Preliminary Environmental Investigation

Site 30 - North of Burwash Landing

Site 39 - Kathleen River Crossing

Site 44 - Marshall Creek Road

Prepared For:
Arctic Environmental Strategy
Indian and Northern Affairs Canada

Prepared By:
CCSG Associates

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prepared for:

Arctic Environmental Strategy
Indian and Northern Affairs Canada

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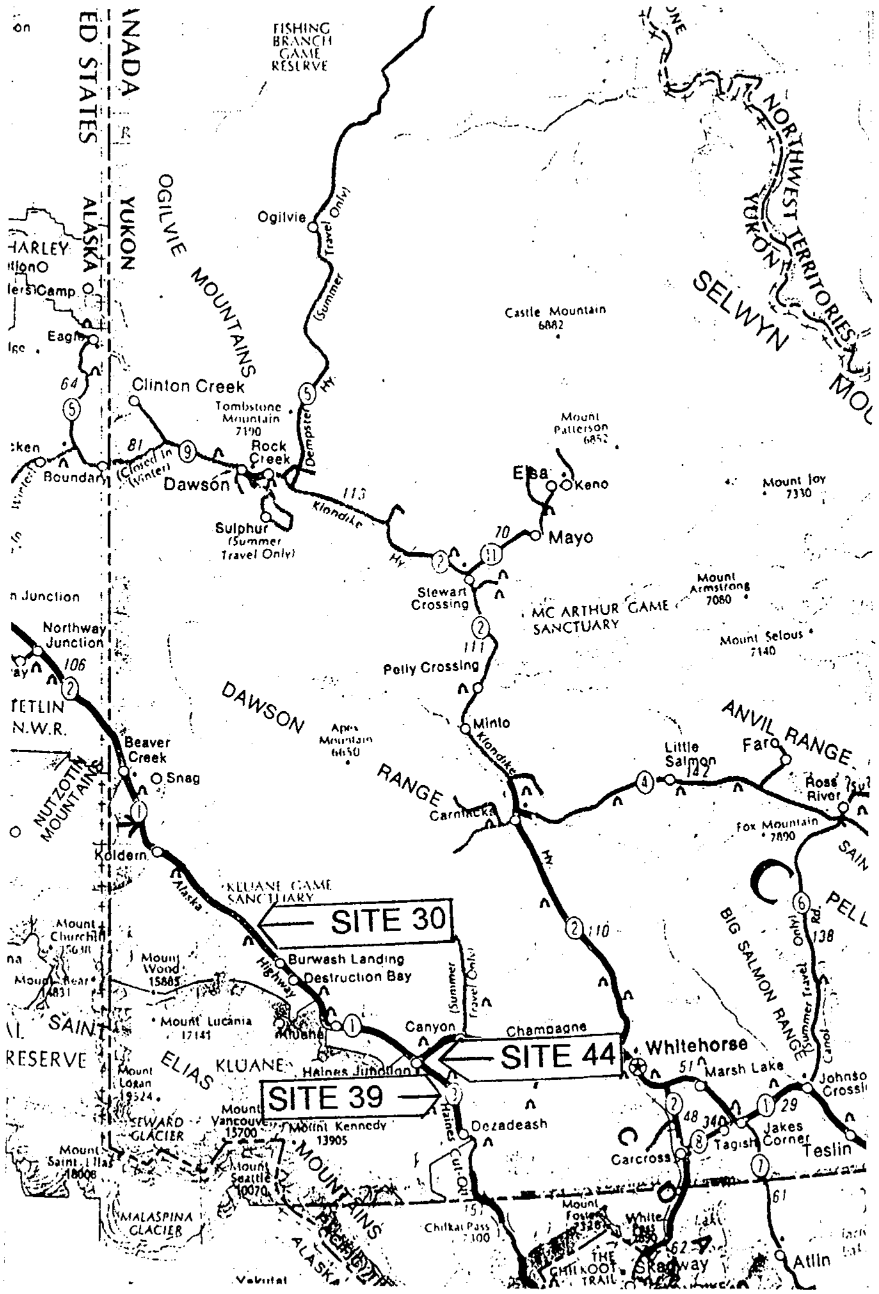


Figure One - Location of Sites 30, 39 and 44

Executive Summary

CCSG Associates conducted a preliminary environmental investigation for Site 30, Site 39 and Site 44. This report was prepared for the Arctic Environmental Strategy, Action on Waste program of Indian and Northern Affairs Canada.

The objectives of this environmental investigation were:
1. Develop a site history of physical wastes;
2. Test for specific contaminants: metals, total hydrocarbons, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, herbicides, pesticides, pH, and asbestos;
3. Determine a contaminant profile;
4. Suggest recommendations for further assessment, monitoring or remediation.

There were four phases used to accomplish these objectives.

In Phase I, the site histories were determined based on literature archival and record searches and through interviews. Contaminant presence and quantity was predicted.

Phase II tested for the presence of contaminants on site through a field and laboratory program.

Phase III interpreted the results of the field and analytical laboratory testing. Contaminant levels were compared to Canadian Council for the Ministers of the Environment (CCME) guidelines for Interim Assessment Criteria for Site Remediation. Contamination source, nature and extent were delineated, and potential for migration predicted.

Phase IV used the CCME National Classification System to predict potential harm to human and environmental health. Recommendations for further assessment, monitoring or remediation were made based on toxicological interpretation of the site contaminant types, quantities and locations.

Site 30

Site 30 is located at Km 1808.3 Alaska Highway north of Burwash Landing. Site 30 was formerly a pumpstation for the original 3" pipeline from Haines to Fairbanks, Alaska constructed in 1942 to 1943. Active use continued as a highway maintenance camp in the 1950's.

Site 30 is classified as a Class 2 site based on the NCS system. This indicates that Site 30 is a medium risk and some action is likely required.

CCSG Associates recommends that:

1. A sampling regime be developed to characterize and delineate the contaminants in the region around soil samples 30-S17 and 30-S23.

2. **Asbestos debris** on surface be picked up, placed in double bags and brought to the landfill.

3. The physical surface debris should be hand collected and correctly disposed of at the Haines Junction municipal landfill.

4. Monitor Future Site Alterations

Site 39

Site 39 is located at the northeast corner of the Kathleen River crossing on the Haines Highway Site 39 was formerly a maintenance and military camp for the building of the Haines Highway in 1942-1943. Buildings and camp waste were considered to have been disposed of on site.

Site 39 is classified as a Class 2 site based on the NCS system. This indicates that Site 39 is a medium risk and some action is required.

CCSG Associates recommends that:

1. Ground water testing should be conducted to ensure the health of the adjacent well for parameters not routinely tested but found to be present at Site 39 such as the herbicides dinoseb and 2,4-D.

2. Berries should be tested for trace metal and herbicide content since this area is used as a berry picking site.

3. A cleanup of potentially physically harmful surface debris should be conducted.

4. If the site is disturbed at a future date, any deep excavation should be monitored.

Site 44

Site 44, located approximately 5 km southwest of Haines Junction on the Marshall Creek Road and is immediately adjacent to the Dezadeash River. Site 44 was formerly a waste disposal site for local and military waste from the 1940's.

Site 44 is classified as a Class 1 site based on the NCS system. This indicates that Site 44 is a high risk and action is required.

CCSG Associates recommends that:

1. Full characterization of pond contaminants be conducted. Extent of contamination in both ponds was not well established. Point source samples of contaminants were located but not well delineated. A more intensive sampling regime should be conducted for the ponds.

2. Pond contaminants be delineated. It is known that waste was deposited into the pond depressions. A geophysical survey conducted in winter to determine extent of metal debris would provide an indication of overall contamination in ponds.

3. Ponds be remediated. Barrels and sludge should be removed from the site.

4. The physical surface debris should be collected and correctly disposed of at the Haines Junction municipal landfill.

5. Should excavation occur on this site monitoring must be conducted.

1.0 INTRODUCTION

1.1 Project Background

In 1996 the Arctic Environmental Strategy (AES), Action on Waste program of the federal department of Indian and Northern Affairs Canada initiated the preliminary environmental investigation of previously identified abandoned waste and disposal sites throughout the Yukon. These sites had been associated with exploration, mining, industrial, pipeline or military operations.

CCSG Associates, a Yukon environmental science consulting team, investigated three abandoned sites between August 1996 and November 1996. These sites were:

- Site 30, Km 1808.3 Alaska Highway north of Burwash Landing;
- Site 39, Kathleen River crossing on the Haines Road;
- Site 44, Approximately 5 km southwest of Haines Junction on the Marshall Creek Road.

1.2 Site Background

Common forms of waste generated by military camps have the potential to introduce specific, detectable contaminants into the environment:

Waste Material	***Detectable Contaminant***
Unused oil, petroleum and diesel	Hydrocarbons
Used oil	Polycyclic Aromatic Hydrocarbons (PAH's), Metals
Coolant from electrical transformers	Polychlorinated biphenyls (PCB's)
Building insulation	Asbestos
Pesticides (eg. DDT) for insect control	Organochlorines
Herbicides (eg. 2,4-D) for clearing vegetation	Phenoxy Acids
Garbage in a landfill site	High-metal, high-pH content leachate

These contaminants, as well as construction and miscellaneous debris have the potential to pose environmental and human health risks. For this reason, CCSG Associates looked and tested for the presence of the above-listed waste materials and corresponding contaminants. Where contaminants were found, potential for migration from the site and impact were assessed. For the purpose of this study a pollutant was considered to be a human generated waste and a contaminant was considered to be a pollutant with potential to be a human or environmental health risk.

Site 30

Site 30 is 54.0 km north of Burwash Landing on the south side of the Alaska Highway. This is 14.4 km north of the Kluane Gas Station. The site should not be confused with the Donjek Pump station, which is 10.1 km from the Kluane Gas Station and is on the north side of the highway.

The distinguishing physical features includes a concrete foundation, some old building lumber, metal debris and a pumphouse.

Site 30 is a classification accorded by AES to an area located at Kilometre 1808.3 Alaska Highway north of Burwash Landing (Fig. 1). Site 30 was formerly a pumpstation (pumpstation F) for the original 3" pipeline from Haines to Fairbanks, Alaska constructed in 1942 to 1943. The pipeline was abandoned in 1946 (page 65, Bisset, 1995). Active use of the site, but not the pipeline, continued as a highway maintenance camp in the 1950's (AES, Appendix A).

The boundaries of Site 30 are delineated on a sketch in Appendix A provided by AES. Site 30 is located on map sheet 115G/12 and has a latitude: 61 36' 45" and a longitude: 139 37' 20". The elevation is 905m. The UTM Coordinates are Easting: E 573 000 and Northing: N 6 831 750.

Site 39

Site 39 is a classification accorded by AES to an area located at the northwest corner of the Kathleen River crossing on the Haines Highway (Fig. 1). This crossing is 25.4 km south of Haines Junction. Site 39 was formerly a construction and maintenance camp for the 1942-43 building of the Haines Highway (pg 46: Bisset, 1995) but is now partially overlaid by the Haines Highway. Buildings and camp waste are suspected to have been disposed of on-site. The size of the site is approximately 100 metres by 100 metres (AES, Appendix A).

The boundaries of Site 39 are not delineated on any map as the Site has no present legal survey boundaries. Site 39 is located at Latitude 60°34', Longitude 137°14'. The UTM Coordinates are Easting: E 377 560 Northing: N 6 719 200.

The distinguishing physical features of Site 39 were surface and buried household waste, some old building lumber and a barrel submerged in a pond.

Site 44

Site 44 is located on the north bank of the Dezadeash River, 5.2 km east of Haines Junction on the Marshall Creek Road (Fig. 1). The site is located 300 metres south of this road and is accessible by a dirt track. The site was originally a military garbage dump site, saw some use as a dumping area for local residents but is now abandoned (AES, Appendix A; Bisset, page 225, 1995; Baltimore, interview)

The boundaries of Site 44 are not delineated on any map as the Site has no present legal survey boundaries. Site 44 is located on map sheet 115A/14 at Latitude 137°25', Longitude 60°46'. The UTM Coordinates are Easting: E 368 500 Northing: N 6 739 000

The distinguishing physical features includes old vehicle bodies, drums, tires, surface and buried general household waste such as cans and bottles (AES, Appendix A), some old building lumber, barrels and metal waste submerged in the ponds.

1.3 Objectives

The objectives of this environmental investigation were to:

1. Develop a site inventory of physical wastes;
2. Test for specific contaminants: metals, total hydrocarbons, PAH's, PCB's, herbicides, pesticides, pH and asbestos;
3. Determine a contaminant profile;
4. Suggest recommendations for further assessment, monitoring or remediation.

1.4 Project Protocol

The project design was developed according to the four phases of investigation described in the *Canadian Standards Association (CSA) Guidelines for Site Remediation* (CSA,1994):

PHASE I

Determine site history and contaminant profile based on literature, archival and record search and interviews. Predict presence and quantity of contamination.

The AES document *Research of Former Military Sites and Activities in the Yukon* (Bisset, 1995) provided a basis for Phase I of this study.

PHASE II

Test for the presence of contaminants on site to confirm or refute predictions made in Phase I.

PHASE III

Delineate contaminant sources and migration pathways. Determine extent and nature of contamination. Analyse and interpret Phase II results.

The results of Phase II and Phase III testing and characterization were compared to standards established by the *Canadian Council of Minister of the Environment (CCME) Interim Assessment Criteria for Contaminated Sites* (CCME, 1991). The CCME criteria are intended to maintain, improve, or protect environmental quality and human health at contaminated sites. These criteria provide numerical limits for contaminants in soil and water.

PHASE IV

Develop recommendations for further assessment, monitoring or remediation.

The sites were assessed for environmental risk according to the *CCME National Classification System (NCS) for Contaminated Sites* (CCME, 1992). This system evaluated the contaminated sites according to current or potential adverse impact on human health and the environment.

2.0 METHODOLOGY

PHASE I

2.1 Review of Existing Information

Phase I consisted of archival research and interviews to amass existing information about the sites. This information was critical because the history of site used to predict the potential for certain types and quantities of contaminants currently at the site.

Phase I research on Site 30, Site 39 and Site 44 had already been completed and documented in the AES-requisitioned report *Research of Former Military Sites and Activities in the Yukon* (Bisset, 1995). This report included archival and interview research. CCSG Associates did not revisit sources that were researched by the Bisset (1995) study.

2.1.1 Archival Research

Some archival information was provided by AES. In addition the following departments and libraries were searched for relevant material:

- Yukon Archives;
- Whitehorse Public Library;
- Government of Yukon Community and Transportation Services Library;
- INAC Library.

2.1.2 Interviews

CCSG Associates interviewed the following local residents:

Site 30: Geraldine Pope, Bob Johnson, Joe Bruno, Dennis Nixon, Ken Baltimore, Andy Williams and Scott Gilbert.

Site 39: Mike Crawshay, Charles and Myra Egli, Ken Anderson and Scott Gilbert.

Site 44: Mike Crawshay, Ken Anderson, Ken Baltimore, Andy Williams, Richard Anderson, Kam Konduc and Scott Gilbert.

Information was requested from a number of Government Departments:

- Government of Yukon Tourism Heritage Branch

This branch maintains project files on former military sites.

- Water Survey Canada

Site 39 is adjacent to the Kathleen River. Site 44 is adjacent to the Dezadeash River.

- Yukon Government Community and Transportation Services

Site 39 is partially covered by the Haines highway.

PHASE II

2.2 Field Program

Field Program was a Phase II component implemented to confirm or refute predictions of contaminant presence noted in Phase I. Phase II was comprised of an initial reconnaissance, survey grid layout and visual survey. Soil, water and vegetation samples were taken from sample locations chosen based on Phase I and survey indications.

2.2.1 Initial Reconnaissance

An initial site reconnaissance was done to establish layout and physical characterization. The following features were noted: signs of stressed vegetation, atypical or nonexistent vegetation, olfactory and staining indications; proximity to water and erosion; surface waste and existing structures.

2.2.2 Survey Grid Layout

Site 30

A 25 meter by 25 meter grid was laid out over Site 30 using a hip chain to measure distances and a hand held Path Instruments Inc. compass for direction bearings. No cut-lines were made. The Alaska Highway was used as baseline for east/west grid lines, from which north/south grid lines were extened. These were set at 20 degrees from the right angle with the highway (Fig. 2). The north/south grid lines were set to magnetic north and no compensation was made for true north. The angle between grid lines is 20 degrees from the perpendicular. The exception to this was the centerline, which only followed the 20 degree from the perpendicular line after extending into the site for 75 metres. The grid is accurate to approximately five metres. No elevations were recorded while performing the field survey.

The reference point on the survey grid is the centre of the gravel access road and where it meets the Alaska. The coordinates of this point were Centerline, 0+00. Any point to the west of the centerline had the prefix W and any point east had the prefix E. For example, a point 25 metres south of the Alaska Highway and 100 metres east of the centreline would be referred to as E100, 0+25. All point sample sites have been referenced in this grid system. The size of the Site 30 was 250 metres by 175 metres.

Site 39

A 25 meter by 25 meter grid was laid out over Site 39 using a hip chain to measure distances and a hand held Path Instruments Inc. compass for direction bearings. No cut-lines were made. The Haines Highway was used as baseline for north/south grid lines which were set 20 degrees from the right angle with the highway (Fig. 3). All lines were set to magnetic north and no compensation was made for true north. The angle between grid lines is 20 degrees from the perpendicular. The grid is accurate to approximately five metres. No elevations were recorded while performing the field survey.The size of the site was 100m x 100m.

The reference point on the survey grid is the northwest end of a concrete barrier on the Kathleen River bridge. The coordinates of this point were 1+00, Y1+00. The first set of coordinate numbers run parallel to the highway and the coordinate numbers with the prefix Y run north/south. All point sample sites have been referenced in this grid system.

Site 44

A 25 meter by 25 meter grid was laid out over Site 44 using a hip chain to measure distances and a hand held Path Instruments Inc. compass for direction bearings. No cut-lines were made. All lines were set either to or at 90 degrees from magnetic north and no compensation was made for true north. The grid is accurate to approximately five metres. No elevations were recorded while performing the field survey. The size of the Site 44 is about 100 meters by 250 meters.

The reference point on the survey grid is at the east end of the site on the promontory of land that separates the Dezadeash River from a marsh area. The coordinates of this point were B1+00, 1+00. The first set of coordinate numbers (with the prefix B) run east/west and the second set of numbers run north/south (Fig. 4). All point sample sites have been referenced in this grid system. The survey marker used by CCSG Associates was not permanent. A subsidiary reference point was also established on a distinguishing physical feature.

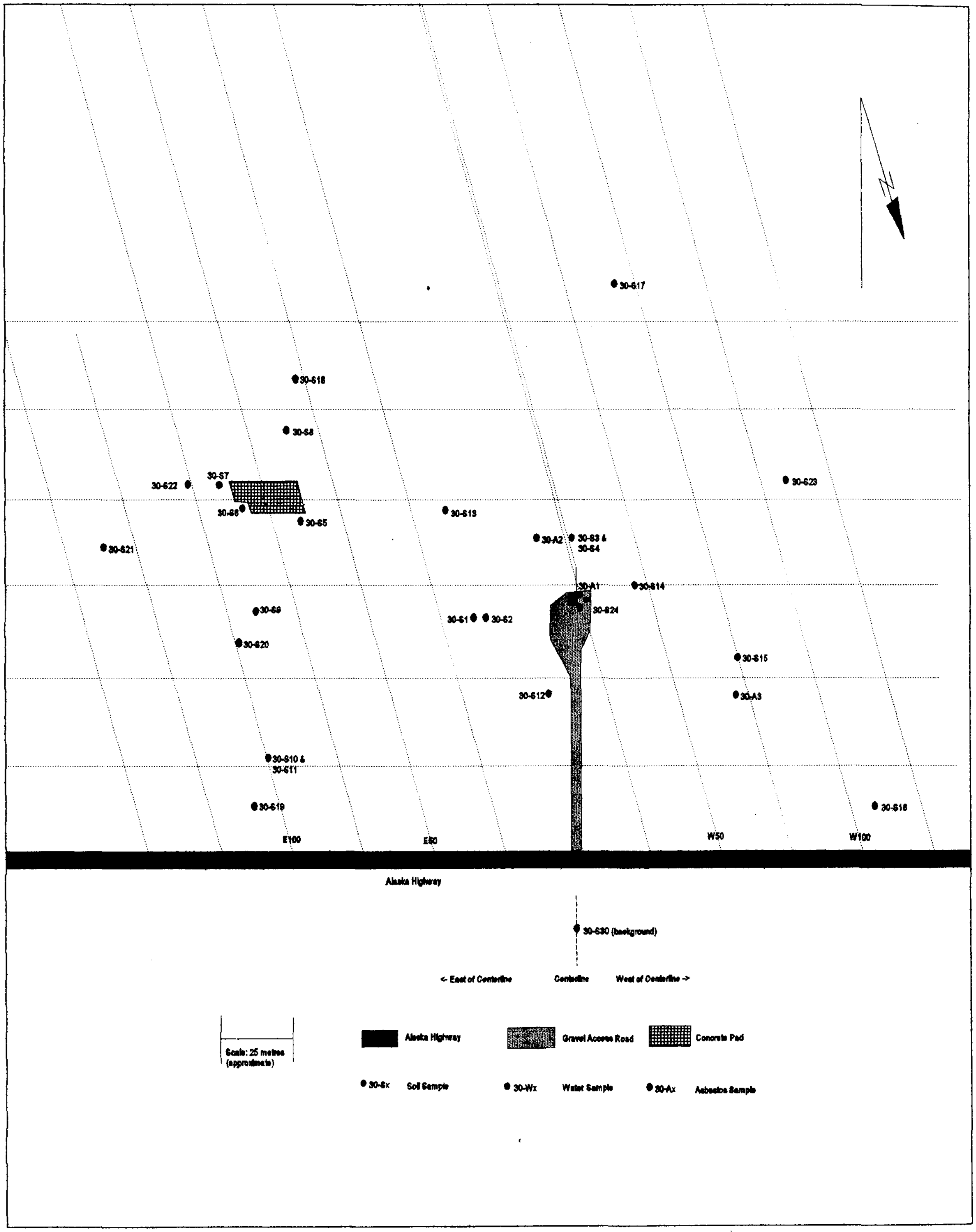


FIGURE TWO
Site 30 Survey Grid Layout and Sample Sites

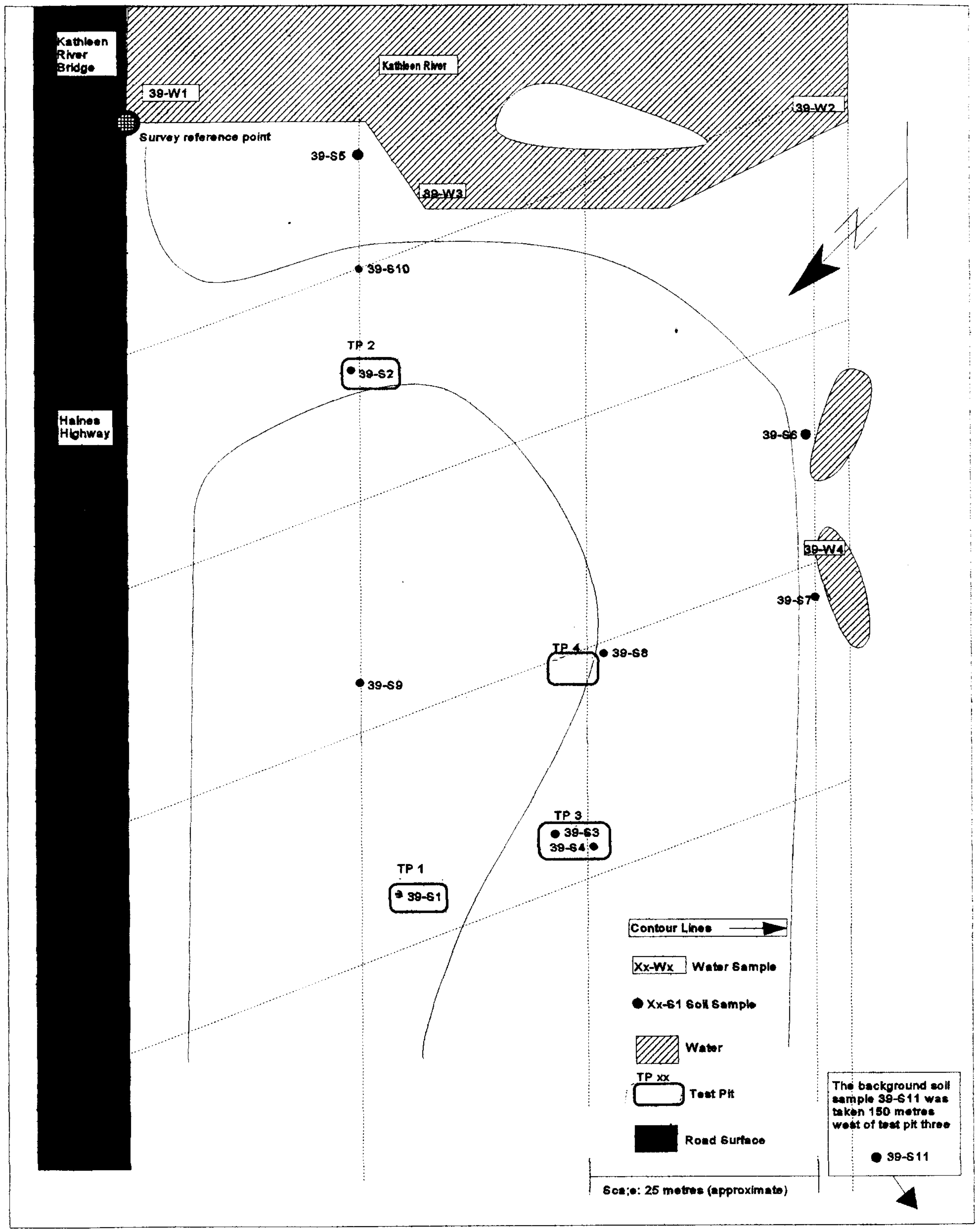


FIGURE THREE
Site 39 Survey Grid Layout and Sample Sites

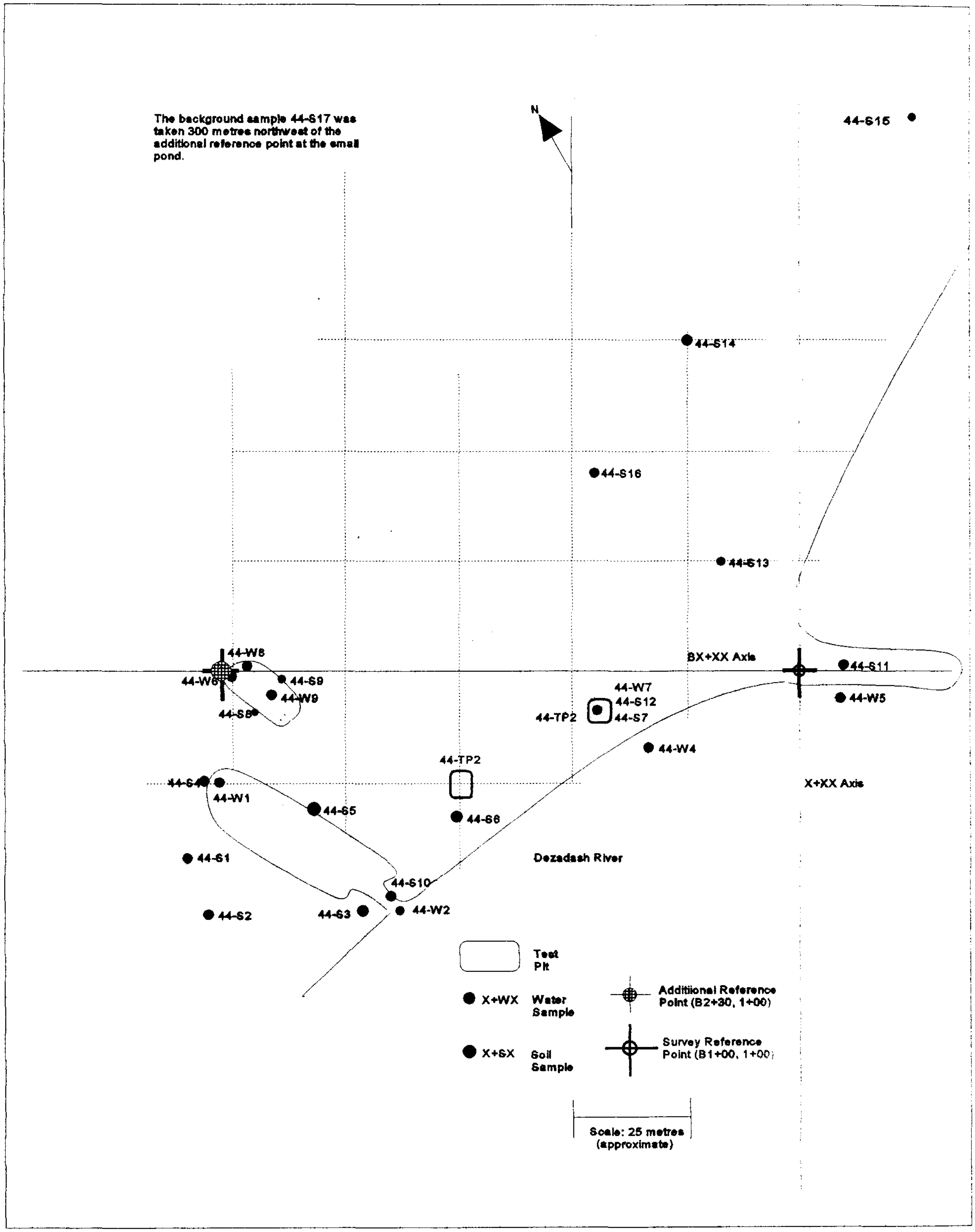


FIGURE FOUR
Site 44 Survey Grid Layout and Sample Sites

2.2.3 Visual Survey

Once grid lines had been laid out, a visual survey of the site was conducted by walking parallel to the north/south gridlines at intervals of 15 metres. The visual survey was extended to 50 metres beyond the predicted extent of impact. Relevant physical features were referenced to the grid.

