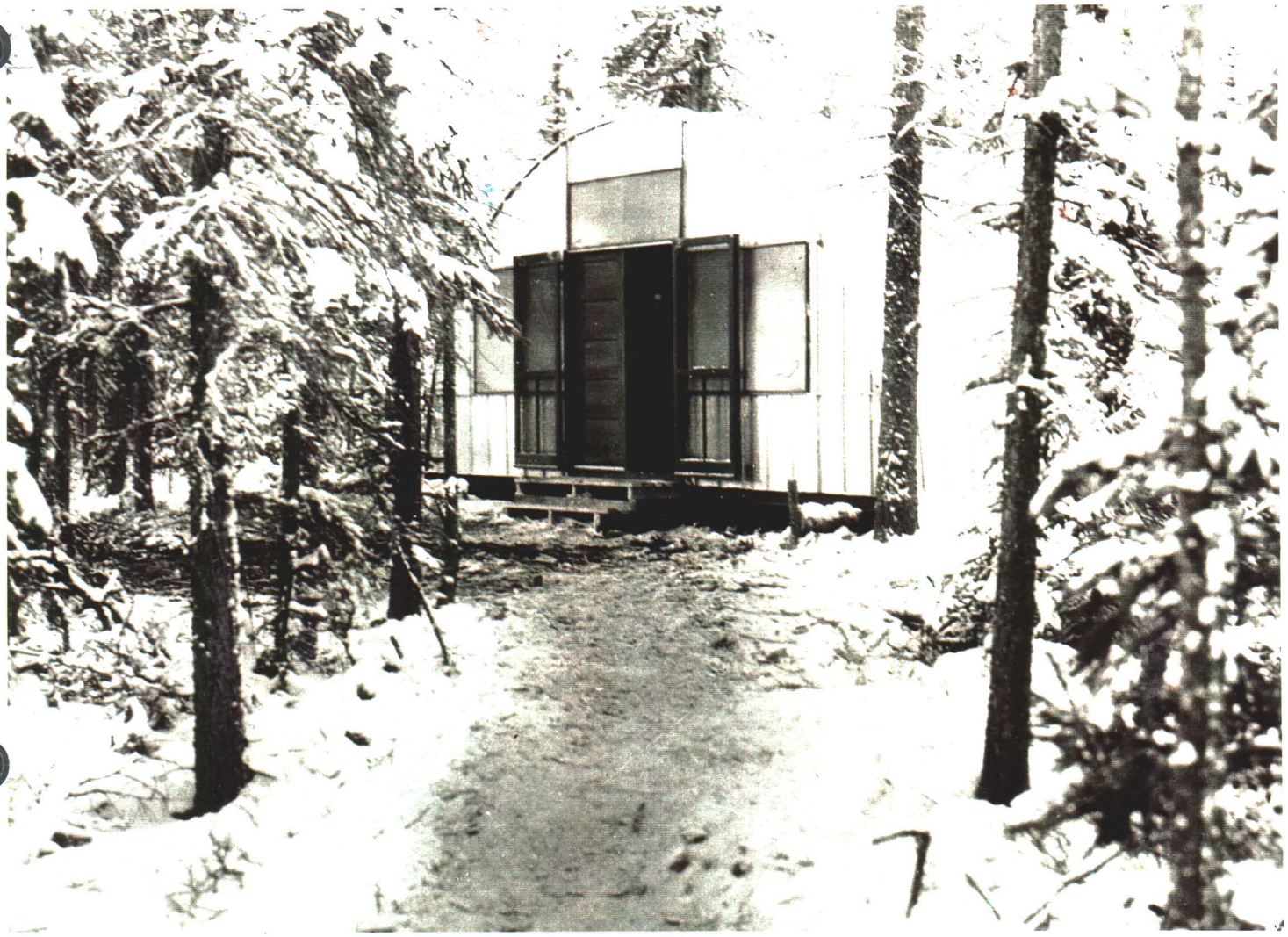
Phase I & II Environmental Site Assessment



Former Military Site
Koidern - White River
Mile Post 1164 - 1167 Alaska Highway
(DIAND Site 33)

Prepared for:

Arctic Environmental Strategy - Action on Waste
Indian and Northern Affairs Canada
Whitehorse, Yukon

Prepared by:

Hycal ENVIRONMENTAL SCIENCES LTD.

November 1996

EXECUTIVE SUMMARY

Hycal Environmental Sciences Ltd. was retained by Action on Waste, Arctic Environmental Strategy, Indian and Northern Development, Canada to carry out an environmental assessment of a former military site, known as "Site 33" or Koidern - White River, in the western Yukon Territory.

Site 33 comprises 3 separate sites:

MP 1164	Koidern River Lodge aka Koidern River #2
MP 1166	Canol Pump Station G
MP 1167.5	Bear Flats-White River Lodge (Camp O'Hara)

The purpose of the investigation was to gather preliminary information on the site in order to determine whether further site assessment or remediation is required and to make recommendations on future assessments or remediation, where necessary. Previous reports indicated that debris was present on the site and there was the possibility of some environmental concerns related to the property.

The investigation consisted of six tasks:

1. Historical Site Assessment
   A history of the site was developed to provide an understanding of the past uses of the site and adjacent properties, to identify conditions or events which could have adversely affected the site, and to facilitate site location, inspection, and sampling.

2. Site Inspection
   The site was visually inspected to identify conditions of environmental concern including signs of surface contamination, evidence of the use or storage of hazardous materials, the presence of equipment or materials that might contain PCBs, indications of pits or sumps, indications of waste incineration, and conditions of concern on adjacent properties.

3. Site Sampling
   Soil sampling was carried out to confirm the presence or absence of contaminants. Geophysical investigation was carried out to determine whether buried metal debris was present on the site.

4. Sample Analysis
   Soil samples from the subject site was analyzed for the presence of contaminants which have been associated with military activities in the Yukon.

5. Risk Assessment
   A preliminary risk evaluation was carried out to determine the degree of risk to humans, or to the environment in general, that might be associated with conditions identified on the site.

6. Recommendations for Further Investigation / Remediation
   Methods and results of each of the tasks undertaken were documented. Recommendations for further investigation were then developed.

Investigation of the subject site was limited by the scope of the study, including the allocated budget and time. Further investigation would be required to more fully assess all of the areas within the site or to allow for more precise risk analysis. However, given the results of the investigation, the following conclusions and recommendations can be offered:

- the investigation confirmed the presence of surficial and subsurface debris on the subject sites. Given the history of the sites and the visible materials, most of this material appears to have been related to military operations in the area during the construction of the Alaska Highway.

- while historical searches yielded some useful information, the site appear to have been subject to activities which were poorly or never documented. Therefore, **further historical record searches are not indicated at this time.**

- surficial metal and wood debris was evident on all of the sites. There was a minor amount of surficial debris at the Koidern Lodge Site and moderate amounts of debris at Canol Pump Station G and the Bear Flats - White River Lodge Site. **This debris does not appear to pose any imminent risk to human health or the environment and might be left on the sites.**

- some buried metal was identified at Canol Pump Station G.

- significant surficial metal was observed at the Bear Flats Site at MP 1167 and there were geophysical indications of buried metal at this site.

- due to time constraints, minimal geophysical data was collected at the Bear Flats Site at MP 1167.5. However, initial indications were that metal was present within the vicinity of several of the survey lines at MP 1167.5.

- while geophysical surveying indicated the presence of buried metal on the sites,. it is not known whether this metal includes any drums or canisters, and whether any contaminants might be present within these areas. The climate and age of the sites would suggest that any buried drums would have been subject to deterioration. **Leachate monitoring would provide information on potential migration from areas of buried metal with less damage to the ground surface than excavation of the metal would entail. Further geophysical work, to identify all major areas of metal burial should be conducted prior to planning the location of any monitoring wells.** Given current information, geophysical investigation (and subsequent leachate monitoring) at the Bear Flats - White River and Canol Pump Station G sites would be a higher priority than further geophysical investigation at the Koidern River Lodge Site.

- analysis of a soil sample from the northern edge of the Koidern River Lodge Site indicated the presence of barium, cadmium, chromium, cobalt, mercury, silver, tin, vanadium, and zinc in excess of CCME Assessment Criteria. Arsenic, copper, lead, nickel and selenium were found at levels exceeding CCME Residential / Parkland Remediation Criteria. The hydrocarbon level of the sample was found to be above the Alberta Tier 1 criterium for hydrocarbons.

- a soil sample from the area beside a pump station outlet at Canol Pump Station G was found to contain levels of nickel, vanadium and zinc in excess of CCME Assessment criteria but below CCME Remediation Criteria. Levels of chromium, lead, nickel, vanadium and zinc from the area beside a concrete foundation at the pump station were above CCME Assessment Criteria but were below CCME Remediation Criteria. Hydrocarbon levels in this sample were greater than Alberta Tier 1 criterium for hydrocarbons.

  a soil sample from one of the two oil change pits at the Bear Flats - White River Lodge Site was found to contain barium, cadmium, chromium, cobalt, mercury, tin and vanadium in excess of CCME Assessment Criteria, but below CCME Remediation Criteria. The levels of arsenic, copper, lead, nickel, selenium and zinc in this sample were above CCME Remediation criteria. Hydrocarbons in this sample exceeded the Alberta Tier 1 Criterium for hydrocarbons. No PCBs were detected in the sample.

- a background soil sample, taken from beside a borrow pit on the western side of the Bear Flats - White River Lodge Site, contained arsenic, chromium, cobalt, copper, nickel, vanadium, and zinc above CCME Assessment Criteria, but below CCME Remediation Criteria.

- **Given the large aerial extent of the sites and indications of the presence of contaminants above CCME Assessment Criteria on all three sites, further soil sampling and analysis would be required to confirm the results of the initial soil analyses and more adequately assess soil conditions on all of the sites.**

Preliminary risk evaluation suggests that the ecological risk associated with contaminants found on at all three sites is moderate to low. This conclusion is based upon the observed health of the ecosystem, relative concentration of contaminants and relative toxicity of the compounds found. However, information about surface and subsurface conditions on the site is limited. **If a greater level of confidence as to risks associated with the subject sites is required, further investigative work would be required and a Level 1 CCME Risk Assessment should be carried out**.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PHOTOGRAPHS

1. INTRODUCTION

1.1 Project Background

This investigation was carried out as part of investigations of abandoned waste and disposal sites throughout the Yukon by Action on Waste, Arctic Environmental Strategy, Indian and Northern Development, Canada. These sites were associated with activities such as exploration, mining, industrial and military operations.

The purpose of the investigations was to gather preliminary information in order to determine whether further site assessment or remediation is required and to make recommendations on future assessments or remediation, where necessary. A primary objective was to determine whether contaminants are present on the site, and if they are, whether they are migrating from the site. A secondary objective was to identify physical hazards. If contaminants were identified on the site, a preliminary risk assessment was to be carried out to determine the degree of risk to humans or the environment in general.

Hycal Environmental Sciences Ltd. (Hycal) was retained by Action on Waste, Arctic Environmental Strategy, Indian and Northern Development, Canada to carry out environmental assessment of four separate sites. This report outlines the investigation of one of these sites, known as "Site 33".

Site 33, also known as the Koidern - White River, is located in the western Yukon Territory, approximately 70 miles (113 kilometres) west of Burwash Landing, from Alaska Highway Mile Posts 1164 to 1167.5 (Figure 1).

Site 33 comprises 3 separate sites:

MP 1164	Koidern River Lodge aka Koidern River #2
MP 1166	Canol Pump Station G
MP 1167.5	Bear Flats-White River Lodge (Camp O'Hara)

A general discussion outlining methodology and history is followed by specific information on each of the three sites. Recommendations for the sites are then presented.

Limitations of the investigation are presented in Appendix A.

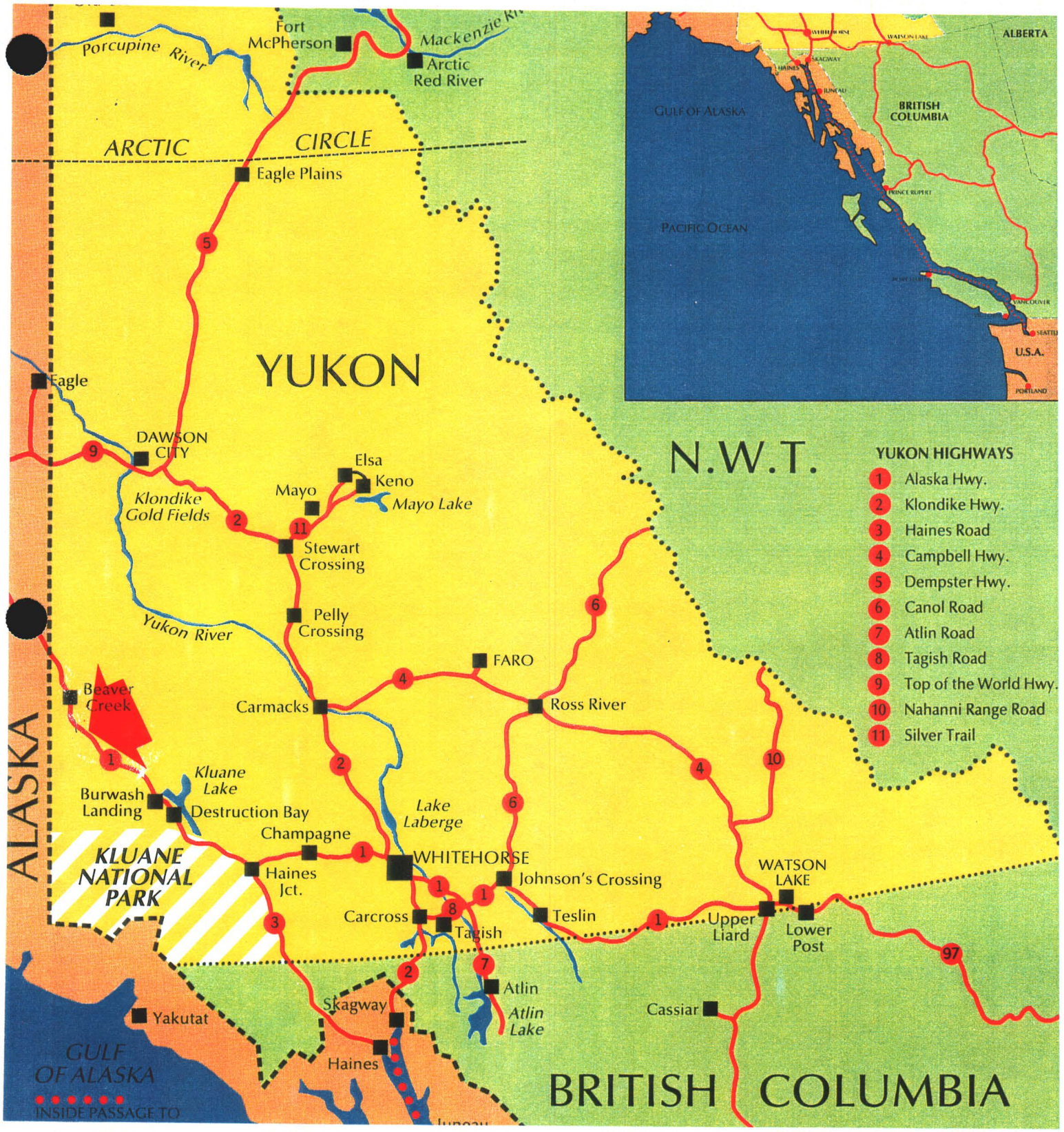


Figure 1. Site Location.

1.2 Previous Investigations

Previous investigations which have discussed the subject site have included:

- the Operation Clean Up Inventory (1973), which identified sites of environmental concern;
- a study on the Alaska Highway - Haines Road Clean Up (Edey, 1976), carried out for the Department of Indian and Northern Development, which included a sketch of the subject site identifying some wastes on the subject site;
- a Summary of Waste Disposal Sites in the Yukon Territory (Reger, 1983), prepared for Environmental Protection Service, Environment Canada, which identified land disposal sites in the Yukon;
- Gray's Alaska Highway Camp and Refuse Locations Preliminary Inventory, and
- a summary of previous work, interviews and historical research by Bisset (1995).

Relevant portions from the above work have been compiled in Appendix B.

Most of the previous work was very general and often repeated the same information. While previous work offered a start to investigation of the subject site, it was necessary to augment previously gathered material in order to more adequately assess the site.

2. SCOPE AND METHODOLOGY

2.1 Site Location and History

A review of records of previous investigations, aerial photographs, and historical material from the Yukon Archives, and interviews with area residents and the local wildlife officer were used to determine the location of the subject site. An investigator then proceeded to the approximate area of the site and carried out a reconnaissance of the area to pinpoint the exact location and access to the site.

2.2 Site Reconnaissance

Site reconnaissance was carried out by Hycal in September 1996 to determine:

- the precise location of the subject site;
- the aerial extent of the subject site;
- vegetative and topographic considerations in planning a sampling program and geophysical investigation;
- surficial evidence of site occupation; and
- a local wildlife and vegetation inventory.

The site reconnaissance was carried out during a period of "fall weather" prior to snow covering the subject site. Site visibility was good with only minor obscuring of some ground surface by deciduous leaves which had fallen from some trees.

2.3 Geophysical Investigation

Geophysical methods were used to supplement/augment other methods of site assessment. Geophysical investigation was indicated due to:

- the age of the sites and the possibility of vegetation and other materials obscuring and covering materials on the site;
- the site history in which materials were reported buried or bulldozed over;
- the metallic nature of some of the materials which would have buried;
- the extent of the sites and scope of the project precluding grid soil sampling and borehole investigations;

The time domain electromagnetic method is generally the preferred geophysical technique for the delineation of subsurface metals due to the speed of data acquisition, high sample density and relative insensitivity to adjacent surficial metals. However, relatively dense vegetation growth at many of the survey regions, precluded its use. At those sites where utilization of electromagnetic instrumentation was not feasible, the magnetic method was employed.

Electromagnetic Method

A time-varying electromagnetic (EM) field produced at surface results in currents flowing within subsurface conductors in configurations defined by the laws of magnetic induction. Resulting secondary EM fields distort the primary field. The resultant field, measurable at any point on the surface of the ground, differs from the primary field in intensity, phase and direction to an extent dependent on the magnitude and geometry of the subsurface conductor(s).

The Geonics Limited EM61 is a high-powered time domain EM metal detector. The decay of secondary currents produced by a pulsed primary field is measured a relatively long time after the primary pulse is terminated. This technique results in a method where results are essentially independent of ground conductivity. The use of two vertically displaced receiver coils enables a filtering, of sorts, of near-surface anomalies.

The EM61 survey data were collected at approximately 0.2 metre intervals along survey lines spaced 1 and 2 metres apart.

Results of the EM61 surveys are presented as coloured contour maps illustrating lateral variations in electromagnetic response (millivolts [mV]0 at each site area. The differential channel is the algebraic difference of the upper coil responses, resulting in partial filtering of near-surface sources. In general, upper coil response (Channel 1) is biased towards metallic objects occurring at shallow depth.

Total Magnetic Field Method

Magnetometers measure the intensity of the geomagnetic field. The geomagnetic field is comprise of two main parts:

- the earth's magnetic field; and
- local magnetic anomalies in the relatively near-surface. These consist of variations caused by geological features and by man-made magnetic objects.

Over relatively small areas, geological features contribute minimally to the geomagnetic field and local magnetic anomalies are generally entirely due to above surface magnetic/electromagnetic sources and to buried metal objects.

Dependent upon instrument and source coupling geometry, both positive and negative magnetic anomalies are significant in the identification of subsurface metals, as illustrated in Figure 2.

At those sites where magnetic methods were employed, a 5 metre by 5 metre survey grid was established. Total field measurements were subsequently recorded on a 2.5 by 5 metre, or a 5.0 metre by 5.0 metre interval grid.

The magnetic response at base stations, located adjacent to each survey grid, were repeatedly measured and recorded at small time intervals (less than 90 minutes) to compensate for diurnal variations in the earth's magnetic field.

Results of the corrected total field magnetometer surveys are presented as coloured contour maps illustrating lateral variations in magnetic intensity (nanoTeslas [nT]). Background magnetic intensity was subtracted from the field measurements, as indicated within each figure, to further clarify data presentation.

2.4 Soil and Vegetation Sampling

Soil and vegetation samples were taken by Hycal so that chemical analyses for contaminants that might be associated with former site activities could be carried out. Soil and vegetation samples were taken in areas suspected to be sites of contamination as indicated by proximity to buildings or activities of concern, areas of stressed vegetation, and in areas in which empty barrels or other metal containers were identified. Baseline soil and vegetation samples were taken at locations inferred to represent baseline conditions due to age of vegetation and location away from signs of past occupation.

The presence of permafrost at the time of the investigation (in October 1996, with surface air temperatures approximately -5°C to -18°C) precluded soil sampling at depths greater than approximately 0.5 metres. Use of a drilling rig or large equipment would have been required to advance sampling past this depth and such equipment was not included in the scope of work.

Soil samples were visually and olfactorily examined for indications of hydrocarbons and other contaminants, then promptly placed in clean, glass jars with teflon lids. The soil samples were packed with no headspace and retained in darkness at approximately 4°C.

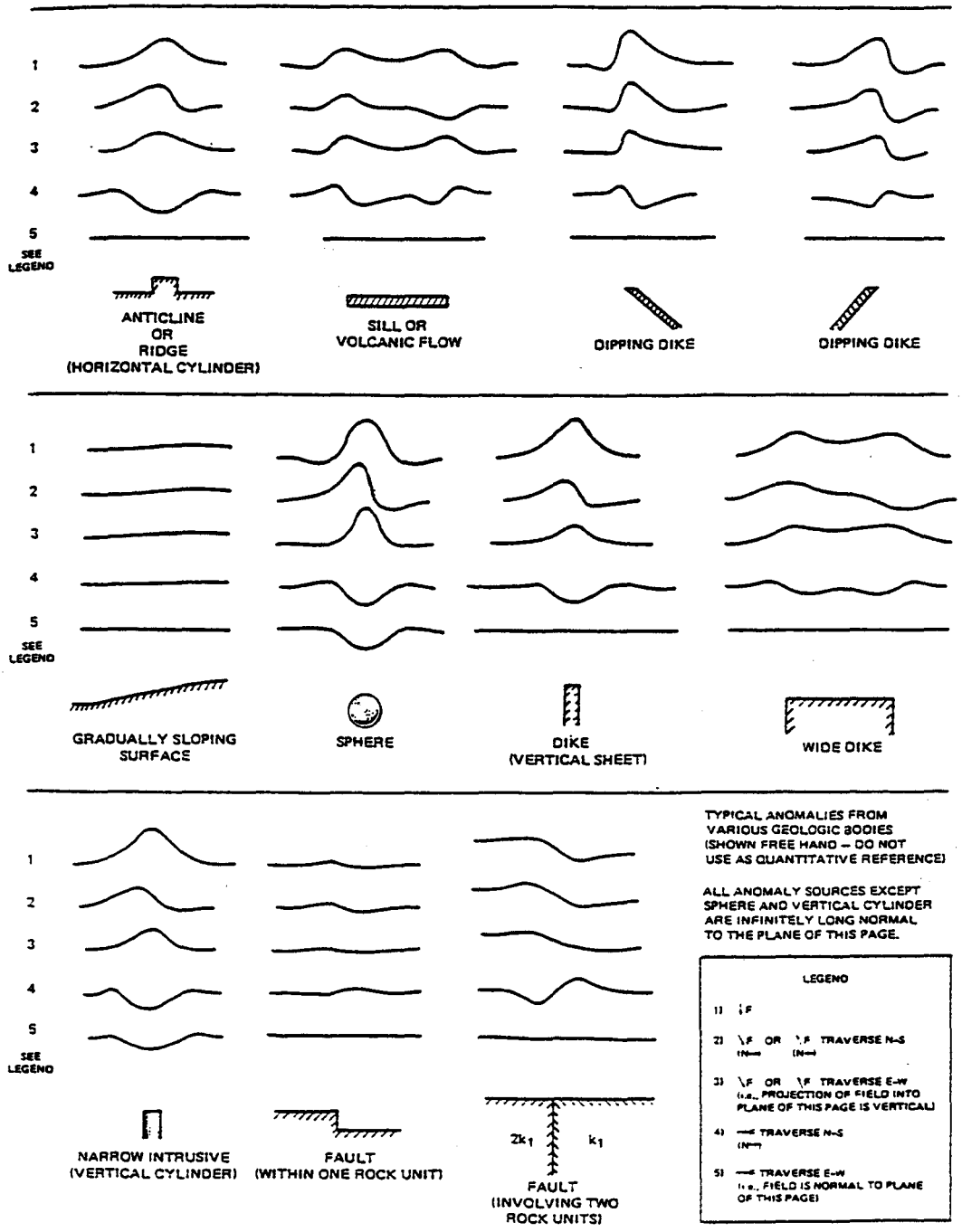


Figure 2. Anomalies for Geologic Bodies at Various Orientations and Different Inclinations of the Field (Breiner, 1973).

Samples of vegetation were taken by using a trowel to extract the plants as intact as possible. Vegetation samples were placed in plastic bags with as little surrounding air as possible, then they were retained in darkness at approximately 4°C.

Soil samples were analyzed for the presence of metals, pesticides (organo-chloride and organo-phosphate and for fenuron, an organo-nitrogen), picloram (a phenoxy/acid herbicide), hydrocarbons, and PCBs. The analytical parameters were selected on the basis of site history and on contaminants which have been previously associated with military activities in the Yukon, as outlined by Bisset (1995). Duplicate samples were not analyzed due to a limited analytical budget.

Vegetation samples, were not analyzed due to a limited sample analysis budget.

2.5 Analytical Methods

Analyses of soil samples was carried out by Norwest Laboratories of Calgary, Alberta. The laboratory is accredited by the Standards Council of Canada and the Canadian Association of Environmental Analytical Laboratories.

Specific analytical methods used in the sample analyses are presented in Appendix C with the laboratory results.

2.6 Preliminary Risk Evaluation

Due to time limitations and budget constraints associated with this project it was not possible to complete a full Level One Ecological Risk Assessment (ERA) as defined in the CCME Framework for Ecological Risk Assessment. However a preliminary evaluation of ecological risk was completed in which site specific data on habitat, species, land use, contaminants, environmental fate and toxicity were used to develop an overview of ecosystem components potentially at risk.

A site specific probabalistic model was not developed therefore fate, effects, conclusions and recommendations are based solely on scientific literature and professional experience with these contaminants. It should, therefore, be recognized that conclusions pertaining to fate and effects will carry a high degree of uncertainty at the site specific level.

2.7 Personnel

Personnel who participated in the investigation are listed in Appendix D.

3. INVESTIGATIVE RESULTS - KOIDERN RIVER LODGE, MP 1164

3.1 Site Location and Description

3.1.1 Location

The Koidern River Lodge site is located at MP 1164, immediately west of the Koidern bridge (Figure 3). The site is approximately 40 metres south of the current Alaska Highway, in an area generally 1 to 2 metres higher than the surrounding topography (Photograph 2). The site is at latitude 61°58'N and longitude 140°24'W, in NTS 115 F/116.

The site is not linked to the current Alaska Highway by any roadways and was accessed by foot. Access to the site is not obvious, with no apparent break in the vegetation surrounding the site indicating the site's presence.

3.1.2 Site Appearance

Wood and metal debris was scattered throughout the site. Several mounds of one to two metres elevation were present throughout the site. In order to determine their possible origin, two of the mounds were investigated using geophysical methods.

3.1.3 Topography, Geology and Soils

The Koidern River Lodge Site is located on a one to two metre high which has been previously interpreted as an esker (Yukon AES Waste Site Inventory). Mapping by Rampton (1977, however, indicated that the site is underlain by postglacial alluvial floodplain deposits consisting of sand and gravel with a veneer of fine sediment. The subject site may, therefore, represent a large area of thermokarsting.

The subject site is located in the discontinuous permafrost zone (Geological Survey of Canada, 1967). Topography over the subject site is variable with 1 to 2 metre localized changes in elevation that appear to be the result of thermokarsting.

Soil is poorly developed in the area. Soil sampling indicated that the soil is generally very dark brown (Munsell colour 2/2) and organic, with silt to very fine grained sand. If the soil was unthawed, its permeability would be characterized as moderate.

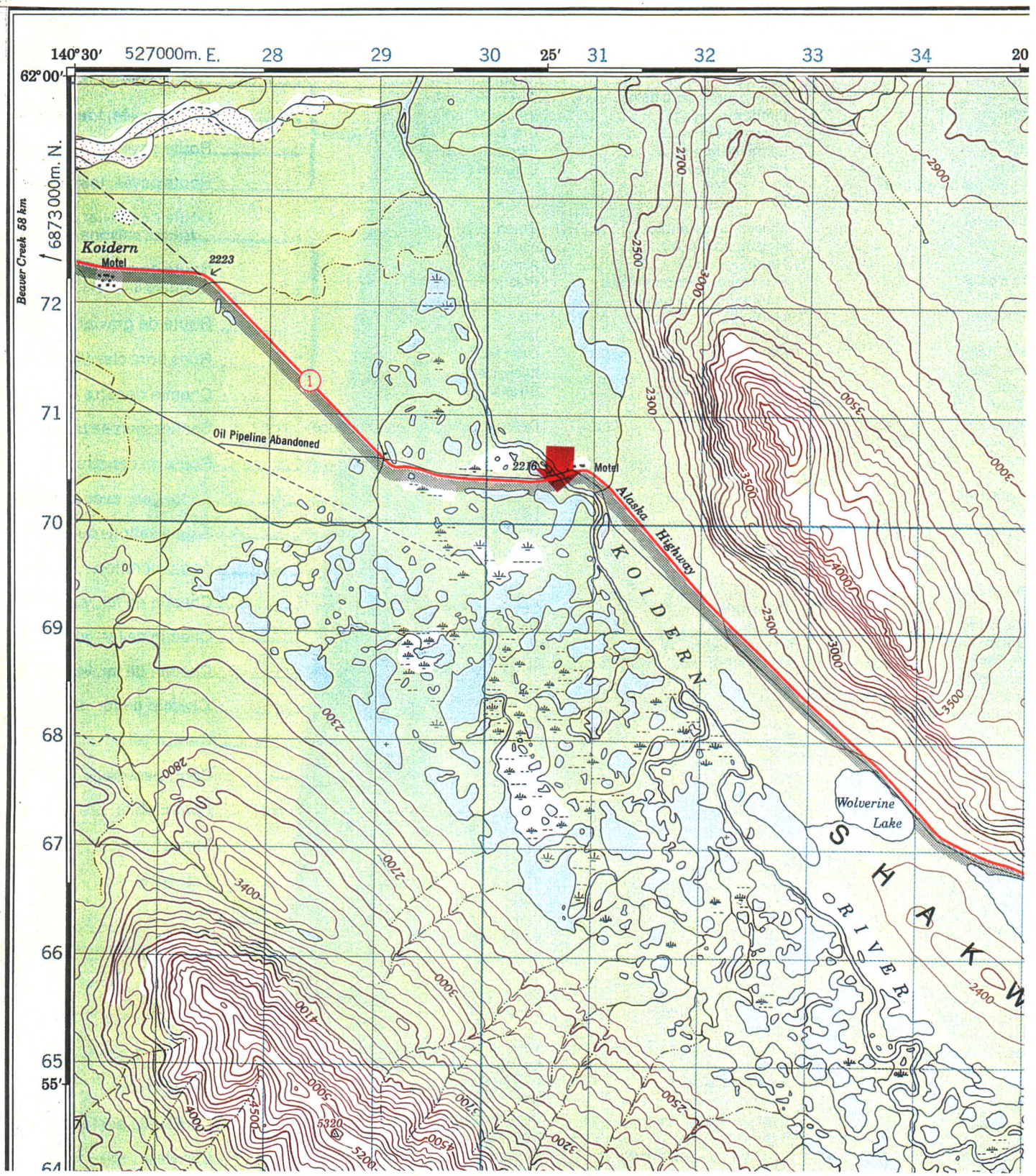


Figure 3. Detailed Location of Koidern River Lodge Site.

Photograph 2. Looking southwest from the Alaska Highway to the subject site. October 1996.

3.1.4 Surface and Subsurface Water

The site is immediately adjacent to the Koidern River and a wetlands area. A pond was present in the centre of the site at the time of the site investigation, and it would be anticipated that there would be significant surficial water ponding during times of snow melt or heavy precipitation.

Regional groundwater flow direction would be anticipated to be towards the Koidern River. However, given the presence of permafrost and dense vegetative cover, shallow groundwater flow in the area may be limited. The vegetative cover may limit the amount of permafrost thawing during the summer and therefore, shallow groundwater flow may be minor to absent in vegetated areas.

No general dip in surficial elevation was discernible over the site.

No streams were noted on the subject site at the time of the site assessment. However, contiguous low areas on the site might act as ephemeral streams during snow melt or after significant rainfall.

3.1.5 Vegetation

The subject area was largely covered by dense vegetation which consisted predominantly of white spruce and some willow. Moss covered much of the ground surface. Vegetation was sparse to absent in the central portion of the site, where building debris was noted.

3.1.6 Wildlife

Wildlife which was observed in the area of the site (through tracks and scat, or through actual sightings) included bear, moose, muskrat, beaver, mice, rabbits, coyotes, golden eagles, ptarmigan, jays, ducks, raven and geese. Some Trumpeter swans were observed in the area during reconnaissance in September. Other wildlife reported in the area include lynx, caribou and fox (Agriculture and Agri-Food Canada and Environment Canada, 1996).

Wildlife officials reported that the Koidern River contains whitefish, chub, chum salmon, and grayling (Lorne Laroque, pers. comm.).

3.1.7 Climate

Environment Canada (Agriculture and Agri-Food Canada and Environment Canada, 1996) describes the climate in the area as follows:

> The climate is characterized by short, cool summers and long, cold winters. Winter temperature inversions are common, giving milder temperatures at higher elevation. Maritime air from the Gulf of Alaska periodically invades the ecoregion during the winter to produce mild spells with near-thawing temperatures. The mean annual temperature for the area is approximately -3°C with a summer mean of 10°C and a winter mean of -17°C. Mean annual precipitation ranges 250-300 mm.

