



**Gartner
Lee**

**PRELIMINARY INVESTIGATIONS AT
THREE SITES IN YUKON
(SITES BC102, HJ044, MA026)**

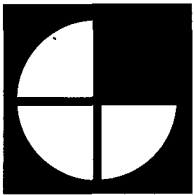
**Prepared for:
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT**

**Prepared by:
GARTNER LEE LIMITED**

GLL 96-776

January 1997

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January 17th, 1997

Department of Indian Affairs and Northern Development
AES - Action on Waste Program
#345 - 300 Main Street
Whitehorse, Yukon Territory
Y1A 2A8

Attention: Mr. Brett Hartshorne, Manager
Action on Waste Program

Dear Mr. Hartshorne,

Re: Final Report - Preliminary Investigations at Three Sites in Yukon

In compliance with the requirements of the Statement of Work associated with Contract No. 96-6135, we are forwarding ten bound copies of our final report summarizing our investigations at the Beaver Creek, Haines Road and Fairchild Lake. As well, we are enclosing one unbound reproducible copy and a diskette (WordPerfect 6.1).

Added to this final version of the report are field methodologies, original analytical results for samples we collected, an Executive Summary, a list of references as well as response to points raised as a result of your review. We appreciate how quickly you were able to provide your comments on our draft report.

We have enjoyed working with you on this Standing Offer and look forward to future opportunities to provide our environmental consulting services.

Yours very truly,
GARTNER LEE LIMITED

Stephen R. Morison, M.Sc.
Senior Geoscientist
Manager, Whitehorse Office



EXECUTIVE SUMMARY

Gartner Lee Limited (GLL) was retained by the Department of Indian Affairs and Northern Development's (DIAND) Arctic Environmental Strategy (AES) Action on Waste Program to conduct preliminary environmental investigations at three separate sites located in the Yukon. The three sites investigated were part of an overall program in the Yukon to evaluate conditions at some 100 sites which may have been impacted from historical activities.

These assessments are considered important components of such initiatives as Land Claims negotiations, self government agreements for Yukon First Nations, devolution of federal responsibilities to the Yukon Government, overall public health and safety and natural resource management.

The three sites investigated by GLL were:

<u>Site Name</u>	<u>Assessment Number</u>	<u>Waste Site Number</u>
Beaver Creek	37	BC102
Haines Road	48	HJ044
Fairchild Lake	45	MA026

The three sites were visited by GLL staff during September of 1996. The site investigation methodologies varied from site to site as conditions dictated and varied from mapping and identifying key features at each site to collecting and analyzing soil samples where potential contamination was suspected.

The **Beaver Creek** site is a former U.S. Army road building camp from the 1940's located south of the town of Beaver Creek. The site was inventoried by Environment Canada in 1976 and was found to consist of several wooden buildings, two borrow pits and an area of refuse. The GLL investigation was limited to the borrow pit and refuse areas as the buildings were on land which is currently leased from the Crown. The site investigation revealed that the refuse identified in the 1976 report had been removed from the site and that there were no indications of any residual contamination.

The **Haines Road** site consists of an abandoned service station located at km 148.8, on the west side of the highway. The site investigation found the remnants of the building foundation as well as several small piles of debris. Also, anecdotal information from local residents indicate that a former owner of the property may be buried somewhere on the property. The site investigation revealed that there appears to be no physical impacts on the site from previous activities; however, the remaining debris results in minor aesthetic impacts. Based on the findings, no further investigation is recommended although the remaining debris should be removed or buried on-site.

The **Fairchild Lake** site was the location of a fuel cache used by mining exploration companies and local outfitters in the 1960s. In 1990 an Environment Canada inventory of the site recorded 185 drums on the site, with some of the drums leaking. The drums were subsequently removed in 1994 although boxes of drill core were left at the north end of the site.

The GLL investigation focused on the area formerly occupied by the fuel drums and samples of the shallow soils were collected from a visually impacted area. The samples were field screened for organic vapours and then submitted to an analytical laboratory for analyses. The laboratory analyses indicated that only one of the ten samples submitted showed concentrations of petroleum hydrocarbons above the appropriate criteria. The laboratory results also showed that the shallow soil contamination was limited to a small area and that migration towards the lake had not occurred.

Based on the findings, it is concluded that a small area at the south end of the site had been impacted by petroleum hydrocarbons and that attempts to remove these soils would likely have a greater impact on the site than contaminant impacts on the surrounding area. However, depending upon the clean-up objectives of AES and the local First Nations, the isolated area of contamination could be removed by hand or left in place to bioremediate naturally over time.

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1.0 INTRODUCTION

Gartner Lee Limited (GLL) was retained by the Department of Indian Affairs and Northern Development's (DIAND) Arctic Environmental Strategy (AES) Action on Waste Program on August 13, 1996 to conduct preliminary environmental investigations at three separate sites located throughout the Yukon Territory. The site locations are shown on Figure 1. The work was issued under government contract number 96-6135.

At that time GLL was requested to submit work plans for preliminary environmental assessments at each of the three sites. These work plans were submitted to AES on August 28, 1996, and were subsequently approved.

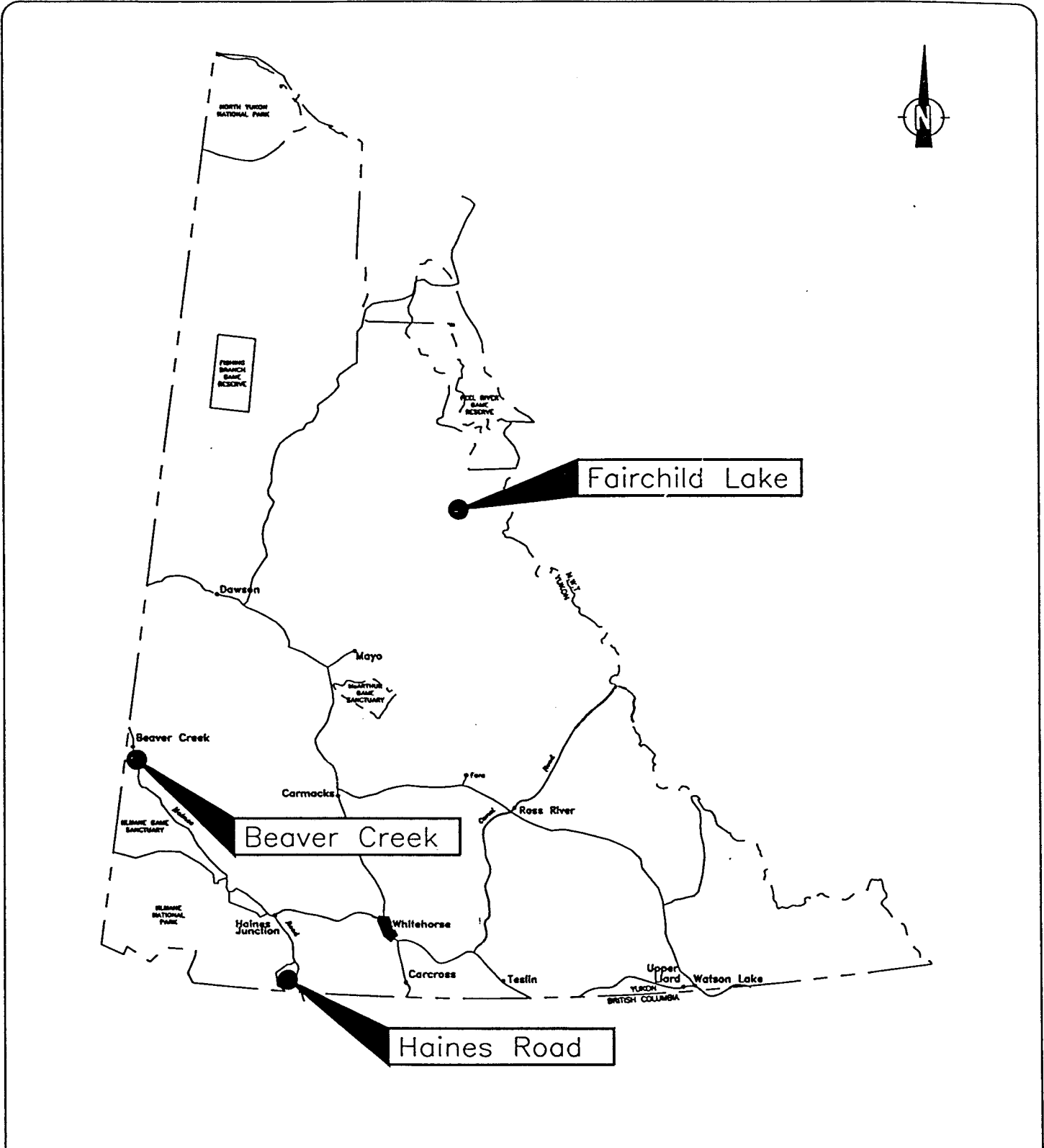
These assessments were conducted as part of an overall program for Yukon Territory to evaluate some 100 sites which are either known to contain or have the potential to contain a variety of contaminants and/or abandoned solid waste products from previous activities. These assessments are important aspects of initiatives such as Land Claims negotiations, self government agreements for Yukon First Nations, devolution of federal responsibilities to the Government of Yukon, overall public health and safety and natural resources management.

