J.R. Paine & Associates Ltd.

ENVIRONMENTAL SITE REMEDIATION
HJ011-MARSHALL CREEK ROAD
HAINES JUNCTION, YUKON

J.R. Paine & Associates Ltd.

REPORT NO.: 8054-24

PROJECT: Environmental Site Remediation

LOCATION: HJ011, km 5.2, Marshall Creek Road
Haines Junction, Yukon

CLIENT: Department of Indian Affairs and Northern Development
300-345 Main Street
Whitehorse, Yukon

ATTENTION: MR. DERRICK FRASER

October 9, 1997

J.R.PAINE & ASSOCIATES LTD.
14 BURNS ROAD
WHITEHORSE, YUKON
Y1A 4Y9

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LOCATION: HJ011, km 5.2, Marshall Creek Road
Haines Junction, Yukon

CLIENT: Department of Indian Affairs and Northern Development
300-345 Main Street
Whitehorse, Yukon

ATTENTION: MR. BRETT HARTSHORNE

October 28, 1997

J.R.PAINE & ASSOCIATES LTD.
14 BURNS ROAD
WHITEHORSE, YUKON
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1.0 INTRODUCTION

The following report details the results of the environmental remediation performed at a former dump site known as HJ011 on September 2-5 & 27, 1997. The site where our remediation efforts were performed is located approximately 5.2 km east of Haines Junction, Yukon, along the Marshall Creek Road (Old Alaska Highway).

The remediation program performed was based upon the *Preliminary Environmental Investigation* conducted in December, 1996, by **CCSG Associates**, an *Environmental Site Assessment* conducted by our firm (J.R.Paine & Associates Ltd.) in August, 1997, as well as objectives stated by the Client upon initiation of the project.

J.R.Paine & Associates Ltd. was retained for this study with authorization to proceed granted by Derrick Fraser of the Department of Indian Affairs and Northern Development (DIAND), on May 28, 1997.

Upon initiating this study, it was the intention of the Department of Indian Affairs and Northern Development (DIAND), Waste Management Program, to delineate the extent of contamination associated with the activities that occurred at the site during its operation and to remediate the site to Level 'A' or aesthetic guidelines.

Upon completion of a *Preliminary Environmental Investigation* conducted by **CCSG Associates**, there were contaminant zones identified which necessitated further study. In order to satisfy this requirement, a test-pit and hand sampling program was proposed and conducted by J.R.Paine & Associates Ltd., in order to identify the lateral and vertical extent of any contamination that may be present within accessible areas. General soil stratigraphy and groundwater conditions also had to be identified so as to intimate possible migration patterns of any contaminants in the subsurface and to obtain recommendations for remediation efforts.

This report contains a description of the methodology which our firm employed to satisfy the required objectives for remediation of the site as stated in our *Environmental Site Assessment*, as well as to provide recommendations for any future studies that may be required efforts.

2.0 BACKGROUND INFORMATION

HJ011 is located approximately 5.2 km east of Haines Junction on the Marshall Creek Road on the north bank of the Dezadeash River as shown in figure 1. The site is located approximately 300 meters south of this road along a dirt trail. The site was initially used as a military dump site for road construction waste during the 1940's. Following this period the area has seen some use as a dumping area for local residents of Haines Junction until the 1960's.

Work conducted at the site to date includes:

Preliminary Environmental Investigation, Site 44- Marshall Creek Road
prepared by **CCSG Associates**, December, 1996

Environmental Site Assessment, HJ011-Marshall Creek Road
prepared by **J.R.Paine & Associates Ltd.**, August, 1997

Environmental Remediation, HJ011- Marshall Creek Road
conducted by **J.R.Paine & Associates Ltd. & Champagne & Aishihik First Nations**, September, 1997

The site is currently designated as Crown Land.

3.0 PROJECT REMEDIATION TEAM

The project remediation team that was utilized during the remediation program was comprised of the following:

J.R.Paine & Associates Ltd.

Project Manager (Office):	Wilbur C. Kofoed, P.Eng.
Project Manager (Field):	Tares Dhara, E.I.T.
Senior Environmental Technician :	Robert Weldon, P.Eng.
Soils Technician :	Rob Williamson

Aishihik First Nations

Aishihik First Nations Liaison:	Harold Kane & Benny Jim
Work Crew:	Aishihik First Nations personnel
	- 5 laborers

4.0 METHODOLOGY

The methodology for the remediation program consisted of reviewing the existing information available and performing clean-up operations sufficient to satisfy the objectives as required. This consisted of carrying out both hand and equipment clean-up operations as well as a laboratory testing program.

Operational services for the clean-up were provided by Champagne & Aishihik First Nations. Managerial and quality control services were provided by J.R.Paine & Associates Ltd.

A detailed description of the clean-up operations performed is described below.

4.1 Hand Clean-up Operations

The hand clean-up operation consisted of using a work crew of approximately 5 laborers to hand clean surface debris identified during previous studies. Hand clean-up operations were conducted from September 2-5 & 27, 1997. The surficial debris general consisted of various metal cans (i.e. beverages, food, oil, etc.), scrap metal, rubber tires and similar items. At times it was necessary to utilize an aluminum boat to help retrieve items from deeper areas of the large pond. Hip-waders were also used along the periphery of the large pond. This debris was placed in large garbage bags and hauled to the Haines Junction municipal landfill by use of an F-350 flatbed truck (please see photos # 1-5). Approximately 25 loads of surface debris were removed from the site during this time (please see photo # 6). Clean-up operations were temporarily halted on September 5 upon completion of heavy equipment operations due to inclemental weather. A single day of hand clean-up operations was conducted on September 27, 1997 to conclude the remediation program. This included spreading grass seeds in areas that were cleared during the remediation program.

