HILLSBOROUGH
Resources Limited

April 28, 1997

Mr. F. W. Hermann, P.Eng.
Chief Inspector of Mines
Ministry of Employment and Investment
PO Box 9323
Station Provincial Government
Victoria, BC
V8W 9N3

Dear Mr. Hermann:

Re: T'Sable River Bulk Sampling
Your File No. 18050-03/T'Sable

Enclosed herewith please find the draft application for the underground bulk sampling, which is an integral part of the T'Sable River Coal project exploration program. In preparing the application, we have followed the requirements of the Health, Safety and Reclamation Code for Mines in British Columbia as well as the draft Application Requirements for a Permit, published in December 1995.

The bulk sampling program will be managed by qualified personnel of Hillsborough Resources Limited, who is the majority shareholder and manager of the T'Sable River Coal Corporation.

We would appreciate your early comments and suggestions so that we can include them in the application, in order to expedite this important project.

Yours very truly,

Dennis Mraz, P.Eng.
Acting C.O.O.

cc: G. Vooro
J. Tatak

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☐ Corporate Office: P.O. Box 5000, Campbell River, British Columbia V9W 5C5 • Phone (250) 286-3224 • Fax (250) 286-9727
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TSABLE RIVER COAL CORPORATION

APPLICATION FOR BULK SAMPLE PROGRAM

AT THE TSABLE RIVER COAL PROPERTY

NEWCASTLE and NELSON
LAND DISTRICT

VANCOUVER ISLAND

April 26, 1997

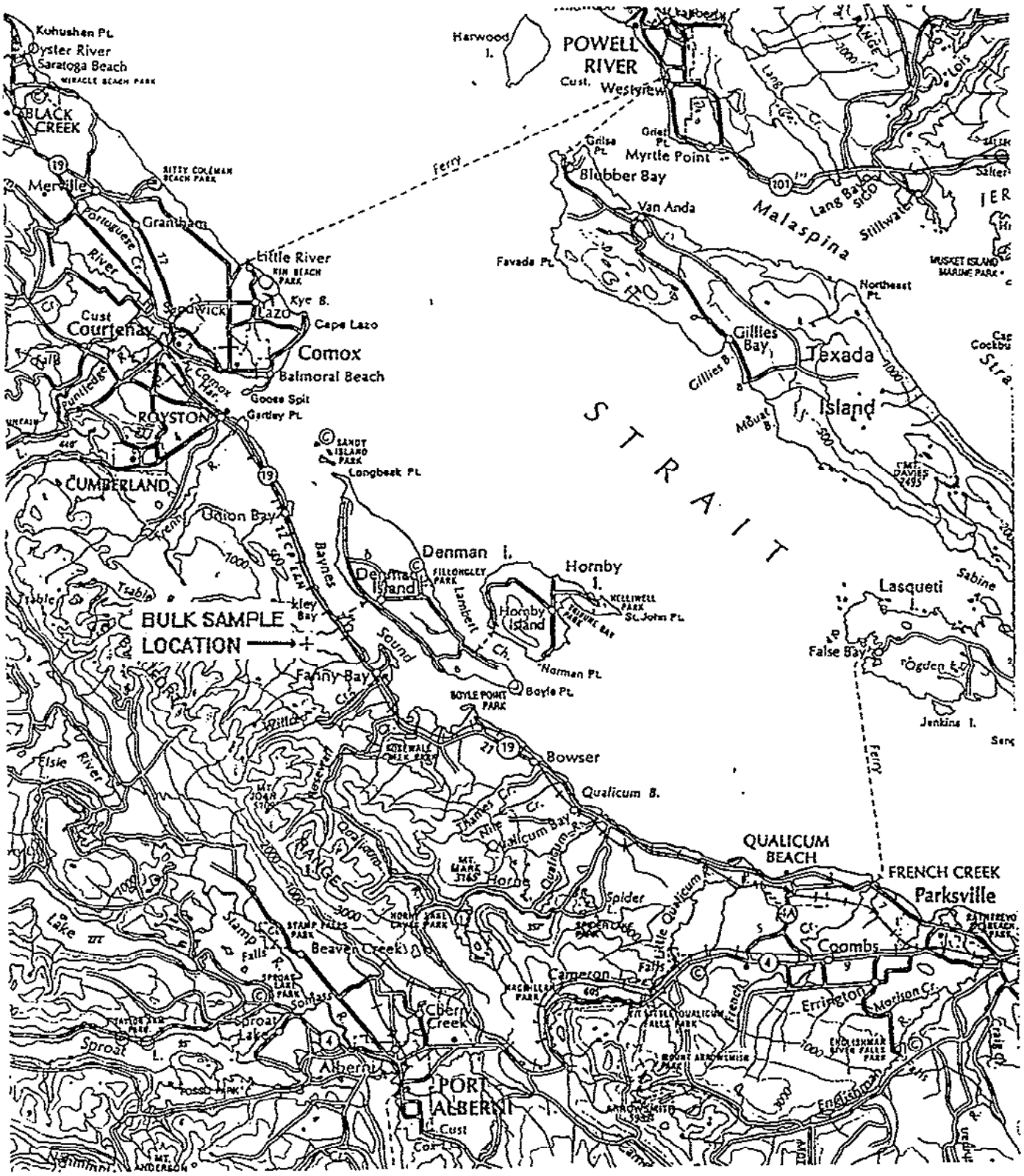
1.0 INTRODUCTION

Tsable River Coal Corporation has been conducting surface exploration work in the form of drilling and seismic on the Tsable River Coal Property for the past two years. As a result of this work, a broad area of some 39 million tonnes of in-situ coal resources have been defined that may be amenable to underground mining methods. In order to provide a better understanding of the deposit and mining conditions, the company is prepared to invest a substantial amount of money to perform underground exploration in the form of a bulk sample of 90,000 tonnes.

