PHASE II ENVIRONMENTAL SITE ASSESSMENT
Site HJ045, Kluane Maintenance Camp
Kluane Lake, YT

0201-97-12447.2

Submitted to:

Indian and Northern Affairs Canada

March, 1998

eba

EBA Engineering Consultants Ltd.

PHASE II ENVIRONMENTAL SITE ASSESSEMENT
SITE HJ045, KLUANE MAINTENANCE CAMP
KLUANE LAKE, YUKON

submitted to:

Department of Indian Affairs and Northern Development

prepared by:

EBA Engineering Consultants Ltd.
Whitehorse, Yukon

0201-97-12447.2

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EXECUTIVE SUMMARY

In October 1997, EBA Engineering Consultants Ltd. (EBA) conducted geophysical and environmental investigations to locate and test soils at a suspected solid waste disposal site. The site is designated as HJ045 by the Waste Management Program of Indian and Northern Affairs Canada and is located near the south end of Kluane Lake. The site was identified during a Phase II Environmental Site Assessment of the former Kluane Maintenance Camp, on behalf of the Waste Management Program.

The objective of the geophysical investigation was to locate any potential buried waste sites. The objective of the environmental assessment was to determine if contaminants were present and if so are the contaminants migrating from the site.

Two locations were found using ground penetrating radar (GPR) which showed characteristics similar to waste buried in trenches. Testpitting was conducted in the two identified locations and soil samples were collected. Field tests were conducted to identify samples with potential contamination. Selected samples were then sent to an accredited laboratory for analysis.

Samples were analyzed for petroleum hydrocarbons, polychlorinated biphenyls and organo-chlorine pesticides, based on location and background information.

Laboratory results show that trace levels of Heavy Extractable Petroleum Hydrocarbons were found in one soil sample from the site. All other contaminants were, at or below, the lower detection limits in the remaining samples.

Water samples could not be obtained from the testpits because of sloughing into the pits. No hydrocarbon sheen was observed on any water which was observed in the testpits.

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1.0 INTRODUCTION

On October 17, 1997, EBA Engineering Consultants Ltd. (EBA) received written approval to proceed with the assessment of a site near the former Kluane Maintenance Camp on the southern end of Kluane Lake as shown in Figure 1. The site had been designated as HJ045 under the Waste Management Program. The approval was based on a proposal submitted by EBA, to the Waste Management Program of Indian and Northern Affairs Canada, dated October 3, 1997.

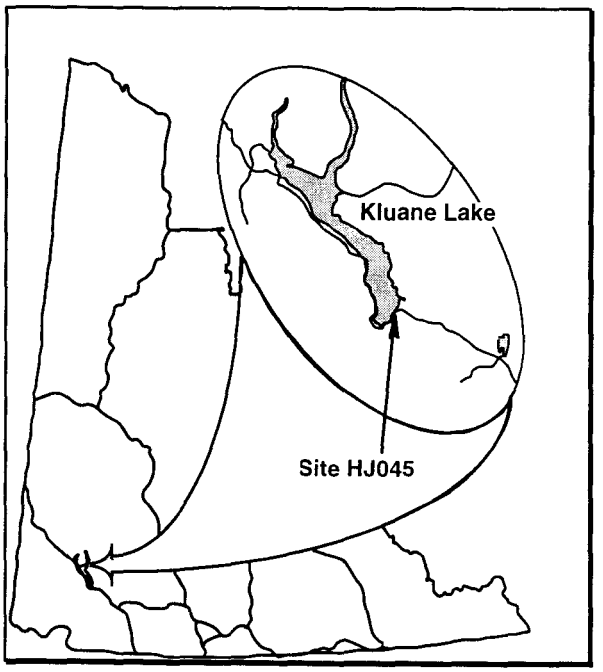


Figure 1: Location of Site HJ045

The proposal was for an a environmental assessment of a site which was thought to contain solid wastes including drums, vehicle parts and transformers. The asssessment was to include geophysical techniques to facilitate locating any waste burial sites and in particular buried drums, vehicle parts and transformers.

The objectives of this assessment were to determine if contaminants are present on the site, and if so are the contaminants migrating from the site.

The site had been identified during previous environmental investigations associated with the Kluane Maintenance Camp.

The tasks completed for this assessment were as follows:

- geological and topographical maps were reviewed, along with air photos, to develop a site assessment plan using geophysical sensing equipment;
- a field sampling and laboratory program was developed to identify contaminants in the soil at the site;
- a geophysical survey was conducted at the site;

- testpitting was conducted to investigate anomalies identified by the geophysical survey;
- field testing was conducted to assist in the selection of soil samples;
- soil samples were submitted for laboratory analysis;
- a report detailing the program results was prepared for technical review by the Waste Management Program;
- the final report was submitted following review of the draft report by Waste Management Program staff.

1.1 STANDARDS APPLIED

Canadian Council of Ministers of the Environment (CCME) guidelines were used for numerical comparison in the assessment of the level of contaminants found in the samples analyzed. Where CCME guidelines were not established, the Yukon's Contaminated Sites Regulations (CSR) have been used for numerical comparison purposes, recognizing that these regulations do not apply to Federal land. The commercial land use category was selected, for comparison with analytical values, for samples from this site.

The CCME has no guidelines established for hydrocarbons, therefore CSR standards for Volatile Petroleum Hydrocarbons (VPH), Light Extractable Petroleum Hydrocarbons (LEPH) and Heavy Extractable Petroleum Hydrocarbons (HEPH) were used.

There are no guideline levels established in either the CCME or CSR for VPH, LEPH or HEPH compounds in water.

2.0 SITE HJ045

This site is located adjacent to the Alaska Highway at the south end of Kluane Lake as shown in Figure 2. The maintenance camp was removed in 1957 and realignment of the Alaska Highway placed the current highway through the center of the former Kluane Maintenance Camp site. The geographic co-ordinates for Site HJ045 are 61° 00′ 46″ N and 138° 25′ 07″ E, the corresponding UTM co-ordinates are northing 6 766 750 m N and easting 639 550 m. The extent of the site investigated is outlined on the airphoto in Figure 2.

3.0 METHODOLOGY

3.1 REVIEW OF EXISTING DATA

The existing data was reviewed during the Phase I and Phase II studies conducted on the Kluane Maintenance Camp. During the field work portion of the Phase II study information was provided by a local resident regarding a previously unidentified site. Using airphotos available at the time, the resident was able to indicate the approximate location of a waste disposal site.

The site was reported to have been used at the time the camp was closed in 1957. Solid wastes including engine blocks, drums and transformers were supposedly deposited in a trench which was then covered.

It was uncertain if the drums were emptied prior to disposal although it was thought that there may have been used oil in some drums. It was also unknown if the transformers were drained prior to disposal into the trench.

3.2 FIELD WORK PROGRAM

The site was first investigated using ground penetrating radar (GPR) to locate any potential buried solid wastes. Areas which showed anomalies were then investigated by excavating testpits and conducting field testing using a photoionization detector (PID) to check soil vapours, and an enzyme immunoassay field kit to check for PCBs.

During the field work portion of this study a photographic record was maintianed of activities at the site. All available photographs are presented in Appendix A along with explanatory captions.

3.2.1 EQUIPMENT OVERVIEW

Ground Penetrating Radar

The GPR system used for the survey was a GSSI SIR 8 System with a 500 MHz antenna. This system from a practical perspective is a monostatic GPR system with a single antenna containing both transmitting and receiving elements.

This system was selected on the basis of the known site conditions and its ability to collect data at high horizontal sampling rates as well as generating a field interpretable paper output. Effective penetration depths of 5 to 6 metres were achieved with the site stratigraphy being clearly identifiable on all records. A sample rate of 51.6 scans per second was used for the survey resulting in a typical sample density of one scan per 1 to 2 cm.

All GPR systems function in a similar fashion to conventional seismic reflection surveys. The GSSI SIR 8 system consists of three major components:

- A control unit generating all timing and triggering functions.
- A transmitter / receiver antenna assembly, generating the radar wavelet pulse that is coupled into the ground and a receiver antenna that detects the returning echoes from the transmitted wavelet pulse.
- A greyscale printer that generates a field copy of the GPR data collected in real time.

Operationally, the GPR data is collected by placing the antenna assembly in contact with the ground and then dragging the antenna along a profile line at a constant rate. While the antenna is being moved it is continually transmitting and receiving vertical profiles at a horizontal sample interval controlled by the control unit scan rate. These vertical profiles (scans) are gained and then printed by a variable density greyscale printer. During the course of this survey a window length of approximately 60 nanoseconds (ns) was used. Assuming a propagation velocity of 0.15 m/ns this gave an effective scanning depth of 9 m.

The type of data collected is determined by the site conditions, more specifically the electrical characteristics of the soil. There are two electrical parameters that influence the type of data collected by GPR systems. These parameters are the soil conductivity and the charge capacity of the soil. The soil conductivity controls the attenuation rate of the radar data. The higher the conductivity the higher the attenuation rates and the lower the penetrating ability of the GPR system. The charge capacity governs whether the signal is reflected back to the receiver. Changes in the charge capacity of the soil result in some of the transmitted wavelet pulse being reflected back to the surface and the remainder of the signal continuing to the next reflector. The reflected signal is detected by the receiver assembly. The amount of time taken between when the wavelet pulse is transmitted and when it is received is proportional to the distance travelled, (i.e. the depth to the reflector). If there is a large change in the charge capacity there will be a large reflection.

Conversely, if the change is small, the reflected signal will also be small. If there is no abrupt change in the charge capacity, or the change is gradual, rather than abrupt, little or no signal will be reflected back to the receiver.

Most geological materials have charge capacity values of between 4 and 10. If the material has water present in the pore space these values can increase from between 6 to 30, depending on the material and the moisture content. This large change is due to the fact that water has a charge capacity of 81.

At this particular site the surficial material is a clean medium to coarse sand with some fine gravel pockets. The water table is within approximately 2.0 m of the ground surface. Above the water table, propagation velocities backcalculated from testpit results are quite fast, and are in the order of 0.15 m/ns. Below the water table it is suspected that velocities are much slower and may be in the order of 0.075 m/ns due the influence of the saturated soil conditions.

Photoionization Detector

The PID was a Photovac MircoTIP® photoionization detector (PID) with a 10.6 eV lamp. This instrument provides a digital readout of the level of ionizable components of the vapour in parts per million (ppm). This unit was chosen because of its ability to detect hydrocarbon vapours, particularly diesel fuel and gasoline. The PID readings provided a semi-quantitative comparison of the vapour levels which were used as an indication of contamination.