The areas where the surficial hand clean-up operations were carried out are depicted in the Site Sketch shown in Figure 2. In general, clean-up operations were successful in removing all surficial debris originally identified at the site. However, it became apparent during the removal program that a larger quantity of vehicles/debris was present at the site than previously determined. The debris was located along the periphery of the large pond and the Dezadeash River underneath the surficial vehicles/debris, supporting the theory that waste materials were bulldozed into the existing ponds and nearby Dezadeash River

4.2 Equipment Clean-up Operations

The equipment clean-up operation utilized a claw equipped tracked backhoe (Caterpillar 215 equivalent) in conjunction with an end-dump dump truck on September 4th and 5th. Operations generally consisted of utilizing the backhoe claw in conjunction with chains to remove old vehicle bodies, metallic drums and similar oversized debris (please see photos # 7-9). This debris was subsequently placed in the dump truck and hauled to the Haines Junction municipal landfill. Approximately ten truck loads were hauled to the landfill during the clean-up operations (please see photos # 10 & 11).

Overall, all accessible vehicle bodies were removed from the site. Three vehicles were however left in densely forested areas due to their relative inaccessibility. It was determined that these vehicles represented only a small contaminant liability and that excessive destruction of forest would be necessary to facilitate their removal. As such, these vehicles were left in-situ. As mentioned above, it became apparent during the removal program that a larger number of vehicles/debris was present at the site than previously determined. This debris was located along the periphery of the large pond and the Dezadeash River underneath the surficial vehicles/debris, supporting the theory that waste materials were bulldozed into the existing ponds and nearby Dezadeash River (please see photos # 12 & 13). As such, in accordance with our scope of work, it was

determined that only vehicles/debris that represented an aesthetic liability would be removed.

Hand samples were collected from sediments located in the drums (samples # 1 & 2) where possible during clean-up operations for laboratory classification and analysis. During the removal of the metallic drums that were previously identified in the small pond, a contaminated gravel stratum was encountered beneath the ponds bottom sludge. This material was brought to the surface during the removal operations and was likewise sampled for further analysis (samples # 3,4,5). Characteristic of these samples will be described in detail in Section 5.3. All metallic drums removed from this pond were rusted and empty. A total of eight drums were removed from the small pond.

Upon completion of the removal program, a single test-pit (T.P.# 7-97) was excavated in the location shown in Figure 2 in an attempt to determine if the contaminated material encountered in the small pond may be migrating towards the river (samples # 6 & 7) . No contaminated material was encountered. The test-pit soil profile for T.P.# 7-97 is shown in the test-pit logs presented in Appendix A.

Locations of the equipment clean-up operations are depicted in the Site Sketch shown in Figure 2.

4.3 Laboratory Testing Program

The primary objective of the laboratory program was to determine relative concentrations of any contaminants present in the soil in the region. This information will be useful in characterizing materials that were encountered during the removal program. Samples of potentially contaminated material were taken during the removal program to help facilitate waste material classification. A total of 7 soil samples were retrieved during the removal program.

4.3.1 Chemical Laboratory Program

All soil samples that were to be chemically tested were kept in EPA approved air-tight glass jars and maintained at or below 4° C.

Chemical laboratory analysis was conducted at Norwest Labs in Langley, B.C., and consisted of the following analysis.

Total Extractable Hydrocarbons		
TEH	(soil)	3 samples
Polycyclic Aromatic Hydrocarbon		
PAH	(soil)	3 samples
Total Metals		
Metals	(soil)	3 samples
Organo-Cloride Pesticides		
Various	(soil)	1 sample

A list of the sample locations, chemical laboratory results & methodology are included in Appendix B.

4.3.2 Physical Testing Program

Physical laboratory tests consisting of plastic & liquid limit analysis on two selected samples was conducted in our Whitehorse office and are presented in Appendix C. (These results conclude the Physical Testing Program conducted during the Environmental Site Assessment).

5.0 EVALUATION, INTERPRETATION & CONCLUSIONS

This section presents the information obtained during the remediation program described above. Briefly a description of the site will be provided along with details of the subsurface soil and groundwater conditions. Finally, all relevant data with respect to contamination encountered at the study area will be presented.

5.1 Site Conditions

The site is located approximately 5.2 km east of Haines Junction, Yukon, along the Marshall Creek Road (Old Alaska Highway) and is accessed by a dirt trail. This trail leads approximately 300 meters to the South and then turns to the east for approximately 100 meters, terminating near the Dezadeash River. The approximate size of the site is 100 meters by 250 meters. Two ponds are also located on the site as depicted in the site sketch presented in Figure 2. The approximate maximum depths of the ponds are 5 feet and 7 feet in the large & small ponds respectively. It should be noted that a new area of surficial debris, approximately 25 meters by 75 meters, was identified at the trailhead immediately adjacent to the Marshall Creek Road during the *Environmental Site Assessment*. The surficial debris in this area consisted of several barrels and rusted metal cans. Representative soil samples were likewise obtained in this area for further characterization and delineation.

5.2 Subsurface Soil and Groundwater Conditions

Subsurface soil conditions in the area surrounding the known contaminant area were originally determined from 6 test-pits excavated at the site during our investigation as well as from pre-existing data. A seventh test-pit was excavated in the location as shown in Figure 2 in an attempt to determine the extent of contamination encountered during clean-up operations (No evidence of contamination was found). The test-pit data was collated and the following trends in soil stratigraphy were noted.

In general, soil conditions at the site consisted of a 0.05 meter thick organic matte overlying a surficial silt stratum. The surficial silt layer is composed primarily of silt with varying amounts of clay, gravel and fine sand. This surficial silt layer extends to an average depth of 0.9 meters, below which lies a clean sandy gravel layer with cobbles in size to 15 cm.. The groundwater table was encountered in all 7 test-pits at an average depth of 1.7 meters terminating the test-pit excavation due to excessive sidewall sloughage. Test-pits were advanced to an average depth of 1.8 m. with the maximum depth of excavation 2.4 meters.