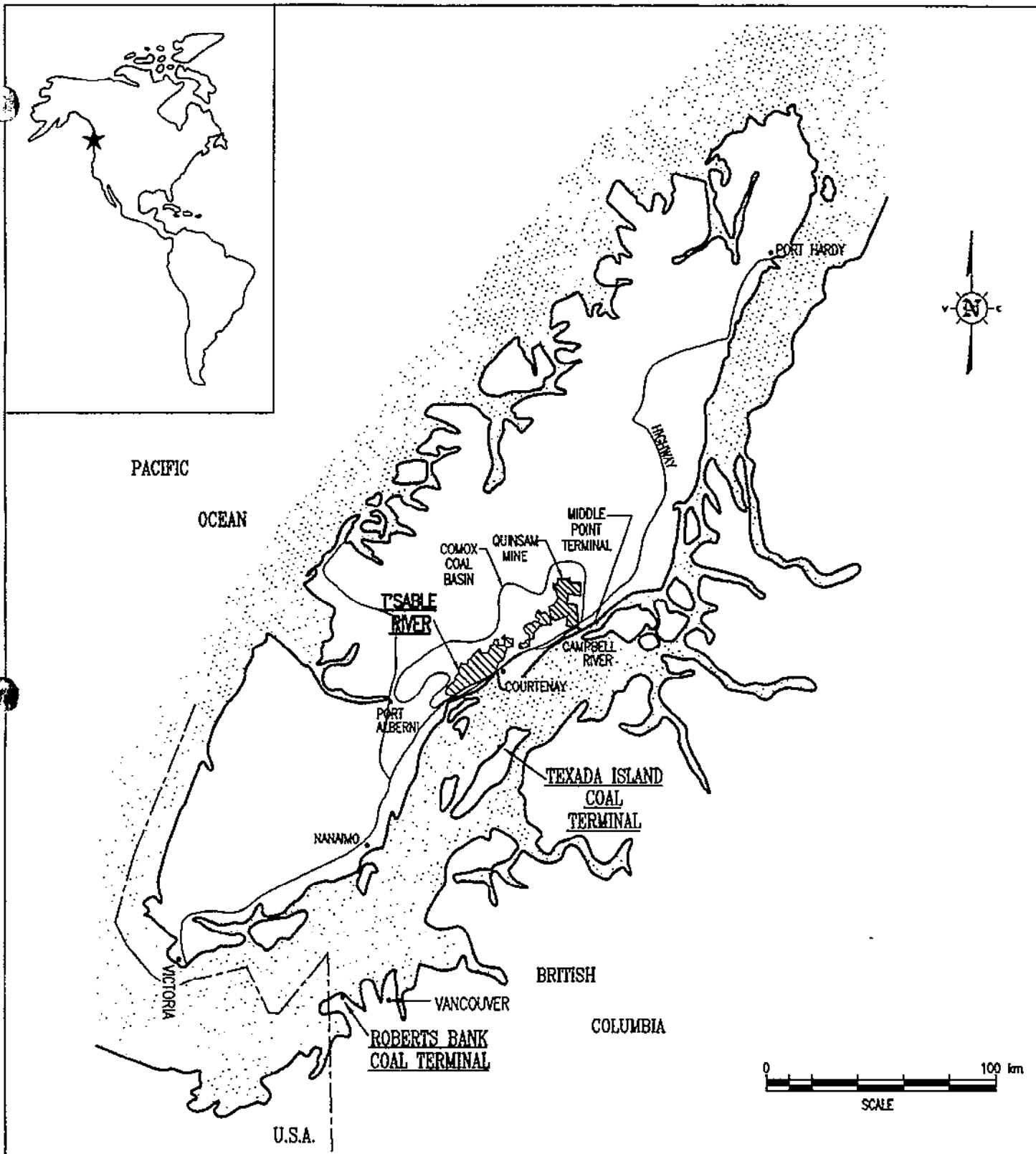
The Tsable River Coal Property is part of the Weldwood of Canada Limited Fee Simple Coal Rights area in the E. and N. Land Grant. Tsable River Coal has an option purchase agreement with Weldwood for these fee simple coal rights. Hillsborough Resources Limited., as Project Manager and majority owner of Tsable River Coal Corporation, is operator of the project.

This document is presented as an information package as a precursor to a formal application for removal of the bulk sample. It has been prepared jointly by Hillsborough Resources technical personnel and AGRA Earth and Environmental, retained as environmental consultants to the project. The removal of all coal produced from the bulk sample operation to the existing Coal Preparation Plant at the Quinsam Coal Mine greatly reduces the impact of the proposed bulk sample operation at Tsable River.

The aim of the document is to provide as much information as possible to allow various agencies to respond in a timely fashion, to assist in the expediting of the application so that work can begin this summer.



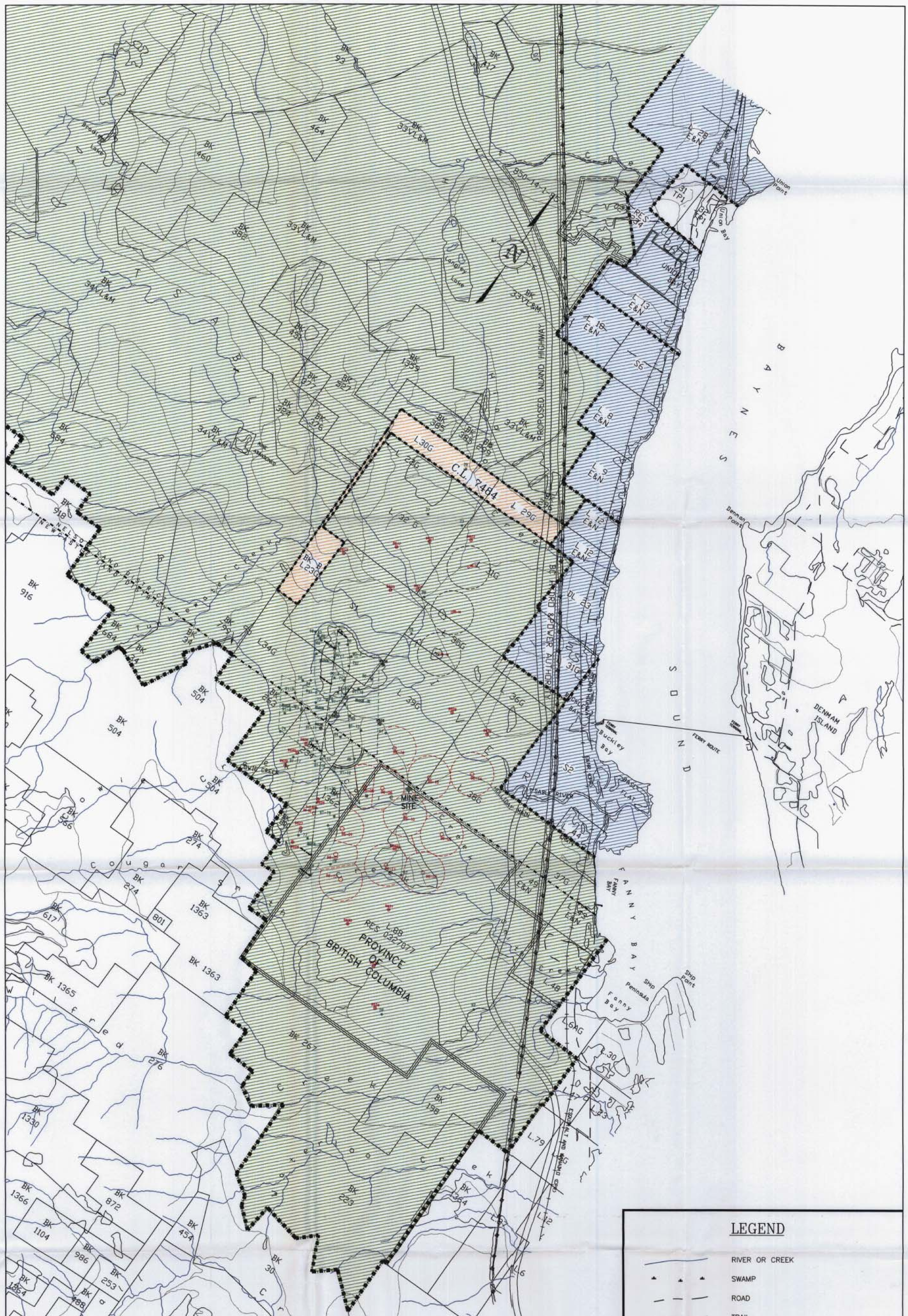
AGRA *Earth & Environmental*	Scale: NTS
	Date: APR.97
	Drawn By: MOELP
BULK SAMPLE LOCATION (NX20129)	Approved By: ARM
	FIGURE 1



SCALE: NTS	DATE	T'SABLE RIVER LOCATION MAP
DESIGNED:		
DRAWN: BDP	97-04-29	
CHECKED:		
APPROVED:		

T'SABLE RIVER COAL CORPORATION

DWG. NO. 97-A-043 REV.