Enzyme Immunoassay

Field testing of soil samples for PCBs was performed by enzyme immunoassay with an EnviroGard PCB Test Kit. This kit provides a semi-quantitative test of soil samples for Aroclors 1016, 1242, 1248, 1254, and 1260. The samples were tested in comparison to a 10 ppm standard. The manufacturer's literature states that tests provide a 95% confidence of no false negatives.

3.2.2 SURVEY PROCEDURE

Standard survey methodology was used by EBA for the GPR survey at the site investigated. The site was divided into a series of smaller grids and then parallel lines profiled either in a north to

south or west to east directions. The parallel profiles were separated by either 1.5 or 3 m depending on which grid the lines were in. Figure 2. shows the approximate location of areas where the profile lines were collected.

All data was reviewed and location annotations made as required to the paper output. Features of interest such as suspected pipes were covered with additional profiles in order to further define their orientation.

Areas which showed anomalies were marked (Figure 2) and testpits were dug to identify the source of the reflection. The PID was used to constantly monitor soil vapour levels in a 1 m grid pattern along the periphery of the excavation. Once testpitting was complete areas within the pit which showed the highest PID readings were identified and duplicate soil samples collected.

The PID readings were taken insitu prior to collecting the soil samples. One sample from each duplicate set was analyzed using the EnviroGard PCB Test Kit to detect the presence of PCB material in excess of 10 ppm. Samples which had the highest PID and PCB results were selected for further analysis, for these selected samples the second sample of the duplicate set was forwarded for laboratory analysis .

3.2.3 EQUIPMENT LIMITATIONS

It should be noted that there are several limitations in the GPR data as collected. They are noted in point form below:

- The depth scales shown in Figures 3 and 4 are only approximate and should be considered as general guides only. This is a result of the fact that the GPR data is actually directly measuring a two-way travel time rather than depth and an average velocity has been assumed to derive the depth scale shown. The conversion from the time delay measured to depth requires an estimate of the propagation velocity of the GPR signal through the ground, and this will vary across the site as the soil and moisture contents vary.

- The GPR data will detect reflection anomalies that are generally within 1 to 1.5 m of the profile centreline. As profile spacings were either 1.5 or 3.0 m apart, small individual objects between these profile swaths may not be detected.

For all sites it should also be noted that Photoionization Detector alone does not assure that all contamination will be detected. This instrument detects only ionizable components of vapours and does not differentiate between the compounds it is detecting. It was used as a field screening tool to determine if any ionizable vapours could be detected. The level of ionizable vapours detected with the PID were used as an indication of the level of contamination.

While the primary contaminants of concern at these sites generally have components that are ionizable, and therefore may be detected by the unit, it is recognized that not all contaminants will produce ionizable vapours and that the 10.6 eV lamp is particularly suited to a specific range of ionizable vapours.

3.3 LABORATORY PROGRAM

The soil samples selected for analysis were frozen prior to being shipped in a cooler, to Enviro•Test Laboratories (ETL) in Edmonton which is an accredited lab under the *Canadian Association for Environmental Analytical Laboratories.*

Soil samples selected for laboratory analysis were tested for Benzene, Toluene, Ethylbenzene and Xylene (BTEX), Volatile Petroleum Hydrocarbons (VPH), Light Extractable Petroleum Hydrocarbons (LEPH), Heavy Extractable Petroleum Hydrocarbons (HEPH), Organo-Chlorine Pesticides and Polychlorinated Biphenyls (PCBs). Analytical protocols are detailed following the Enviro•Test Laboratories *Chemical Analysis Report* in Appendix B.

The selection of samples was based on field observations, and field tests of contaminant vapours in the soil and PCBs in soil.

No ground water samples were collected from this site.

4.0 RESULTS OF STUDY

4.1 SITE DESCRIPTION

The site is flat and slightly sloping northwest toward Kluane Lake. The site is bordered on the southern side by the former Alaska Highway alignment and on the eastern side by Topham

Creek. A Trans North Helicopters landing pad, office and various other buildings are located on the western end of the site as shown in Figure 2.

Testpitting in the area revealed that the soil strata is predominantly fine to coarse gravel with some sand and silt. Ground water was encountered at approximately 2.0 m below ground surface in Testpit # 1. The area generally shows signs of disturbance from surface scraping and other excavation activities.

4.2 SITE CONDITIONS

GPR data quality was good with strong and clear reflections being obtained down to 5 m. A marked increase in attenuation below 2 to 2.5 m was caused by the saturated soil conditions below the water table. Typical traces are included in Figures 3 and 4.

Figure 3 shows a section of line that traverses a solid waste disposal pit (Testpit #1) located on the site surveyed. The change in reflection strength due to the presence of rebar and wooden beams is very obvious. In addition to the solid waste pit there are numerous single point reflectors caused by metallic debris of one kind or another. These objects may range in size from rebar to engine blocks and are scattered throughout the area surveyed. No evidence was seen that would suggest a concentration of these objects in a pit.

Figure 4 shows reflections that are very typical of undisturbed pad material. Strong horizontal reflectors are present. These reflectors are likely a result of abrupt changes in moisture content and/or natural depositional layering. A distinct region was tentatively identified as a second possible pit and is shown on Figure 4. Within this area the distinctive horizontal layering seen in other areas is broken and more chaotic reflectors are seen. Upon digging a testpit in this area (Testpit #2) it was determined that a waste disposal pit did not exist at this location. The chaotic reflectors seen are a result of pockets of coarser granular material within the ground. A single metallic reflector is seen in this example and is typical of reflections caused by lengths of steel wire found on the ground surface.

On both figures a largely horizontal reflector was seen that appears to correlate with the water table identified during testpitting. All metallic type reflectors seen on the records are between

2.5 m and ground surface, i.e., there does not appear to be foreign objects below the water table.

Results of the GPR work concur with information provided by Mr. Maurice Bouvier at the time of the field work. Mr Bouvier, who has leased property covering part of the site investigated, indicated that he had found and removed engine blocks from the site in past years. He also indicated that he had excavated at locations other than the testpit sites but had not encountered any electrical equipment or drums.

4.3 SUBSURFACE SOIL CONDITIONS

Soil vapour sampling on a 1 m grid covering the sides and base of the excavation revealed slightly elevated PID readings for three locations in Testpit #1 and one location in Testpit #2.

The results of PID and PCB testing for Testpits #1 & 2 are presented in Table 1, the sample locations are shown in Figure 5. All PID readings are at or near the lower detection limit for the unit. This indicates a lack of ionizable vapours in the near surface soils. The field kit analyses of PCBs indicates all results were less than the calibration standard of 10 ppm.

Table 1: Field Test Results

	Testpit # 1			Testpit # 2	
Sample (Depth)	1 (2 m)	2 (2 m)	3 (1 m)	4 (1.5 m)	5 (2 m)
PID Results (ppm)	11.5	10.4	10.2	0.0	2.9
PCB Results (ppm)	<10	<10	<10	<10	<10

The results of the laboratory analyses are presented in Table 2, for the samples submitted. The laboratory results show all parameters to be near or below the lower detection limits.

4.4 GROUND WATER CONDITIONS

Ground water was encountered at approximately 2 m below ground surface in Testpit # 1. The loose gravels and sand encountered on the site caused constant sloughing into the pits. Water samples could not be obtained from the testpits because of this sloughing. No hydrocarbon sheen was observed on any water which was observed in the testpits.

Table 2: Soil Analysis Site HJ045

Results in ppm unless otherwise noted

PARAMETER	TEST RESULTS				CRITERIA*	DETECTION LIMIT
Sample Number	1	2	3	5		
Sample Depth (m)	2	2	1	2		
% Moisture		6.6	2.5	5.1	---	
PCBs						
All Aroclors	<0.15✶	<0.03	<0.03	<0.03	5	0.03
BTEX & Volatile Petroleum Hydrocarbons						
Benzene		< 0.02	< 0.02	< 0.02	0.5	0.02
Toluene		< 0.02	< 0.02	< 0.02	3	0.02
Ethylbenzene		< 0.02	< 0.02	< 0.02	5	0.02
Xylenes		< 0.02	< 0.02	< 0.02	5	0.02
Volatile Petroleum Hydrocarbons		< 0.5	< 0.5	< 0.5	200†	0.5
Heavy Extractables (Soil)		<5	13	<5	1000†	5
Light Extractables (Soil)		<5	<5	<5	1000†	5
Organo-Chlorine Pesticides						
Quintozine		<0.003	<0.003	<0.003	n/a	0.003
Gamma-BHC		<0.003	<0.003	<0.003	n/a	0.003
Beta-BHC		<0.003	<0.003	<0.003	n/a	0.003
Alpha-BHC		<0.003	<0.003	<0.003	n/a	0.003
Oxychlordane		<0.003	<0.003	<0.003	n/a	0.003
Heptachlor		<0.003	<0.003	<0.003	n/a	0.003
Nonachlor		<0.003	<0.003	<0.003	n/a	0.003
Endrin		<0.003	<0.003	<0.003	n/a	0.003
a-Chlordane		<0.003	<0.003	<0.003	n/a	0.003
g-Chlordane		<0.003	<0.003	<0.003	n/a	0.003
Endosulfan I		<0.003	<0.003	<0.003	n/a	0.003
Endosulfan II		<0.003	<0.003	<0.003	n/a	0.003
Aldrin		<0.003	<0.003	<0.003	n/a	0.003
pp-DDE		<0.003	<0.003	<0.003	n/a	0.003
Dieldrin		<0.003	<0.003	<0.003	n/a	0.003
pp-DDD		<0.003	<0.003	<0.003	n/a	0.003
pp-DDT		<0.003	<0.003	<0.003	n/a	0.003
Methoxychlor		<0.006	<0.006	<0.006	n/a	0.006
Mirex		<0.003	<0.003	<0.003	n/a	0.003

Notes:

* CCME Remediation Guidelines for Soil (Commercial)

† Contaminated Sites Regulations Commercial Land Use Soil Standard

✶ PCB detection limit raised due to interferences which could not be removed with clean-ups.

n/a No standard developed

4.5 CONTAMINATION CONSIDERATIONS

The results of field testing using the PID and immunoassay kit suggested levels of contaminants in the vicinity of the site to be near the lower detection limits of the field equipment.

Laboratory analysis of soil samples collected confirmed that only a trace of Heavy Extractable Petroleum Hydrocarbons (HEPH) was present in one sample collected at the 1 m level. All other parameters were at or below the detection limits.

These results indicate that none of the samples analyzed have levels of Benzene, Toluene, Ethylbenzene and Xylene (BTEX), Volatile Petroleum Hydrocarbons (VPH), Light Extractable Petroleum Hydrocarbons (LEPH), Heavy Extractable Petroleum Hydrocarbons (HEPH), Organo-Chlorine Pesticides or Polychlorinated Biphenyls (PCBs) that exceed the CCME guidelines for remediation or the standards in the Contaminated Sites Regulations for commercial land use.