3.1.8 Land Use

The subject site was is not in formal use at the time of the site investigation. No signs of recent use were noted.

Trapping and hunting is reported to occur in the general region of the site. Environment Canada has reported that "Land Use recollects high recreational, tourism and hunting values. (Agriculture and Agri-Food Canada and Environment Canada, 1996). Hunting is, however, prohibited within 1 kilometre of the Alaska Highway, so hunting is not allowed in the immediate site area.

The site is currently held by the Crown.

The closest known human occupation is a residence and a lodge (Koidern River Lodge, currently occupied by Jim Cook) across the Koidern River, to the east of the site.

3.2 Site History

The first suspected occupation of the subject site was during World War II when it was occupied by United States military camps associated with the building of the Alaska Highway.

Records of the Eighteenth Engineers Regiment (Rust, 1944) indicate that camps were present in 1942 at Mile Post 268, which would have been 36 miles from the Donjek River, at the approximate location of today's MP 1166 (the Canol Pump Station "G"). However, no records of a camp at MP 1164 (1942's MP 266) were discovered in the Yukon Archives, aside from a 1943 PRA map showing a relay

station at MP 1164 (Figure 4). This lack of historical documentation led Bisset (1995, p.265) to conclude that :

> By all descriptions it would appear that there was only one [U.S. army] station [in the area during World War II] and it was located at MP 1167, near Bear Flats, not at Koidern River.

However, the presence of wooden debris (Photographs 3), a pit which appears to be a remnant of an army-style latrine, and several discarded metal barrels, (which may be of World War II vintage (Photographs 4 and 5), suggests that there was some army occupation at MP 1164 and would seem to verify the PRA map.

Sources on the demobilization of the American army from the Alaska Highway and subsequent disposition of material associated with the highway construction vary on how much and what kinds of material were abandoned on military sites. The Vancouver Daily Province and the Edmonton Journal reported that one dump "was littered with cans, debris and decaying food" and that another contained barrel heaters, water heaters and hot-air chambers for furnaces (Remley, 1976, p.171). Contrary to these reports, a study by the House Roads Committee of the United States Congress, whose investigations included flying the length of the road to ascertain the amount of debris left behind, concluded that "rumors of abandoned equipment, wild extravagances, fraud and corruption" were vastly exaggerated and not borne out by investigation.

The 'old' Alaska Highway was, originally, immediately north of the site. The Highway was, however, moved approximately 40 metres north of the site "several years ago" (Jim Cook, pers. comm.).

Local residents who were interviewed during the course of the investigation included the DIAND officer at Beaver Creek, and Jim and Dorothy Cook at the Koidern River Lodge. Members of the area's aboriginal community were contacted through the investigation's field assistant, Rosemarie Vander Meer, of the White River Nation.

Aerial photographs of the site housed at the Yukon Archives and at the University of Calgary were reviewed. Available aerial photographs of the area were sparse and were, for the most part, at very poor scale, with little detail being discernible at the site level. On two aerial photographs, one undated (probably from the late 1940s or the 1950s) and one from 1964 (Figures 5 and 6), the subject site was notably visible as an unvegetated area.

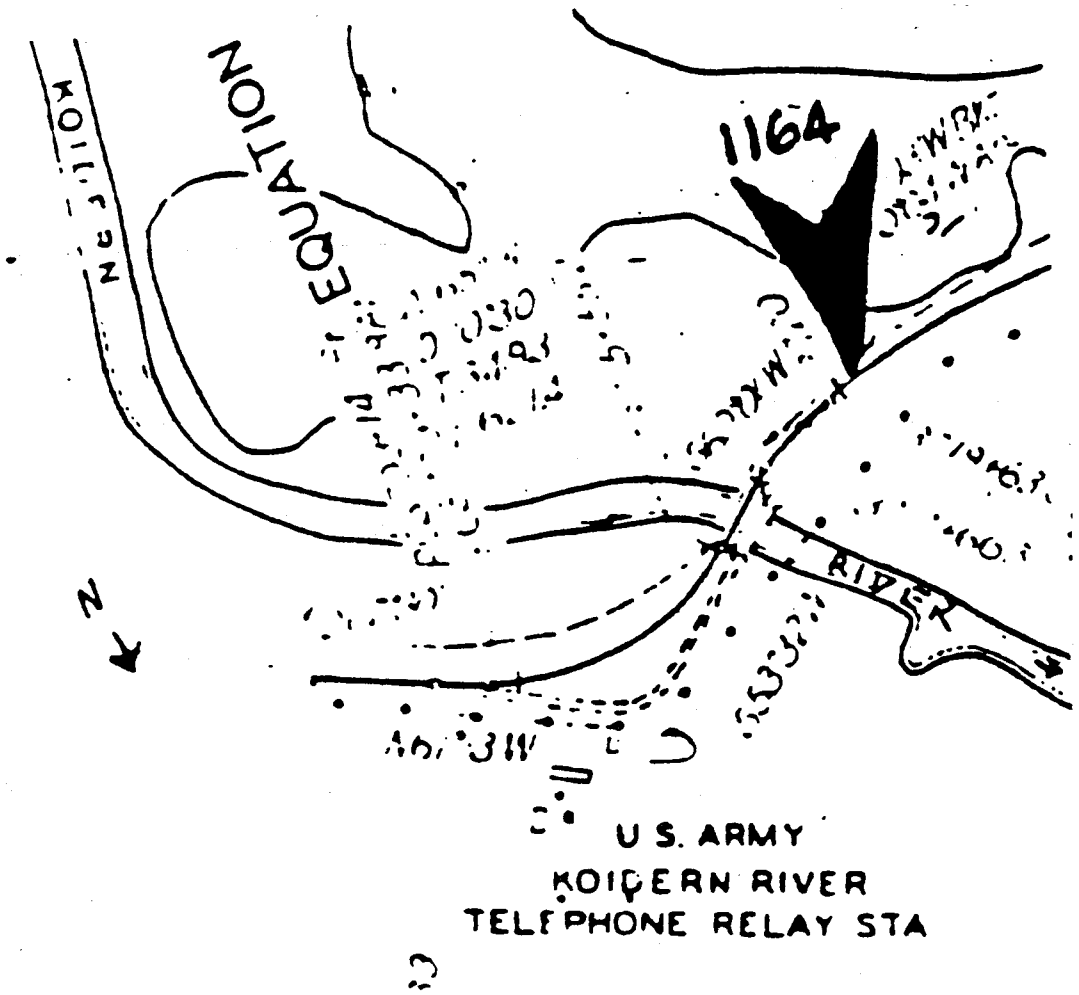
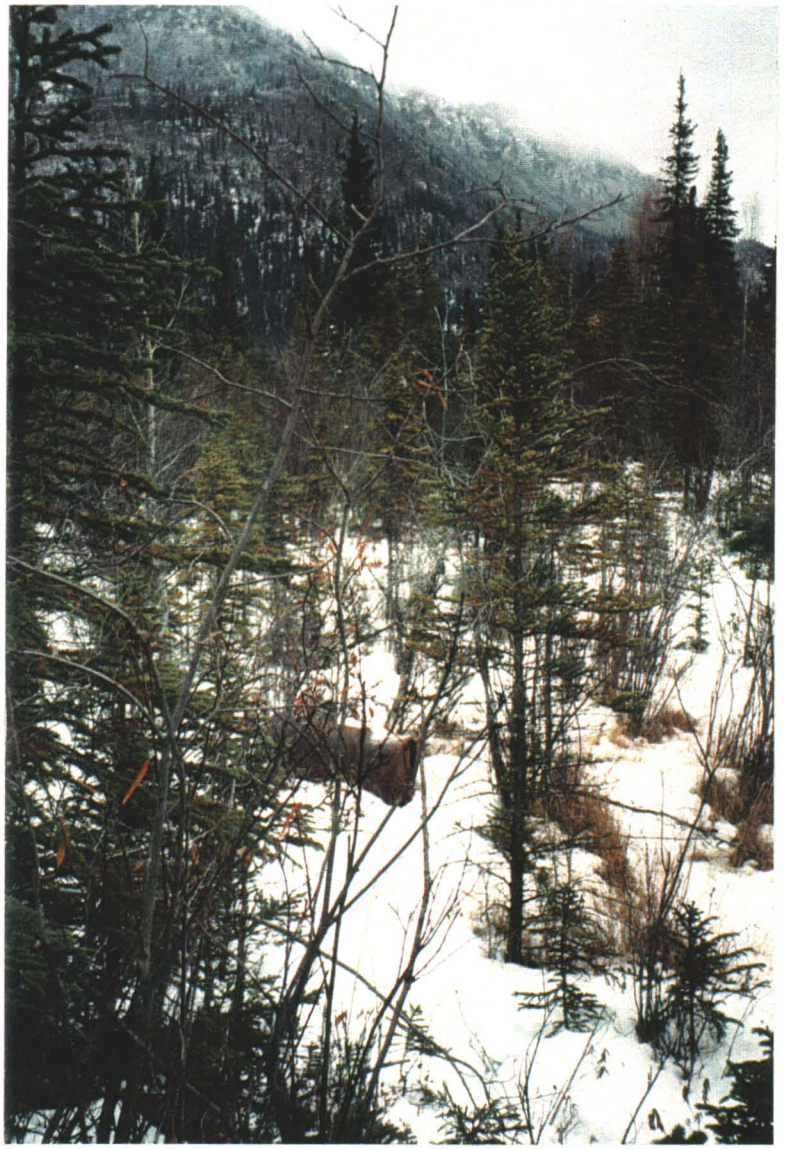
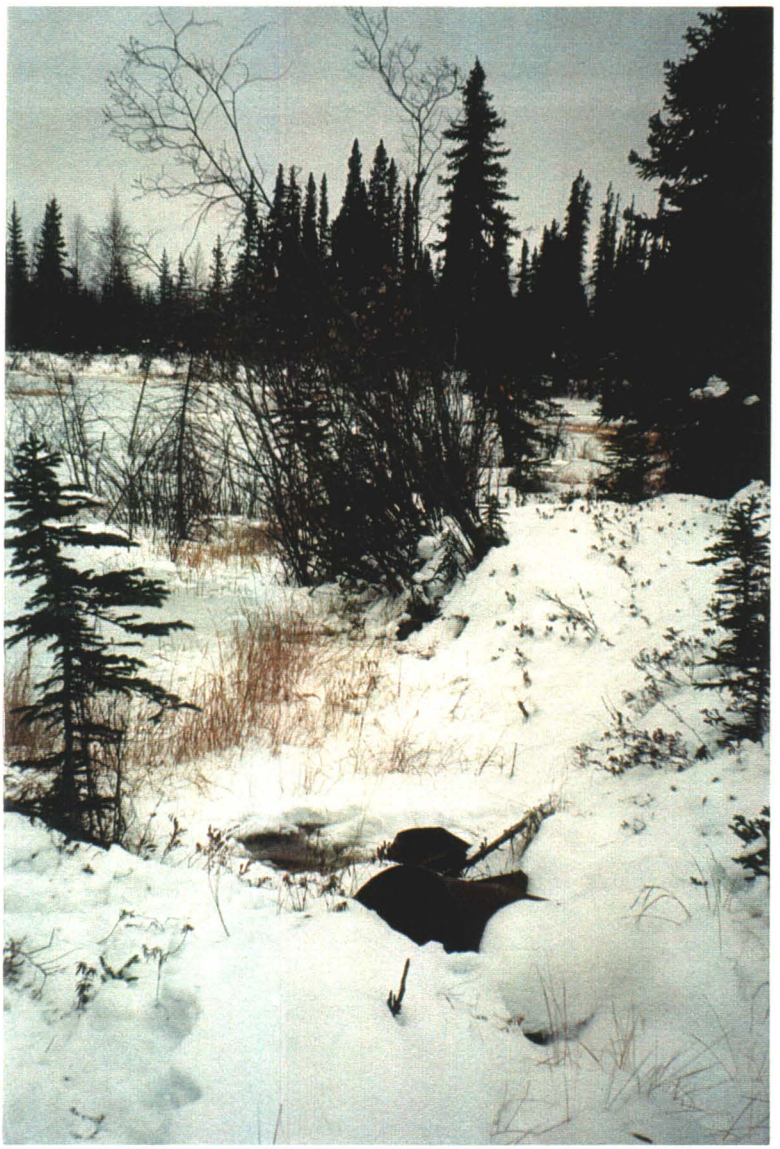


Figure 4. Public Roads Administration Map of the subject site, 1943 (with later amendments).

Photograph 3. Wooden debris on the northern edge of the Koidern River Lodge site in the area of Sample S1). October 1996.



Photograph 4. Discarded barrel on Koidern River Lodge site. October 1996.



Photograph 5. Discarded barrel and 'jerry can' at the southeastern edge of the Koidern River Lodge site. October 1996.

Figure 5. Aerial Photograph of the Koidern River Lodge Site, undated. Source: Yukon Archives, 115 F16 Line A11537.

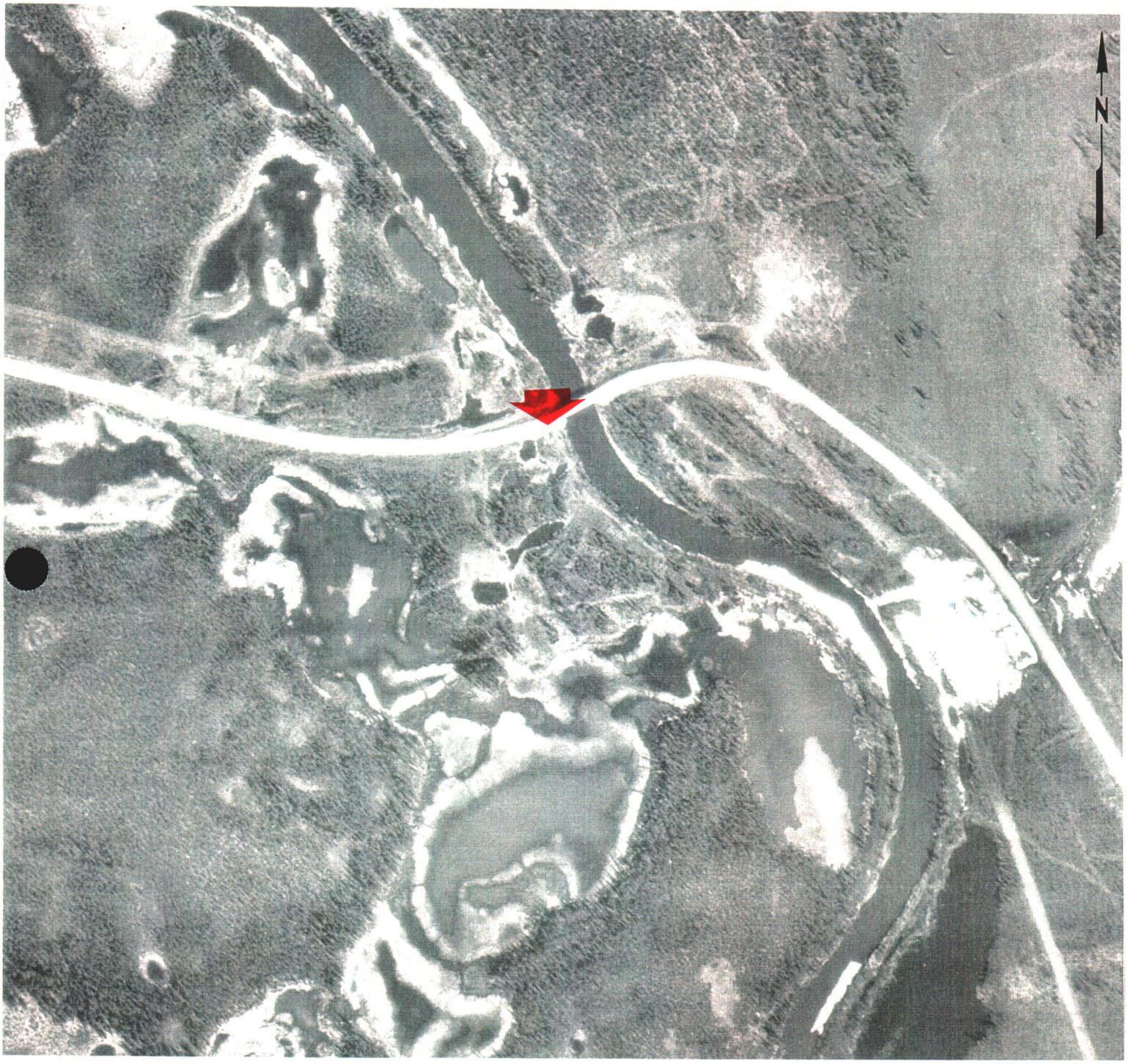


Figure 6. Aerial Photograph of the Koidern River Lodge Site, 1:6000, 1964. (115F 18 1964 A 18395-36).

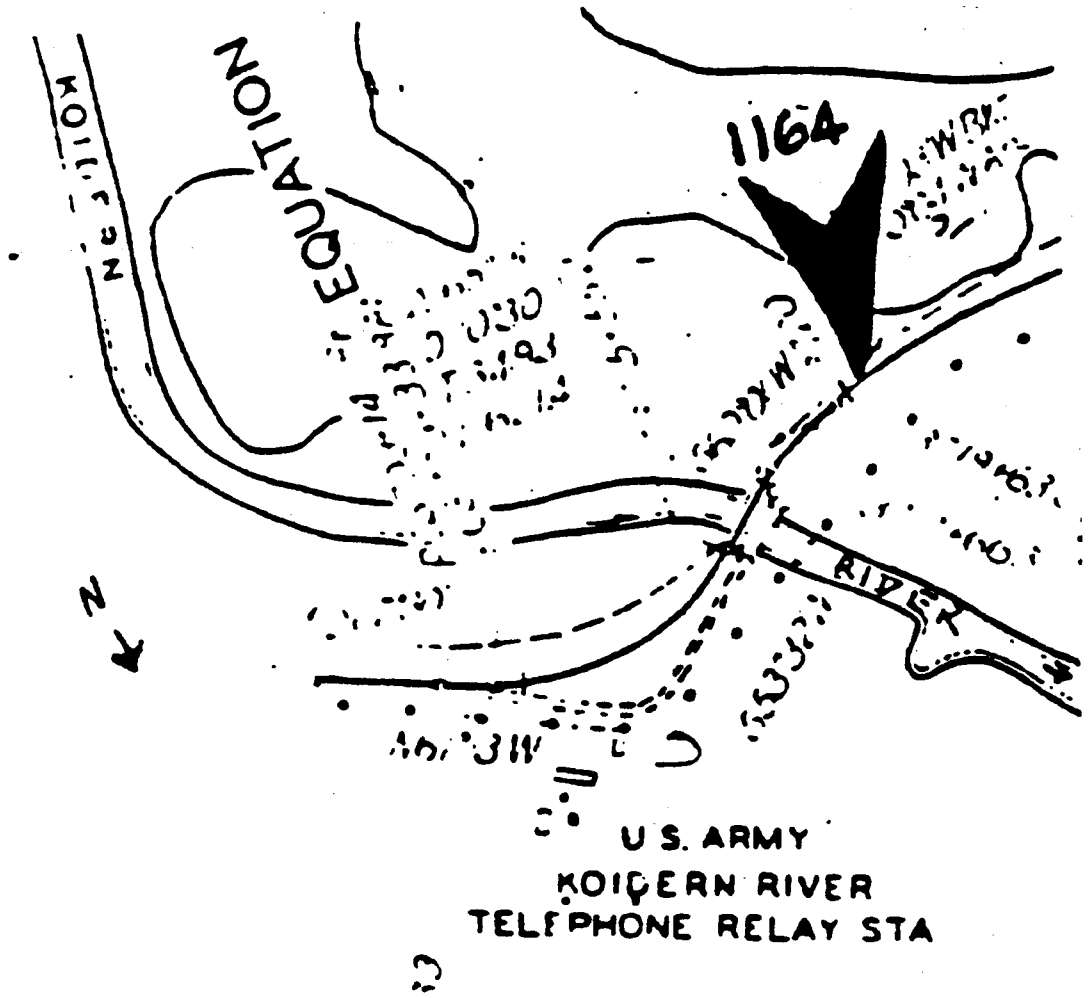


Figure 4. Public Roads Administration Map of the subject site, 1943 (with later amendments).

3.3 Geophysical Results

The scope of the project prevented the undertaking of a detailed geophysical study over the full extent of the site. Instead, areas were prioritized for geophysical evaluation based upon site inspection. As vegetation density precluded the use of the EM61 survey method, magnetic measurements were acquired to investigate the occurrence of buried metal.

Line 33A (Figure 7) extended across an area were evidence of a camp (45 gallon drums and directional lumber) remained on the surface. The orientation of Line 33A was variable in order to transect areas of topographic variation. Magnetic response along the line was relatively constant, with only slight variations towards the southwest extent of the line in the vicinity of observed surface metal (45 gallon drum). No significant quantity of metal was indicated in the immediate vicinity of survey Line 33A.

Line 33B transected a topographic high south of the an existing pond. Scrap metal was evident on the ground surface within this region. The slight variations in magnetic intensity measured along Line 33B were attributed exclusively to metal observed at the ground surface.

Tabulated results of the magnetic measurement are presented in Appendix B.

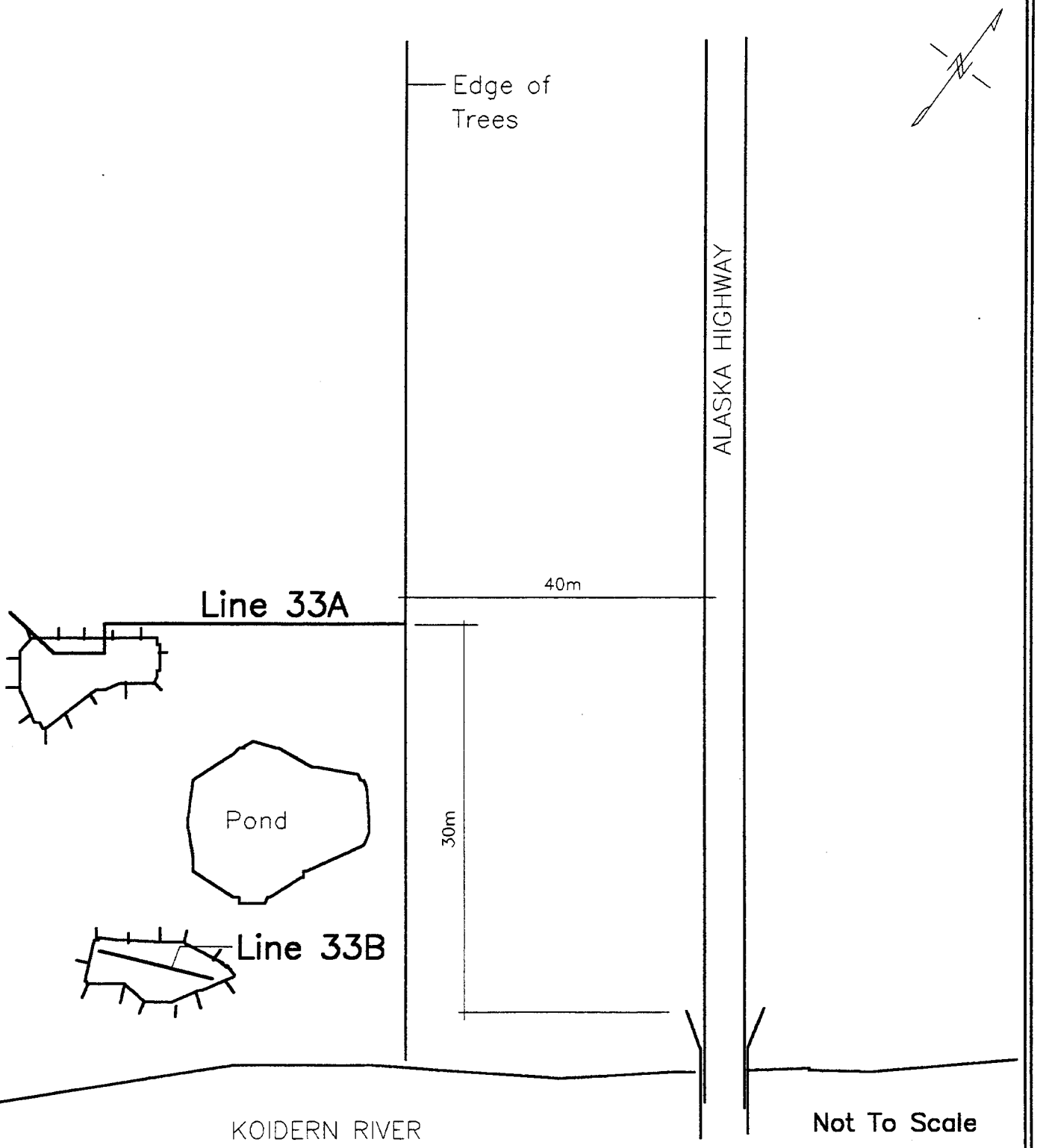
3.4 Adjacent Properties

Land west of the subject property was undeveloped. It was humocky and covered by dense vegetation which consisted predominantly of white spruce and some willow. Moss covered much of the ground surface.

A grass covered trough was located to the north of the site in the area previously occupied by the Alaska Highway. The present-day Alaska Highway was located immediately north of the trough north of the subject property. The Koidern River was located immediately east of the site. A wetlands area, known as the "Koidern Potholes" was located to the south.

3.5 Soil Analyses

Analysis of a soil sample (Sample S1) from the northern edge of the property indicated the presence of barium, cadmium, chromium, cobalt, mercury, silver, tin, vanadium, and zinc in excess of CCME Assessment Criteria (CCME, 1991).



HYCAL ENVIRONMENTAL SCIENCES LTD

PRELIMINARY ENVIRONMENTAL INVESTIGATIONS
CONTRACT 96-6136

KOIDERN RIVER LODGE SITE, MP 1164
GEOPHYSICAL SURVEY AREAS
November, 1996 - Figure 7

ASSOCIATED MINING CONSULTANTS LTD - PG93

Arsenic, copper, lead, nickel and selenium were found at levels exceed CCME Residential / Parkland Remediation Criteria. The hydrocarbon level of the sample was found to be above the Alberta Tier 1 Criterium for Hydrocarbons (Alberta Environmental Protection, 1994). Results of the soil analyses are summarized in Figures 8 and 9. A copy of the laboratory report is presented in Appendix C.

3.6 Preliminary Risk Evaluation

Based on the available information (refer to Section 3.1 for a detailed description of site location, soil characteristics, site drainage, adjacent water bodies, and land use), it is likely that the following factors will act to increase the ecological risk at this site:

1) Contaminants

   The presence of contaminants in exceedence of CCME assessment and remediation criteria increases the risk of an ecological impact. In addition it is likely these contaminants will be taken up and concentrated within vegetation of the site due to the chemical characteristics of the contaminants found

2) Proximity To Surface Water

   The subject site is immediately adjacent to the Koidern river and one pond was found on site.

3) Soils

   Soil and subsurface materials would be moderately permeable when thawed. In areas in which thawing occurs, this would increase the risk of contaminant migration and exposure to additional receptors.

4) Land Use

   The use of nearby land for hunting increases the risk of humans consuming animals exposed to contaminants through foraging or habitation on site.

5) Wildlife

   The number of plant and animal species found at this site increases the likelihood that a species will be impacted by the contaminants found here.

Figure 8: Summary of Soil Sample Analyses, Koidern - White River, MP 1164-1167

	CCME Assessment Criteria	CCME Remediation-Parkland/ Residential Criteria	Site 33 Background	Site 33 Oil Pit	Site 33 Sample #1	Pump Station G Sample 5	Pump Station G Sample 6
METALS							
Arsenic	5	30	**5.7**	**48**	**33.5**	4.1	4.8
Antimony	20	20	0.88	1.73	1.64	0.69	<0.50
Barium	200	500	109	**338**	**401**	76.4	98.8
Beryllium	4	4	0.287	0.276	0.263	0.259	0.279
Cadmium	0.5	5	0.252	**1.76**	**1.57**	0.134	0.284
Chromium	20	250	**25.8**	**92.5**	**121**	16	**28.1**
Cobalt	10	50	**12.9**	**11.7**	**13.4**	9.96	8.48
Copper	30	100	**35.9**	**143**	**143**	25.6	24.3
Lead	25	500	19.9	**28200**	**851**	9.1	**69.9**
Mercury	0.1	2	0.03	**0.27**	**0.34**	0.02	0.03
Molybdenum	2	10	0.5	1.91	1.8	0.37	0.55
Nickel	20	100	**47.2**	**124**	**164**	**21.7**	**20.4**
Selenium	1	3	0.5	**1.58**	**1.04**	0.37	0.67
Silver	2	20	<0.001	1.07	**18.7**	<0.001	0.013
Thallium	0.5	-	0.24	<0.20	<0.20	<0.20	<0.20
Tin	5	50	0.5	**11.3**	**10.4**	0.35	0.38
Vanadium	25	200	**44.8**	**111**	**100**	**34.5**	**31.6**
Zinc	60	500	**69.6**	**512**	**423**	**60.5**	**75.4**
PESTICIDES							
Organo-Chloride Pesticides	-	-	BDL	BDL	BDL	BDL	BDL
Organo-Phosphate Pesticides	-	-	BDL	BDL	BDL	BDL	BDL
Organonitrogen Pesticides	-	-	BDL		BDL	BDL	
HERBICIDES							
2,4-D	-	-	<0.1		<0.1	<0.1	
Picloram	-	-	<0.1		<0.1	<0.1	
2,4,5-T	-	-	<0.1		<0.1	<0.1	
OTHER							
Hydrocarbons	*	-	167	**2630**	**2280**	68	**1510**
Moisture (wt%)	-	-	15.2	60.6	60.8	5.3	11.6
PCB's	0.1	5	<0.1	<0.1	<0.1	<0.1	<0.1

All soil values are in mg/kg dry weight (ppm) unless otherwise stated

BDL = Below Detection Limits for all constituent compounds

Exceeds Assessment Criteria

Exceeds Remediation-Parkland/ Residential Criteria

Exceeds Alberta Tier I for Hydrocarbons (1000 mg/kg)

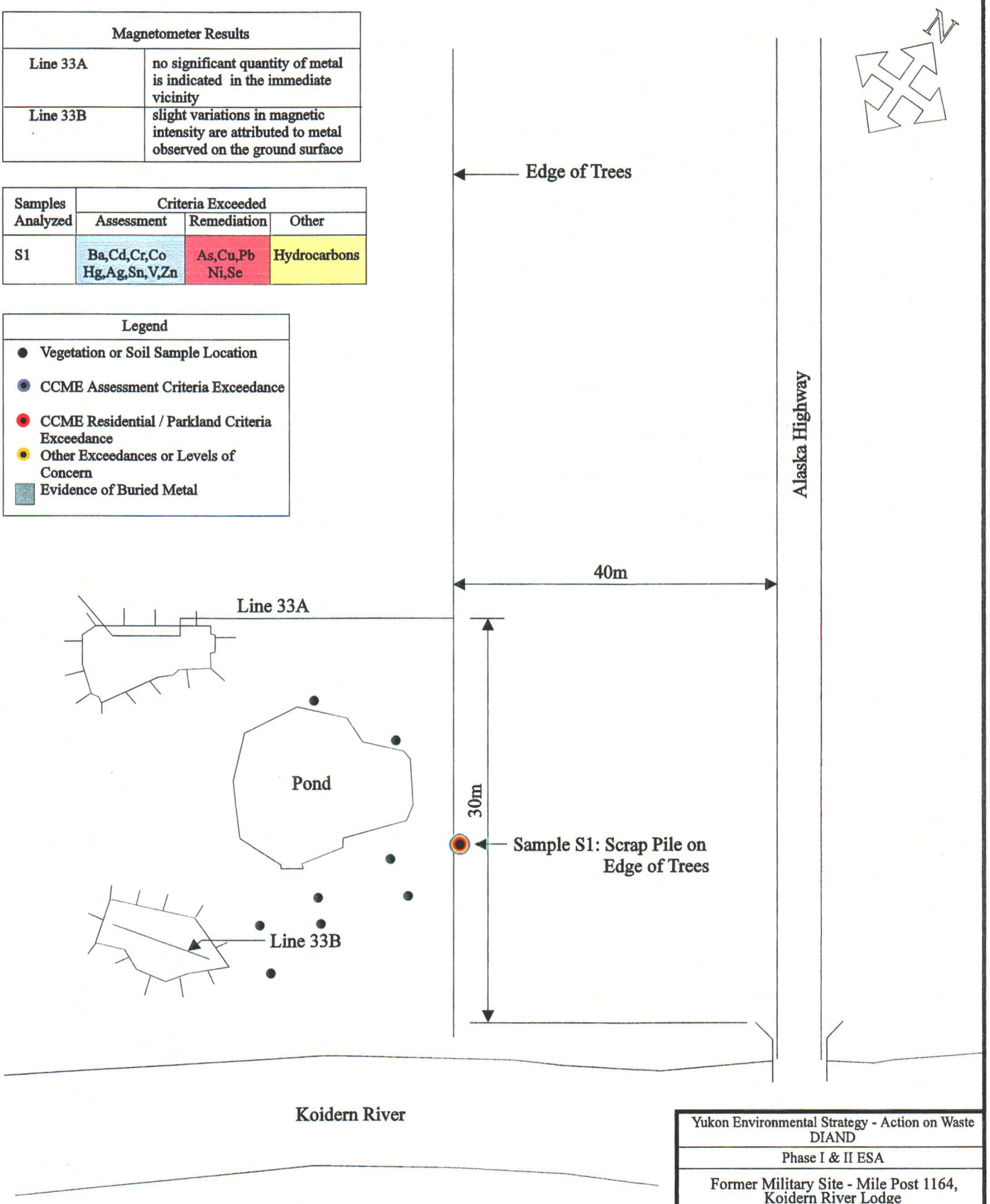
** No CCME Criteria for Hydrocarbons*

Magnetometer Results	
Line 33A	no significant quantity of metal is indicated in the immediate vicinity
Line 33B	slight variations in magnetic intensity are attributed to metal observed on the ground surface

Samples Analyzed	Criteria Exceeded		
	Assessment	Remediation	Other
S1	Ba,Cd,Cr,Co Hg,Ag,Sn,V,Zn	As,Cu,Pb Ni,Se	Hydrocarbons

Legend

- Vegetation or Soil Sample Location
- CCME Assessment Criteria Exceedance
- CCME Residential / Parkland Criteria Exceedance
- Other Exceedances or Levels of Concern
- Evidence of Buried Metal



Yukon Environmental Strategy - Action on Waste DIAND		
Phase I & II ESA		
Former Military Site - Mile Post 1164, Koidern River Lodge DIAND Site 33		
Summary of Geophysical and Soil Investigations		
Figure 9	November, 1996	Not to Scale
Hycal ENVIRONMENTAL SCIENCES LTD.		