BAYNES SOUND
DENMAN ISLAND
Denman Point
Union Point
Union Bay
Buckley Bay
FERRY ROUTE
FANNY BAY
Fanny Bay
Ship Peninsula
Ship Point
MINE SITE
C.L. 7484
RES. 0327077
L.88
PROVINCE OF BRITISH COLUMBIA
LEGEND
RIVER OR CREEK
SWAMP
ROAD
TRAIL
O 96-01 1996 DRILLHOLES
80 DRILL HOLES PRIOR TO 1996
UNDERSURFACE COAL RIGHTS BOUNDARY
WELDWOOD OF CANADA LTD. FEE SIMPLE
WELDWOOD OF CANADA LTD. COAL LICENCE
T'SABLE RIVER COAL CORPORATION COAL LICENCE APPLICATION
DESCRIPTION OF REVISION
SCALE: 1:25,000
DATE
DESIGNED:
DRAWN: BDP 97-04-23
CHECKED:
APPROVED:
T'SABLE RIVER PROJECT
UNDERSURFACE COAL RIGHTS
T'SABLE RIVER COAL CORPORATION
BRAMPTON, ONT.
DWG. NO. 97-D-079
REV.

868

T'SABLE RIVER PROJECT
SURFACE RIGHTS OWNERSHIP

T'SABLE RIVER COAL CORPORATION
BRAMPTON, ONT.

SCALE: 1:25,000	DATE
DESIGNED:	
DRAWN: BDP	96-08-21
CHECKED:	
APPROVED:	

DESCRIPTION OF REVISION

DWG. NO. 96-D-034 REV.

LEGEND

- RIVER OR CREEK
- SWAMP
- ROAD
- TRAIL
- 96-01 1996 DRILLHOLES
- 80 DRILL HOLES PRIOR TO 1996
- UNDERSURFACE COAL RIGHTS BOUNDARY
- WELDWOOD OF CANADA LTD.
- PACIFIC FOREST PRODUCTS LTD.
- MACMILLAN BLOEDEL LTD

SECTION 2

Baseline Information for Application for a Mine Permit Tsable River Bulk Sample

Submitted to:

Tsable River Coal Corporation
P.O. Box 5000
Campbell River, B.C.
V9W 5C5

Submitted by:

AGRA Earth & Environmental Limited
4385 Boban Drive
Nanaimo, B.C.
V9T 5V9

NX20129
April 1997

AGRA
Earth & Environmental

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2.0 BASELINE INFORMATION

2.1 CLIMATE

The following are direct excerpts from the report entitled "Soils of Southern Vancouver Island" Ministry of Environment Technical Report 17, 1985 by J.R. Jungen;

"The weather of Vancouver Island is dominated by low pressure systems in the winter and high pressure systems in the summer (Tuller, 1979). Prevailing winds are predominantly from the southeast in winter, while northwest winds predominate in the summer. The Vancouver Island Range significantly modifies the easterly moving moisture-laden air masses."

"Solar radiation and hours of bright sunshine decrease from the southeast of Vancouver Island to the northwest. Summer temperatures are cool to mild; winter temperatures are also mild and extremes of temperature are rare. The freeze free period is relatively long, up to 230 days along the coast and 150 days in inland locations."

"The major portion of Vancouver Islands' precipitation falls during the winter. Winter and mean monthly precipitation increase from south to north and from east to west."

The bulk sample area is located on the western edge of a lowland plateau area approximately 1 kilometre to the west of Fanny Bay (See Figure 1). The weather stations at Courtenay and Comox Airport are the closest to the bulk sample area and selected data for these stations are included in Appendix 3 for reference. The data for the Comox Airport appears to be more complete and therefore will be used at the site, e.g., for final design of the water management system.

2.2 GEOLOGY AND DESCRIPTION OF DEPOSIT

Detailed geology of the bulk sampling area and of the deposit has been described by Steven Gardner, P.Geo. for Tsable River Coal Corporation. This analysis has been included in Section 3 of the application document.

2.3 TOPOGRAPHY AND SURFACE DRAINAGE FEATURES

Figure 2 provides the bulk sample location plan including drainage features and 2.5 metre topographic intervals.

The site is moderately sloped from west to east from the 100 metre contour above the site to approximately the 77.5 metre contour at the existing logging road. The vertical drop of 22.5 metres occurs over a horizontal distance of approximately 240 metres giving an average

slope of 9.4%, west to east at the site. The area further to the east of the logging road is relatively flat for approximately 750 metres to the new Island Highway right-of-way.

Cowie Creek runs in a west to east direction approximately 100 metres to the south of the bulk sample site. A slight depression with base sloping towards Cowie Creek from north to south through the bulk sample site lies between the 75 metre and 77.5 metres contours.

The bulk sample area lies on the drainage divide between the Tsable River and Cowie Creek. The mine plan for the bulk sample calls for diverting upslope drainage to the north along the western boundary the site by means of an interception ditch excavated at approximately the 97 metre elevation. This clean drainage will be routed along the northern side of the site and drain into existing watercourses which discharge to the Tsable River approximately 1500 metres to the north of the site.

Site drainage will be collected by a ditch system along the northern, southern and eastern boundaries of the site and routed to a settling pond system as described in Section 2.4.1. The effluent from the settling system will be routed into the same watercourses used for the clean water drainage and will also discharge to the Tsable River.

2.4 WATER QUALITY

2.4.1 Surface Water

Baseline water quality has been monitored at up to 10 sampling locations from July 1996 to present. The sampling locations were selected by Tsable River Coal Company to represent upstream, downstream and on-site water quality conditions. Sampling and analysis has taken place on a biweekly basis for the major sampling locations on Cowie Creek, Tsable River and Cougar-Smith Creek throughout the fall and winter months of 1996/1997. Smaller tributary streams in the proposed bulk sample area include Sammy, Grade, January, Fastwater and Kilometre 4 Creeks which have been sampled on a monthly basis over the same period. Sampling locations are shown on Figure 3.
Parameters analyzed include physical parameters, suspended and dissolved solids, sulphate, nutrients and total and dissolved metals. The tabulated analytical results and the laboratory data are included in Appendix 4.

Table 1 summarizes the applicable water quality criteria for the bulk sample area. The identified resource value of Cowie and Cougar-Smith Creek and their tributaries as identified in Section 2.5 are drinking water and fish habitat and therefore the Canadian Drinking Water Guidelines[1] (CDWG) and the BC Environment freshwater aquatic life criteria[2] (BCE) are

[1] Reference 20

applicable. The most stringent of the two criteria should be applied to the analytical results. The identified resource value of the Tsable River and its tributaries is fish habitat and therefore the BC Environment freshwater aquatic life criteria are applicable. In instances where BCE criteria does not exist the CDWG criteria may be useful for comparison.