Standards for residential and park land use were reviewed in consideration of any future land use changes. The lab analysis shows levels of all contaminants tested to be well below the current standards for all land use categories.

5.0 INTERPRETATIONS

The ground penetrating radar (GPR) used on the site was successful in detecting buried wastes. This was confirmed by the testpitting program which found waste material to be located as indicated by the GPR. The extent of the buried waste "pit" was small, although other buried items scattered in the area were noted on the GPR records. During the testpitting no evidence of electrical transformers was found, although electrical wiring was encountered in Testpit #1.

Soil samples were collected from near surface to the groundwater table with the focus being near the groundwater table. It is anticipated that this would be the zone most likely impacted by contaminant migration in the area. It is likely that groundwater movement in the area will be similar to the observed surface water movement, ie. in a northwesterly direction accross the site The testpits being located on the northern edge of the site would intersept this migration path.

Field testing did not identify any suspected contamination. This is confirmed by laboratory analyses which did not detect levels of contamination above any of the established guidelines.

6.0 PRELIMINARY ENVIRONMENTAL RISK ASSESSMENT

Laboratory analyses did not detect levels of contamination above any of the established guidelines. Other than trace levels of Heavy Extractable Petroleum Hydrocarbons in one sample from Testpit #1 all parameters tested were at or below detection limits. This indicates that contamination was not found in the samples tested and therefore is not causing environmental concerns at the locations tested.

7.0 RECOMMENDATIONS

No further environment assessment is recommended for the areas investigated.

8.0 CONCLUSIONS

A solid waste disposal site was found in the area under investigation. The wastes match the description of some of the material which was expected to be buried at this site. It appears from conversations with Mr. Bouvier that some wastes have been uncovered and removed during past activities on the site. There was no evidence found to suggest that hydrocarbons, organo chlorine pesticides or PCB contamination currently exists at the site.

9.0 CLOSURE

This report has been prepared for the exclusive use of the Department of Indian and Northern Affairs Canada, for the purposes as described in Section 1 of this report. It has been prepared in accordance with generally accepted geo–environmental practices.

For further limitations regarding the use of this report, reference should be made to the Geo-Environmental Terms and Conditions, attached.

EBA trusts this report meets your requirements at this time. If you have any concerns or comments EBA would be pleased to discuss the report or any questions which you may have.

Respectively submitted,
EBA Engineering Consultants Ltd.

Donald J. Wilson
Senior Environmental Scientist

Neil S. Parry
Senior Geophysical Scientist

Paul A. Evans, P. Eng.
Project Director - Environmental

TERMS AND CONDITIONS
GEO-ENVIRONMENTAL SERVICES

This report incorporates and is subject to these "Terms and Conditions"

1. EBA shall provide and exercise the degree of skill, care and diligence required by customarily accepted professional practices and procedures normally provided in the performance of the services contemplated at the time and location in which the services are performed.

2. EBA shall use reasonable efforts to perform the services within prescribed time schedules. EBA shall not, however, be responsible for any delays caused by circumstances beyond its control.

3. EBA may engage as subconsultants any person, firm or corporation with appropriate recognized professional status or with special skills or knowledge to assist in performing the services.

4. EBA can not give any warranties, express or implied, about the existence or absence of any contaminants or hazardous materials on the site. EBA shall provide an opinion respecting the presence of contaminants or environmental impairment based on the evidence available, if so requested within the scope of investigations authorized by the Client.

5. The Client shall obtain all the permits, authorizations or consents and give any required notices necessary to enable EBA to perform the services including, but not limited to, any consents necessary to allow EBA, its agents, employees and equipment the necessary access to, and use of, the site.

6. Any documents provided by the Client to EBA shall be deemed to be the property of the Client and, on the written demand of the Client, EBA shall, as soon as practicable, return all of the Client's documents to him. Any information collected and documents prepared by EBA while performing the services shall be deemed to be the property of EBA.

7. Both EBA and the Client shall take reasonable care to prevent disclosure of any reports or documents prepared by EBA, or information obtained for or contained in any reports or documents, to any person except those persons who require access to such information to discharge their responsibilities in relation to the services performed by EBA.

8. If EBA becomes aware of any contamination or hazardous materials on the site which could damage property or endanger health or lives, EBA shall notify the Client as soon as possible and appropriate authorities as required.

9. The Client shall provide EBA with accurate and complete delineations of the location of all subsurface structures and utilities at, on or near the site, except as otherwise may be agreed.

10. Where the services to be performed require taking samples from the site, the Client shall be responsible for payment of appropriate storage and disposal for any contaminated samples taken from the site. The Client shall be responsible for all costs incurred to decontaminate any equipment (used by EBA or its agents in the performance of the services) which are contaminated by conditions encountered at the site.

11. EBA shall not be responsible for any costs, damages or loss suffered by any person, including the Client, its employees, agents or related companies, as a result of:

    a) any decisions taken by the Client without the advice of EBA, or contrary to the advice of EBA, pertaining to activities during, or subsequent to, the services being performed by EBA;

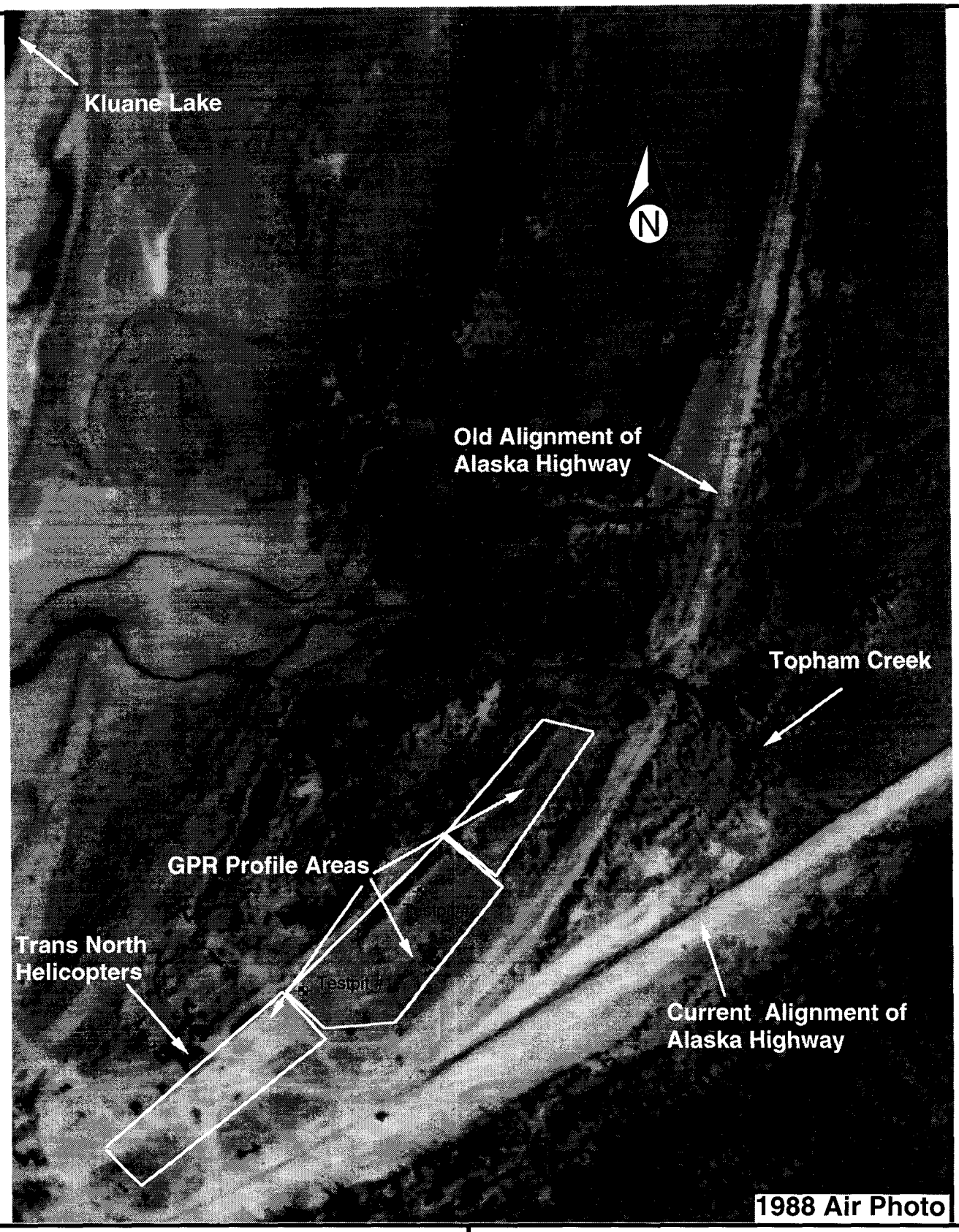
    b) any subsurface exploration or sample-taking on the site by EBA including cross-contamination;

    c) the disclosure, as permitted or required by law of any opinion, information or report prepared by EBA;

    d) the failure of the Client, or other agencies, to accurately identify the location of all subsurface structures or utilities.

    nor shall EBA be responsible or liable for any indirect or consequential losses, damages, costs or expenses incurred by any person including the Client, relating to or as a result of services provided by EBA.

12. The Client shall assume the defence of, and indemnify and save harmless, EBA, its agents and employees, from all claims or liability by any third parties relating to or arising out of the performance of the services, except where the claim or liability arises out of negligence or wilful misconduct of EBA, and the Client whenever it is bound to indemnify EBA shall reimburse EBA for time spent and expenses incurred by EBA in defence of any such claims.