2.0 SCOPE OF WORK AND TECHNICAL APPROACH

The scope of the work completed by Gartner Lee Limited is summarized below on a task-by-task basis. It should be noted that not all of the tasks identified were completed at each site, as site conditions dictated the level of effort required at each individual site.

The tasks completed include:

- consultation with local First Nations in terms of the program and the field studies to be conducted;
- a thorough review of previous reports for the sites to be evaluated and contact with the district Resource Management Officers;
- a review of aerial photographs for each site and a terrain analysis to identify potential receptor areas;
- field investigations for each of the three sites by either truck or helicopter;
- identification, mapping and documentation of key features on each site;



LEGEND	
●	SITE LOCATION

SCALE 1:6,250,000	
Drawn By: C. Synold	Project No. 96776
Site Name: AES Standing Offer	File Name: D:\96776\776-1

SITE LOCATIONS	
AES Standing Offer Site Assessments	
Gartner Lee	Figure No. 1

- detection of buried metal debris with a metal detector, the collection of soil samples, water samples, and field screening with a photoionization detector were some of the field techniques applied;
- interpretation of field data and production of a detailed map for each site;
- the production of a report documenting site conditions and provided recommendations for any remedial measures.

The site investigations were conducted by Terry Duffy, B.Sc., a GLL hydrogeologist and Bruce Thomson from the community of Ross River, from September 7 to 13, 1996. The coordination for access to the sites and communications with the local First Nations communities was carried out by Mr. Gerald Issac, Principle of First Nations Consulting and Public Relations Services. Mr. S.R. Morison, Manager and Senior Geoscientist for Gartner Lee's Whitehorse office was the Project Manager for this work.

3.0 FINDINGS

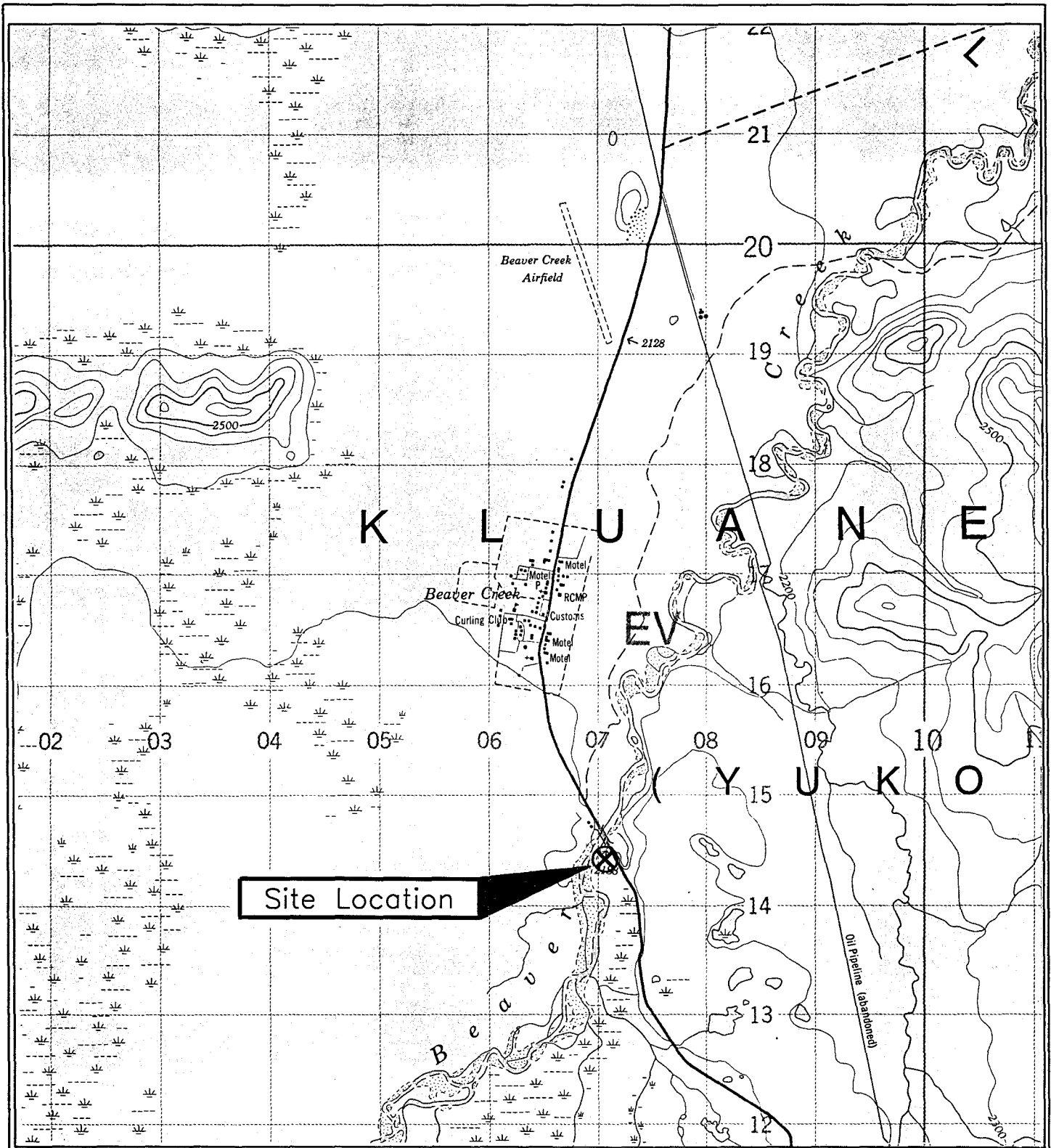
The following section presents the findings of the site investigations on a site-by-site basis. It includes a summary of the history and background information available for each of the sites as well as a summary of any previous AES reports.

3.1 BEAVER CREEK

Background

The Beaver Creek site, referenced as Site 37 in the initial Yukon AES Waste Site Inventory, has now been assigned the Waste Site Number BC102. The site is located on the west side of the Alaska Highway at MP 1200.7, just south of the town of Beaver Creek (Figure 2). The original site was used as a road building camp by the U.S. Army in the 1940's and encompassed land on both the north and south sides of Beaver Creek. At that time the camp consisted of 22 wooden buildings located on the north side of the creek and a dump and borrow pits on the south side.

An inventory of the site in 1976 by Environment Canada's Environmental Protection Service identified four truck hulks, a refuse dump, two borrow pits and wooden debris all located on the south side of the creek. Recommendations made at that time were to burn the wooden debris and remove the truck hulks and refuse to the Beaver Creek landfill.