The water quality data for the period of monitoring indicate that the baseline water quality in the area of the proposed bulk sample location is within the CDWG and BCE guidelines with the exception of one sample taken at the Tsable River site during the first week of September 1996. The sulphate result at 162 mg/L exceeds the BCE aquatic life criteria of 100 mg/L. The analytical result for TDS of 2300 mg/L, while not comparable to BCE criteria, is much higher than the CDWG TDS criteria of 500 mg/L. It is also noted the dissolved magnesium concentration is elevated, although it does not exceed the CDWG criteria. Comparison of these results to the analytical results for the Tsable River taken 2 weeks later indicates that the elevated concentrations of TDS, sulphate and magnesium are comparable to the other streams in the area. The elevated concentrations appear to be a short-term occurrence and may be related to a storm or other event. Two other instances of elevated TDS and sulphate, not exceeding criteria, are noted for the Tsable River during the first week of August 1996 and the third week of December 1996. Tsable River Coal Corporation suspects that the elevated levels may be the result of seawater mixing at the Tsable River sampling site which is located at the Highway 19 bridge. Further sampling and analysis to augment the baseline data will take place upstream at the new Tsable River bridge beginning in May 1997.

Effluent from the bulk sample project area will consist of surface runoff and water pumped out of the bulk sample adits. An application will be made to BC Environment for a 15 month Approval to discharge effluent from the bulk sample settling ponds. It is anticipated that the effluent will discharge into the Tsable River drainage in order to afford maximum protection to Cowie Creek which is used as a drinking water supply for the Fanny Bay Waterworks District. Discharge to the Tsable drainage will also allow additional space for installation of additional control structures if required. Sediment control and the potential for acid rock drainage (ARD) are two issues which will require further study although preliminary reviews of acid base accounting (ABA) data for drill core samples indicated low potential. Preliminary layout and sizing of the settling ponds is provided in Section 2 of this report. Further sizing in accordance with the applicable design criteria contained in the BC Environment settling pond design criteria[3]. ARD source control will be applied to the bulk sample area. ARD potential and control is addressed in Section 3 of this report. It is anticipated that the metals criteria applied to BC Environment's current Waste Management Permit PE07008 for effluent at the Quinsam minesite will be applicable to the discharge from the Tsable River bulk sample settling ponds.

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[2] Reference 19

[3] Reference 21

2.4.2 Groundwater

A 1990 water resources study[4] prepared for the Ministry of Transportation and Highways surveyed the groundwater use in the Fanny Bay area (Section 441 of the Vancouver Island Highway Project). The report indicates that 20 wells existed in Section 441 as of 1990. Of these, 18 are shallow dug wells ranging in depth from 4.5 to 26 feet. Known well yields range from 10 to 20 gallons per minute, although yields are not available for most wells in this section.

Groundwater use in Section 441 includes community and domestic water supply and irrigation. The Fanny Bay Waterworks District draws its water from Cowie Creek by means of a 26 foot deep well located in the alluvial gravels of Cowie Creek.

The majority of wells in Section 441 are located near Fanny Bay and Buckley Bay in deposits of tills, silts and clays. The nearest wells to the proposed bulk sampling location are approximately 750 to 1000 metres to the east.

Baseline groundwater sampling and analysis has not been performed to date. A well located directly above the proposed bulk sampling adits is in place and will be sampled during May 1997 to establish baseline groundwater data.

2.5 FISHERIES AND AQUATIC RESOURCES

2.5.1 Watercourses in the Area

Water courses downgradient of the bulk sample area include the Tsable River and Cowie Creek which flows into Cougar-Smith Creek. Kilometre 4 Creek, a tributary of the Tsable River is also in the vicinity upgradient from the bulk sample area. Stream classification for these watercourses was recently carried out in the area of the bulk sample for MacMillan Bloedel Limited. Figure 4 is the stream classification map which was prepared as part of the study.

Figure 4 indicates that the Tsable River, Kilometre 4 Creek and Cowie Creek, downgradient of the bulk sample area, are all fish bearing. Cowie Creek, upgradient of the bulk sample area, is indicated to contain resident fish.

The MOTH report[5] prepared for the new Island Highway summarized Cowie Creek and the Tsable River as follows; Cowie Creek has a drainage area of 23.5 km^2. Fish species present

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[4] Reference 7

[5] Reference 3, pp. 8-12.

in Cowie Creek include coho and chum salmon, steelhead and sea-run cutthroat trout. The Tsable River has a drainage area of 102.9 km^2. Fish species present in the Tsable River include coho, pink and chum salmon, steelhead and sea-run cutthroat trout. The lower 1.75 kilometres of the River is used extensively for both spawning and rearing.

Kilometre 4 Creek is indicated as fish bearing on Figure 4. According to the Tsable River Coal Corporation, the Federal Department of Fisheries and Oceans (DFO) electrofished the Creek in the late fall of 1996 and no fish were found to be present. A further round of electrofishing may be performed by DFO during a selected time in 1997.

2.5.2 Baynes Sound

Baynes Sound is known as an important shellfish habitat area. Locations of shellfish beds and species present have not been determined. DFO will be consulted in conjunction with the Vancouver Island Mine Review Committee (VIMRC) to determine if concerns exist for protection of shellfish habitat near the mouths of the Tsable River and Cougar-Smith Creek, and issues to be addressed regarding Baynes Sound as a whole.

2.6 SURFICIAL GEOLOGY, TERRAIN AND SOILS MAPPING

2.6.1 General

A summary of the surficial geology, terrain, soil survey and soil capability mapping has been compiled from information from existing sources only; no field work was conducted as part of the current assessment. This information applies to the immediate minesite portal area, workshop, coal storage area, proposed topsoil and till storage and settling pond areas.

Primary sources of existing information include provincial and federal government inventory information, and inventory information and interpretive information from other major projects in the area. The latter include:

- Vancouver Island Highway Project;
- BC Hydro 500 KV powerline construction; and
- Centra Gas natural gas pipeline project.

Existing government map inventory information sources are at scales of 1:50,000 or smaller. The scale of the source maps is small, and the map polygons are large relative to the size of minesite and related activity areas for the areas noted above.

The existing maps and descriptions allow a broad framework to be established for understanding surficial geology and soils conditions in the context of the landscape of the proposed project area. Opportunity is also provided by these maps for understanding the

overall relationships between surficial geology and soil conditions and various interpretations, e.g., slope stability, erosion and sedimentation potential and soil suitability for various uses such as agriculture.

The following sections provide a discussion of conditions at the site as can be inferred from the existing information.

2.6.2 Surficial Geology and Terrain Mapping

Surficial geologic mapping at a scale of 1:50,000 by Fyles (1963) indicates that the proposed bulk sample area is underlain by late glaciomarine and marine deposits consisting of silty to stony clay ranging in thickness from 2 m to more than 10 m.

Site specific information on the surficial geology of the area and region was gathered for the corridor evaluation study conducted for the Vancouver Island Highway project[6] (B.C. Ministry of Transportation and Highways, 1988). The study identified scattered exposures of gravel and sand within the glaciomarine clay unit mapped by Fyles. Isolated exposures of glaciofluvial sand and terraced, gravelly and silty sands (Capilano Sands) flank the Tsable River some 600 m to 700 m north of the site and in a separate outlier south of the site between Cougar Smith and Cowie Creeks. Till deposits are apparently present in the region (MoTH, 1988), but continuous exposures have not been mapped. Organic materials are present in low, poorly drained areas. The range in thicknesses of surficial deposits is governed by the underlying bedrock topography which undergoes dramatic changes throughout this area.