EBA Engineering Consultants Ltd.				PROJECT	PHASE II ESA Site HJ045
CLIENT	DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS			TITLE	FIGURE 2 GPR PROFILE AREAS AND TP LOCATIONS
DATE Feb/98	DWN. NSP	CHKD. DJW		DRWG NO. 0201-12447.2	FIGURE 2

APPROXIMATE HORIZONTAL SCALE (metres)

0m 5m 10m 15m 20m 25m 30m

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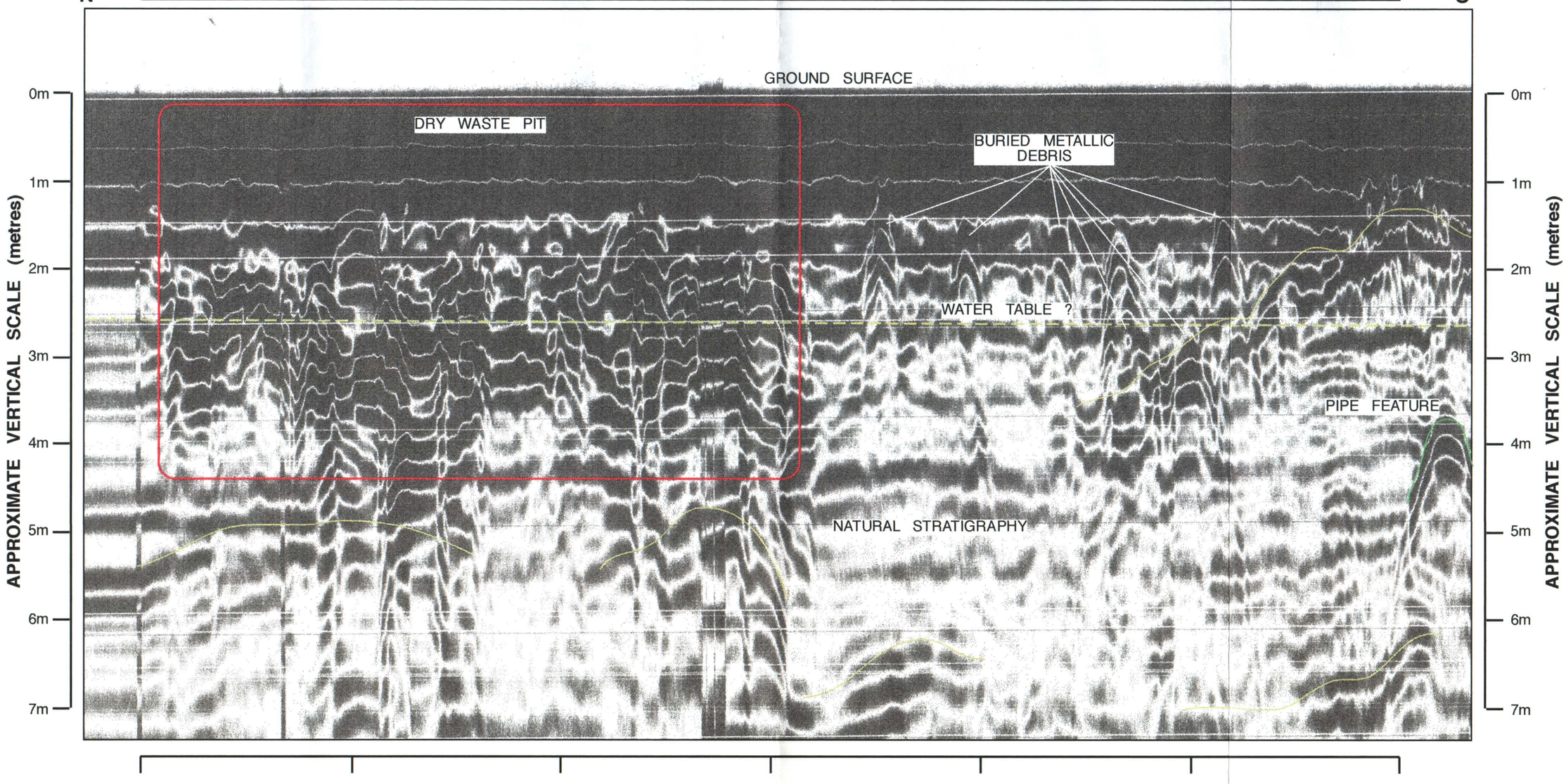


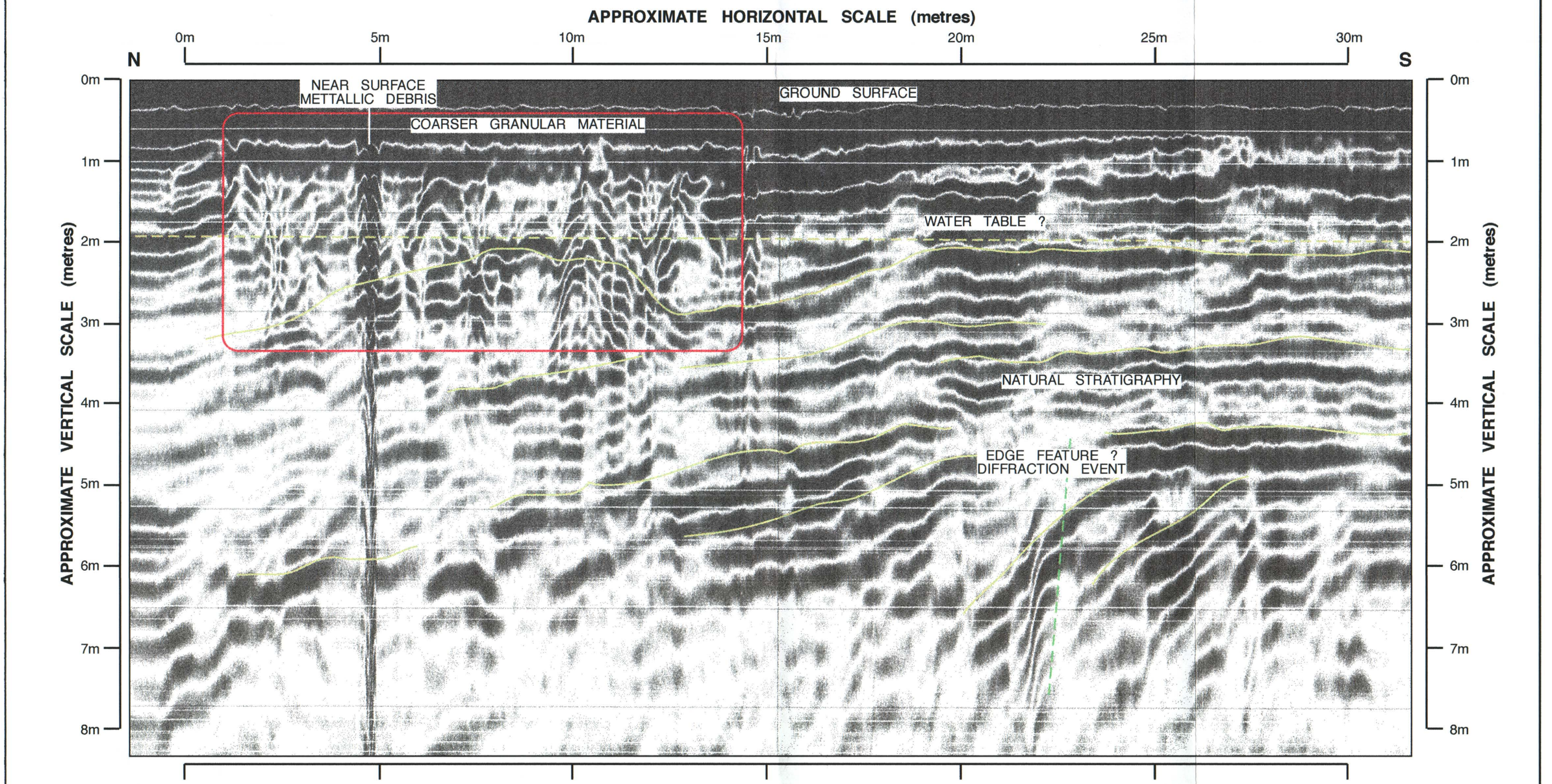
EBA Engineering Consultants Ltd.

PROJECT: Phase II ESA Site HJ045

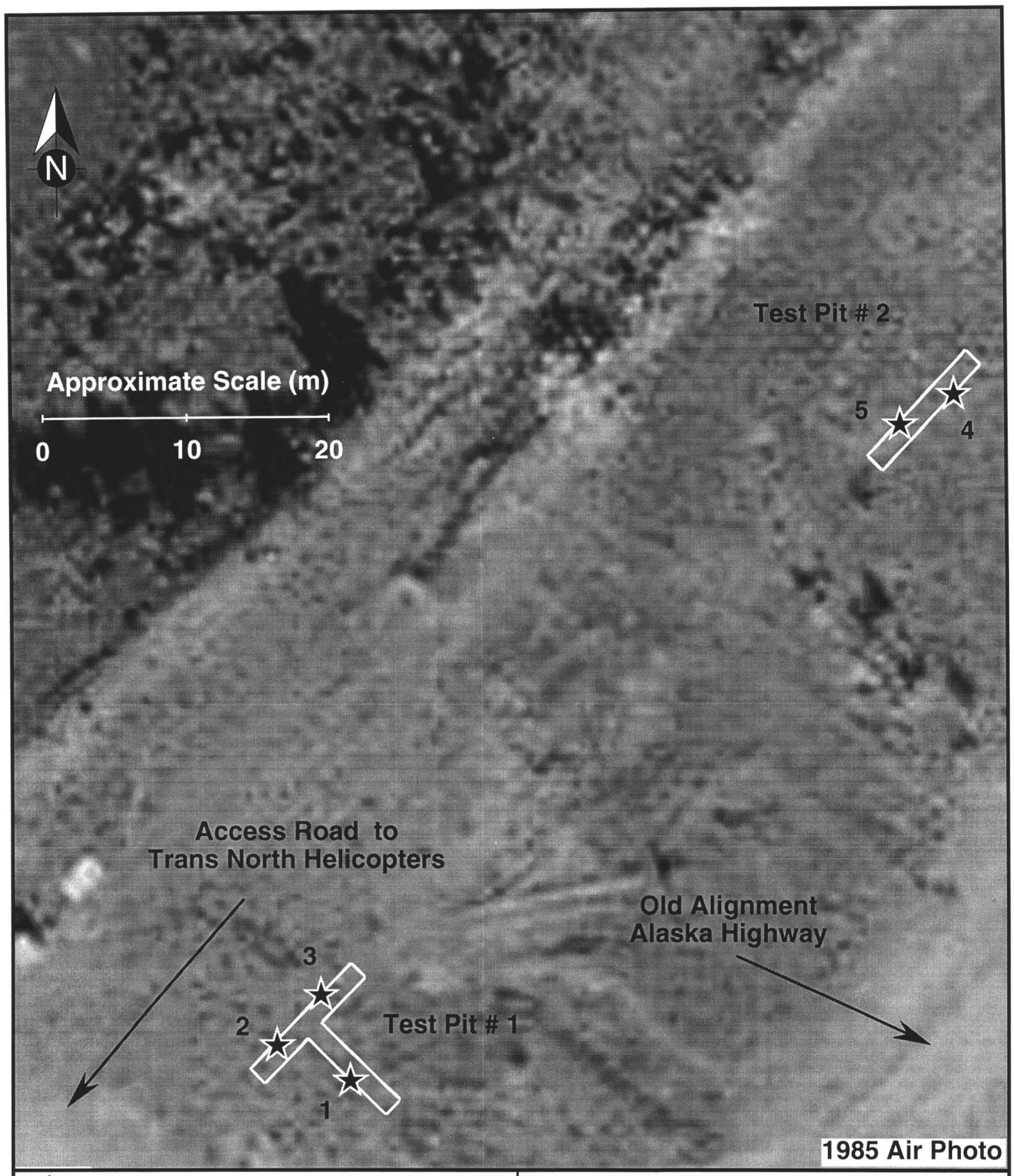
CLIENT: DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS

TITLE: TYPICAL GPR PROFILE, TEST PIT AREA #1

DATE	DWN.	CHKD.	FILE NO.	
97-11-28	NSP	NSP	201-12447NSP02	FIGURE 3



EBA Engineering Consultants Ltd.				PROJECT	Phase II ESA Site HJ045
CLIENT	DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS			TITLE	TYPICAL GPR PROFILE, TEST PIT AREA #2
DATE 97-11-28	DWN. NSP	CHKD. NSP		FILE NO. 201-12447NSP01	FIGURE 4

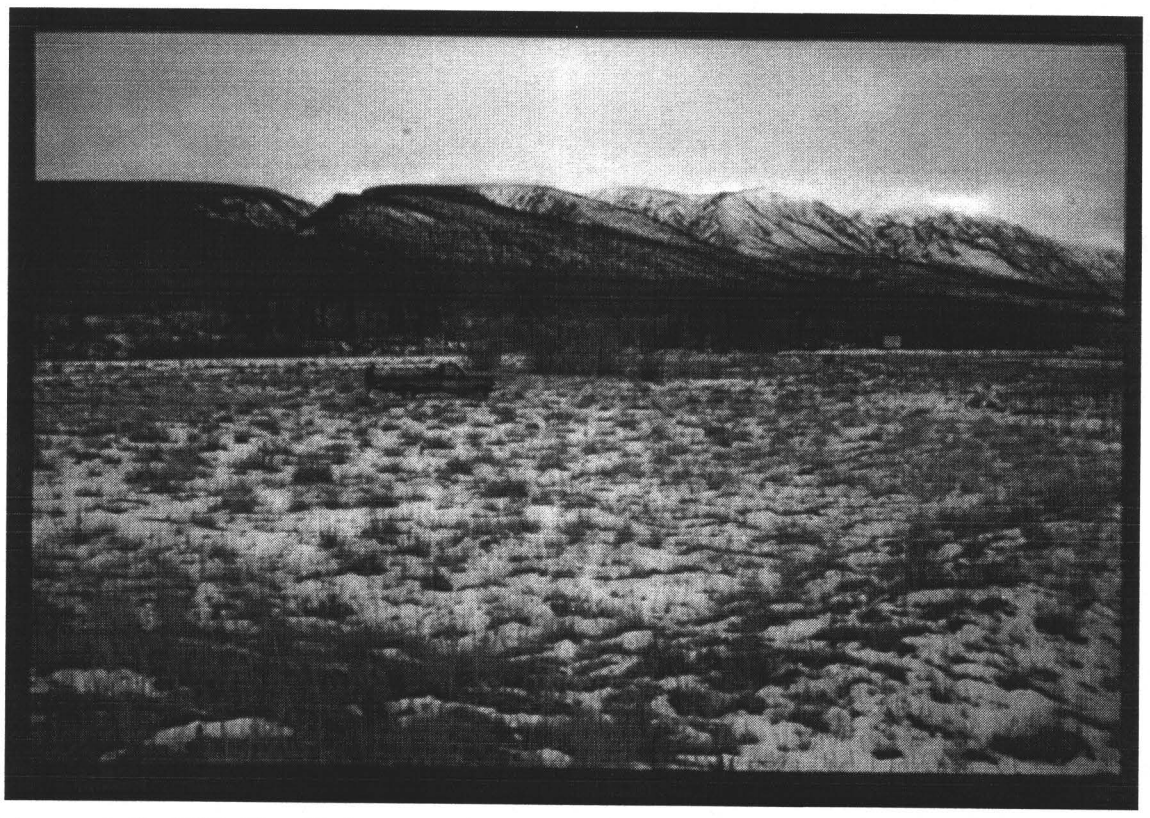


EBA Engineering Consultants Ltd.			PROJECT	PHASE II ENVIRONMENTAL SITE ASSESSMENT WASTE MANAGEMENT PROGRAM	
CLIENT INDIAN and NORTHERN AFFAIRS CANADA			TITLE **Figure 5: Site HJ045 Test Pit and Sample Locations**		
DATE 98 01 21	DWN. DJW	CHKD. DJW	FILE NO. 0201-97-12447.2	DWNG. 12447.2 Figure 5	REVISION 0

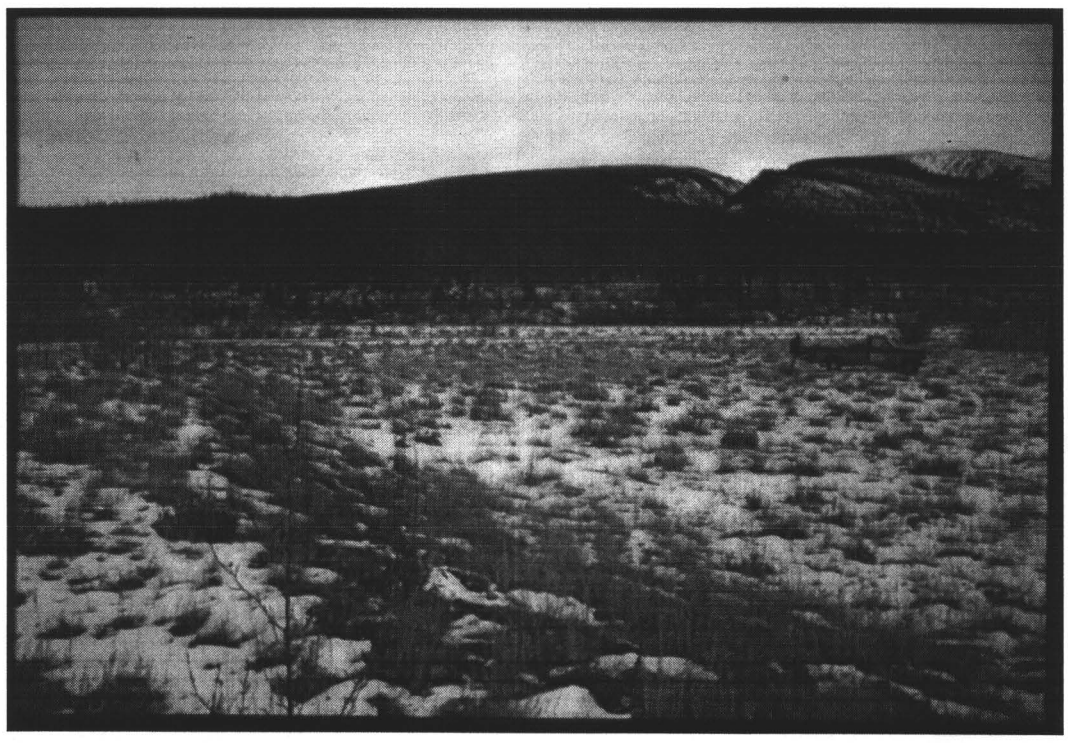
APPENDIX A

Site Photographs

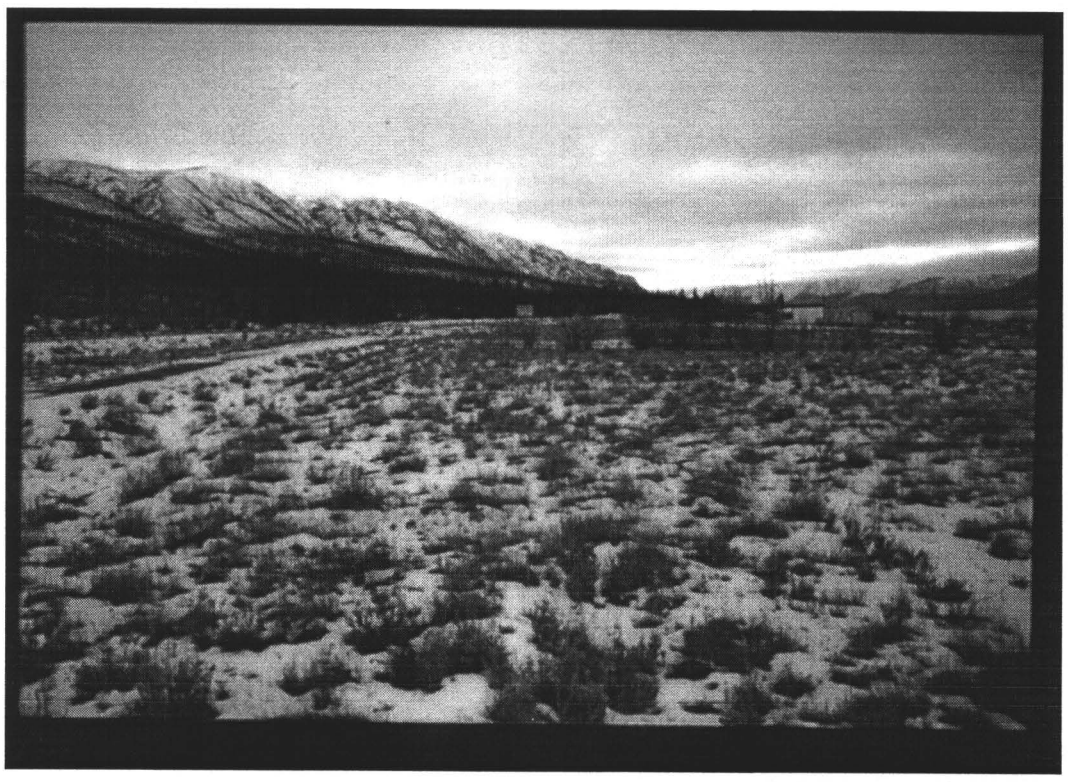
Photograph 1: GPR Site #1 from northeast corner looking southwest.



Photograph 2: GPR Site #1 from northeast corner looking south.