No presence of permafrost was noted.

5.3 Contamination Considerations

Currently the site has been remediated to a level such that all of the surficial debris identified during the previous investigations has been removed. However, during the clean-up operations conducted at the site during September, 1997, there were materials identified in the ponds that may represent a contaminant liability.

As noted in section 3.2, a contaminated gravel stratum was encountered below the base of the small pond. The material can best be described as a black tar-like gravel with a strong hydrocarbon odour. Based upon the chemical laboratory results and information to date, this material represents a possible contaminant liability that should be further classified. As noted in Appendix B, metal test results for sample # 4 displays levels well above acceptable limits for both arsenic and chromium. These levels are approximately 30 times and 5 times higher respectively, than the allowable soil numerical criteria based upon the Canadian Council of Ministers of the Environment (CCME) guidelines for Parks (PL) and Residential (RL) standards. High levels of these metals were likewise detected in sample # 2 collected from sediment found in a rusted barrel removed from the large pond. The material can best be described as a grey/brown pond sediment with a very slight hydrocarbon odour. Levels for Arsenic and Chromium were respectively,

approximately fifteen (15) times and three (3) times higher than the allowable numerical soil criteria. The presence of high levels of both arsenic and chromium may be indicative of a parent product originating from a possible wood preservative or form of pesticide.

The levels of trace metals detected may be considered a contaminant concern due to their tendency to bioaccumulate in the food chain. The presence of this contaminated material within the saturated zone presents difficulties in analysis due to the complexity of various factors such as dispersive mixing and because the geological, hydrological and geochemical settings are commonly more diverse. Further chemical laboratory analysis and engineering interpretations will be needed in order to further characterize this contaminant.

It should be noted that due to the high degrees of natural mineralization that may occur in the area, some samples may exceed certain CCME guidelines due to natural constituents alone. The background levels for the theoretical baseline concentrations presented in Appendix D indicate concentrations of Chromium approximately 2.5 times higher than acceptable standards.

Apart from the contaminant material mentioned above, no further environmental liabilities were detected.

From screening tests and chemical laboratory analysis performed on our selected samples obtained during our *Environmental Site Assessment*, we can conclude that the contamination levels detected for the remainder of the site were below CCME guidelines for park and residential levels.

Results from the *Preliminary Environmental Investigation* carried out by **CCSG Associates** indicated a few samples exceeded certain CCME guidelines. After comparing these results to the ones obtained at the conclusion of our *Environmental Site Assessment* during our study of nearby samples, we believe that some samples may be located in

contaminated areas that are relatively localized and as such are not considered a high environmental liability based on their constituents.

Due to the high permeability of the subsurface granular material which is present throughout the site and the relatively shallow depth of groundwater encountered, it can be intimated that if mobile contaminants were present, they have most likely been flushed and diluted by natural groundwater flow and incidents of flooding.

6.0 RECOMMENDATIONS

The following chapter will outline recommendations which may be initiated according to the desired objectives of the client in order to address the contaminant materials encountered in the ponds during the remediation program.

A thorough field work/sampling program will be essential prior to the execution of any continued remediation program. Sufficient information must be obtained to enable a safe and economic design as well as to avoid any difficulties during site remediation.

In general, an investigation should be initiated which would involve characterizing and quantifying the contaminant materials present in the ponds. Due to the nature of the site and the activities that were believed to have taken place (i.e. bulldozing of waste material into the ponds & Dezadeash River), it may be advisable to undertake a similar investigation of the Dezadeash River as well. The investigation may be conducted during the winter through the use of geophysical techniques in conjunction with a drilling and laboratory program. Laboratory analysis would be carried out following these programs to help aid in the design for remedial actions.

The objective of a geophysical investigation would be to detect and locate any additional subsurface structures possibly related to environmental liabilities, estimate the physical and mechanical properties of the subsurface units and possible identify contaminant zones.

Geotechnical drilling using hollow stem augers may be required to accurately define subsurface conditions. The drilling program may be initiated at identified contaminant zones and progress outwards in order to help identify the lateral and vertical extent of any subsurface contamination that may be present. In addition, the installation of subsurface insitu monitoring equipment, such as piezometers or standpipes, can be facilitated during a field drilling program.

An outline of possible future actions will be presented in our *Terms-of-Reference, HJ011-Pond Remediation* to follow.

7.0 CLOSURE

This report has been prepared for the exclusive and confidential use of the Department of Indian Affairs and Northern Development (DIAND). It applies only to the environmental remediation performed in September 1997, at the study area described above.

The recommendations provided herein are based on the subsurface soil conditions encountered during the field work programs, current investigative techniques, and generally accepted engineering practices. Due to the geological randomness of many soil formations, no interpolation of soil conditions between testholes has been made or implied. Soil conditions are known only at testhole locations. Furthermore, contaminant presence is known only in those testhole locations where qualitative observations have been made and where laboratory verification has been conducted. Recommendations are based, in part, on current environmental criteria which may change in time Should other soils be encountered during anytime or other pertinent information become available, the recommendations may be altered or modified in writing by the undersigned.

Thank you for the opportunity to provide this service to your organization. We would be pleased to meet with you to discuss the contents of this report or to more thoroughly outline the recommendations listed in our terms-of-reference provided. If you should have any questions or comments, please do not hesitate to contact the undersigned at your convenience.