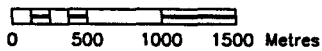


LEGEND

⊗ SITE LOCATION

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NTS 115K/7 EDITION 3

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BEAVER CREEK LOCATION MAP

AES Standing Offer
Site Assessments



Figure No.

2

Drawn By: B. Belzoc Project No. 96776
Site Name: AES Standing Offer File Name: D:\96776\776-BEAV

Site Description and Field Observations

The area investigated was limited to the portion of the site south of Beaver Creek. The land to the north is either privately owned or leased from the Crown. A site plan is provided in Figure 3.

The site is located in a flat area adjacent to Beaver Creek. To the south the topography rises slightly and the area is tree covered. Beaver Creek forms the north and west boundaries of the site and the site is bounded to the east by the Alaska Highway. Access is from a gravel road that heads west from the highway (Photographs 1 and 2).

The site is heavily overgrown with vegetation consisting of aspen, willow and alder, with only two cleared areas remaining as evidence of past site activities. Two, water-filled borrow pits are located in one of the cleared areas (Photographs 3 and 4). The second clearing is located at the terminus of the access road near the creek (Photograph 5).

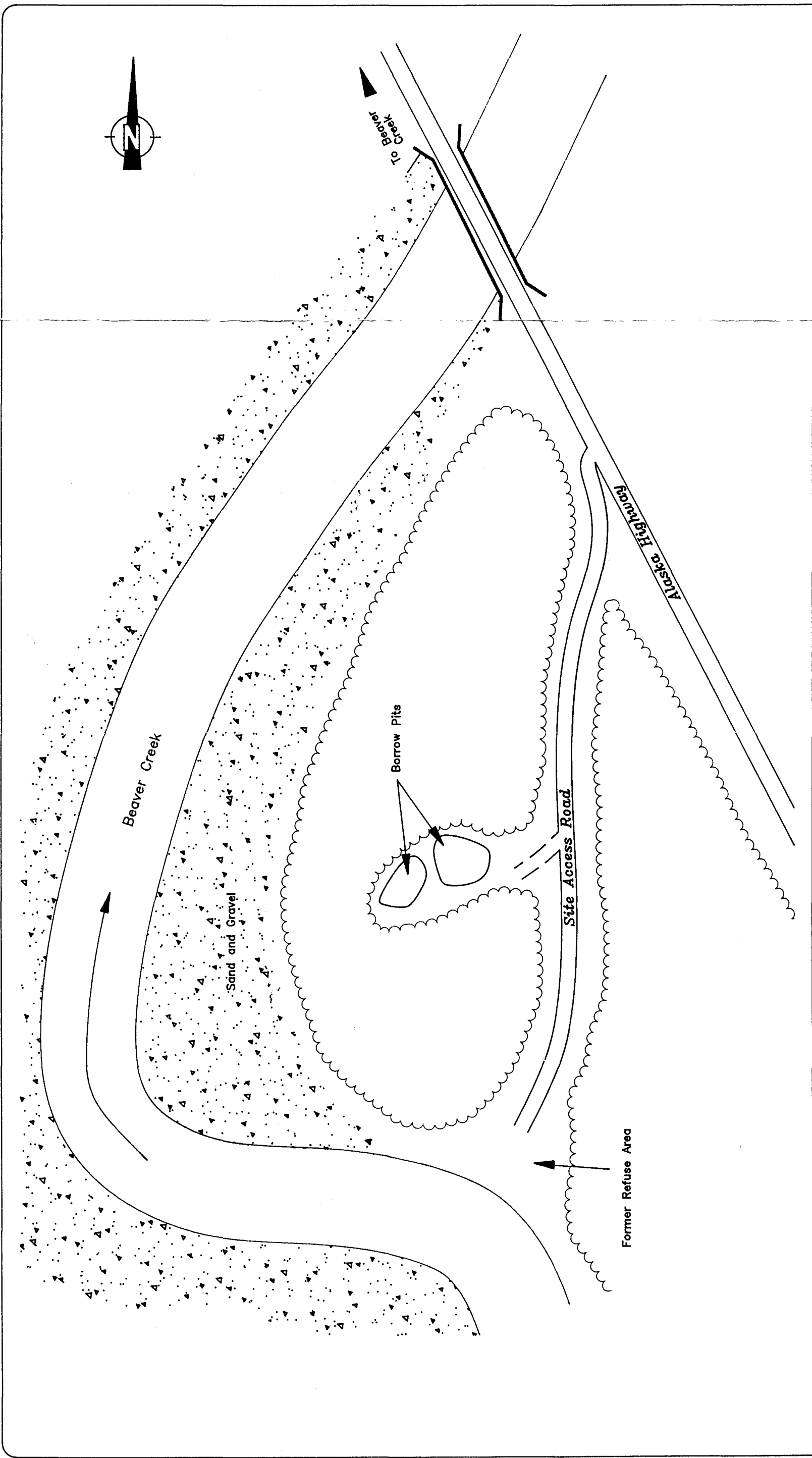
The borrow pits are located to the north of the access road, near the centre of the site. They were excavated by road construction crews and the material was used on the Alaska Highway (N. Wortley, pers. comm.).

The second clearing is believed to be the area identified on the site map provided by AES as that which contained the refuse. There were no signs of any garbage as previous recommendations in the 1976 site report suggested that the refuse be removed to the Beaver Creek landfill. This appears to have been carried out and was confirmed with the local Resource Management Officer (RMO), Mr. Neale Wortley. Further discussions with Mr. Wortley resulted in the identification of two other potential sites near Long's Creek and behind the White River Inn. The site at Long's Creek apparently has several buried drums whose contents are unknown, and the site behind the White River Inn reportedly was the location of a large oil pipeline spill.

Conclusions

Based on the findings of the site investigation, the following conclusions can be made:

- a) Little evidence remains from past activities on the site. Two cleared areas and two borrow pits were the only evidence remaining.
- b) The refuse identified in the earlier report appears to have been removed from the site to the Beaver Creek landfill.



LEGEND

Tree Line
 Surface Water Flow

Scale 1:2000 (approximate)

0 10 20 40 60 metres

Drawn By: B. Babine
 Project No. 84776
 Site Name: AES Standing Offer
 File Name: E5195776\776-ALL

SKETCH MAP
BEAVER CREEK

AES Standing Offer
 Site Assessments

Garthner
 Lee

Figure No. 3

PHOTOGRAPHS - BEAVER CREEK

96-776

PHOTOGRAPH 1



Access to site from Alaska Highway.

PHOTOGRAPH 2



Gravel access road through site.

PHOTOGRAPHS - BEAVER CREEK

96-776

PHOTOGRAPH 3



West side of borrow pit area.

PHOTOGRAPH 4



East side of borrow pit area.

PHOTOGRAPHS - BEAVER CREEK

96-776

PHOTOGRAPH 5



Investigating former refuse area with metal detector.

PHOTOGRAPH 6



Beaver Creek looking southwest.

- c) There were no indications of any residual contamination resulting from previous site activities.
- d) Two other local sites were mentioned by the local RMO as requiring further investigation.

Recommendations

The following recommendations can be made based on the conclusions outlined above:

- a) Based upon the site observations, no further investigation of this site is warranted.
- b) Based on input provided by the local RMO, follow-up work on two other local sites should be considered owing to the unknown nature of contents and / or volumes of the materials involved.