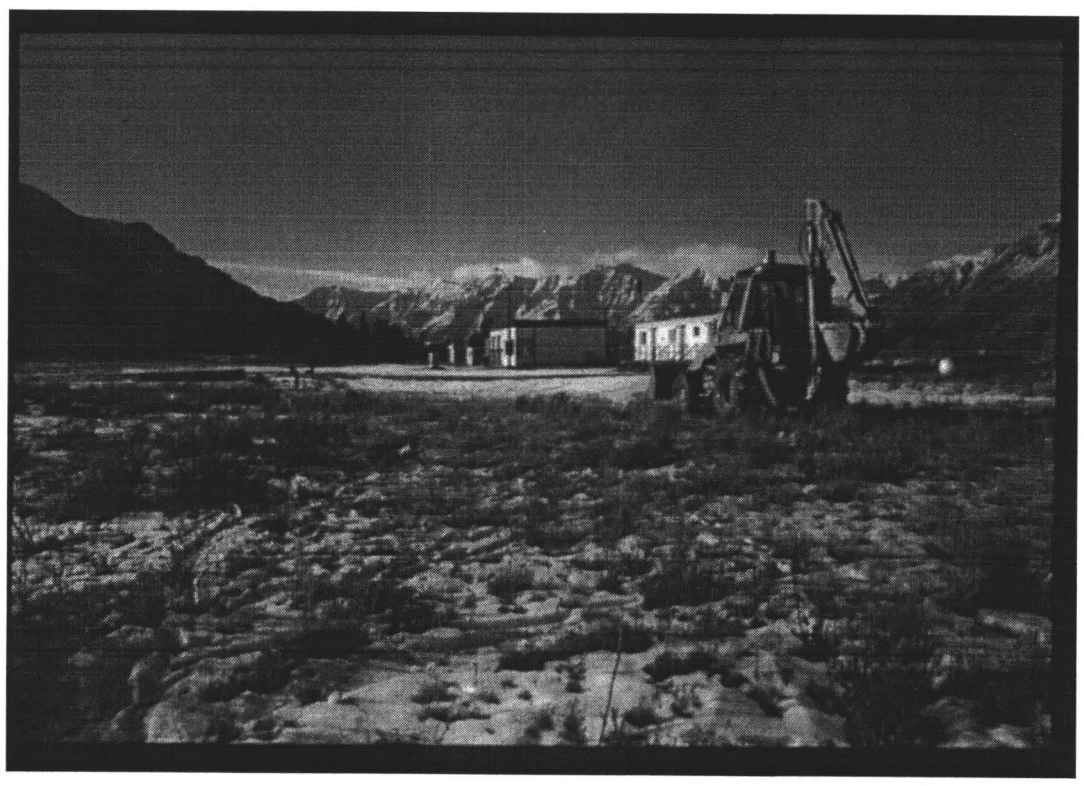


Photograph 3: GPR Site #1 from northeast corner looking southeast.



Photograph 4: GPR Site #1 from southeast corner looking southwest.

Photograph 5: GPR Site #2 from southeast corner looking southwest.



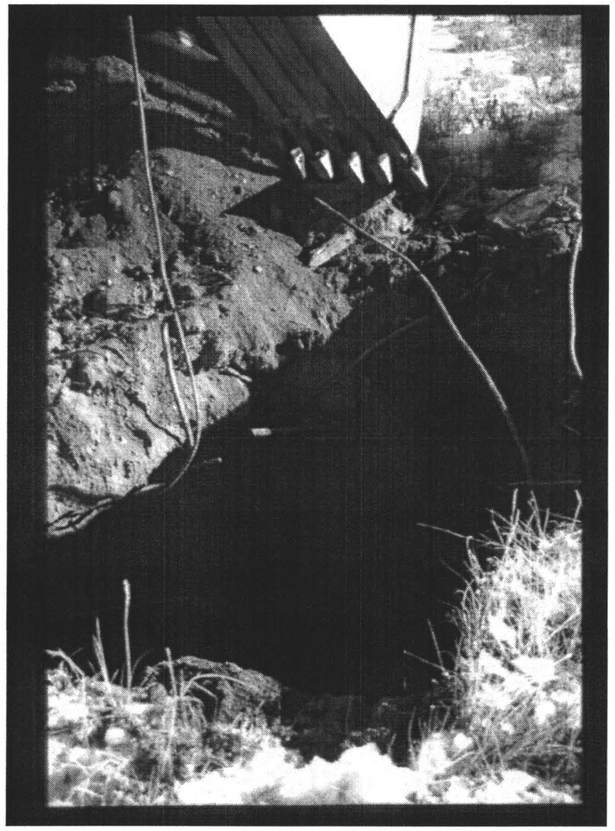
Photograph 6: GPR Site #2 and 3 from southeast corner looking southwest. Backhoe is at Testpit #1.

Photograph 7: GPR Site #2 and 3 from Testpit #1 looking southwest.

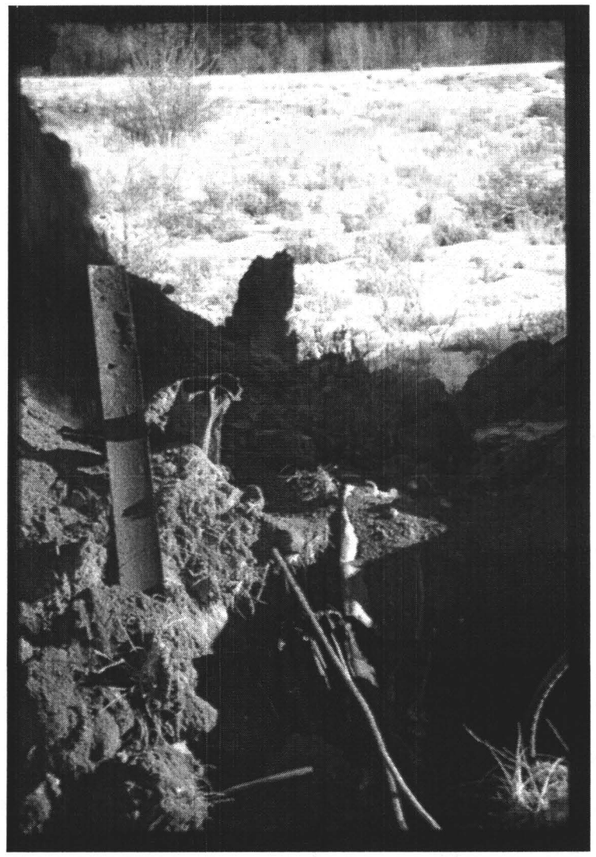
Photograph 8: GPR Site #2 from northwest corner looking northeast at Testpit #1.

Photograph 9: Excavating Testpit # 1.

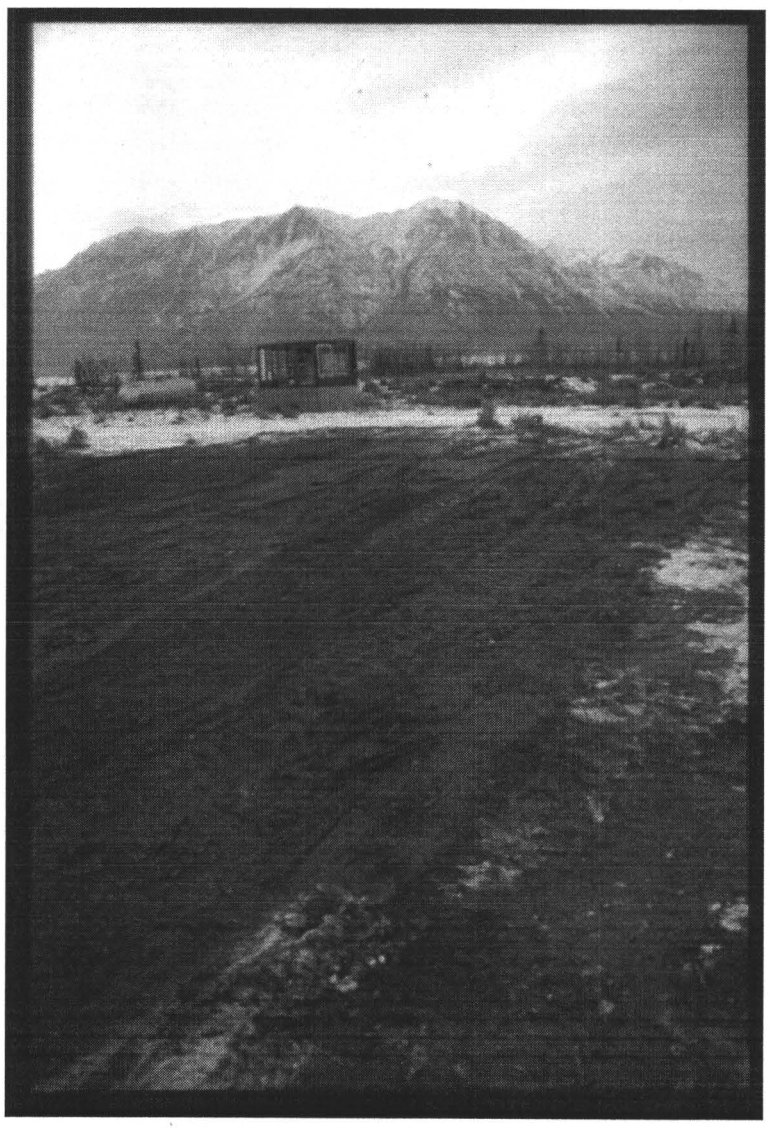
Photograph 10: Metal debris (rebar) in Testpit # 1.



Photograph 12: Metal debris in Testpit # 1.



Photograph 13: Debris in Testpit #1, grader blade, rebar, stove pit and crushed pails.

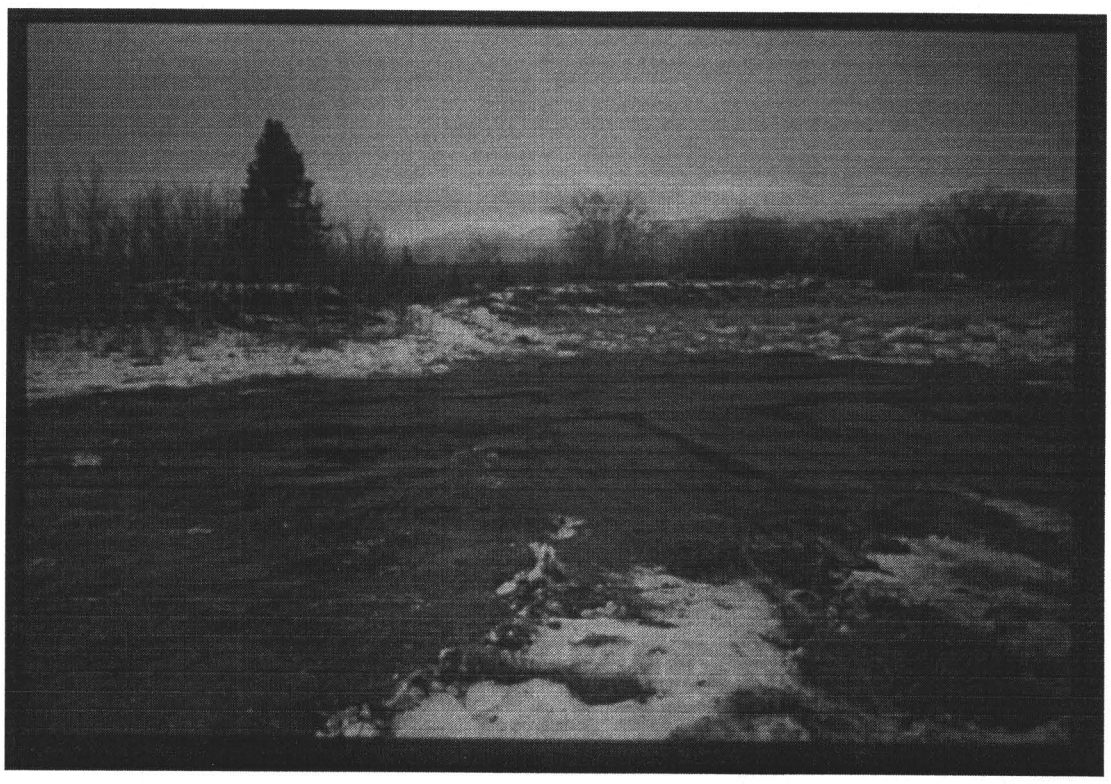


Photograph 14: Testpit #1 following backfilling.