The survey walk ensured that any visual anomalies were accurately described and mapped in greater detail than provided in the initial reconnaissance. Vegetation was examined for signs of stress and anomalies from expected abundance and types of plants, and described in spacial relation to other vegetation regions. Surface debris, topography and structures were noted as indicators of potential contamination and recorded as a surface area layout.

2.2.5 Sampling

Point sample sites had been selected during the visual survey. These sites were chosen form indications derived in the archival research, initial reconnaissance and visual survey.

Ambient conditions were recorded at the time of sampling: air temperature, precipitation, cloud cover and general weather

2.2.5.1 Soil

Soil samples were collected using a 3 1/2 inch hand auger with a 3 foot extension. At every soil sample site a number of observations were recorded; location on survey grid, surface debris, vegetation, location, depth, soil type, colour, moisture and general particle size. These sampling details are located in Appendix B -30 for Site 30, Appendix B -39 for Site 39, Appendix B -44 for Site 44.

Soil samples were stored in sample bags or glass jars. Soil sample labels consisted of three codes: site number, the letter 'S' for soil and a number which indicated the order in which the sample had been taken. For example the second soil sample taken at Site 30 was labeled 30-S2. Sample bags were also labeled with the survey grid coordinates at the point location where the sample had been taken. All soil samples were stored at approximately four degrees Celsius before transport to the analytical laboratory. Analysis was conducted within two weeks of the sampling date.

2.2.5.2 Water

Water samples were collected by dipping the appropriate storage receptacle into the water source. Water temperature and pH (using an Oakton waterproof field tester) were recorded at the time and place of sampling. Water samples intended for metal analysis were stored in 750 mililitre plastic jars. Nitric acid was added to these samples to preserve metal content. Water samples not intended for metal analysis were stored in one liter glass jars without preservative.

Water sample labels consisted of three codes: site number, the letter 'W' for water and a number which indicated the order in which the sample had been taken. For example the second water sample taken at Site 39 was labeled 39-W2. Sample bags were also labeled with the survey grid coordinates at the point location where the sample had been taken. All samples were stored at approximately four degrees Celsius before transport to the analytical laboratory. Analysis was conducted within two weeks of the sampling date.

2.2.5.3 Test Pits

Test pits were dug to provide a stratigraphic view of natural soils and waste deposited on Site 39 and Site 44. A Case 580 Super E rubber wheeled backhoe was used for test pit sampling. Test pits were excavated to a depth of 1.75 metres. At this depth soil stratification and some forms of subsurface contamination could be noted.

Samples taken from test pits were assigned a label consisting of three codes: site number, the letters 'TP' for test pit and a number which indicated the order in which the pit had been dug. For example the second test pit on Site 44 was labelled 44-TP2. Soil and water samples were obtained and stored following the sampling protocol described in the previous paragraphs.

2.2.5.4 Vegetation

Plants that displayed stress were sampled. A piece of the plant was removed and stored in a sample bag. Stress was defined as any indication that plant health, growth or reproduction was adversely influenced, for example stunted growth, unhealthy appearance, or insect and mold infections.

Microscopic analysis was conducted within two weeks of the sampling date.

2.2.5.5 Waste

Some pieces of miscellaneous waste with potential for dating the site were picked up and stored in sample bags.

2.2.6 Photographs

Photographs were taken of:
- the site from various vantages
- point sample sites
- test pit excavation
- surface debris
- stressed vegetation

Photographs were assigned a label consisting of a site number and a photograph number, for example the second photograph at Site 30 was labelled 30-P2.

2.3 Laboratory Program

The laboratory program consisted of two parts: field and off-site analytical laboratory analysis.

The first analysis on every soil sample was a PetroFLAG field test for total extractable hydrocarbons. Samples that indicated high total extractable hydrocarbon concentrations were then field tested using DTECH immunoassay analysis for PAH. PCB field analysis using DTECH immunoassay analysis was performed on samples from sites which indicated a potential concern, for example sites where electrical generation equipment may have been originally used or stored.

Analyses performed in the field were subject to fluctuations in ambient temperature. The maximum daytime temperature recorded was 19 degrees Celsius. The minimum daytime temperature recorded was four degrees Celsius. Reaction rates varied with temperature and interpretation of field generated results accounted for these variations.

Some soil, water and other samples were sent to a commercial analytical laboratory where testing took into account a wider range of parameters and guaranteed a higher level of accuracy than field testing. CCSG Associates submitted samples to Chemex Labs Alberta Inc. of Calgary, Alberta. Chemex is approved by the Canadian Association for Environmental Analytical Laboratories (CAEAL). Chemex analysed all samples in compliance with the CCME Interim Canadian Environmental Quality Criteria for Contaminated Sites Guidelines.

Samples were chosen for laboratory analysis based on:

- required replication of field samples to ensure Quality Assurance/Quality Control
- indications of potential high contamination derived from field results

2.3.1 Quality Assurance/Quality Control

All sampling and testing adhered to the principals outlined in the CCME Guidance Manual on Sampling Analysis and Data Management for Contaminated Sites. CCME Data Quality Objectives were used to develop the experimental design for laboratory analysis.

The experimental design for laboratory analysis was developed and implemented according to the CCME Quality Assurance/Quality Control (QA/QC) guidelines. For quality assurance:

1. blank and spike samples were verified with each sample run;
2. ambient air temperature variation was accounted for;
3. 10% of all field tests were replicated in the field to confirm analysis.

For quality control 10% of field samples were submitted to Chemex Labs to undergo testing for the same compounds (total extractable hydrocarbons, polycyclic aromatic hydrocarbons and/or polychlorinated biphenyls) for which they had been tested in the field.

2.3.2 Field Laboratory Analysis

Samples were tested on-site for:

- total hydrocarbons
- PAH's
- PCB's

Total Hydrocarbons:
Visual and odour observations, and subsequently UVic Photo-ionization, were used to initially detect for total hydrocarbons. The UVic detector was supplied by Span Gas Safety Services Limited, Edmonton, Alberta.

The PetroFLAG hydrocarbon analysis system is a field analytical tool which tests for a broad spectrum of hydrocarbon contamination regardless of the source or the state of hydrocarbon degradation. The PetroFLAG meters and reagents were supplied by Osprey Scientific Inc., St. Albert, Alberta.

In the PetroFLAG analysis system, hydrocarbons are extracted from soils using an extraction solvent which contains no chlorofluorocarbons or chlorinated solvents. Extraction efficiency is not affected by soil moisture content. The resulting solution is analysed in an analyser which can be set to a particular response factor based on suspected contamination. This analyser is most sensitive to heavier hydrocarbons such as oils and greases and less sensitive to lighter more volatile hydrocarbon fuels.

Soils with high organic content produce a relatively high hydrocarbon reading using PetroFLAG analysis because naturally occurring waxes and oils as well as hydrocarbon-like compounds such as terpenes or creosotes are extracted by the solvent.

Field trials conducted to confirm effectiveness of the PetroFLAG method for samples contaminated with diesel fuel, oil and grease correlated well with EPA laboratory methods. Results indicated there were no false negatives and 10% false positives.

PAH's:
The DTECH immunoassay analysis system provides semiquantitative field analysis for polycyclic aromatic

hydrocarbons (PAHs) in soil and water samples. Immunoassay analysis uses antibodies (biological molecules) to bind only the target compound in the sample matrix. The antibodies are then linked to a colour indicator and the colour intensity can be measured to determine the target compound concentration.

DTECH can detect and measure PAH concentrations in the range of 8 to 250 ppb in water and 0.6 to 25 ppm in soil. It is possible for DTECH to indicate a positive test result for PAH due to cross-reactivity with structurally similar compounds.

The DTECH meters and reagents were supplied by Osprey Scientific Inc., St. Albert, Alberta.

PCBs:
The DTECH immunoassay analysis system provides semiquantitative field analysis for polychlorinated biphenyls in soil or wipe samples. Immunoassay analysis uses antibodies (biological molecules) to bind only the target compound in the sample matrix. The antibodies are then linked to a colour and the colour intensity can be measured to determine the target compound concentration.

DTECH can detect and measure PCB concentrations in the range of 0.5 ppm to 25 ppm in soil. This test reacts directly with Aroclors 1254,1260, and 1262, reacts well with Aroclors 1242,1248, and 1268, reacts moderately with Aroclors 1232 and 1016, and shows little reactivity with Aroclor 1221.

The DTECH meters and reagents were supplied by Osprey Scientific Inc., St. Albert, Alberta.

2.3.3 Analytical Laboratory Program

Some soil, water and other samples were chosen to be sent to a commercial analytical laboratory. This testing was done for the following reasons:
1. To provide more accurate quantitative analysis of parameters already tested in field;
2. To test greater specificity within parameters;
3. To confirm accuracy of field results through replicate samples;
4. To test parameters that could not be tested in the field.

Soil and water samples were sent to Chemex Labs Alberta Inc. of Calgary, Alberta were tested for some or all of the components listed in the following chart.

TYPE OF TEST	METHOD OF TEST	ITEMS TESTED FOR
Total Metal Content	ICP	barium beryllium cadmium chromium cobalt copper lead molybdenum nickel silver vanadium thallium arsenic selenium tin antimony zinc
Total Extractable Hydrocarbons	Modified Method ASTN D2887	C8-C60
Volatile Organic Hydrocarbons	BTEX EPA Method 8260 Modified	Benzene Ethylbezene Toluene m&p-Xylene o-Xylene
PAHs	GC/MSD (US EPA SW-846 Method 8270 Modified)	Naphthalene Acenapthene Pyrene Benzo(c)phenanthrene 7,12-Dibenz(a)anthracene Benzo(K)fluoranthene Benzo(a)pyrene Dibenzo(a,h)anthracene Dibenzo(a,h)pyrene Dibenzo(a,l)pyrene Acenaphthylene Flouranthene Chrysene Benzo(a)anthracene Benzo(b&j)fluoranthene 3-Methylcholanthrene Indeno(1,2,3-cd)pyrene Benzo(g,h,i)perylene Dibenzo(a,i)pyrene
Organochlorine Pesticides	GC/MSD (US EPA SW-846 Method 8270 Modified)	Trifluralin Triallate Endosulfan I Endosulfan II 4,4'-DDT Methoxychlor gamma-Chlordane beta-BHC heptachlor Dieldrin Endrin Aldehyde Endosulfan Sulfate Heptachlor Epoxide alpha-Chlordane gamma-BHC (Lindane) Aldrin Endrin alpha-BHC delta-BHC 4,4'-DDE 4,4'-DDD
Phenoxy Acid Herbicides	GC/MSD (US EPA SW-846 Method 8270 Modified)	Lontrel MCPP (Mecoprop) 3,5-Dichlorobenzoate 2,4-dichlorophenol (2,4-D) 2,4,5-trichlorophenol (2,4,5-T) 2,4-DB Acifluoren Dicamba Bromoxynil Dinoseb Pentachlorophenol Chloramben Picloram Diclofop-methyl MCPA Dichloroprop Bentazon 2,4,5-TP MCPB DCPA Diacid

PHASE III

2.4 Delineation

The results of field and Chemex laboratory testing, in conjunction with knowledge of the physical characteristics of the site, were used to:

1. Analyse and interpret levels of contaminants detected in Phase II.
2. Determine contaminant sources.
3. Delineate the extent and nature of contamination.
5. Predict the potential for contaminant migration.

PHASE IV

2.5 Developing Recommendations

Phase IV develops recommendations for further assessment, monitoring or remediation.

Background levels are compared with concentrations found in the site sampling regime. Concentrations above the background levels are considered a potential pollutant. CCME Interim Assessment Criteria are compared to the sample analysis results to determine level of concern presented.

Interpretation of analytical results included the use of the National Classification System (CCME NCS, 1992) work sheets. This system uses a work sheet scoring system to assess the hazard of a site. Site classification is based on individual characteristics and the site is placed into classes according to their priority for action. These classes are:

Class 1 - Action Required
Class 2 - Action Likely Required
Class 3 - Action May Be Required
Class N - Action Not Likely Required
Class I - Insufficient Information

Determination of these ratings assess potential hazard to human and ecological health by:

1. Establishing contaminants, receptors and pathways involved.
2. Combining site specific data with literature review to assess toxicity potential.
3. Delineating contaminant sources and assessing potential exposure levels and pathways.
4. Classifying potential hazard of site and recommending degree of action priority.

The National Classification System evaluates sites by scoring them on a scale from 0 to 100. In general, sites that exhibit observable or measured impacts on the surrounding environment or have a high potential for causing negative impacts will score high under the system. Sites with minimal observed impacts or a low potential for causing impacts will generally receive a low score. The system is not designed to provide a quantitative risk assessment, but rather is a tool to screen sites with respect to need for further action (e.g., characterization, risk assessment, remediation, etc.) to protect human and animal health and the environment.

Sites are not ranked relative to one another. Sites are classified on their individual characteristics and placed into classes according to their priority for action.

3.0 RESULTS

PHASE 1 : Site 30

3.1 Archival Research and Interviews

A primary source of historical information regarding military activities in the Yukon Territory was the "Research of Former Military Sites and Activities in the Yukon", compiled by K. Bisset and Associates in April, 1995. It was compiled for the Arctic Environmental Strategy of DIAND and essentially comprises a Phase I analysis of all former military sites and activities in the Yukon. Additional information was compiled from the Yukon Archives, the Whitehorse Public Library, the Department of Indian and Northern Affairs Library, the Heritage Branch of YTG Tourism Department, Yukon Territorial Government Community and Transportation Services, Yukon Weather Centre and the Water Survey of Canada. Residents and commercial companies of the area also provided information. The Kluane First Nations and the Arctic Research Institute at Kluane Lake were contacted. Initial site reconnaissance provided basic information about the physical site.

3.1.1 Site History

Site 30 was formerly a pumpstation (Pumpstation F) for the original 3" pipeline (called the CANOL #4) from Haines to Fairbanks, Alaska constructed in 1942 to 1943. The pipeline was abandoned in 1946 (page 65, Bisset, 1995). Active use of the site, but not the pipeline, continued as a highway maintenance camp in the 1950's and was associated with the US Army (Baltimore, interview). Site 30 was historically called Standard Oil Pumpstation F, Mile 1126.5 Alaska Highway, and is now called Kilometre 1808.3.

3.1.2 Type and Quantity of Contaminants

According to Bisset: "Little information was located on the salvage of the Canol No. 3 & 4 pump stations" (page 66). However, the Environment Canada Environmental Protection Service (AES, Appendix A) report from 1987 indicated waste on site included 5 buildings, metal scrap, and one oil tank in an open uncovered site. In the centre of the site is a water pumphouse that is privately leased. On the rest of the site there is barbed wire fence, wood debris, concrete foundations, wood debris from Quonset hut and approx 100 feet of pipe (AES, Appendix A). The interview with Ken Baltimore revealed that US army waste from the 1940"s and 50's might be present.

Archival research did not indicate what specific contaminants would have been stored at Site 30.

3.1.3 Geology of the Area

The geology of the Site 30 area is a greenstone and limestone of the Wrangellia Terraine. This is an accreted insular superterraine from the mid-cretaceous time period. Middle pennsylvannian plutons intrude the basement rocks of Wrangellia.

3.1.4 Depth of Water Table

Unknown from archival research.

3.1.5 Annual Rainfall Data

Annual rainfall data indicated in the 1987 report was 300 mm (AES, Appendix A). However, annual rainfall data for Site 30 is taken from readings from the Burwash Landing weather station for the years 1967 to 1996. The annual rainfall over these years is 191.7 mm/annum. Annual rainfall does not take into account snowpack runoff.

3.1.6 Surface and subsurface stratigraphy

Permafrost is discontinuous but present at Site 30 in 1987 (AES, Appendix A).

3.1.7 Proximity to surface water

Approximately 300 metres (AES, Appendix A).

3.1.8 Flood potential of site

Flood potential of this site is considered to be very low.

3.1.9 Proximity to drinking water supply

Unknown.

3.1.10 Uses of adjacent water resources

Unorganized fishing and camping area approximately 2 kilometres east of site on Alaska Highway. There is a small lake within 300 metres provides habitat for waterfowl.

3.1.11 Land use information

The site is bisected by a gravel access road leading to a disused water pumphouse. According to AES information, it is Lease #3391-2 C.M. Bradley. The rest of the land is Crown property (AES, Appendix A).

3.1.12 Fish and Wildlife

Willow, aspen, spruce and muskeg were noted as the vegetation present in 1987. There was an indicated presence of muskrat, beaver and nesting ducks in 1987 (AES, Appendix A).

PHASE II : Site 30

3.2 Current Physical Conditions

The location of Site 30, alias Pump Station F, is on south side of Alaska highway a distance of 54.0 kilometers from Burwash Landing, 14.4 Kilometers from Kluane Gas Station, and 4.3 kilometers from the Donjeck Pumpstation on the north side of the Alaska Highway.

Site 30 is large, being 250 metres wide (along a east/west axis) and 175 metres deep (along a north/south axis).

Vegetation types and debris locations of the site are shown in Figure Five.

The north edge of the site is the Alaska Highway. The south edge of the examined site has no physical boundary, but a survey cut line was found curving across the far portion of the site. This line ranges in distance from 142.5 metres to 225 metres distance from the Alaska Highway.

Vehicle access to the site is through either a gravel access road or a dirt track. The gravel access road is perpendicular to the Alaska Highway and divides the site into two halves. It extends for 70 metres from the highway and terminates in front of still standing abandoned pumphouse. The pumphouse is 13' square and has a 8' by 4' concrete pad 10' to its east. There is a disused "Peerless Pump" and modern garbage inside the pump house. Outside the pumphouse on the west side there is scrap metal and a protruding pipe that is encased with an insulating material which may be asbestos (Photographs 30-P1, 30-P2 and 30-P3).

Within 15 metres to the south of the pumphouse there is a small mound of broken concrete, roofing material, burnt and decaying wooden platforms and material which may be asbestos insulation. East of the pump house there is old cut timbers.

To the east side of the pump house there is an artificial mound with gravel cover. Small poplars, fireweed and shrub grow on this mound. There is metal and cut wood protruding from the mound.

A dirt track enters the site area 150 metres east of the gravel access road. It is perpendicular to the Alaska Highway for 50 meters then curves to the west. It reaches the apex of the curve after 75 metres and crosses a culvert. At this point there is a turnoff to the south from the main track. The turnoff heads straight south for at least 500 metres. The main branch of the dirt track continues westwards for 30 metres. It goes south of a 21.5 metre by 10 metre concrete pad. Vegetation is growing through portions of concrete. The track then turns northeast, and fades out prior to connecting with the southeast corner of the pumphouse (Photographs 30-P4, 30-P5, 30-P6, 30-P7 and 30-P8).

There are two drainage ditches on the site. One starts 20 metres to the west of the pumphouse and extends southwards. The second ditch extends south from the west end of the concrete foundation.

Between the concrete foundation and the Alaska highway, there is thick bush with clearings interspersed. In some of these clearings and within the bush there are scattered small cans and glass, pieces of 4" metal pipe and jumbled concrete blocks (Photographs 30-P9 and 30-P10).

To the west and south of the pumphouse is a wooded area with open spaces which has the following debris: some building waste, metal, timber and tile material (which may have asbestos); partially buried garbage, scattered square patches of sparse vegetation (which may have previously been Quonset huts), bits of metal and glass, 4"diameter by 6' long metal pipe pieces (Photographs 30-P11, 30-P12 and 30-P13).

Vegetation in the woods 50 to 75 metres west of the pumphouse is comprised of scattered patches of sparser vegetation with debris similar to that described as being to the west and south of the pumphouse. There is a swath of poplars and grassed areas diagonally bisecting the southwest corner of the site. It is fifty metres thick and has little debris in it. Within the swath are two small pits, one smelling strongly of hydrocarbons and the other of organic material (Photographs 30-P14, 30-P15 and 30-P16).

Barbed wire was found on the west side of both the gravel access road and the dirt access track.

Bear and moose feces were noted at the site. There is a lake on the north side of the highway, 300 west of Site 30. There is a small marsh surrounding this lake with shrubs and a black spruce periphery. Loons and ducks were observed.

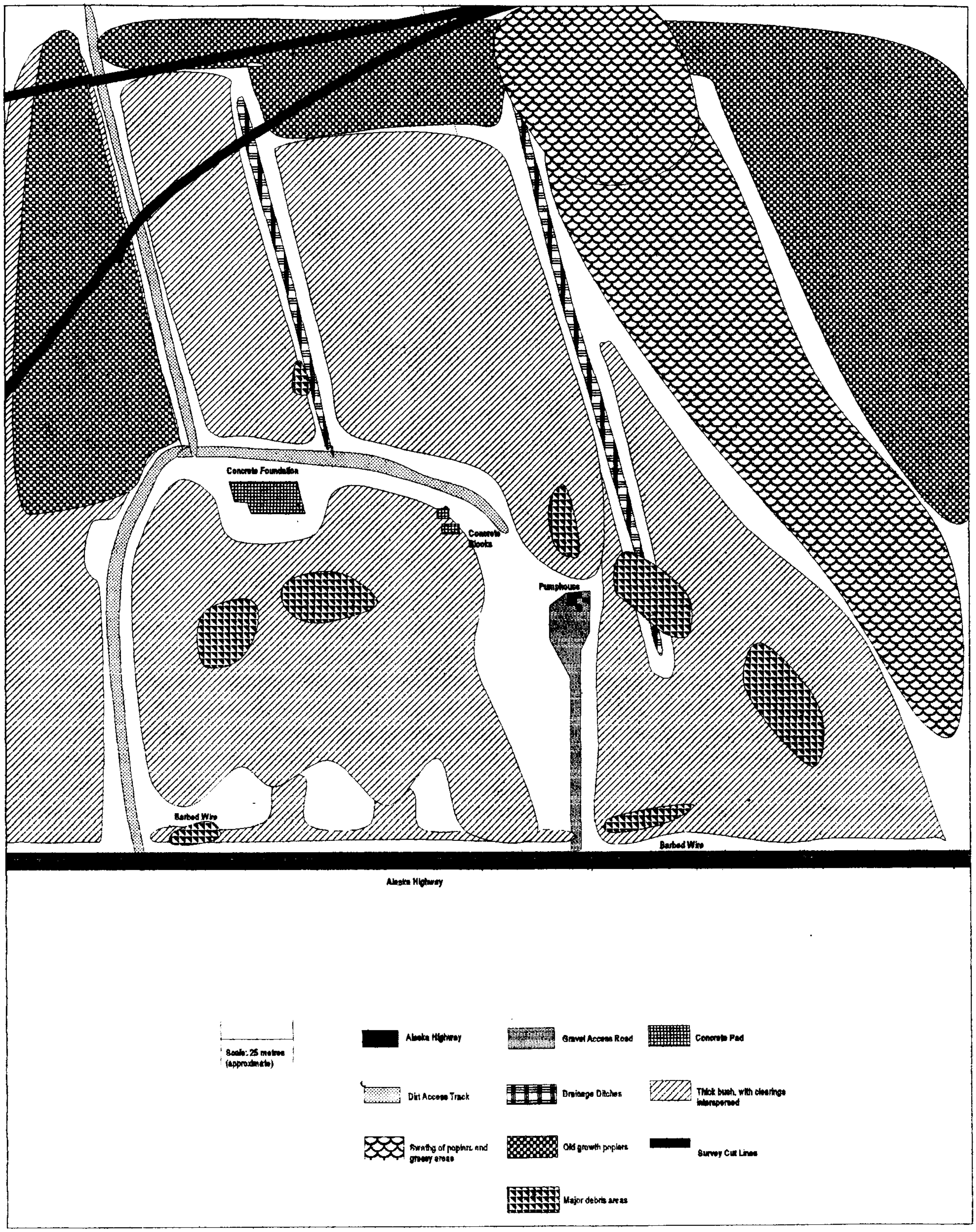


FIGURE FIVE
Site 30 Vegetation Types and Debris Locations

3.3 Laboratory Analysis Results

The September site visit was part of Phase II and Phase III of the Assessment Plan, to determine the presence of contaminants on site and initiate delineation. This visit included a site survey, a site inventory and soil and water sampling for both field and laboratory testing. Sampling details, such as depth and location, are listed in Appendix B-30.

3.3.1 Field Laboratory Analysis

Concentration ranges and locations of soil and water samples analysed in the field for total extractable hydrocarbons based on PetroFLAG analysis, and for polycyclic aromatic hydrocarbons and polychlorinated biphenyls by DTECH analysis are depicted in Figure Six. Field analysis results are listed in Appendix C-30.

3.3.1.1 Total Hydrocarbons

Total hydrocarbons were detected using the general qualitative Uvic photoionization system, visual and olfactory observations. Sample sites 30-S17 and 30-S23 were of greatest concern for presence of strongly smelling hydrocarbons.

Soil samples were tested for total extractable hydrocarbons using the PetroFLAG broad spectrum analysis system. Sample 30-S17 was the highest level of total hydrocarbons tested in the field at Burwash Site 30. Analysis of samples 30-S1, 30-S15 and 30-S23 indicated high levels of total extractable hydrocarbons. Samples 30-S2 , 30-S5, 30-S7, 30-S8 and 30-S19 were found to be in the high range for total extractable hydrocarbons. Samples 30-S6 , 30-S12, 39-S16, 39-S18, 30-S20 and 30-S22 were found to be in the medium range for total extractable hydrocarbons. Very low presence of total extractable hydrocarbons was found in samples 30-S10, 30-S11, 30-S13, 30-S14, 30-S16, 30-S21, 30-S24 and the theoretical baseline sample 30-S30.