3.2 HAINES ROAD

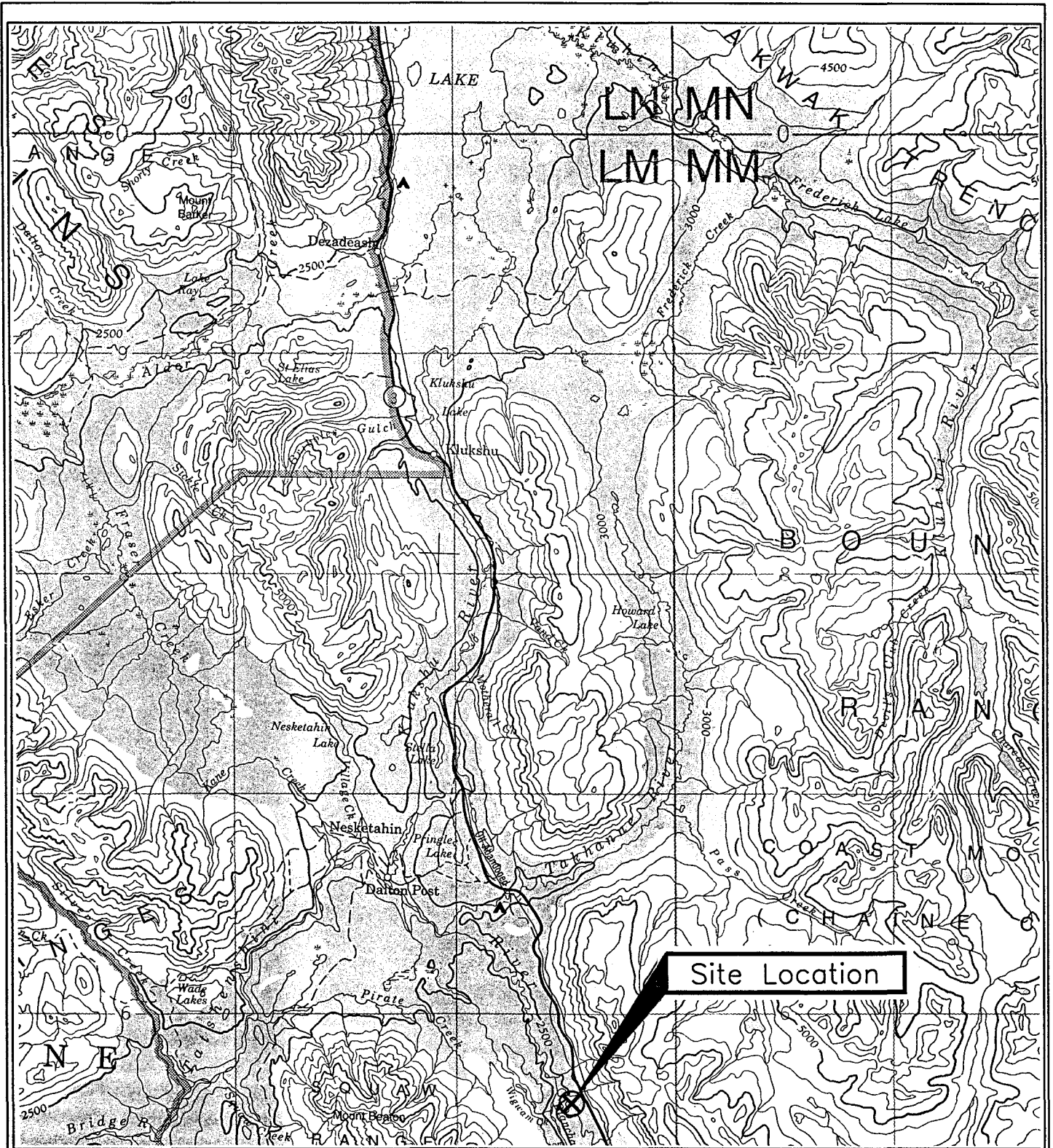
Background

This site identified as Site 48 in the initial Yukon AES Waste Site Inventory, has now been assigned the Waste Site Number HJ044. The site is located at km 148.8 of the Haines Highway, just north of the British Columbia-Yukon border. The site location is shown in Figure 4. This site was assigned as a priority site for investigation because an automobile service station once occupied the site.

Little is known of the history of this site except that it operated from 1968 to approximately 1976. The site has been abandoned for several years and several attempts were made to contact individuals familiar with the site with limited success. According to unverified anecdotal information, human remains are buried somewhere on site.

Site Description and Field Observations

The site is located adjacent to an abandoned section of the old Haines Road, approximately 75 m west of the new Haines Highway (see Figure 5 - Site Sketch Map and Photograph 7). The property slopes gently to the west and is bordered by steep tree covered slopes to the north and west. To the south, a small gully separates the site from a cleared area.

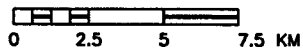


LEGEND

⊗ SITE LOCATION

Source:
NTS 115A EDITION 2

SCALE 1:250,000



HAINES ROAD LOCATION MAP

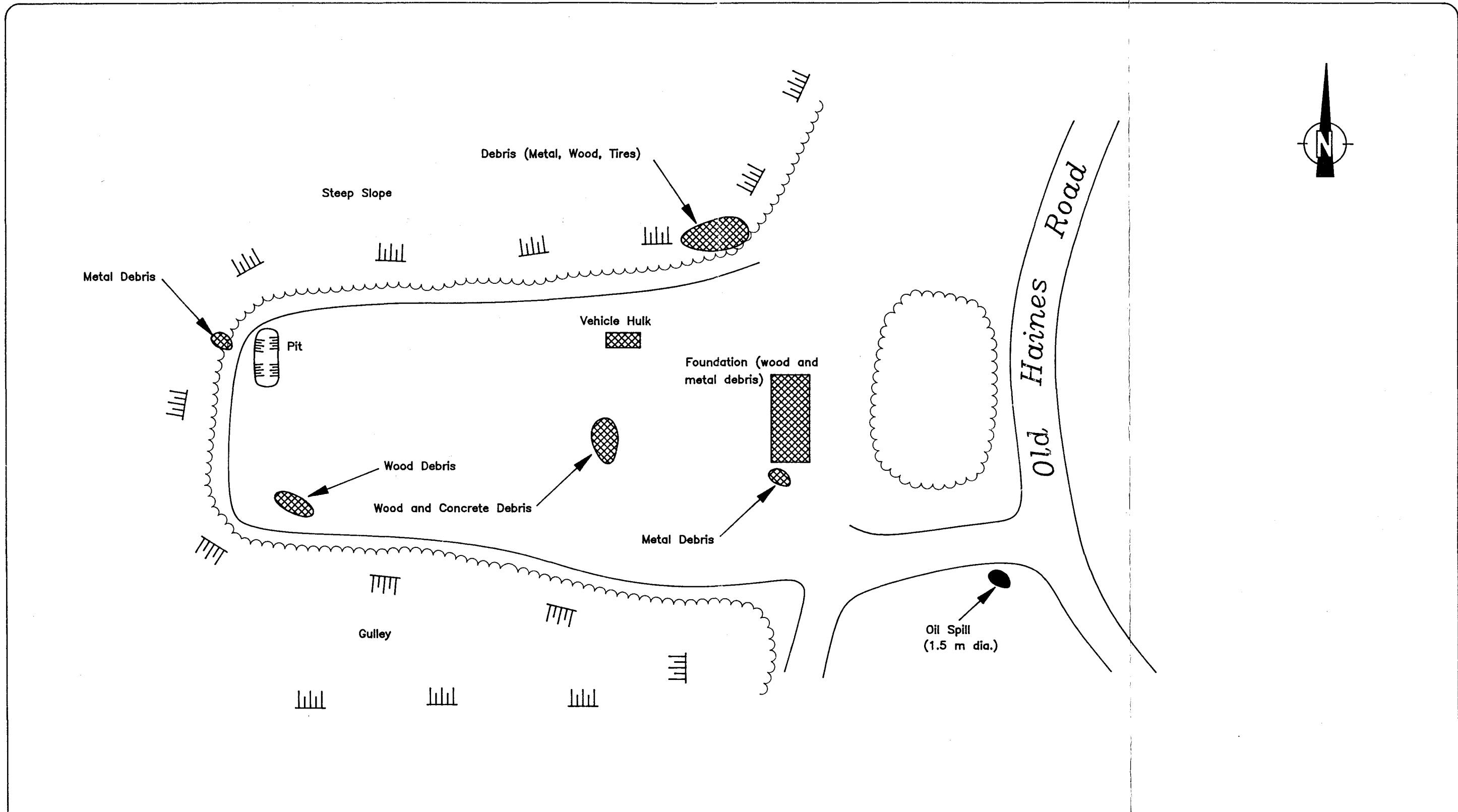
AES Standing Offer
Site Assessments

Drawn By: B. Belzoc Project No. 96776
Site Name: AES Standing Offer File Name: D:\96776\776-HAIN






Figure No.