Yours truly,

Tares Dhara, E.I.T.
Junior Engineer

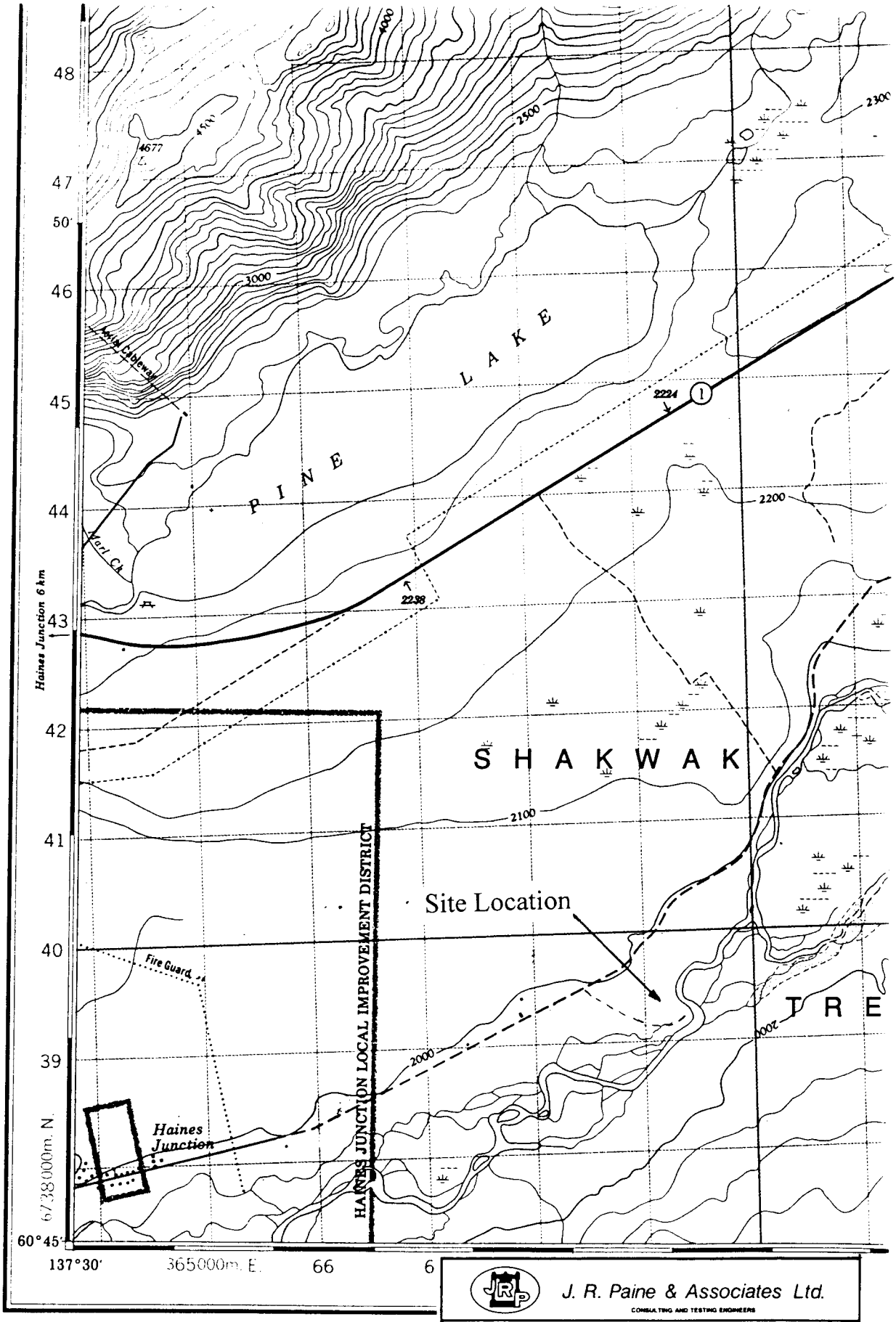
TD/td

c:\priv\8054-24\8054-24.rep

PROFESSIONAL ENGINEER
YUKON TERRITORY
WILBUR C. KOFOED

Wilbur C. Kofoed, P.Eng.
Office Manager

FIGURES



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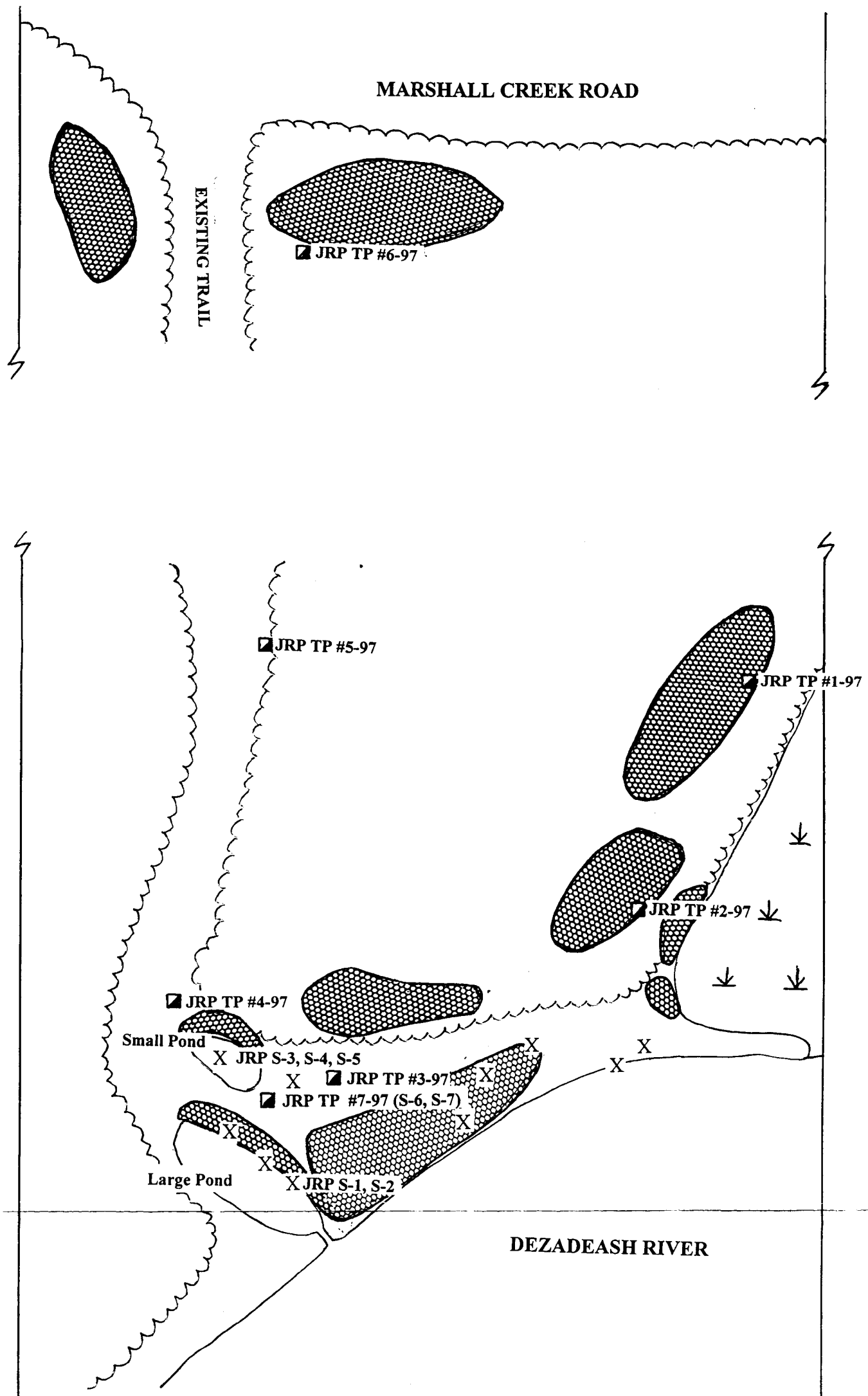
Copies may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa, or your nearest map dealer.

J. R. Paine & Associates Ltd.
CONSULTING AND TESTING ENGINEERS

FIGURE 1
Site Location

Dwn. By	TD	Date	08/15/97
Scale	1:50,000	Plate No.	



J. R. Paine & Associates Ltd.
CONSULTING AND TESTING ENGINEERS

FIGURE 2-
Remediation Operations,
Test-pit & Sample
Locations

Dwn. By TD	Date 09/06/97
Scale As Shown	Plate No. 1-2

APPENDIX A

- Soil Logs

DIAND	Champagne & Aishihik First Nations	TEST HOLE NO: TP#7-97
Haines Junction	Komatsu	PROJECT NO: 8054-24
HJ011	Tracked Backhoe	ELEVATION:

SAMPLE TYPE ■ DISTURBED ▨ BULK ⊠ AUGER ▤ SPT ▥ SHELBY TUBE ▮ CORE

DEPTH(m)	SAMPLE TYPE	SAMPLE NO	SPT(N)	SOIL DESCRIPTION	● % CLAY ● 20 40 60 80	▲ % SILT ▲ 20 40 60 80	■ % SAND ■ 20 40 60 80	◆ % GRAVEL ◆ 20 40 60 80	◆ SPT COUNT (N/300mm) ◆ 20 40 60 80	▲ PLASTIC LIMIT ▲ 12 24 36 48	■ LIQUID LIMIT ■ 12 24 36 48	● MOISTURE CONTENT ● 12 24 36 48	USC	SOIL SYMBOL	DEPTH(ft)
0.0				ORGANICS– moss, lichen, roots, rootlets									ORG		0.0
		6		GRAVELLY SANDY SILT –moist, firm, non–plastic,grey									SM		1.0