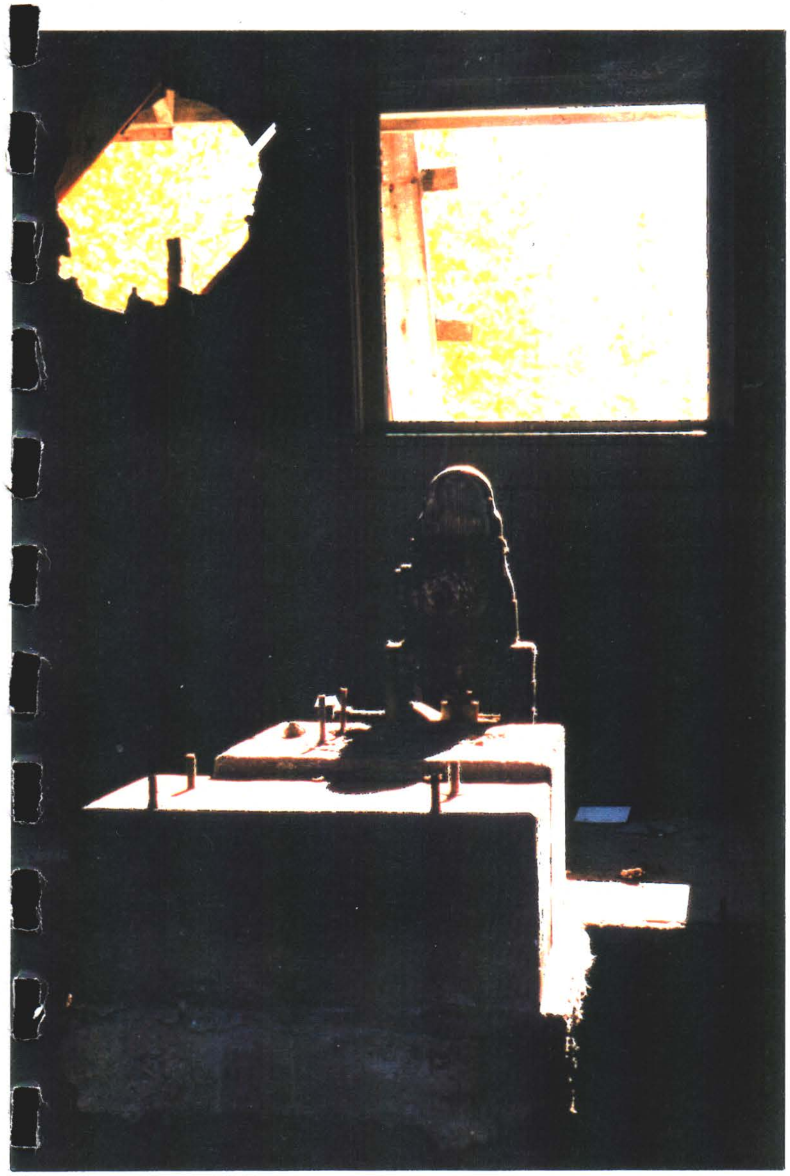
3.3.1.2 Polycyclic Aromatic Hydrocarbons

PAH's were detected in the field using the D TECH semiquatitative immunoassay technique for total PAH concentration. Results of field analysis for PAH's are compared to CCME Interim Assessment Criteria for Soil and Water, however the CCME guidelines indicate criteria for individual PAH's (0.1 ppm for soil and 0.01 ppm for water) whereas the immunoassay technique analyses for total PAH concentration (Appendix C-30). British Columbia Ministry of the Environment remediation criteria indicates total PAH levels for soil at 20 ppm and for freshwater aquatic life at 0.02 -0.9 ppm Concentrations of PAH's were below the detectable limits in soil sample 30-S1, 30-S7 and 30-S15. PAH concentrations in soil sample 30-S23 and water sample 30-W2 were analysed at levels which may exceed CCME criteria for individual PAH concentrations at 8 ppm and 10.4 ppb respectively. Water sample 30-W1 approaches CCME criteria at 8 ppb. A very high concentration of total PAH's was measured in soil sample 30-S17, greater than 25 ppm, exceeding BCMOE criteria for total PAH content.

3.3.1.3 Polychlorinated Biphenyls

PCB's were detected in the field using the D TECH semiquatitative immunoassay technique. Results of field analysis for total PCB concentrations are compared to the CCME Interim Assessment Criteria for Soil and Water guidelines for mixtures of PCB's (Appendix C-30). PCB concentrations were below detection levels for field analysis of samples 30-S2, 30-S5, 30-S6, 30-S8, 30-S15, 30-S19 and 30-S23. At site 30-S17 field analysis indicated a test positive with a high concentration of 0.65 ppm and exceeding the CCME criteria.

Photograph 30-P1: South facing view of pumphouse. Gravel access road is in the foreground.



Photograph 30-P2: Interior shot of pumphouse showing non-working wellhead gear.

Photograph 30-P3: Small concrete pad to the east of the pumphouse. The left side of this pad was sample site 30-S24.

Photograph 30-P4: View of the concrete foundation facing northwest.

Photograph 30-P5: View of the concrete foundation facing south.

Photograph 30-P6: Channel on the north side of the concrete foundation. Note small pit in the right foreground.

Photograph 30-P7: Small pit in the channel of the concrete foundation.

Photograph 30-P8: Depression on the outside of the northwest corner of the concrete foundation.

Photograph 30-P9: Clearing in poplars 30 metres west of the pumphouse. View is north facing and shows typical surface debris.

Photograph 30-P10: Bearberry growth between jumbled concrete blocks. Sample site 30-S13.

Photograph 30-P11: View of sample site 30-S15. Note typical surface debris.

Photograph 30-P12: Unbroken bottle found near sample site 30-S15.

Photograph 30-P13: Vegetation being sampled near site 30-S15.

Photograph 30-P14: View of water filled pit which had a foul organic smell. Sample site 30-W1 and 30-S23.

Photograph 30-P15: View of water filled pit with strong hydrocarbon smell. Sample site 30-W2 and 30-S17.

Photograph 30-P16: Removing portion of sample 30-S17 from auger.

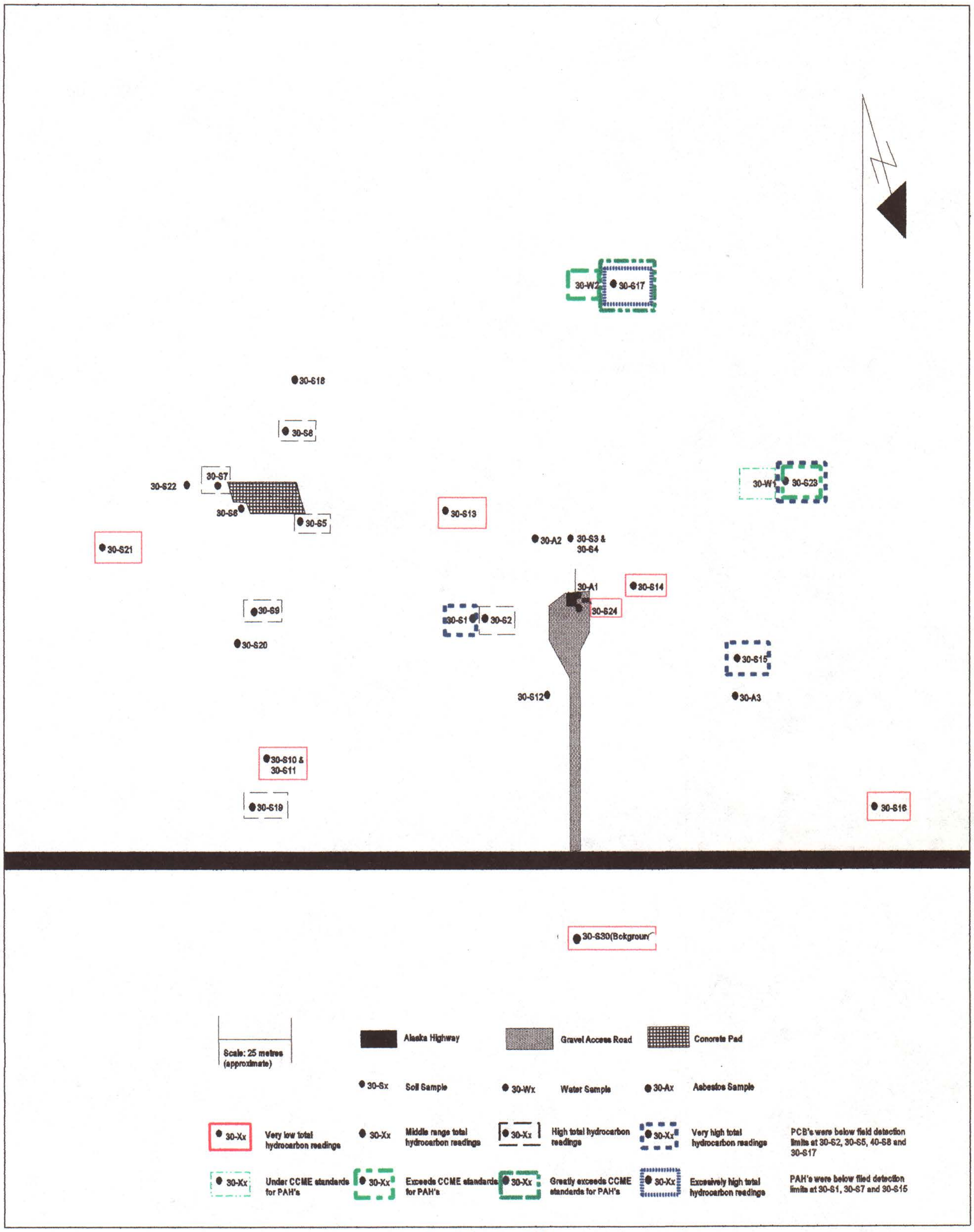


FIGURE SIX
Site 30 Field Laboratory Results

3.3.1.4 Vegetation

Stressed vegetation was noted in two locations. Balsam poplar trees found on the mound at sample site 30-S8 had a high incidence of leaf base galls. A dead tree in the drainage ditch at sample site 30-S15 was found with blue coloured pith.

Balsam Poplar: *Populus balsamifera*

Yellow swollen leaf base sealed gals indicate infection of psyllids (plant sucker family) or aphids. Potentially an overwintering tactic for psyllids. Under magnification larval forms are observed.

Balsam Poplar: *Populus balsamifera*

Dead trunk with 8 centimeter diameter broken with blue green colour in pith. Primary infection is from spruce beetle which creates passage under the bark. Secondary infection in center is probably fungal. Smell of mushroom is apparent and microscope observation reveals white matt of hyphae colonizing the edge of the inner pith.

Nitrogen fixing vegetation at Site 30 included Soapberry *(Shepherdia canadensis* (L.)Nutt.) and Wolfberry (*Symphoricarpos occidentalis)*.

3.3.2 Analytical Laboratory Analysis

Sampling regime for analytical laboratory analysis confirmed credibility of field analysis and provided greater specificity. Additional parameters were analysed that could not be effectively tested in the field. Figure 7 indicates locations and types of samples sent to the laboratory for analysis. Appendix D lists the data sheets for all samples and quality control tests analysed by Chemex Analytical Laboratories.

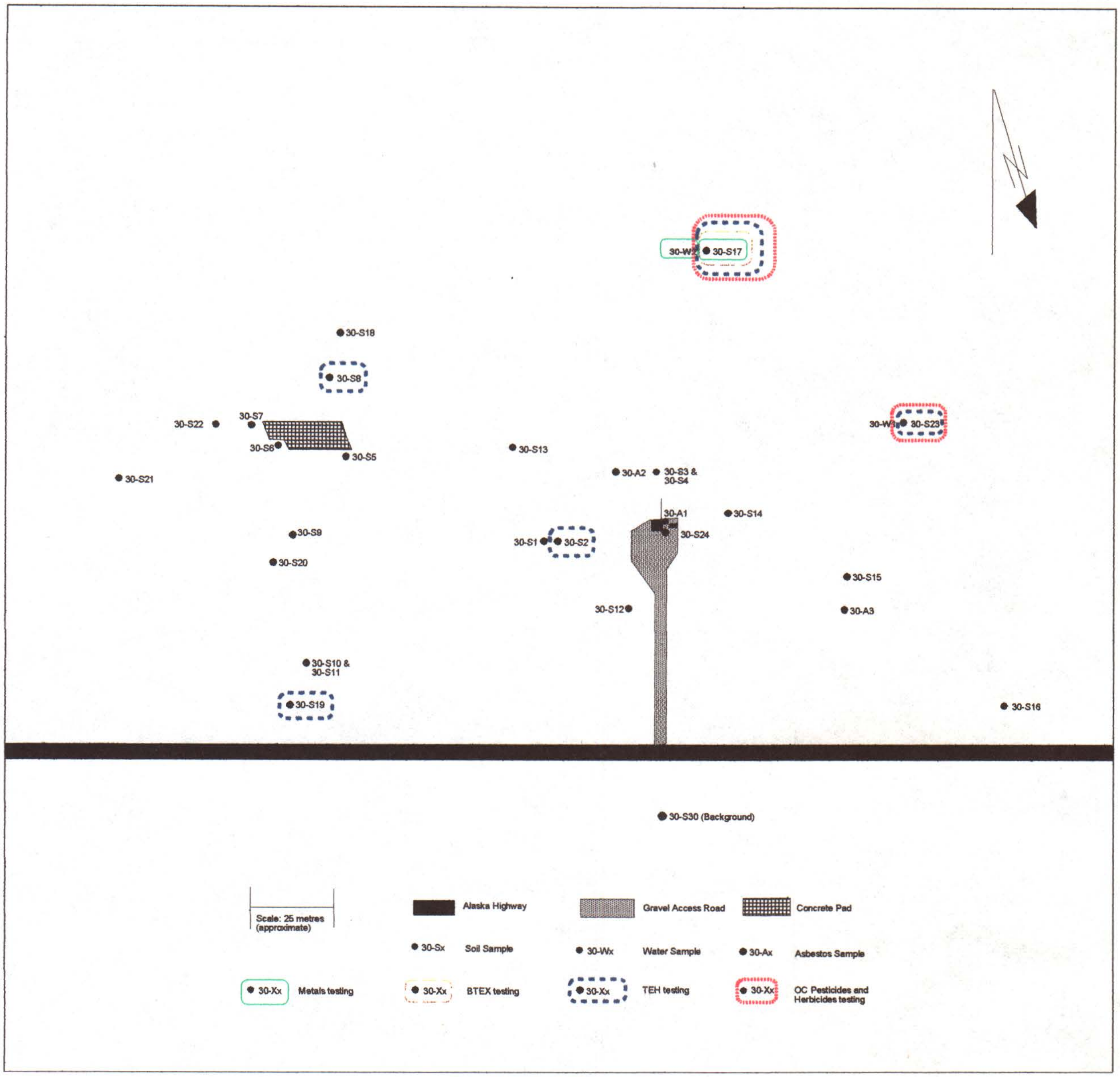


FIGURE SEVEN
Site 30 Laboratory Testing

3.3.2.1 Metals

Water:

Water sample 30-W2 analysed for metal content, indicated levels well below the CCME guidelines for fresh water aquatic life and Interim Assessment Criteria for all metals except aluminum. Aluminum may exceed CCME guidelines at the level measured, 33.2 ug/L depending on pH, calcium and dissolved organic carbons, however there are no CCME Site Remediation Interim Criteria for aluminum. See Figure 8 for depiction of the laboratory analysis for metal content of water samples 30-W2.

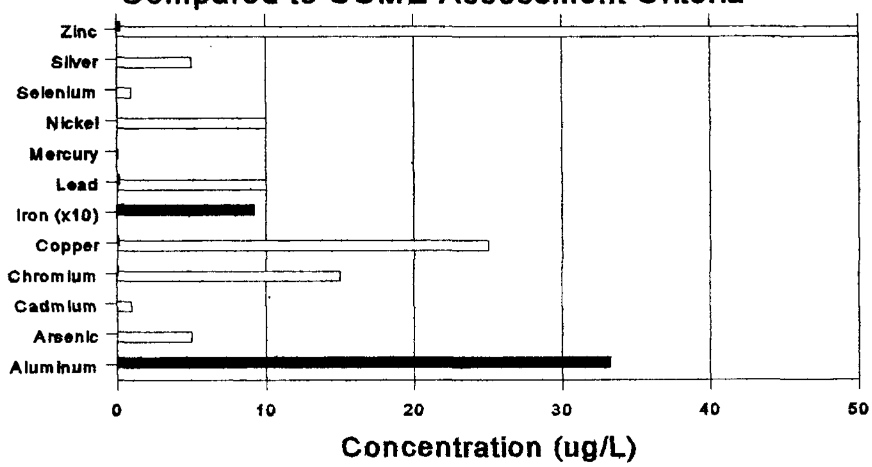
Soil:

Soil sample 30-S17 exceeded CCME Interim Assessment Criteria for 9 metals, chromium, cobalt, copper, lead, molybdenum, nickel, vanadium, zinc and arsenic. Theoretical soil baseline 30-S30 did not exceed CCME Interim Assessment Criteria for any of the metals analysed. See Figures 9 and 10 for depiction of the laboratory analysis for metal content of soil samples 30-S17 and 30-S30.

FIGURE EIGHT

Metal Concentrations for Water Sample 30-w2

Compared to CCME Assessment Criteria



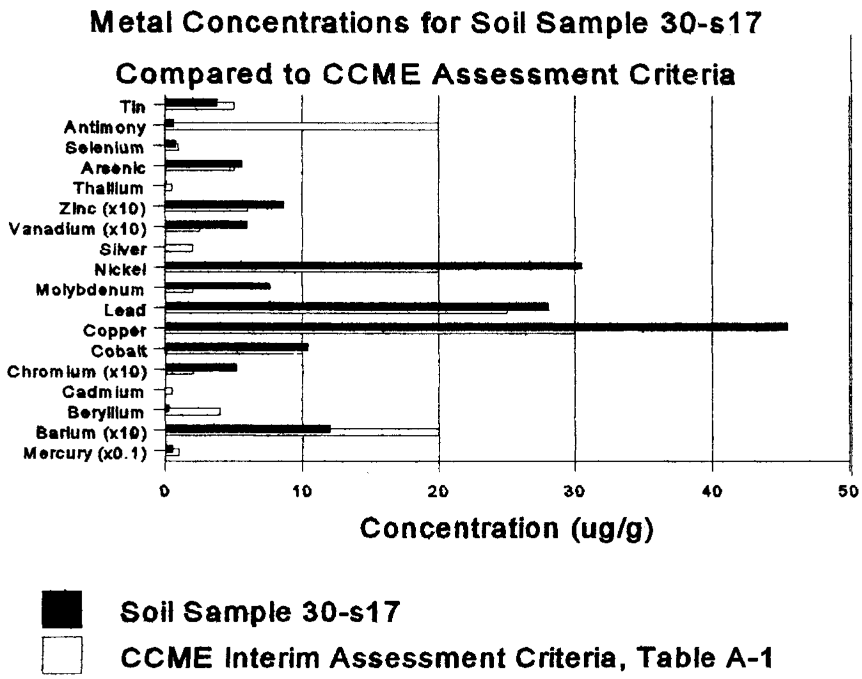
Water Sample 30-w2

CCME Interim Assessment Criteria, Table A-1*

TableA1 CCME ug/L	TableA-3 Aquatic ug/L**	30-w2 ug/L
50.0		0.276
5.0		0.0011
1.0		0.0016
10.0		0.0063
0.1	0.1	<0.05
10.0	1.0-7.0	0.162
*	300.0	92.40
25.0	2.0-4.0	0.134
15.0	2.0-20.0	0.097
1.0	0.2-1.8	0.0039
5.0	50.0	0.0007
*	5.0-100	**33.20**

* No guidelines are defined on CCME Table A-1 for Aluminum or Iron.

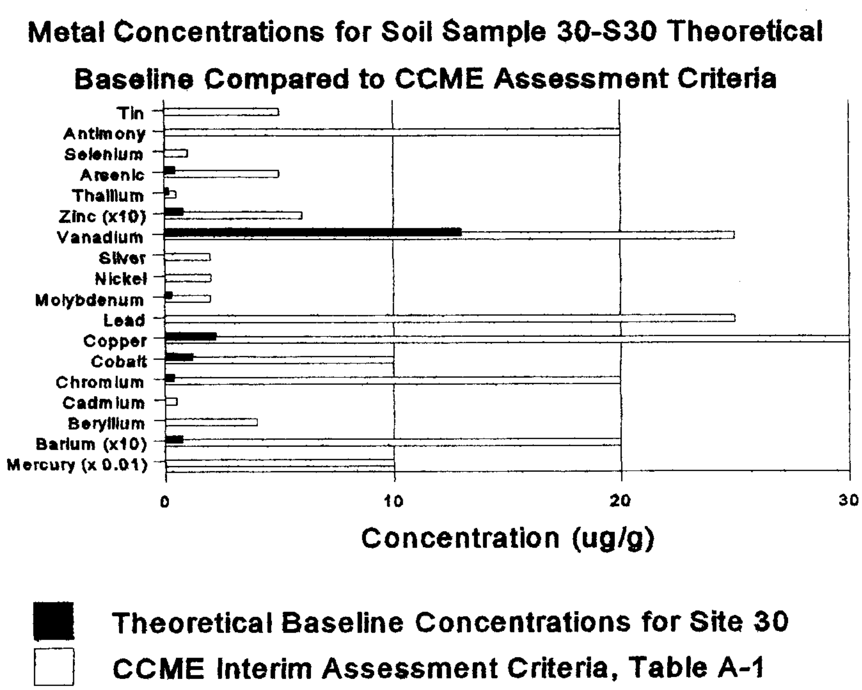
** Guideline varies with pH, calcium, and dissolved organic carbons for aluminum, and hardness for cadmium, copper, lead and nickel.



CCME ug/g	30-S17 ug/g
5	3.77
20	0.63
1	0.80
5	5.60
0.5	0.11
60	86.40
25	59.60
2	<0.20
20	30.50
2	7.60
25	28.00
30	45.50
10	10.40
20	51.70
0.5	<0.30
4	0.30
200	120.00
0.1	0.052

FIGURE NINE Metal Concentrations for 30-S17

FIGURE TEN Metal Concentrations for 30-S30



CCME ug/g	30-S30 ug/g
5	< 0.10
20	0.03
1	< 0.10
5	0.47
0.5	0.19
60	8.0
25	13.0
2	< 0.2
20	< 0.5
2	0.3
25	<2
30	2.2
10	1.2
20	0.4
0.5	<0.30
4	<0.1
200	7.4
0.1	<0.020

3.3.2.2 Total Extractable Hydrocarbons

See Figure 11 for the depiction of total extractable hydrocarbon content of soil samples 30-S2, 30-S8, 30-S17, 30-S19 and 30-S23 and comparing the ranges C8-C10 and C11-C60. Total extractable hydrocarbons for the range C8-C10 were below the method detection limits for soil samples 30-S2, 30-S8, 30-S19 and 30-S23, and measured as a total concentration of 740 mg/Kg in 30-S17 with 670 mg/Kg of C10.

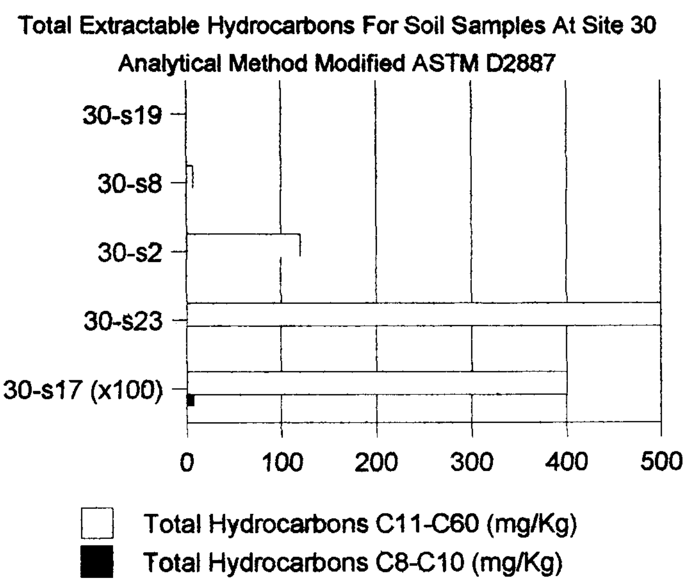
Total extractable hydrocarbons for the range C11-C60 were very high in soil sample 30-S17 at total 40000 mg/Kg primarily found as C11-C27. Content of 30-S17 indicated the highest constituent was C13 at 9000 mg/Kg, with the range C10-C20 all exceeding British Columbia Ministry of the Environment (BCMOE) guidelines.

Soil sample 30-S23 was analysed with a total extractable hydrocarbon content in the range C11-C60 of 500 mg/Kg, distributed in its highest concentrations in the C29-C34 range with C30 as the most prevalent component at 110 mg/Kg followed by C56 at 94 mg/Kg.

Soil sample 30-S2 was analysed with a total extractable hydrocarbon content in the range C11-C60 of 120 mg/Kg primarily distributed in the C25-C34 range. The highest concentration of a single component was C33 at 35 mg/Kg.

Analysis of soil sample 30-S8 indicated very little total extractable hydrocarbon were present, 7 mg/Kg, and soil sample 30-S19 levels were below the method detection levels.

FIGURE ELEVEN Total Extractable Hydrocarbons At Site 30



* no bar depiction indicates total extractable hydrocarbon content was below the method detection level

3.3.2.3 pH

All water samples tested within a normal range for pH, ranging from 7.3 at 30-W1 to 7.6 at 30-W2.

3.3.2.4 Volatile Organic Hydrocarbons

Soil samples 30-S17 was analysed for volatile organic hydrocarbon (BTEX) content. BTEX content exceeded the CCME Interim Assessment Criteria for m&p-Xylene at 0.63 mg/Kg and 0-Xylene at 0.43 mg/Kg. Ethylbenzene and Toluene were present at levels between the reliable detection levels and the method detection levels.

3.3.2.5 Polycyclic Aromatic Hydrocarbons

Analysis of soil samples 30-S17 and 30-S23 indicated PAH content were not detected at levels above the CCME Interim Assessment Criteria (0.1 mg/Kg), however, the method detection level for analysis of sample 30-S17 was higher than the CCME guidelines for most of the PAH parameters tested in a range of 0.24 - 2.4 mg/Kg; it is possible that some contaminant concentrations may have exceeded CCME guidelines and not been detected.

3.3.2.6 Polychlorinated Biphenyls

Analysis of soil samples 30-S17 and 30-S6 for PCB's indicate levels were below the method detection levels of 0.006 mg/Kg and below the CCME Interim Assessment Criteria for PCB's

3.3.2.7 Organo Chloride Pesticides

Soil sample 30-S17 was analysed for organo chloride pesticides, content was found to be below the method detection levels, however, the method detection limits were 10x higher than the CCME Interim Assessment Criteria. It is possible that some contaminant concentrations may have exceeded CCME guidelines and not been detected.

3.3.2.8 Asbestos

Material sample 30-3A was identified as asbestos at 30-50% Chrysotile. Material samples 30-A1 and 30-A2 were not asbestos.