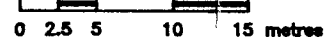
4



LEGEND

-  Debris
-  Slope
-  Tree Line

Scale 1:500 (approximate)



**SKETCH MAP
HAINES ROAD**

AES Standing Offer
Site Assessments

Figure No.

5

Drawn By: B. Baboo Project No. 96776
Site Name: AES Standing Offer File Name: EA96776/776-ALL



PHOTOGRAPHS - HAINES ROAD

96-776

PHOTOGRAPH 7



The site as viewed from the Haines Highway, looking west. Note old Haines Road in foreground.

PHOTOGRAPH 8



The site looking west. Remnants of old foundation are located in centre of photograph.

PHOTOGRAPHS - HAINES ROAD

96-776

PHOTOGRAPH 9



Looking west downslope. Note pit near right centre of photograph.

PHOTOGRAPH 10



Old vehicle hulk and concrete and wood debris. Looking west.

PHOTOGRAPHS - HAINES ROAD

96-776

PHOTOGRAPH 11



Metal debris and cans pushed over bank along north edge of site.

PHOTOGRAPH 12



Brush covered foundation in foreground. Note old engine in centre of photograph. Looking south.

PHOTOGRAPHS - HAINES ROAD

96-776

PHOTOGRAPH 13



Close-up view of pit near northwest corner of site.

PHOTOGRAPH 14



Metal debris in base of pit. Note gravelly soils.

The Blanchard River is located approximately 300 m west of the site.

The site is mostly clear of vegetation and has a sand and gravel surface (Photographs 8 and 9). Many small piles of debris (metal, wood, concrete, tires) are scattered about the site with two areas of debris also pushed over the banks of the slopes (Photographs 10 and 11). A single vehicle hulk is located within the cleared area as is the burnt remnants of a building (Photograph 12).

A 7 m x 8 m pit containing a small amount of metal debris is located in the northwest corner of the site (Photographs 13 and 14). The origin of this pit is unknown but its isolation from the main building would suggest that it is not the site of the service station's underground storage tanks (USTs).

A metal detector was used during the site walkover to detect the presence of any USTs or buried debris. None were detected, and visual signs of contamination were limited to a 1.5 m diameter area of surficial oil staining located at the southwest corner of where Old Haines Road meets the site access road.

The local RMO, John Jennings, was contacted in an attempt to determine if the USTs had been removed; however, he had no information on the site. We were then advised that the original owner, Bill Brewster, still lived in Haines Junction and attempted to contact him without success.

Geology/Hydrogeology

Regional mapping of the area shown on Geological Survey of Canada Map 15-1981 (Rampton and Paradis, 1979) indicates that the site is located on a kame terrace and that the shallow surficial geology is comprised of sand and gravel up to 60 m in thickness, with minor silt occurrences. These sediments were deposited by meltwaters flowing from a glacier, which once occupied this valley.

Visual observations of the site and in the excavated pit located in the northeast corner of the site confirm the regional mapping.

The depth to ground water beneath the site is inferred to be at least 30 to 50 m below the surface. The permeable nature of the sediments and the location of the terrace on the edge of the valley would tend to result in a deep water table. The ground water flow direction is inferred to be to the west towards the Blanchard River.

Conclusions

Based on the findings of the site investigation, the following conclusions can be made:

- a) An automobile service station was once located on the site.
- b) Areas of metal and wood debris as well as a burnt foundation are all that remain as evidence of past activities.
- c) There is anecdotal evidence of human remains buried on the site.
- d) There appear to be little to no physical impacts on the site from past activities; however, the remaining debris results in minor aesthetic impacts.

Recommendations

The following recommendations are made based on the conclusions outlined above:

- a) No further environmental investigation of this site is warranted.
- b) The remaining debris should be removed or buried on site; however, burial should be initiated only after the possibility of disturbing human remains on the site is duly considered.
- c) During site clean-up, the small oil stained area should be scarified using the heavy equipment.

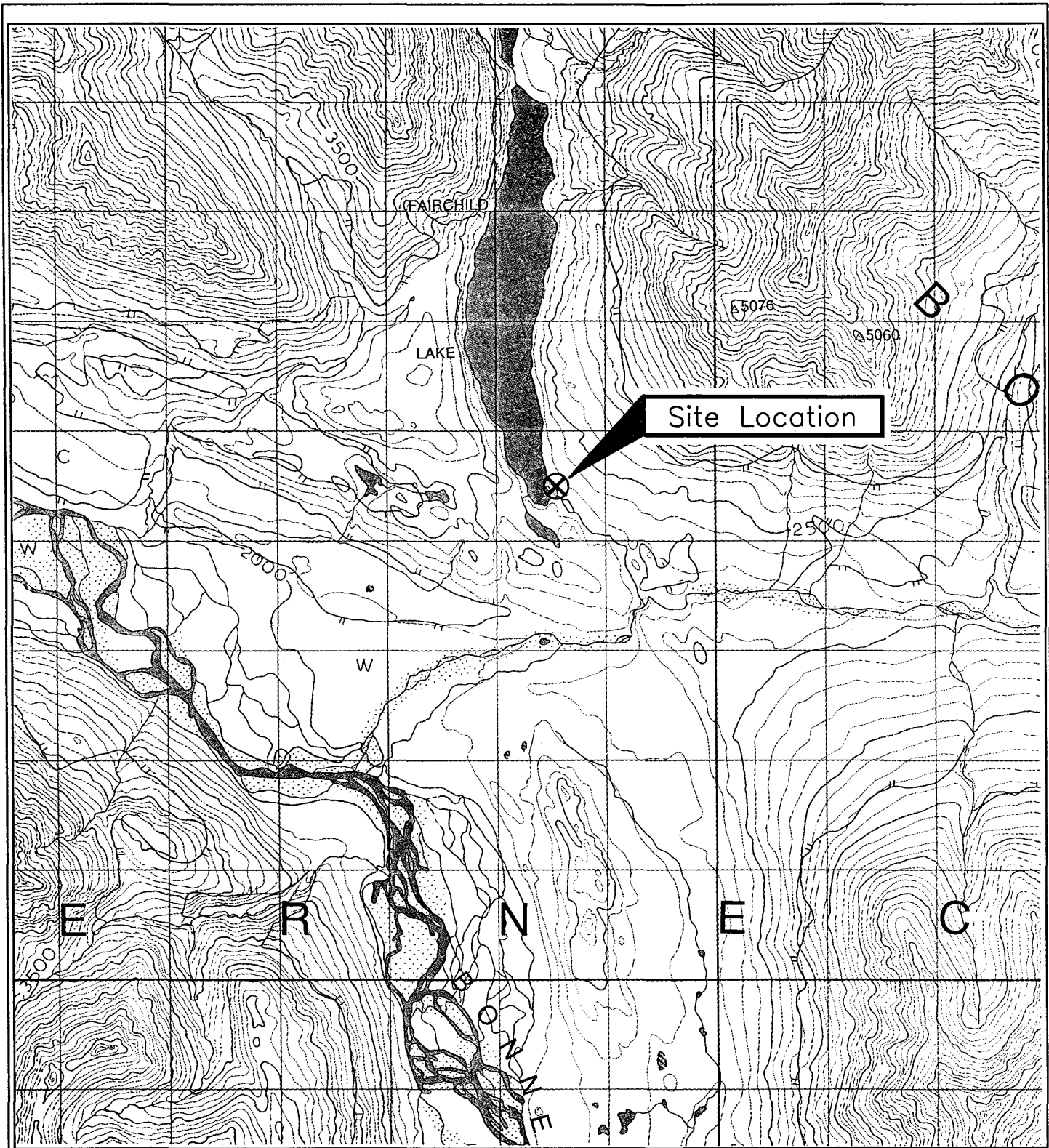
3.3 FAIRCHILD LAKE

Background

The Fairchild Lake site, identified as Site 26 in the initial Yukon AES Waste Site Inventory, has now been assigned the Waste Site Number MA026. The site is located approximately 150 km northeast of Mayo (see Figure 6 and Photographs 15 and 16) in the Bonnet Plume area.