1.0				SANDY GRAVEL –moist to wet, loose, poorly graded, medium to coarse grained, gravels in size to 5 cm., cobbles to 10 cm.											2.0 3.0
		7		Watertable Encountered									GP		4.0 5.0
2.0				END OF HOLE @ 2.0 m.											6.0 7.0
3.0															8.0 9.0 10.0
4.0															11.0 12.0 13.0 14.0
5.0															15.0 16.0

J.R. Paine & Associates Ltd.
Whitehorse, Yukon

LOGGED BY: TD	COMPLETION DEPTH: 2.0 m
REVIEWED BY: WCK	COMPLETE:
Fig. No:	Page 1 of 1

97/10/06 09:52AM

APPENDIX B

- Chemical Laboratory Analysis

NORWEST LABS

Langley PH (604) 530-4344 FAX (604) 534-9996
Edmonton PH.(403) 438-5522 FAX (403) 438-0396
Calgary PH (403) 291-2022 FAX(403) 291-2021
Lethbridge PH.(403) 329-9266 FAX(403) 327-8527
Winnipeg PH.(204) 982-8630 FAX(204) 275-6019

WO (Lang.) : 29336
WO (Other) :
PO # :
Date Samp. :
Date Rec'd. : 09-Sep-97
Date Comp. : 18-Sep-97

Client		Received From	
Name	: J.R. Paine & Associates Ltd.	Name	:
Address	: 14 Burns Road Whitehorse, Yukon Y1A 4Y9	Address	:
Phone	: 403-668-4648	Phone	:
Fax	: 403-668-2400	Fax	:
Attn.	: Tares Dhara	Attn.	:
Project	: Haines Junction		

Petroleum Hydrocarbons in Soil

Parameter	29336-1 S-1	29336-3 S-3	29336-6 S-6	Detection Limit
LEPH (C10-C18)	<10	18	<10	10 ppm
HEPH (C19-C32)	140	490	<10	10 ppm
Percent Moisture	21	37	24	

Results are expressed in ppm (mg/kg), dry weight, without correction for recovery data.