The following site characteristics will act to decrease ecological risk:

1) Permafrost

The ubiquitous presence of permafrost beneath surface soils will act as a natural barrier preventing contaminants from deep migration.

While wildlife observed in the area during the investigation is outlined in Section 3.1.6, a detailed inventory of wildlife in the area was precluded by the scope of the investigation. Therefore, at this point in time, Valued Ecosystem Components (VEC) cannot be adequately assessed since this would require a detailed examination of interrelationships within the ecosystem of this site. If the site's ecosystem was better understood, keystone species as well as hypersensitive species could be identified and used in statistical models to predict impacts to the ecosystem.

Based on the limited species information readily available, no species listed as endangered by the World Wildlife Foundation of Canada (WWF) were identified on the site. The only site species listed as vulnerable that was identified on the site was the grizzly bear.

Contaminants of Concern

As detailed in Section 3.5, nine metal contaminants (barium, cadmium, chromium, cobalt, mercury, silver, tin, vanadium and zinc) were found in excess of CCME assessment criteria. In addition 5 metals (selenium, nickle, lead, copper and arsenic) were found to exceed CCME remediation criteria for residential/parkland areas. A potential risk mitigating factor is that those compounds found in exceedance of CCME assessment criteria seem to be relatively close to background concentrations for this area. In addition, those compounds in excess of remediation criteria may be isolated around the oil change pit, which should eliminate several potential exposure routes. The primary concern associated with these metal contaminants is that they are readily taken up in vegetation as micronutrients where they are bioconcentrated. Animal species then consume this vegetation while foraging on site and receive a concentrated dose of metals.

The only other contaminant of concern found at this site was hydrocarbons within the former oil change pit. The hydrocarbons represent a moderate to low risk since concentrations are fairly low, and they are localized within the concrete pit where little vegetation can grow.

4.0 INVESTIGATIVE RESULTS - CANOL PUMP STATION G, MP 1166

4.1 Site Location and Description

4.1.1 Site Location

Canol Pump Station G is located approximately 200 metres south of MP 1166 of the Alaska Highway (Figure 10). The site is at latitude 61°58'30"N and longitude 139°27'45"W, within NTS 115 F/16.

The site is accessible from the current Alaska Highway via two unpaved roads on the south side of the highway.

4.1.2 Site Appearance

The subject property contained two areas which had been previously occupied. The southern portion of the site included the remains of a decommissioned oil pipeline pump station (Photograph 6, 7 and 8). Concrete foundations and scrap piles were present in this area (Photographs 9 and 10). This area was largely unvegetated.

The northern portion of the site included a partially vegetated area with remains of a former camp (Photograph 11). Wooden foundations (Photograph 12) and metal debris were visible in this area.

4.1.3 Topography, Geology and Soils

The subject site is located in the discontinuous permafrost zone (Geological Survey of Canada, 1967). Topography over the subject site is variable with 1 to 2 metre localized changes in elevation that appear to be the result of thermokarsting.

The site is underlain by terraced postglacial alluvial gravel (Rampton, 1977). Soil is poorly developed in the area. Soil sampling indicated that the soil is generally very dark brown (Munsell colour 2/2) and organic, with minor silt to very fine sand. Scattered areas of soil were found to consist of gray (Munsell colour 6/1) to pinkish gray (Munsell colour 6/2) very sandy soil with pebbles and granules. This soil contains little organic content.

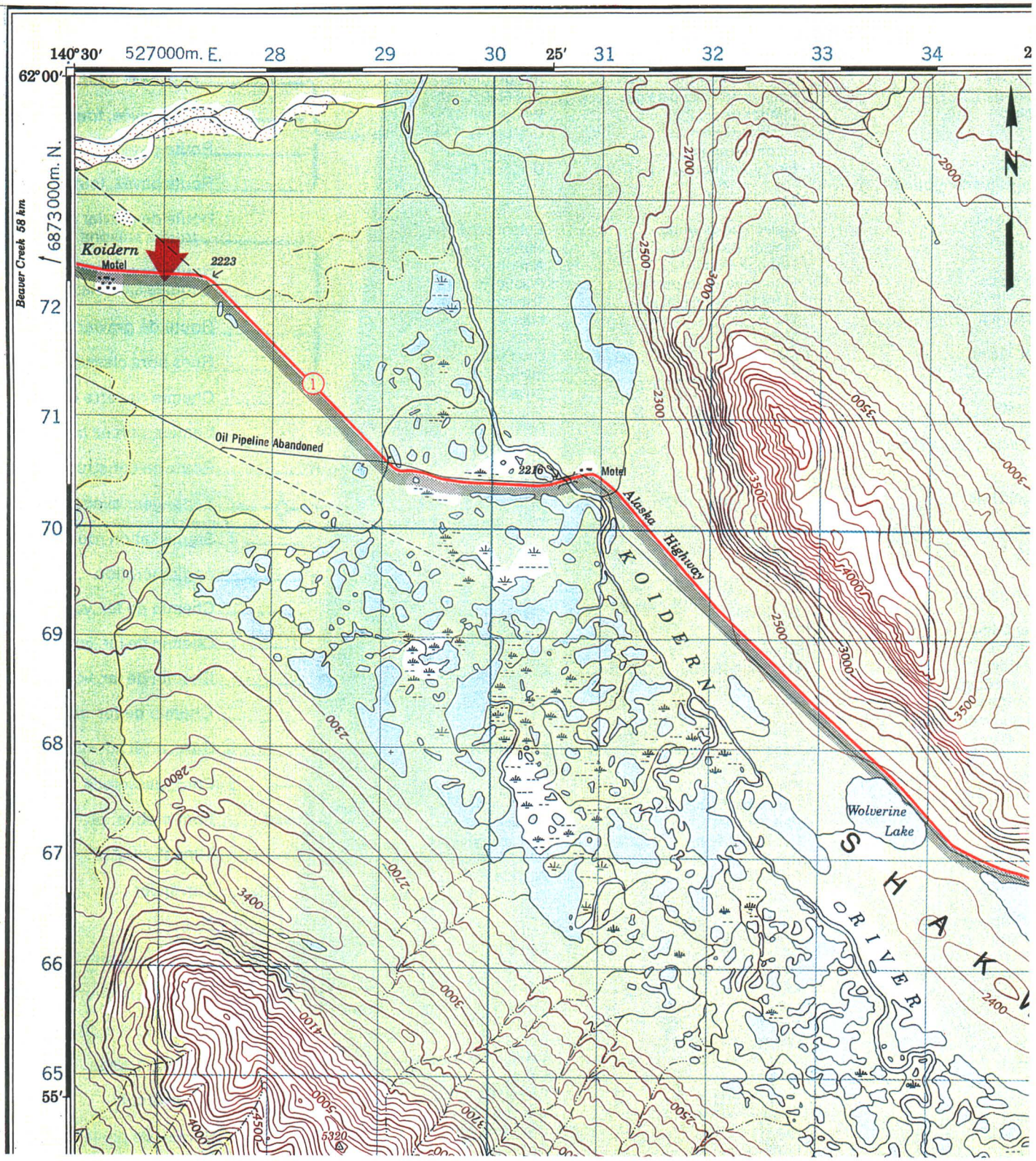
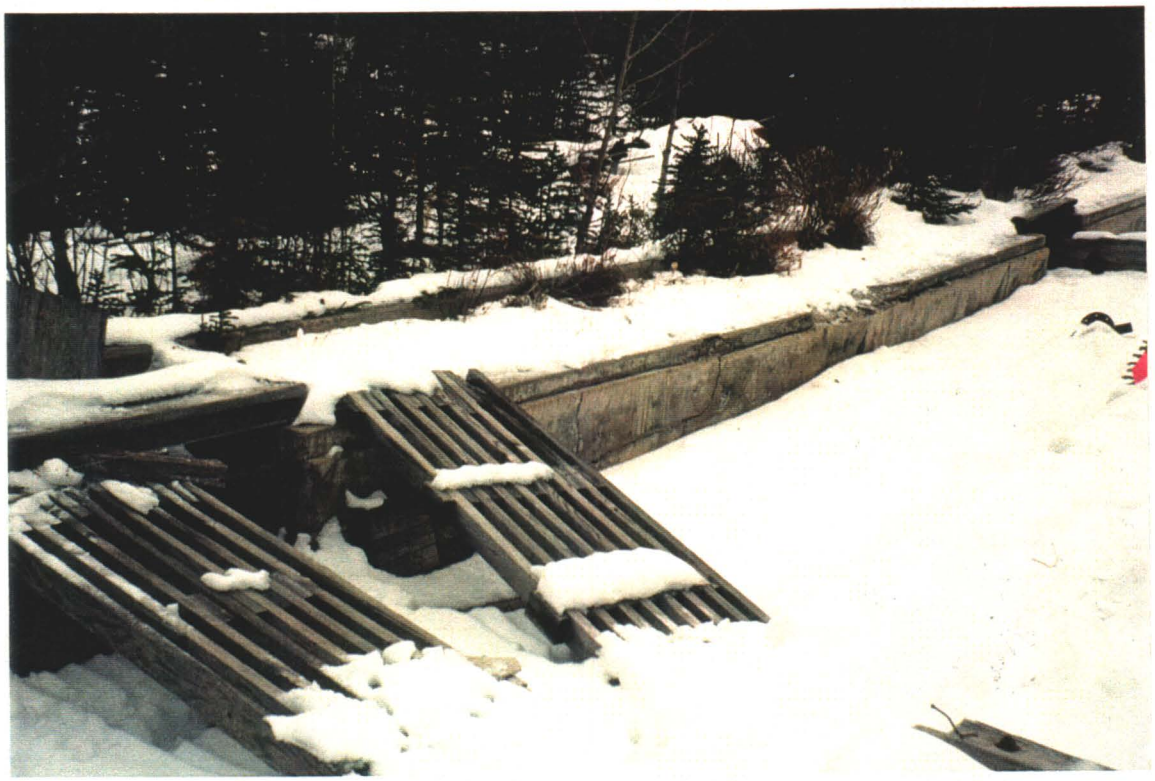


Figure 10. Detailed Location of Canol Pump Station G.



Photograph 6. View of Canol Pump Station G, MP 1166. October 1996.

Photograph 7. View of Canol Pump Station G, MP 1166. October 1996.

Photograph 8. View of Canol Pump Station G, MP 1166. October 1996.

Photograph 9. View of Canol Pump Station G, MP 1166. October 1996.

Photograph 10. Wood and Metal Debris at Canol Pump Station G, MP 1166. October 1996.

Photograph 11. Remnant Building Foundations at Canol Pump Station G, MP 1166. October 1996.

Photograph 12. Former Building Site, Canol Pump Station G, MP 1166. October 1996.

4.1.4 Surface and Subsurface Water

Shallow subsurface groundwater flow in the area of the subject site may be limited due to the presence of permafrost. While permafrost in open areas may thaw during the summer months, permafrost in areas covered by vegetation may not thaw and may, therefore, act as a barrier to shallow subsurface water movement.

Regional groundwater flow direction would be anticipated to be towards the north or northwest, in the direction of a braided river and the White River.

4.1.5 Vegetation

The subject area was partially covered by dense vegetation which consisted predominantly of new growth poplar and white spruce, and old growth white spruce. Some black spruce was also present. Moss was present over much of the ground surface.

The southern portion of the site, in the area of concrete foundations remaining from the old pump station, was sparsely vegetated. Vegetation was also sparse in some areas in the northern portion of the site, where buildings appeared to have been formerly located.

4.1.6 Wildlife

Wildlife which was observed in the area of the site (through tracks and scat, or through actual sightings) included bear, muskrat, beaver, mice, rabbits, coyotes, and grouse. Other wildlife reported in the area include moose, caribou, lynx, fox, eagles, swans, ducks and geese (Agriculture and Agri-Food Canada and Environment Canada, 1996).

Wildlife officials reported that clear creeks in the area contain grayling. (Lorne Laroque, pers. comm.)

4.1.7 Climate

Environment Canada (Agriculture and Agri-Food Canada and Environment Canada, 1996) describes the climate in the area as follows:

> The climate is characterized by short, cool summers and long, cold winters. Winter temperature inversions are common, giving milder temperatures at higher elevation. Maritime air from the Gulf of Alaska

periodically invades the ecoregion during the winter to produce mild spells with near-thawing temperatures. The mean annual temperature for the area is approximately -3°C with a summer mean of 10°C and a winter mean of -17°C. Mean annual precipitation ranges 250-300 mm.

4.1.8 Land Use

The subject site was is not in formal use at the time of the site investigation. No signs of recent use were noted.

Trapping and hunting is reported to occur in the general region of the site. Environment Canada has reported that "Land Use recollects high recreational, tourism and hunting values. (Agriculture and Agri-Food Canada and Environment Canada, 1996). Hunting is, however, prohibited within 1 kilometre of the Alaska Highway, so hunting is not allowed in the immediate site area.

The site is currently held by the Crown.

The closest known human occupation is approximately 1 kilometre from the site.

4.2 Site History

The first known occupation of the subject site was during World War II.

The historian of the Eighteenth Engineers Regiment (Rust, 1943) recorded army encampment at Mile Post "268". Given that Whitehorse was MP 0 at this time, it would seem that MP 268, which was called the "First Koidern Camp" or alternatively, "Lower Koidern", represents the subject site in 1943. Rust indicated that the following U.S. army companies were present at MP 268 during the following periods:

"A" Company	
1st Unit	September 23 to November 23, 1942
3rd Unit	September 23 to October 2, 1942
"B" Company	
2nd Unit	October 2 to October 29, 1942
"D" Company	October 25 to December 18, 1942

The Canol Pump Station being "penciled-in" on a 1943 Public Roads Administration map (Figure 11). would suggest that the Pump Station postdated the map.

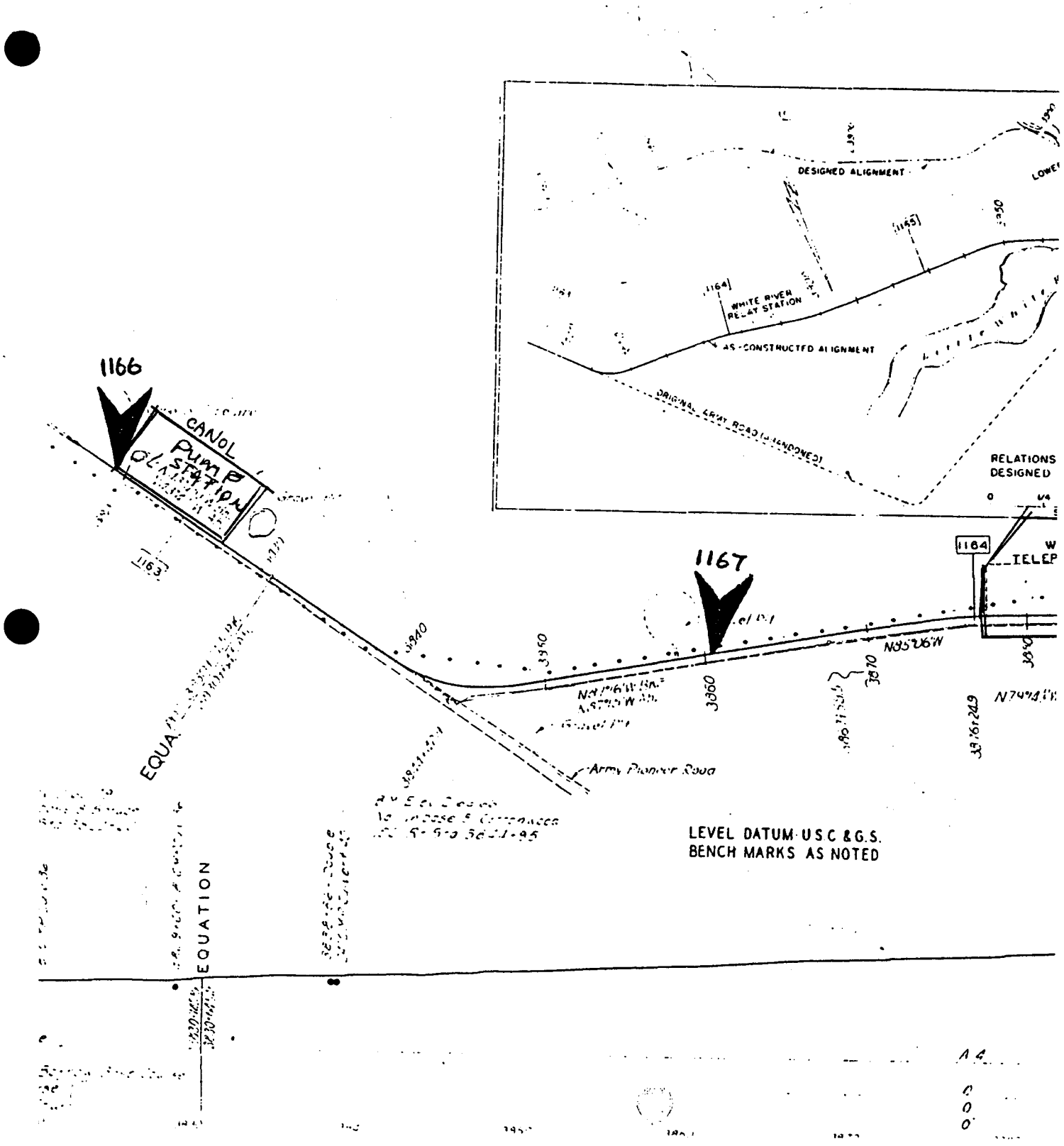


Figure 11. Public Road Administrations Map (1943) With the Addition of the Canol Pump Station.

Operation Clean Up recorded building debris and other materials on the site in 1973, as did 1976 mapping by Edey (Figure 12).

Approximately 15% of hydrocarbons pumped through the Canol pipeline system from 1943 to 1945 was unaccounted for and presumed lost due to spills and leakage (Kershaw, 1983). Given the nature of operations at Pump Station "G", it would be anticipated that hydrocarbon spillage occurred at the site.

Aerial photographs of the site housed at the Yukon Archives and at the University of Calgary were reviewed. Available aerial photographs of the area were sparse and were, for the most part, at very poor scale, with little detail being discernible at the site level. On aerial photographs from 1964 (Figure 13) the subject site was notably visible as an unvegetated area.

4.3 Geophysical Results

The scope of the project prevented the undertaking of a detailed geophysical study over the full extent of the site. Instead, areas were prioritized for geophysical evaluation based upon site inspection. Geophysical studies at Pump Station G were concentrated in two areas (Figure 14) a survey grid in the immediate vicinity of the pump infrastructure (Area "C"); and a survey line (Line 33G) transecting remnants of wooden structures to the north. Vegetation in the two areas precluded use of EM61 instrumentation. Magnetic methods were used to delineate subsurface metal.

Magnetic data, acquired at 5 metre by 5 metre intervals within Area "C", is presented in Figure 15. Identified anomalies were as follows:

33m, 33n and 33o: Located along the northeastern perimeter of the surveyed area, the anomalies are the response to the remaining pump infrastructure as illustrated. Materials included steel reinforcement bars within the existing concrete foundations/pads.

33p: Centred at Station 26E,30S, anomaly 33p is coincident with an existing scrap pile. Anomalous magnetic response also extended from this point to the western perimeter of the survey area; evidence that buried metal extends west within this area.

33q: Anomalous response attributed to a one inch diameter metal pipe on the ground surface.

Magnetic measurements were acquired at 2.5 metre intervals along Line 33G. Slight variations were evident in the resulting data set, corresponding to the

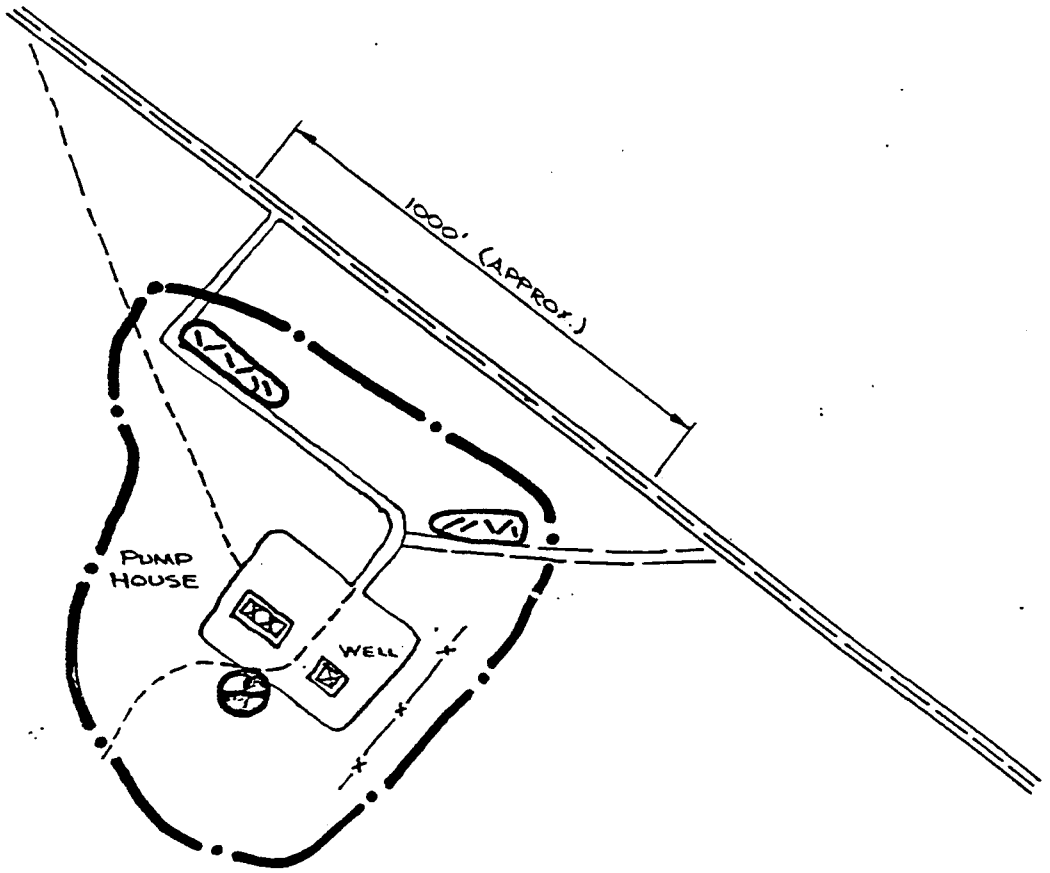


Figure 12. 1976 Mapping of Canol Pump Station G by Edey.

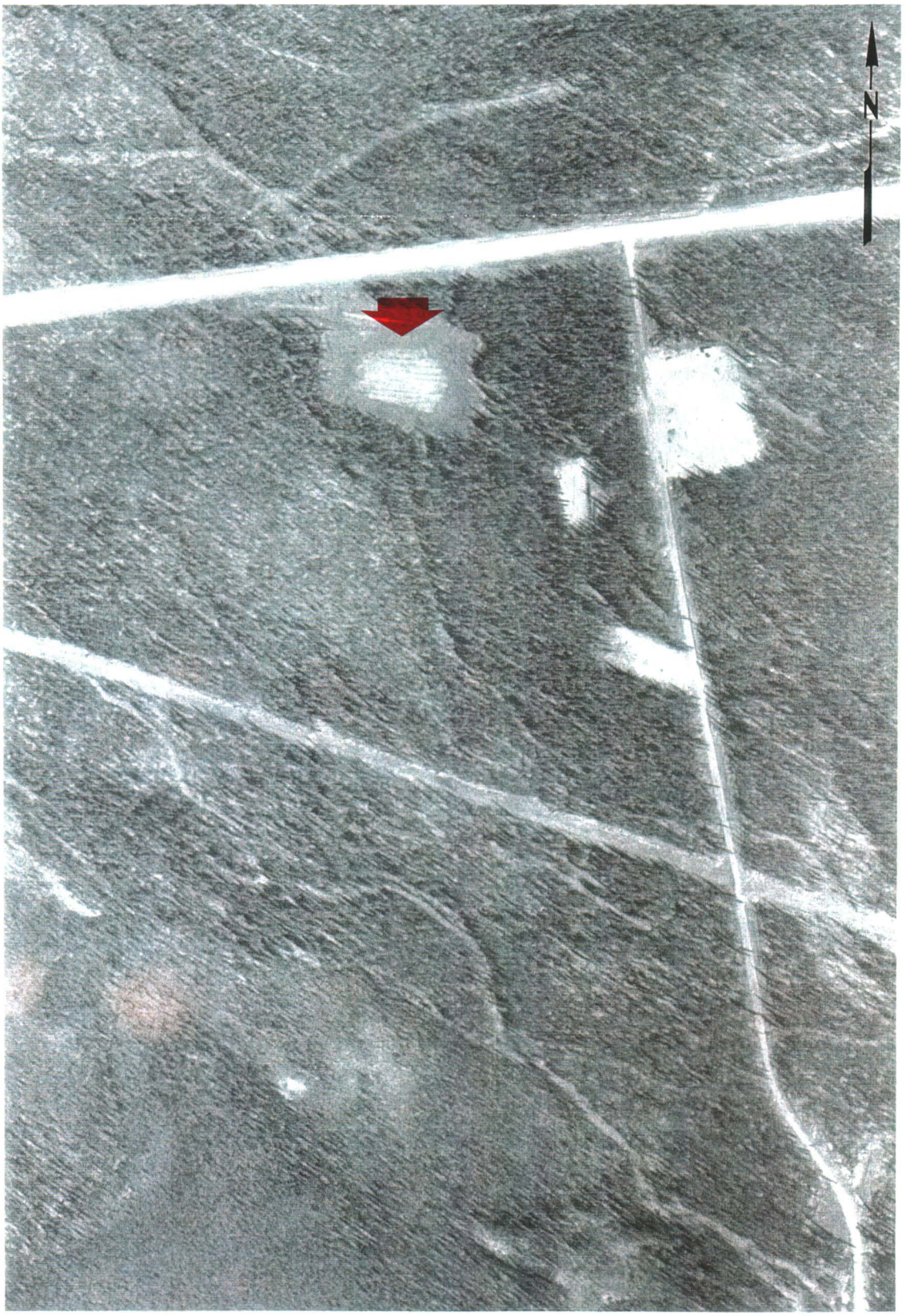
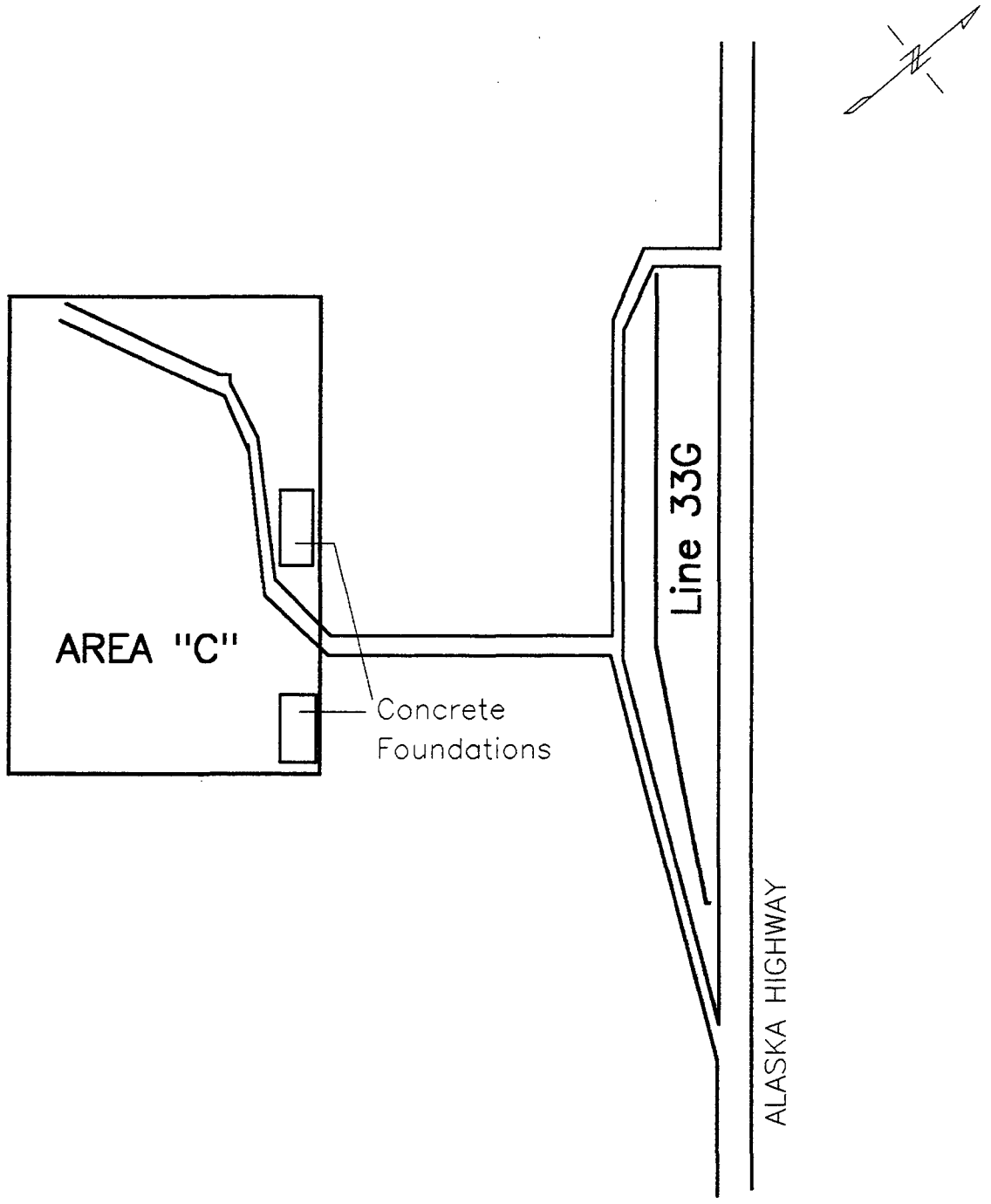


Figure 13. Aerial Photograph of Canol Pump Station G.



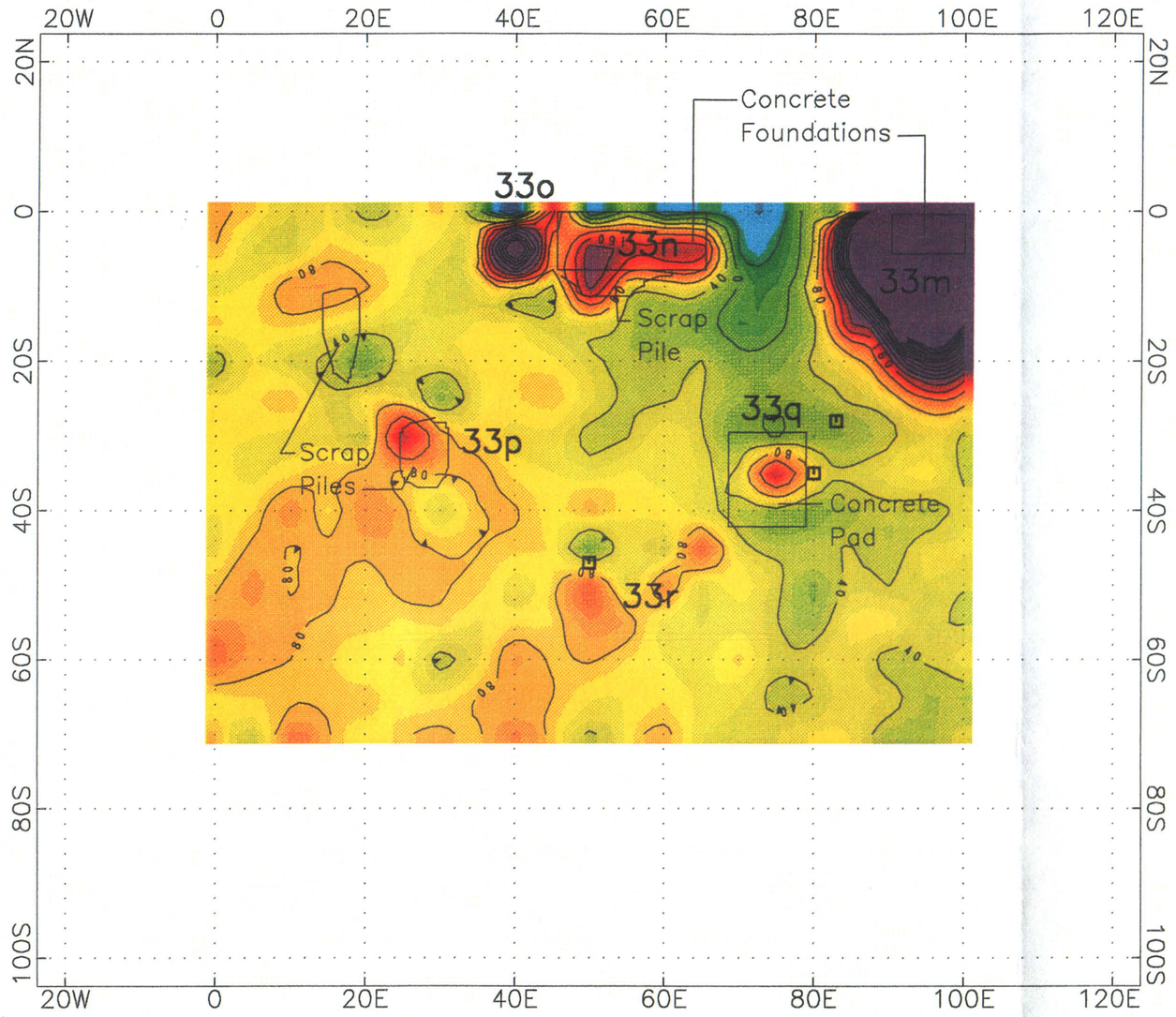
Not To Scale

HYCAL ENVIRONMENTAL SCIENCES LTD

PRELIMINARY ENVIRONMENTAL INVESTIGATIONS
CONTRACT 96-6136

CANOL PUMP STATION G, MP 1166
GEOPHYSICAL SURVEY AREAS
November, 1996 - Figure 14

ASSOCIATED MINING CONSULTANTS LTD - PG93



33m Magnetic Anomaly

Surface Metal

230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100

MAGNETIC INTENSITY
(nT) (56450 nT subtracted)

Scale 1:750

10 0 10 20 30 40
(meters)

HYCAL ENVIRONMENTAL SCIENCES LTD

PRELIMINARY ENVIRONMENTAL INVESTIGATIONS
CONTRACT 96-6136

CANOL PUMP STATION G, MP 1166
TOTAL FIELD MAGNETOMETER SURVEY - AREA 'C'
November, 1996 - Figure 15

ASSOCIATED MINING CONSULTANTS LTD - PG93

location of the foundations of pre-existing buildings. Only small quantities of buried metal are, therefore, indicated.