Existing terrain mapping has been completed as part of the Vancouver Island Highway Project. The site is located at the eastern edge of the unsubmerged coastal plain located between the Vancouver Island Ranges to the west and the Strait of Georgia to the east. The surface expression of the upland area, including the proposed bulk sample site, is generally dominated by undulating terrain with incised stream valleys. The Tsable River, approximately 200 m to the north, lies within a channel that is 15 to 20 m deep on average. Stream channels in the areas contain recent fluvial deposits.

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[6] Reference 6.

2.6.3 Soil Survey and Soil Capability Mapping

Several existing inventory sources of information have been used.

Relatively old but still very useful soil survey information is provided in a report of the British Columbia Soil Survey[7]. Mapping is at a scale of 1:63,360. Soil series are identified and features described on the map legend include: soil group (classification); drainage; dominant topography; stoniness; and description of virgin soils.

Provincial soil survey and terrain inventory information is provided in a relatively recent B.C. Ministry of Environment document[8]. Soil associations are mapped at a scale of 1:50,000 and published at a scale of 1:100,000. Soil components are described along with such characteristics as: parent material; most common texture; most common drainage; vegetation zonation; slope classes; and soil phases.

Manuscript maps to accompany the above are available for: terrain; and land capability for agriculture.

Soils in the area of the proposed Tsable River bulk sample area can be briefly described as follows:

Proposed sandstone excavated stockpile area and future stacker & coal pile, major portion of eastern end - Soils are primarily gravelly and very gravelly loamy sands less than a metre thick developed in the glaciomarine, marine and shallow fluvial deposits. The area occupied is relatively level. Coarse fragment content is generally at least 40% and may be >50%. Surface horizons are strong brown to brown and medium to strongly acid. A prominent feature of the type of soils occurring in this area is a strongly cemented horizon (duric layer) usually occurring in the range of 75 to 120 centimetres below surface, and immediately above the unweathered surficial geologic materials. Drainage is likely impeded by this secondary cementation. Classification according to the Canadian System of Soil Classification is Duric Brunisols or Humo-ferric Podzols.

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7 Reference 17. Accompanying map sheet specific to the subject site is: *Soil Map of Vancouver Island, British Columbia, Qualicum-Alberni sheet.*

8 Reference 18. Accompanying map sheets specific to the subject site is: Soils of South Vancouver Island, British Columbia. Soil Survey Report. No. 44. Sheet 5 (Powell River), Sheet 3 (Port Alberni).

Proposed topsoil storage, till storage and western end of sandstone excavated stockpile area and future stacker and coal pile - Soils are predominantly gravelly loam with some very gravelly and gravelly loamy sands less than a metre thick and usually developed in glacial tills. The area occupied is moderately sloping. Coarse fragment content is generally 20 to 50%. Surface horizons are strong brown to brown and strongly acidic. In the soils in this area there is also usually a strong to moderately cemented layer in the range of 60 to 100 centimetres immediately above the relatively unweathered compact surficial geologic materials. Drainage may be impeded by this secondary cementation. Classification according to the Canadian System of Soil Classification is likely to be Humo-ferric Podzols.

2.6.4 Discussion

The information obtained from existing maps and reports, related in the foregoing summary, and the limitations in applying these data to the current project, are fully recognized by AEE. They do not allow detailed planning for critical reclamation related activities such as soil salvage, soil stockpiling and soil replacement strategies. Selection of specific areas for storage of soils or for location of settling ponds can only be generally based on these maps. Similarly, prescriptions cannot be prepared for the depths of excavation for soil salvage based on the existing information.

Preliminary field investigations in the immediate area of the mine can be undertaken within a relatively short period of time, as required, in order to create smaller map polygons and more specifically attribute the legend and report descriptions to smaller areas of the landscape. Such work is required if mapping at a scales of 1:5,000 are to be prepared in accordance with Resource Inventory Committee (RIC) Guidelines[9] and Standards and the requirements indicated in Appendix 1 of the *Application to Obtain a Mines Act Permit Approving the Mine Plan and Reclamation Program*.

2.7 VEGETATION AND WILDLIFE

The understorey vegetation type for the site appears to be comprised of salal-huckleberry and sword fern. Potential impacts of concern for the subject area involve the riparian vegetation (vegetation adjacent to and influenced by waterways). Riparian vegetation functions to provide slope stability, preventing soil erosion into the waterway which can result in siltation of downstream spawning beds. It also acts as a solar buffer for the waterway on which it borders, and provides habitat to wildlife.

[9] Reference 14.

The wetland areas are used for bird nesting and year round production for different fish species (estimated that wetlands account for over 50% of coho production in many streams).

Vegetation and wildlife mapping for the subject site is currently not available at a 1:5,000 scale. A 1:5,000 map may be available for the wetland mapped areas, however, it appears to be derived from air photo interpretation where many habitats and wetlands maybe missed due to scale. Field surveys should be conducted to confirm the mapped information and can also provide additional data on season water depths, water chemistry and plant species for many habitats.

Studies in the area of the site have indicated that there is regular use by numerous species of wildlife. Of particular importance are elk, black tailed deer, black bear, wolf, cougar, beaver, muskrat, otter mink, raccoon, marten, weasel and red squirrel. Ducks, Canada geese, trumpeter swans, blue grouse, ruffled grouse band-tailed pigeon, great-blue heron and bald eagles have all been sited in the area with approximately 260 other species of birds. The creeks and rivers along with the wetland areas provide important habitat and rearing areas. The most sensitive period is expected to be from March through June when wildlife are nesting and rearing their young.

No species listed as threatened or endangered in a Canadian context are believed to occur in the site area. The BC Ministry of Environment Lands and Parks, however, has prepared lists of vertebrate animals whose status is of concern in the province. Species of vertebrates which occur or are believed to occur in the area of the site include: marbled murrelet, Keen's long-eared myotis, Townsend's big-eared bat, clouded salamander, bald eagle, great blue heron and the Roosevelt elk.

2.8 LAND STATUS AND USE

The population forecast for the Fanny Bay/Buckley Bay area indicates an expected medium growth rate of 1.2% per year.

Sport hunting is permitted in the autumn, with black bears also being hunted in the spring. Some trapping occurs in the region, however, it is not a major economic activity for this area.

Existing transportation for the area includes the Island Highway, Highway 19, the E&N Railway and various logging roads.

Aboriginal use of the bulk sample area has not been determined. Tsable River Coal Corporation will seek direction from the VIMRC as to which aboriginal groups, if any, will require consultation as part of the mine permit application process.

The proposed bulk sample area occupies approximately 4 hectares in the Newcastle Land District immediately south of the boundary between the Newcastle and Nelson Land Districts. The site, as proposed, is entirely on Crown Land.