NORWEST LABS

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WO (Lang.) : 29336
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PO # :
Date Samp. :
Date Rec'd.: 09-Sep-97
Date Comp. : 18-Sep-97

Petroleum Hydrocarbons in Soil (cont.)

Definitions / Methods

LEPH + HEPH: LEPH (Light Extractable Pet. Hydro.), HEPH (Heavy Extractable Pet. Hydro.) Summation of the C10 - C18 or C19 - C32 carbon range respectively, determined using a calibrated standard. Alberta Environmental Centre Method G108.0 which involves extraction of the sample with dichloromethane followed by analysis with capillary gas chromatography using a flame ionization detector.

Comments

Quality Control Results

QA/QC		Analyst		
Compound	% Recovery	Analysis	Date	Analyst
diesel fuel	122	LEPH/HEPH	12-Sep-97	Dave D.

Supervisor

Note: All samples will be disposed of after 30 days following analysis unless other arrangements are made.

NORWEST LABS

Langley PH (604) 530-4344 FAX (604) 534-9996
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Winnipeg PH.(204) 982-8630 FAX(204) 275-6019

WO (Lang.) : 29336
WO (Other) :
PO # :
Date Samp. :
Date Rec'd. : 09-Sep-97
Date Comp. : 18-Sep-97

Client		Received From	
Name	: J.R. Paine & Associates Ltd.	Name	:
Address	: 14 Burns Road Whitehorse, Yukon Y1A 4Y9	Address	:
Phone	: 403-668-4648	Phone	:
Fax	: 403-668-2400	Fax	:
Attn.	: Tares Dhara	Attn.	:
Project	: Haines Junction		

Polynuclear Aromatic Hydrocarbons in Soil

Parameter	29336-1 S-1	29336-3 S-3	29336-6 S-6	Detection Limit
Naphthalene	<0.1	<0.1	<0.1	0.1 ppm
Acenaphthylene	<0.1	<0.1	<0.1	0.1 ppm
Acenaphthene	<0.1	<0.1	<0.1	0.1 ppm
Fluorene	<0.1	<0.1	<0.1	0.1 ppm
Phenanthrene	<0.1	**0.4**	<0.1	0.1 ppm
Anthracene	<0.1	<0.1	<0.1	0.1 ppm
Fluoranthene	<0.1	**0.1**	<0.1	0.1 ppm
Pyrene	<0.1	**0.1**	<0.1	0.1 ppm
Benzo(a)anthracene	<0.1	<0.1	<0.1	0.1 ppm
Chrysene	<0.1	**0.2**	<0.1	0.1 ppm
Benzo-fluoranthenes (b&k)	<0.1	**0.1**	<0.1	0.1 ppm
Benzo(a)pyrene	<0.1	<0.1	<0.1	0.1 ppm
Indeno(1,2,3-cd)pyrene	<0.1	<0.1	<0.1	0.1 ppm
Dibenzo(a,h)anthracene	<0.1	<0.1	<0.1	0.1 ppm
Benzo(g,h,i)perylene	<0.1	<0.1	<0.1	0.1 ppm

Surrogate	% Recovery			Recovery Range
Nitrobenzene-d5	90	84	81	23-120
2-Fluorobiphenyl	89	84	89	30-115
4-Terphenyl-d14	106	101	104	18-137

Results are expressed in ppm (ug/g) dry weight, without correction for recovery data.

NORWEST LABS

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WO (Lang.) : 29336
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PO # :
Date Samp. :
Date Rec'd. : 09-Sep-97
Date Comp. : 18-Sep-97

Polynuclear Aromatic Hydrocarbons in Soil (cont.)

Definitions / Methods

Polynuclear Aromatic Hydrocarbons: This analysis is carried out in accordance with U. S. Environmental Protection Agency Method 3540/8270 (#SW 846, 3rd Edition, Washington DC) which involves extraction of the components with an organic solvent followed by analysis by capillary gas chromatography using a mass selective detector.

Percent Moisture: Percentage of the total wet weight of the sample as received. This analysis is carried out gravimetrically by drying the sample to constant weight at 105 C.

Comments

Quality Control Results

QA/QC		Analyst		
Compound	% Recovery	Analysis	Date	Analyst
fluoranthene	107	PAHs	16-Sep-97	Trevor A.
benzo(a)pyrene	112			

Supervisor

Note: All samples will be disposed of after 30 days following analysis unless other arrangements are made.

To: J.R. PAINE & ASSOCIATES LTD.
14 Burns Road
Whitehorse, Yukon
Y1A 4Y9

Workorder: 29336
Received : 09-Sep-97
Draft Completed: 23-Sep-97
Final Completed: 24-Sep-97

Attn: Tares Dhara

Re: Soil Samples

ANALYSIS

OF

ENVIRONMENTAL SAMPLES

METHODOLOGY

PREPARATION
Samples were dried at 55 degrees Celsius and pulverized in a non-contaminating ceramic grinder to pass a 100 mesh screen.

DIGESTION
A portion (0.5 grams) of the prepared sample was acid digested in a closed teflon vessel in a microwave oven (modified EPA Method 3051).

ANALYSIS
Metals were determined on the resulting solution by UNICP-AES (EPA Method 200.15).
Mercury was determined by cold vapour-UV (EPA Method 245.1).
Indicated metals were determined by graphite furnace atomic absorption (GFAA).
Chromium +6 was determined colormetrically on a water extract.

RESULTS
Results are reported as micrograms of soluble element per gram of dry sample (ug/dry g).