4.4 Adjacent Properties

Lands immediately surrounding the subject property were undeveloped and consisted of northern boreal forest, with black spruce, scrub willow, birch and moss. The Alaska Highway was located north of the subject property. No conditions were identified on adjacent properties that would suggest that the subject property has been adversely affected by activities on neighbouring land.

4.5 Soil Analyses

Results of analyses of soil sample analyses from the subject site are presented in Figure 8. Geophysical and soil investigations of the site are summarized in Figure 16.

A soil sample from the area beside a pump station outlet (Sample S5) was analyzed for metal content. It was found to contain levels of nickel, vanadium and zinc in excess of CCME Assessment criteria but below CCME Remediation Criteria.

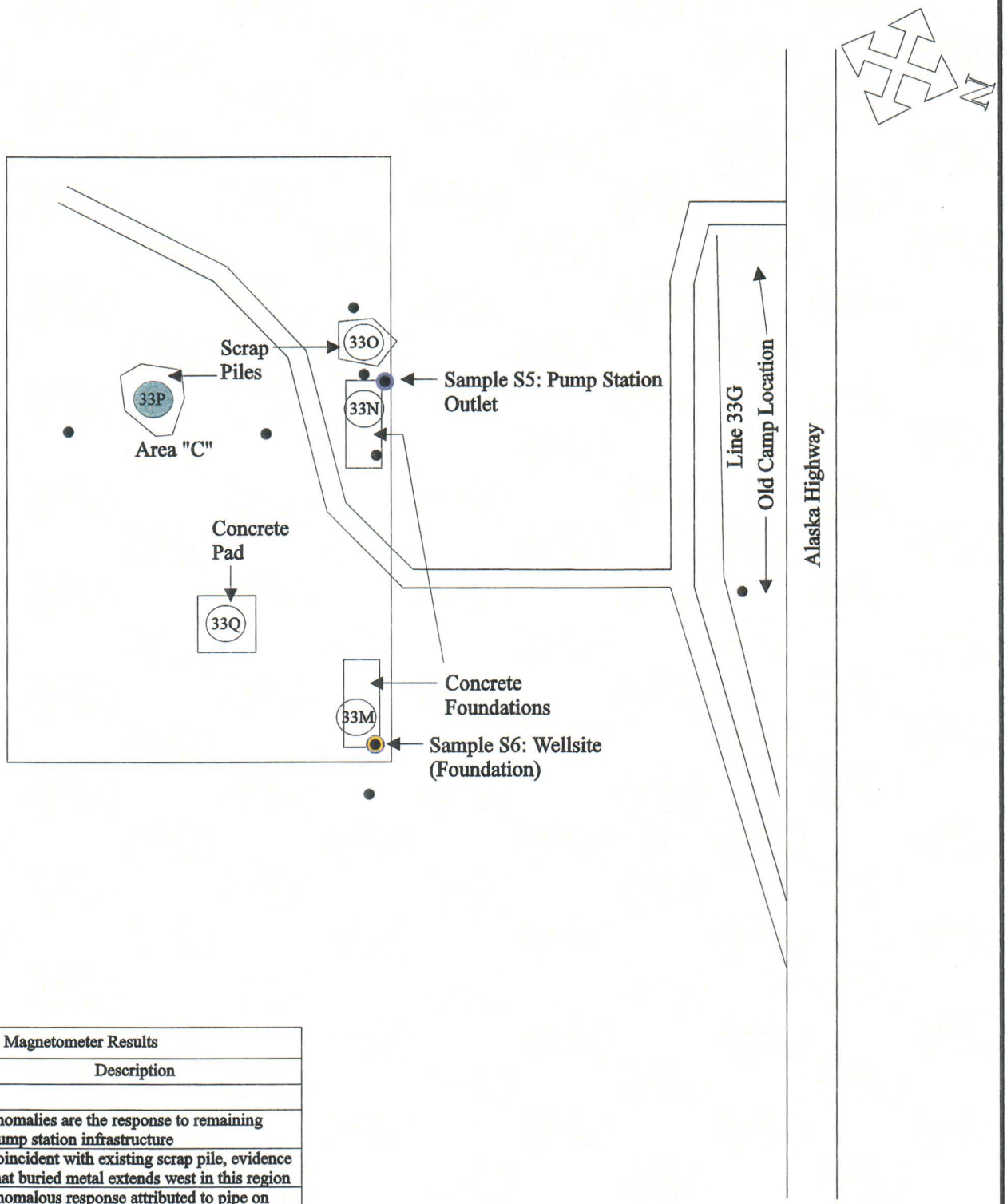
A soil sample from the area beside a concrete foundation at the pump station (Sample S6) was analyzed for metal and hydrocarbon content. Levels of chromium, lead, nickel, vanadium and zinc in this sample were above CCME Assessment Criteria but were below CCME Remediation Criteria. Hydrocarbon levels in this sample were greater than Alberta Tier 1 criterium for hydrocarbons.

4.6 Preliminary Risk Evaluation

Based on the available information (refer to Section 4.1 for a detailed description of site location, soil characteristics, site drainage, adjacent water bodies, and land use), it is likely that the following factors will act to increase the ecological risk at this site:

1) Contaminants

The presence of contaminants in exceedence of CCME assessment criteria increases the risk of an ecological impact. In addition it is likely these contaminants will be



Magnetometer Results	
Anomaly	Description
Area "C":	
33m, 33n & 33o	anomalies are the response to remaining pump station infrastructure
33p	coincident with existing scrap pile, evidence that buried metal extends west in this region
33q	anomalous response attributed to pipe on ground surface
Line 33G	slight variations correspond with the location of the foundations of pre-existing buildings

Samples Analyzed	Criteria Exceeded		
	Assessment	Remediation	Other
S5	Ni,V,Zn	-	-
S6	Cr,Pb,Ni,V,Zn	-	Hydrocarbons

Legend

- Vegetation or Soil Sample Location
- CCME Assessment Criteria Exceedance
- CCME Residential / Parkland Criteria Exceedance
- Other Exceedances or Levels of Concern
- Evidence of Buried Metal

Yukon Environmental Strategy - Action on Waste
DIAND

Phase I & II ESA

Former Military Site - Mile Post 1166, Koidern - White River (Canol Pump Stat. G)
DIAND Site 33

Summary of Geophysical and Soil Investigations

Figure 16	November, 1996	Not to Scale

Hycal ENVIRONMENTAL SCIENCES LTD.

taken up and concentrated within vegetation of the site due to the chemical characteristics of the contaminants found.

2) Soils

The moderate permeability of the subsurface material on the site increases risk of contaminant migration and exposure to additional receptors.

3) Land Use

The use of nearby land for hunting increases the risk of humans consuming animals exposed to contaminants through foraging or habitation on site.

4) Wildlife

The number of plant and animal species found at this site increases the likelihood that a species will be impacted by the contaminants found here.

The following site characteristics will act to decrease ecological risk:

1) Permafrost

The ubiquitous presence of permafrost beneath surface soils will act as a natural barrier preventing contaminants from deep migration.

While wildlife observed in the area during the investigation is outlined in Section 4.1.6, a detailed inventory of wildlife in the area was precluded by the scope of the investigation. Therefore, at this point in time, Valued Ecosystem Components (VEC) cannot be adequately assessed since this would require a detailed examination of interrelationships within the ecosystem of this site. If the site's ecosystem was better understood, keystone species as well as hypersensitive species could be identified and used in statistical models to predict impacts to the ecosystem.

Based on the limited species information readily available, no species listed as endangered by the World Wildlife Foundation of Canada (WWF) were identified on the site. The only site species listed as vulnerable that was identified on the site was the grizzly bear.

Contaminants of Concern

As detailed in Section 4.5, chromium, lead, nickel, vanadium and zinc were found in excess of CCME assessment criteria. In addition 6 metals (Zinc,

Selenium, Nickle, Lead, Copper and Arsenic) were found to exceed CCME remediation criteria for residential/parkland areas. A potential risk mitigating factor is that chromium, vanadium and zinc were found in exceedance of CCME Assessment Criteria in the background sample for the area (Sample S1, refer to Section 5.5). The primary concern associated with these metal contaminants is that they are readily taken up in vegetation as micronutrients where they are bioconcentrated. Animal species then consume this vegetation while foraging on site and receive a concentrated dose of metals.

The only other contaminant of concern found at this site is hydrocarbons. The hydrocarbons represent a moderate to low risk since the hydrocarbon concentrations is fairly low.

5.0 INVESTIGATIVE RESULTS - BEAR FLATS-WHITE RIVER LODGE, MP 1167 to 1167.5

5.1 Site Location and Description

5.1.1 Location

The Bear Flats-White River Lodge site is located immediately south of the Alaska Highway from MP 1167 to 1167.5 (Figure 17), directly west of the Bear Flats Lodge. The site is at latitude 61°58'N and longitude 140°30'.. Most of the site is located south of the Alaska Highway. However, an old wooden building and some wooden debris is present to the north of the highway, on private land.

The site is approximately 1.5 kilometres east of the White River. A braided river is located approximately 150 metres north of the site.

5.1.2 Site Appearance

The eastern portion of the subject property included a clearing which contained a large pit (Photograph 13), and a forested area which contained buildings (Photograph 14) and remains (scrap piles and wooden and metal debris) of a former camp (Photographs 15, 16 and 17). The western portion of the site included a vegetated area containing a number of mounds (Photograph 18), and a clearing which contained a concrete scrap pile and a concrete pad with oil change pits and sumps (Photographs 19 and 20).

The area north of the site, across the Alaska Highway, contains some buildings which appear to have been associated with activities at the subject site (Photographs 20 and 21). While the northern area was assessed visually, it was reported to be located on private lands and was not accessed for geophysical and soil investigations.

5.1.3 Topography, Geology and Soils

The Bear Flats-White River site is underlain by terraced postglacial alluvial gravel (Rampton, 1977).

The subject site is located in the discontinuous permafrost zone (Geological Survey of Canada, 1967). Topography over the subject site is variable with 1 to 2 metre localized changes in elevation that appear to be the result of thermokarsting.

Photograph 13. Pit Area, Northern Portion of Bear Flats - White River Site, MP 1166. October 1996. Note: Bear Flats Lodge in Background.

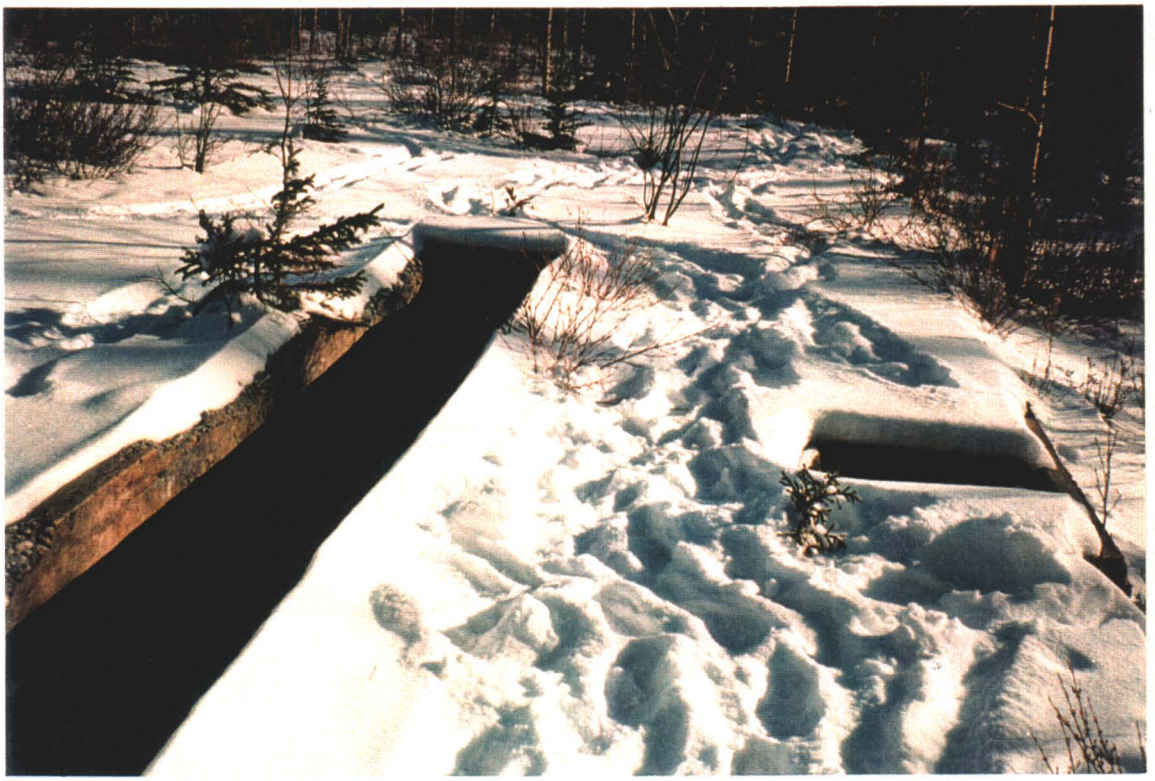
Photograph 14. Former Military Barracks and Latrine, Bear Flats - White River Site, MP 1166. October 1996.

Photograph 15. Debris Mound at Bear Flats - White River Lodge Site, MP 1166. October 1996.

Photograph 16. Possible Tank Outlet, Bear Flats - White River Lodge Site, MP 1166. October 1996.

Photograph 17. Discarded Barrel, Bear Flats - White River Lodge Site, MP 1166. October 1996.

Photograph 18. Barbed Wire Fencing On Top of Mound, Bear Flats - White River Lodge Site, MP 1166. October 1996.



Photograph 19. Oil Change Pit and Sump, Bear Flats - White River Lodge, MP 1167.5. October 1996.

Photograph 20. Oil Change Pits, Bear Flats - White River Lodge, MP 1167.5. October 1996.

Photograph 21. Building Debris on Northern Side of the Alaska Highway, Bear Flats - White River Site. October 1996.

Photograph 22. Abandoned Building on Northern Side of the Alaska Highway, Bear Flats - White River Site. October 1996.

Soil is poorly developed in the area. Soil sampling indicated that the soil is generally very dark brown (Munsell colour 2/2) and organic, with minor silt to very fine sand. Scattered areas of soil were found to consist of gray (Munsell colour 6/1) to pinkish gray (Munsell colour 6/2) very sandy soil with pebbles and granules. This soil contain little organic content.

5.1.4 Surface and Subsurface Water

No water ponding was noted on the site at the time of the investigation. A small stream was present directly south of the site.

No groundwater wells were present in the area and groundwater flow direction is unknown. Groundwater flow direction may be to the south, towards the small stream, however, this stream appears to be the result of minor topographic change and may not reflect a deeper water gradient. Groundwater flow direction may, rather, be towards major river systems to the west or north.

5.1.5 Vegetation

The area at MP 1167 was largely covered by dense vegetation which consisted predominantly of white spruce and poplar. Moss was present over much of the ground surface.

The area at MP 1167.5 was somewhat open, with sparse vegetation, consisting of poplar and some willow. Moss was present over much of the ground surface.

5.1.6 Wildlife

Wildlife which was observed in the area of the site (through tracks and scat, or through actual sightings) included bear, muskrat, beaver, mice, rabbits, coyotes, and grouse. Other wildlife reported in the area include moose, caribou, lynx, fox, eagles, swans, ducks and geese (Agriculture and Agri-Food Canada and Environment Canada, 1996). Bear in the area are reported to be of the black and grizzly varieties. It was reported the area has a very active bear (black and grizzly) population and that in 1995, approximately 13 bears were believed killed in the area of the Bear Flats Lodge (Jim Cook, pers.comm.).

Local wildlife officials reported that the White River contains whitefish, chub, chum salmon and grayling (Lorne Laroque, pers.comm.).

5.1.7 Climate

Environment Canada (Agriculture and Agri-Food Canada and Environment Canada, 1996) describes the climate in the area as follows:

> The climate is characterized by short, cool summers and long, cold winters. Winter temperature inversions are common, giving milder temperatures at higher elevation. Maritime air from the Gulf of Alaska periodically invades the ecoregion during the winter to produce mild spells with near-thawing temperatures. The mean annual temperature for the area is approximately -3°C with a summer mean of 10°C and a winter mean of -17°C. Mean annual precipitation ranges 250-300 mm.

5.1.8 Land Use

The subject site was not in formal use at the time of the site investigation. However, the lodge immediately east of the site is used from the spring to the fall. A borrow pit, immediately west of the site appeared to have been in recent use.

Trapping and hunting is reported to occur in the general region of the site. Environment Canada has reported that "Land Use recollects high recreational, tourism and hunting values. (Agriculture and Agri-Food Canada and Environment Canada, 1996). Hunting is, however, prohibited within 1 kilometre of the Alaska Highway, so hunting is not allowed in the immediate site area.

The site is currently held by the Crown.

5.2 Site History

The first known occupation of the subject site was during World War II when it was occupied by United States military camps associated with the building of the Alaska Highway. The camp at this location was known as Camp O'Hara or the Koidern Way Station (Truck Tracks, 1944).

Records of camps and bivouacs of the Eighteenth Engineers Regiment (U.S.) in the Yukon from 1942 to 1943 (Rust, 1943) do not record a camp on the eastern side of the site. These records report that a camp was present at MP 268, one mile east of the mile post at which the most easterly remains of a camp were found during the investigation. A 1943 map (Figure 18) shows the U.S. Army White River Telephone Relay Station west of MP 1167 but nothing east of this point. The barracks building remaining on the eastern edge of the site and the

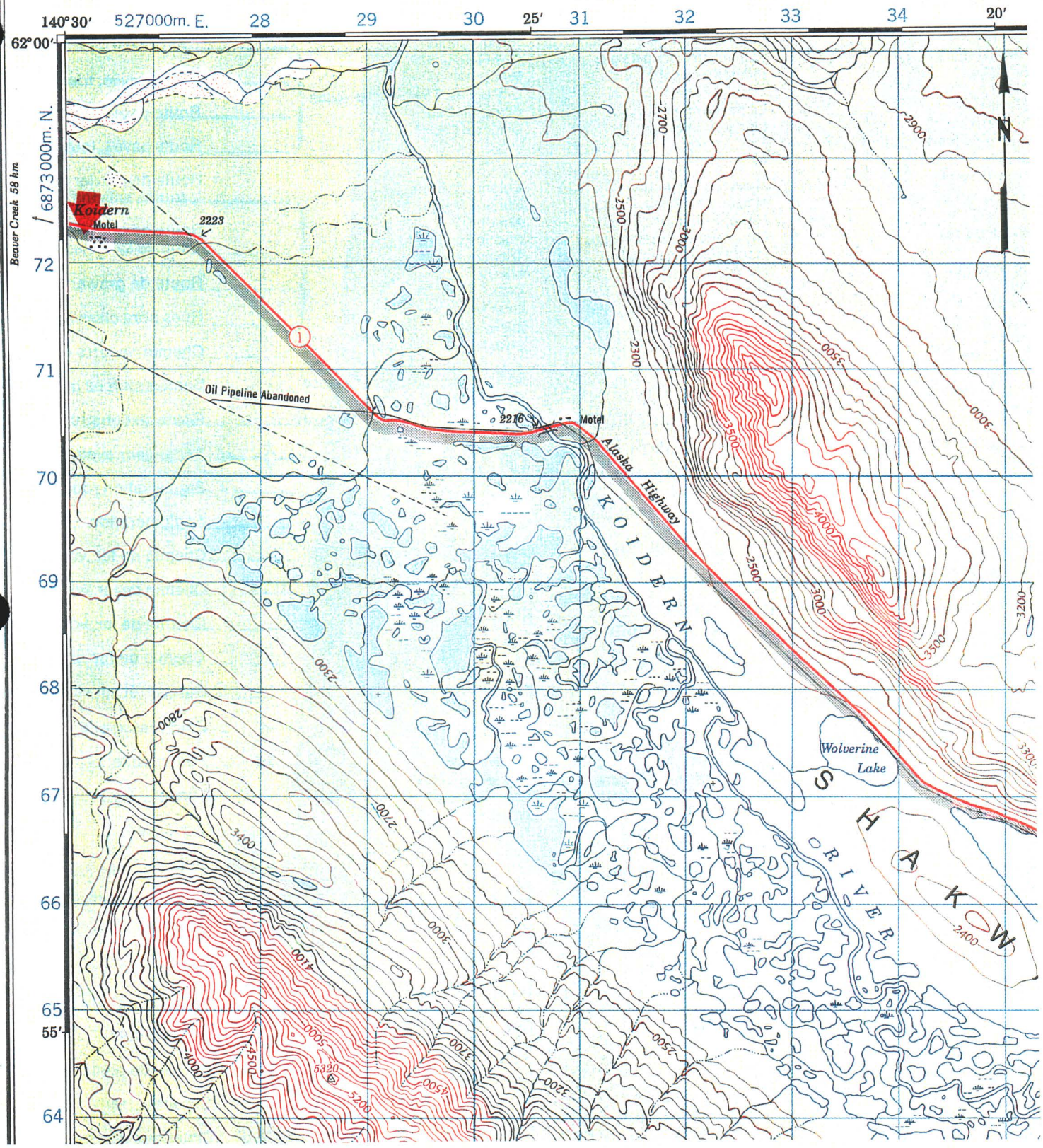


Figure 17. Detailed Location of Bear Flats - White River Lodge Site, MP 1167-1167.5.

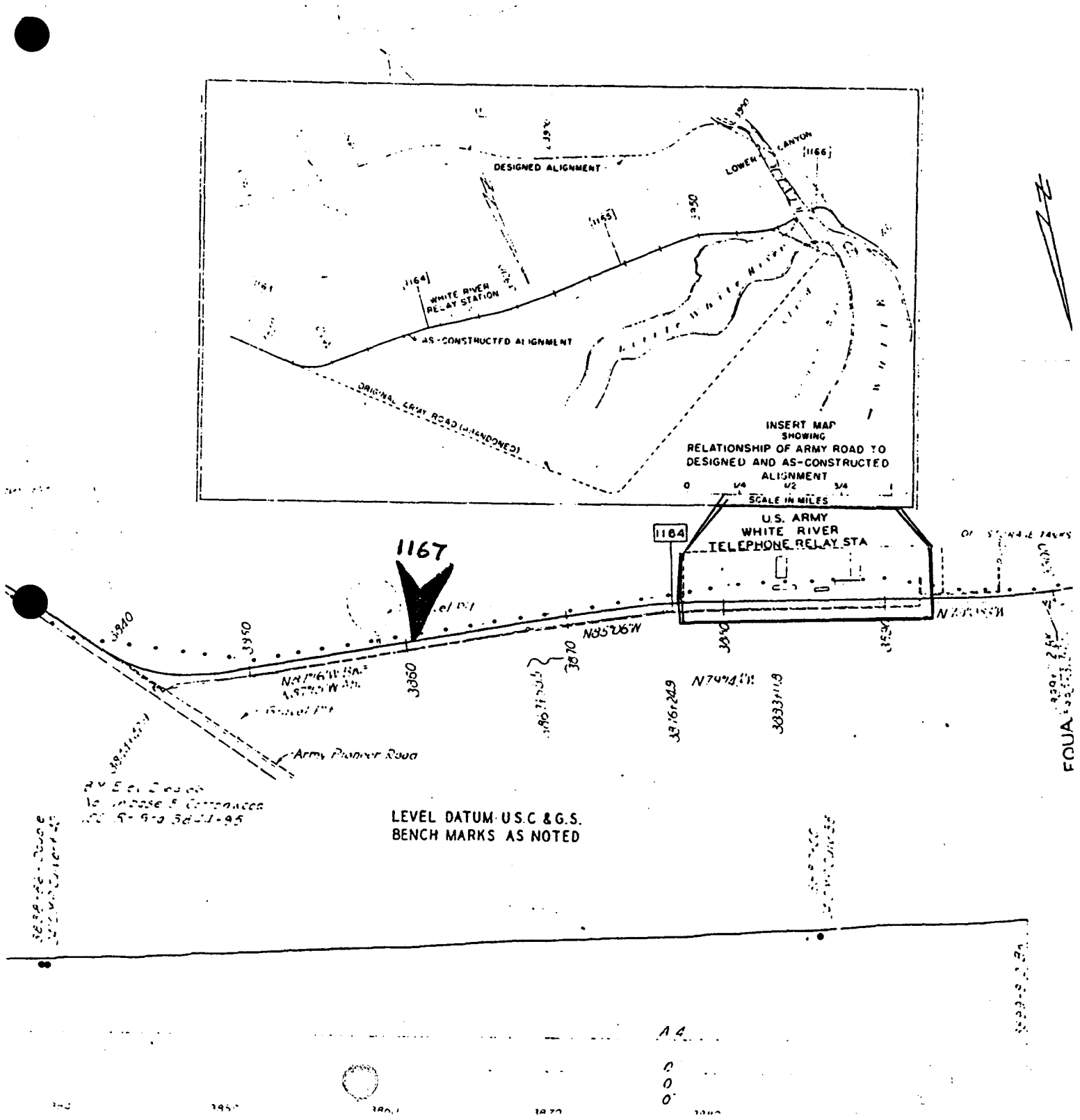


Figure 18. Public Roads Administration Map of the Bear Flats - White River Lodge Site, 1943 (with later ammendments).

presence of old barracks buildings at the Bear Flats Lodge indicate that barracks were indeed present east of where some historical sources may locate them.

1976 mapping by Edey (Figure 19) and an undated and unattributed set of notes in the Yukon Archives (Appendix B), presumably from the 1980, recorded debris remained on the site.

Aerial photographs of the site housed at the Yukon Archives and at the University of Calgary were reviewed. Aerial photographs from 1964 (Figure 20) indicated that the Alaska Highway was originally located to the south of the site. The current Alaska Highway was evident directly north of the site. An old road, running through the camp, perpendicular to the Alaska Highway, was still evident in aerial photographs.

Site reconnaissance revealed the presence of a number of small (approximately 4 m^2 in aerial extent), open pits on the site. These pits suggested that plans to bury material on the site may have been interrupted. It is unknown at what stage these burials could have been interrupted and how many pits were filled at the site. Results of the geophysical investigation do suggest that some materials were buried in pits on the subject site.

5.3 Geophysical Results

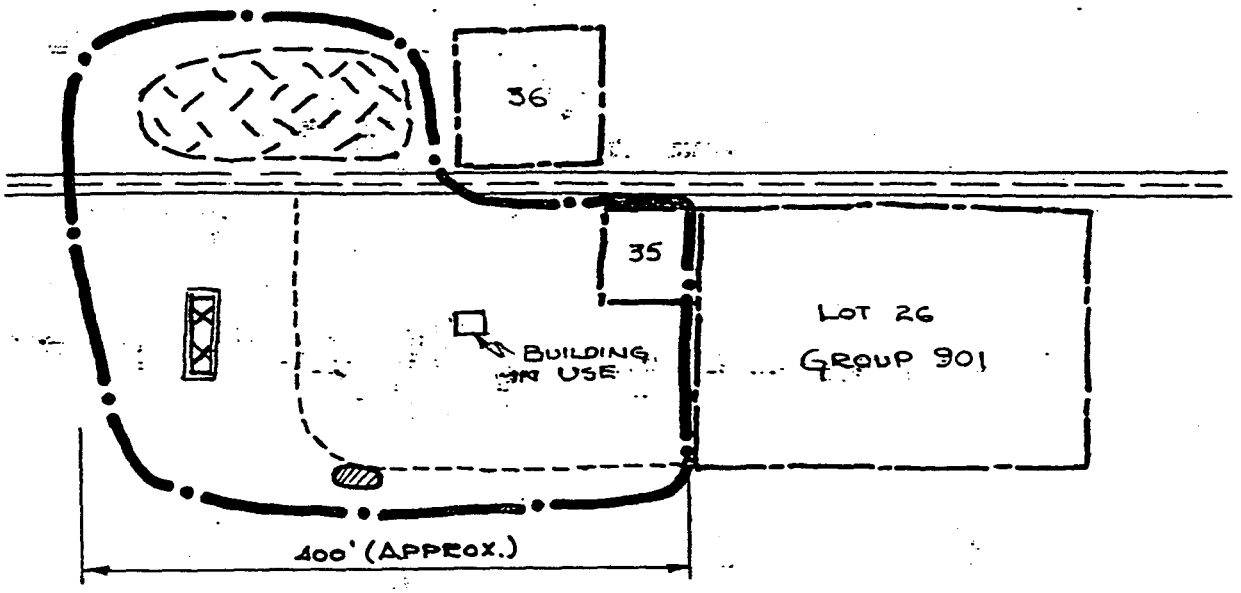
The scope of the project prevented the undertaking of a detailed geophysical study over the full extent of the site. Instead, areas were prioritized for geophysical evaluation based upon site inspection.

Two areas were investigated by geophysical means within the Bear Flats-White River site at MP 1167 (Figure 21). Area "A" occupied a relatively extensive area encompassing several scrap metal piles and an existing building remaining from the original Alaska Highway construction camp. Dense vegetation resulted in the use of magnetic methods to delineate subsurface metals.

Magnetic data in Area "A" was acquired at 5 metre intervals along survey lines spaced 5 metres apart. Results, as illustrated in Figure 22, identified a number of prominent magnetic anomalies resulting from proximity to metal:

33a Anomalous magnetic response attributed to metal within the adjacent building.

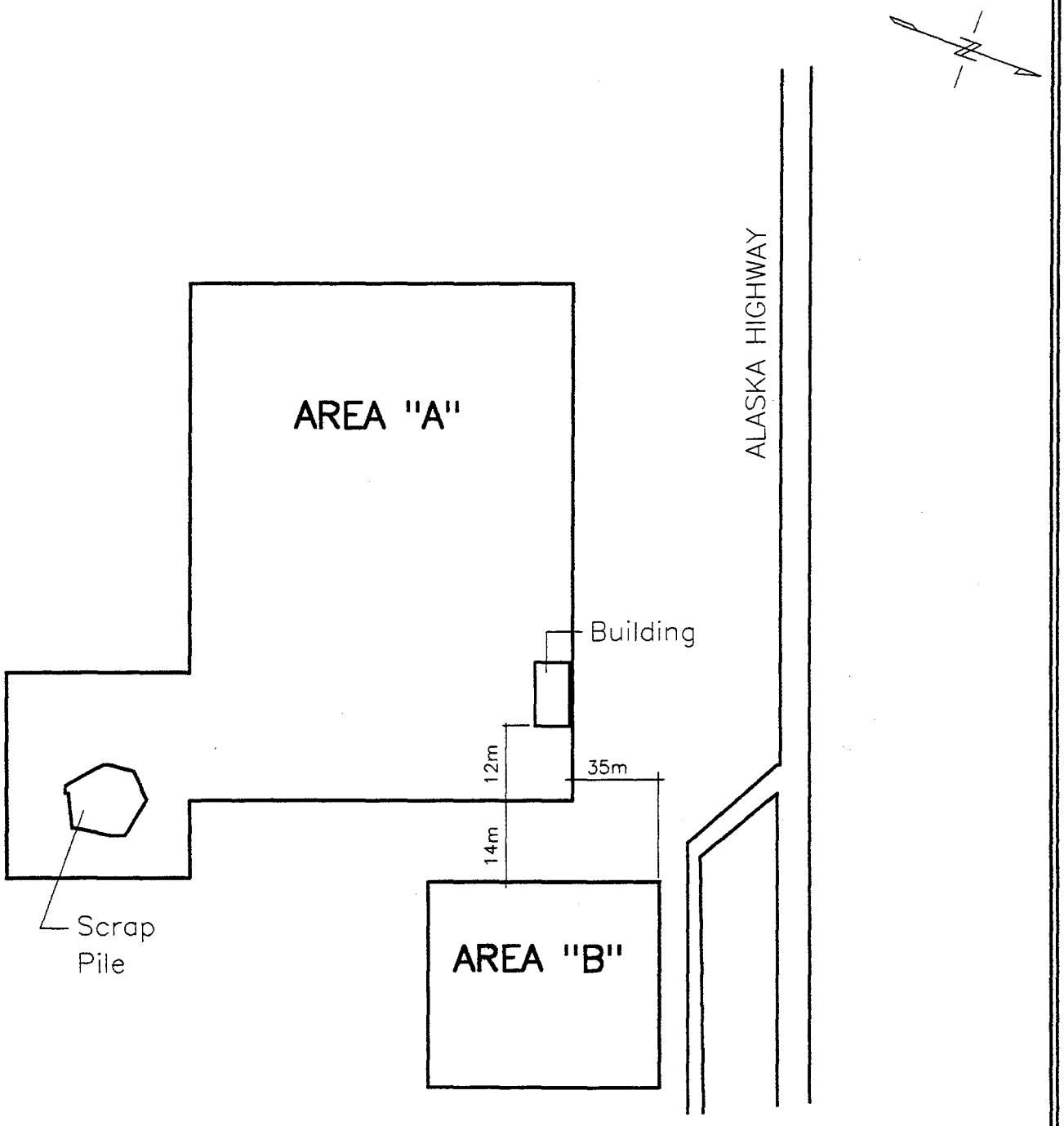
33b Anomalous magnetic response due to 45 gallon drum on ground surface.