Photograph 15: Testpit #1 following backfilling.

Photograph 16: Testpit #1 following backfilling.

Photograph 18: Testpit #2 following backfilling.



Photograph 19: Testpit #2 following backfilling.

APPENDIX B

Chemical Analysis Report
Enviro•Test Laboratories Ltd.

ETL Enviro-Test
LABORATORIES
A DIVISION OF ETL CHEMSPEC ANALYTICAL LIMITED

Edmonton (Main)
36 - 67 Avenue
monton, AB
T6E 0P5
Phone: (403) 413-5227
(403) 437-2311

monton (Downtown)
Flr., 10158 - 103 Street
Edmonton, AB
T5J 0X6
(403) 413-5265
(403) 424-4602

gary
Bay 2, 1313-44th Ave. N.E.
Calgary, AB
6L5
(403) 291-9897
Fax: (403) 291-0298

Saskatoon
Veterinary Road
katoon, SK
5E3
Phone: (306) 668-8370
(306) 668-8383
0-667-7645

ipeg
745 Logan Avenue
Winnipeg, MB
3L5
(204) 945-3705
(204) 945-0763

Thunder Bay Analytical
1081 Barton Street
Thunder Bay, ON
N3
Phone: (807) 623-6463
Fax: (807) 623-7598

Canada Wide Phone:
668-9878

rn Canada Fax:
286-7319

CHEMICAL ANALYSIS REPORT

EBA ENG CONSULTANTS LTD
UNIT 6 151 INDUSTRIAL RD
WHITEHORSE YT Y1A 2V3

DATE: November 14, 1997

ATTN: DON WILSON

Lab Work Order #:	E710A59	**Sampled By:**	DJW
Project Reference:	0201-97-12447.2	**Date Received:**	10/28/97
Project P.O.#:	NOT SUBMITTED		

Comments:
* PCB detection limit raised due to interferences which could not be removed with clean-ups.

APPROVED BY:

Ron Minks
Project Manager

ACCREDITATIONS: **STANDARDS COUNCIL OF CANADA (SCC)**, IN COOPERATION WITH **THE CANADIAN ASSOCIATION FOR ENVIRONMENTAL ANALYTICAL LABORATORIES (CAEAL)**: FOR SPECIFIC TESTS AS REGISTERED BY THE COUNCIL (EDMONTON, CALGARY)
AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA): FOR INDUSTRIAL HYGIENE ANALYSIS (EDMONTON)
AGRICULTURE CANADA: UNDER THE CANADIAN FERTILIZER QUALITY ASSURANCE PROGRAM (SASKATOON)

ENVIRO-TEST CHEMICAL ANALYSIS REPORT

LAB ID	SAMPLE ID	TEST DESCRIPTION	RESULT	D.L.	UNITS	EXTRACTED	ANALYZED	BY
E710A59-01	12447.2 - 1							
Sample Type:SOIL								
Collected:10/23/97								
		PCB'S in Soil						
		All Aroclors	<0.15	* 0.15	ug/g (ppm)	10/29/97	10/31/97	CSI
E710A59-02	12447.2 - 2A							
Sample Type:SOIL								
Collected:10/23/97								
		BTEX/VPH/LEPH/HEPH in Soil						
		% Moisture	6.6	0	%		10/29/97	0
		BTEX and VPH in Soil						
		Benzene	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Toluene	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Ethylbenzene	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Xylenes	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Volatile Petroleum Hydrocarbon	< 0.5	0.5	ug/g (ppm)	10/28/97	11/03/97	QVP
		Heavy Extractables (Soil)	<5	5	ug/g (ppm)	10/28/97	10/30/97	YDY
		Light Extractables (Soil)	<5	5	ug/g (ppm)	10/28/97	10/30/97	YDY
E710A59-03	12447.2 - 2B							
Sample Type:SOIL								
Collected:10/23/97								
		OC Screen in Soil (GC/ECD)						
		Quintozine	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Gamma-BHC	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Beta-BHC	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Alpha-BHC	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Oxychlordane	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Heptachlor	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Nonachlor	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Endrin	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		a-Chlordane	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		g-Chlordane	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Endosulfan I	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Endosulfan II	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Aldrin	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		pp-DDE	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Dieldrin	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		pp-DDD	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		pp-DDT	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Methoxychlor	<0.006	0.006	ug/g(ppm)		11/09/97	LC
		Mirex	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		PCB'S in Soil						
		All Aroclors	<0.03	0.03	ug/g (ppm)	10/29/97	10/31/97	CSI
E710A59-04	12447.2 - 3A							
Sample Type:SOIL								
Collected:10/23/97								
		BTEX/VPH/LEPH/HEPH in Soil						
		% Moisture	2.5	0	%		10/29/97	0
		BTEX and VPH in Soil						
		Benzene	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Toluene	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Ethylbenzene	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Xylenes	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Volatile Petroleum Hydrocarbon	< 0.5	0.5	ug/g (ppm)	10/28/97	11/03/97	QVP
		Heavy Extractables (Soil)	13	5	ug/g (ppm)	10/28/97	10/30/97	YDY
		Light Extractables (Soil)	<5	5	ug/g (ppm)	10/28/97	10/30/97	YDY
E710A59-05	12447.2 - 3B							
Sample Type:SOIL								
Collected:10/23/97								
		OC Screen in Soil (GC/ECD)						
		Quintozine	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Gamma-BHC	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Beta-BHC	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Alpha-BHC	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Oxychlordane	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Heptachlor	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Nonachlor	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Endrin	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		a-Chlordane	<0.003	0.003	ug/g(ppm)		11/09/97	LC

ENVIRO-TEST CHEMICAL ANALYSIS REPORT

LAB ID	SAMPLE ID	TEST DESCRIPTION	RESULT	D.L.	UNITS	EXTRACTED	ANALYZED	BY
E710A59-05	**12447.2 - 3B**							
Sample Type:SOIL								
Collected:10/23/97								
		g-Chlordane	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Endosulfan I	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Endosulfan II	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Aldrin	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		pp-DDE	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Dieldrin	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		pp-DDD	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		pp-DDT	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Methoxychlor	<0.006	0.006	ug/g(ppm)		11/09/97	LC
		Mirex	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		PCB'S in Soil						
		All Aroclors	<0.03	0.03	ug/g (ppm)	10/29/97	10/31/97	CSI
E710A59-06	**12447.2 - 5A**							
Sample Type:SOIL								
Collected:10/23/97								
		BTEX/VPH/LEPH/HEPH in Soil						
		% Moisture	5.1	0	%		10/29/97	0
		BTEX and VPH in Soil						
		Benzene	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Toluene	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Ethylbenzene	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Xylenes	< 0.02	0.02	ug/g (ppm)	10/28/97	11/03/97	QVP
		Volatile Petroleum Hydrocarbon	< 0.5	0.5	ug/g (ppm)	10/28/97	11/03/97	QVP
		Heavy Extractables (Soil)	<5	5	ug/g (ppm)	10/28/97	10/30/97	YDY
		Light Extractables (Soil)	<5	5	ug/g (ppm)	10/28/97	10/30/97	YDY
E710A59-07	**12447.2 - 5B**							
Sample Type:SOIL								
Collected:10/23/97								
		OC Screen in Soil (GC/ECD)						
		Quintozine	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Gamma-BHC	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Beta-BHC	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Alpha-BHC	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Oxychlordane	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Heptachlor	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Nonachlor	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Endrin	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		a-Chlordane	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		g-Chlordane	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Endosulfan I	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Endosulfan II	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Aldrin	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		pp-DDE	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Dieldrin	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		pp-DDD	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		pp-DDT	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		Methoxychlor	<0.006	0.006	ug/g(ppm)		11/09/97	LC
		Mirex	<0.003	0.003	ug/g(ppm)		11/09/97	LC
		PCB'S in Soil						
		All Aroclors	<0.03	0.03	ug/g (ppm)	10/29/97	10/31/97	CSI

N.D. - NOT DETECTED, LESS THAN THE DETECTION LIMIT

THIS IS THE FINAL PAGE OF THE REPORT
NOT INCLUDING APPENDICES

Appendix A Test Methodologies

BTEX and VPH in Soil

PREPARATION METHOD: Methanol extraction with purge and trap analysis.

INSTRUMENTAL METHOD: GC/PID for BTEX.
GC/FID for VPH - summation of hydrocarbons from C5 to C9 carbon range and is calculated against m+p-Xylenes.
NOTE: Results based upon dry weight.

METHOD REFERENCE: Modified SW-846 USEPA Method 5030 and 8015/8020.

BTEX QC SUMMARY:

Accuracy	Precision
97%	+/- 22%

NOTE: Accuracy is expressed as the average % recovery and Precision as the relative standard deviation (RSD) of fortifications made using certified standards (BTEX).

% Moisture

Preparation Method: Sample is oven dried at 105 degrees C
Instrumental Method: Gravimetric analysis

OC Screen in Soil (GC/ECD)

Method Overview: Samples were extracted into Acetone/Water which was diluted into water, partitioned into Dichloromethane, concentrated, and exchanged into Hexane. Florisil clean-up is done on all extracts should it be required. Samples were analyzed by GC/ECD. Positive results may be confirmed by GC/MSD if requested.

PCB'S in Soil

Preparation Method: Extraction with acetone/hexane

Instrument Method: GC/ECD analysis

Method Reference: Extraction Method: EPA 3550 (modified)
Analytical Method: EPA 8080 (modified)

Minimum Detection Limit (MDL) - 0.030 ppm for all Aroclors

QA/QC Statement:

Accuracy is 99% (expressed as the average recovery of PCB in soil at a 5 ppm level).

Precision is +/- 15% (expressed as the relative standard deviation or RSD).

Light Extractables (Soil)

PREPARATION METHOD: Shake and sonication extraction with organic solvent

INSTRUMENTAL METHOD: GC/FID - summation of hydrocarbons from C10 to C18 carbon range (excluding benzene, toluene, ethylbenzene, and xylenes) and calculated against a calibrated n-decane standard. Result is not corrected for PAH concentration.
NOTE: Results based upon dry weight.