The numbers next to the parameter names refer to the Soil Numerical Criteria in B.C. Ministry of Environment "Criteria for Managing Contaminated Sites (CMCS) in British Columbia, April, 1997" and are provided for information only.

ACCREDITATION

Norwest Labs is accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL), by the Standards Council of Canada (SCC), and by Washington State Department of Ecology for specific tests. Norwest Labs is also registered in the B.C. Ministry of Environment Laboratory Registration Program.

NORWEST LABS

To: J.R. PAINE & ASSOCIATES LTD. W/O: 29336 Page 1

Sample type		soil	soil	soil
Identification		S-2	S-4	S-7
Lab Reference #		29336-002	29336-004	29336-007
ICP - ULTRASONIC NEBULIZATION				
Method used		uwave HNO3/H2O2 soluble	uwave HNO3/H2O2 soluble	uwave HNO3/H2O2 soluble
Amount analysed		0.520 g	0.506 g	0.513 g
SOIL NUMERICAL CRITERIA-PL&RL				
aluminum		20300	18600	23600
antimony	20	< 2.	< 2.	< 2.
arsenic	30	470.	930	6.
barium	500	144.	142.	156.
beryllium	4	0.3	0.2	0.3
bismuth		< 5.	< 5.	< 5.
cadmium	5	0.2	0.2	0.2
calcium		15700	22400	19400
chromium	250	711.	1330	38.5
cobalt	50	8.8	7.9	12.0
copper	100	24.0	26.4	34.5
iron		27000	29000	31000
lead	500	9.	13.	9.
lithium		14.5	12.7	18.1
magnesium		10600	9730	13800
manganese		270.	235.	512.
mercury	2	< 0.02	< 0.02	< 0.02
molybdenum	10	< 1.0	2.	< 1.0
nickel	100	16.5	16.0	24.0
phosphorus		699.	707.	824.
potassium		3230	2860	2870
selenium	3	< 2.	< 2.	< 2.
silicon		769.	2480	1890
silver	20	< 0.5	< 0.5	< 0.5
sodium		2050	1830	1340
strontium		58.	58.	56.
sulfur		2490	5600	50
thallium by GFAA		< 0.3	< 0.3	< 0.3
thorium		< 1.	< 1.	< 1.
tin	50	1.	1.	< 1.
titanium		1580	1440	2060
uranium		< 5.	< 5.	< 5.
vanadium	200	57.	49.	67.
zinc	500	61.5	63.0	67.5
zirconium		9.3	7.4	11.4
Results in		ug/dry g	ug/dry g	ug/dry g
chrome+6	8	< 3.	< 3.	< 3.
Results in		ug/dry g	ug/dry g	ug/dry g

 Approved:

NORWEST LABS

Langley PH (604) 530-4344 FAX (604) 534-9996
Edmonton PH.(403) 438-5522 FAX (403) 438-0396
Calgary PH.(403) 291-2022 FAX(403) 291-2021
Lethbridge PH.(403) 329-9266 FAX(403) 327-8527
Winnipeg PH.(204) 982-8630 FAX(204) 275-6019

WO (Lang.) : 29336
WO (Other) :
PO # :
Date Samp. :
Date Rec'd. : 09-Sep-97
Date Comp. : 16-Sep-97

Client		Received From	
Name	: J.R. Paine & Associates Ltd.	Name	:
Address	: 14 Burns Road Whitehorse, Yukon Y1A 4Y9	Address	:
Phone	: 403-668-4648	Phone	:
Fax	: 403-668-2400	Fax	:
Attn.	: Tares Dhara	Attn.	:
Project	: Haines Junction		

Organo-Chloride Pesticides in Soil

Parameter	29336-5 S-5	Detection Limit
Pesticide		
Aldrin	<0.05	0.05 ppm
BHC (alpha isomer)	<0.05	0.05 ppm
4,4'-DDD	<0.05	0.05 ppm
4,4'-DDE	<0.05	0.05 ppm
2,4'-DDT	<0.05	0.05 ppm
4,4'-DDT	<0.05	0.05 ppm
Dieldrin	<0.05	0.05 ppm
Endosulfan I	<0.05	0.05 ppm
Endosulfan II	<0.05	0.05 ppm
Endrin	<0.05	0.05 ppm
Heptachlor	<0.05	0.05 ppm
Heptachlor epoxide	<0.05	0.05 ppm
Hexachlorobenzene	<0.05	0.05 ppm
Lindane	<0.05	0.05 ppm
Methoxychlor	<0.05	0.05 ppm
Mirex	<0.05	0.05 ppm
Percent Moisture	33	

Results are expressed in ppm (mg/kg), dry weight, without correction for recovery data.

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Organo-Chloride Pesticides in Soil (cont.)

Definitions / Methods

Organo-Chloride Pesticides: This analysis is carried out in accordance with U. S. Environmental Protection Agency Method 8080 (#SW 846, 3rd Edition, Washington DC 20460) which involves extraction of the components with an organic solvent (EPA 3540) followed by analysis by capillary gas chromatography using an electron capture detector.

Percent Moisture: Percentage of the total wet weight of the sample as received. This analysis is carried out gravimetrically by drying the sample to constant weight at 105 C.

Comments

Quality Control Results

QA/QC		Analyst		
Compound	% Recovery	Analysis	Date	Analyst
Lindane	89	O-C Scan	10-Sep-97	Stephen H.
Endosulfan I	126			
2,4-DDT	143			
Surrogate	89			

Supervisor

Note: All samples will be disposed of after 30 days following analysis unless other arrangements are made.

