of 2 barrels, both 1/6 full	cloudy brown liquid	water
F026	½ full	clear colourless liquid	gasoline: fuel (1:1)
F027	½ full	2 phases: top clear colourless liquid bottom yellow liquid (50:1)	top: fuel; bottom: 5% diethylene glycol methyl ether
F028	1/3 full	2 phases: top clear colourless liquid; bottom: clear yellowish liquid (2:1)	top: gasoline, fuel (1:2); bottom: water
F029	composite of 2 barrels ¼ full	clear colourless liquid	gasoline: fuel (1:2);
F030	full	brownish green liquid	water
F031	¼ full	2 phases: top clear colourless liquid; bottom cloudy brown liquid (4:1)	gasoline: fuel (1:2); bottom: water
F032	full	2 phases: top clear colourless liquid; bottom clear colourless liquid (8:1)	gasoline: fuel (1:2); bottom: water
F033	1/3 full	clear yellow liquid	water
F034	¼ full	clear liquid	fuel
F035	1/3 full	clear yellowish liquid	gasoline
F037	composite of 3	2 phases: top clear colourless liquid; bottom clear yellowish	top: gas, fuel (1:1); bottom: water

Barrel No Prefix RI02-	Amount	Description of Contents	Identity of Barrel Contents
	barrels 1/8 full	liquid (1:6)	
F039	1/5 full	2 phases: top yellow/brown viscous liquid; bottom clear yellow liquid (1:3)	top: lubricating oil & grease; bottom: water
F042	¼ full	clear colourless liquid	water
F043	1/3 full	clear colourless liquid	water
F044	1/3 full	clear colourless liquid	gasoline
F045	½ full	clear colourless liquid	gasoline: fuel (1:1)
F046	full open overpack with leaky barrel inside	brown liquid	5% ethylene glycol
F051	full	thick brown grease	lubricating oil and grease
F053	1/5 full	clear yellow liquid	water
F055	1/4 full	clear yellow-orange liquid	gasoline
F057	¼ full	clear yellow liquid	water
F058	¼ full	2 phases: top brown viscous liquid; bottom clear yellow liquid (1:1)	top: lubricating oil & grease; bottom: water
F060	full	black grease	lubricating oil & grease
F061	1/5 full	clear brown liquid	water
F062	½ full	clear yellow/brown liquid	water
F063	1/8	2 phases water with trace of fuel	water
F065	1/3 full	clear yellow liquid	water
F066	1/3 full	2 phases: top cloudy yellow liquid; bottom clear colourless liquid (1:2)	top: lubricating oil & grease; bottom: water
F067	full	brown grease	lubricating oil & grease
F068	full	2 phases: top cloudy brown; bottom clear colourless liquid	top: fuel ; bottom: water

Barrel No Prefix RI02-	Amount	Description of Contents	Identity of Barrel Contents
		(1:1)	
F069	<1/10 full*	brown sludge	wet soil
F071	1/5 full	cloudy yellow liquid	water
F072	1/9 full	cloudy brown liquid	water
F073	1/5 full	clear yellow liquid	water
F074	¼ full	clear yellow liquid	water
F075	1/3 full	dark brown oil	lubricating oil & grease
F076	½ full	2 phases: top cloudy brown; bottom clear colourless (3:1)	top: fuel; bottom: water
F077	1/5	In a small rectangular can approx. 3 L; thin white liquid	water and white solid (probably water based paint)
F078	composite of 3 barrels, all <1/10 full	clear yellow liquid	water
F079	4/5	clear liquid	varsol
F081	full	oily paint-like material - orange colour	varsol and lubricating oil and grease(2:1) and white solid (probably oil based paint)
F082	full	In a small paint can approximately 4 L; black grease	lubricating oil and grease
F083	full	In a small rectangular can approx. 3L; thin white liquid	water and white solid (probably water based paint)

\* oil leaked from a hole hear the bottom of the barrel. The resulting residue consisted of oil contaminated soil.