PHASE 1 : Site 39

3.4 Archival Research and Interviews

A primary source of historical information regarding military activities in the Yukon Territory was the "Research of Former Military Sites and Activities in the Yukon", compiled by K. Bisset and Associates in April, 1995. It was compiled for the Arctic Environmental Strategy of DIAND and essentially comprises a Phase I analysis of all former military sites and activities in the Yukon. Additional information was compiled from the Yukon Archives, the Whitehorse Public Library and the Department of Indian and Northern Affairs, the Heritage Branch of YTG Tourism Department, Yukon Territorial Government Community and Transportation Services, Yukon Weather Centre and the Water Survey of Canada. Residents and commercial companies of the area also provided information. The village of Haines Junction, the Kluane Park Adventure Centre (a river guiding operation based in Haines Junction), Kluane Machine (a Haines Junction based contracting company) and the Arctic Research Institute at Kluane Lake were contacted. Initial site reconnaissance provided basic information about the physical site.

3.4.1 Site History

The original Haines Road was constructed during 1942-43. According to the Bisset report, Site 39 was a construction and maintenance camp at MP 138.3 (page 46, Bisset 1995).

Kathleen River Camp - 1943 - Haines Road MP 138.3
Foley Brothers had a construction camp here in 1943, on the north bank of the Kathleen River. This was a smaller camp, with one barrack and mess hall, on the west side of the road and a garage on the east side of the road (page 237, Bisset 1995).

This site was not a pumpstation for the eight inch 1954 Haines-Fairbanks pipeline. No mention is made of this site in the Preliminary Environmental Assessment Haines-Fairbanks Pipeline report (UMA, 1995).

In the late 1960's the highway bridge across the Kathleen river was replaced and the highway realigned (Paul Knysch, Yukon Territorial Government Community and Transportation Services). This resulted in the new highway and highway bridge being placed approximately forty meters to the south west, thus going over the north east half of the site. Mr. Knysch thought an Environmental Impact Statement been done around 1977.

The new highway covers part of original site. Garbage from east side of highway was excavated but on the west side buildings and site material were bulldozed over into piles (Appendix A).

Two archeologists, Ruth and David, from the Tourism Department of Heritage Branch, YTG were consulted to date cans found on-site. David thought that a tin can found in 39-TP3 was a type of condensed milk can that ceased being produced in the late 1940's/early 1950's. This can has a lead plug in the base, and only the condensed milk cans of this period had this feature once lead was not used in general can manufacture from 1905 onwards (Heritage Branch, YTG).

3.4.2 Type and Quantity of Contaminants

The waste site includes bulldozed building materials, concrete, cans, wooden debris (AES, Appendix A).

Archival research did not indicate what contaminants would have been stored at Site 39.

3.4.3 Geology of the Area

The geology of the area south of Haines Junction along the Kathleen River is a greenstone and limestone of the Wrangellia Terraine. This is an accreted insular superterraine from the mid-cretaceous time period. Middle pennsylvannian plutons intrude the basement rocks of Wrangellia.

3.4.4 Depth of Water Table

No groundwater was encountered during the site investigation of Site 39. In the adjacent residential property, well water is taken at a depth of 250 feet.

3.4.5 Annual Rainfall Data

Annual rainfall data for Site 39 is taken from readings from the Haines Junction Highway Maintenance yard for the years 1987 to 1996. The annual rainfall over these years is 166.2 mm/annum. The annual rainfall data for the years 1944 - 1985 is 154.3 mm/annum. However, the location of these readings is unknown, and a yearly breakdown was not provided (Yukon Weather Centre). The 1944- 1985 readings were not included for the CCME analysis. Annual rainfall does not take into account snowpack runoff.

3.4.6 Surface and subsurface stratigraphy

Permafrost is unpredictable in the region (Mike Crawshay).

3.4.7 Proximity to surface water

Site 39 is adjacent to the Kathleen River on the south east side. This river flows from Kathleen Lake, 750 metres upstream, into Lower Kathleen Lake, 500 metres downstream.

3.4.8 Flood potential of site

Site 39 can be divided into two main elevation areas. The low lying portions adjacent to the river are considered to have a high flood potential, but the mound and the slopes leading up to the mound have a minimal flood potential. As any soil contamination will eventually wash out to the low lying portions of the site (which is just above the high water river elevation) the site is classified as having a high flood potential.

3.4.9 Proximity to drinking water supply

Adjacent to Site 39 is a residential property, upstream of the Kathleen River. This property obtains drinking water from a groundwater well (Egli). Kathleen River flows into the Dezadeash River, from which the Village of Haines Junction obtains drinking water. The distance from Site 39 to Haines Junction is over 40 kilometres.

3.4.10 Uses of adjacent water resources

Site 39 is 750 metres downstream of Kathleen Lake. This lake is within Kluane National Park and is the only road accessible recreational lake in the park accessible to the public. It sees extensive use by boaters, fishers and swimmers.

3.4.11 Land use information

The site is not currently occupied by any dwelling or structure. Human activity includes fishing along the Kathleen River bank and berry picking.

The Egli land parcel is 0.54 acres in size. The exact location cannot be determined from the Lands Branch maps due to the large scale used. To find the exact location and how it impacts on the site, the legal survey should be reviewed. This is available from the Natural Resources Department of Geomatics Canada, Legals Survey Division.

3.4.12 Fish and Wildlife

There are Rainbow Trout spawning grounds on the Kathleen River near Site 39. There is an abundance and diversity of wildlife in the vicinity of Site 39 ranging from birds and squirrels to bears (Egli).

There is a movement in mid to late winter of an important moose population from the sub-alpine areas of Marshall and Garnet Creeks across the Alaska Highway to their winter and spring grounds along the Dezadeash River, Kathleen River and Quill Creek area. This population is presently quite low (Ken Anderson, 1996).

PHASE II : Site 39

3.5 Current Physical Conditions

The size of the site is approximately 100 metres by 100 metres as gauged by visible human impact on the site and the extent of surface debris . There are no survey markers, fences or cleared cut lines to indicate boundaries.

Vegetation types and debris locations are shown in Figure 12.

The sites' main feature includes a large mound running parallel to the highway, sloping steeply to the river on the south side and the south west side (Photograph 39-P1). The north end of the mound gradually declines into the natural landscape. The plateau at the top of the mound has a flat surface covered in gravel. There is a 10 metre by 12 metre bare vegetation spot in the middle (Photograph 39-P2). Judging by soil composition, vegetation growth and on-site investigation the mound is man-made.

Southeast from the mound the site goes towards the Kathleen River. There is a two tiered embankment with steep slopes descending to the river. Cans and bottles protrude from the steep slope and are concentrated in pockets (Photograph 39-P3). Between the foot of the slope and the river bank (a distance of about seven metres) there is metal wire. The river has a clear water swift current with a deeper flow on south bank. The north bank has a shallow inlet water diversion near the road bridge. There is a pipe buried and protruding inside a puddle on the North bank, with a profuse orange algal growth scum and lush bright green algal growth in the puddle. People were observed fishing on the far (southern) bank of the river.

There are two small ponds in a marshy area on the south west side of the mound (Photograph 39-P4). They have no direct surface flow connection with the river. The embankment down to the ponds is very steep and has bare sand patches due to erosion. The ponds are oval, about two metres by three, and half a metre deep. They have clear water, visible insect life, floating brown algae and silt bottoms. The eastern most pond has a pipe in bottom. The west one has a large metal drum. Thereafter, the ground slopes southwest up to a privately owned lot.

The southwest side of the mound has protruding cut timbers. They appear to have been bulldozed and are approximately two feet from the top surface.

Vegetation on the mound is very sparse in the centre compared to surrounding areas which are well vegetated. The bare spot on the top of the mound has poplars (1 to 2 metres in height) surrounding it. To the south of this area there was a stunted poplar with red leaf growths which looked deformed (Photograph 39-P5) and some poplars with central raised yellow leaf spots. These appeared to be insect galls. To the southeast of the mound there were stressed fireweed plants (Photograph 39-P6). These had extensive black circle pock growth with yellow necrotization. The surrounding black growth left ring holes which had black, brown and yellow concentric rings.

There is lush growth on the south face of the mound. The plants are clover, fireweed, wild rose, raspberry, poplar (6-10m in height). This leads into old growth trees and less dense undergrowth at the base of the mound.

The marsh area was well vegetated with marsh grasses and low bush cranberry plants.

Surface debris consists of household type garbage and is not visible from the highway. It is concentrated in two areas and covers no more the 20 square metres in total. It is possible to discern cut timber logs sticking out of the mound on the south west side. During the excavation of 39-TP3, an old can was unearthed at a depth of 1 metre. It was identified as being a condensed milk can from the 1940's (Yukon Tourism, Heritage Branch).

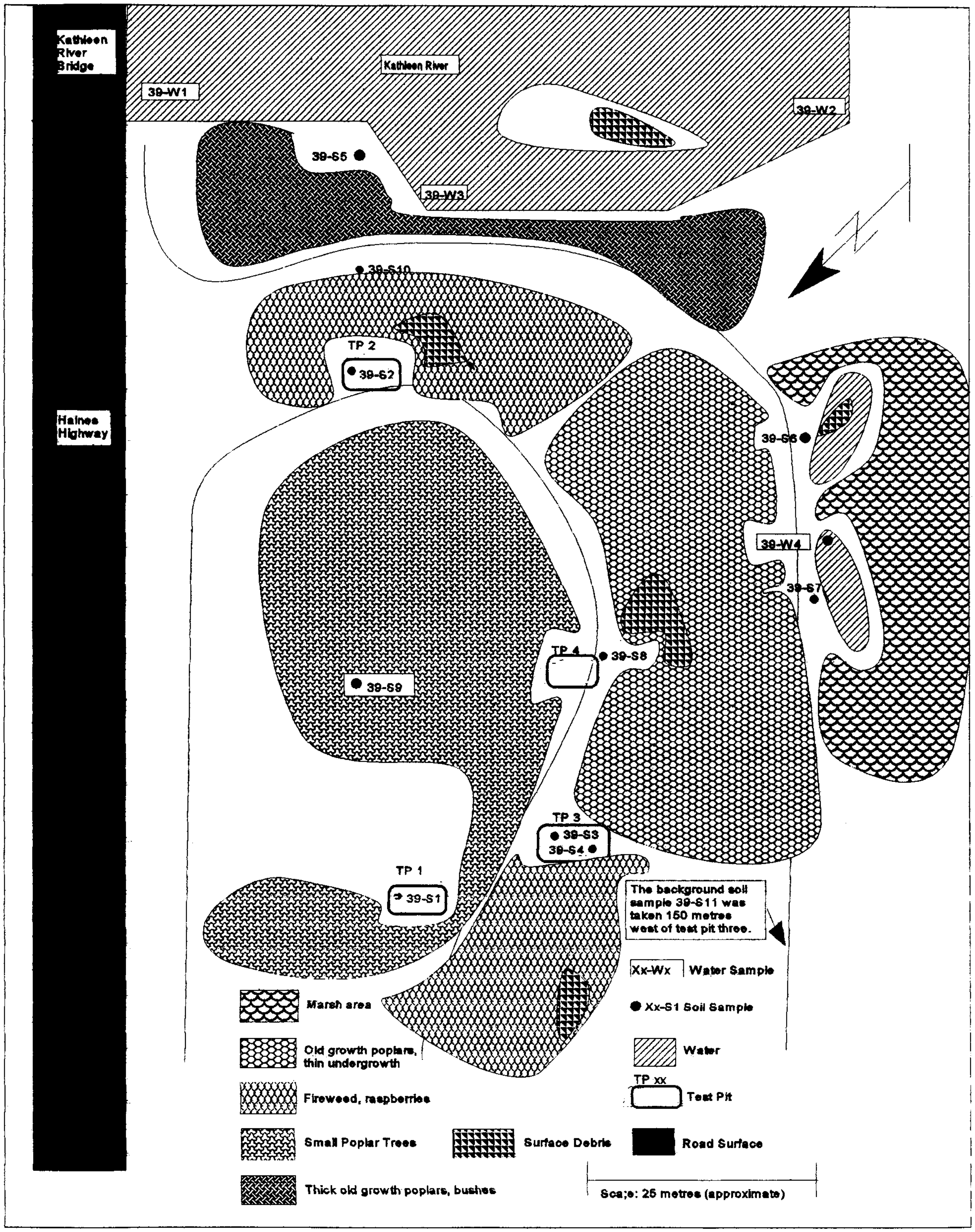
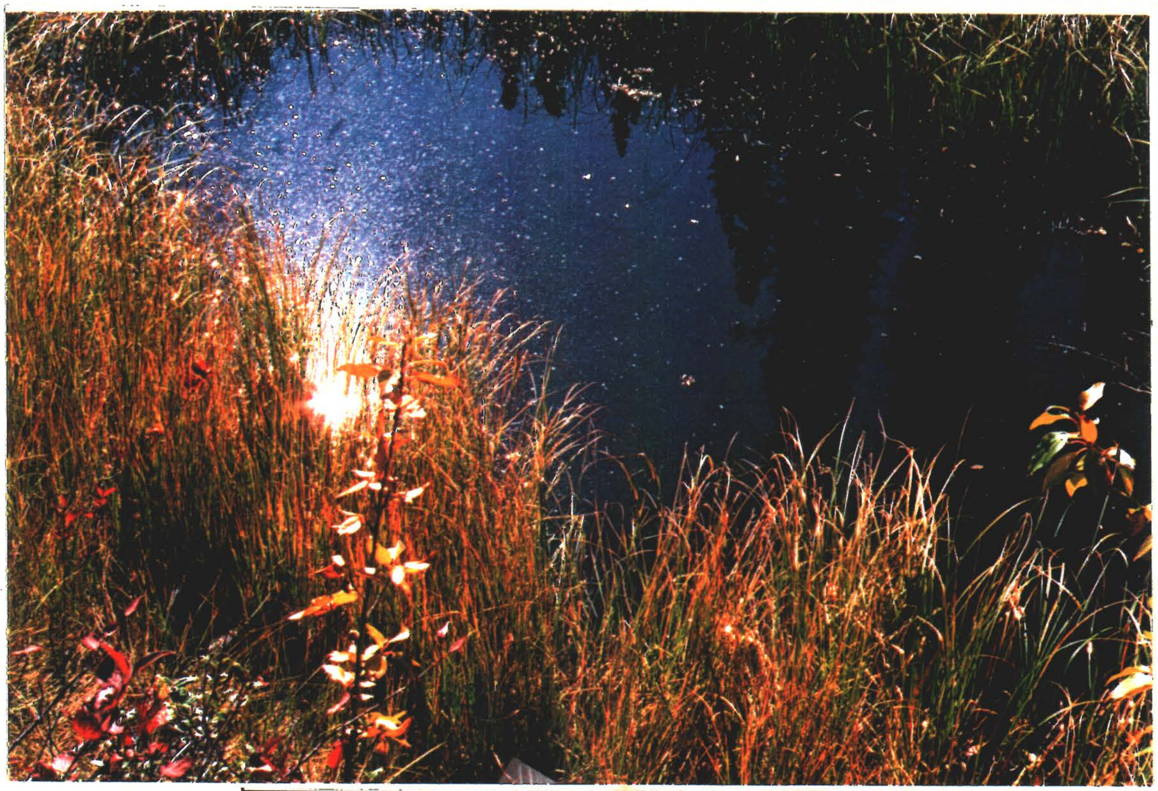


FIGURE TWELVE
Site 39 Vegetation Types and Debris Locations

Photograph 39-P1: Upriver view of the Kathleen River as seen from the Haines Highway bridge over it. Site 39 is on the right.

Photograph 39-P2: View of mound plateau looking west.

Photograph 39-P3: Garbage debris found on surface east of 39-TP4. This view is to the south.



Photograph 39-P4: East pond with 39-S7 in the foreground.

Photograph 39-P5: View of the mound centre looking southeast. Background shows 39-TP1 being excavated.

Photograph 39-P6: Excavation of 39-TP3 looking north. Garbage debris was found in 39-TP3.

Photograph 39-P7: Poplar leaves near 39-TP1

Photograph 39-P8: Stressed fireweed near 39-TP2

3.6 Laboratory Analysis Results

The September site visit was part of Phase II and Phase III of the Assessment Plan, to determine the presence of contaminants on site and initiate delineation. This visit included a site survey, a site inventory and soil and water sampling for both field and laboratory testing. Sampling details, such as depth and location, are listed in Appendix B-39.

3.6.1 Field Laboratory Analysis

Concentration ranges and locations of soil and water samples analysed in the field for total extractable hydrocarbons based on PetroFLAG analysis, and D TECH analysis for polycyclic aromatic hydrocarbons and polychlorinated biphenyls are depicted in Figure 13. Field analysis results are listed in Appendix C-39.

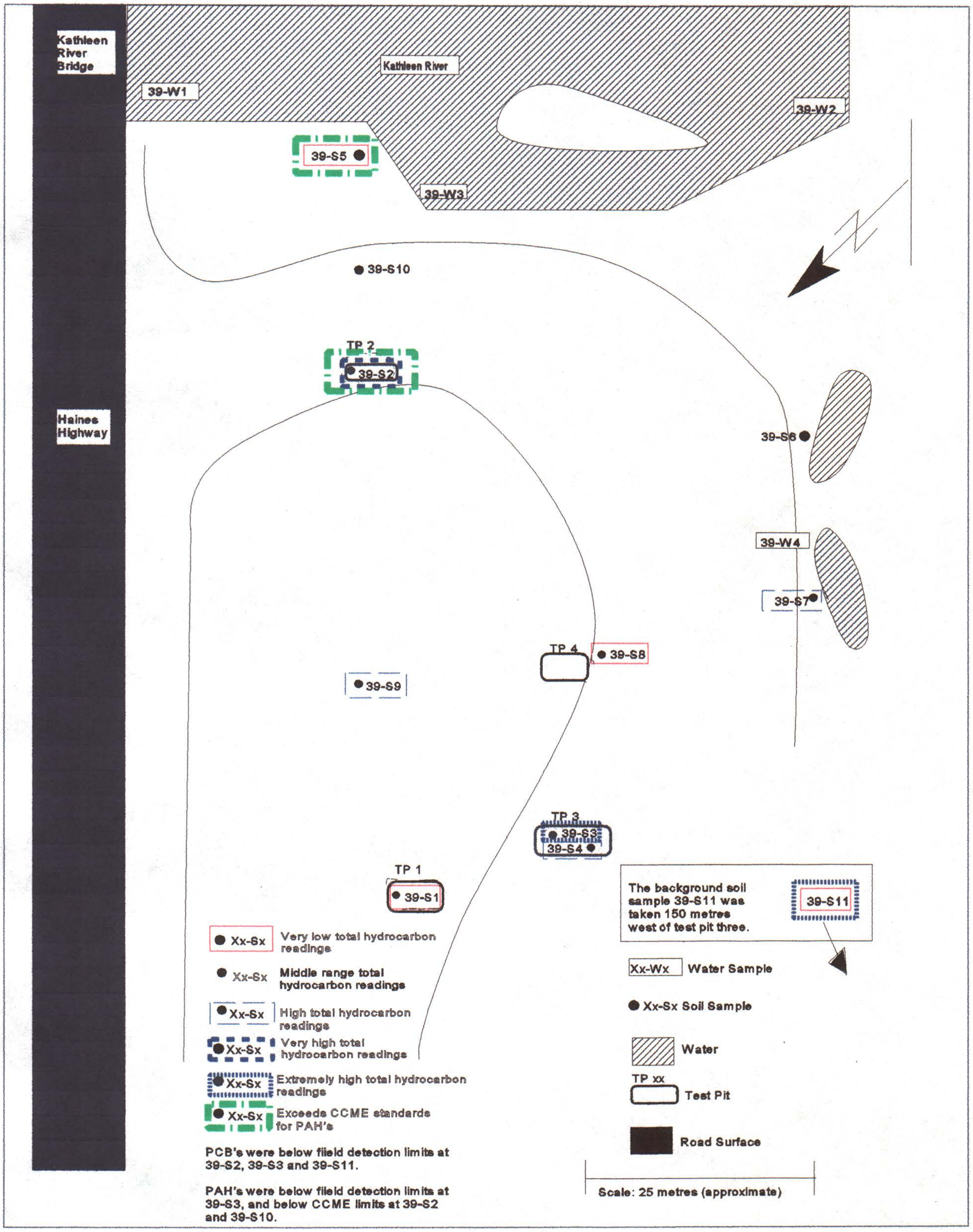


FIGURE THIRTEEN
Site 39 Field Laboratory Results

3.6.1.1 Total Hydrocarbons

Soil samples were tested for total extractable hydrocarbons using the PetroFLAG broad spectrum analysis system. Sample 39-S2 in 39-TP2, sample 39-S4 in 39-TP3 and the theoretical baseline sample 39-S11 were the highest levels of total hydrocarbons tested in the field at Site 39. Samples 39-S4 in 39-TP3, 39-S4, 39-S6, 39-S7 and 39-S9 were found to be in the medium range for total extractable hydrocarbons. Very low presence of total extractable hydrocarbons was found in samples 39-S1 in 39-TP1, 39-S5 and 39-S8.

3.6.1.2 Polycyclic aromatic hydrocarbons

Polycyclic aromatic hydrocarbons (PAH's) were detected in the field using the D TECH semiquatitative immunoassay technique for total PAH concentration. Results of field analysis for PAH's are compared to CCME Interim Assessment Criteria for Soil and Water, however the CCME guidelines indicate criteria for individual PAH's (0.1 ppm for soil and 0.01 ppm for water) whereas the immunoassay technique analyses for total PAH concentration (Appendix C-39). British Columbia Ministry of the Environment (BCMOE) remediation criteria indicates total PAH levels for soil at 20 ppm and for freshwater aquatic life at 0.02 -0.9 ppm Concentrations of PAH's were below the detectable limits in soil sample 39-S3. PAH concentrations in soil samples 39-S2 and 39-S10 were analysed at levels which may exceed CCME criteria for individual PAH concentrations, 0.64 ppm and 0.66 ppm respectively.

3.6.1.3 Polychlorinated Biphenyls

Polychlorinated biphenyls (PCB's) were detected in the field using the D TECH semiquatitative immunoassay technique. Results of field analysis for total PCB concentrations are compared to the CCME Interim Assessment Criteria for Soil and Water guidelines for mixtures of PCB's (Appendix C). PCB concentrations were below detection levels for field analysis of samples 39-S2 in 39-TP2, 39-S3 in 39-TP3 and 39-S11.

3.6.1.4 Vegetation

Stressed vegetation was noted in two main regions:

The first region was to the south side of the open gravel area on the top plateau around sample site 39-s9. Balsam poplar trees, *Populus balsamifera,* were noted to have a greater prevalence of red coloured curled leaf edges forming unsealed galls and to be stunted in growth compared to surrounding poplars.

> Balsam Poplar: *Populus balsamifera*
> Red coloured curled leaf edges forming unsealed gals indicate infection of psyllids (plant sucker family) or aphids. Potentially an overwintering tactic for psyllids. Under magnification waxy forms of larval bodies are observed in opened gal.

The second region was on the downhill slope and first tier down to the south of the first region, around test pit 2. Fireweed plants, *Epilobium angustifolium L.,* had a greater prevalence of leaf infestation and necrotization than surrounding plants. Circular infection on under side of leaf indicates plant pathogen infection in outer air pore of stomata. In this area there was an abundance of raspberry plants, *Rubus strigosus* Michx.

> Fireweed: *Epilobium angustifolium L.*
> Circular infection on under side of leaf indicates plant pathogen infection in outer air pore of stomata. Microscope analysis indicates infections are possibly smuts, rusts, fungal, viral, or bacterial, absolute identification was not possible. Plants under stress are more subject to these types of infections as a secondary source of stress. Primary stress could be nutrient or water stress, or could be indication of contaminant influence.

> Raspberry: *Rubus strigosus* Michx.
> Raspberries were abundantly growing on south edge of plateau down to first tier. Raspberries grow well on gravel

possibly due to drainage and heat off gravel. It is also possible that hydrocarbon contamination has contributed to raspberry growth.

3.6.2 Analytical Laboratory Analysis

Sampling regime for analytical laboratory analysis confirmed credibility of field analysis and provided greater specificity. Additional parameters were analysed that could not be effectively tested in the field. Figure 14 indicate locations and types of samples sent to the laboratory for analysis. Appendix D lists the data sheets for all samples and quality control tests analysed by Chemex Analytical Laboratories.

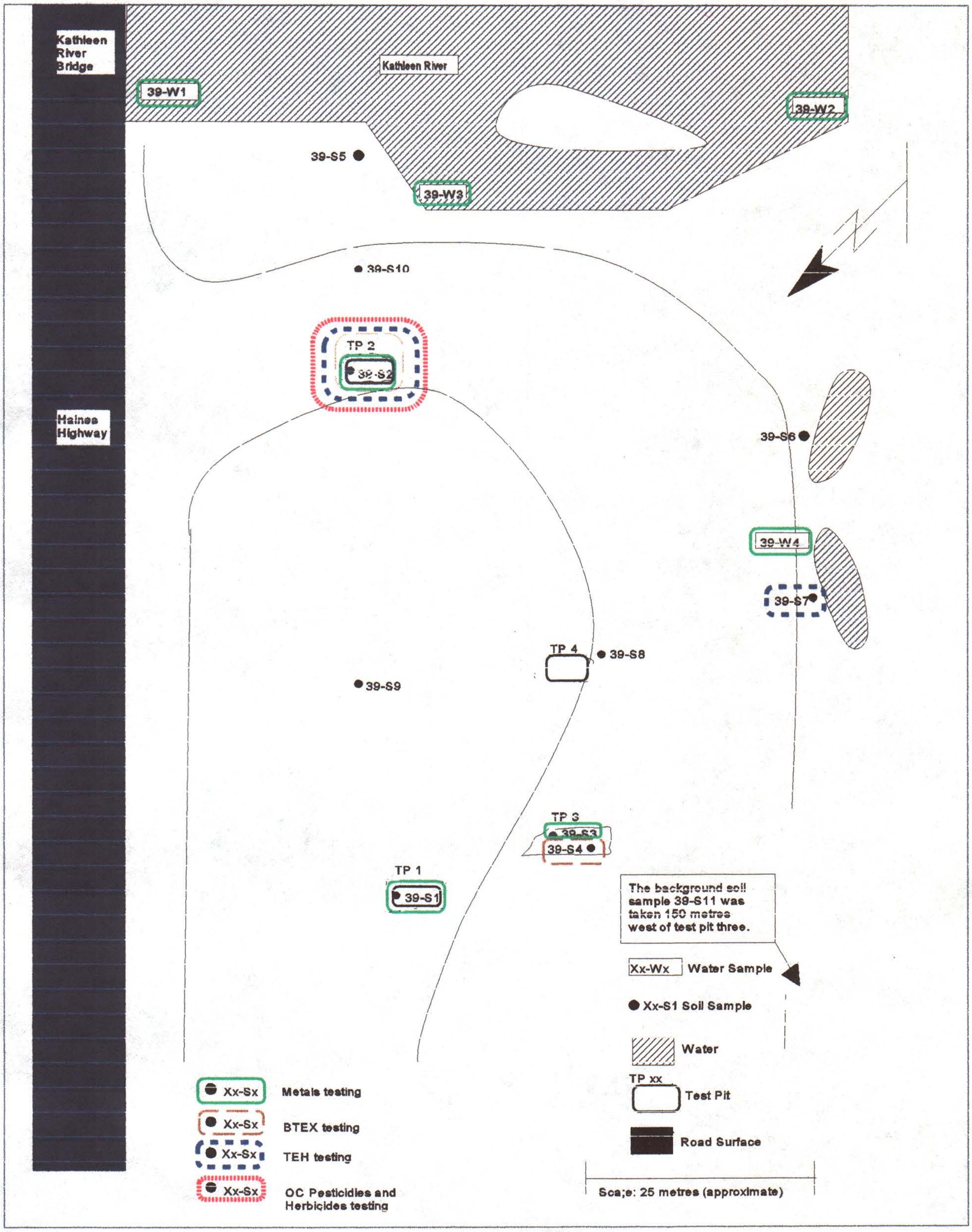


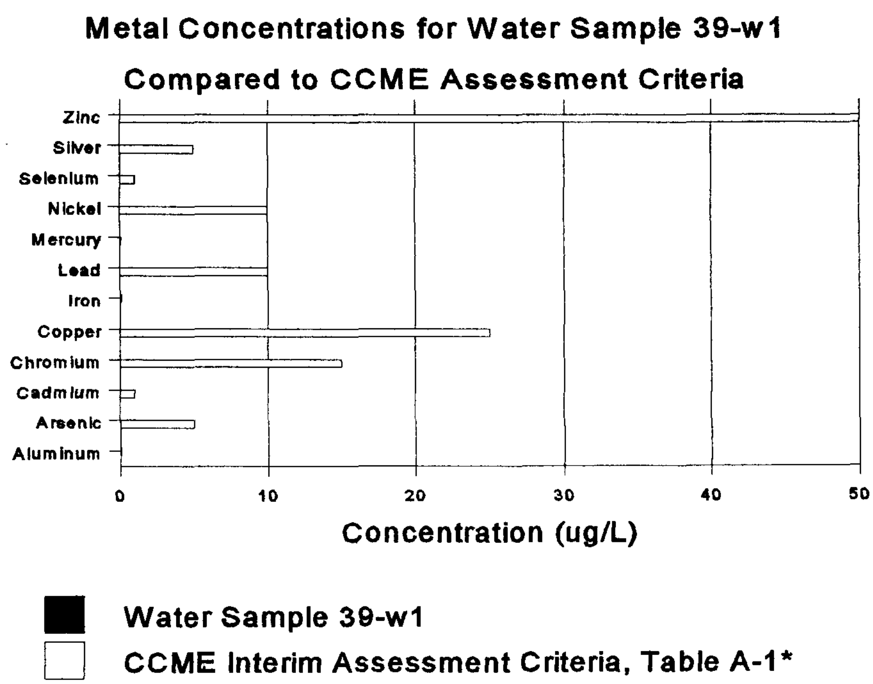
FIGURE FOURTEEN
Site 39 Laboratory Testing

3.6.2.1 Metals

Water:
All water samples were analysed for metal content, concentrations were well below the CCME Guidelines for Fresh Water Aquatic Life and Interim Assessment Criteria. See Figures 15, 16 and 17 for depiction of the laboratory analysis for metal content of water samples 39-W1, 39-W3 and 39-W4.