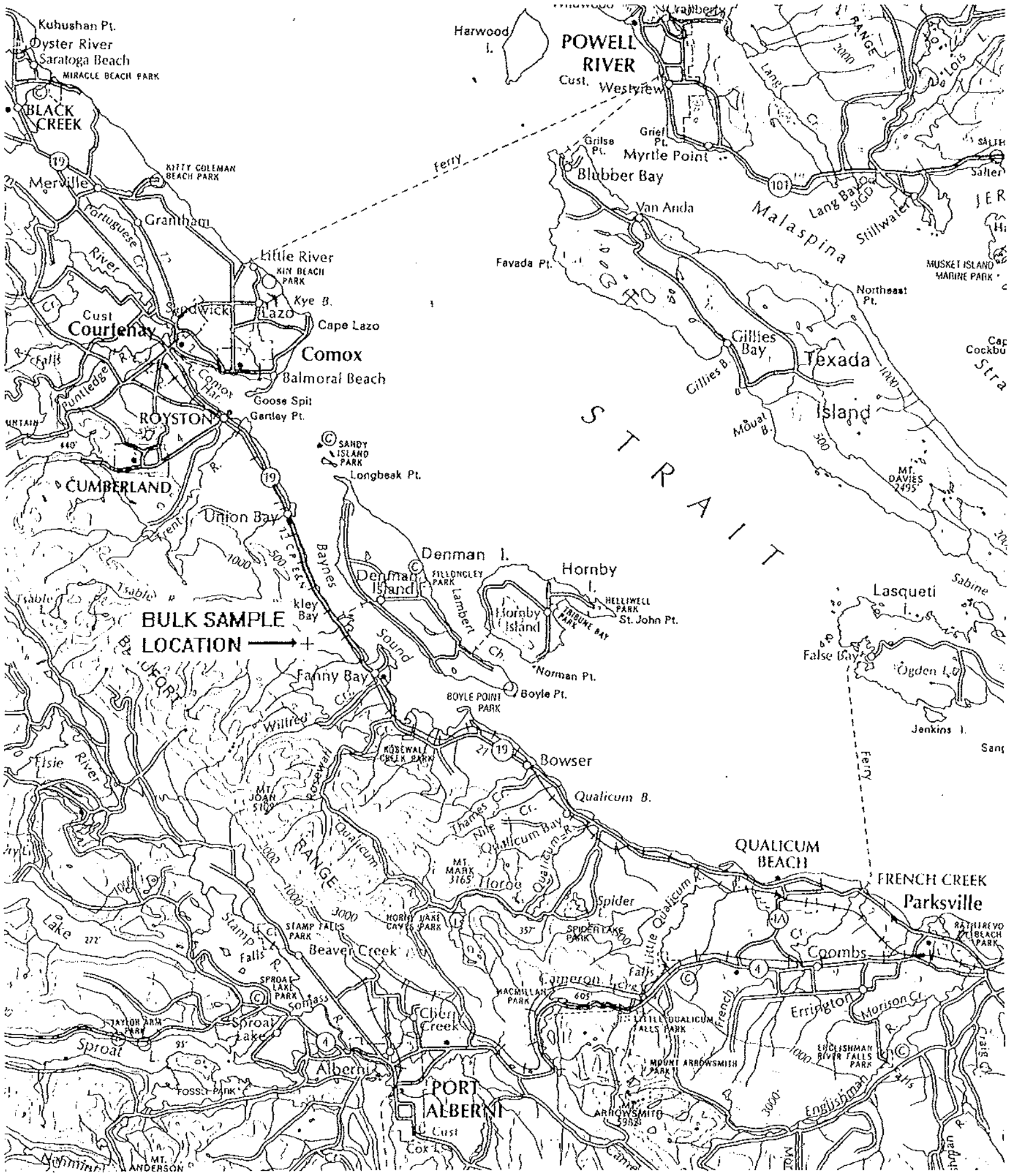
The land immediately north of the site, in the Nelson Land District is owned by MacMillan Bloedel Limited. MacMillan Bloedel is a major forestry owner and has established numerous plots to measure volume/yield ratios. MacMillan Bloedel has also established rapid growing poplar plantations for fibre production on lands immediately adjacent to the facilities for the proposed project. The uses of MacMillan Bloedel land which is anticipated at this time in relation to the proposed project is the use of the present watercourses for routing of the settling pond effluent into the Tsable River drainage, the re-routing of the present logging road to the east and the use of the logging roads for hauling the bulk sample coal. Tsable River Coal Corporation has entered into discussion with MacMillan Bloedel on these issues. The undersurface coal rights in the vicinity of the bulk sample are owned by Weldwood of Canada Limited.

2.9 LAND CAPABILITY

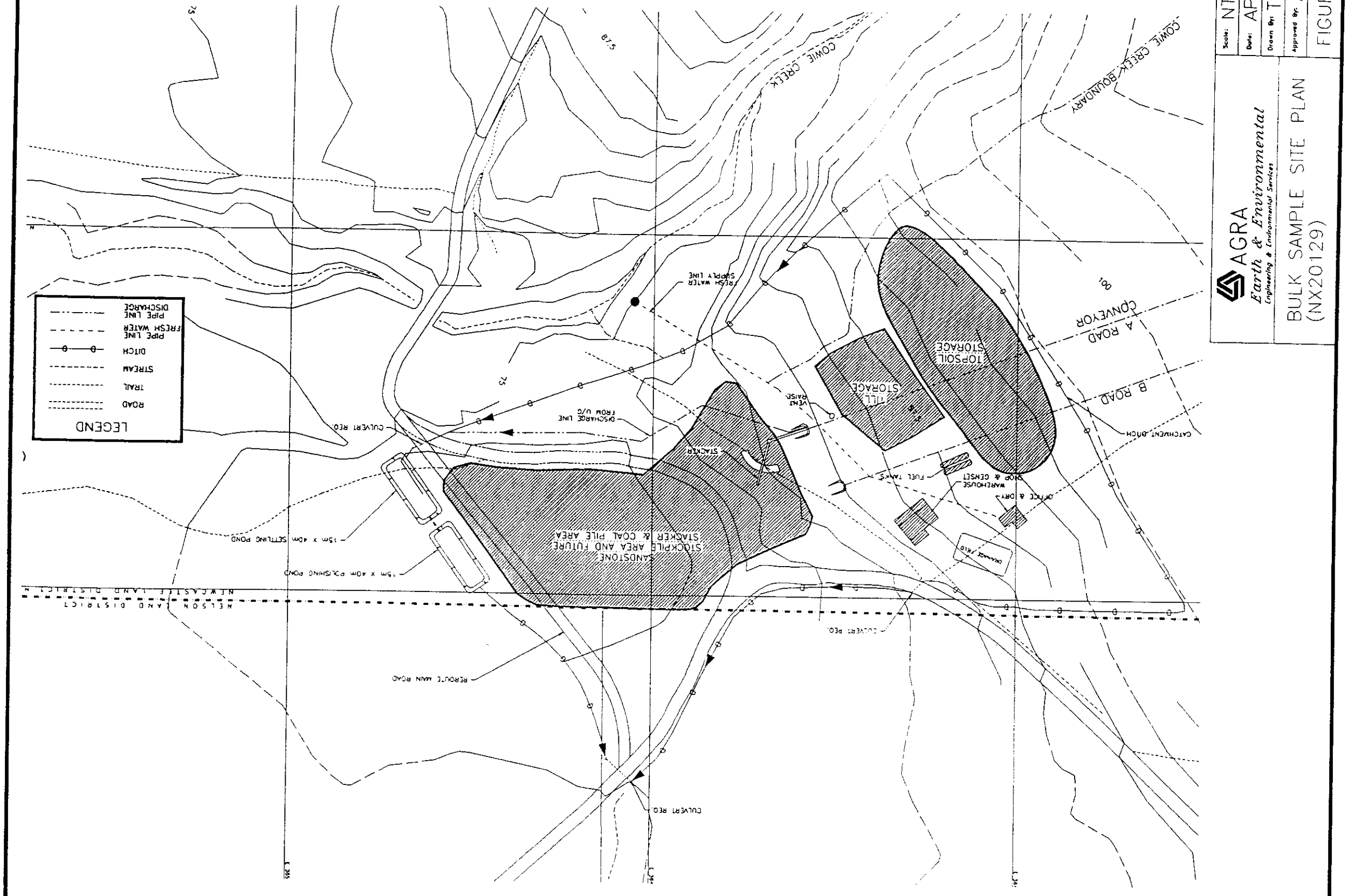
The present land use for the bulk sample area is Crown Land commercial forest. It is anticipated that this use will continue after reclamation of the bulk sample area. Crown Lands will require the area to be returned to its present forest productivity and these issues are addressed in the Reclamation Plan in Section 3 of this application document.