NORTH ALASKA HIGHWAY
MILE - 1167.5
KOIDERN
FIGURE 33
EDEY, C.E. 197

Figure 19. 1976 Mapping of the Bear Flats - White River Lodge Site by Edey.

Figure 20. Aerial Photograph of Bear Flats - White River Lodge Site, 1964, 1:6000.



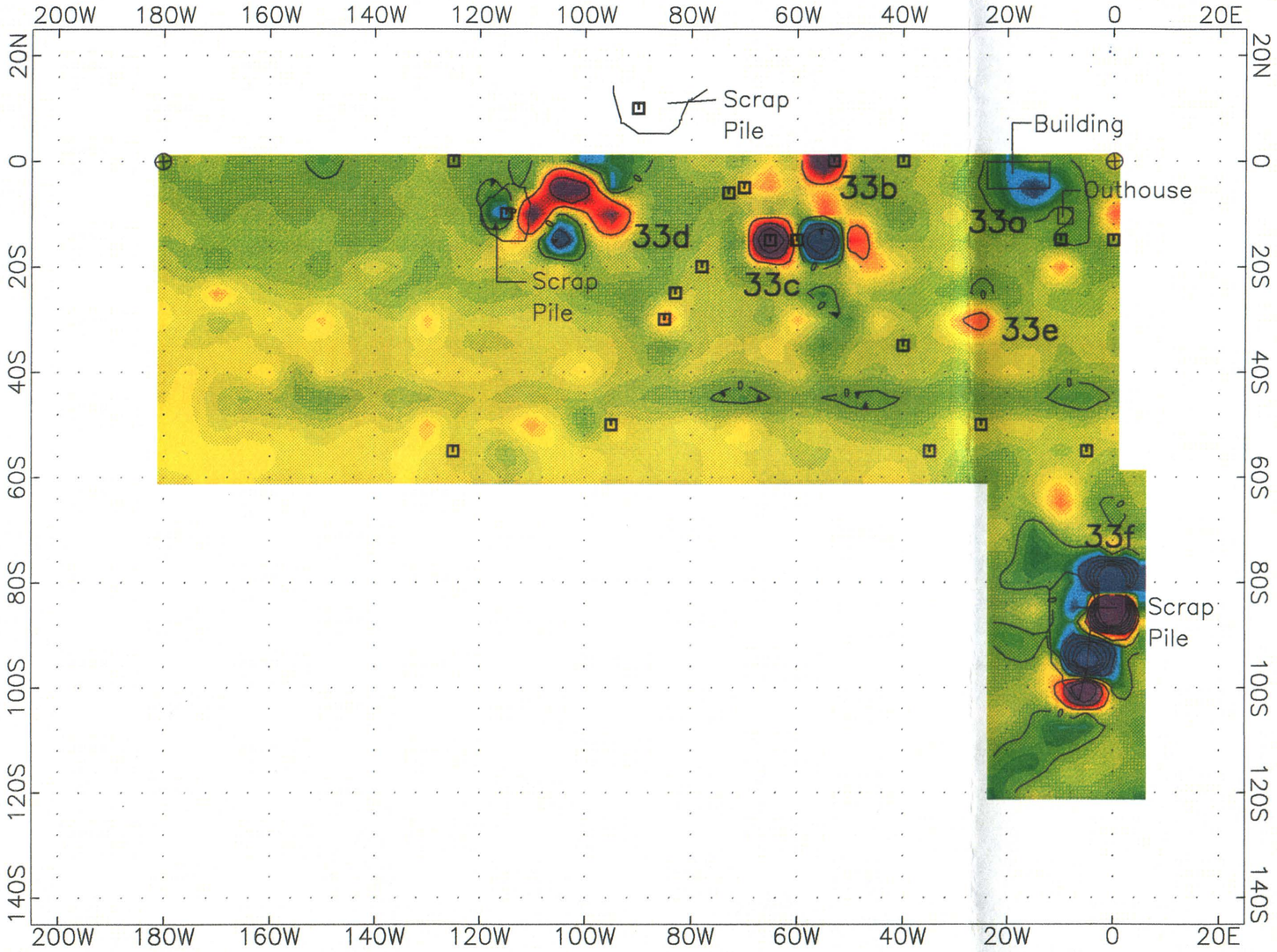
Not To Scale

HYCAL ENVIRONMENTAL SCIENCES LTD

PRELIMINARY ENVIRONMENTAL INVESTIGATIONS
COTRACT 96-6136

BEAR FLATS - WHITE RIVER LODGE SITE, MP 1167
GEOPHYSICAL SURVEY AREAS
November, 1996 - Figure 21

ASSOCIATED MINING CONSULTANTS LTD - PG93



33a Magnetic Anomaly
⊡ Surface Metals
⊕ Survey Grid Markers

230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100

MAGNETIC INTENSITY
(nT) (56550 nT subtracted)

Scale 1:1000

10 0 10 20 30 40 50 60
(meters)

HYCAL ENVIRONMENTAL SCIENCES LTD

PRELIMINARY ENVIRONMENTAL INVESTIGATIONS
CONTRACT 96-6136

BEAR FLATS - WHITE RIVER, MP 1167
TOTAL FIELD MEGNETOMETER SURVEY - AREA 'A'
November, 1996 - Figure 22

ASSOCIATED MINING CONSULTANTS LTD - PG93

33c Magnetic anomaly resulting from metal (pipe and bracket) visible at surface.

33d Elevated magnetic response resulting from metal within an adjacent scrap pile.

33e No metal apparent at surface. The magnetic anomaly was attributed to the occurrence of subsurface metal.

33f Anomalous magnetic response attributed exclusively to adjacent scrap pile containing large quantities of visible metal.

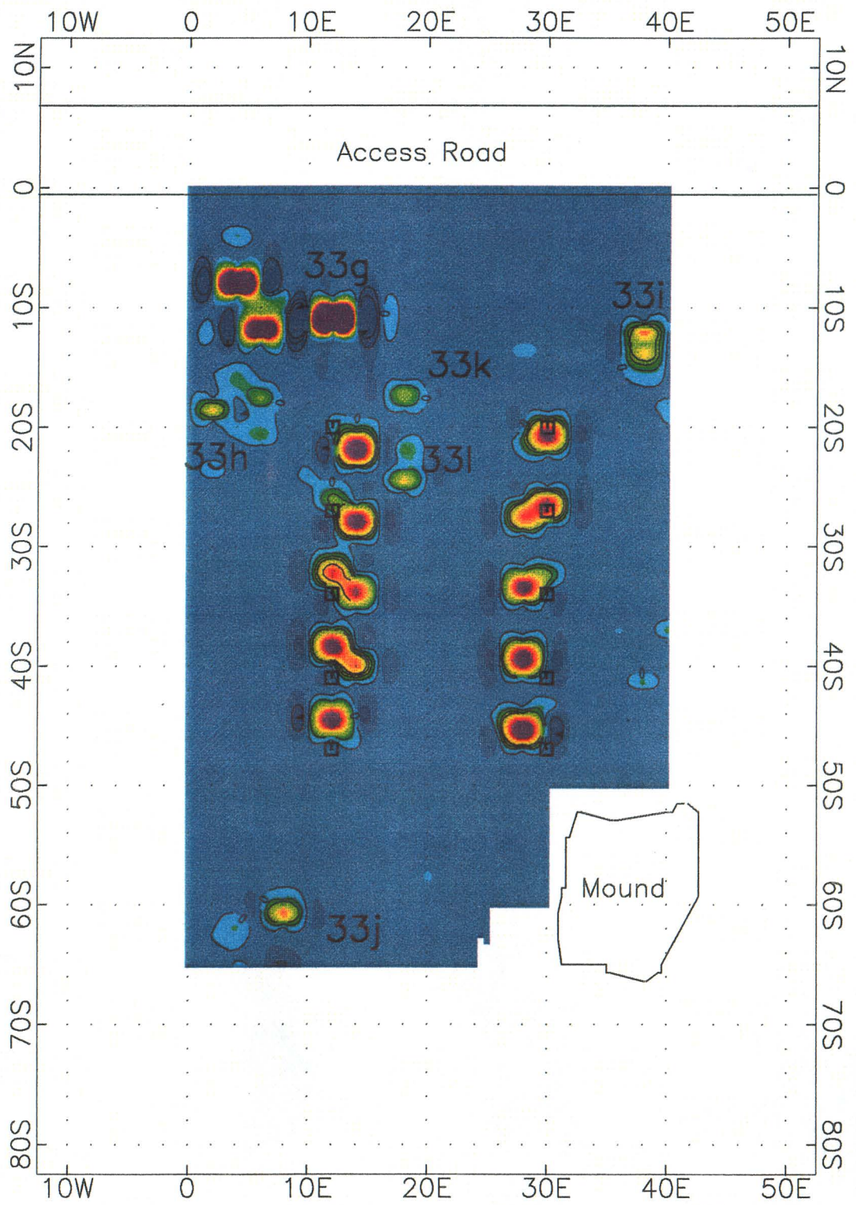
Area"B" was an open, flat area east of Area"A". Site conditions enabled the use of EM61 instrumentation to investigate the presence of subsurface metals. The EM61 Channel 2 survey data (Figure 23) identified regions of elevated electromagnetic response indicative of metal. Scrap metal was evident at ground surface at Stations 4E,8S and 6E,12S, resulting in anomaly 33g. Anomalies 33h, 33I, 33j, 33k and 33l, apparent in the EM61 Channel 2 survey data, were significantly less prominent in the EM61 Differential Channel data (Figure 24), indicating that the identified metal occurs at relatively shallow depth. In addition, ten localized areas of electromagnetic response (unlabelled) occurred at constant intervals along survey Lines 12E and 30E, corresponding with existing 1 metre by 1 metre square metal panels mounted flush with the ground surface.

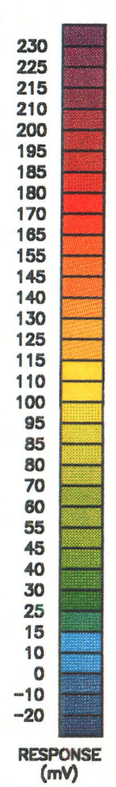
Results of the geophysical investigation of the area around MP 1167 are summarized in Figure 25.

Three areas within a relatively large and somewhat open area northwest of the Alaska Highway, at MP 1167.5 were selected for geophysical investigation (Figure 26). The prominent feature at the site consisted of a large (approximately 50 metres by 30 metres) concrete pad and an adjacent concrete scrap pile. Although vegetation was relatively sparse within the site perimeter, the magnetic method was employed to reduce instrument set-up time.

Line 33c Located along the axis of a prominent mound, magnetic measurements acquired along Line 33C varied only slightly. This suggested that any metal that may be present within the mound in the vicinity of the survey line was not extensive.

Lines 33D and 33E Two perpendicular lines transected a prominent earth mound. Variations within magnetic response was indicative of some quantity of buried metal.





33g EM61 Anomaly

⊡ Surface Metal

Scale 1:500

5 0 5 10 15 20 25 30

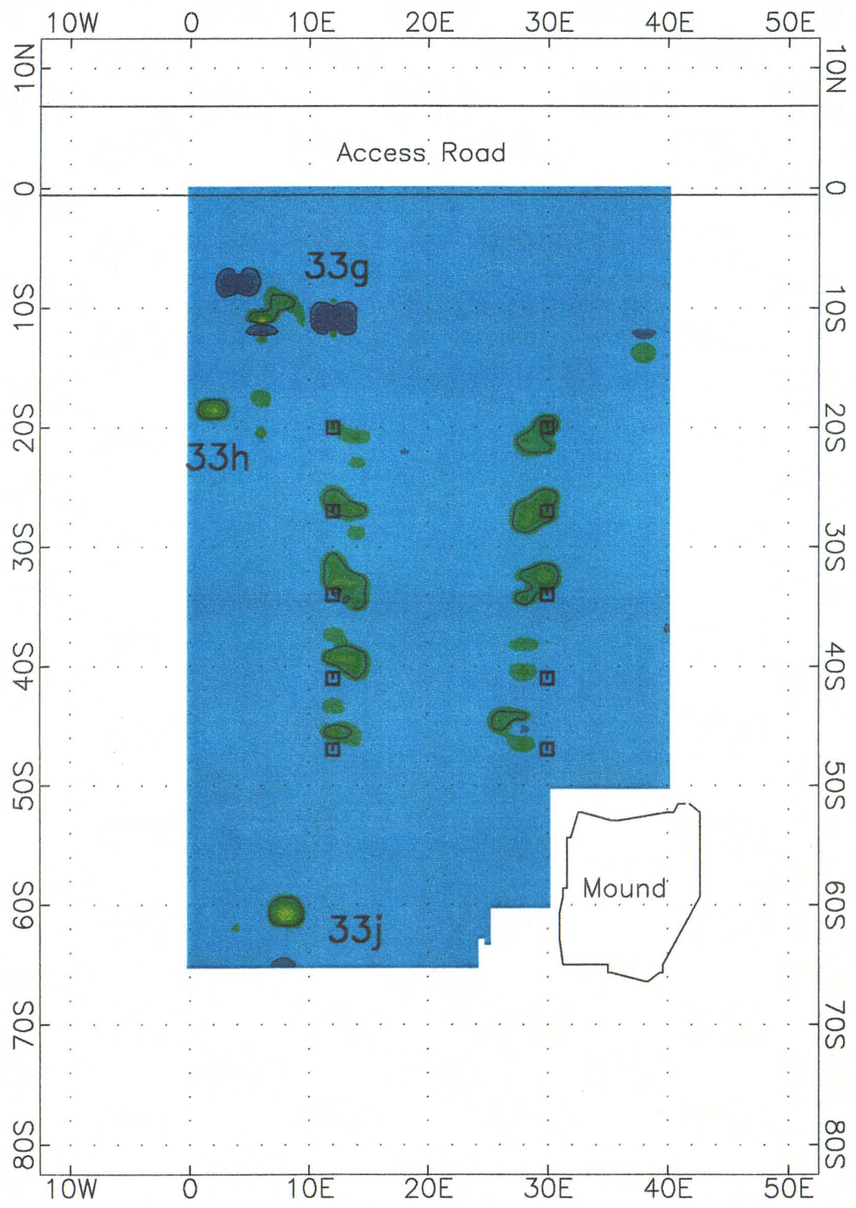
(meters)

HYCAL ENVIRONMENTAL SCIENCES LTD

PRELIMINARY ENVIRONMENTAL INVESTIGATIONS
CONTRACT 96-6136

BEAR FLATS - WHITE RIVER, MP1167
EM61 SURVEY - Channel 2 - AREA 'B'
November, 1996 - Figure 23

ASSOCIATED MINING CONSULTANTS LTD - PG93



33g EM61 Anomaly

Surface Metal

RESPONSE (mV)

230
225
215
210
200
195
185
180
170
165
155
145
140
130
125
115
110
100
95
85
80
70
60
55
45
40
30
25
15
10
0
−10
−20

Scale 1:500

5 0 5 10 15 20 25 30

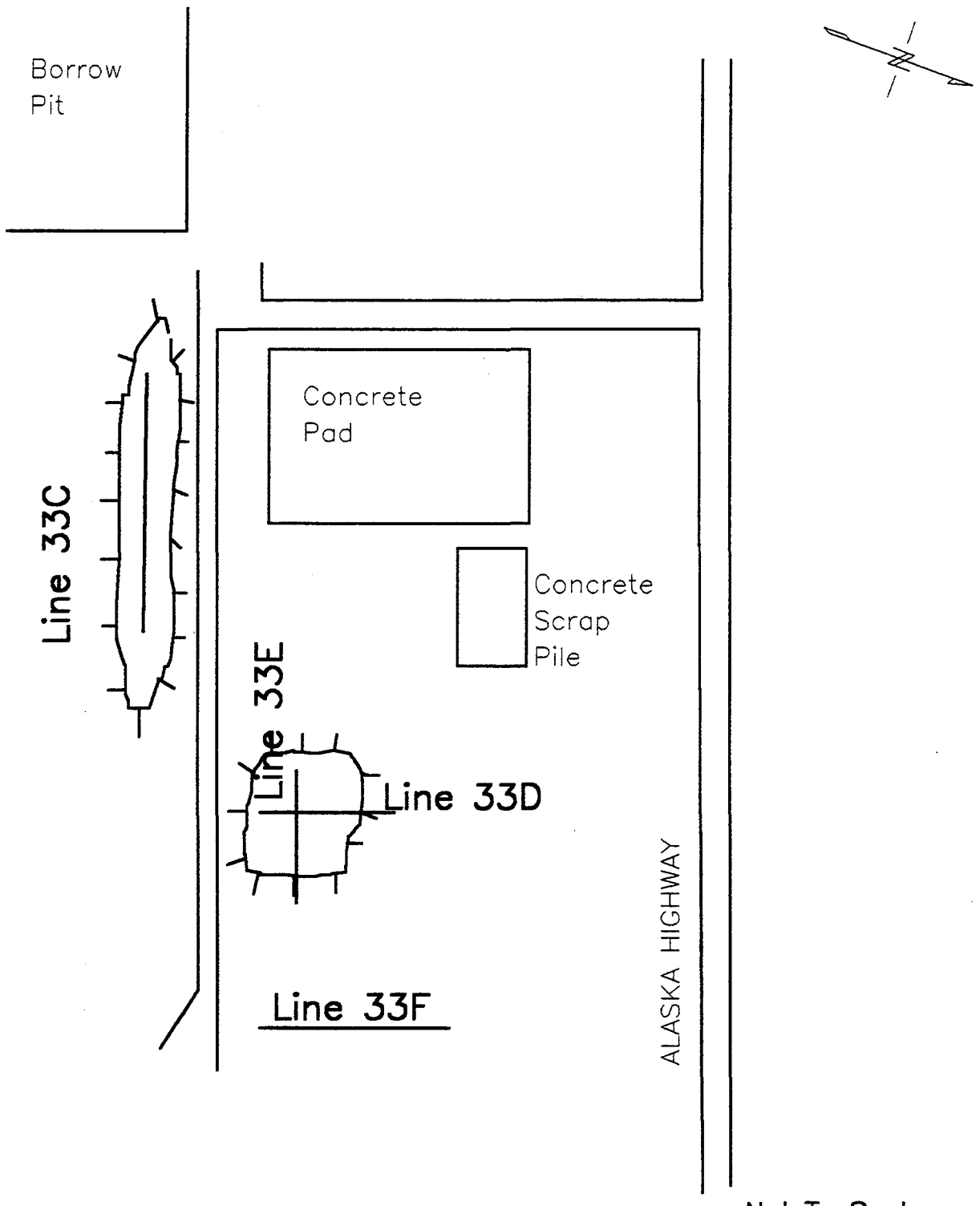
(meters)

HYCAL ENVIRONMENTAL SCIENCES LTD

PRELIMINARY ENVIRONMENTAL INVESTIGATIONS
CONTRACT 96-6136

BEAR FLATS - WHITE RIVER, MP 1167
EM61 SURVEY - differential Channel - AREA 'B'
November, 1996 - Figure 24

ASSOCIATED MINING CONSULTANTS - PG93



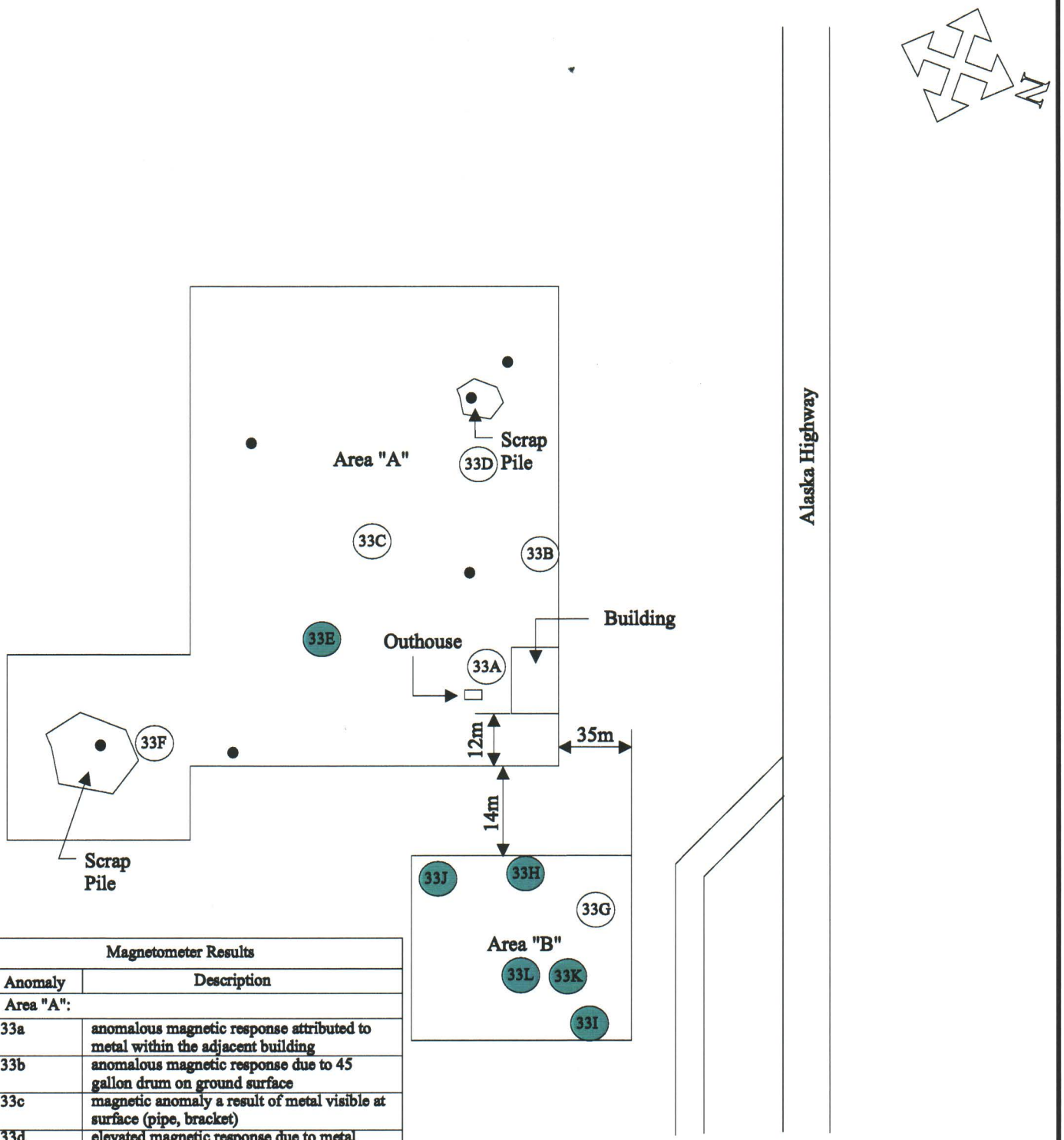
Not To Scale

HYCAL ENVIRONMENTAL SCIENCES LTD

PRELIMINARY ENVIRONMENTAL INVESTIGATIONS
CONTRACT 96-6136

BEAR FLATS - WHITE RIVER LODGE SITE, MP 1167.5
GEOPHYSICAL SURVEY AREAS
November, 1996 - Figure 26

ASSOCIATED MINING CONSULTANTS LTD - PG93



Magnetometer Results	
Anomaly	Description
Area "A":	
33a	anomalous magnetic response attributed to metal within the adjacent building
33b	anomalous magnetic response due to 45 gallon drum on ground surface
33c	magnetic anomaly a result of metal visible at surface (pipe, bracket)
33d	elevated magnetic response due to metal within adjacent scrap pile
33e	magnetic anomaly attributed to subsurface metal
33f	anomalous magnetic response due to metal within adjacent scrap pile

EM61 Survey Results	
Area "B"	Anomaly 33g is attributed to surface metal. Anomolies 33h - 33l are attributed to shallow, buried metal. Other anomolies were consistent with metal panels mounted at ground surface.

Legend
Vegetation or Soil Sample Location
Evidence of Buried Metal

Yukon Environmental Strategy - Action on Waste
DIAND

Phase I & II ESA

Former Military Site - Mile Post 1167, Koidern, White River (Bear Flats)
DIAND Site 33

Summary of Geophysical and Soil Investigations

Figure 25	November, 1996	Not to Scale

Hycal ENVIRONMENTAL SCIENCES LTD.

Line 33F Located within an area where the vegetation appeared to be stressed, magnetic measurements did not suggest the occurrence of buried metal in the immediate vicinity of the line.

5.4 Soil Analyses

A soil sample from one of the two oil change pits on the site (Sample S2) was analyzed for the presence of metals, hydrocarbons and PCBs. The sample was found to contain barium, cadmium, chromium, cobalt, mercury, tin and vanadium in excess of CCME Assessment Criteria, but below CCME Remediation Criteria. The levels of arsenic, copper, lead, nickel, selenium and zinc in this sample were above CCME Remediation criteria. Hydrocarbons in this sample exceeded the Alberta Tier 1 Criterium for hydrocarbons. No PCBs were detected in the sample.

A background soil sample (S1), taken from beside a borrow pit on the western side of the site, contained arsenic, chromium, cobalt, copper, nickel, vanadium, and zinc above CCME Assessment Criteria, but below CCME Remediation Criteria.

Geophysical and soil investigations at MP 1167.5 are summarized in Figure 27.

5.5 Preliminary Risk Evaluation

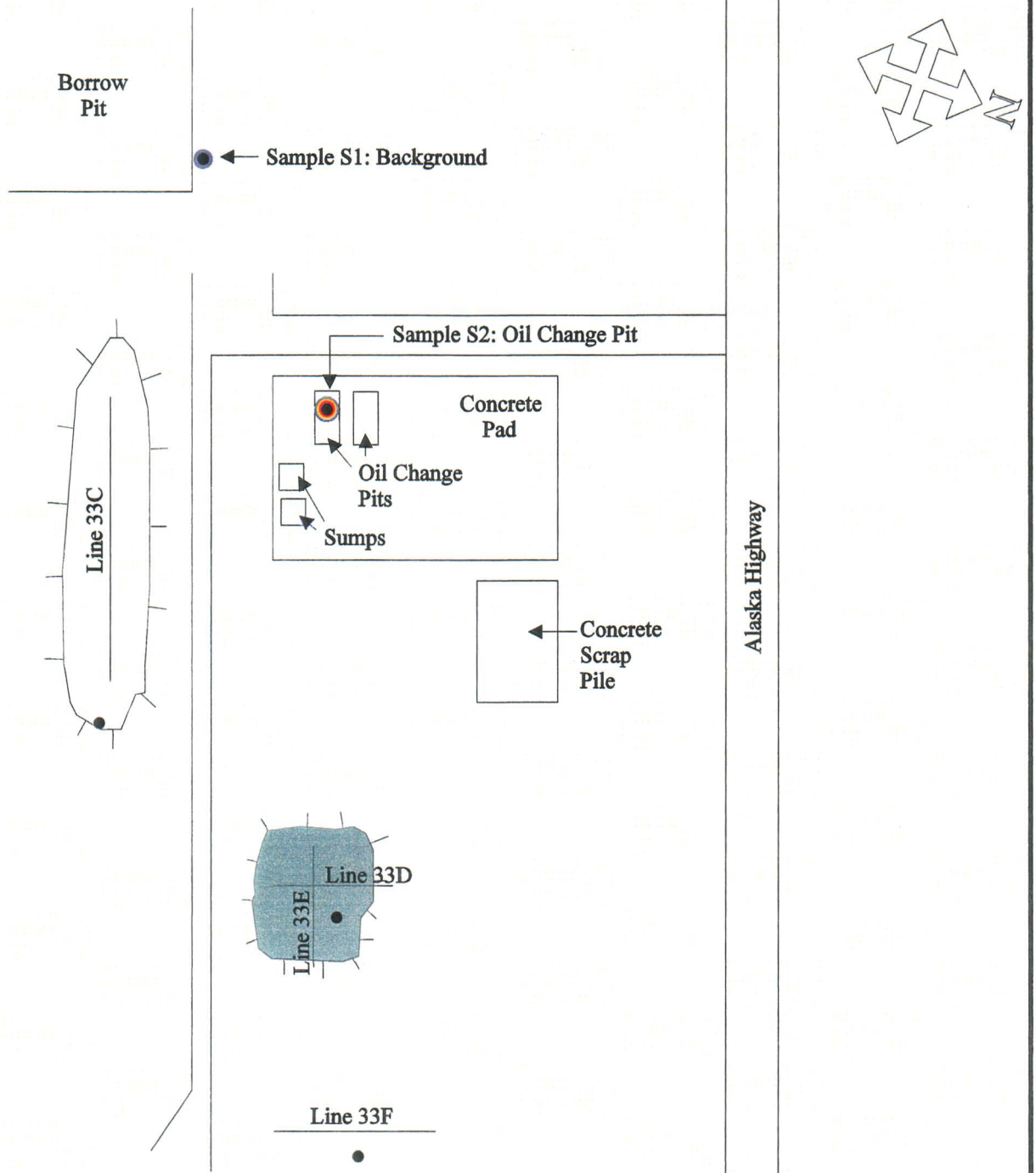
Based on the available information (refer to Section 5.1 for a detailed description of site location, soil characteristics, site drainage, adjacent water bodies, and land use), it is likely that the following factors will act to increase the ecological risk at this site:

1) Contaminants

The presence of contaminants in exceedence of CCME assessment and remediation criteria increases the risk of an ecological impact. If these contaminants extend beyond the oil change pit, they will be taken up and concentrated within vegetation of the site due to the chemical characteristics of the contaminants found

2) Soils

The moderate permeability of the subsurface material (if thawed) in the area, increase the risk of contaminant migration and exposure to additional receptors.



Magnetometer Results	
Line 33C	magnetic measurements vary slightly, any metal present is not extensive
Lines 33D & 33E	variations in magnetic response is indicative of some quantity of buried metal
Line 33F	no evidence of buried metal in immediate vicinity

Samples Analyzed	Criteria Exceeded		
	Assessment	Remediation	Other
S1	As,Cr,Co,Cu Ni,V,Zn	-	-
S2	Ba,Cd,Cr,Co Hg,Sn,V	As,Cu,Pb,Ni Se,Zn	Hydrocarbons

Legend

- Vegetation or Soil Sample Location
- CCME Assessment Criteria Exceedance
- CCME Residential / Parkland Criteria Exceedance
- Other Exceedances or Levels of Concern
- Evidence of Buried Metal

Yukon Environmental Strategy - Action on Waste
DIAND

Phase I & II ESA

Former Military Site - Mile Post 1167.5, Koidern, White River (Bear Flats)
DIAND Site 33

Summary of Geophysical and Soil Investigations

Figure 27 | November, 1996 | Not to Scale

Hycal ENVIRONMENTAL SCIENCES LTD.

3) Land Use

The use of nearby land for hunting increases the risk of humans consuming animals exposed to contaminants through foraging or habitation on site.

4) Wildlife

The number of plant and animal species found at this site increases the likelihood that a species will be impacted by the contaminants found here.

The following site characteristics will act to decrease ecological risk:

1) Permafrost

The ubiquitous presence of permafrost beneath surface soils will act as a natural barrier preventing contaminants from deep migration.

2) Containment

Concrete containment within the oil pit may eliminate several potential exposure routes.

6. CONCLUSIONS AND RECOMMENDATIONS

Investigation of the subject site was limited by the scope of the study. Investigation was prioritized to fit with allotted time and budget. **Further investigation would be required to more fully assess all of the areas within the site or to allow for more precise risk analysis.**

The investigation confirmed the presence of surficial and subsurface debris on all of the subject sites. Given the history of the sites and the visible materials, most of this material appears to have been related to military operations in the area during the construction of the Alaska Highway.

6.1 Historical Data

While historical searches yielded some useful information, the sites appears to have been subject to activities which were poorly or never documented. Therefore, **further historical record searches are not indicated at this time.**

6.2 Surficial Debris

Surficial metal and wood debris was evident on all of the sites. There was a minor amount of surficial debris at the Koidern Lodge Site and moderate amounts of debris at Canol Pump Station G and the Bear Flats - White River Lodge Site. **This debris does not appear to pose any imminent risk to human health or the environment.** The surficial debris is not visible from the road at the Koidern Lodge Site and Pump Station G and at these locations, it does not result in any diminished aesthetic value, other than from within the sites itself. Debris at the Bear Flats - White River Lodge Site is partially visible from the Alaska Highway. The debris may, however, add some sense of history to the area, and may be considered to have a positive value.

6.3 Subsurface Metals

Geophysical surveying indicated the presence of varying quantities of buried metal on the sites.

No subsurface metals were detected at the Koidern River Lodge Site. Measured magnetic response along the two geophysical survey lines at the

Koidern Lodge site at MP 1164 identified relatively small variations in magnetic intensity. The locations of the variations coincided with existing surficial metal. A detailed geophysical survey in this area would be required to fully delineate the occurrence of buried metal, however, **investigation to-date does not suggest that subsurface metals are a major concern at this location**

Some buried metal was identified at Canol Pump Station G. Anomalous magnetic responses that were apparent on the site corresponded, for the most part, with features observed at surface. However, elevated magnetic response within the eastern corner of the surveyed area indicated the presence of buried metal in that region. The single magnetic profile along Line 33G identified slight increase in magnetic response that were coincident with remnant infrastructure, indicative of buried metal.