This site was the location of a fuel cache used by mining exploration companies and local outfitters. Approximately 185 drums of varying types of fuels (Jet fuel B, stove oil, diesel) were dropped in a small muskeg meadow on the eastern shore of Fairchild Lake during the 1960's.

An inventory of the site was conducted in 1990 by AES staff inspector, D. White, and it was reported that all the drums were full and dated. Some of the drums were reported as leaking.

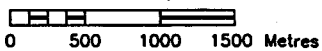


LEGEND

⊗ SITE LOCATION

Source:
NTS 106 C/13 EDITION 1

SCALE 1:50,000



FAIRCHILD LAKE LOCATION MAP

AES Standing Offer
Site Assessments



Figure No.

6

Drawn By: B. Belzoc

Project No. 96776

Site Name: AES Standing Offer

File Name: D:\96776\776-FAIR

PHOTOGRAPHS - FAIRCHILD LAKE

96-776

PHOTOGRAPH 15



The south end of Fairchild Lake, looking east.

PHOTOGRAPH 16



Fairchild Lake, looking north. Site is located by wooden dock along east shoreline.

It was recommended that all of the fuel drums be removed to Mayo as soon as possible and this apparently was carried out in the summer of 1994.

Residual contamination from leaked fuels was a concern at the site and those concerns made this site a priority for investigation.

Site Description and Field Observations

The site is located in a flat meadow, at the base of a west facing slope, near the southeast end of Fairchild Lake (Figure 7 and Photographs 17 and 18). The slope is gentle and to the west towards the lake. Most of the original trees appear to have been removed from the site and the site is currently vegetated with small coniferous trees and brush.

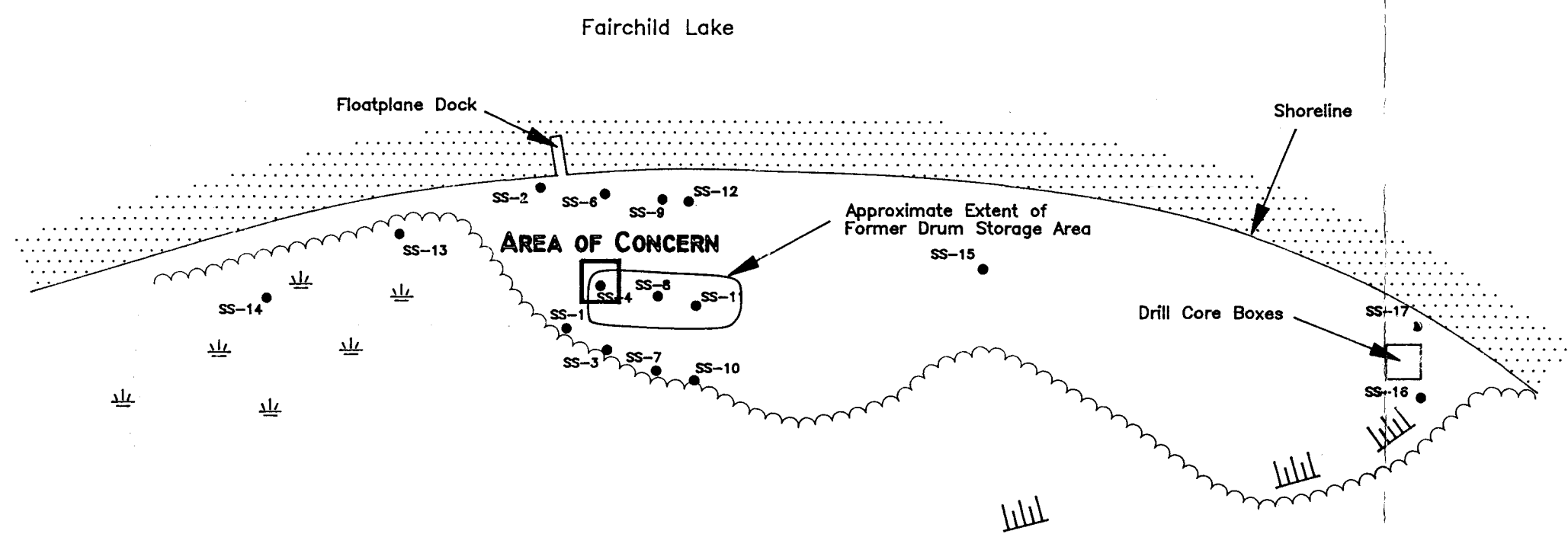
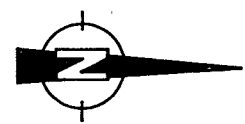
The slope of the shoreline steepens to the north. To the south, the ground surface becomes very wet and continues to the lake's outlet to the Bonnet Plume River. To the east, the topography rises moderately, then steeply to a north-south trending ridge.

At the north end of the site, there is a large stack of wooden drill core boxes, complete with core samples (Photographs 19 and 20), and a few small areas of wooden debris. Near the south end of the site, where the fuel drums had been located, there was an area devoid of vegetation with ground water at surface (Photographs 21 and 22). Within the unvegetated area, evidence of leaked fuel was observed as a hydrocarbon sheen on the ground water and a noticeable odour emanating from the soils (Photographs 22, 23 and 24). This area of impacted soils and ground water appeared to be limited to the area shown on the Site Plan (Figure 7) as "Area of Concern".

Sampling and Field Screening

Soil samples were collected in a grid fashion around the area visually impacted by the leaked fuels. Grab samples were also collected from around the core boxes and from other areas of the site. Sampling locations are shown on the Site Plan.

The soil samples were collected and screened in the field for the occurrence of volatile organic vapours using a photoionization detector (PID). Sampling and field screening methodologies are provided in the Appendix.



- LEGEND**
- SS-1 ● Soil Sampling Location
 - ≡ Swamp/Bog
 - ▮ Slope
 - ⌋ Tree Line

Scale 1:1000 (approximate)

0 5 10 20 50 metres

SKETCH MAP FAIRCHILD LAKE

AES Standing Offer
Site Assessments

Drawn By: B. Baboo
Site Name: AES Standing Offer

Project No. 09776
File Name: ES_09776_776-ALL



Figure No.
7

PHOTOGRAPHS - FAIRCHILD LAKE

96-776

PHOTOGRAPH 17



The site as it appeared in 1994 with fuel cache at south end. Looking north. (Photograph courtesy of Bill Leary).

PHOTOGRAPH 18



The Fairchild Lake site as it appeared at time of site investigation, September 1996. Looking north.

PHOTOGRAPH 19



Aerial view of drill core boxes located at northend of site. Looking west.

PHOTOGRAPH 20



Close-up of drill core boxes at north end of site

PHOTOGRAPHS - FAIRCHILD LAKE

96-776

PHOTOGRAPH 21



Aerial view over affected area of site. Note lack of vegetation in area at centre of photograph.

PHOTOGRAPH 22



Close-up of affected area with soil sample being collected by First Nations student.

PHOTOGRAPHS - FAIRCHILD LAKE

96-776

PHOTOGRAPH 23



Close-up of hydrocarbon sheen on ground water at surface.