Appendix A Test Methodologies

METHOD REFERENCE: Modified SW-846 USEPA Method 3550/3580 and 8000

Heavy Extractables (Soil)

PREPARATION METHOD: Shake and sonication extraction with organic solvent

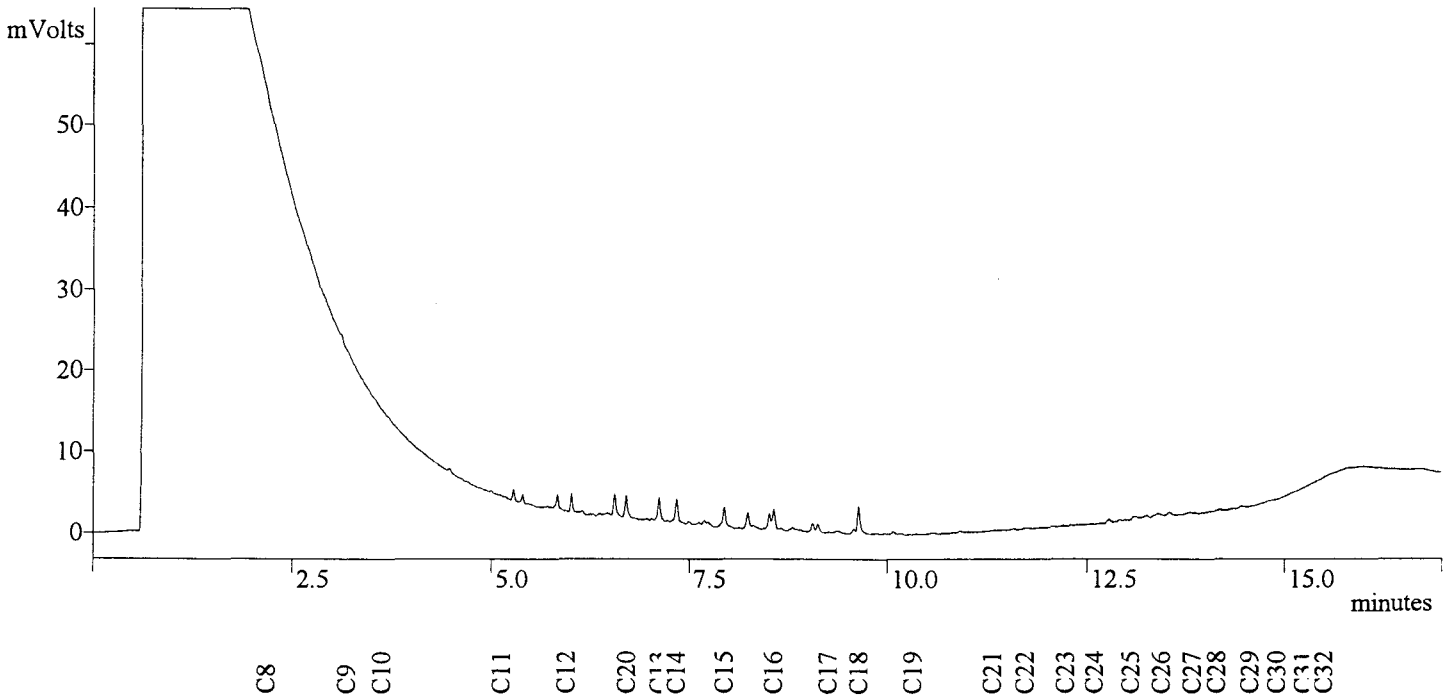
INSTRUMENTAL METHOD: GC/FID - summation of hydrocarbons from C19 to C32 carbon range (excluding benzene, toluene, ethylbenzene, and xylenes) and calculated against a calibrated n-eicosane standard. Result is not corrected for PAH concentration. NOTE: Results based upon dry weight.

METHOD REFERENCE: Modified SW-846 USEPA Method 3550/3580 and 8000

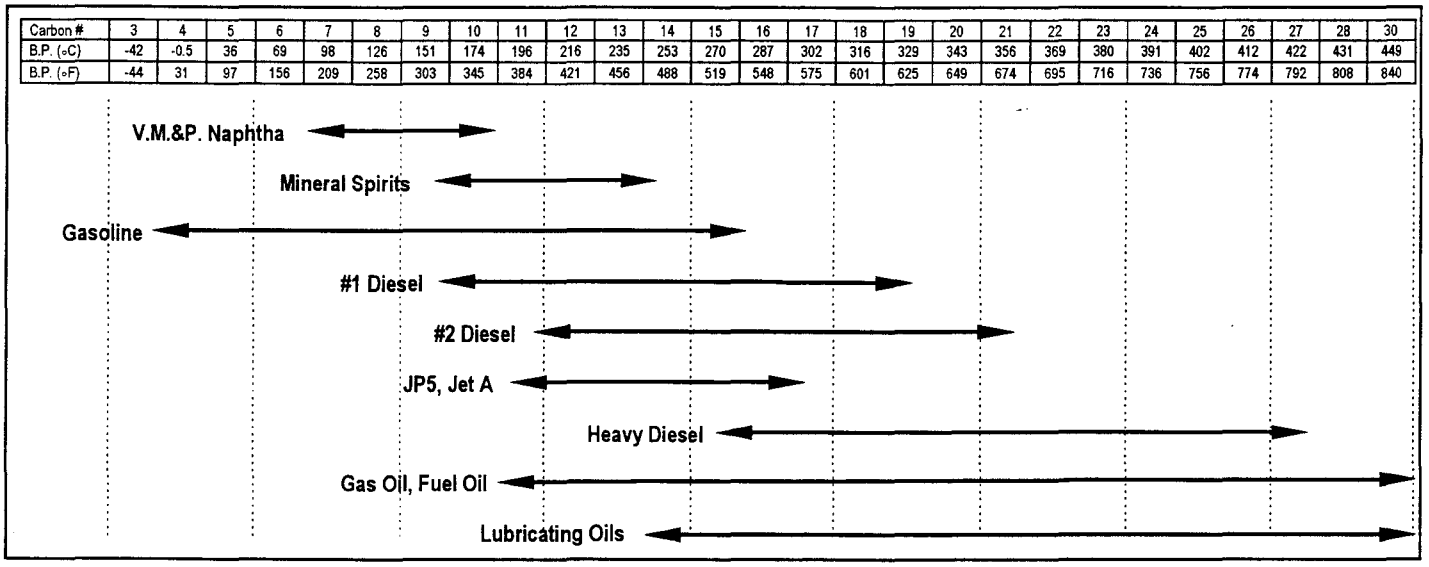
THIS IS THE LAST PAGE OF THE METHODOLOGY APPENDIX.

CLIENT I.D.:

Data File:	c:\star\module18\oct658.run
Sample ID:	E710A59-04A-10
Injection Date:	10/30/97 12:01:21 PM
Instrument (Inj):	GC 3600 SIDE B



Carbon #	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	30
B.P. (°C)	-42	-0.5	36	69	98	126	151	174	196	216	235	253	270	287	302	316	329	343	356	369	380	391	402	412	422	431	449
B.P. (°F)	-44	31	97	156	209	258	303	345	384	421	456	488	519	548	575	601	625	649	674	695	716	736	756	774	792	808	840



Boiling Point Distribution Range for Petroleum Based Fuel Products

Adapted from: Drews, A.W.., ED; Manual on Hydrocarbon Anaysis, 4th ed.; American Society for Testing and Materials: Philadelphia, PA, 1989: p XVIII.

ETL Enviro-Test

A DIVISION OF ETL CHEMSPEC ANALYTICAL LIMITED

EBA-WH-1
MU 11/03/97 Remainder 11/10/97

9936 - 67th Avenue, Edmonton, Alberta T6E 0P5 — Telephone: (403) 434-9509 — Fax: (403) 437-2311
Edmonton Toll Free Line — Telephone: 1-800-668-9878 — Fax: 1-800-286-7319
1313 - 44 Avenue N.E., Calgary, Alberta T2E 6L5 — Telephone: (403) 291-9897 — Fax: (403) 291-0298
107 - 111 Research Drive, Saskatoon, Sask. S7N 3R2 — Telephone: (306) 668-8370 — Fax: (306) 668-8383

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

DATE SUBMITTED: 971027 DATE REQUIRED:

SERVICE REQUESTED: ☑ REGULAR ☐ PRIORITY (50% SURCHARGE) ☐ EMERGENCY (100% SURCHARGE)

C0900E7.SKF

E710A59

ANALYSIS REQUESTED:

SAMPLE ID	SAMPLED BY	DATE / TIME SAMPLED	SAMPLE TYPE	BTEX	TOTAL PURGEABLES	TOTAL EXTRACTABLES	LEAD	PHENOLS	Yukon Kg BTEX	OC 5151	PCB 151	SAMPLE RECEIVED (Y OR N)	SAMPLE BROKEN (Y OR N)	LAB SAMPLE NO.
12447.2-1	DJW	971023	Soil							/				-01
12447.2-2A								/		/				-02
12447.2-2B								/	/	/				-03
12447.2-3A								/	/					-04
12447.2-3B									/	/				-05
12447.2-5A								/						-06
12447.2-5B									/	/				-07
			PRESERVED / FILTERED											

NOTES & CONDITIONS:

1. Quote number must be provided to ensure proper pricing.
2. Turnaround times will vary dependant on complexity of analysis & lab workload at time of submission. Please contact the lab to confirm turnaround times.
3. All hazardous samples submitted must be labelled to comply with WHMIS regulations. This must include the nature of the hazard, as well as a contact name and phone number that the lab can contact for further information.

NOTE: Failure to properly complete all portions of this form may delay analysis.

CLIENT: EBA - Whitehorse
CONTACT: D. Wilson
REPORT ADDRESS: Unit 6
151 Industrial Rd
BILLING ADDRESS: Whitehorse, YT
Y1A 2B3

NO. SAMPLES SUBMITTED: 7
NO. COOLERS / BOXES: 1
PHONE: (867) 668-3068
FAX: (867) 668-4349
P.O. #:
JOB NO.: 12447.2

RELINQUISHED BY:	DATE	RECEIVED BY:	DATE Oct 28/97
	TIME	S Prendergast	TIME 1359
RELINQUISHED BY:	DATE	RECEIVED BY:	DATE 10/28/97
	TIME	C. Hawke	TIME 14:39

SAMPLE CONDITION UPON RECEIPT:

FROZEN: COLD: AMBIENT:

OTHER (BREAKAGE, LEAKAGE, ETC.):

WHITE - Report Copy
PINK - File Copy
YELLOW - Customer Copy