APPENDIX C

- Plastic & Liquid Limit Analysis

CONSISTENCY LIMIT SUMMARY

PROJECT: Environmental Assessment and Remediation
Marshall Creek, Site HJ011
Yukon Territory

DATE: 1997/09/15

CLIENT: Indian and Northern Affairs Canada
Waste Management
345-300 Main Street
Whitehorse, Yukon
Y1A 2B5

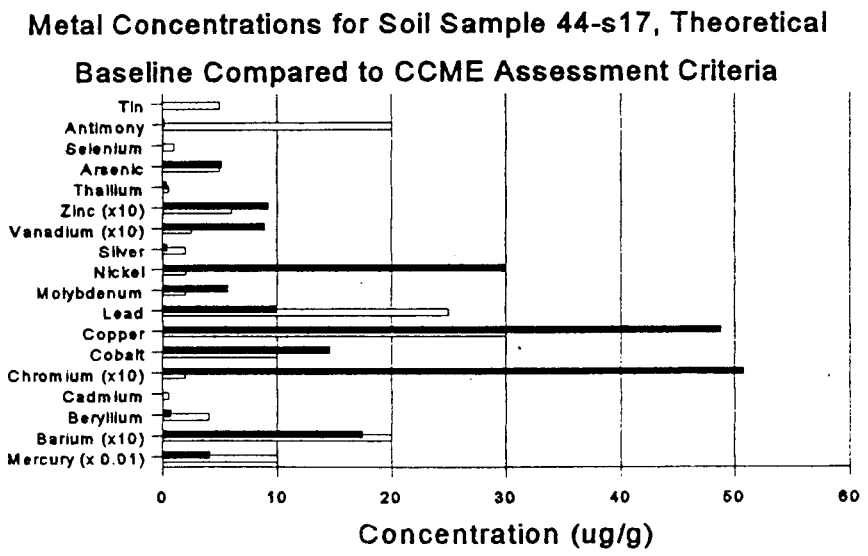
J.R.P. FILE: 8054-24

SAMPLE #	LOCATION/ DEPTH	CONSISTENCY LIMITS
10	Testpit # 3-97 / 0.6 meters	PL = N/P
14	Testpit # 4-97 / 0.9 meters	PL = 22.4% LL = 27.5% IP = 5.1%

APPENDIX D

- Theoretical Baseline Concentrations

FIGURE 34 Metal Concentrations for 44-S17



CCME ug/g	44-S17 ug/g
5	< 0.10
20	0.15
1	< 0.10
5	5.18
0.5	0.36
60	92.10
25	89.10
2	0.40
20	29.90
2	5.7
25	10.00
30	48.80
10	14.60
20	50.80
0.5	<0.30
4	0.70
200	175
0.1	0.044

PHOTOGRAPHS

Photo # 1- Typical haul load during hand clean-up operations.

Photo # 2 - Site conditions near T.P.# 1-97 prior to hand clean-up operations.

Photo # 3 - Site conditions near T.P.# 1-97 near completion of clean-up operations

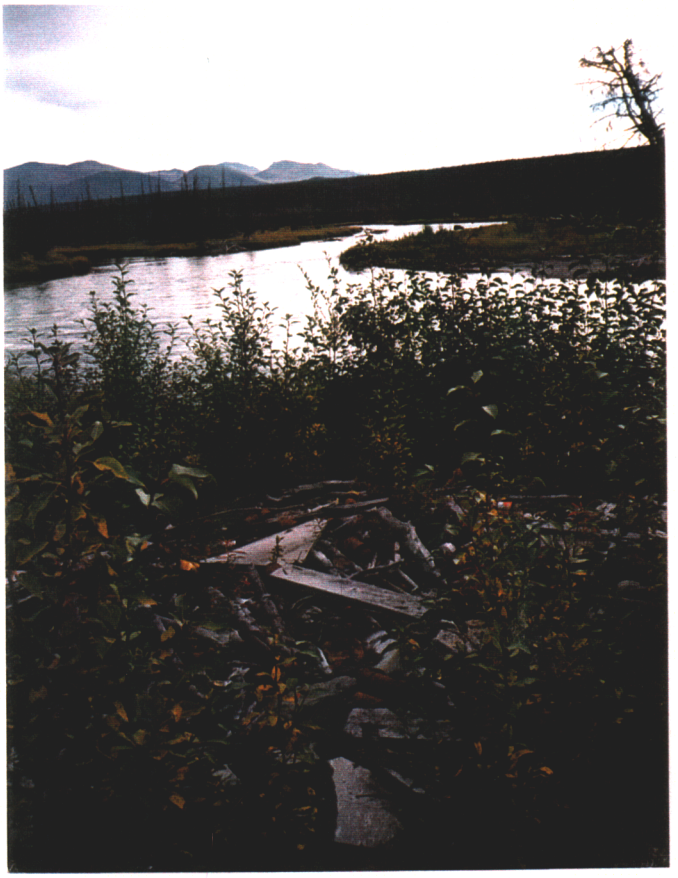


Photo # 4 - Site conditions near the Dezadeash River prior to hand clean-up operations.

Photo # 5- Site conditions near the Dezadeash River upon completion of hand clean-up operations.

Photo # 6 - Surficial debris removed near completion of hand clean-up operations. Photo taken at Haines Junction landfill.

Photo # 7- Site conditions in the large pond prior to clean-up operations.

Photo # 8 - Site conditions in the large pond upon completion of clean-up operations.

Photo # 9 - Removal of debris during heavy equipment clean-up operations.

Photo # 10 - A portion of surficial debris removed near completion of heavy equipment clean-up operations.
Photo taken at Haines Junction landfill.

Photo # 11- A portion of surficial debris removed near completion of heavy equipment clean-up operations.
Photo taken at Haines Junction landfill.

Photo # 12 - Site conditions near the Dezadeash River during heavy equipment clean-up operations.

Photo # 13 - Site conditions near the large pond during heavy equipment clean-up operations.