APPENDIX A

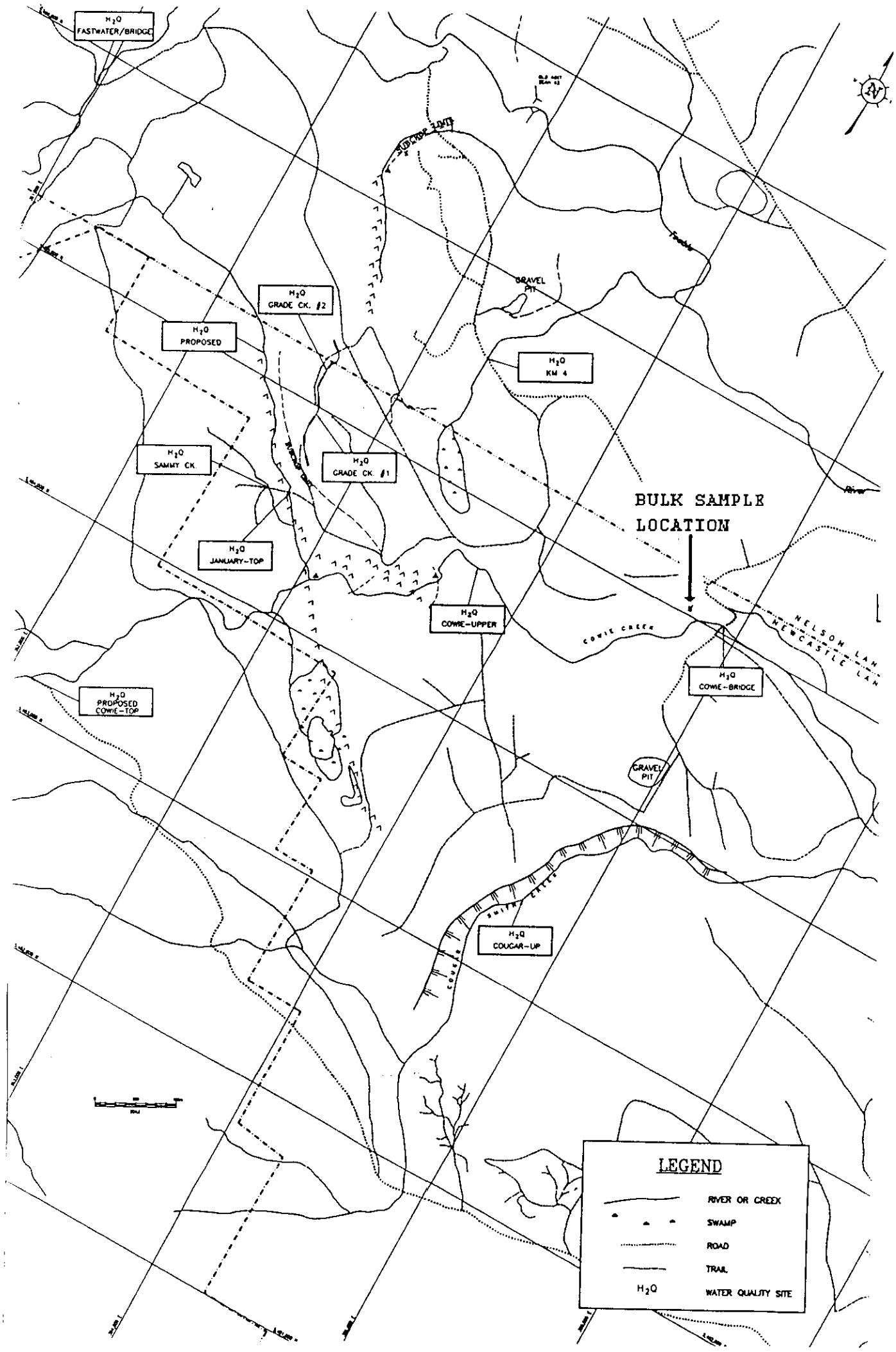
FIGURES



AGRA *Earth & Environmental* Engineering & Environmental Services	Scale: NTS
	Date: APR,97
	Drawn By: MOELP
BULK SAMPLE LOCATION (NX20129)	Approved By: ARM
	FIGURE 1


AGRA
Earth & Environmental
Engineering & Environmental Services
BULK SAMPLE SITE PLAN
(NX20129)
Scale: NTS
Date: APR,97
Drawn By: TRCC
Approved By: ARM
FIGURE 2
LEGEND
ROAD
TRAIL
STREAM
DITCH
FRESH WATER PIPE LINE
DISCHARGE PIPE LINE
COWIE CREEK
COWIE CREEK BOUNDARY
FRESH WATER SUPPLY LINE
A ROAD
CONVEYOR
B ROAD
TOPSOIL STORAGE
TILL STORAGE
VENT RAISE
STACKER
DISCHARGE LINE FROM U/G
CULVERT R.O.
CATCHMENT DITCH
FUEL TANKS
WAREHOUSE
SHOP & GENSET
OFFICE & DRY
SANDSTONE STOCKPILE AREA AND FUTURE STACKER & COAL PILE AREA
15m x 40m SETTLING POND
15m x 40m POLISHING POND
NELSON LAND DISTRICT
NEWCASTLE LAND DISTRICT
REROUTE MAIN ROAD
CULVERT R.O.
CULVERT R.O.
CULVERT R.O.
DISCHARGE POINT