PHOTOGRAPH 24



Close-up of site soils in small hand dug test hole.

Only two samples, both from the visually impacted area, had organic vapour concentrations which indicated the presence of contamination (Sample 5 is a duplicate of Sample 4). The results of the field screening are presented below in Table 1.

Table 1 Field Screening Results: Fairchild Lake

Sample	PID Reading (ppm)
1	6.4
2	6.3
3	6.7
4	341
5	328
6	130
7	7.8
8	6.7
9	4.9
10	3.7
11	4.9
12	3
13	3.6
14	3.2
15	4.2
16	5.1
17	4.3

Note: Sample 5 is a duplicate of Sample 4.

Three sediment samples from along the lakeshore were also collected and visually observed for signs of hydrocarbon contamination. There were no indications of contamination in either of the samples. Also, no hydrocarbon sheen was observed in the lake water along the shoreline.

Soil Chemistry

Ten soil samples were submitted to the analytical laboratory for analysis. The samples were analyzed for BTEX (benzene, toluene, ethylbenzene, xylenes) and LEPH/HEPH (light and heavy extractable petroleum hydrocarbons). The complete analytical results are summarized in Table 2, and the laboratory data is presented in Appendix B.

Table 2 Soil Chemistry Results

Sample Information	Benzene	Toluene	Ethyl - benzene	Xylenes	LEPH ⁴ (C ₁₀ - C ₁₈)	HEPH ⁴ (C ₁₉ - C ₃₂)
CMCS Park Land ²	0.5	3	5	5	1000	1000
CMCS Commercial ²	5	30	50	50	2000	5000
Special Waste ³	100	100	100	100		
FL SS-3	< 0.01	< 0.01	< 0.01	< 0.01	< 250	< 250
FL SS-4	< 0.01	< 0.01	< 0.01	< 0.01	42000	6400
FL SS-6	< 0.01	< 0.01	< 0.01	< 0.01	< 250	< 250
FL SS-7	< 0.01	< 0.01	< 0.01	< 0.01	< 250	< 250
FL SS-8	< 0.01	< 0.01	< 0.01	< 0.01	< 250	< 250
FL SS-9	< 0.01	< 0.01	< 0.01	< 0.01	< 250	< 250
FL SS-11	< 0.01	< 0.01	< 0.01	< 0.01	< 250	< 250
FL SS-12	< 0.01	< 0.01	< 0.01	< 0.01	< 250	< 250
FL SS-13	< 0.01	< 0.01	< 0.01	< 0.01	< 250	< 250
FL SS-15	< 0.01	< 0.01	< 0.01	< 0.01	< 250	< 250

Notes 1 All values in mg/kg (ppm).

2 CMCS = Criteria for Managing Contaminated Sites in B.C. (Draft 7), July 1995.

3 Special Waste refers to the standards in the Special Waste Regulation of the Waste Management Act (April, 1992).

4 Investigation criteria listed in B.C. Environment's memorandum "New Petroleum Hydrocarbon Criteria for Contaminated Sites", August 25, 1995.

LEPH = light extractable petroleum hydrocarbons; HEPH = heavy extractable petroleum hydrocarbons.

5 Shaded areas indicate concentrations which exceed Park Land and Commercial Land criteria.

Only one of the ten soil samples analyzed for the above mentioned parameters indicated a concentration which was above the analytical detection limits. Sample FL SS-4 had concentrations of LEPH and HEPH above the B.C. Park Land criteria.

Discussion

The results from the field screening of the soil samples indicates that a small area of residual contamination from spilled or leaked fuels exists on the site. This area is highlighted on the Site Plan. The organic vapour concentrations do not indicate that gross contamination of the shallow soils has occurred, and the absence of vegetation in the impacted area is likely attributable to the length of time that drums were stored in this area and the short rehabilitation time which has passed since their removal in 1994.

The PID reading from Sample 6 indicates that either a spill had occurred near the lakeshore, or that some contaminant migration has occurred. However, the analytical results did not detect measurable concentrations of any contaminants in the soil.

The analytical results of soil sample FL SS-4 show concentrations of LEPH and HEPH to exceed B.C. Park Land criteria. The analytical results also support the trend observed in the field screening that the shallow soil contamination appears to be confined to a limited area and that significant migration towards the lake has not occurred.

The absence of any clear indications of contaminant migration is likely the result of naturally occurring site conditions. The organic nature of the soil and the propensity of organic soils to bind or adsorb petroleum hydrocarbons likely has played a large role in preventing migration. Also, the presence of ground water very near the surface of the site and the shallow depth to the underlying till precludes the occurrence of a deep soil plume.

Conclusions

Based on the findings of the site investigation, the following conclusions can be made:

- a) The south end of the site has been impacted from past usage as a fuel cache. There are no fuel drums remaining on the site.
- b) The analytical results indicate that the contamination from the fuel cache is limited to one area and that migration towards the lake has not occurred.
- c) No evidence of impacts to the lake were suspected or observed.
- d) Impacts from attempts to remove the affected soils would likely be greater than contaminant impacts on the surrounding area. Mobilizing equipment to the site and stripping the overlying organic soils would greatly affect the site conditions.
- e) Presence of drill core boxes does not pose a significant environmental concern.

Recommendations

The following recommendation is made based on the conclusions outlined above:

Depending on the clean-up objectives of AES and the local First Nations, the isolated area of soil contamination could be dealt with in either of the following two manners:

- a) The impacted soils could be left in place to eventually bioremediate themselves over time. This will minimize any further aesthetic impacts to the site.

- b) The impacted soils around the FL SS-4 sample location could be dug up by hand and removed from the site. A two man crew could be mobilized to the site to excavate the contaminated area with shovels. The excavated material could then be placed in one or two steel drums and removed from the site. A composite sample of the soil in the drum should then be collected and analyzed to determine the appropriate disposal method or location.

Currently, there are no requirements to store and/or remove drill core on federal Crown land. Therefore, there is no need for immediate action. However, upon implementation of Mining Land Use Regulations (MLUR), the existence of drill core on mineral properties will become regulated.

Report prepared by:



Terry Duffy, B.S.c
Hydrogeologist

4.0 REFERENCES

The following references were used in preparing this report:

- ♦ B.C. Ministry of Environment, July 1995. *Criteria for Managing Contaminated Sites (CMCS) in British Columbia (draft seven)*.
- ♦ B.C. Ministry of Environment, April 1992. *Special Waste Regulation*.
- ♦ B.C. Ministry of Environment Memorandum, August 1995. *New Petroleum Hydrocarbon Criteria for Contaminated Sites*.
- ♦ Environment Canada, March 1992. *Technical Assistance Bulletins (TABs) on Contaminated Sites*.
- ♦ NTS Maps 115A, 115K/7, 106C/13.
- ♦ Rampton, V.N. and Paradis, S. 1979. *Surficial Geology and Geomorphology, Frederick Lake, Yukon Territory*. Geological Survey of Canada Map 15-1981.

APPENDICES

APPENDIX A

METHODOLOGIES

APPENDIX A - METHODOLOGIES

The following section outlines the field methodologies used during the preliminary Environmental Site Investigations.

A-1.0 TESTING

A photoionization detector (PID) was utilized to screen soil and vapour samples on site, thereby providing an immediate indication of petroleum contamination. The instrument used was a portable organic vapour meter manufactured by Thermo Environmental Instruments Inc. (Model 580B). It is capable of detecting and quantifying most organic vapours relative to an isobutylene standard (100 ppm). The instrument has an operating range of 0-2000 parts per million (ppm) with a minimum detection limit of 0.1 ppm.

The PID provides a semi-quantitative method for assessing the relative degree of volatile hydrocarbon contamination between samples. Soil samples can then be screened in the field and selected samples submitted for analytical testing.