Significant surficial metal was observed at the Bear Flats Site at MP 1167 in Area "A". This was accompanied by a corresponding magnetic response. In addition, subsurface metals were indicated by a region of elevated magnetic intensity towards the southwestern region of the geophysical survey grid.

Metals identified by electromagnetic methods within Area "B" of the Bear Flats site at MP 1167 occur at shallow depth and are of very limited lateral extent.

Due to time constraints, minimal geophysical data was collected at the Bear Flats Site at MP 1167.5. However, **initial indications were that metal is present within the vicinity of several of the survey lines at MP 1167.5.**

Further detailed geophysical investigations would be required to more fully map subsurface metal on the sites. It is suggested that, given current information, that geophysical investigation at the Bear Flats - White River and Canol Pump Station G sites would be a higher priority than further geophysical investigation at the Koidern River Lodge Site.

Excavation would be required to determine whether the indicated subsurface metal debris includes any canisters or barrels containing any contaminants. Given the fragile nature of the environment in this area, and the severe damage to the permafrost and the ecosystem related to it that might result from disturbance of the ground surface, **the risk related to not determining the nature of subsurface metal debris must be weighed against the risk of disturbing the area's ecosystem**.

The climate and age of the sites would suggest that any buried drums would have been subject to deterioration. **Leachate monitoring would provide information on potential migration from areas of buried metal with less damage to the ground surface than excavation of the metal would entail**.

Further geophysical work, to identify all major areas of metal burial should be conducted prior to planning the location of any monitoring wells.

6.4 Soil Sample Analysis

While a number of soil samples were taken during the investigation of the subject site, the project budget allowed for the analysis of only a limited number of soil samples from the sites.

Analysis of a soil sample from the northern edge of the Koidern River Lodge Site indicated the presence of barium, cadmium, chromium, cobalt, mercury, silver, tin, vanadium, and zinc in excess of CCME Assessment Criteria. Arsenic, copper, lead, nickel and selenium were found at levels exceeding CCME Residential / Parkland Remediation Criteria. The hydrocarbon level of the sample was found to be above the Alberta Tier 1 criterium for hydrocarbons.

A soil sample from the area beside a pump station outlet at Canol Pump Station G was found to contain levels of nickel, vanadium and zinc in excess of CCME Assessment criteria but below CCME Remediation Criteria. Levels of chromium, lead, nickel, vanadium and zinc from the area beside a concrete foundation at the pump station (Sample S6) were above CCME Assessment Criteria but were below CCME Remediation Criteria. Hydrocarbon levels in this sample were greater than Alberta Tier 1 criterium for hydrocarbons.

A soil sample from one of the two oil change pits at the Bear Flats - White River Lodge Site was found to contain barium, cadmium, chromium, cobalt, mercury, tin and vanadium in excess of CCME Assessment Criteria, but below CCME Remediation Criteria. The levels of arsenic, copper, lead, nickel, selenium and zinc in this sample were above CCME Remediation criteria. Hydrocarbons in this sample exceeded the Alberta Tier 1 Criterium for hydrocarbons. No PCBs were detected in the sample.

A background soil sample (S1), taken from beside a borrow pit on the western side of the Bear Flats - White River Lodge Site, contained arsenic, chromium, cobalt, copper, nickel, vanadium, and zinc above CCME Assessment Criteria, but below CCME Remediation Criteria.

Given the large aerial extent of the sites and indications of the presence of contaminants above CCME Assessment Criteria on all three sites, further soil sampling and analysis would be required to confirm the results of the initial soil analyses and more adequately assess soil conditions on all of the sites.

Further soil analysis would be recommended for samples from:

- areas of stressed vegetation;
- topographic lows (where water ponding may occur and where runoff may be concentrated);
- the area along the bank of the Koidern River, at the Koidern River Lodge Site;
- the vicinity of the foundations remaining at Canol Pump Station G; and
- the area around the oil change pits at the Bear Flats - White River Lodge Site.

Analysis of duplicate samples would be recommended to verify analytical results.

6.5 Risk Associated With the Sites

Preliminary risk evaluation suggests that the ecological risk associated with contaminants found on at all three sites is moderate to low. This conclusion is based upon the observed health of the ecosystem, relative concentration of contaminants and relative toxicity of the compounds found. **If a greater level of confidence as to risks associated with the subject sites is required**, further investigative work would be required and **a Level 1 CCME Risk Assessment should be carried out**.

As noted previously, the risk evaluation associated with this investigation was limited in scope. It is not possible to predict ecological fate and effect without completing a more detailed environmental risk assessment where a probabalistic model is developed. No groundwater wells were present in the vicinity of the subject sites and the permanence of the permafrost in the area could only be inferred. Installation of groundwater monitoring wells and an assessment of permafrost conditions in the area over time (including the summer months) would be required to assess possible contaminant migration pathways with more confidence. Further soil sample analysis would be required to assess possible soil contamination more fully. Animal and vegetation studies would be required to assess whether there has been uptake of contaminants from the sites.

6.6 Project Implications for Assessments at Other Sites

Results of this investigation suggest that:

- **the presence of vegetative growth cannot be used to infer the absence of materials on a site**. Some areas of the site which were found to contain surficial and subsurface debris, were well-vegetated. Therefore, **aerial reconnaissance may not be effective in identifying areas of concern and sites of prior occupation.**

- **geophysical methods were invaluable in identifying dumping areas** which were either not obvious at surface or which were dubious due to the presence of frost heaving in the area.

- the discovery of wooden and metal debris at MP 1164 suggests that some form of army occupation took place at the site. Only one historical document suggesting this area as a site of occupation was, however, found in the Yukon Archives. This lack of documentation led previous workers (Bisset, 1995) relying on archival information to conclude that MP 1164 was not a site of army occupation. This illustrates the **there may be difficulty in using the sparse historical data to locate possible occupation sites**.

- activities that occurred on the sites, such as burial of materials, were not documented in historical background materials. While historical information may be valuable in locating sites and identifying some issues of concern, **on-site investigation is required to assess whether a site has been subject to activities of concern**.

7. REFERENCES

Agriculture and Agri-Food Canada and Environment Canada, 1996. Ecoregion Description: Ruby Ranges. http:/www.cciw.ca/eman-temp/ecozones/ecoregion-174.html, 5 November 1996.

Alberta Environmental Protection, 1994. Alberta Tier I Criteria for Contaminated Soil Assessment and Remediation. Alberta Environmental Protection, March 1994.

Bisset, K., 1995. Research of Former Military Sites & Activities in the Yukon. Action on Waste Program, Arctic Environmental Strategy, Indian and Northern Affairs Canada. April 1995.

Breiner, S., 1973. Applications Manual for Portable Magnetometer Geometrics.

Cohen, S., 1979. The Trail of 42. Missoula: Pictorial Histories Publishing Co.

Christy, J., 1979. Rough Road to the North. Toronto: Doubleday Canada Ltd.

CCME, 1991. Interim Canadian Environmental Quality Criteria for Contaminated Sites. Canadian Council of Ministers of the Environment, September 1991.

Duesenberg, H.M., 1994. Alaska Highway Expeditionary Force: A Roadbuilder's Story. Clear Lake Iowa: H & M Industries Limited.

Edey, 1976. [set of maps obtained via the Department of Indian and Northern Development, Action on Waste]

Environment Canada, 1983. Identification and Verification of Active and Inactive Land Disposal Sites in the Yukon Territory.

Geological Survey of Canada, 1967. Permafrost in Canada. Map 1246A.

Godsell, P., 1944. Romance of the Alaska Highway. Toronto: The Ryerson Press.

Gray, L. Alaska Highway Camp and Refuse Locations Preliminary Inventory.

Indian and Northern Affairs Canada, 1994. Yukon Geoprocess File: Geological Processes and Terrain Hazards Inventory, Kluane Lake Map Area, NTS 115 F (E1/2) and 115G

Department of Indian and Northern Affairs Canada, undated (1976?). Information on Operation Clean-Up, Canol Road Clean-Up Assessment Study, Campsite & Dump Site Study. Government Records, Volume 1168-69.

Kershaw, P., 1983. Long Term Ecological Consequences in Tundra Environments of the Canol Crude Oil Pipeline Project NWT 1942-1945. University of Alberta, Thesis.

Office of the Special Commissioners for Defense Projects in Northwest Canada, 1945. Road Log: Alaska Military Highway. Yukon Archives # PAM 1945-39.

Pictorial Histories Productions. The Trail of '42 - Building the Alaska Highway. Missoula, Montana: Pictorial Histories Productions.

Rainey, F., 1943. Alaska Highway An Engineering Epic. National Geopgraphic, Volume LXXXIII, pp.43-168.

Rampton, V.N., 1967. Surficial Geology and Geomorphology, Generc River, Yukon Territory. Geological Survey of Canada, Map 7-1978.

Remley, D.A., 1976. Crooked Road: The Story of the Alaska Highway. New York: McGraw-Hill Book Company.

Rust, F., 1944 The Eighteenth Engineers Regiment (Combat) in Yukon Territory: April 1942-January 1943. 65pp typescript. Yukon Archives #358-22

PHOTOGRAPHS

Yukon Archives Photograph File
Cat 1505 Alaska Highway - Koidern River Bridge 1942
Cat. 1538 Alaska Highway Camp - Koidern 1942
Photo 235 Alaska Highway - White River, c.1942-1982

Truck Tracks [magazine]
Volume 2, Number 8, 16 February 1944

CONTACTS

Jim and Dorothy Cook
long-time residents of the Koidern River area
Koidern River Lodge, Yukon

Neal Wortley
Resource Management Officer
Northern Affairs Program
Beaver Creek District
Indian and Northern Affairs Canada
Beaver Creek, Yukon

Lorne Laroque
Fish and Wildlife Branch
Yukon Government

Bev Morris
White River Nation Office
Beaver Creek, Yukon

Rosemary Vander Meer
Beaver Creek, Yukon

Personnel at the Yukon Archives
Whitehorse, Yukon

APPENDIX A
LIMITATIONS

LIMITATIONS

The information and data contained in this report, including without limitation the results of any sampling and analyses conducted by or for Hycal Environmental Sciences Ltd. (Hycal) pursuant to Hycal's engagement, have been set forth to the best of Hycal's knowledge, information and belief.

Although every effort has been made to confirm that all such information and data is factual, complete and accurate, Hycal makes no guarantees or warranties whatsoever, whether expressed or implied, with respect to such information or data and accept no responsibility for any loss or damage arising therefrom or related thereto.

Any use which a third party makes of this report, any reliance on or decisions to be made based on it, are the responsibility of such third parties. Hycal accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The conclusions and recommendations provided in this report are derived from information gathered from the sites identified in the report. They include Hycal's best judgments based on experience and in compliance with accepted investigative techniques. Hycal shall not by the act of issuing this report be deemed to have represented thereby that any sampling and analyses conducted by them have been exhaustive, and persons relying on the results thereof do so at their own risk.

APPENDIX B
PREVIOUS WORK

LIST OF DOCUMENTS

Document 1. Operation Clean Up file (1973) on the subject site.

Document 2. Environment Canada (1983) information sheets on the subject site.

Document 3. Undated and unattributed set of notes on the subject site from Yukon Archives Government Records Volumes 1168-69.

Document 4. Waste Management Inventory - Beaver Creek District, Indian and Northern Development Canada (1996)

OPERATION CLEAN UP

Beaver Creek R.M.O. Area

- U.S. Army Dump m.p. 1130 Alaska Hwy.
- U.S. Army Dump m.p. 1154.6 Alaska Hwy.
- U.S. Army Dump m.p. 1155.6 Alaska Hwy.
- U.S. Army Dump m.p. 1165.8 Alaska Hwy.
- U.S. Army Dump m.p. 1174.5 Alaska Hwy. - YFS. cleaned this up this fall (1974)

.115 Army

Fed. Govt.

Site No. 6 Alaska Hwy.

GARBAGE SITES

Location

Location - Latitude ~~142 8/4~~ N. Longitude ~~62 36~~ W.
Highway ~~Alaska~~ Mile ~~1130~~ Distance off Road ¼
Access By Road
Size of Clearing _____ Acres _____ Dimensions _____
Garbage occupies ~~10~~ Acres Site in use - ___ Yes X No
Distance from Improvements _____ Type of Improvements _____

Originator

___ Town or Village
___ Lodge, Motel
X Camp (Industrial)
___ Camp (Tourist, Roadside stop)
___ Official Campground

Type of Garbage

___ Vehicle Bodies - Amount _____
X Building Debris
___ Kitchen Refuse
X Abandonned Site, Tires, etc.
___ Debris from Clearing
Age of Garbage _____
This debris the U.S.Army.

Fire Hazard Involved

___ High X Medium ___ Low
___ Paper, Debris, etc. scattered in adjacent area
Fire Guard - X Nil ___ Satisfactory ___ Unsatisfactory

Site

___ Natural Depression ___ Dug out, Hole X Piled on ground
Vegetation cover around site Willow, Aspen And Black Spruce.
Pollution Potential - X Nil ___ Existing ___ Future
Pollution would effect ___ Stream ___ Lake,
Remarks: Site should be cleaned up.
Aesthetic Value Medium
Visible from Road ___ Yes X No
Recommendations for Site ___ Cleanup and abandon ___ Development
Remarks on Cleanup/Improvement Costs Approx. 56 man hrs. will be required
General Remarks on Site ~~to clean up this site. It would require a dozer~~ for 8 hrs. to excavate and bunch old truck bodies, and the other unburnables.

July 25/73 — Date
Inspecting Officer
Supervisor

Fed. Site No. 4 Alaska Hwy.
Govt
U.S. Army

GARBAGE SITES

Location

Location - Latitude [illegible] N. Longitude [illegible] W.
Highway Alaska Mile 1154.6 Distance off Road ½ mile
Access By Road
Size of Clearing _____ Acres 2 Dimensions _____
Garbage occupies 2 Acres Site in use - ___ Yes X No
Distance from Improvements _____ Type of Improvements _____

Originator

___ Town or Village
X Lodge, Motel
___ Camp (Industrial)
___ Camp (Tourist, Roadside stop)
___ Official Campground

Type of Garbage

___ Vehicle Bodies - Amount _____
X Building Debris
X Kitchen Refuse
X Abandonned Site, Tires, etc.
___ Debris from Clearing
Age of Garbage was left behind by the U.S. Army after construction of the hiway.

Fire Hazard Involved

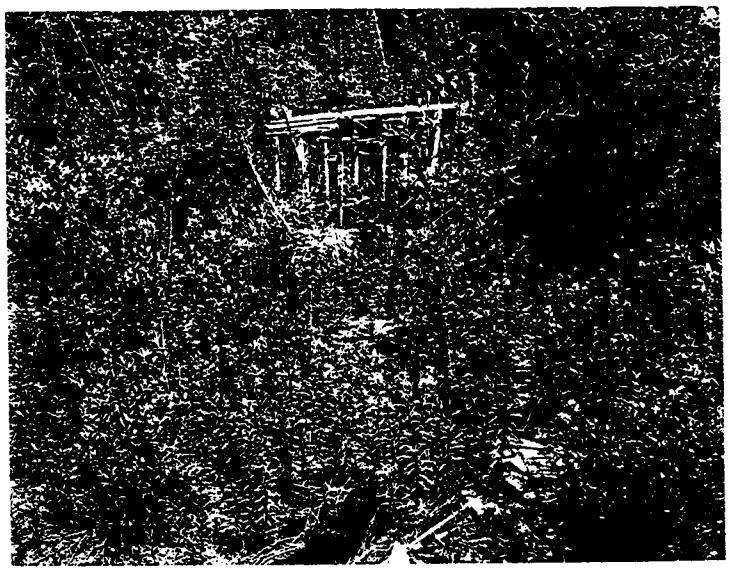
X High ___ Medium ___ Low
___ Paper, Debris, etc. scattered in adjacent area
Fire Guard - X Nil ___ Satisfactory ___ Unsatisfactory

Site

___ Natural Depression ___ Dug out, Hole X Piled on ground
Vegetation cover around site Black Spruce and Willow
Pollution Potential - X Nil ___ Existing ___ Future
Pollution would effect ___ Stream ___ Lake,
Remarks: Should be turned and buried.
Aesthetic Value Medium
Visible from Road ___ Yes X No
Recommendations for Site X Cleanup and abandon ___ Development
Remarks on Cleanup/Improvement Costs Approx. 56 man hrs. required.
General Remarks on Site Site should be burned and then unburnables should be buried with a cat or bucket loader.

July 25/73 — Date
Allen Campbell — Inspecting Officer
_____ — Supervisor

MILE 1154.6 ALASKA HIGHWAY



MILE 1154.6 ALASKA HIGHWAY

Fed. Gov't Site No. 3 Alaska Hwy.
U.S. Army

GARBAGE SITES

Location

Location - Latitude ~~140°32' N.~~ Longitude ~~62°23' W.~~
Highway ~~Alaska~~ Mile ~~1155.6~~ Distance off Road Road Side
Access
Size of Clearing ~~200x400~~ Acres Dimensions
Garbage occupies Acres Site in use - X Yes ___ No
Distance from Improvements Type of Improvements

Originator

___ Town or Village
___ Lodge, Motel
X Camp (Industrial)
___ Camp (Tourist, Roadside stop)
___ Official Campground

Type of Garbage

X Vehicle Bodies - Amount 2
X Building Debris
___ Kitchen Refuse
X Abandonned Site, Tires, etc.
___ Debris from Clearing
Age of Garbage

Fire Hazard Involved

___ High ___ Medium X Low
___ Paper, Debris, etc. scattered in adjacent area
Fire Guard - X Nil ___ Satisfactory ___ Unsatisfactory

~~Mostly boards and scrap metal.~~

Site

___ Natural Depression ___ Dug out, Hole X Piled on ground
Vegetation cover around site Willow
Pollution Potential - X Nil ___ Existing ___ Future
Pollution would effect ___ Stream ___ Lake,
Remarks: This site was left by U.S.Army.
Aesthetic Value High
Visible from Road X Yes ___ No
Recommendations for Site X Cleanup and ~~abandon~~ ___ Development
Remarks on Cleanup/Improvement Costs Approx. 40 man hrs.
General Remarks on Site ~~There is a clear area of approx. 200x400 being~~ used for tourist parking. The debris is around the outside in the bush that has grown up in the last 20 years or so.

July 17/73
Date

Allen Campbell
Inspecting Officer

Supervisor

MILE 1155.6 ALASKA HIGHWAY

Site No. 2 Alaska Hwy.

Fed. Gov't.
US Army

GARBAGE SITES

Location

Location - Latitude 62°50' N. Longitude 140°27' W.
Highway _____ Mile 1165.8 Distance off Road ¼ mile
Access By Road
Size of Clearing _____ Acres _____ Dimensions _____
Garbage occupies _____ Acres Site in use - ___ Yes X No
Distance from Improvements _____ Type of Improvements _____

Originator

___ Town or Village
___ Lodge, Motel
X Camp (Industrial)
___ Camp (Tourist, Roadside stop)
___ Official Campground

Type of Garbage

___ Vehicle Bodies - Amount _____
X Building Debris
___ Kitchen Refuse
X Abandonned Site, Tires, etc.
___ Debris from Clearing
Age of Garbage _____

Fire Hazard Involved

___ High X Medium ___ Low
___ Paper, Debris, etc. scattered in adjacent area
Fire Guard - X Nil ___ Satisfactory ___ Unsatisfactory

Site

___ Natural Depression ___ Dug out, Hole ___ Piled on ground
Vegetation cover around site Black Spruce
Pollution Potential - X Nil ___ Existing ___ Future
Pollution would effect ___ Stream ___ Lake.
Remarks: This site was a pump station left by the U.S.Army
Aesthetic Value Medium
Visible from Road ___ Yes X No

Recommendations for Site X Cleanup and abandon ___ Development

Remarks on Cleanup/Improvement Costs Approx. 48 man hrs. are required.

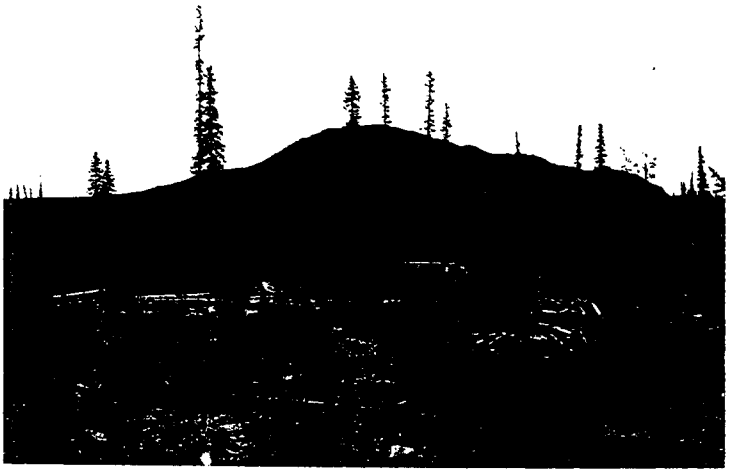
General Remarks on Site A lot of debris will burn. One mile of barbed wire needs to be rolled up and disposed of.

July 17/73
Date

Allen Campbell
Inspecting Officer

Supervisor

MILE 1165.8 ALASKA HIGHWAY



U.S. ARMY PUMP STATION

Document 1. Operation Clean Up (1973) file on the subject site.

OPERATION CLEAN UP

Beaver Creek R.M.O. Area

- U.S. Army Dump m.p. 1130 Alaska Hwy.
- U.S. Army Dump m.p. 1154.6 Alaska Hwy.
- U.S. Army Dump m.p. 1155.6 Alaska Hwy.
- U.S. Army Dump m.p. 1165.8 Alaska Hwy.
- U.S. Army Dump m.p. 1174.5 Alaska Hwy. - Y.F.S. cleaned this up this fall (1974)

Site No. 2 Alaska Hwy.

Fed. Gov't.
US Army

GARBAGE SITES

Location

Location - Latitude [illegible] N. Longitude [illegible] W.
Highway _____ Mile 1166.8 Distance off Road ½ mile
Access By Road
Size of Clearing _____ Acres _____ Dimensions _____
Garbage occupies _____ Acres Site in use - ___ Yes X No
Distance from Improvements _____ Type of Improvements _____

Originator

___ Town or Village
___ Lodge, Motel
X Camp (Industrial)
___ Camp (Tourist, Roadside stop)
___ Official Campground

Type of Garbage

___ Vehicle Bodies - Amount _____
X Building Debris
___ Kitchen Refuse
X Abandonned Site, Tires, etc.
___ Debris from Clearing
Age of Garbage _____

Fire Hazard Involved

___ High X Medium ___ Low
___ Paper, Debris, etc. scattered in adjacent area
Fire Guard - X Nil ___ Satisfactory ___ Unsatisfactory

Site

___ Natural Depression ___ Dug out, Hole ___ Piled on ground
Vegetation cover around site Black Spruce
Pollution Potential - X Nil ___ Existing ___ Future
Pollution would effect ___ Stream ___ Lake.
Remarks: This site was a pump station left by the U.S.Army
Aesthetic Value Medium
Visible from Road ___ Yes X No

Recommendations for Site X Cleanup and abandon ___ Development

Remarks on Cleanup/Improvement Costs Approx. 48 man hrs. are required.

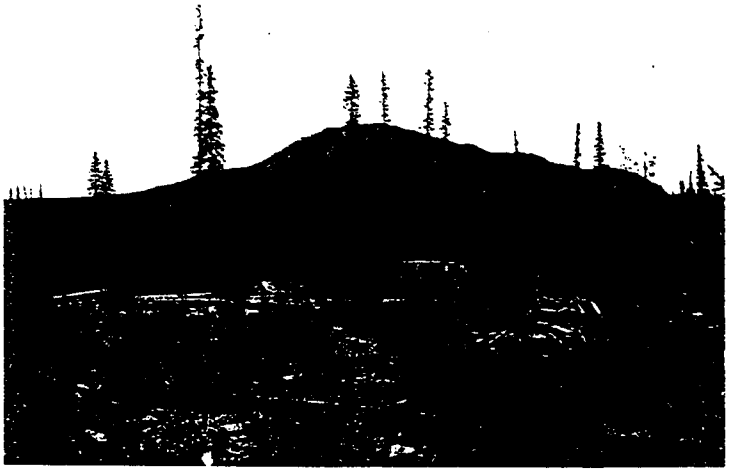
General Remarks on Site A lot of debris will burn. One mile of barbed wire needs to be rolled up and disposed of.

July 17/73
Date

Allen Campbell
Inspecting Officer

Supervisor

MILE 1165.8 ALASKA HIGHWAY



U.S. ARMY PUMP STATION

Document 2. Environment Canada (1983) information sheets on the subject site.

Environment Canada
Environmental Protection Service

Site Code 130
NTS Sheet 115 F/16 Koidern

IDENTIFICATION AND VERIFICATION OF ACTIVE AND INACTIVE LAND DISPOSAL SITES IN THE YUKON TERRITORY

Community Landfill — Presently in use yes

Community Name Koidern River Lodge — Region South western Yukon

1.0 LOCATION Mile 1164 Alaska Highway

1.1 Latitude N 61°58' Longitude W 140°24' Elevation 770 M.

1.2 Distance from disposal area to townsite N.A. km.

1.3 Distance from disposal area to town water source N.A km.
Is there any chance of contamination? unknown 20

1.4 What type of water source unknown 5

1.5 Population served by water source less than 10 2

1.6 Distance from disposal area to major surface water 300 m Koidern River 10 5

1.7 Uses of major surface water recreation 7

1.8 Distance to nearest house less than 200m

1.9 Surrounding land use:

1/4 km radius	1/4 - 1 km radius	Beyond 1 km radius	
Koidern River Lodge	bush	Residential	20
Alaska Highway		Commercial	
Koidern River			

2.0 DISPOSAL SITE CHARACTERISTICS

2.1 Dimensions: Length unknown meters Width _____ meters
Approximate depth of waste _____ meters 5

2.2 Present condition: Open yes
Covered _____ details _____
Other _____ specify _____ 5

2.3 Source of waste commercial lodge

2.4 Types of waste:
Liquid sewage no Garbage biodegradable yes
Non degradable (appliances, car/truck bodies, metal scrap) yes 5
Industrial waste (specify) (oils, chemicals etc) unknown
Inventory of other likely wastes _____

2.5 Operation:
Open Dump yes
Open Dump with Burning unknown

Dump with Occasional Cover unknown
Sanitary Land Fill unknown
Other (specify) _____

2.6 Who had access to the site during operation? Public minimal
Community Services Koidern River Lodge Specify commercial

2.7 Methods of containment for high concern wastes none

2.8 Evidence of leachate (liquids produced by garbage) YES unknown NO _____

2.9 Leachate containment (liquids escaping from dump) YES unknown NO _____

2.10 Evidence of methane gas or odours YES unknown NO _____
Comments _____

2.11 Period of operation 19 N.A. to 19 present

2.12 Mean high temperature for July 19.0 °C

2.13 General soil type clay, gravel

2.14 Vegetation willow, aspen, black spruce

2.15 Depth to permafrost during the summer discontinuous - possibly present here

2.16 Are there any sensitive environments or critical habitats such as endangered species breeding grounds in the area? NO _____ YES ✓
Specify muskrat, beaver, nesting ducks and geese are common in this area

2.17 How far from the landfill are they? 200 m

3.0 GENERAL NOTES : ANNUAL RAINFALL - 300 m.m.

3.1 Property owner: Present _____ N.A.
Past (during operation) _____ N.A.

3.2 Past or present problems with site unknown

3.3 Reason for closing or abandoning site still open

3.4 Closure procedures still open

3.5 Information source and/or references List of Dumps from Territorial Government; employee of Koidern

4.0 COMMENTS
I did not visually inspect this site, however I know that it does exist near the Koidern River Lodge

M.R. Initials

Date Δ

Activity # 33

Environment Canada
Environmental Protection Service

Site Code ??
NTS Sheet 115 F/16

IDENTIFICATION AND VERIFICATION OF ACTIVE AND INACTIVE LAND DISPOSAL SITES IN THE YUKON TERRITORY

Community Landfill — Presently in use unknown

Community Name Koidern — Region Southwestern Yukon

Pump Station G

1.0 LOCATION Mile 1166 Alaska Highway

1.1 Latitude N 61°58'30" Longitude W 139°27'45" Elevation 735 M.

1.2 Distance from disposal area to townsite N.A km.

1.3 Distance from disposal area to town water source N.A. km.
Is there any chance of contamination? no

1.4 What type of water source N.A

1.5 Population served by water source N.A

1.6 Distance from disposal area to major surface water 1.5 Km

1.7 Uses of major surface water recreational

1.8 Distance to nearest house 50 m

1.9 Surrounding land use:

1/4 km radius	1/4 - 1 km radius	Beyond 1 km radius
Alaska Highway	bush	Residential ✓
bush		Commercial ✓

2.0 DISPOSAL SITE CHARACTERISTICS

2.1 Dimensions: Length 300 meters Width 250 meters
Approximate depth of waste 0 - 1 meters

2.2 Present condition: Open yes
Covered ____ details ____
Other ____ specify ____

2.3 Source of waste U.S. Army

2.4 Types of waste:
Liquid sewage no Garbage biodegradable yes
Non degradable (appliances, car/truck bodies, metal scrap) yes
Industrial waste (specify) (oils, chemicals etc) OIL - PUMP STATION
Inventory of other likely wastes ____

2.5 Operation:
Open Dump yes
Open Dump with Burning unknown

Dump with Occasional Cover unknown
Sanitary Land Fill no
Other (specify) —

2.6 Who had access to the site during operation? Public yes
Community Services _____ Specify U.S. Army

2.7 Methods of containment for high concern wastes none

2.8 Evidence of leachate (liquids produced by garbage) YES _____ NO ✓

2.9 Leachate containment (liquids escaping from dump) YES _____ NO ✓

2.10 Evidence of methane gas or odours YES _____ NO ✓
Comments no

2.11 Period of operation 19 42 to 19 N.A.

2.12 Mean high temperature for July 18.5 °C

2.13 General soil type clay

2.14 Vegetation black spruce

2.15 Depth to permafrost during the summer discontinuous - possibly present at this site

2.16 Are there any sensitive environments or critical habitats such as endangered species breeding grounds in the area? NO _____ YES ✓
Specify muskrat, beaver, nesting ducks and geese are common in this area

2.17 How far from the landfill are they? 500m

3.0 GENERAL NOTES: ANNUAL RAINFALL = 300 mm.

3.1 Property owner: Present crown
Past (during operation) crown

3.2 Past or present problems with site unknown

3.3 Reason for closing or abandoning site U.S. Army left area

3.4 Closure procedures none apparent

3.5 Information source and/or references Alaska Highway Clean-up of 1970 by Colin Eddy

4.0 COMMENTS
I did not visually inspect this site

Initials

Date August 1983

Document 3. Undated and unattributed set of notes on the subject site from Yukon Archives Government Records Volume 1168-69.

Mile 1166.0 -Koidern
-Standard oil pump Station G
-Crown
-km1876.4 Ak Hwy Lat 61 58' 30" Long 139 27' 45"
-US Army

Conditions:
-2 concrete foundations
-scattered wood debris
-wood and metal from Quonset hut
-portion of 6 strand barb wire fence

Vegetation:
-Black spruce on residual areas.
-Willow advanced growth.

Restoration:
-Collect and burn wood
-Collect and bury metal on site
-Remove barb wire fence
-Remove and bury metal from concrete

SITE # 8

Mile 1167.5 KM 1877.9 Koidern Location area Not Indicated in Contract.

This is a many ones as to clean up here and I was unaware of any ~~clean~~ recent clean up at the cement pad of Old Pump Station nothing could be seen as cleaned up.

West of the Forestry ~~Bdg~~ Lodge there was a Cement pad that Forestry Cleaned up under Glen Campbell and the Cement pad was Cleaned off for storage of Calcium by T. Gov.

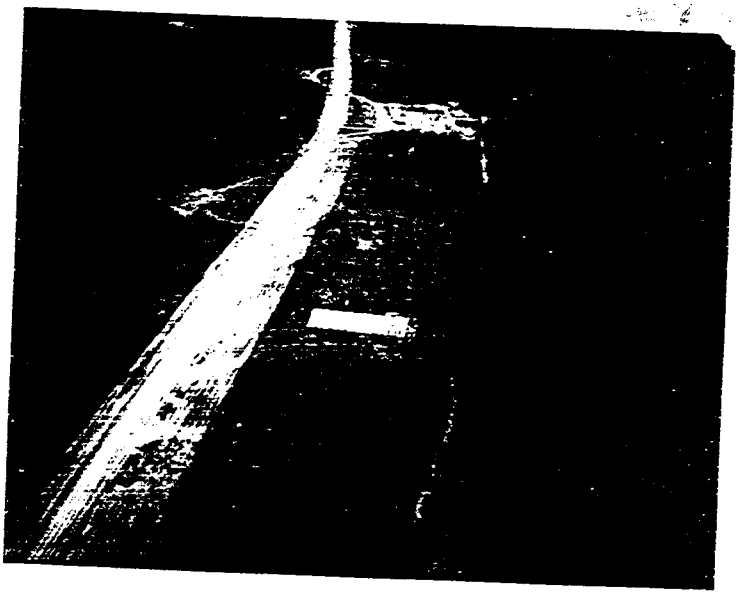
If any contaminates where removed I could not tell not having been involved with this district clean up operations.

Photo # 8 - A #6 This is the old ~~Pump~~ Pump Station East of Koidern River Lodge on the North side of the Hwy. As can be seen if ~~there~~ was a clean up here I could not find it and I am uncertain if any clean up was carried out here.

Photo # 8 - B #6 is of the pad cleaned up by T. Gov. Note Koidern River Lodge complex and red roof of Forestry Bldg the stand of Spruce between it and pad. There also is a area opposite Forestry where a old Building and large amount of debris remains see photo # 8. This I believe is private land and I do not know if this area was to be cleaned up or not. Peter Verdonck is believed to be the Owner.

Photo # 8 - C Opposite Forestry Bldg Koidern No Clean up.