**Table IV-2: PCB, Chlorine, and Metal Concentrations of Barrel Contents**

Barrel No	PCB's	Chlorine	Chromium	Lead	Cadmium	Disposal
Prefix RI02-	ppm <sup>b</sup>					Option <sup>a</sup>
F001	<2.0	<1000	<10	<100	<2.0	incinerate
F003	<2.0	<1000	<10	<100	<2.0	incinerate
F004	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F005	<2.0	<1000	<10	<100	<2.0	incinerate
F006	<2.0	<1000	<10	<100	<2.0	incinerate
F007	<2.0	<1000	<10	<100	<2.0	incinerate
F008	<2.0	<1000	<10	<100	<2.0	incinerate
F009	<2.0	<1000	<10	<100	<2.0	incinerate
F010	<2.0	<1000	<10	<100	<2.0	incinerate
F011	<2.0	<1000	<10	<100	<2.0	incinerate
F012	<2.0	<1000	<10	<100	<2.0	incinerate
F013	<2.0	<1000	<10	<100	<2.0	incinerate
F014	<2.0	<1000	<10	<100	<2.0	incinerate
F015	<2.0	<1000	<10	<100	<2.0	incinerate
F016	<2.0	<1000	<10	<100	<2.0	incinerate
F017	<2.0	<1000	<10	<100	<2.0	incinerate
F018	<2.0	<1000	<10	<100	<2.0	incinerate
F019	<2.0	<1000	<10	<100	<2.0	incinerate
F020	<2.0	<1000	<10	<100	<2.0	incinerate
F021	<2.0	<1000	<10	<100	<2.0	incinerate
F022	<2.0	<1000	<10	<100	<2.0	incinerate
F023	<2.0	<1000	<10	<100	<2.0	incinerate
F024	<2.0	<1000	<10	<100	<2.0	incinerate
F025	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F026	<2.0	<1000	<10	<100	<2.0	incinerate

Barrel No	PCB's	Chlorine	Chromium	Lead	Cadmium	Disposal
Prefix RI02-	ppm <sup>b</sup>					Option <sup>a</sup>
F027	<2.0	<1000	<10	<100	<2.0	incinerate
F028	<2.0	<1000	<10	<100	<2.0	incinerate
F029	<2.0	<1000	<10	<100	<2.0	incinerate
F030	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F031	<2.0	<1000	<10	<100	<2.0	incinerate
F032	<2.0	<1000	<10	<100	<2.0	incinerate
F033	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F034	7.9	<1000	<10	<100	<2.0	ship south
F035	<2.0	<1000	<10	<100	<2.0	incinerate
F037	<2.0	nd	<10	<100	<2.0	incinerate
F039	<2.0	<1000	<10	<100	<2.0	incinerate
F042	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F043	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F044	<2.0	<1000	<10	<100	<2.0	incinerate
F045	<2.0	<1000	<10	<100	<2.0	incinerate
F046	<2.0	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F051	<2.0	<1000	<10	<100	<2.0	incinerate <sup>e</sup>
F053	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F055	<2.0	<1000	<10	<100	<2.0	incinerate
F057	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F058	<2.0	<1000	<10	<100	<2.0	incinerate
F060	<2.0	<1000	<10	<100	<2.0	incinerate
F061	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F062	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F063	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F065	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>



Barrel No Prefix RI02-	PCB's	Chlorine	Chromium	Lead	Cadmium	Disposal Option <sup>a</sup>
	ppm <sup>b</sup>					
F066	<2.0	<1000	<10	<100	<2.0	incinerate
F067	<2.0	<1000	<10	<100	<2.0	incinerate
F068	<2.0	<1000	<10	<100	<2.0	incinerate
F069	<2.0	nd	nd	nd	nd	shred barrel
F071	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F072	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F073	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F074	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F075	<2.0	<1000	<10	<100	<2.0	incinerate
F076	<2.0	<1000	<10	<100	<2.0	incinerate
F077	<2.0	<1000	<10	<100	<2.0	ship south
F078	aqueous	aqueous	aqueous	aqueous	aqueous	on land <sup>c</sup>
F079	<2.0	<1000	<10	<100	<2.0	incinerate
F081	<2.0	<1000	<10	<100	<2.0	ship south
F082	<2.0	<1000	<10	<100	<2.0	incinerate
F083	<2.0	<1000	<10	<100	<2.0	ship south

Bottom phase was also analyzed when the top phase contained greater than the DLCU

Barrel Incineration Criteria:

a: Disposal as per DCLU Barrel Protocol:

b: Top phase where there are two phases present:

c: Water disposal by dumping on land at least 30 m from natural water courses:

d: Thin layer of petroleum product to be removed by oil absorbent material prior to disposal as above.

e: Incinerate by blending with fuel, or bury in landfill in separate cell if approved, or ship south.

nd: not determined, insufficient sample for analysis

**Table IV-3 : Data for Blank and Quality Control Samples**

	PCB	Chlorine
	ug/g	ug/g
Blank	<2.0; <2.0; <2.0; <2.0; <2.0; <2.0	<100; <100; <100; <100; <100; <100
Control	51; 50; 40; 41; 51; 50	1015; 1035; 1015; 1022; 1025; 1025
Control Target	50	1022

**Table IV-4: Replicate Analysis Results for Barrel Contents**

Sample	PCBs	Chlorine	Chromium	Lead	Cadmium
	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
F035	<2.0; <2.0	<1000; <1000	<10; <10	<100; <100	<2.0; <2.0
F045	<2.0; <2.0	<1000; <1000	<10; <10	<100; <100	<2.0; <2.0
F060	<2.0	<1000; <1000	<10	<100	<2.0
F075	<2.0; <2.0	<1000	<10	<100	<2.0
F081	<2.0	<1000; <1000	<10	<100	<2.0
F083	<2.0	<1000	<10; <10	<100; <100	<2.0; <2.0