Soil:
Soil sample 39-S1 exceeded CCME Interim Assessment Criteria for 8 metals, chromium, cobalt, copper, molybdenum, nickel, vanadium, zinc and arsenic. Soil sample 39-S2 exceeded CCME Interim Assessment Criteria for 9 metals, chromium, cobalt, copper, molybdenum, nickel, vanadium, zinc, arsenic and selenium. Soil sample 39-S3 exceeded CCME Interim Assessment Criteria for 7 metals, chromium, cobalt, copper, molybdenum, nickel, vanadium and zinc. Theoretical soil baseline for Site 39 was sample 39-S11 which exceeded CCME guidelines for 8 metals, chromium, cobalt, copper, molybdenum, nickel, vanadium, zinc, and arsenic. See charts below for depiction of the laboratory analysis for metal content of soil samples 39-S1, 39-S2 and 39-S3.

FIGURE 15 Metal Concentrations for 39-W1



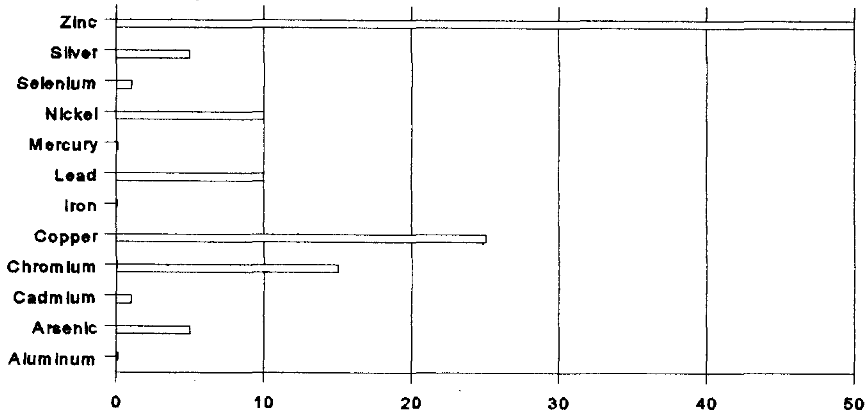
TableA-1 CCME ug/L	TableA-3 Aquatic ug/L**	39-W1 ug/L
50.0		0.023
5.0		<.0001
1.0		<.0002
10.0		< .0005
0.1	0.1	<0.05
10.0	1.0-7.0	<.0003
*	300.0	0.07
25.0	2.0-4.0	0.02
15.0	2.0-20.0	0.008
1.0	0.2-1.8	<.0002
5.0	50.0	0.0002
*	5.0-100	0.05

* No guidelines are defined on CCME Table A-1 for Aluminum or Iron.

** Guideline varies with pH, calcium, and dissolved organic carbons for aluminum, and hardness for cadmium, copper, lead and nickel.

Metal Concentrations for Water Sample 39-w3

Compared to CCME Assessment Criteria



Concentration (ug/L)

■ Water Sample 39-w3

□ CCME Interim Assessment Criteria, Table A-1*

TableA-1 CCME ug/L	TableA-3 Aquatic ug/L**	39-W3 ug/L
50.0		0.031
5.0		<.0001
1.0		<.0002
10.0		<.0005
0.1	0.1	<0.05
10.0	1.0-7.0	<0003
*	300.0	0.07
25.0	2.0-4.0	0.004
15.0	2.0-20.0	0.015
1.0	0.2-1.8	<.0002
5.0	50.0	0.0002
*	5.0-100	0.09

* No guidelines are defined on CCME Table A-1 for Aluminum or Iron.

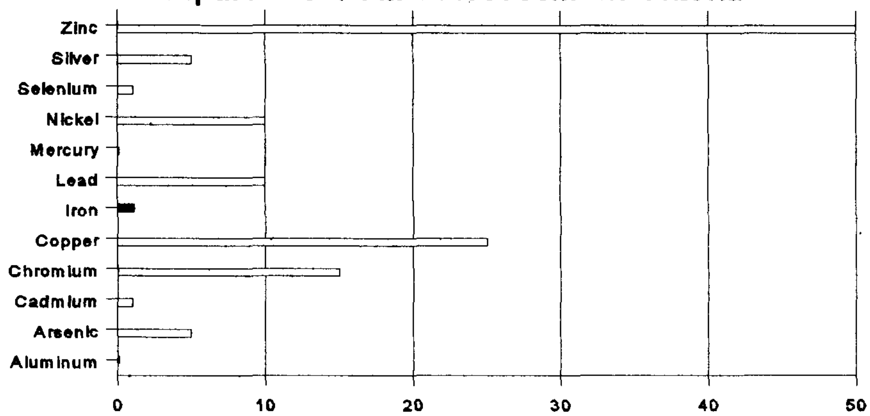
** Guideline varies with pH, calcium, and dissolved organic carbons for aluminum, and hardness for cadmium, copper, lead and nickel.

FIGURE 16 Metal Concentrations for 39-W3

Figure 17 Metal Concentrations for 39-W4

Metal Concentrations for Water Sample 39-w4

Compared to CCME Assessment Criteria



Concentration (ug/L)

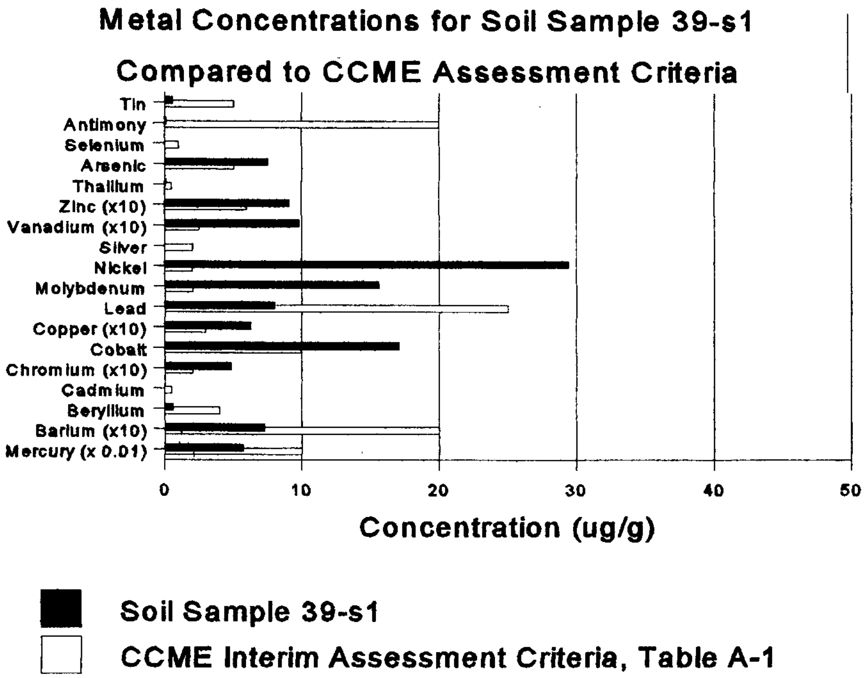
■ Water Sample 39-w4

□ CCME Interim Assessment Criteria, Table A-1*

TableA-1 CCME ug/L	TableA-3 Aquatic ug/L**	39-W4 ug/L
50.0		0.011
5.0		<.0001
1.0		<.0002
10.0		< .0005
0.1	0.1	< 0.05
10.0	1.0-7.0	<.0003
*	300.0	1.11
25.0	2.0-4.0	0.002
15.0	2.0-20.0	0.015
1.0	0.2-1.8	0.010
5.0	50.0	<.0002
*	5.0-100	0.08

* No guidelines are defined on CCME Table A-1 for Aluminum or Iron.

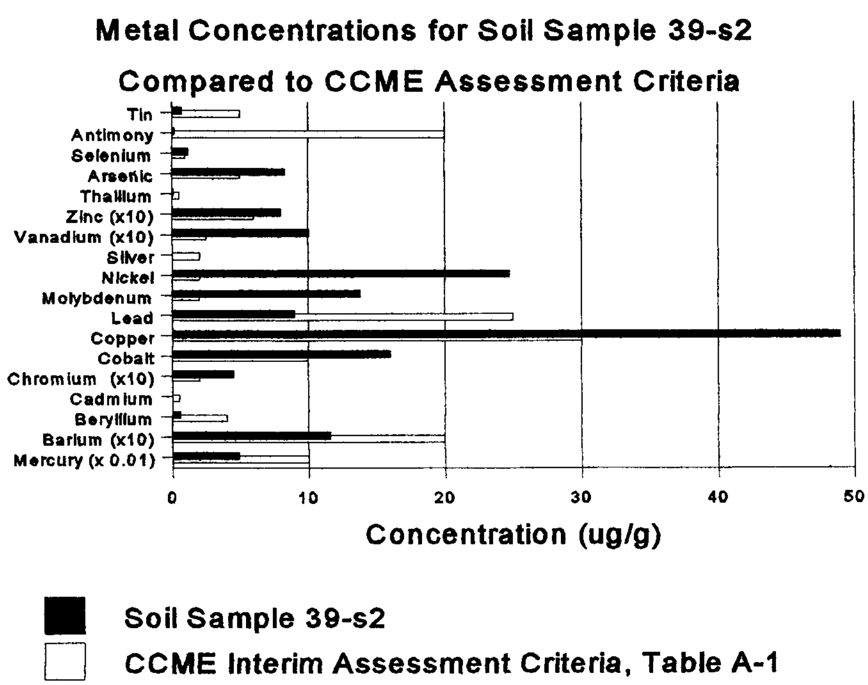
** Guideline varies with pH, calcium, and dissolved organic carbons for aluminum, and hardness for cadmium, copper, lead & nickel.



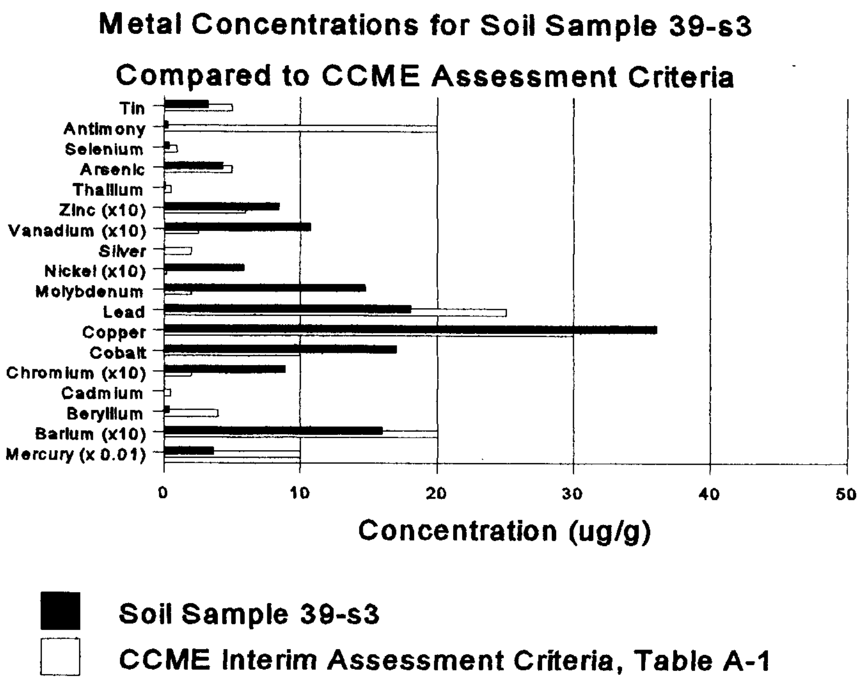
CCME ug/g	39-S1 ug/g
5	0.53
20	0.12
1	0.10
5	**7.50**
0.5	0.08
60	**91.10**
25	**98.00**
2	<0.20
20	**29.40**
2	**15.60**
25	8.00
30	**62.90**
10	**17.10**
20	**48.40**
0.5	<0.30
4	0.60
200	72.90
0.1	0.057

FIGURE 18 Metal Concentrations for 39-S1

FIGURE 19 Metal Concentrations for 39-S2



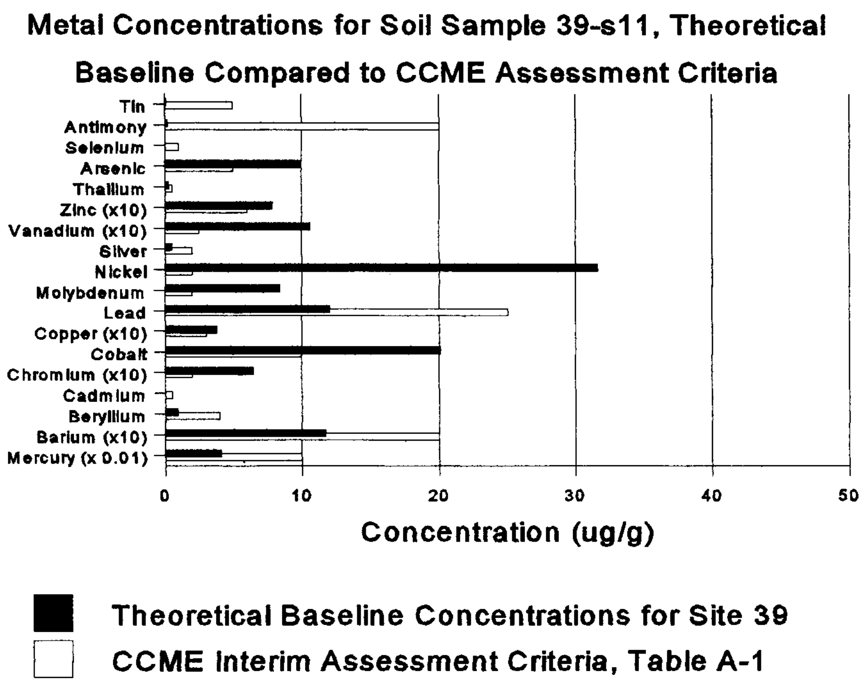
CCME ug/g	39-S2 ug/g
5	0.71
20	0.17
1	**1.20**
5	**8.30**
0.5	0.08
60	**79.90**
25	**101.00**
2	<0.20
20	**24.70**
2	**9.00**
25	48.90
30	**44.90**
10	**16.00**
20	**44.90**
0.5	<0.30
4	0.60
200	116.00
0.1	0.048



CCME ug/g	39-S3 ug/g
5	3.22
20	0.34
1	0.40
5	**4.30**
0.5	0.10
60	**84.30**
25	**107.00**
2	<0.20
20	**59.00**
2	**14.70**
25	18.00
30	**36.10**
10	**17.00**
20	**88.50**
0.5	<0.30
4	0.40
200	159.00
0.1	0.036

FIGURE 20 Metal Concentrations for 39-S3

FIGURE 21 Metal Concentrations for 39-S11

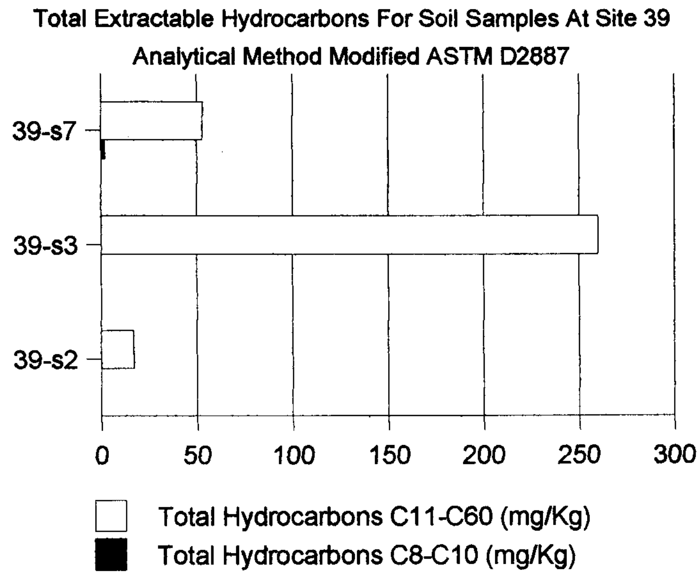


CCME ug/g	39-S11 ug/g
5	< 0.1
20	0.15
1	< 0.10
5	**9.92**
0.5	0.27
60	**78.5**
25	**106**
2	0.5
20	**31.6**
2	**8.4**
25	12
30	**37.7**
10	**20.10**
20	**64.8**
0.5	<0.30
4	0.9
200	117
0.1	0.041

3.6.2.2 Total Extractable Hydrocarbons

See Figure 22 for depiction of total extractable hydrocarbon content of soil samples 39-S2, 39-S3 and 39-S7, and comparing the ranges C8-C10 and C11-C60. Total extractable hydrocarbons for the range C8-C10 were below the method detection limits for soil samples 39-S2 and 39-S3, and measured as a concentration of 2 mg/Kg of C10 in 39-S7. Total extractable hydrocarbons for the range C11-C60 were analysed in soil samples 39-S2 at 17 mg/Kg primarily found as C33, C34 and C53; 39-S3 at 260 mg/Kg distributed from C25-C54 with the concentration of 29 mg/Kg of C32 as highest concentration of a single component; and 39-S7 at 53 mg/Kg primarily distributed in the C23-C38 range.

FIGURE 22 Total Extractable Hydrocarbons At Site 39



* no bar depiction indicates total extractable hydrocarbon content was below the method detection level

3.6.2.3 pH

All water samples tested within a normal range for pH, ranging from 7.7 at 39-W4 to 8.4 at 39-W2.

3.6.2.4 Volatile Organic Hydrocarbons

Soil samples 39-S2 and 39-S4 were analysed for volatile organic hydrocarbon (BTEX) content. In both samples, BTEX content was below the method detection limit and below the CCME Interim Assessment Criteria.

3.6.2.5 Polycyclic Aromatic Hydrocarbons

Analysis of soil samples 39-S2, 39-S3 and 39-S10 indicated polycyclic aromatic hydrocarbon content was below CCME Interim Assessment Criteria for all three samples. Napthalene was the most prevalent constituent in BTEX analysis of all soil samples 39-S2, 39-S3 and 39-S10 with a content of 0.0095 mg/Kg, 0.014 mg/Kg and 0.014 mg/Kg respectively.

3.6.2.6 Phenoxy Acid Herbicides

Soil sample 39-S2 was analysed for phenoxy acid herbicides. Presence of 2,4-D and Dinoseb were detected at levels which fell between the reliable detection levels and the method detection levels at 0.025 mg/Kg and 0.020 mg/Kg respectively. These levels are below the CCME Interim Assessment Criteria for 2,4-D and Dinoseb.

3.6.2.7 Organo Chloride Pesticides

Soil sample 39-S2 was analysed for organo chloride pesticides, levels were found to be below the method detection levels and below the CCME Interim Assessment Criteria.

PHASE 1 : Site 44

3.7 Archival Research and Interviews

A primary source of historical information regarding military activities in the Yukon Territory was the "Research of Former Military Sites and Activities in the Yukon", compiled by K. Bisset and Associates in April, 1995. It was compiled for the Arctic Environmental Strategy of DIAND and essentially comprises a Phase I analysis of all former military sites and activities in the Yukon. Additional information was compiled from the Yukon Archives, the Whitehorse Public Library and the Department of Indian and Northern Affairs, the Heritage Branch of YTG Tourism Department,Yukon Territorial Government Community and Transportation Services, Yukon Weather Centre and the Water Survey of Canada. Residents and commercial companies of the area also provided information. The village of Haines Junction, the Kluane Park Adventure Centre (a river guiding operation based in Haines Junction), Kluane Machine (a Haines Junction based contracting company) and the Arctic Research Institute at Kluane Lake were contacted. Initial site reconnaissance provided basic information about the physical site.

3.7.1 Site History

Site 44 was a dumpsite for old military waste and was also used for road construction waste in early 1940's. This site was still active until the 1960's as the old dump site for Haines Junction (Ken Baltimore, interview). There is little record information about the site, although according to Bisset::

> At Marshall Creek (MP 1006); South side of hwy, near the confluence of the creek and the Dezadeash River, there is scattered debris from an old military camp along the bank of the river (Bisset, page 225, 1995)

In the information package provided by AES, the site is referred to as a "old garbage dump".

3.7.2 Type and Quantity of Contaminants

The waste site includes old vehicle bodies, drums, tires, surface and buried general household waste such as cans and bottles (AES, Appendix A).

The approximate size of site is 100 by 250 meters. Quantity of contaminants is uncertain from archival research, but it does indicate that there does not appear to be a pit, only surface garbage (AES, Appendix A).

Straight edged depressions in the ground, probably indicative of human activity, has been mentioned (Scott Gilbert, Interview).

Archival research did not indicate what contaminants would have been stored at Site 44.

3.7.3 Geology of the Area

The geology of the area east of Haines Junction along the Dezadeash River is a greenstone and limestone of the Wrangellia Terraine. This is an accreted insular superterraine from the mid-cretaceous time period. Middle pennsylvannian plutons intrude the basement rocks of Wrangellia.

3.7.4 Depth of Water Table

Groundwater was encountered at a depth of approximately 1.75 meters during the site investigation of Site 44 in the process of digging the test pits.

3.7.5 Annual Rainfall Data

Annual rainfall data for Site 44 is taken from readings from the Haines Junction Highway Maintenance yard for the years 1987 to 1996. The annual rainfall over these years is 166.2 mm/annum. The annual rainfall data for the years 1944 - 1985 is 154.3 mm/annum. However, the location of these readings is unknown, and a yearly breakdown was not provided (Yukon Weather Centre). The 1944- 1985 readings were not included for the CCME analysis. Annual rainfall does not take into account snowpack runoff.

3.7.6 Surface and subsurface stratigraphy

Permafrost is unpredictable in the region (Mike Crawshay, interview).

3.7.7 Proximity to surface water

Archival research gave conflicting information stating a distance of both 8M and 8 KM to Dezadeash River (AES, Appendix A).

Site 44 is immediately adjacent to the Dezadeash River on the south side. One pond at the site contains waste and is directly connected via surface water (Anderson, interview). There are small pockets of waste on the river and the pond edges with water entering around debris (Scott Gilbert, interview).

3.7.8 Flood potential of site

Site 44 is adjacent to the Dezadeash River and has one pond containing waste that is connected via surface water (Scott Gilbert, interview). This area is considered to have a high flood potential.

Dezadeash River has a drainage area of 8500 square kilometers. Averaged over forty years, 1953-1992, maximum flows on the Dezadeash River were measured in June at 104 cubic meters per second and July at 94 cubic meters per second, low flows were measured in February at 16.2 cubic meters per second and March at 15.3 cubic meters per second (Water Survey of Canada).

3.7.9 Proximity to drinking water supply

Downstream use of Dezadeash River water might include agricultural use on Leases #620, #612, #614 (AES, Appendix A) and local residence use on Lots #86, #62, #84, #85 (AES, Appendix A). The Village of Haines Junction (5 km downstream) obtains its water supply from the river.

3.7.10 Uses of adjacent water resources

The Dezadeash River is a popular canoe and boating area for local residents and tourists, and is extensively used for fishing and swimming. Site 44 is over 100 kilometres downstream of Dezadeash Lake. This lake is road accessible from the Haines Highway and provides a popular starting point for recreational boating on the Dezadeash River.

3.7.11 Land use information

The site is not currently occupied by any dwelling or structure. Refer to Appendix A for the proximity of Agriculture Leases #620, #612 and #614 and Residential Lots #86, #62, #84, #85.

There are two fuel wood cutting operations along the Dezadeash River between Marshal Creek and Haines Junction.

Marshall Creek road is used extensively for hunting, trapping, cycling, jogging, skiing, driving snowmachines, sightseeing and paddling access (Ken Anderson, interview).The access track from Marshall Creek Road to Site 44 is used to reach fishing locations along the Dezadeash River bank.

3.7.12 Fish and Wildlife

There is an abundance and diversity of wildlife in the vicinity of Site 44. Squirrels, Whisky Jacks and beaver have been noted.

There is a movement in mid to late winter of an important moose population from the sub-alpine areas of Marshall and Garnet Creeks across the Alaska Highway to their winter and spring grounds along the Dezadeash River, Kathleen River and Quill Creek area. This population is presently quite low (Ken Anderson, 1996).

Fishers use Site 44 to catch fish, mainly grayling, in the Dezadeash River.

3.8 Current Physical Conditions

The size of the site is approximately 100 metres by 250 metres as gauged by visible human impact on the site and the extent of surface debris. There are no survey markers or cleared cut lines to indicate boundaries and the one fence line does not appear to follow any legal boundary.

Vegetation types are depicted in Figure 23 and surface debris locations in Figure 24.

The site is approached via a 300 metre dirt track running south off the Marshall Creek Road. This turnoff is 5.2 km east of the Village of Haines Junction. At the 300 metre mark, the dirt track heads between two ponds, a small one to the east and a large one to the west. The track then veers east and for 100 metres travels parallel to the Dezadeash River (located to the south of the track at a distance of 25 metres). The track ends at a promontory of land (5 - 10 metres wide, 30 metres long) that has the river on its south side and a marsh on its north side. The promontory ends in the river.

The Dezadeash River is moderately clear with a swift current. At the end of the promontory there is a confluence of two river channels occurring to the east. There is waste on the undercut bank of the Dezadeash River consisting of tires, metal and barrels, Between the ponds and the promontory area there is a small pit in the river bank. It is filled with water and connected to the river. This contains metal, lumber, cans and a caterpillar track.