Selected soil samples were submitted to CanTest Ltd. Soil samples were analyzed for all of the following parameters:

BTEX (benzene, toluene, ethylbenzene, xylene) was analyzed as an indicator of petroleum hydrocarbon contamination, especially contamination associated with gasoline and other lighter end fuels. There are established environmental criteria for BTEX based on land use in federal and provincial guidelines.

LEPH (light extractable petroleum hydrocarbons) was analyzed as a gross parameter, investigative scan for petroleum hydrocarbons in the range of C₁₀ to C₁₉. The test is recommended in a memorandum from B.C. Environment regarding "New Petroleum Hydrocarbon Criteria for Contaminated Sites" (August 25, 1995). The LEPH results are provided with a gas chromatograph helpful in trying to identify or finger-print specific types of hydrocarbon contamination.

HEPH (heavy extractable petroleum hydrocarbons) is similar to LEPH, except that it detects heavier end petroleum hydrocarbons in the range of C₁₉ to C₃₂.

A-2.0 SOIL SAMPLING

Shallow soil samples were collected using a small metal trowel. Samples were placed in sterile, 125 ml glass jars with Teflon-lined lids. At each sampling interval, two jars were collected: one filled to capacity with no head space; the second only half filled. The full jar was placed in a cooler with ice and submitted to the analytical laboratory. Soil vapours in the second jar, only half full, were analyzed on-site with the PID according to the Jar Head Space Procedure described in Environment Canada's Technical Assistance Bulletin (TAB) No. 1

Trowels were cleaned with water and detergent, and rinsed with clean water after each soil sample was taken.

APPENDIX B

ANALYTICAL DATA

Analysis Report

CANTEST

CanTest Ltd

Professional
Analytical
Services

1523 West 3rd Ave
Vancouver, BC
V6J 1J8

Fax: 604 731 2386

Tel: 604 734 7276

1 800 665 8566

REPORT ON: Analysis of Soil Samples

REPORTED TO: Gartner Lee Limited
Suite 490
6400 Roberts Street
Burnaby, B.C.
V5G 4C9

Att'n: Mr. Terry Duffy

CHAIN OF CUSTODY: 19391, 19392, 19393
PROJECT NUMBER: 96-776



NUMBER OF SAMPLES: 10

REPORT DATE: December 4, 1996

DATE SUBMITTED: November 28, 1996

GROUP NUMBER: 6112833

SAMPLE TYPE: Soil

TEST METHODS:

Volatile Organic Compounds in Water and Soil - analysis was performed using procedures based on U.S. EPA Methods 624/8240/8260, involving sparging with a Purge and Trap apparatus and analysis using GC/MS.

Extractable Petroleum Hydrocarbons in Water/Soil (LEPH/HEPH-GNS) - analysis was performed using a draft DCM extraction-GC/FID procedure specified by the B.C. MOELP. Compounds eluting between n-decane (n-C10) and n-nonadecane (n-C19) are defined as Light Extractable Petroleum Hydrocarbons (LEPH). Compounds eluting between n-nonadecane and n-dotriacontane (n-C32) are defined as Heavy Extractable Petroleum Hydrocarbons (HEPH). These results can be compared to Generic Numerical Standard (GNS) criteria. The results may or may not be corrected for specified PAH's, as noted on the report.

TEST RESULTS:

(See following pages)

CAN TEST LTD.

Matthew Hartley, M.Sc.
Supervisor, Trace Organics

Page 1 of 7



REPORTED TO: Gartner Lee Limited



REPORT DATE: December 4, 1996

GROUP NUMBER: 6112833

Monocyclic Aromatic Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	FL SS-3	FL SS-4	FL SS-6	FL SS-7	
CAN TEST ID:	611280180	611280181	611280183	611280184	DETECTION LIMIT
ANALYSIS DATE:	Dec 1/96	Dec 1/96	Dec 1/96	Dec 1/96	
Benzene	<	<	<	<	0.01
Ethylbenzene	<	<	<	<	0.01
Toluene	<	<	<	<	0.01
Xylenes	<	<	<	<	0.01
1,3,5-Trimethylbenzene	<	0.54	0.02	<	0.01
Surrogate Recovery					
Toluene-d8	83	84	101	101	-
Bromofluorobenzene	105	93	100	89	-

Results expressed as micrograms per gram, on a dry weight basis. ($\mu\text{g/g}$)

Surrogate recoveries expressed as percent (%)

< = Less than detection limit



REPORTED TO: Gartner Lee Limited



REPORT DATE: December 4, 1996

GROUP NUMBER: 6112833

Monocyclic Aromatic Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	FL SS-8	FL SS-9	FL SS-11	FL SS-12	
CAN TEST ID:	611280185	611280186	611280187	611280188	DETECTION LIMIT
ANALYSIS DATE:	Dec 1/96	Dec 1/96	Dec 1/96	Dec 1/96	
Benzene	<	<	<	<	0.01
Ethylbenzene	<	<	<	<	0.01
Toluene	<	<	<	<	0.01
Xylenes	<	<	<	<	0.01
1,3,5-Trimethylbenzene	<	<	<	<	0.01
Surrogate Recovery					
Toluene-d8	85	92	87	84	-
Bromofluorobenzene	104	104	97	106	-

Results expressed as micrograms per gram, on a dry weight basis. ($\mu\text{g/g}$)

Surrogate recoveries expressed as percent (%)

< = Less than detection limit



REPORTED TO: Gartner Lee Limited



REPORT DATE: December 4, 1996

GROUP NUMBER: 6112833

Monocyclic Aromatic Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	FL SS-13	FL SS-15	
CAN TEST ID:	611280189	611280190	DETECTION LIMIT
ANALYSIS DATE:	Dec 1/96	Dec 1/96	
Benzene	<	<	0.01
Ethylbenzene	<	<	0.01
Toluene	<	<	0.01
Xylenes	<	<	0.01
1,3,5-Trimethylbenzene	<	<	0.01
Surrogate Recovery			
Toluene-d8	84	81	-
Bromofluorobenzene	104	102	-

Results expressed as micrograms per gram, on a dry weight basis. ($\mu\text{g/g}$)

Surrogate recoveries expressed as percent (%)

< = Less than detection limit



REPORTED TO: Gartner Lee Limited



REPORT DATE: December 4, 1996

GROUP NUMBER: 6112833

Extractable Petroleum Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	FL SS-3	FL SS-4	FL SS-6	FL SS-7	DETECTION LIMIT
CAN TEST ID:	611280180	611280181	611280183	611280184	
LEPH-uncorrected for PAH's	<	42000	<	<	250
HEPH-uncorrected for PAH's	<	6400	<	<	250

Results expressed as micrograms per gram, on a dry weight basis. ($\mu\text{g/g}$)

< = Less than detection limit



REPORTED TO: Gartner Lee Limited



REPORT DATE: December 4, 1996

GROUP NUMBER: 6112833

Extractable Petroleum Hydrocarbons in Soil

CLIENT SAMPLE IDENTIFICATION:	FL SS-8	FL SS-9	FL SS-11	FL SS-12	DETECTION LIMIT
CAN TEST ID:	611280185	611280186	611280187	611280188	
LEPH-uncorrected for PAH's	<	<	<	<	250
HEPH-uncorrected for PAH's	<	<	<	<	250

Results expressed as micrograms per gram, on a dry weight basis. ($\mu\text{g/g}$)

< = Less than detection limit



REPORTED TO: Gartner Lee Limited

REPORT DATE: December 4, 1996

GROUP NUMBER: 6112833



CanTest Ltd

Professional
Analytical
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Extractable Petroleum Hydrocarbons in Soil

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Tel: 604 734 7276

1 800 665 8566

CLIENT SAMPLE IDENTIFICATION:	FL SS-13	FL SS-15	DETECTION LIMIT
CAN TEST ID:	611280189	611280190	
LEPH-uncorrected for PAH's	<	<	250
HEPH-uncorrected for PAH's	<	<	250

Results expressed as micrograms per gram, on a dry weight basis. ($\mu\text{g/g}$)

< = Less than detection limit