7A



7B

7c

Mile 1167.5 -White River
-13 buildings, army checking & relay station (Camp O'hara)
-Crown, private lands adjacent
-km 1878 Ak Hwy Lat 61 59' Long 140 28'
-perhaps part of Army camp
-Relay station
-13 bldgs in 1945

-Private: Lot 26, Group 901: Title #72VV, R.A. Dickson PO Box 581, Whse

Crown: Lot 35, Group 901, Reservation Yukon Forest Service 18/5/55

Condition:
-approximately 5 partial buildings
-1 standing building, in use
-quantities of metal and wood scattered
-25, 45 gallon drums
-2 hulks

Vegetation: -willow and aspen

Restoration:
-Establish boundaries of private lands
-Collect and burn wood debris
-Collect and remove metal to mile 1166 for burial

Comment: -Site formerly under lease, and cancelled, reverting back to Crown. Inventory of debris inadequate and complicated by associated private land holders use of lands.

Document 4. Waste Management Inventory - Beaver Creek District, Indian and Northern Development Canada (1996).

YUKON AES WASTE SITE INVENTORY X

UPDATED: **DISTRICT:** BC **SITE NUMBER:** 065

GENERAL: KOIDERN RIVER #2

LATITUDE: 61 58 0 **LONGITUDE:** 140 25 0

PRESENT LAND TENURE: FEDERAL **STATUS:** INVENTORIED

SITE DESCRIPTION: POSSIBLE OLD 1940'S HIGHWAY CONSTRUCTION CAMP SITE LOCATED ON ESKER SURROUNDED BY WETLANDS

SIZE OF SITE:

SITE ACTIVITY: **E.P. RANK:** 0 **ABANDONED:** YES

WASTE MATERIAL:

DRUMS NUMBER: 4 **FULL:** **EMPTY:** 4

CONTENTS: N/A

ACCESS:

PRESENT OCCUPANT:

PREVIOUS OCCUPANT:

PERMANENT IMPROVEMENTS: NOT ERECT, REFUSE (METAL, WOOD) ON SITE

VEGETATION: BRUSH & SPRUCE

IMPACT POTENTIAL: MINIMAL

ASPECT AFFECTED: AESTHETICS

RECOMMENDATIONS: REMOVAL OF METAL, BURN WOOD DEBRIS ON SITE

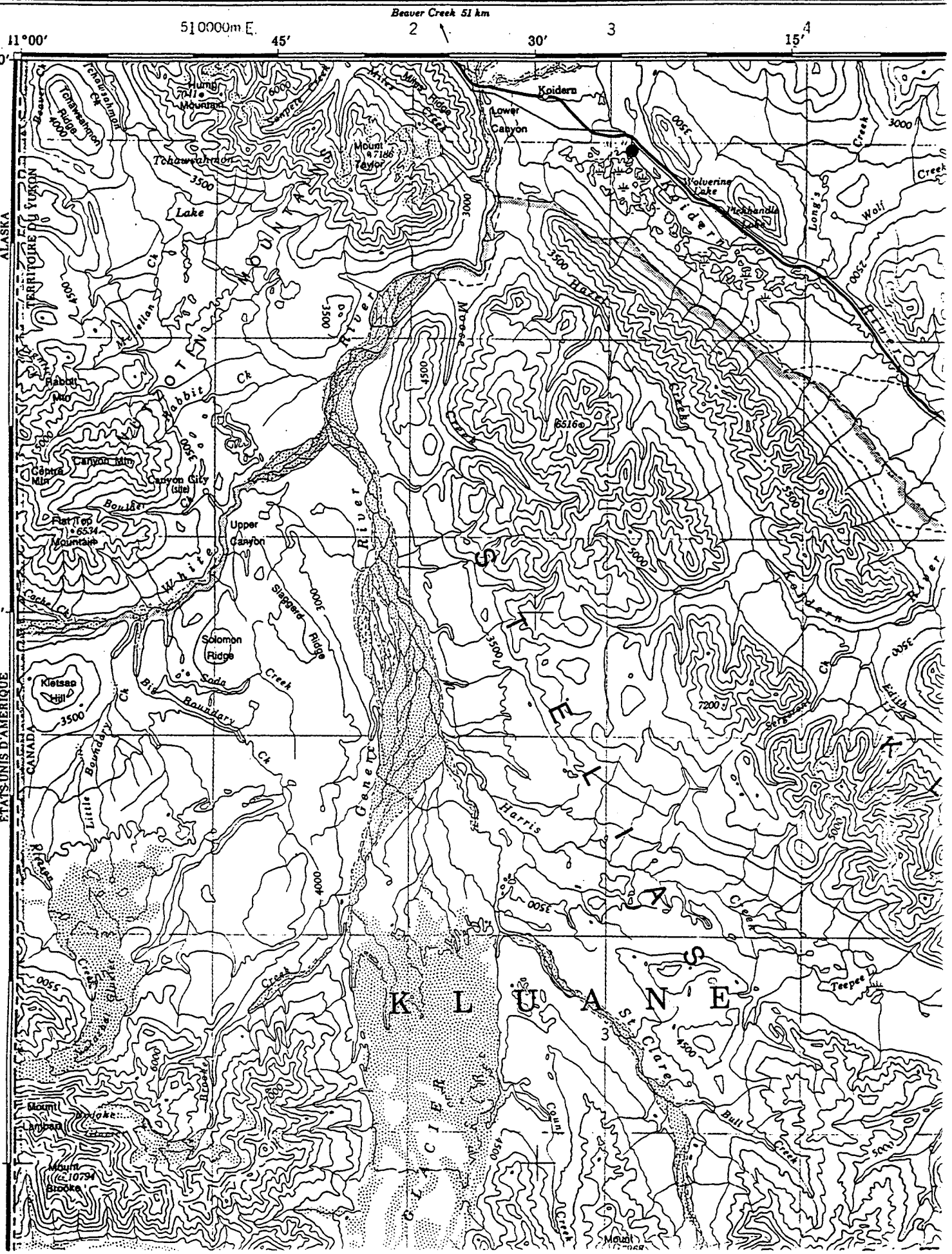
DISTRICT AND SITE: BC 065

CLEAN-UP COST ESTIMATE:

INSPECTOR: NEALE WORTLEY **INSPECTION DATE:** 05.01.94

FOLLOW UP: HERITAGE REPORT: HIGHWAY CONSTRUCTION CAMP - c. 1940. LOCATED ON ESKER SURROUNDED BY WETLANDS. CONTACT HERITAGE BRANCH WITH DATE OF PROPOSED CLEAN UP. HERITAGE BRANCH TO RECORD BEFORE DESTROYING.

115 G & 115 F EDITION 2 BC .65



WASTE MANAGEMENT SITE INVENTORY

DISTRICT: BC SITE NUMBER: 043

LOCATION

GENERAL: MILE 1167 - BEAR FLATS Historic MP 1167 White R. Relay Station (Telephone)

LATITUDE: 61° 59' 00" LONGITUDE: 140° 30' 00"

STATUS: INVENTORIED

PRESENT LAND TENURE: FEDERAL

PRESENT OCCUPANT:

ADDRESS:

CITY :

PROVINCE: POSTAL CODE:

PHONE NUMBER:

CLAIM NUMBER:

BC 43
MP 1167
WR Tel relay

PREVIOUS OCCUPANT:

SITE
DESCRIPTION: OLD CABINS

WIDTH: 100 M LENGTH: 400 M HECTARES: 4

SITE ACTIVITY: OLD TOWN SITE

WASTE MATERIAL: TENT FRAMES, DRUMS, REFUSE, METAL SCRAP

DRUMS NUMBER: FULL: EMPTY:

CONTENTS:

CHEMICAL TYPE:

ACCESS: VEHICLE

ROAD NAME: TRAIL NAME:

HWY: ALASKA HWY DISTANCE: KM

ABANDONED: Y

DISTRICT AND SITE: BC 043

PERMANENT IMPROVEMENTS: Y

VEGETATION: RESIDUAL GROWTH WHITE SPRUCE, SOME DECIDUOUS

POLLUTION POTENTIAL (E.P. RANK): NIL

ASPECT AFFECTED: AESTHETICS

IMPACT POTENTIAL: VISUAL IMPACT ALONG THE ALASKA HWY

RECOMMENDATIONS: CLEANUP AND HAUL TO APPROVED LAND FILL SITE

CLEAN-UP COST ESTIMATE:

ACTUAL COST:

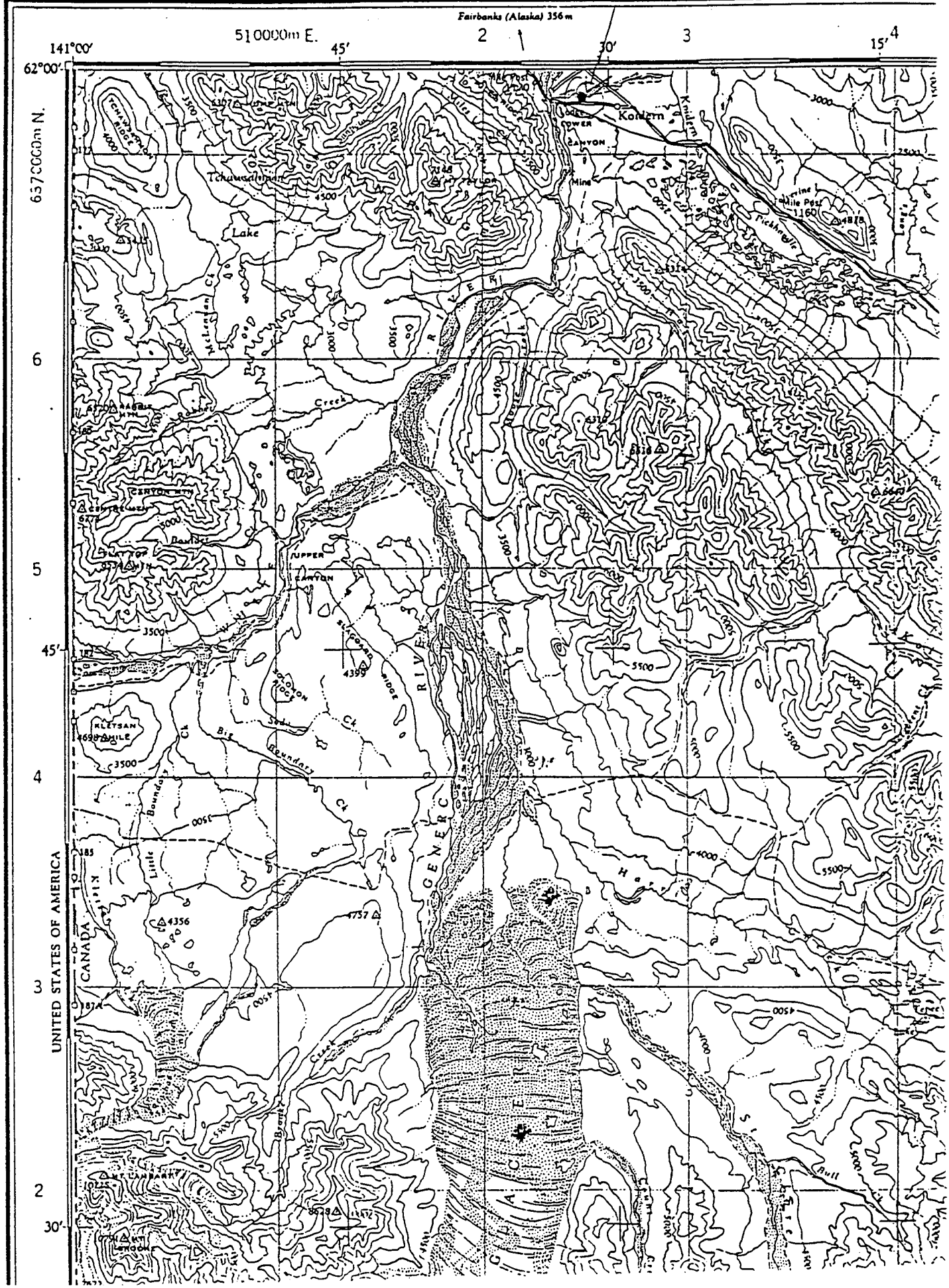
INSPECTOR: NEALE WORTLEY

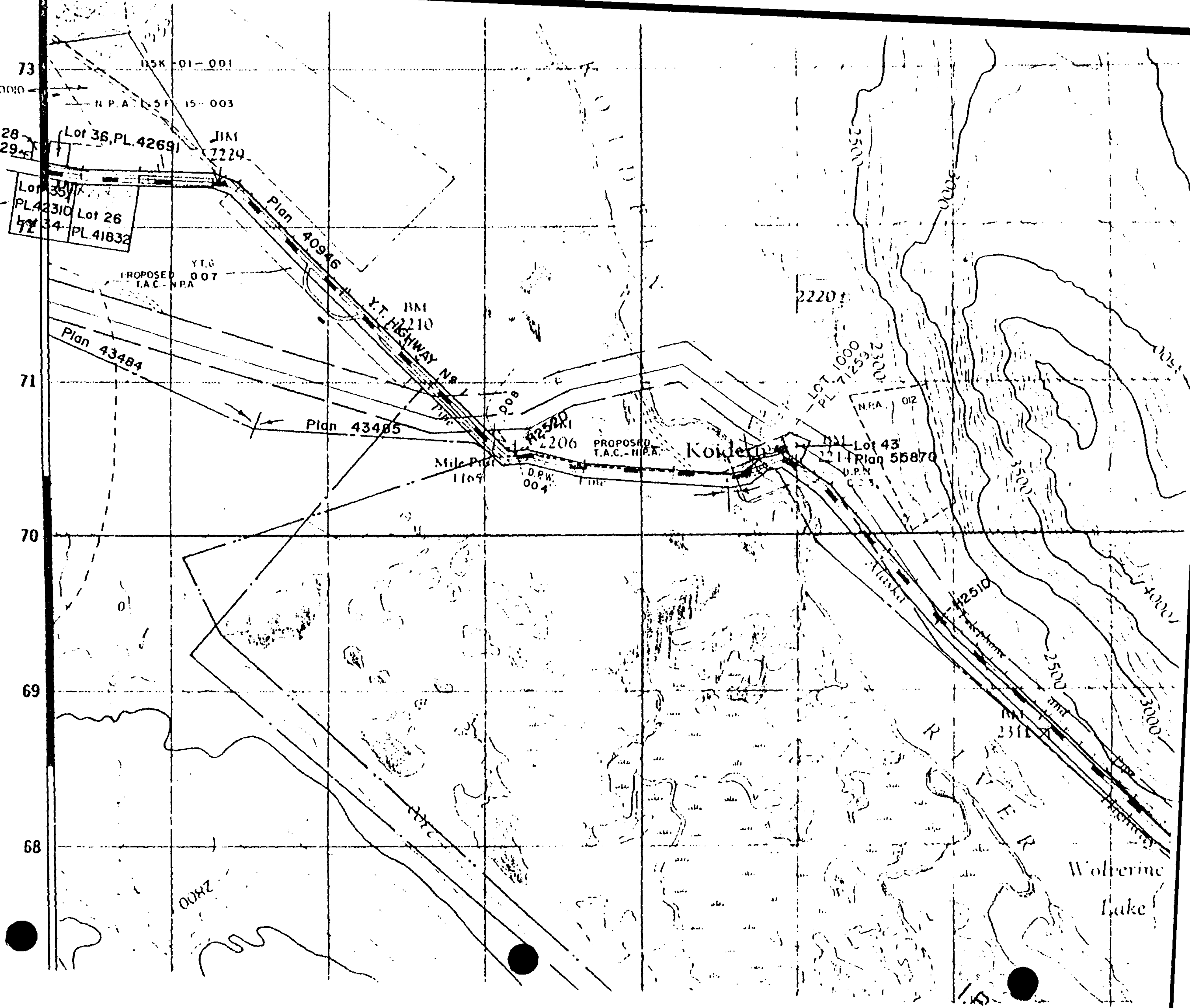
INSPECTION DATE: 06.07.93

FORM DATE: 22.11.93

FOLLOW UP: 2 BUILDINGS STILL STANDING (MAYBE HISTORIC SITE) THERE IS ALSO SOME BUILDINGS WHICH HAVE FALLEN AND ARE FLAT ON THE GROUND. THESE COULD ALSO BE CLEANED UP BY A LOADER. EITHER STACKED AND BURNED OR HAULED AWAY. (SEE ATTACHED LETTER).

115 G & 115 F (E½) #43 1:250,000




73
115-0000-00010
Y.T.G.
115K-01-001
N.P.A. L.S.F. 15-003
42310 Lot 28
Lot 29
Lot 36, PL.42691
BM 7229
026
PL.42310
Lot 34
Lot 26
PL.41832
Plan 40946
PROPOSED T.A.C.-N.P.A.
Y.T.G. 007
BM 2210
Y.T. HIGHWAY No.
Plan 43484
71
008
Plan 43485
BM 2206
Mile Post 1169
D.P.W. 004
PROPOSED T.A.C.-N.P.A.
Koidern
2220
LOT 1000
Lot 43
Plan 55870
N.P.A. 012
2300
2500
3000
3500
4000
70
2510
Alaska
Telephone
and
Highway
69
2311
2500
3000
RIVER
68
2800
Wolverine
Lake

APPENDIX C
LABORATORY ANALYSES

NORWEST LABS

EDMONTON	PH. (403) 438-5522	FAX (403) 438-0396
CALGARY	PH. (403) 291-2022	FAX (403) 291-2021
LANGLEY	PH. (604) 530-4344	FAX (604) 534-9996
LETHBRIDGE	PH. (403) 329-9266	FAX (403) 327-8527
WINNIPEG	PH. (204) 982-8630	FAX (204) 275-6019

DATE 19 NOV 96 08:48
P.O. NO. 96-10-2834
W.O. NO. 3 122930

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
E6-243
08 11 96

SOILS AND SEDIMENTS ANALYSIS REPORT

SAMPLE		1 R9371 10 SITE 32 KOIDERN V3	2 R9372 11 SITE 31 DONJEK B3
PHYSICAL			
MOIST.WET WT.	%	57.0	37.8
SOIL ORGANICS			
HYDROCARBONS	ug/gm	464	836
ELEMENTAL COMP			
ARSENIC	ug/gm	13.7	6.7
ANTIMONY	ug/gm	3.08	1.01
BARIUM	ug/gm	122	111
BERYLLIUM	ug/gm	0.178	0.152
CADMIUM	ug/gm	1.79	1.18
CHROMIUM	ug/gm	75.9	39.9
COBALT	ug/gm	12.9	7.28
COPPER	ug/gm	91.6	32.6
LEAD	ug/gm	34.1	269
MERCURY	ug/gm	0.10	0.09
MOLYBDENUM	ug/gm	4.14	0.93
NICKEL	ug/gm	81.2	26.3
SELENIUM	ug/gm	2.30	0.91
SILVER	ug/gm	<0.001	<0.001
THALLIUM	ug/gm	<0.20	<0.20
TIN	ug/gm	7.09	1.03
VANADIUM	ug/gm	46.9	27.4
ZINC	ug/gm	145	143

Lab Manager: _____

NORWEST LABS

EDMONTON	PH. (403) 438-5522	FAX (403) 438-0396
CALGARY	PH. (403) 291-2022	FAX (403) 291-2021
LANGLEY	PH. (604) 530-4344	FAX (604) 534-9996
LETHBRIDGE	PH. (403) 329-9266	FAX (403) 327-8527
WINNIPEG	PH. (204) 982-8630	FAX (204) 275-6019

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
E6-243
08 11 96

SOILS AND SEDIMENTS ANALYSIS REPORT

note HYDROCARBONS ANALYSIS REPORTED ON A DRY WEIGHT BASIS.

Lab Manager: _____

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

DATE 19 NOV 96 08:48
P.O. NO. 96-10-2834
W.O. NO. 3 122930

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
E6-243
08 11 96

SOILS AND SEDIMENTS ANALYSIS REPORT

The following published METHODS OF ANALYSIS were used:

EPA3540H HYDROCARBONS
Soxhlet extraction with Freon; add
silica gel. Analysis by IR spectroscopy.
Ref. US EPA 3540/EPA 418.1

EPA3051 ARSENIC
EPA3051 ANTIMONY
EPA3051 BARIUM
EPA3051 BERYLLIUM
EPA3051 CADMIUM
EPA0351 CHROMIUM
EPA3051 COBALT
EPA3051 COPPER
EPA3051 LEAD
EPA3051 MERCURY
EPA3051 MOLYBDENUM
EPA3051 NICKEL
EPA3051 SELENIUM
EPA3051 SILVER
EPA3051 THALLIUM
EPA3051 TIN
EPA3051 VANADIUM
EPA3051 ZINC

Method References:

1. APHA Standard Methods for the Examination of Water and Wastewater, American Public Health Assoc., 17th ed.
2. EPA a. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, 3rd ed., US EPA, 1986
   b. Methods for Chemical Analysis of Water and Wastewater, US EPA, 1983
3. MSS Manual on Soil Sampling and Methods of Analysis, Cdn. Soc. of Soil Science, J. A. McKeague, 2nd ed.

NORWEST SOIL RESEARCH LTD has been accredited by the STANDARDS COUNCIL of CANADA for specific tests registered with the COUNCIL.

Lab Manager: _____

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

DATE 19 NOV 96 08:48
P.O. NO. 96-10-2834
W.O. NO. 3 122930
PAGE

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
E6-243
08 11 96

Quality Assurance Analysis

Standard Reference Material Analysis

METHOD	ANALYSIS	-UNITS--	----STANDARD---- --DESCRIPTION---	--D.L.--	TARGET	-----QC WITH----- ---THIS ORDER---- #	MEAN	% Y	-HISTORICAL-- --PRECISION-- #	MEAN	-WARNING LIMITS-- LOW	HIGH
1381	HYDRO-CARBONS	mg/kg	IN HOUSE OIL STD	10	29184	1	27218	93.3	173	29024	27269	31099
35502	As	mg/kg	NBS	1.0	18.686	1	20.17	107.9	151	18.42	16.8	20.6
35503	Sb	mg/kg	NBS	0.5	0.969	1	0.9600	99.1	123	0.9940	0.20	1.80
35504	Ba	mg/kg	NBS	.010	89.704	1	90.89	101.3	149	90.73	81.5	97.9
35505	Be	mg/kg	NBS	0.025	.650	1	0.6220	95.7	147	0.6452	0.60	0.70
35508	Cd	mg/kg	NBS	0.025	3.615	1	3.558	98.4	144	3.608	3.5	3.7
35510	Cr	mg/kg	NBS	0.04	86.545	1	84.40	97.5	154	86.46	82.2	90.9
35512	Cu	mg/kg	NBS	0.15	100.532	1	96.69	96.2	156	101.0	94.3	106.8
35514	Pb	mg/kg	NBS	0.1	154.273	1	157.3	102.0	162	153.3	142.9	165.6
35518	Hg	mg/kg	NBS	0.01	1.47	1	1.052	71.6	164	1.416	0.98	1.55
35519	Mo	mg/kg	NBS	0.05	2.814	1	2.684	95.4	149	2.778	2.3	3.4
35520	Ni	mg/kg	NBS	0.05	39.033	1	42.09	107.8	157	39.90	35.7	42.3
35523	Se	mg/kg	NBS	0.15	1.502	1	1.492	99.3	139	1.246	.5	2.50
35524	Ag	mg/kg	NBS	0.001	.318	1	0.2000	62.9	121	0.3342	0.2	0.4
35533	V	mg/kg	NBS	0.05	22.532	1	21.55	95.6	148	22.25	19.0	26.1
35534	Zn	mg/kg	NBS	0.025	395.712	1	401.5	101.5	151	393.4	381.0	410.4
35502	As	mg/kg	REAGENT BLANK	1.0	0.0	1	0.02199		158	0.04536	-1.0	1.0
35503	Sb	mg/kg	REAGENT BLANK	0.5	0.0	1	0.0		129	-0.00835	-0.5	0.5
35504	Ba	mg/kg	REAGENT BLANK	.010	0.0	1	0.0		157	0.003070	-.02	.02
35505	Be	mg/kg	REAGENT BLANK	0.025	0.0	1	0.002998		155	0.001194	-0.05	0.05
35508	Cd	mg/kg	REAGENT BLANK	0.025	0.0	1	-0.03698		161	-0.00377	-.05	.05
35510	Cr	mg/kg	REAGENT BLANK	0.04	0.0	1	-0.05497		162	0.008790	-.08	.08
35511	Co	mg/kg	REAGENT BLANK	0.035	0.0	1	-0.04197		158	0.001867	-.07	.07
35512	Cu	mg/kg	REAGENT BLANK	0.15	0.0	1	-0.05996		162	0.009546	-.1	.1

QC/QA Manager:

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

DATE 19 NOV 96 08:48
P.O. NO. 96-10-2834
W.O. NO. 3 122930
PAGE

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
E6-243
08 11 96

Quality Assurance Analysis

Standard Reference Material Analysis

METHOD	ANALYSIS	-UNITS--	----STANDARD---- --DESCRIPTION---	--D.L.--	TARGET	-----QC WITH----- ---THIS ORDER---- #	MEAN	% Y	-HISTORICAL-- --PRECISION-- #	MEAN	-WARNING LIMITS-- LOW	HIGH
35514	Pb	mg/kg	REAGENT BLANK	0.1	0.0	1	0.08395		168	0.02738	-.2	.2
35518	Hg	mg/kg	REAGENT BLANK	0.01	0.0	1	0.0		163	0.0	-.01	.01
35519	Mo	mg/kg	REAGENT BLANK	0.05	0.0	1	-0.07695		156	-0.00610	-.1	.1
35520	Ni	mg/kg	REAGENT BLANK	0.05	0.0	1	-0.02698		163	0.008761	-.1	.1
35523	Se	mg/kg	REAGENT BLANK	0.15	0.0	1	0.0		156	-0.00394	-.3	.3
35524	Ag	mg/kg	REAGENT BLANK	0.001	0.0	1	-0.06396		127	0.005965	-0.1	0.1
35529	Tl	mg/kg	REAGENT BLANK	0.20	0.0	1	0.03898		158	0.01703	-.4	.4
35531	Sn	mg/kg	REAGENT BLANK	0.15	0.0	1	-0.03298		127	0.01508	-.3	.3
35533	V	mg/kg	REAGENT BLANK	0.05	0.0	1	-0.09194		157	0.01150	-.1	.1
35534	Zn	mg/kg	REAGENT BLANK	0.025	0.0	1	0.0		163	0.000282	-.05	.05

QC/QA Manager:

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

DATE 15 NOV 96 11:14
P.O. NO. 96-10-2834
W.O. NO. 2 121871
PAGE 1

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
23 10 96

SOILS AND SEDIMENTS ANALYSIS REPORT

SAMPLE		1 R8864 1130 DONJEK BACKGROUND	2 R8865 SITE 33 OIL PIT #1	3 R8866 SITE 33 BACKGROUND	4 R8867 PUMP STN. G SAMPLE 5
PHYSICAL					
MOIST.WET WT.	%	32.6	60.6	15.2	5.3
SOIL ORGANICS					
HYDROCARBONS	ug/gm	118	2630	167	68
ELEMENTAL COMP					
ARSENIC	ug/gm	4.3	48.0	5.7	4.1
ANTIMONY	ug/gm	<0.50	1.73	0.88	0.69
BARIUM	ug/gm	67.9	338	109	76.4
BERYLLIUM	ug/gm	0.103	0.276	0.287	0.259
CADMIUM	ug/gm	0.168	1.76	0.252	0.134
CHROMIUM	ug/gm	11.4	92.5	25.8	16.0
COBALT	ug/gm	4.90	11.7	12.9	9.96
COPPER	ug/gm	18.7	143	35.9	25.6
LEAD	ug/gm	6.0	28200	19.9	9.1
MERCURY	ug/gm	0.03	0.27	0.03	0.02
MOLYBDENUM	ug/gm	0.42	1.91	0.50	0.37
NICKEL	ug/gm	13.2	124	47.2	21.7
SELENIUM	ug/gm	0.63	1.58	0.50	0.37
SILVER	ug/gm	<0.001	1.07	<0.001	<0.001
THALLIUM	ug/gm	<0.20	<0.20	0.24	<0.20
TIN	ug/gm	0.74	11.3	0.50	0.35
VANADIUM	ug/gm	16.6	111	44.8	34.5
ZINC	ug/gm	39.7	512	69.6	60.5

Lab Manager: _____

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

DATE 15 NOV 96 11:14
P.O. NO. 96-10-2834
W.O. NO. 2 121871

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
23 10 96

SOILS AND SEDIMENTS ANALYSIS REPORT

SAMPLE		5	6	7
		R8868	R8869	R8870
		1130 DONJEK PIT	SITE 33	PUMP STN. G
			KOIDERN SAMPLE 1	SAMPLE 6
PHYSICAL				
MOIST.WET WT.	%	54.8	60.8	11.6
SOIL ORGANICS				
HYDROCARBONS	ug/gm	10300	2280	1510
ELEMENTAL COMP				
ARSENIC	ug/gm	14.0	33.5	4.8
ANTIMONY	ug/gm	1.51	1.64	<0.50
BARIUM	ug/gm	197	401	98.8
BERYLLIUM	ug/gm	0.172	0.263	0.279
CADMIUM	ug/gm	2.43	1.57	0.284
CHROMIUM	ug/gm	43.9	121	28.1
COBALT	ug/gm	8.79	13.4	8.48
COPPER	ug/gm	95.2	143	24.3
LEAD	ug/gm	335	851	69.9
MERCURY	ug/gm	0.06	0.34	0.03
MOLYBDENUM	ug/gm	2.82	1.80	0.55
NICKEL	ug/gm	68.2	164	20.4
SELENIUM	ug/gm	1.14	1.04	0.67
SILVER	ug/gm	0.265	18.7	0.013
THALLIUM	ug/gm	<0.20	<0.20	<0.20
TIN	ug/gm	8.27	10.4	0.38
VANADIUM	ug/gm	123	100	31.6
ZINC	ug/gm	2490	423	75.4

Lab Manager: _____

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

DATE 15 NOV 96 11:14
P.O. NO. 96-10-2834
W.O. NO. 2 121871

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
23 10 96

SOILS AND SEDIMENTS ANALYSIS REPORT

note HYDROCARBONS ANALYSIS REPORTED ON A DRY WEIGHT BASIS.

Lab Manager: _____

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
23 10 96

SOILS AND SEDIMENTS ANALYSIS REPORT

The following published METHODS OF ANALYSIS were used:

EPA3540H HYDROCARBONS
Soxhlet extraction with Freon; add
silica gel. Analysis by IR spectroscopy.
Ref. US EPA 3540/EPA 418.1

EPA3051 ARSENIC
EPA3051 ANTIMONY
EPA3051 BARIUM
EPA3051 BERYLLIUM
EPA3051 CADMIUM
EPA0351 CHROMIUM
EPA3051 COBALT
EPA3051 COPPER
EPA3051 LEAD
EPA3051 MERCURY
EPA3051 MOLYBDENUM
EPA3051 NICKEL
EPA3051 SELENIUM
EPA3051 SILVER
EPA3051 THALLIUM
EPA3051 TIN
EPA3051 VANADIUM
EPA3051 ZINC

Method References:

1. APHA Standard Methods for the Examination of Water and Wastewater, American Public Health Assoc., 17th ed.
2. EPA a. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, 3rd ed., US EPA, 1986
   b. Methods for Chemical Analysis of Water and Wastewater, US EPA, 1983
3. MSS Manual on Soil Sampling and Methods of Analysis, Cdn. Soc. of Soil Science, J. A. McKeague, 2nd ed.

NORWEST SOIL RESEARCH LTD has been accredited by the STANDARDS COUNCIL of CANADA for specific tests registered with the COUNCIL.