The west pond is 50 metres long (running north/south) and 25 metres wide (Photograph 44-P1 and 44-P2). The pond has an open outlet to the Dezadeash River at the south end. There is a sand and gravel bar across the river at the outlet, but water flows across this with a depth of a 0.5 meters. Extensive waste is submerged on the north and east sides of the pond, and there are pockets of waste on the west side. This waste includes a pickup truck body, at least two vehicle batteries, numerous vehicle tires, 45 gallon barrels and extensive unidentifiable metal and other debris (Photograph 44-P8 and 44-P12). The depth of the pond 1 metre from the shoreline is 0.5 metres and is unknown in the middle. An Arctic Grayling was seen in the pond, approximately one foot in length.

The east pond is 20 metres long (running north/south) and 7.5 metres wide. It has at least five 45 gallon barrels submerged within a metre of water at the north end (Photograph 44-P5 and 44-P9). A pickup truck body is partially submerged at the south end. Additional smaller metal scraps are scattered within the pond. The water depth is at least 1.75 metres. There is no surface water outlet from this pond. Vegetation consists of a moss edge with floating orange scum (particularly at the north end), a bright green algal growth and profuse floating algal blooms. Aquatic plants and marsh grasses were both submerged and partially submergent (Photograph 44-P10, 44-P11 and 44-P13). Dragon flies, black flies and horse flies were abundant at the time of the site visit.

Between the ponds (forming a western boundary) , the dirt track (forming a northern boundary) and the promontory (forming a eastern boundary) is an area composed of bare ground, small poplars and underbrush. This area is extensively covered in small debris such as tin cans (including oil cans and motor vehicle product containers), broken glass, metal parts and vehicle tires (Photograph 44-P3, 44-P4 and 44-P16). In addition, there are three vehicle bodies.

To the north of this area, beyond the dirt access track and with the marsh to the east and the small (east) pond to the west, is a 10 to 25 metre wide band of extremely thick young poplar growth. In this area, but within 15 metres of the pond are five vehicle bodies.

North of the young poplar area, bounded by the access track to the west and the marsh to the east, is an area dominated by old growth poplars. The western portion of this area has experienced severe blowdown and is difficult to walk through. Surface garbage is scattered in a 100 metre strip 50 metres deep, parallelling the marsh to the east. The majority of this garbage is cans, broken glass and small pieces of metal but there is one vehicle body (Photograph 44-P7), some metal office fixtures, numerous tires and empty 20 gallon barrels (Photograph 44-P14 and

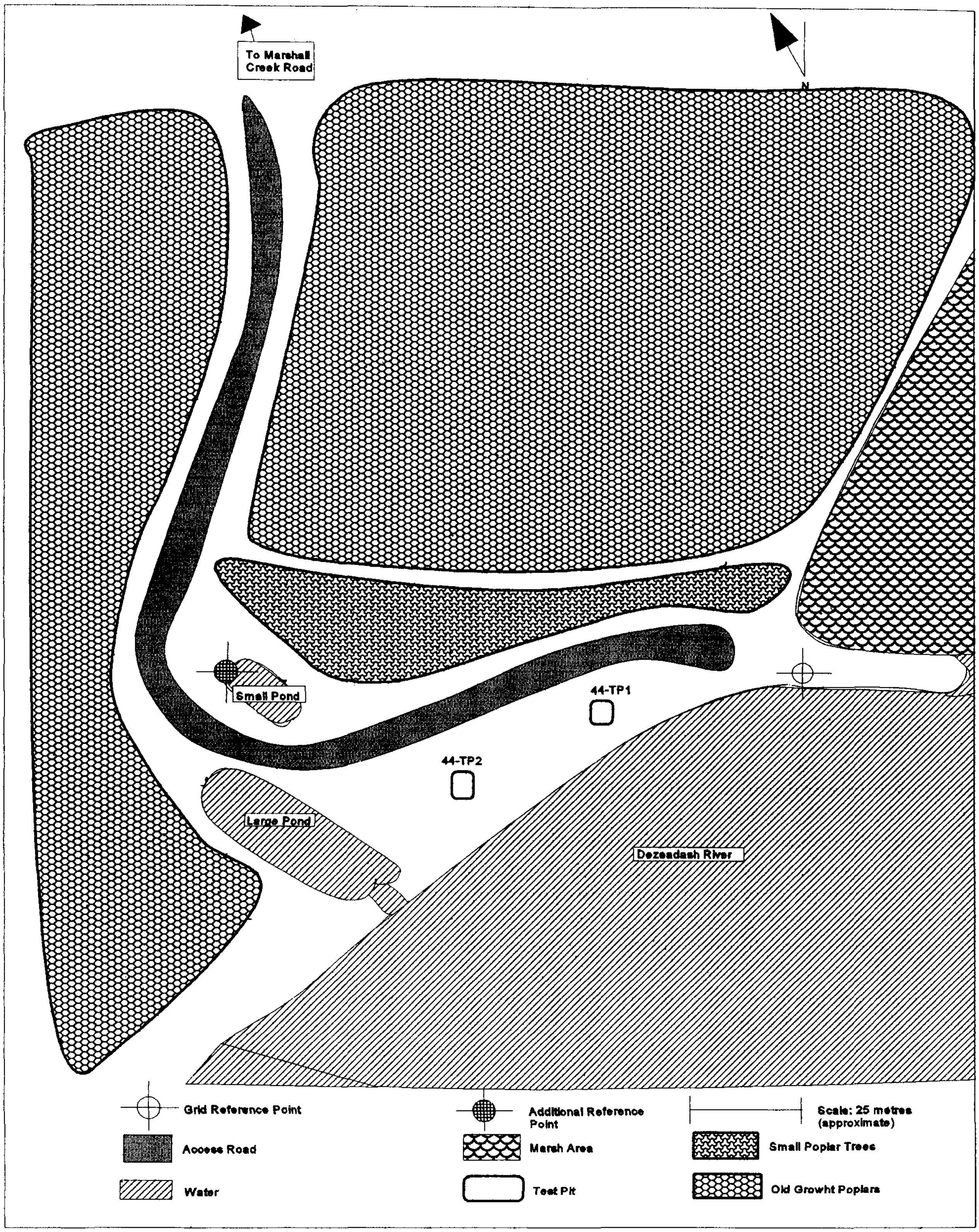


FIGURE TWENTY-THREE
Site 44 Vegetation Locations

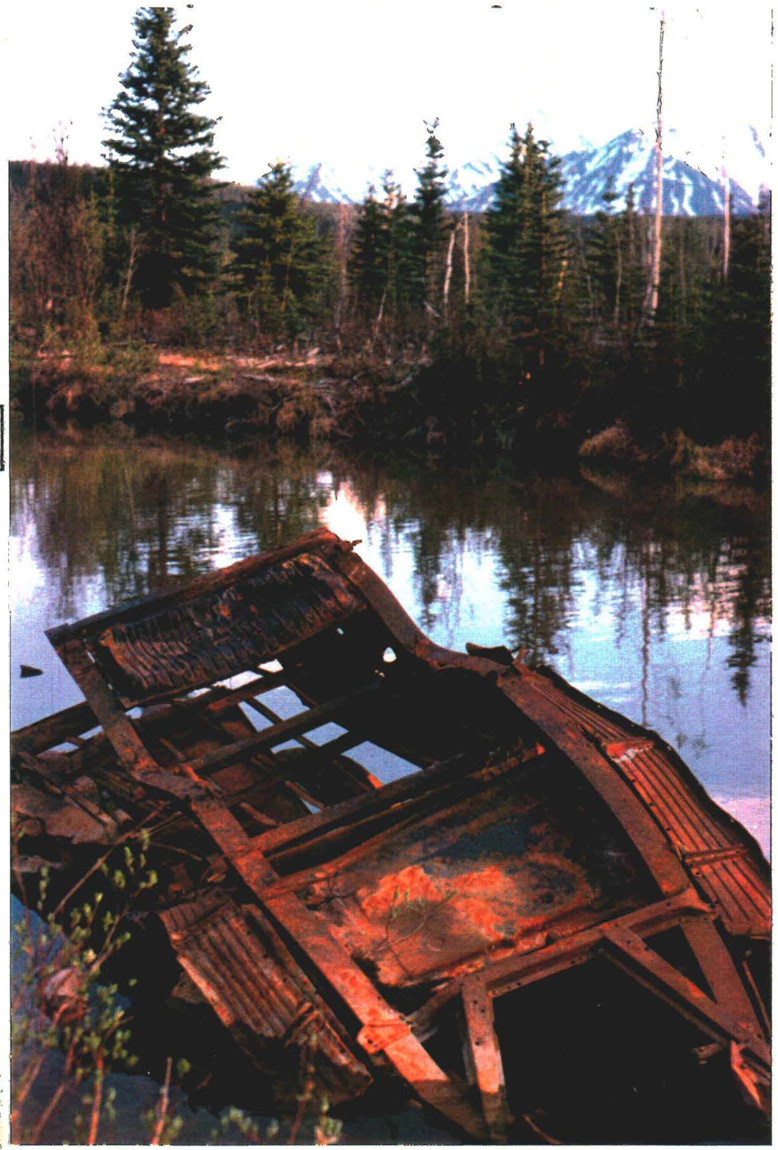
Photograph 44-P1: View of the outlet of the west pond into the Dezadeash River as seen from 44-S11.

Photograph 44-P2: North facing view of the west pond from its outlet into the Dezadeash River.

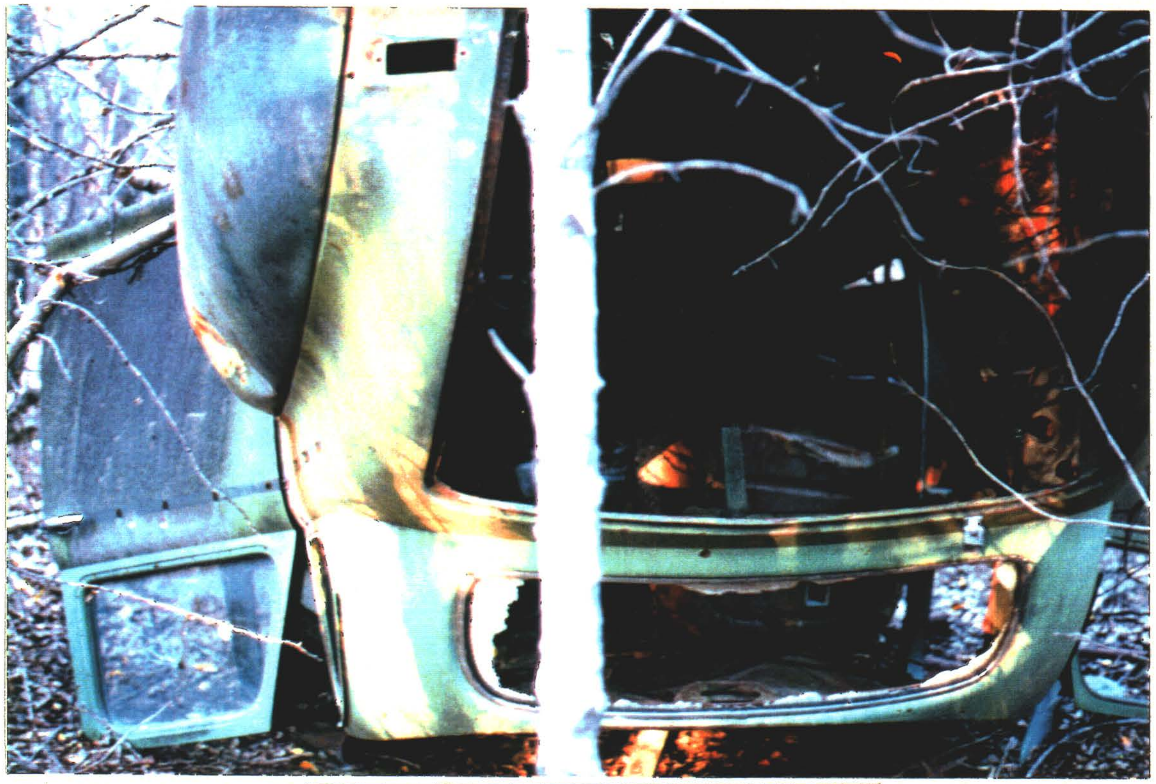
Photograph 44-P3: View of surface debris near 44-TP1.

Photograph 44-P4: View of surface debris near 44-TP2.

Photograph 44-P5: West facing view of east pond. The vehicle wreck on the east shore.



Photograph 44-P6: East facing view of vehicle wreck in the marsh area. This is 10 metres north of the survey reference point.



Photograph 44-P7: Vehicle wreck near 44-S16.

Photograph 44-P8: Batteries and large metal drums submerged on east side of the west pond.

Photograph 44-P9: Submerged large metal drums at north end of east pond.

Photograph 44-P10: Backhoe on west bank of the east pond.

Photograph 44-P11: Backhoe on the west bank of east pond with its bucket in pond.

Photograph 44-P12: South facing view of west pond. 44-S4 is in the background.

Photograph 44-P13: South facing view of east pond. 44-S9 is in the foreground.

Photograph 44-P14: View of surface debris in old growth poplars. 44-S14 is on the left.

Photograph 44-P15: View of surface debris in old growth poplars. 44-S15 is on the right.

Photograph 44-P16: Poplars near 44-TP2.

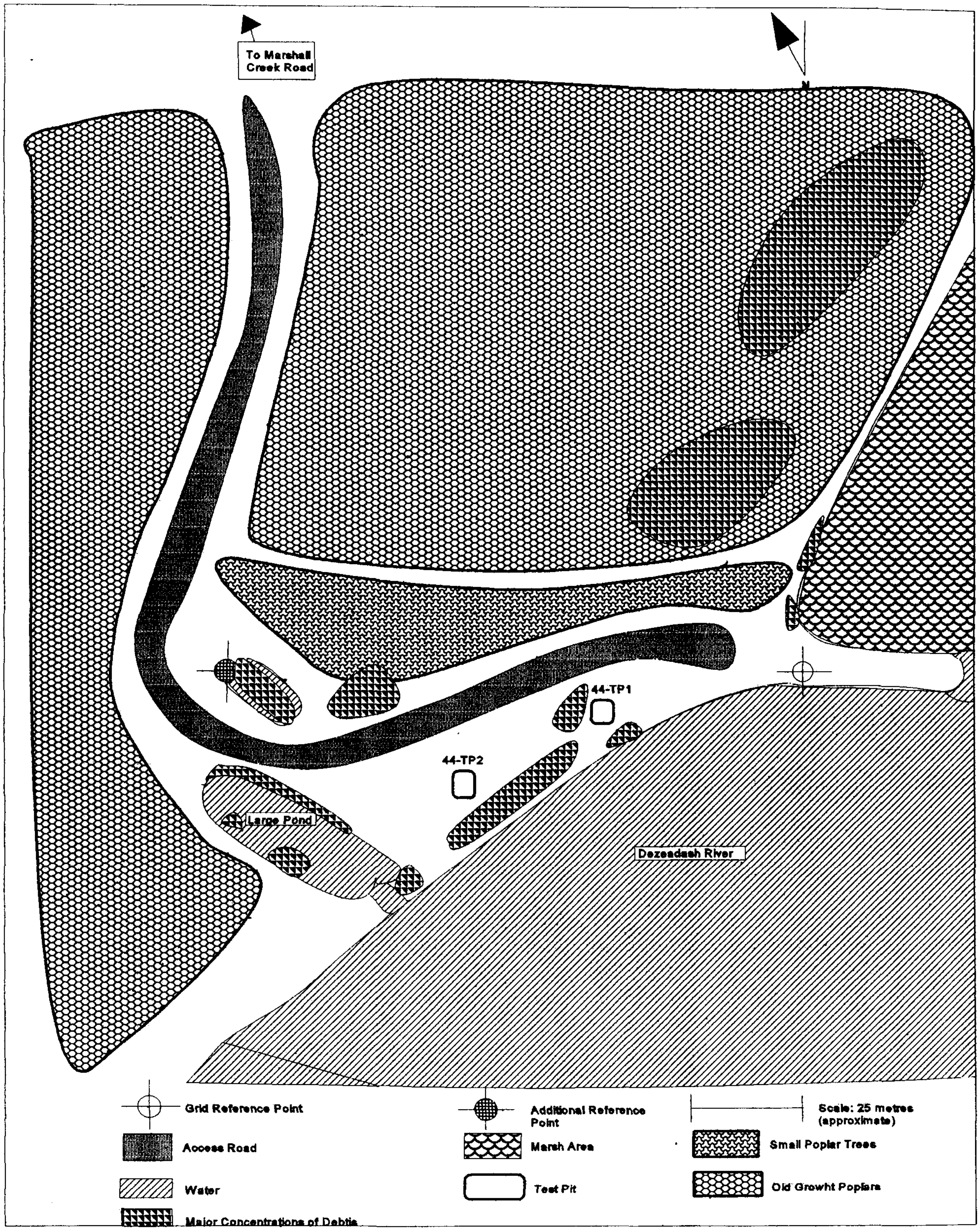


FIGURE TWENTY-FOUR
Site 44 Debris Locations

44-P15). There are small (2 metre diameter, 0.5 metres high) clay mounds in this area, clear of any underbrush and having garbage and debris in and around them.

There is a path which runs along the banks of the marsh area. The marsh appears to be mostly clear of debris, although there is one vehicle body by the land promontory (Photograph 44-P6), a 20 gallon drum and some metal wire that is visible. After walking 250 metres up this path, a beaver dam is visible in a stream that flows through the marsh. Gnawed trees seem to be the recent work of beaver activity, and there are trees felled in woods by beavers.

Squirrels and Whisky Jacks were visible throughout the site and according to a local fisher who has lived in the area for his entire life there is grayling at this location.

3.9 Laboratory Analysis Results

The September site visit was part of Phase II and Phase III of the Assessment Plan, to determine the presence of contaminants on site and initiate delineation. This visit included a site survey, a site inventory and soil and water sampling for both field and laboratory testing. Sampling details, such as depth and location, are listed in Appendix B-44.

3.9.1 Field Laboratory Analysis

Concentration ranges and locations of soil and water samples were tested in the field for total extractable hydrocarbons based on PetroFLAG analysis, and for polycyclic aromatic hydrocarbons and polychlorinated biphenyls DTECH immunoassay analysis. These are depicted in Figure 25. Field analysis results are listed in Appendix C-44.

3.9.1.1 Total Hydrocarbons

Soil samples were tested for total extractable hydrocarbons using the PetroFLAG broad spectrum analysis system (Appendix C-44). Sample 44-S1, 44-S5, 44-S13 and 44-S15 were the highest levels of total hydrocarbons tested in the field at Marshall Creek Site 44. Samples 44-S2, 44-S8, 44-S9, 44-S10 and 44-S14 were found to be in the medium range for total extractable hydrocarbons. Very low presence of total extractable hydrocarbons was found in samples 44-S3, 44-S4, 44-S6 in 44-TP1, 44-S7 in 44-TP2, 44-S11, 44-S12, 44-S16 and 44-S17.

3.9.1.2 Polycyclic aromatic hydrocarbons

PAH's were detected in the field using the D TECH semiquatitative immunoassay technique for total PAH concentration. Results of field analysis for PAH's are compared to CCME Interim Assessment Criteria for Soil and Water, however the CCME guidelines indicate criteria for individual PAH's (0.1 ppm for soil and 0.01 ppm for water) whereas the immunoassay technique analyses for total PAH concentration (Appendix C-44). British Columbia Ministry of the Environment remediation criteria indicates total PAH levels for soil at 20 ppm and for freshwater aquatic life at 0.02-0.9 ppm Concentrations of PAH's were below the detectable limits in soil samples 44-S5, 44-S10, 44-S8 and water sample 44-W9. PAH concentrations in soil sample 44-S13 and water sample 44-W8 were analysed at levels which may exceed CCME criteria for individual PAH concentrations, 0.62 ppm and 12.6 ppb respectively.

3.9.1.3 Polychlorinated Biphenyls

PCB's were detected in the field using the D TECH semiquatitative immunoassay technique. Results of field analysis for total PCB concentrations are compared to the CCME Interim Assessment Criteria for Soil and Water guidelines for mixtures of PCB's (Appendix C-44). PCB concentrations were below detection levels for field analysis of samples 44-S2, 44-S4, 44-S14, 44-S15 and 44-S16.

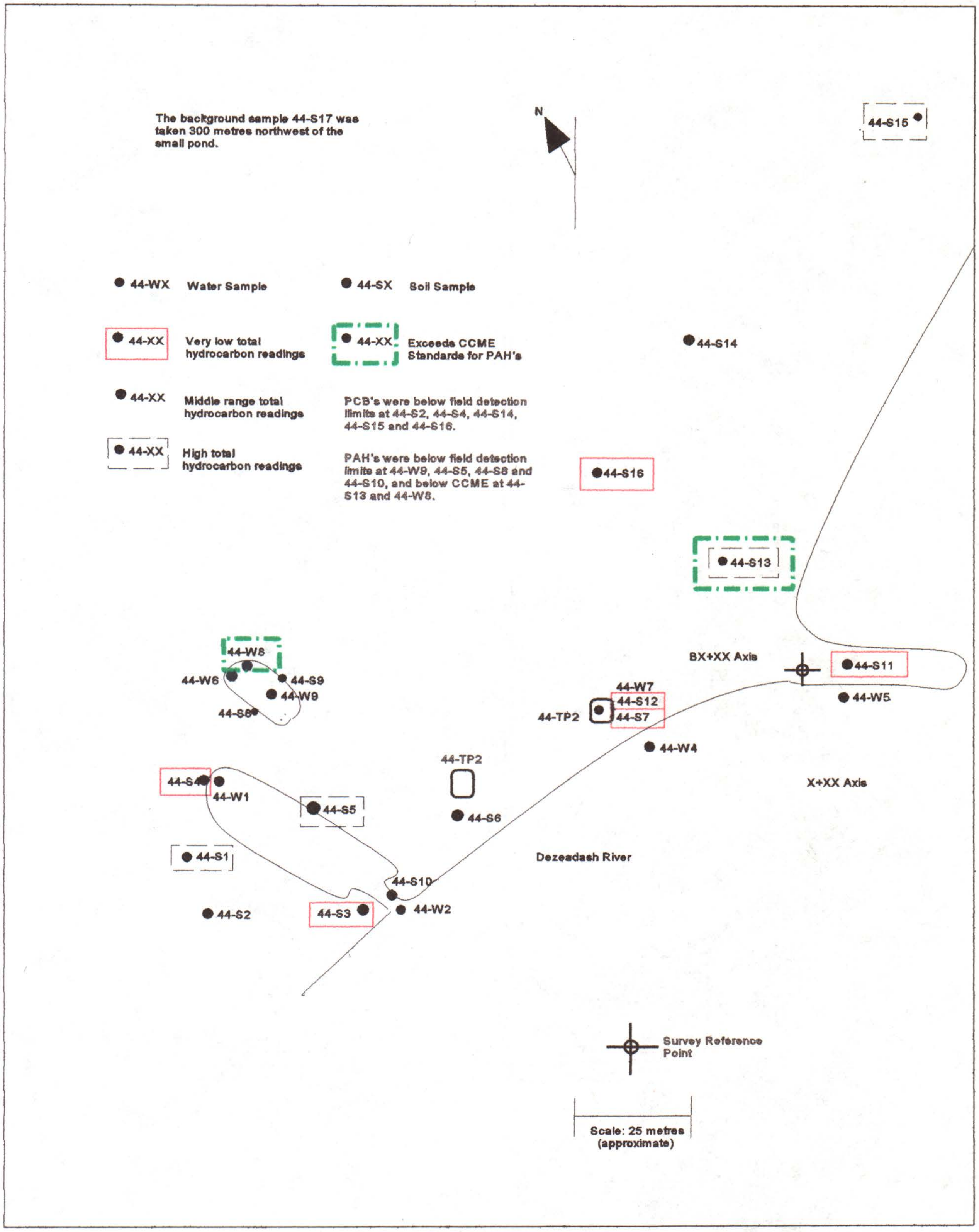


FIGURE TWENTY-FIVE
Site 44 Field Laboratory Results

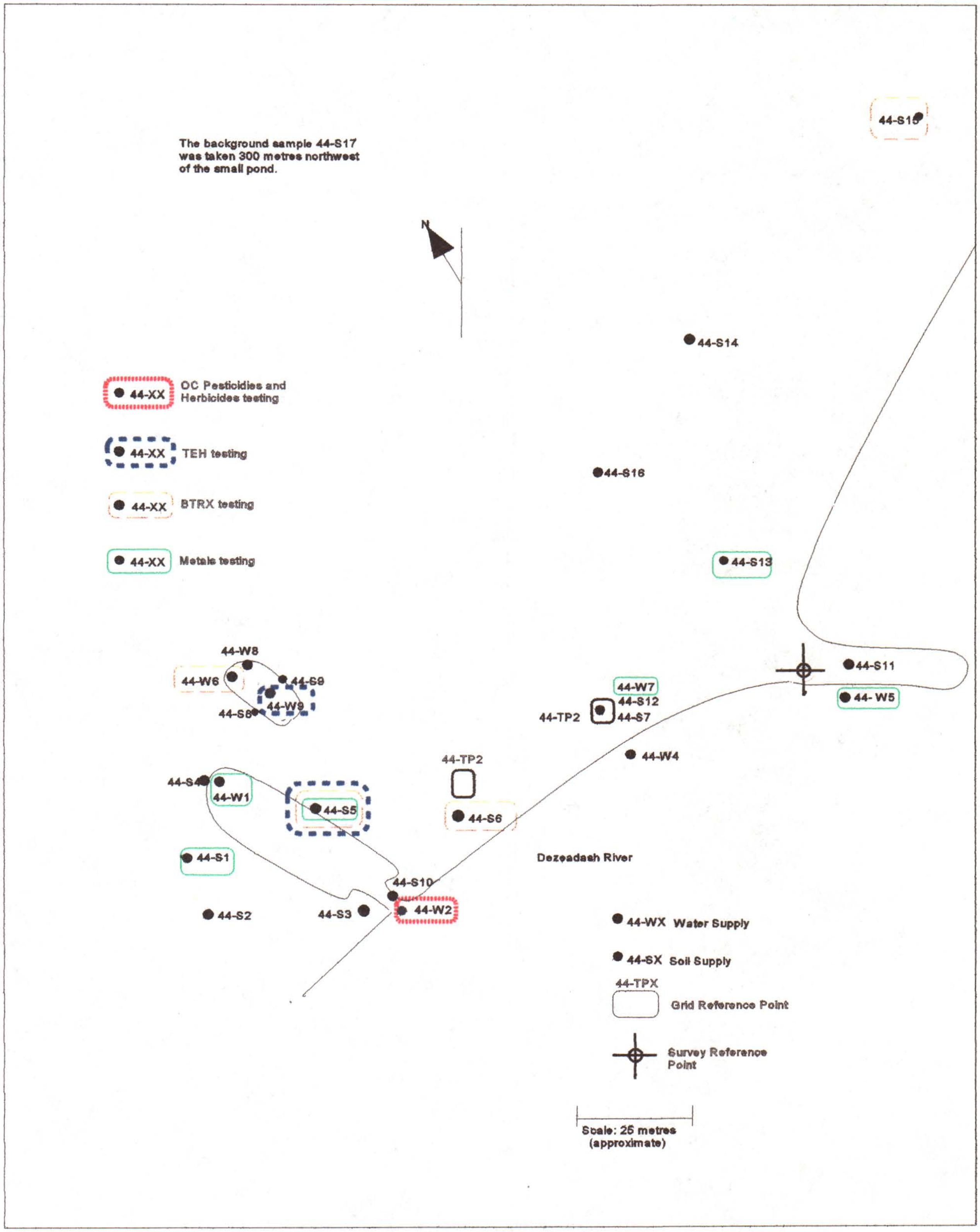


FIGURE TWENTY-SIX
Site 44 Laboratory Testing

3.9.1.4 Vegetation

Balsam Poplar: *Populus balsamifera*

Irregular shaped silver spots were scattered on top of a leaf with a dusty appearance (located near 44-TP2, see Photograph 44-P16). This is possibly a mold infection on plant, or it could be some kind of rust or smut infection.

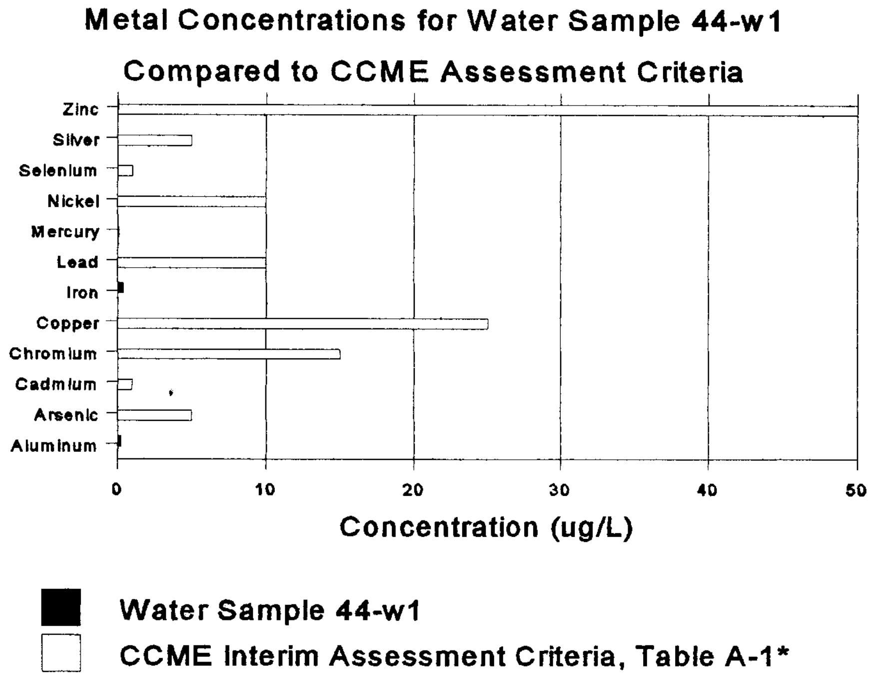
3.9.2 Analytical Laboratory Analysis

Sampling regime for analytical laboratory analysis confirmed credibility of field analysis and provided greater specificity. Additional parameters were analysed that could not be effectively tested in the field. Figure 26 indicates locations and types of samples sent to the laboratory for analysis. Appendix D lists the data sheets for all samples and quality control tests analysed by Chemex Analytical Laboratories.

3.9.2.1 Metals

<u>Water:</u>
Water samples 44-W1, 44-W3 and 44-W5 were analysed for metal content, concentrations were well below the CCME guidelines for Fresh Water Aquatic Life and Interim Assessment Criteria. Water sample 44-W7 was taken from test pit 2 and is considered a ground water sample. 44-W7 exceeded CCME guidelines for Freshwater Aquatic Life in concentrations of iron and aluminum, there are no CCME Interim Assessment Criteria defined for iron and aluminum. See Figures 27, 28, 29 and 30 for depiction of the laboratory analysis for metal content of water samples.

<u>Soil:</u>
Soil sample 44-S1 exceeded CCME Interim Assessment Criteria for 9 metals, chromium, cobalt, copper, molybdenum, nickel, vanadium, zinc, selenium and tin, and arsenic was comparable to CCME levels. Soil sample 44-S5 exceeded CCME Interim Assessment Criteria for 12 metals, mercury, barium, chromium, cobalt, copper, lead, molybdenum, nickel, vanadium, zinc, arsenic and tin, many of these are very high levels. Soil sample 44-S13 exceeded CCME Interim Assessment Criteria for 9 metals, chromium, cobalt, copper, molybdenum, nickel, vanadium, zinc, arsenic and selenium. Theoretical soil baseline 44-S17 exceeded CCME Interim Assessment Criteria for 8 metals, chromium, cobalt, copper, molybdenum, nickel, vanadium, zinc and arsenic. See Figures 31, 32, 33 and 34 for depiction of the laboratory analysis for metal content of soil samples.



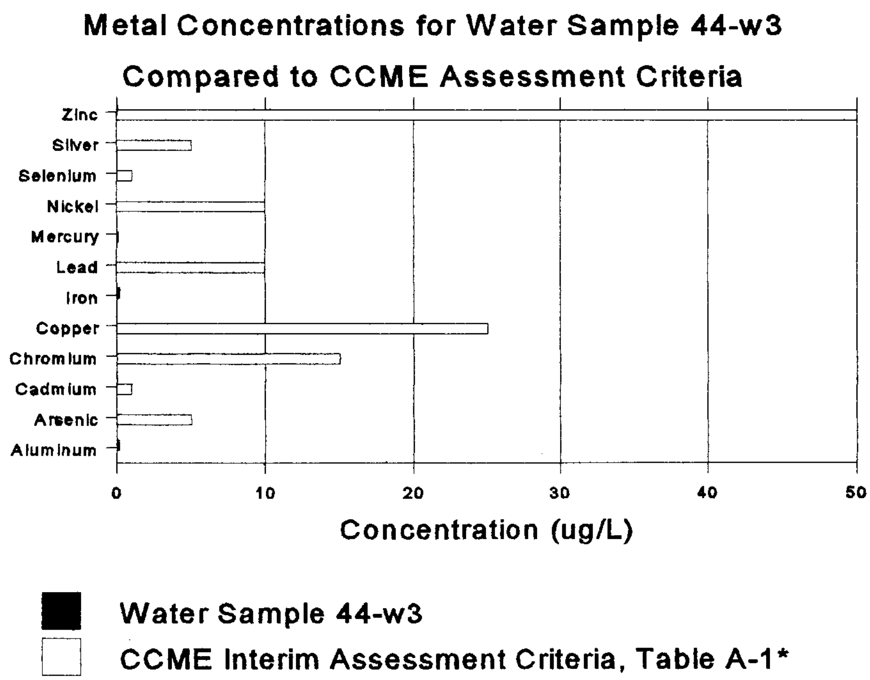
TableA-1 CCME ug/L	TableA-3 Aquatic ug/L**	44-W1 ug/L
50.0		0.044
5.0		<.0001
1.0		0.0002
10.0		<.0005
0.1	0.1	<0.05
10.0	1.0-7.0	0.0009
*	300.0	0.38
25.0	2.0-4.0	0.001
15.0	2.0-20.0	0.015
1.0	0.2-1.8	<.0002
5.0	50.0	<.0002
*	5.0-100	0.21

* No guidelines are defined on CCME Table A-1 for Aluminum or Iron.

** Guideline varies with pH, calcium, and dissolved organic carbons for aluminum, and hardness for cadmium, copper, lead and nickel.

FIGURE 27 Metal Concentrations for 44-W1

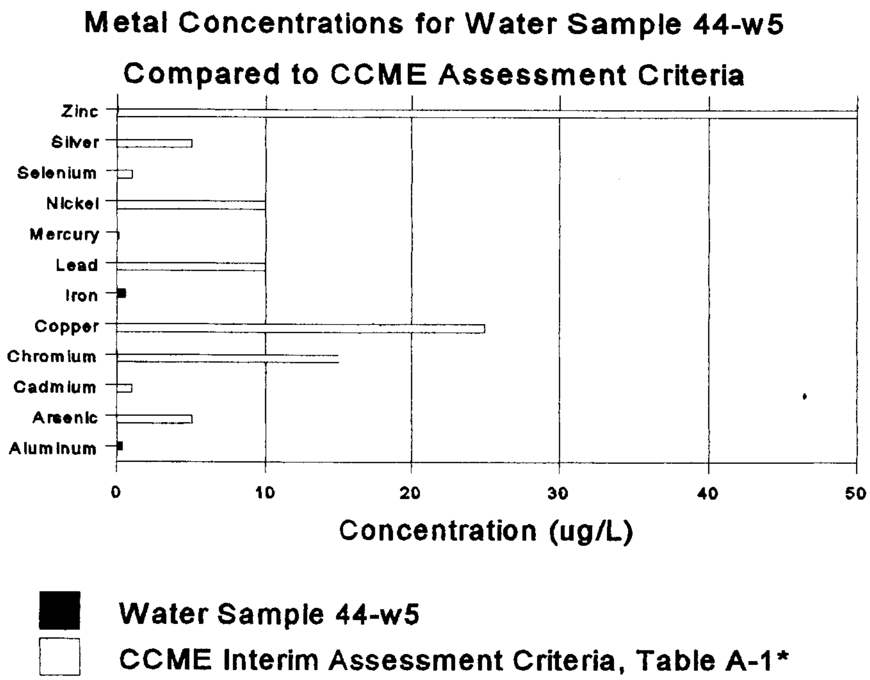
FIGURE 28 Metal Concentrations for 44-W3



TableA-1 CCME ug/L	TableA-3 Aquatic ug/L**	44-W3 ug/L
50.0		0.024
5.0		<.0001
1.0		<.0002
10.0		<.0005
0.1	0.1	<0.05
10.0	1.0-7.0	<.0003
*	300.0	0.16
25.0	2.0-4.0	0.003
15.0	2.0-20.0	0.006
1.0	0.2-1.8	<.0002
5.0	50.0	0.0003
*	5.0-100	0.014

* No guidelines are defined on CCME Table A-1 for Aluminum or Iron.

** Guideline varies with pH, calcium, and dissolved organic carbons for aluminum, and hardness for cadmium, copper, lead and nickel.



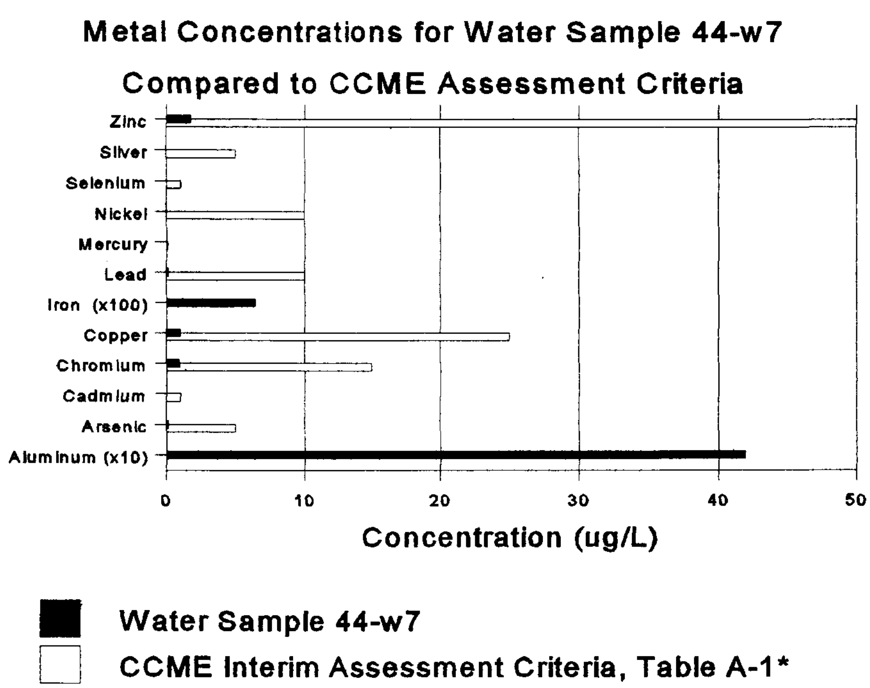
TableA-1 CCME ug/L	TableA-3 Aquatic ug/L**	44-W5 ug/L
50.0		0.018
5.0		<.0001
1.0		0.0004
10.0		<.0005
0.1	0.1	<0.05
10.0	1.0-7.0	0.0004
*	300.0	0.58
25.0	2.0-4.0	0.003
15.0	2.0-20.0	0.016
1.0	0.2-1.8	<.0002
5.0	50.0	0.0016
*	5.0-100	0.36

* No guidelines are defined on CCME Table A-1 for Aluminum or Iron.

** Guideline varies with pH, calcium, and dissolved organic carbons for aluminum, and hardness for cadmium, copper, lead and nickel.

FIGURE 29 Metal Concentrations for 44-W5

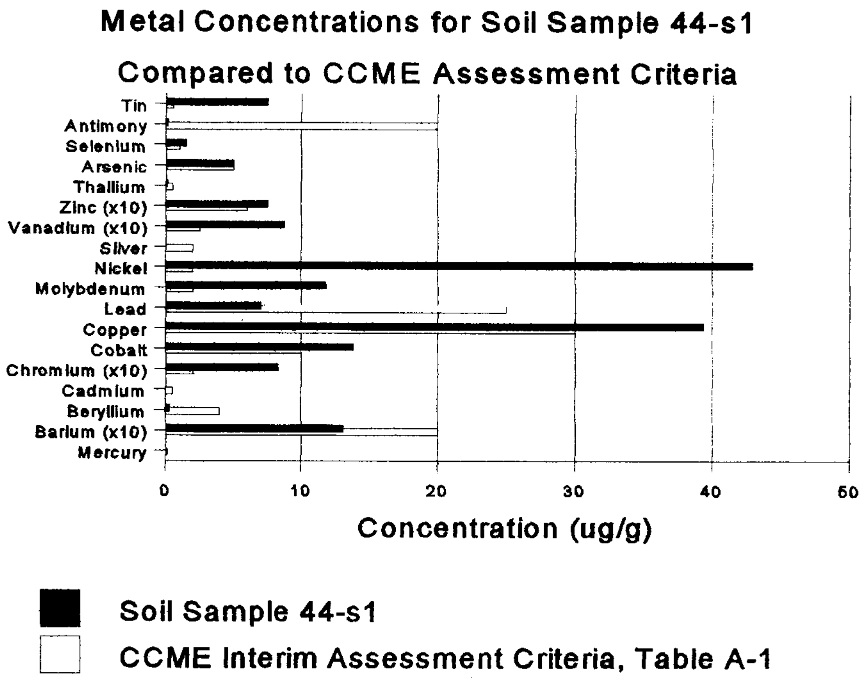
FIGURE 30 Metal Concentrations for 44-W7



TableA-1 CCME ug/L	TableA-3 Aquatic ug/L**	44-W7 ug/L
50.0		1.71
5.0		0.0044
1.0		0.0019
10.0		<.0005
0.1	0.1	<0.05
10.0	1.0-7.0	0.153
*	300.0	**640.00**
25.0	2.0-4.0	1.02
15.0	2.0-20.0	0.957
1.0	0.2-1.8	0.0034
5.0	50.0	0.150
*	5.0-100	**419.00**

* No guidelines are defined on CCME Table A-1 for Aluminum or Iron.

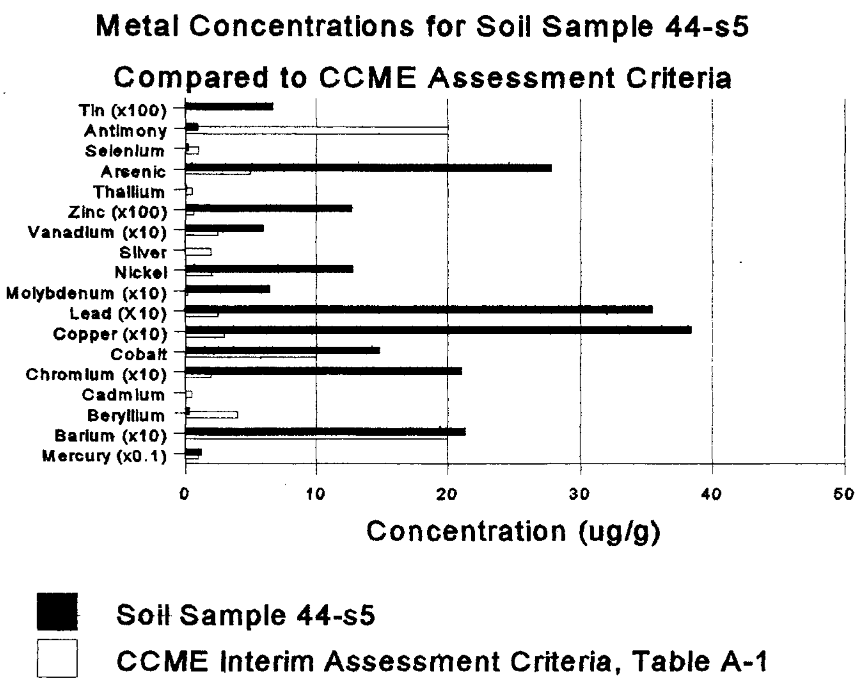
** Guideline varies with pH, calcium, and dissolved organic carbons for aluminum, and hardness for cadmium, copper, lead and nickel.



CCME ug/g	44-S1 ug/g
5	7.5
20	0.15
1	1.5
5	5.0
0.5	0.12
60	75.1
25	87.4
2	< 0.2
20	42.9
2	11.8
25	7
30	39.4
10	13.9
20	82.5
0.5	<0.3
4	0.50
200	131.00
0.1	<0.02

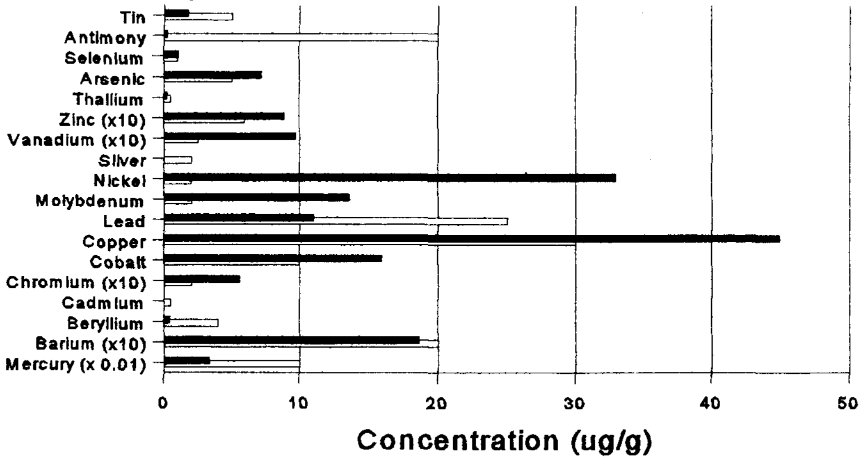
FIGURE 31 Metal Concentrations for 44-S1

FIGURE 32 Metal Concentrations for 44-S5



CCME ug/g	44-S5 ug/g
5	668.00
20	0.94
1	0.20
5	27.80
0.5	0.10
60	1270.00
25	59.60
2	<0.20
20	128.00
2	64.60
25	355.00
30	384.00
10	14.80
20	210.00
0.5	<0.30
4	0.30
200	213.00
0.1	0.126

Metal Concentrations for Soil Sample 44-s13 Compared to CCME Assessment Criteria



CCME ug/g	44-S13 ug/g
5	1.75
20	0.20
1	1.10
5	7.20
0.5	0.23
60	88.90
25	97.00
2	<0.20
20	32.90
2	13.60
25	11.00
30	44.90
10	16.00
20	55.70
0.5	<0.30
4	0.40
200	186.00
0.1	0.033

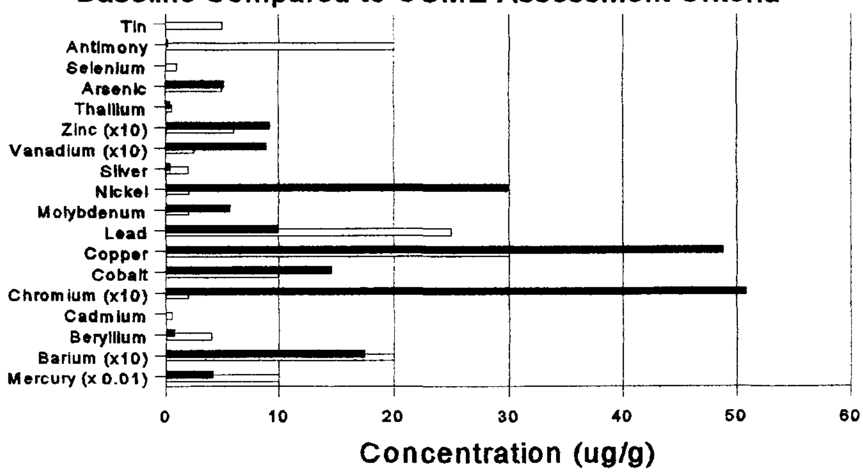
■ Soil Sample 44-s13

□ CCME Interim Assessment Criteria, Table A-1

FIGURE 33 Metal Concentrations for 44-S13

FIGURE 34 Metal Concentrations for 44-S17

Metal Concentrations for Soil Sample 44-s17, Theoretical Baseline Compared to CCME Assessment Criteria



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

■ Theoretical Baseline Concentrations for Site 44

□ CCME Interim Assessment Criteria, Table A-1

3.9.2.2 Total Extractable Hydrocarbons

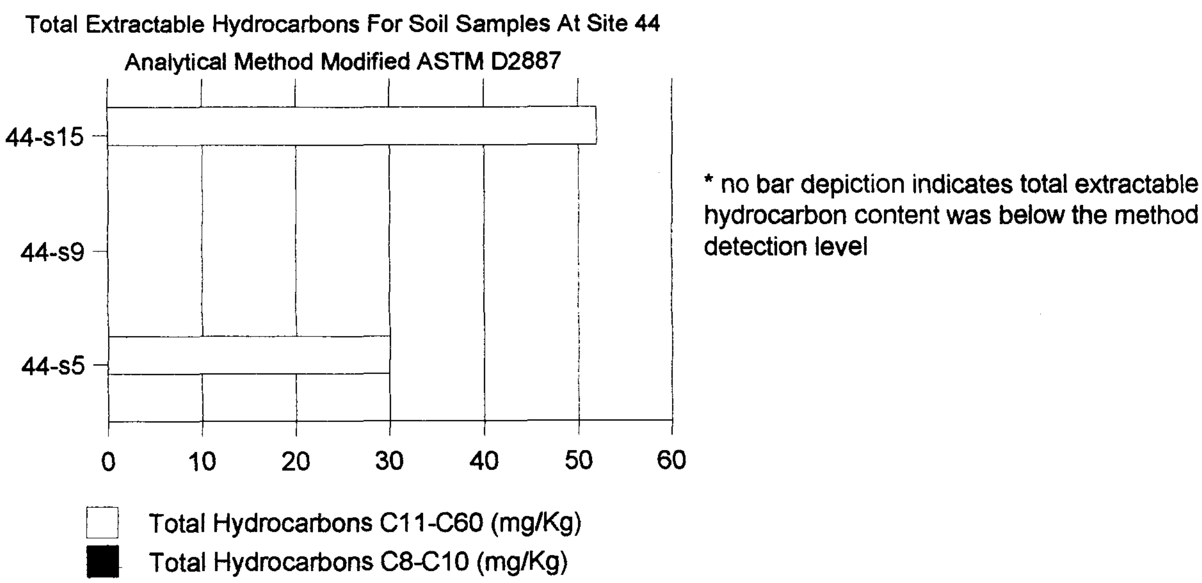
Soil

See Figure 35 for depiction of total extractable hydrocarbon content of soil samples 44-S5, 44-S9 and 44-S15 and comparing the ranges C8-C10 and C11-C60. Total extractable hydrocarbons for the range C8-C10 were below the method detection limits for all three soil samples 44-S5, 44-S9 and 44-S15. Total extractable hydrocarbons for the range C11-C60 were analysed in soil samples were found to be below method detection levels for soil sample 44-S9. Total extractable hydrocarbons for the range C11-C60 were analysed in soil sample 44-S15 was found to be at 30 mg/Kg primarily in the range C28-C38 with the concentration of 10 mg/Kg of C33 as highest concentration of any single constituent and soil sample 44-S5 at 30 mg/Kg primarily distributed in the C26-C34 range.

Water:

Water sample 44-W9 was extracted for total hydrocarbons and was found to have no detectable levels for C8-C11, and 0.15 mg/Kg for the range C11-C60 which were primarily found in the C19-C20 range.

FIGURE 35 - TEH's At Site 44



3.9.2.3 pH

All water samples tested within a normal range for pH, ranging from 8.4 at 44-W2, 44-W3, 44-W4 and 44-W5 to 8.8 at 44-W6.

3.9.2.4 Volatile Organic Hydrocarbons

Soil samples 44-S5 and 44-S6 were analysed for volatile organic hydrocarbon (BTEX) content. In both samples, BTEX content was below the method detection limit and below the CCME Interim Assessment Criteria.

3.9.2.5 Polycyclic Aromatic Hydrocarbons

Analysis of water sample 44-W8 indicated PAH content exceeded CCME Interim Assessment Criteria for Benzo(b&j)fluoranthene at 0.011 ug/L and Benzo(k)fluoranthene at 0.011 ug/L.

3.9.2.6 Polychlorinated Biphenyls

Water sample 44-W9 was intended to be analysed for PCB's but was extracted in the analytical laboratory for total extractable hydrocarbons.

4.0 INTERPRETATION

The chemical behaviour of any element in the environment depends on the nature of its compounds and species. Physiological, ecological and toxicological effects of a metal are usually strongly structure specific, that is, they depend on the species. Physiological effect of an essential element on an organism depends on concentration range of the element and other contributing chemical influences. A very low concentration range of an essential element limits growth, in an optimum range growth is obtained, in high concentrations toxic effects are observed. Toxicity ranges are specific to the metals and the organisms involved. Other contributing chemical influences are variables such as the total concentrations of the metal in question, pH, alkalinity, the concentration of natural chelators, the concentration of competing metals, and the presence of adsorptive surfaces all can affect the concentration of free metal ions and thus affect the response of an organism to that particular metal.

In soils and sediments, the speciation in the dissolved aqueous phase is primarily important to assess bioavailability and toxicity. The total concentration (adsorbed and solid phase) gives an idea of the capacity of a reactive element which could under certain circumstances (acidification, complex formation) be mobilized. Sediment toxicity to benthic organisms (amphipods, oligochaetes and snails) is essentially related to the free metal ions in solubility equilibrium with the solid metals present. The scope of this project did not encompass this scale of detail.

Hydrocarbons or petroleum distillates are available in a wide variety of forms, including motor oil, gasoline, diesel or kerosene, and in combination with other chemicals as a vehicle or solvent. The toxicity of hydrocarbons is generally indirectly proportional to the agent's viscosity, with high viscosity products such as heavy greases and oils having only limited toxicity compared to low viscosity which present an aspiration risk (clinical toxicology).

PHASE III : Site 30

4.1 Site Survey

The concrete foundation was the foundation for Pumpstation F, used to pump oil for the CANOL # 4 pipeline. Pipe and other debris scattered around the site is associated with this era. It is inferred that the site was used for industrial-type activities related to highway construction and maintenance and that small numbers of people resided at this station.

4.2 Site Contamination

4.2.1 Soil

Field testing of **total hydrocarbons** indicated the highest levels were found in the same general region on the west side of Site 30. These were **detected in soil samples 30-S15, 30-S17 and 30-S23. BCMOE defines guidelines for site remediation of light aliphatics (C1-C10) at 150 ug/g in soil, soil sample 30-S17 exceeds this criteria**. Based on carbon ranges detected through analytical laboratory sampling and standard chromatographs, contamination source is possibly diesel. **US Federal guidelines for site remediation define criteria for diesel at 200 ug/g in soil and both** soil **samples 30-S23 and 30-S17 exceed** this. **PAH levels of significant concern were detected in field analysis** in soil **samples taken at 30-S17 and 30-S23, and corresponding water samples 30-W2** and 30-W1.

PCB's were detected in field analysis in soil sample 30-S17 (0.65 ppm). The presence of PCB's was not confirmed as a positive result in analytical laboratory testing. No other field samples or analytical laboratory samples tested positive for presence of PCB's at Site 30.