Lab Manager: _____

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

DATE 15 NOV 96 11:14
P.O. NO. 96-10-2834
W.O. NO. 2 121871
PAGE

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
23 10 96

Quality Assurance Analysis

Standard Reference Material Analysis

METHOD	ANALYSIS	-UNITS--	----STANDARD---- --DESCRIPTION---	--D.L.--	TARGET	-----QC WITH----- ---THIS ORDER---- #	MEAN	% Y	-HISTORICAL-- --PRECISION-- #	MEAN	-WARNING LIMITS-- LOW	HIGH
1381	HYDRO-CARBONS	mg/kg	IN HOUSE OIL STD	10	29184	1	27114	92.9	173	29024	27269	31099
35502	As	mg/kg	NBS	1.0	18.686	1	18.73	100.2	151	18.42	16.8	20.6
35503	Sb	mg/kg	NBS	0.5	0.969	1	1.300	134.1	123	0.9940	0.20	1.80
35504	Ba	mg/kg	NBS	.010	89.704	1	85.77	95.6	149	90.73	81.5	97.9
35508	Cd	mg/kg	NBS	0.025	3.615	1	3.566	98.6	144	3.608	3.5	3.7
35512	Cu	mg/kg	NBS	0.15	100.532	1	98.01	97.5	156	101.0	94.3	106.8
35514	Pb	mg/kg	NBS	0.1	154.273	1	157.8	102.3	162	153.3	142.9	165.6
35518	Hg	mg/kg	NBS	0.01	1.47	1	1.466	99.7	164	1.416	0.98	1.55
35519	Mo	mg/kg	NBS	0.05	2.814	1	2.610	92.8	149	2.778	2.3	3.4
35520	Ni	mg/kg	NBS	0.05	39.033	1	36.55	93.6	157	39.90	35.7	42.3
35523	Se	mg/kg	NBS	0.15	1.502	1	1.844	122.7	139	1.246	.5	2.50
35524	Ag	mg/kg	NBS	0.001	.318	1	0.3497	110.0	121	0.3342	0.2	0.4
35533	V	mg/kg	NBS	0.05	22.532	1	19.22	85.3	148	22.25	19.0	26.1
35534	Zn	mg/kg	NBS	0.025	395.712	1	402.5	101.7	151	393.4	381.0	410.4
35502	As	mg/kg	REAGENT BLANK	1.0	0.0	1	-0.05300		158	0.04536	-1.0	1.0
35503	Sb	mg/kg	REAGENT BLANK	0.5	0.0	1	-0.3180		129	-0.00835	-0.5	0.5
35504	Ba	mg/kg	REAGENT BLANK	.010	0.0	1	0.0		157	0.003070	-.02	.02
35505	Be	mg/kg	REAGENT BLANK	0.025	0.0	1	0.003000		155	0.001194	-0.05	0.05
35508	Cd	mg/kg	REAGENT BLANK	0.025	0.0	1	-0.01400		161	-0.00377	-.05	.05
35510	Cr	mg/kg	REAGENT BLANK	0.04	0.0	1	0.02400		162	0.008790	-.08	.08
35511	Co	mg/kg	REAGENT BLANK	0.035	0.0	1	0.03500		158	0.001867	-.07	.07
35512	Cu	mg/kg	REAGENT BLANK	0.15	0.0	1	0.0		162	0.009546	-.1	.1
35514	Pb	mg/kg	REAGENT BLANK	0.1	0.0	1	0.04400		168	0.02738	-.2	.2
35518	Hg	mg/kg	REAGENT BLANK	0.01	0.0	1	0.0		163	0.0	-.01	.01

QC/QA Manager: _____

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

DATE 15 NOV 96 11:14
P.O. NO. 96-10-2834
W.O. NO. 2 121871
PAGE

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
23 10 96

Quality Assurance Analysis

Standard Reference Material Analysis

METHOD	ANALYSIS	-UNITS--	----STANDARD---- --DESCRIPTION---	--D.L.--	TARGET	-----QC WITH----- ---THIS ORDER---- #	MEAN	% Y	-HISTORICAL-- --PRECISION-- #	MEAN	-WARNING LIMITS-- LOW	HIGH
35519	Mo	mg/kg	REAGENT BLANK	0.05	0.0	1	-0.01300		156	-0.00610	-.1	.1
35520	Ni	mg/kg	REAGENT BLANK	0.05	0.0	1	0.06700		163	0.008761	-.1	.1
35523	Se	mg/kg	REAGENT BLANK	0.15	0.0	1	0.003000		156	-0.00394	-.3	.3
35524	Ag	mg/kg	REAGENT BLANK	0.001	0.0	1	0.05900		127	0.005965	-0.1	0.1
35529	Tl	mg/kg	REAGENT BLANK	0.20	0.0	1	0.1180		158	0.01703	-.4	.4
35531	Sn	mg/kg	REAGENT BLANK	0.15	0.0	1	0.2680		127	0.01508	-.3	.3
35533	V	mg/kg	REAGENT BLANK	0.05	0.0	1	-0.00700		157	0.01150	-.1	.1
35534	Zn	mg/kg	REAGENT BLANK	0.025	0.0	1	0.0		163	0.000282	-.05	.05

QC/QA Manager: _____

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4344 FAX (604) 534-9996
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8630 FAX (204) 275-6019

DATE 15 NOV 96 11:14
P.O. NO. 96-10-2834
W.O. NO. 2 121871
PAGE

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
23 10 96

Quality Assurance Analysis

Client Material - Duplicate Analysis

METHOD	ANALYSIS	-UNITS--	--D.L.--	--RUN 1-	--RUN 2-	--RUN 1-	--RUN 2-	--RUN 1-	--RUN 2-	--RUN 1-	--RUN 2-
5860	MOISTURE WET WT.	%	0.1	54.75	59.18						
1381	HYDRO-CARBONS	mg/kg	10	10273	8908						

QC/QA Manager: _____

Phone:
(604) 530-4344
1-800-889-1433
Fax:
(604) 534-9996

NORWEST LABS

203-20771 Langley Bypass
Langley, B.C. V3A 5E8

WO (Lang.) : 21703
WO (Other) : 96102834
PO # :
Date Samp. : 23-Oct-96
Date Rec'd. : 29-Oct-96
Date Comp. : 8-Nov-96

Client		Received From	
Name	: Hycal Environmental	Name	: Norwest Labs
Address	: 1338A - 36th Ave. NE Calgary, Alberta CANADA T2E 6T6	Address	: Bay 6, 2712-37 Ave. NE Calgary, Alberta CANADA T1Y 5L3
Phone	: (403) 735-6454	Phone	: (403) 291-2022
Fax	: (403) 291-2795	Fax	: (403) 291-2021
Attn.	:	Attn.	:
Project	:		

Organo-Chloride Pesticides in Soil

Parameter	21703-1 R8864 1130 Donjek Background	21703-2 R8865 Site 33 Oil pit #1	21703-3 R8866 Site 33 Background	21703-4 R8867 Pump Stn. 6 Sample 5	Detection Limit
Pesticide					
Aldrin	<0.05	<0.05	<0.05	<0.05	0.05 ppm
BHC (alpha isomer)	<0.05	<0.05	<0.05	<0.05	0.05 ppm
4,4'-DDD	<0.05	<0.05	<0.05	<0.05	0.05 ppm
4,4'-DDE	<0.05	<0.05	<0.05	<0.05	0.05 ppm
2,4'-DDT	<0.05	<0.05	<0.05	<0.05	0.05 ppm
4,4'-DDT	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Dieldrin	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Endosulfan I	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Endosulfan II	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Endrin	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Heptachlor	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Heptachlor epoxide	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Hexachlorobenzene	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Lindane	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Methoxychlor	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Mirex	<0.05	<0.05	<0.05	<0.05	0.05 ppm
Percent Moisture	37.30	67.31	15.49	6.89	

Results are expressed in ppm (mg/kg), dry weight, without correction for recovery data.
ND = Not Determined.

Phone:
(604) 530-4344
1-800-889-1433
Fax:
(604) 534-9996

NORWEST LABS

203-20771 Langley Bypass
Langley, B.C. V3A 5E8

WO (Lang.) : 21703
WO (Other) : 96102834
PO # :
Date Samp. : 23-Oct-96
Date Rec'd. : 29-Oct-96
Date Comp. : 8-Nov-96

Organo-Chloride Pesticides in Soil (cont.)

Parameter	21703-5 R8868 1130 Donjek Pit	21703-6 R8869 Site 33 Koidern Sample 1	21703-7 R8870 Pump Stn. 6 Sample 6	Detection Limit
Pesticide				
Aldrin	<0.05	<0.05	<0.05	0.05 ppm
BHC (alpha isomer)	<0.05	<0.05	<0.05	0.05 ppm
4,4'-DDD	<0.05	<0.05	<0.05	0.05 ppm
4,4'-DDE	<0.05	<0.05	<0.05	0.05 ppm
2,4'-DDT	<0.05	<0.05	<0.05	0.05 ppm
4,4'-DDT	<0.05	<0.05	<0.05	0.05 ppm
Dieldrin	<0.05	<0.05	<0.05	0.05 ppm
Endosulfan I	<0.05	<0.05	<0.05	0.05 ppm
Endosulfan II	<0.05	<0.05	<0.05	0.05 ppm
Endrin	<0.05	<0.05	<0.05	0.05 ppm
Heptachlor	<0.05	<0.05	<0.05	0.05 ppm
Heptachlor epoxide	<0.05	<0.05	<0.05	0.05 ppm
Hexachlorobenzene	<0.05	<0.05	<0.05	0.05 ppm
Lindane	<0.05	<0.05	<0.05	0.05 ppm
Methoxychlor	<0.05	<0.05	<0.05	0.05 ppm
Mirex	<0.05	<0.05	<0.05	0.05 ppm
Percent Moisture	54.11	58.46	27.73	

Results are expressed in ppm (mg/kg), dry weight, without correction for recovery data.
ND = Not Determined.

Phone:
(604) 530-4344
1-800-889-1433
Fax:
(604) 534-9996

NORWEST LABS

203-20771 Langley Bypass
Langley, B.C. V3A 5E8

WO (Lang.) : 21703
WO (Other) : 96102834
PO # :
Date Samp. : 23-Oct-96
Date Rec'd. : 29-Oct-96
Date Comp. : 8-Nov-96

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	82	O-C Scan	7-Nov-96	Ken M.
Endosulfan I	90			
Surrogate	85			

Supervisor

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

Phone:
(604) 530-4344
1-800-889-1433
Fax:
(604) 534-9996

NORWEST LABS

203-20771 Langley Bypass
Langley, B.C. V3A 5E8

WO (Lang.) : 21703
WO (Other) : 96102834
PO # :
Date Samp. : 23-Oct-96
Date Rec'd. : 29-Oct-96
Date Comp. : 8-Nov-96

Client		Received From	
Name	: Hycal Environmental	Name	: Norwest Labs
Address	: 1338A - 36th Ave. NE Calgary, Alberta CANADA T2E 6T6	Address	: Bay 6, 2712-37 Ave. NE Calgary, Alberta CANADA T1Y 5L3
Phone	: (403) 735-6454	Phone	: (403) 291-2022
Fax	: (403) 291-2795	Fax	: (403) 291-2021
Attn.	:	Attn.	:
Project	:		

Organo-Phosphate Pesticides in Soil

Parameter	21703-1 R8864 1130 Donjek Background	21703-2 R8865 Site 33 Oil pit #1	21703-3 R8866 Site 33 Background	21703-4 R8867 Pump Stn. 6 Sample 5	Detection Limit
Pesticide					
Azinphos-Methyl (Guthion)	< 0.25 ppm	< 0.25 ppm	< 0.25 ppm	< 0.25 ppm	0.25 ppm
Chlorpyrifos	< 0.25 ppm	< 0.25 ppm	< 0.25 ppm	< 0.25 ppm	0.25 ppm
Coumaphos	< 0.35 ppm	< 0.35 ppm	< 0.35 ppm	< 0.35 ppm	0.35 ppm
Diazinon	< 0.05 ppm	< 0.05 ppm	< 0.05 ppm	< 0.05 ppm	0.05 ppm
Dichlorvos (DDVP, Vapona)	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Dimethoate (Cygon)	< 0.35 ppm	< 0.35 ppm	< 0.35 ppm	< 0.35 ppm	0.35 ppm
Disulfoton (Disyston)	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Ethion	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Fonofos (Dyfonate)	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Malathion	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Methamidophos	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Methyl Parathion	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Mevinphos (Phosdrin)	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Naled	< 0.25 ppm	< 0.25 ppm	< 0.25 ppm	< 0.25 ppm	0.25 ppm
Phorate (Thimet)	< 0.10 ppm	< 0.10 ppm	< 0.10 ppm	< 0.10 ppm	0.10 ppm
Phosalone	< 0.35 ppm	< 0.35 ppm	< 0.35 ppm	< 0.35 ppm	0.35 ppm
Terbufos	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Percent Moisture	37.30	67.31	15.49	6.89	

Results are expressed in ppm (mg/kg), dry weight, without correction for recovery data.
ND = Not Determined.

Phone:
(604) 530-4344
1-800-889-1433
Fax:
(604) 534-9996

NORWEST LABS

203-20771 Langley Bypass
Langley, B.C. V3A 5E8

WO (Lang.) : 21703
WO (Other) : 96102834
PO # :
Date Samp. : 23-Oct-96
Date Rec'd. : 29-Oct-96
Date Comp. : 8-Nov-96

Organo-Phosphate Pesticides in Soil (cont.)

Parameter	21703-5 R8868 1130 Donjek Pit	21703-6 R8869 Site 33 Koidern Sample 1	21703-7 R8870 Pump Stn. 6 Sample 6	Detection Limit
Pesticide				
Azinphos-Methyl (Guthion)	< 0.25 ppm	< 0.25 ppm	< 0.25 ppm	0.25 ppm
Chlorpyrifos	< 0.25 ppm	< 0.25 ppm	< 0.25 ppm	0.25 ppm
Coumaphos	< 0.35 ppm	< 0.35 ppm	< 0.35 ppm	0.35 ppm
Diazinon	< 0.05 ppm	< 0.05 ppm	< 0.05 ppm	0.05 ppm
Dichlorvos (DDVP, Vapona)	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Dimethoate (Cygon)	< 0.35 ppm	< 0.35 ppm	< 0.35 ppm	0.35 ppm
Disulfoton (Disyston)	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Ethion	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Fonofos (Dyfonate)	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Malathion	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Methamidophos	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Methyl Parathion	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Mevinphos (Phosdrin)	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Naled	< 0.25 ppm	< 0.25 ppm	< 0.25 ppm	0.25 ppm
Phorate (Thimet)	< 0.10 ppm	< 0.10 ppm	< 0.10 ppm	0.10 ppm
Phosalone	< 0.35 ppm	< 0.35 ppm	< 0.35 ppm	0.35 ppm
Terbufos	< 0.15 ppm	< 0.15 ppm	< 0.15 ppm	0.15 ppm
Percent Moisture	54.11	58.46	27.73	

Results are expressed in ppm (mg/kg), dry weight, without correction for recovery data.
ND = Not Determined.

Phone:
(604) 530-4344
1-800-889-1433
Fax:
(604) 534-9996

NORWEST LABS

203-20771 Langley Bypass
Langley, B.C. V3A 5E8

WO (Lang.) : 21703
WO (Other) : 96102834
PO # :
Date Samp. : 23-Oct-96
Date Rec'd. : 29-Oct-96
Date Comp. : 8-Nov-96

Organo-Phosphate Pesticides in Soil (cont.)

Definitions / Methods

Organo-Phosphate Pesticides: This analysis is carried out in accordance with U. S. Environmental Protection Agency Method 8140 (#SW 846, 3rd Edition, Washington DC 20460) which involves extraction of the components with an organic solvent followed by analysis by capillary gas chromatography using a flame ionization 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
Phorate	62	O-P Scan	7-Nov-96	Ken M.
Dyfonate	121			
Malathion	89			

R R Neuman
Supervisor

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

NORWEST LABS

Calgary, AB	Phone (403) 291-2022	Fax (403) 291-2021
Edmonton, AB	Phone (403) 438-5522	Fax (403) 434-8586
Lethbridge, AB	Phone (403) 329-9266	Fax (403) 327-8527
Langley, B.C.	Phone (604) 530-4344	Fax (604) 534-9996
Winnipeg, MB	Phone (204) 982-8630	Fax (204) 275-6019

TO:	Hycal Environmental	**DATE SAMPLED:**	23-Oct-96
		DATE RECEIVED:	24-Oct-96
ATTN:	Lisa	**DATE REPORTED:**	01-Nov-96
	Henri Kirkland	**LAB FILE#:**	96-10-2834
		Project: E6-243	

POLYCHLORINATED BIPHENYLS IN SOIL

LAB #	**R8864**	**R8865**	**R8866**	**R8867**	**R8868**	**Detection**
CLIENT #	**#1**	**#2**	**#3**	**#4**	**#5**	**Limit**
	1130 Donjek	**Site 33**	**Site 33**	**Pump Stn G**	**1130**	
	Background	**Oil Pit #1**	**Background**	**Sample 5**	**Donjek Pit**	
PCB Content	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Aroclor Type	----	----	----	----	----	

QUALITY ASSURANCE DATA

(This QA/QC data is representative of the lab based quality assurance program and is not to be utilized as field data.)

Surrogate Recovery %	75	83	83	74	73
Decachlorobiphenyl					

Results expressed in mg/kg dry wt. (ppm)

NORWEST LABS

Calgary, AB	Phone (403) 291-2022	Fax (403) 291-2021
Edmonton, AB	Phone (403) 438-5522	Fax (403) 434-8586
Lethbridge, AB	Phone (403) 329-9266	Fax (403) 327-8527
Langley, B.C.	Phone (604) 530-4344	Fax (604) 534-9996
Winnipeg, MB	Phone (204) 982-8630	Fax (204) 275-6019

TO: Hycal Environmental

ATTN: Lisa
Henri Kirkland

DATE SAMPLED: 23-Oct-96
DATE RECEIVED: 24-Oct-96
DATE REPORTED: 01-Nov-96
LAB FILE#: 96-10-2834

Project: E6-243

POLYCHLORINATED BIPHENYLS IN SOIL

LAB # / CLIENT #	R8869 #6 Site 33 Koidern Sample 1	R8870 #7 Pump Stn G Sample 6	Method Blank Oct-31	Detection Limit
PCB Content	<0.1	<0.1	<0.1	0.1
Aroclor Type	----	----	----	

QUALITY ASSURANCE DATA

(This QA/QC data is representative of the lab based quality assurance program and is not to be utilized as field data.)

Surrogate Recovery % Decachlorobiphenyl	93	NA	82

NA - not available due to matrix interferences

R. Corbet, M.Sc., P.Ag.
Manager - Organics

Results expressed in mg/kg dry wt. (ppm)

NORWEST LABS

Calgary, AB	Phone (403) 291-2022	Fax (403) 291-2021
Edmonton, AB	Phone (403) 438-5522	Fax (403) 434-8586
Lethbridge, AB	Phone (403) 329-9266	Fax (403) 327-8527
Langley, B.C.	Phone (604) 530-4344	Fax (604) 534-9996
Winnipeg, MB	Phone (204) 982-8630	Fax (204) 275-6019

TO: Hycal Environmental

ATTN: Lisa

DATE SAMPLED: 23-Oct-96
DATE RECEIVED: 24-Oct-96
DATE REPORTED: 01-Nov-96
LAB FILE#: 96-10-2834

Project: E6-243

POLYCHLORINATED BIPHENYLS
QUALITY ASSURANCE DATA

(This QA/QC data is representative of the lab based quality assurance program and is not to be utilized as field data.)

Calibration Check (CC)

	Actual Amt. (ng)	Detected Amt. (ng)	% Rec.
Aroclor 1254	5.0	5.47	109

QA/QC Sample

	Actual Amt. (ug/g)	Recovered	% Rec.
Aroclor	50	51.9	104

$$\text{Accuracy} = \frac{\text{Ave \% Rec. MS + Ave \% Rec. MSD}}{2} = 101.3 \text{ \% Accuracy}$$

$$\text{\% RSD} = \frac{\text{Ave \% Rec. MS - Ave \% Rec. MSD}}{\text{\% Accuracy}} = 5.3 \text{ \% RSD}$$

The calculated values are based on matrix spike and duplicate recovery data performed on your samples at the time of analysis.

Date Acquired: Oct 31/96 Analyst: Trevor Ahlstrom

Phone:
(604) 530-4344
1-800-889-1433
Fax:
(604) 534-9996

NORWEST LABS

203-20771 Langley Bypass
Langley, B.C. V3A 5E8

WO (Lang.) : 22033
WO (Other) : 96-10-2834
PO # :
Date Samp. :
Date Rec'd. : 14-Nov-96
Date Comp. : 27-Nov-96

Client		Received From	
Name	: Hycal Environmental	Name	: Norwest Labs
Address	: 1338A - 36th Ave. NE Calgary, Alberta CANADA T2E 6T6	Address	: Bay 6, 2712-37 Ave. NE Calgary, Alberta CANADA T1Y 5L3
Phone	: (403) 735-6454	Phone	: (403) 291-2022
Fax	: (403) 291-2795	Fax	: (403) 291-2021
Attn.	:	Attn.	:
Project	:		

Herbicide Analysis in Soil

Parameter	22033-1 #1 R8864 1130 Donjeck Backgr	22033-2 #3 R8866 ite 33 Background	Detection Limit
Phenoxy/Acid Herbicides			
2,4-D	<0.1	<0.1	0.1 ppm
Picloram	<0.1	<0.1	0.1 ppm
2,4,5-T	<0.1	<0.1	0.1 ppm
Organonitrogen Pesticides			
Fenuron	<0.5	<0.5	0.5 ppm
Percent Moisture	34.52	21.12	

Parameter	22033-3 #4 R8867 Pump Station G Sample	22033-4 #6 R8869 Site 33 Koidern Sample	Detection Limit
Phenoxy/Acid Herbicides			
2,4-D	<0.1	<0.1	0.1 ppm
Picloram	<0.1	<0.1	0.1 ppm
2,4,5-T	<0.1	<0.1	0.1 ppm
Organonitrogen Pesticides			
Fenuron	<0.5	<0.5	0.5 ppm
Percent Moisture	6.04	56.6	

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

Phone:
(604) 530-4344
1-800-889-1433
Fax:
(604) 534-9996

NORWEST LABS

203-20771 Langley Bypass
Langley, B.C. V3A 5E8

WO (Lang.) : 22033
WO (Other) : 96-10-2834
PO # :
Date Samp. :
Date Rec'd. : 14-Nov-96
Date Comp. : 27-Nov-96

Client		Received From	
Name	: Hycal Environmental	Name	: Norwest Labs
Address	: 1338A - 36th Ave. NE Calgary, Alberta CANADA T2E 6T6	Address	: Bay 6, 2712-37 Ave. NE Calgary, Alberta CANADA T1Y 5L3
Phone	: (403) 735-6454	Phone	: (403) 291-2022
Fax	: (403) 291-2795	Fax	: (403) 291-2021
Attn.	:	Attn.	:
Project	:		

Herbicide Analysis in Soil

Parameter	22033-1 #1 R8864 1130 Donjeck Backgr	22033-2 #3 R8866 ite 33 Background	Detection Limit
Phenoxy/Acid Herbicides			
2,4-D	<0.1	<0.1	0.1 ppm
Picloram	<0.1	<0.1	0.1 ppm
2,4,5-T	<0.1	<0.1	0.1 ppm
Organonitrogen Pesticides			
Fenuron	<0.5	<0.5	0.5 ppm
Percent Moisture	34.52	21.12	

Parameter	22033-3 #4 R8867 Pump Station G Sample	22033-4 #6 R8869 Site 33 Koidern Sample	Detection Limit
Phenoxy/Acid Herbicides			
2,4-D	<0.1	<0.1	0.1 ppm
Picloram	<0.1	<0.1	0.1 ppm
2,4,5-T	<0.1	<0.1	0.1 ppm
Organonitrogen Pesticides			
Fenuron	<0.5	<0.5	0.5 ppm
Percent Moisture	6.04	56.6	

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

NORWEST LABS

INFORMATION SHEET - SOILS

WORK ORDER NO.

SHEET ___ OF ___

DATE STAMP

COMPANY: HYCAL Environmental
ADDRESS:
CITY/TOWN: Calgary
PROVINCE:
POSTAL CODE:
ATTENTION:
PROJECT:

PHONE: 735-6463
FAX:
RESULTS TO: Lisa-Henri Kirkland

P.O. NO.	REPORTING SELECTIONS
E6-243	Q.A. REPORT ☐
REF./QUOTE NO.	

REPORT RESULTS: MAIL ☐ FAX ☑ COURIER ☐ — RUSH DATE REQUIRED D ___ M ___ Y ___ — SURCHARGE WILL APPLY ON RUSHES

SAMPLE CUSTODY				
SAMPLED BY	LH Kirkland	RECEIVED BY	[signature]	RELINQUISHED BY		RECEIVED BY	
COMPANY	Hycal	COMPANY	NWL	COMPANY		COMPANY	
DATE	23 Oct 96	DATE	3:40 23/10/96	DATE		DATE	

DATE SAMPLED D ___ M ___ Y ___ — NUMBER OF SAMPLES: SOIL ___ WASTE ___ WATER ___ PLANT ___ OTHER SPECIFY ___

SPECIAL INSTRUCTIONS (SEE OVER FOR IMPORTANT SAMPLE INFORMATION INSTRUCTIONS AND ANALYSIS CODES)

hold ~~all~~ remaining samples for possible future analysis
future analysis may include dioxins furans
esterone
tordon
fenuron

CLIENT NO.
INVOICE NO.
COMPLETION DATE D ___ M ___ Y ___

	SITE I.D.	SAMPLE DESCRIPTION	DEPTH (CM)	ANALYSIS PACKAGE CODES (USE CODES LISTED ON THE REVERSE OF THIS SHEET)	LAB CODING
1	1	1130 Donjek Background	-	PCB 2, PP1, P01, H4, TM44	
2	2	Site 33 ~~Sample~~ Oil Pit #1	-	as above	
3	3	Site 33 Background	-	as above	
4	4	Pump Stn. G Sample 5	-	as above	
5	5	1130 Donjek Pit	-	as above	
6	6	Site 33 Koidern Sample #1	-	as above	
7	7	Pump Stn G Sample 6	-	as above	
8	8	Pump Stn G Sample 5	-	no analysis at this point	
9	9	Site 33 North Pit	-	no analysis at this point	
10			-		
11			-		
12			-		
13			-		
14			-		
15			-		
16			-		
17			-		
18			-		
19			-		
20			-		

NORWEST LABS

Calgary, AB	Phone (403) 291-3022	Fax (403) 291-2021
Edmonton, AB	Phone (403) 438-5522	Fax (403) 434-8586
Lethbridge, AB	Phone (403) 328-9266	Fax (403) 327-8527
Langley, B.C.	Phone (604) 530-4344	Fax (604) 534-9996
Winnipeg, MB	Phone (204) 982-8630	Fax (204) 275-6019

TO:	Hycal Environmental	**DATE SAMPLED:**	23-Oct-96
		DATE RECEIVED:	24-Oct-96
ATTN:	Lisa	**DATE REPORTED:**	01-Nov-96
	Henri Kirkland	**LAB FILE#:**	96-10-2834
		Project: E6-243	

POLYCHLORINATED BIPHENYLS IN SOIL

LAB #	**R8864**	**R8865**	**R8866**	**R8867**	**R8868**	**Detection**
CLIENT #	**#1**	**#2**	**#3**	**#4**	**#5**	**Limit**
	1130 Donjek	**Site 33**	**Site 33**	**Pump Stn G**	**1130**	
	Background	**Oil Pit #1**	**Background**	**Sample 5**	**Donjek Pit**	
PCB Content	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Aroclor Type	---	---	---	---	---	

QUALITY ASSURANCE DATA

(This QA/QC data is representative of the lab based quality assurance program and is not to be utilized as field data.)

Surrogate Recovery % **Decachlorobiphenyl**	75	83	83	74	73

Results expressed in mg/kg dry wt. (ppm)

NORWEST LABS

Calgary, AB	Phone (403) 291-2022	Fax (403) 291-2021
Edmonton, AB	Phone (403) 438-5522	Fax (403) 434-8588
Lethbridge, AB	Phone (403) 329-9266	Fax (403) 327-8527
Langley, B.C.	Phone (604) 530-4344	Fax (604) 534-9996
Winnipeg, MB	Phone (204) 982-8830	Fax (204) 275-6018

TO:	Hycal Environmental	**DATE SAMPLED:**	23-Oct-96
		DATE RECEIVED:	24-Oct-96
ATTN:	Lisa	**DATE REPORTED:**	01-Nov-96
	Henri Kirkland	**LAB FILE#:**	96-10-2834
		Project: E6-243	

POLYCHLORINATED BIPHENYLS IN SOIL

LAB # / CLIENT #	R8869 #6 Site 33 Koldern Sample 1	R8870 #7 Pump Stn G Sample 6	Method Blank Oct-31	Detection Limit
PCB Content	<0.1	<0.1	<0.1	0.1
Aroclor Type	---	---	---	

QUALITY ASSURANCE DATA

(This QA/QC data is representative of the lab based quality assurance program and is not to be utilized as field data.)

Surrogate Recovery % Decachlorobiphenyl	93	NA	82

NA - not available due to matrix interferences

R. Corbet, M.Sc., P.Ag.
Manager - Organics

Results expressed in mg/kg dry wt. (ppm)

NORWEST LABS

Calgary, AB	Phone (403) 291-2022	Fax (403) 291-2021
Edmonton, AB	Phone (403) 438-5522	Fax (403) 434-8586
Lethbridge, AB	Phone (403) 329-9266	Fax (403) 327-8527
Langley, B.C.	Phone (604) 530-4344	Fax (604) 534-9996
Winnipeg, MB	Phone (204) 982-8630	Fax (204) 275-6016

TO:	Hycal Environmental	**DATE SAMPLED:**	23-Oct-96
		DATE RECEIVED:	24-Oct-96
ATTN:	Lisa	**DATE REPORTED:**	01-Nov-96
		LAB FILE#:	96-10-2834
		Project: E6-243	

POLYCHLORINATED BIPHENYLS
QUALITY ASSURANCE DATA

(This QA/QC data is representative of the lab based quality assurance program and is not to be utilized as field data.)

Calibration Check (CC)

	Actual Amt. (ng)	Detected Amt. (ng)	% Rec.
Aroclor 1254	5.0	5.47	109

QA/QC Sample

	Actual Amt. (ug/g)	Recovered	% Rec.
Aroclor	50	51.9	104

$$\text{Accuracy} = \frac{\text{Ave \% Rec. MS + Ave \% Rec. MSD}}{2} = 101.3 \text{ \% Accuracy}$$

$$\text{\% RSD} = \frac{\text{Ave \% Rec. MS - Ave \% Rec. MSD}}{\text{\% Accuracy}} = 5.3 \text{ \% RSD}$$

The calculated values are based on matrix spike and duplicate recovery data performed on your samples at the time of analysis.

Date Acquired: Oct 31/96 Analyst: Trevor Ahlstrom

NORWEST LABS

EDMONTON	PH. (403) 438-5522	FAX (403) 436-0396
CALGARY	PH. (403) 291-2022	FAX (403) 291-2021
LANGLEY	PH. (604) 530-4344	FAX (604) 534-9996
LETHBRIDGE	PH. (403) 329-9266	FAX (403) 327-8527
WINNIPEG	PH. (204) 982-8630	FAX (204) 275-6019

DATE 15 NOV 96 11:14
P.O. NO. 96-10-2834
W.O. NO. 2 121871
PAGE 1

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY, AB
T1Y 5L3

HYCAL ENVIRON.
29 10 96

SOILS AND SEDIMENTS ANALYSIS REPORT

SAMPLE		1 R8864 1130 DONJEK BACKGROUND	2 R8865 SITE 33 OIL PIT #1	3 R8866 SITE 33 BACKGROUND	4 R8867 PUMP STN. G SAMPLE 5
PHYSICAL					
MOIST.WET WT.	%	32.6	60.6	15.2	5.3
SOIL ORGANICS					
HYDROCARBONS	ug/gm	118	2630	167	68
ELEMENTAL COMP					
ARSENIC	ug/gm	4.3	48.0	5.7	4.1
ANTIMONY	ug/gm	<0.50	1.73	0.88	0.69
BARIUM	ug/gm	67.9	338	109	76.4
BERYLLIUM	ug/gm	0.103	0.276	0.287	0.259
CADMIUM	ug/gm	0.168	1.76	0.252	0.134
CHROMIUM	ug/gm	11.4	92.5	25.8	16.0
COBALT	ug/gm	4.90	11.7	12.9	9.96
COPPER	ug/gm	18.7	143	35.9	25.6
LEAD	ug/gm	6.0	28200	19.9	9.1
MERCURY	ug/gm	0.03	0.27	0.03	0.02
MOLYBDENUM	ug/gm	0.42	1.91	0.50	0.37
NICKEL	ug/gm	13.2	124	47.2	21.7
SELENIUM	ug/gm	0.63	1.58	0.50	0.37
SILVER	ug/gm	<0.001	1.07	<0.001	<0.001
THALLIUM	ug/gm	<0.20	<0.20	0.24	<0.20
TIN	ug/gm	0.74	11.3	0.50	0.35
VANADIUM	ug/gm	16.6	111	44.8	34.5
ZINC	ug/gm	39.7	512	69.6	60.5

Lab Manager: _____

NORWEST LABS

EDMONTON PH. (403) 438-5522 FAX (403) 438-0396
CALGARY PH. (403) 291-2022 FAX (403) 291-2021
LANGLEY PH. (604) 530-4346 FAX (604) 534-8998
LETHBRIDGE PH. (403) 329-9266 FAX (403) 327-8527
WINNIPEG PH. (204) 982-8550 FAX (204) 275-6019

DATE 15 NOV 96 11:14
P.O. NO. 96-10-2834
W.O. NO. 2 121871
PAGE 2

NORWEST LABS-CALGARY
BAY 6, 2712-37 AVE NE
CALGARY. AB
T1Y 5L3

HYCAL ENVIRON.
23 10 96

SOILS AND SEDIMENTS ANALYSIS REPORT

SAMPLE		5 R8868 1130 DONJEK PIT	6 R8869 SITE 33 KOIDERN SAMPLE 1	7 R8870 PUMP STN. G SAMPLE 6
PHYSICAL				
MOIST.WET WT.	%	54.8	60.8	11.6
SOIL ORGANICS				
HYDROCARBONS	ug/gm	10300	2280	1510
ELEMENTAL COMP				
ARSENIC	ug/gm	14.0	33.5	4.8
ANTIMONY	ug/gm	1.61	1.64	<0.50
BARIUM	ug/gm	197	401	98.8
BERYLLIUM	ug/gm	0.172	0.263	0.279
CADMIUM	ug/gm	2.43	1.57	0.284
CHROMIUM	ug/gm	43.9	121	26.1
COBALT	ug/gm	8.79	13.4	8.48
COPPER	ug/gm	95.2	143	24.3
LEAD	ug/gm	335	851	69.9
MERCURY	ug/gm	0.06	0.34	0.03
MOLYBDENUM	ug/gm	2.82	1.80	0.55
NICKEL	ug/gm	68.2	164	20.4
SELENIUM	ug/gm	1.14	1.04	0.67
SILVER	ug/gm	0.265	18.7	0.013
THALLIUM	ug/gm	<0.20	<0.20	<0.20
TIN	ug/gm	8.27	10.6	0.38
VANADIUM	ug/gm	123	100	31.6
ZINC	ug/gm	2490	423	75.4

Lab Manager: _____

APPENDIX D
PROJECT PERSONNEL

PROJECT PERSONNEL

Personnel who participated in the investigation included:

Lisa-Henri Kirkland, B.A., B.Sc., P.Geol.	historical investigation, field sampling, data analysis, and report preparation
Rod Ewacha, B.Sc., E.I.T.	field sampling, data analysis
Mark Bowman, B.Sc., P. Geoph.	geophysical investigation
Rosemarie Vander Meer, White River Nation	assistance in field sampling and historical investigation
Douglas Lee, M.Sc., P.Biol.	preliminary risk evaluation
Alan MacDonald, M.E.Des.	report review