Organo chloride pesticides and phenoxy acid herbicides were not detected in soil sample 30-S17.

Samples of tile material tested positive as 30 to 50% chrysotile asbestos.

4.2.2 Water

In water sample 30-W2, aluminum content exceeded CCME guidelines for Freshwater Aquatic Life, however, this sample was taken from a small puddle over 300 metres from surface water sustaining extensive aquatic life. No guideline criteria are recommended by CCME for site remediation for aluminum contamination.

4.3 Impact Potential

There is an abundance and diversity of wildlife in the area, bears, birds, squirrels, moose, frogs. People from the Kluane First Nation have traplines closer to the Donjek and hunt in this area.

4.3.1 Surface Debris

Surface debris, scrap metals and asbestos tiles could present a potential physical hazard. This site is in close proximity to the Alaska Highway. This area has low potential for physical harm to human and wildlife from surface debris, although the presence of barbed wire is noted.

4.3.2 Hydrocarbons

Based on the chromatogram of total extractable hydrocarbons, low concentration of PAH's and the presence of the BTEX compounds m&p xylene and o-xylene, it is probable that the contaminant present at in soil sample 30-S17 is primarily diesel and waste oil.

4.3.3 Metals

30-S17:
Soil sample 30-S17 was analysed for total metal content and indicated high concentrations for many metal constituents.

Chromium has potential to be a hazardous metal, and was found in concentrations greater than the CCME Interim Assessment Guidelines and exceeding the theoretical baseline 0.4 ug/g with a concentration of 51.7 ug/g. Copper is an essential protein and enzyme metal which also has a potential for toxicity. Copper was detected at concentrations both higher than the CCME guidelines (30 ug/g) and higher than the theoretical baseline (2.2 ug/g) with a concentration of 45.50 ug/g. Zinc is a biologically essential metal which, unlike copper, does not usually accumulate biologically with chronic exposure since homeostasis is maintained by limiting gastrointestinal absorption and through liver levels. Zinc was detected at 86.4 ug/g which exceeded the baseline 8.0 ug/g and the CCME Interim Assessment Guidelines of 60 ug/g. Nickel and vanadium tend to be a concern when potential for chronic inhalation is high, sample 30-S17 does not present a high concern for inhalation risks. Nickel, similar to zinc, is not well absorbed gastrointestinally and therefore is not extremely toxic at the levels detected.

PHASE III : Site 39

4.4 Site Survey

The slope of the plateau at Site 39 is very steep, approximately 40 degrees. The slope is two tiered on the southern side running towards the Kathleen River. Very little signs of erosion were noted, surface runoff being minimal due to high water permeability of the sand and gravel and of the presence of vegetation on slope surface. Rainfall data was 166.2 millimeters per annum based on 1987 to 1996 figures. This should not highly influence erosion rates (this data does not include snow pack, consequently snow fall may play a larger role in slope erosion). One location near the small ponds indicated signs of slope slumping due to the presence of a very steep embankment.

The surface debris consisted of household-type garbage. Rusted metal cans and broken glass bottles are on the surface. This could pose a physical threat to someone should they come into contact with it. The excavation of the test pits revealed garbage within the mound. It is unknown what type of garbage is buried elsewhere within the mound.

4.5 Site Contamination

4.5.1 Soil

Field testing of total hydrocarbons indicated the highest levels were found in 39-TP2 and 39-TP3. Indications suggest the source of the highest hydrocarbon levels is primarily natural organics such as oils and waxes. Concentrations of individual hydrocarbon constituents are below levels of concern based on the BCMOE guidelines.

In general, the soil samples indicating high metal concentrations were comparable to the levels found in the theoretical baseline 39-S11. In 39-S1 copper was detected at concentrations both higher than the CCME guidelines (30 ug/g) and higher than the theoretical baseline (37 ug/g) with a concentration of 62.90 ug/g, molybdenum was detected at 15.60 ug/g which is above the theoretical background 8.4 ug/g and above CCME Interim Guideline Criteria (2 ug/g) and vanadium was detected at 91.10 ug/g which is above the theoretical background 78.5 ug/g and above CCME Interim Guideline Criteria (60 ug/g). In 39-S3 nickel was detected at 59.0 ug/g which is above the theoretical background 31.6 ug/g and above CCME guideline Criteria (20 ug/g), and cobalt was detected at 88.50 ug/g which is above the theoretical background 64.8 ug/g and above CCME Interim Guideline Criteria (20 ug/g). .

Volatile organic hydrocarbon concentrations analysed in soil were below levels of concern.

Polycyclic aromatic hydrocarbons were detected in field analysis at levels with potential for concern in 39-S2 and 39-S10 but not at 39-S3. Analytical laboratory results indicated that concentrations of all individual PAH constituents in 39-S2, 39-S3 and 39-S10 were below CCME Interim Assessment Criteria.

No polychlorinated biphenyls (PCB's) were detected at Site 39.

The phenoxy acid herbicides Dinoseb and 2,4-D were present at in 39-S2 of 39-TP2 , concentrations being below CCME Interim Remediation Criteria. Organochloride pesticides were tested at this site as well, but no detectable levels were found.

4.5.2 Water

Water sampling regime at Site 39 was limited to surface water sampling. Laboratory analysed metal concentrations were below CCME guidelines for Fresh Water Aquatic Life for all water samples. All water samples were in a normal pH range for fresh water streams. The residents (Egli's) of Lot 68 have had the groundwater well routinely tested since it was drilled five years ago. Prior to this, they had the Kathleen River surface water tested as it used to be their water source. All samples tested within drinking water standards (Egli).

4.6 Impact Potential

The area is frequented for berry picking, particularly raspberries and rose hips. Analysis of soil samples in the berry picking region indicated some high levels of metals (copper and nickel were analysed at higher levels than baseline) but were unlikely to be harmfully concentrated in the berries. Vegetation was not sampled for actual plant concentrations.

There are rainbow trout spawning grounds in the Kathleen River near Site 39. Surface water testing indicated that detrimental effects to aquatic life due to metal content is unlikely.

4.6.1 Surface Debris

Surface debris is minimal but could present a potential physical hazard. This hazard presents itself in the form of rusted tin cans, broken glass and lumber debris. This site is in close proximity to the Haines highway, provides a scenic lookout over the Kathleen River and access to regional resources such as berries and fish. This area has high potential for human and wildlife contact with the physical hazards.

4.6.2 Hydrocarbons

There is a ground water well used for household purposes on Lot 68, approximately 150 metres west of the site. The well is 250 feet deep and reported to have been drilled through ground material as found digging 39-TP1. This type of soil was a sand gravel mix which provides little resistance for movement of water and contaminants carried in water. Consequently, contaminants with high mobility in water may be of concern as contamination to the ground water well at Lot 68. Since the water of this area tends to be slightly basic, mobility of most metals will be low. Past testing of the groundwater in the well indicated that contaminant levels were find but special testing for herbicides was not conducted (Egli).

4.6.3 Metals

Chromium is potentially hazardous metal, and was found in concentrations two times greater than the CCME Interim Assessment Guidelines in all the soil samples analysed at Site 39, including the theoretical baseline. The metals essential to biological health copper , molybdenum (an enzyme cofactor and in plants is necessary for fixing atmospheric nitrogen by bacteria) and cobalt (component of vitamin B12) also have a potential for toxicity if levels are too high. Copper is an essential protein and enzyme metal which was detected in soil sample 39-S1 at concentrations both higher than the CCME guidelines (30 ug/g) and higher than the theoretical baseline (37 ug/g) with a concentration of 62.90 ug/g. Molybdenum was detected at levels above background and above CCME guidelines in 39-S1. Molybdenum can be a health risk to grazing animals causing chronic effects at concentrations above 20 ug/g. The vegetation in this area was limited to sparse low lying plants which would present a high potential for harm through grazing. However, the presence of high copper concentrations at the same location may prevent accumulation of molybdenum in liver of animals eating this vegetation and decrease the overall absorption of molybdenum. Cobalt was detected at four times the CCME guidelines in 39-TP3 sample 39-S3 at 88.5 ug/g, this was greater than the background sample 39-S11 which indicated a level of 64.8 ug/g of cobalt. Nickel and vanadium tend to be a concern when potential for chronic inhalation is high, sample 39-S2 (high vanadium) and sample 39-S3 (high nickel) do not present a high concern for inhalation risks.

Low surface water concentrations of metals at Kathleen River indicates it is likely that metal impact to aquatic life at this site is low. However, seasonal variation and potential future disturbances to this site have not been accounted for.

PHASE III : Site 44

4.7 Site Survey

Surface debris layout indicates garbage was dumped along the Dezadeash River bank, in two ponds adjacent to the river and directly into the river. A bulldozer track indicates that debris was bulldozed into the west pond which has direct surface flow to the river, and the potential that debris was bulldozed directly into the Dezadeash River. No evidence of buried material was found when test pits were dug. There is no other indication that garbage was buried.

The vintage of garbage in the old growth poplars indicates that this site has been active over a long period of time. Within these poplars is a car body that appears to have been there before the trees around it grew to 60'. Garbage in the more accessible areas is rusted and weather beaten, indicating that it too is old. There is some recent garbage (modern beer bottles). While no longer actively used as a dump site, the mere presence of old garbage could attract new garbage disposal to the site.

Many of the barrels in the ponds appear to be empty, gaping holes are visible in the metal. Visual inspection does not indicate the depth or total number of barrels. The small pond has a sheen on it and when the bottom of the pond was disturbed by the backhoe a very dark sediment was raised. This sediment is uncharacteristic of the area. It is possible the barrels or some other garbage have contaminated the sediment at the bottom of the pond.

Marshall Creek is a relatively flat area. Signs of erosion are noted at the bank of the Dezadeash River due to fast flowing current (Water Survey data, Appendix F). Material taken from test pits indicates stratigraphy is primarily sand and gravel after a very thin organic layer. Potentially high permeability of soil raises concerns about contaminants which are highly mobile in water. The rainfall data of the area was 166.2 millimeters per annum based on the 1987 to 1996 figures which should not highly influence erosion, however, snow pack is not included in this data and snow melt may play a large role in stream flows and bank erosion.

4.8 Site Contamination

4.8.1 Soil

Soil sample 44-S5, taken from the edge of the West pond indicated extremely high metal concentrations compared to the theoretical baseline sample 44-S17, and the CCME Interim Assessment Criteria. Mercury (0.128 ug/g), lead (355 ug/g), tin (668 ug/g), arsenic (27.8 ug/g), zinc (1270 ug/g), copper (384 ug/g), cobalt (210 ug/g), molybdenum (64.8 ug/g) and nickel (128 ug/g) are all very high concentrations. Soil sample 44-S1 metal content was comparable to theoretical baseline except for two metals which were indicated as high concentrations and exceeded CCME Interim Assessment Criteria, chromium (82.5 ug/g) and nickel (42.9 ug/g).

Field testing of total hydrocarbons indicated the highest levels were found in 44-S1, 44-S5, 44-S13 and 44-S15. Concentrations of total hydrocarbon for other samples were below levels of concern. Based on carbon ranges detected through analytical laboratory sampling, pollution source at 44-S15 was likely mineral oil and grease (range C10-C40), however, the level detected (30 mg/Kg) was well below the recommended BCMOE remediation criteria 1000 mg/Kg.

Soil sample 44-S13 was the only site testing positive for field analysis of total PAH content in soil at 0.62 ppm. Metal content was analysed for in this sample and indicated levels which exceeded CCME Interim Assessment Criteria for eight metals but at levels which were comparable to the theoretical baseline sample 44-S17 except for molybdenum which was analysed at 13.6 ug/g, approximately twice the concentration in the baseline.

Field laboratory results indicated that concentrations of total PAH constituents in soil samples 44-S5, 44-S10 and 44-S8 were below method detection limits and CCME Interim Assessment Criteria.

Volatile organic hydrocarbons (BTEX) are readily mobile in water and therefore present a concern for both ground water and surface water contamination by moving through soil. Two soil samples, 44-S6 a subsurface soil sample from 44-TP1 which was within 10 metres to the Dezadeash River and 44-S5 taken on the central east edge of the West pond , were sent to the analytical laboratory as representatives of potential migration routes for BTEX contamination. BTEX concentrations were below method detection limits and below CCME Interim Assessment Criteria. Ground water samples were not analysed for BTEX.

No polychlorinated biphenyls were detected at Site 44 Marshall Creek.

4.8.2 Water

Metal analysis of water samples 44-W3 and 44-W5 taken from the Dezadeash River and sample 44-W1 from the West pond indicated very low metal content in all cases. Sample 44-W7 was taken from the test pit and is considered a ground water sample. Metal content for 44-W7 greatly exceeded CCME Guidelines for Freshwater Aquatic Life for the constituents iron and aluminum, at 640.0 ug/L and 419 ug/L respectively (there are no CCME Interim Assessment Criteria for iron and aluminum).

Water sample 44-W9 has not been well characterised. This water sample was taken from a visible surface sheen on the East pond. Field analysis for PAH indicated a total content in this water sample that was below detectable limits. The sample was mistakenly extracted for total extractable hydrocarbons in the analytical laboratory. This test result indicated 0.15 mg/L total extractable hydrocarbon content primarily in the range C19-C23. The chromatograph is not easily identified compared to sample standards. Since there was no appreciable PAH content, it is unlikely that water sample 44-W9 was waste oil or diesel unless there was undetected experimental error in field analysis. Water sample 44-W8 was taken from the edge of the East pond. PAH analysis of 44-W8 in the field indicated a total content of 12.6 ppb which could potentially exceed CCME Interim Assessment Criteria for individual PAH constituents. Analytical laboratory results confirmed this indicating that PAH content in water sample 44-W8 marginally exceeded CCME Interim Assessment Criteria (10 ppb) for two specific PAH's, Benzo(b&j)fluoranthene and Benzo(k)fluoranthene, each at 11 ppb.

4.9 Impact Potential

4.9.1 Physical Debris

Surface debris could present a potential physical hazard. These hazards are present in the form of rusted tin cans, broken glass, car bodies and submerged barrels. This site is in close proximity to Haines Junction and Marshall Creek Road. The site road provides access to the Dezadeash River and fish resources. This area has high potential for human and wildlife contact with the physical hazards. The site is a visual eyesore from the Dezadeash River. Representatives from the Kluane Adventure Centre, who conduct trips along this river, contacted CCSG Associates about this site and the concerns they have about it.

4.9.2 Hydrocarbons

44-S15:
Soil sample 44-S15 indicated the highest hydrocarbon content analysed in the field and off-site laboratory from Site 44. The hydrocarbon present was likely mineral oil and grease (range C10-C40) This sample is does not present a serious concern because the level detected was low, and the high viscosity of the heavy greases and oils detected have low toxicity potential.

Water:
The predominant soil type on Site 44 is a sand gravel mix. This provides little resistance for movement of water and contaminants carried in water. Consequently, contaminants with high mobility in water may be of concern as contamination to the surface water ponds and Dezadeash River. Since the water of this area tends to be slightly basic, mobility of most metals will be low. Flow rates will influence the deposition rates, and distances from source, of water borne contaminants from the site. This in turn will be influenced by seasonal changes such as snow melt versus rainfall.

Since BTEX is both volatile and readily mobile in water, it is likely that little BTEX residue would be still present at Site 44.

4.9.3 Metals

44-S1:
Chromium is a potentially hazardous metal, and was found in high concentrations in 44-S1. Molybdenum was detected at levels above background concentration of 10 ug/g and above CCME criteria in soil sample 44-S1 at 42.9 ug/g. Molybdenum can be a health risk to grazing animals causing chronic effects at concentrations above 20 ug/g. Moose or caribou could be affected in this area.

44-S5:
Analysis of soil sample 44-S5 indicated very high metal concentrations.

Mercury, lead and chromium are potentially hazardous metals found in high concentrations in soil sample 44-S5. Mercury can act as a sulfur seeking toxicant and is most toxic in methyl or alkyl form. Since this sample site is in close proximity to the West pond, the chemical form of the mercury will influence the degree of impact to the aquatic system through the combined effects on mobility potential and overall aquatic toxicity of a particular mercury species. This level of detail was not accomplished in general chemical analysis regime, however, the high concentration of mercury (12.6 ppb) and close proximity to surface water is cause for concern. Lead was analysed at extremely high concentration 355 ug/g. Lead can act as a sulfur seeking toxicant. In aquatic systems, lead has a strong tendency to be adsorbed on particle surfaces, usually only very small concentrations are found dissolved in rivers and ground waters, small quantities of organic and inorganic complexes are formed. Movement of lead from location of soil sample 44-S5 could occur during high water levels through overall soil particle movement as bank erodes. Chromium was detected at 210 ug/g in soil sample 44-S5. Chromium can be found adsorbed and dissolved in aquatic systems and therefore can move to surface water through water movement or bank erosion.

Many of the metals detected at elevated concentrations in soil sample 44-S5 were biologically essential metals. Zinc is a biologically essential metal which is found in at the very high concentration of 1270 ug/g in 44-S5. However, zinc does not accumulate in biological systems with continued exposure, homeostasis is maintained by overall absorption and liver levels. The biologically essential metals copper (protein and enzyme metal), molybdenum (an enzyme cofactor and in plants is necessary for fixing atmospheric nitrogen by bacteria) , and cobalt (component of vitamin B12) also have a potential for toxicity. Copper was detected in this soil sample at concentrations both higher than the CCME guidelines (30 ug/g) and higher than the theoretical baseline (48.8 ug/g) with a concentration of 384.0 ug/g. Molybdenum was detected at levels above background and above CCME in soil sample 44-S17. Molybdenum can be a health risk to grazing animals causing chronic effects at concentrations above 20 ug/g. Presence of high copper concentrations at the same location may lower accumulation of molybdenum in liver of animals eating this vegetation and decrease the overall absorption of molybdenum to its biological system. However, concentrations of both copper and molybdenum are quite high and biological systems could be overloaded by these levels if plant uptake and animal consumption are high. Cobalt was detected at a level of 210.0 ug/g, one hundred times the CCME guidelines and four times greater than the theoretical background sample 44-S5 which indicated a level of 50.8 ug/g of cobalt. Cobalt will readily mobilize in water in a free chemical form depending on pH influences.

Other metals detected in high concentrations in soil sample 44-S5 were the minor toxic metals nickel, vanadium, tin and major toxic arsenic. Each can take many forms, and are generally more toxic as organic compounds. Nickel, tin and vanadium tend to be a concern when potential for chronic inhalation is high, sample 44-S5 does not present a high concern for inhalation risks. Other chronic effects of nickel and vanadium are not well characterised in toxicological literature. Nickel and tin are not extremely toxic through oral ingestion due to poor gastrointestinal absorption. Tin can be readily moved to aquatic system in a free metal form depending on pH influence. Arsenic was detected at almost six times both the background levels and the CCME Interim Assessment Criteria (approximately 5 ug/g) at 27.8 ug/g. Arsenic can have multiple toxic effects to varying degrees which depend on extent of exposure, both chronic and acute effects can occur at low concentrations. Acute exposure through plant uptake is unlikely, but chronic effects are possible in locally grazing animals. These chronic effects include liver and kidney toxicity, carcinogenicity and teratogenicity.

<u>44-S13</u>:
Molybdenum was detected at 13.6 ug/g, a level above the background concentration of 10 ug/g and above CCME Interim Assessment Criteria, in soil sample 44-S13. This concentration of molybdenum is unlikely to cause extensive chronic effects in grazing animals, however, bioaccumulation factors are difficult to predict. Geological metal concentrations of this area are naturally high in molybdenum and can exhibit a wide range of natural levels.

<u>Water:</u>
From the East pond, laboratory analysis water sample 44-W9 (visible surface slick) was extracted for total extractable hydrocarbons rather than PCB's, since PAH's in field analysis were below detectable limits of 8 ppb, it is unlikely that this sample was diesel or waste oil.

Low surface water concentrations of metals at Dezadeash River indicates it is likely that metal impact to aquatic life at this site is low. The slightly basic pH of the surface waters will lower metal mobility for most metals. Of the high concentration metals detected at this site, only molybdenum is more readily mobile with basic solutions.

High aluminum and iron content in ground water sample 44-W7 and very high metal content in close proximity to the West pond in soil sample 44-S5 indicates a possibility that the high flows of the Dezadeash River have provided a high dilution factor in the river samples adjacent to this site. Through seasonal variation in water flows, rainfall and particularly during ice melt, flushing of metal contaminants from the site to the river may be apparent, both as free metal compounds and adhered to eroded soil particles. Overall impact and chronic effects to aquatic ecosystems and crops watered with water from the Dezadeash River downstream of Site 44, is difficult to estimate based on a single site visit. Aluminum is of particular concern as a health risk to fish because it chelates in fish gills and at high concentrations will suffocate the fish.

5.0 PRELIMINARY ENVIRONMENTAL RISK ASSESSMENT

CCME National Classification System was used to determine preliminary environmental risk assessments of each site. It must be emphasised that this is a preliminary environmental assessment and that the determination of contaminants was not exhaustive.

Site 30

CCSG Associates assigns **Site 30 a site score of 62.6 (+/- 13) points** and **classify it as Class 2** (Appendix E-30). CCME defines this as:

Class 2 (Score 50 to 69.9): Action Likely Required

The available information indicates that there is high potential for adverse off-site impacts, although the threat to human health and the environment is generally not imminent. There is probably no indication of off-site contamination, however, the potential for this was high and therefore some action is likely required (NCS, 1992)

With the calculated uncertainty factor, this site is borderline Class 2 and could be a Class 1. There are plans to realign the highway as part of the Shakwak reconstruction project. This site should be marked as Class 1 to ensure proper monitoring and sampling in that event.

Site 39

CCSG Associates assigns **Site 39 a site score of 56.2 (+/- 0.0) points and classify it as Class 2** (Appendix E). CCME defines this as:

Class 2 (Score 50 to 69.9): Action Likely Required

The available information indicates that there is high potential for adverse off-site impacts, although the threat to human health and the environment is generally not imminent. There is probably no indication of off-site contamination, however, the potential for this was rated high and therefore some action is likely required (NCS, 1992).

Site 44

CCSG Associates assigns **Site 44 a site score of 80.2 (+/- 11) points and classify it as Class** 1 (Appendix E). CCME defines this as:

Class 1 (Score 70 to 100): Action Required

The available information indicates that action (e.g. further site characterization, risk management, remediation, etc.) is required to address existing concerns. Typically, Class 1 sites show a propensity to high concern for several factors, and measured or observed impacts have been documented. (NCS, 1992)

5.2 Risk Assessment

Site 30

The primary concerns at Site 30 are impact potential to wildlife in the area and humans through contact from highway access or from consumption of plant and animal food sources.

Soil sample site 30-S17 is a well characterised point that indicates potential for concern. Depth and surface area of this contaminant site is not delineated. Elevated total extractable hydrocarbon content sampled in the same region, at site 30-S23, indicates potential for contamination extending from 30-S17, but the current sampling regime has not confirmed this.

Archival records indicate that this was a 1940's United States construction camp and 1950's highway maintenance. There could be 1940's debris buried further down, encapsulated by the overburden and not causing any contamination in its undisturbed state. There are survey lines set out in the area and there is potential for the highway to be realigned in this area. Should excavation occur on this site, on-site monitoring must be applied.

Site 39

The primary concerns at Site 39 are the impact potential to humans through ground water use, to sensitive aquatic life and habitat of Kathleen River surface water, to humans and wildlife using the plants as a food source.

Dinoseb and 2,4-D were present in very low levels in soil analysed from test pit 2 sample 39-S2. Delineation of these herbicides is not well established. The region surrounding 39-TP2 had an abundance of raspberries and rosehips. Though some plants indicated signs of some stress they were growing well and uptake of herbicides is likely minimal. These herbicides may have potential to move through soil to groundwater. Since general testing of ground water from wells intended for household use does not include the more specialized analysis required to detect phenoxy acid herbicides, samples from the well on Lot 68 should be tested for these potential contaminants.

There is some physical surface debris (approximately 20 square metres). This debris consists almost entirely of household-type garbage (tin cans, broken glass). It is not a visual eyesore for the highway traveller but could pose a physical threat to someone crossing the site. If public access is foreseen for this site, or if it is going to be encouraged through emphasis of the recreational aspects of the Kathleen River (fishing, hiking along the banks) this should be hand collected and correctly disposed of at the Haines Junction municipal landfill.

If the groundwater testing is negative, CCSG Associates recommends that Site 39 not be disturbed by excavation. During the site investigation, a major source of debris could not be found. Archival records indicate that this was a 1940's maintenance camp and this is borne out by some of the garbage unearthed. There could be other 1940's debris buried further down, encapsulated by the overburden and not causing any contamination in its undisturbed state. Should excavation occur on this site, on-site monitoring must be applied.

Site 44

The primary concerns at Site 44 are impact potential to the aquatic ecosystem and to drinking water supply for humans and wildlife. High erosion potential combined with high contamination immediately adjacent to surface water and directly within ponds, is a serious concern. Contamination point sources have been determined, but higher concentrations in ponds have not been well delineated. The East pond in particular needs to be better characterised for contaminant sources.

There is an abundance and diversity of wildlife which could potentially be affected through consumption of vegetation which has potentially taken up contaminants.

6.0 RECOMMENDATIONS

PHASE IV : Site 30

Site 30 is class 2 as per CCME Interim guidelines.

CCSG Associates recommends that the following be done:

1. **Delineate West Region**

A sampling regime be developed to characterize and delineate the contaminants in the region around soil samples 30-S17 and 30-S23.

2. **Asbestos Cleanup**

Asbestos debris on surface should be picked up, placed in double bags and disposed of in a proper landfill.

3. **Physical Cleanup**

The physical surface debris (especially the barbed wire) should be hand collected and correctly disposed of at a proper landfill.

4. **Monitor Future Site Alterations**

Should future excavation occur on this site, monitoring must be conducted.

PHASE IV : Site 39

Site 39 is class 2 as per CCME Interim guidelines.

CCSG Associates recommends that the following be done:

1. **Groundwater Testing**

Groundwater should be taken from the adjacent neighbour well. A full sampling characterisation with seasonal appropriateness should be accomplished, testing for BTEX, metals, total extractable hydrocarbons, organochlorine pesticides and phenoxy acid herbicides.

2. **Vegetation Analysis**

Berries should be sampled for metal and trace herbicide content.

3. **Physical Cleanup**

The physical surface debris should be hand collected and correctly disposed of at the Haines Junction municipal landfill.

4. **Monitor Future Site Alterations**

If the groundwater testing is negative, CCSG Associates recommends that Site 39 not be disturbed by any form of excavation greater that 1.75 metres. During the site investigation, a major source of debris could not be found. Archival records indicate that this was a 1940's maintenance camp and this is borne out by some of the garbage unearthed. There could be other 1940's debris buried further down, encapsulated by the overburden and not causing any contamination in its undisturbed state. Should future excavation occur on this site, monitoring must be applied.

Site 44 is class 2 as per CCME Interim guidelines.

CCSG Associates recommends that the following be done:

1. Fully characterize Pond Contaminants

The extent of contamination in both ponds was not well established. Point source samples of contaminants were located but not well delineated. A more intensive sampling regime should be conducted for the ponds.

2. Delineate Pond Contaminants

It is known that waste was deposited into the pond depressions. A geophysical survey conducted in winter to determine the extent of metal debris would provide an indication of overall contamination in ponds.

3. Remediate Ponds

Barrels and sludge should be removed from site and correctly disposed.

4. Physical Cleanup

The physical surface debris should be collected and correctly disposed of in a proper landfill.

5. Monitor Future Excavations

Should future excavation occur on this site monitoring must be conducted.

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Appendix A

Arctic Environmental Strategy Information Package