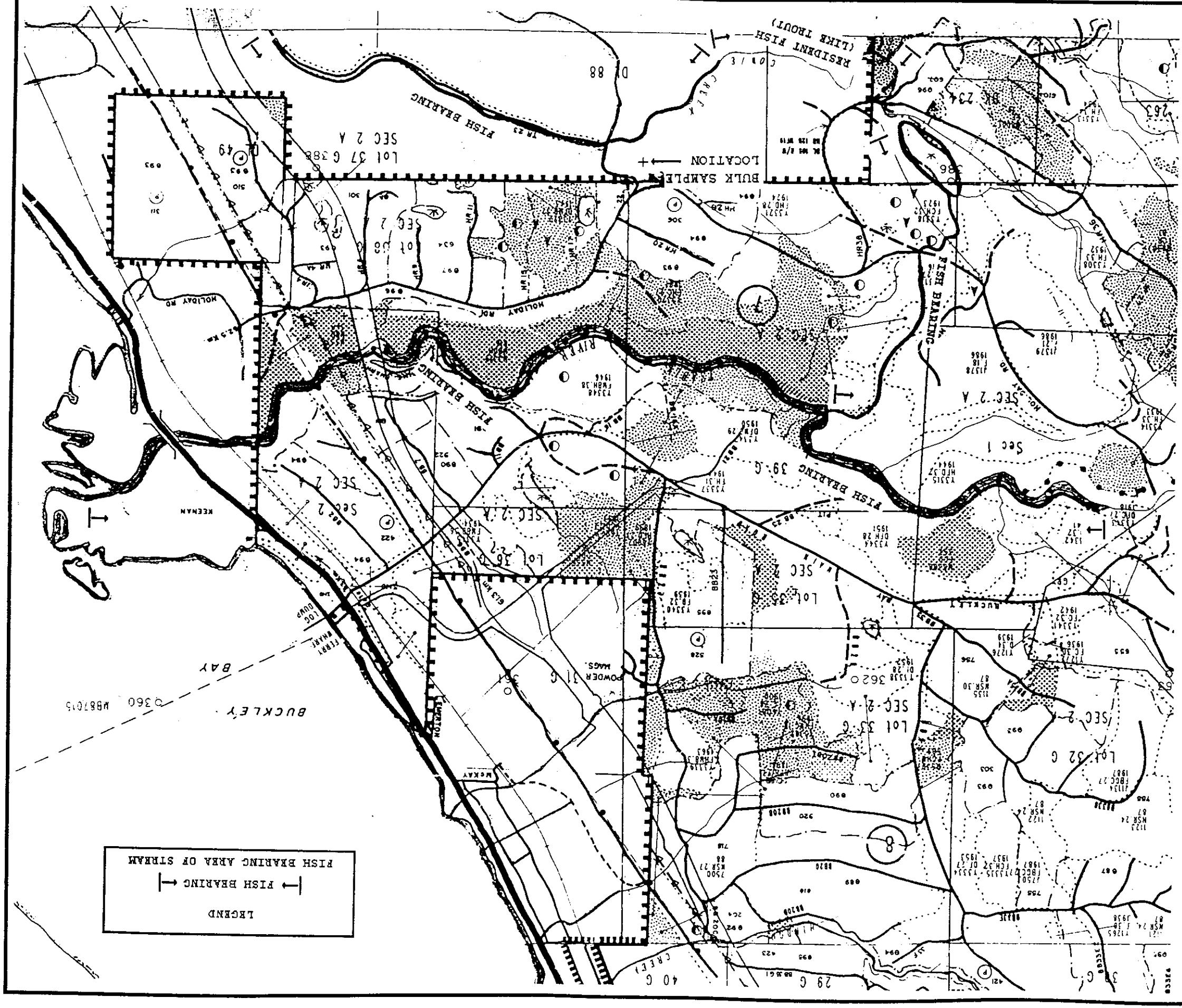
868



AGRA
Earth & Environmental
Engineering & Environmental Services

SURFACE WATER BASELINE
SAMPLING LOCATIONS (NX20129)

Scale:	NTS
Date:	APR 97
Drawn By:	TRCC
Approved By:	ARM
	FIGURE 3



AGRA
Earth & Environmental
Engineering & Environmental Services

STREAM CLASSIFICATION OF BULK SAMPLE AREA (NX20129)

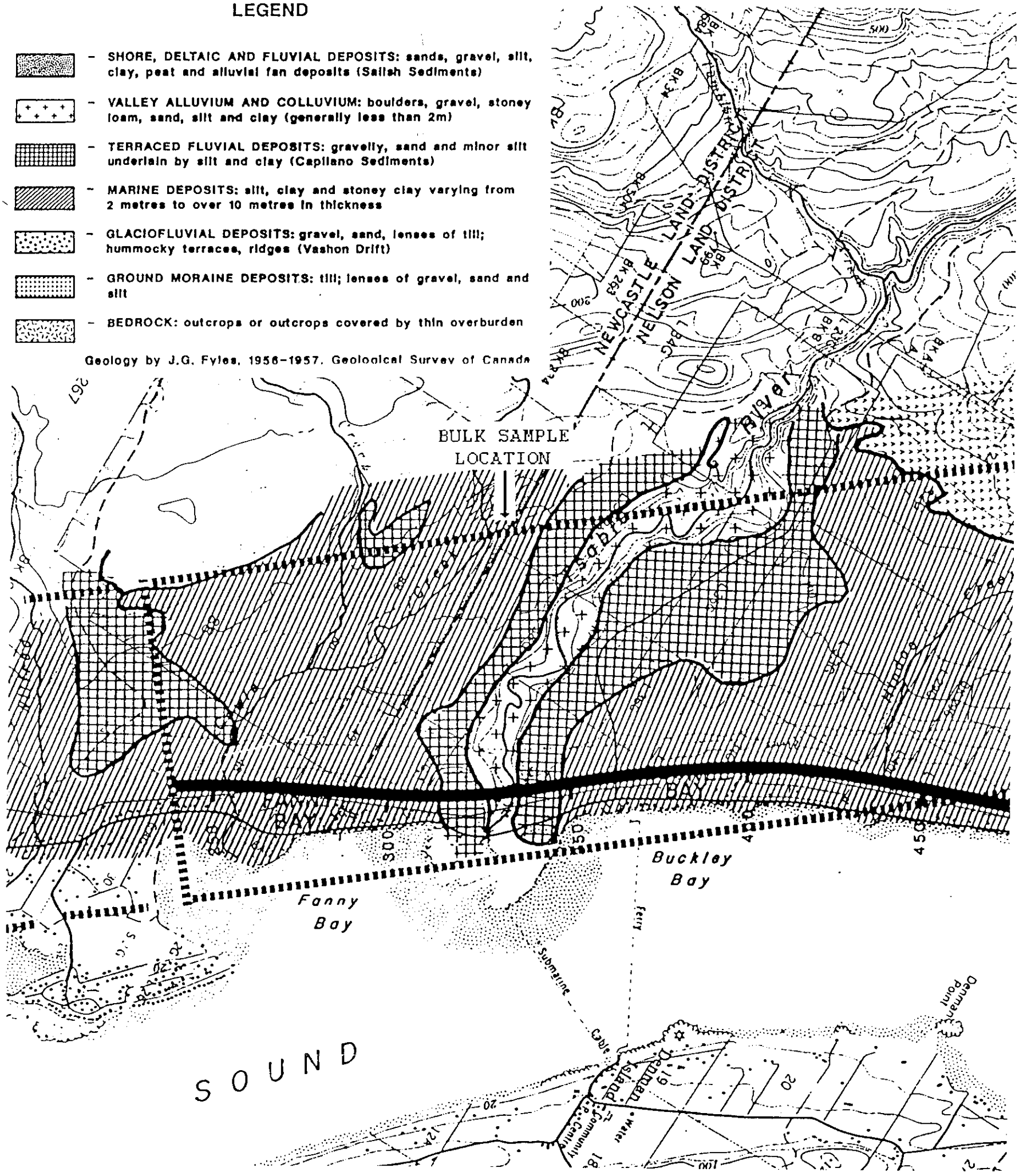
Scale: NTS	Date: APR,97	Drawn By: M&B	Approved By: ARM	FIGURE 4

868

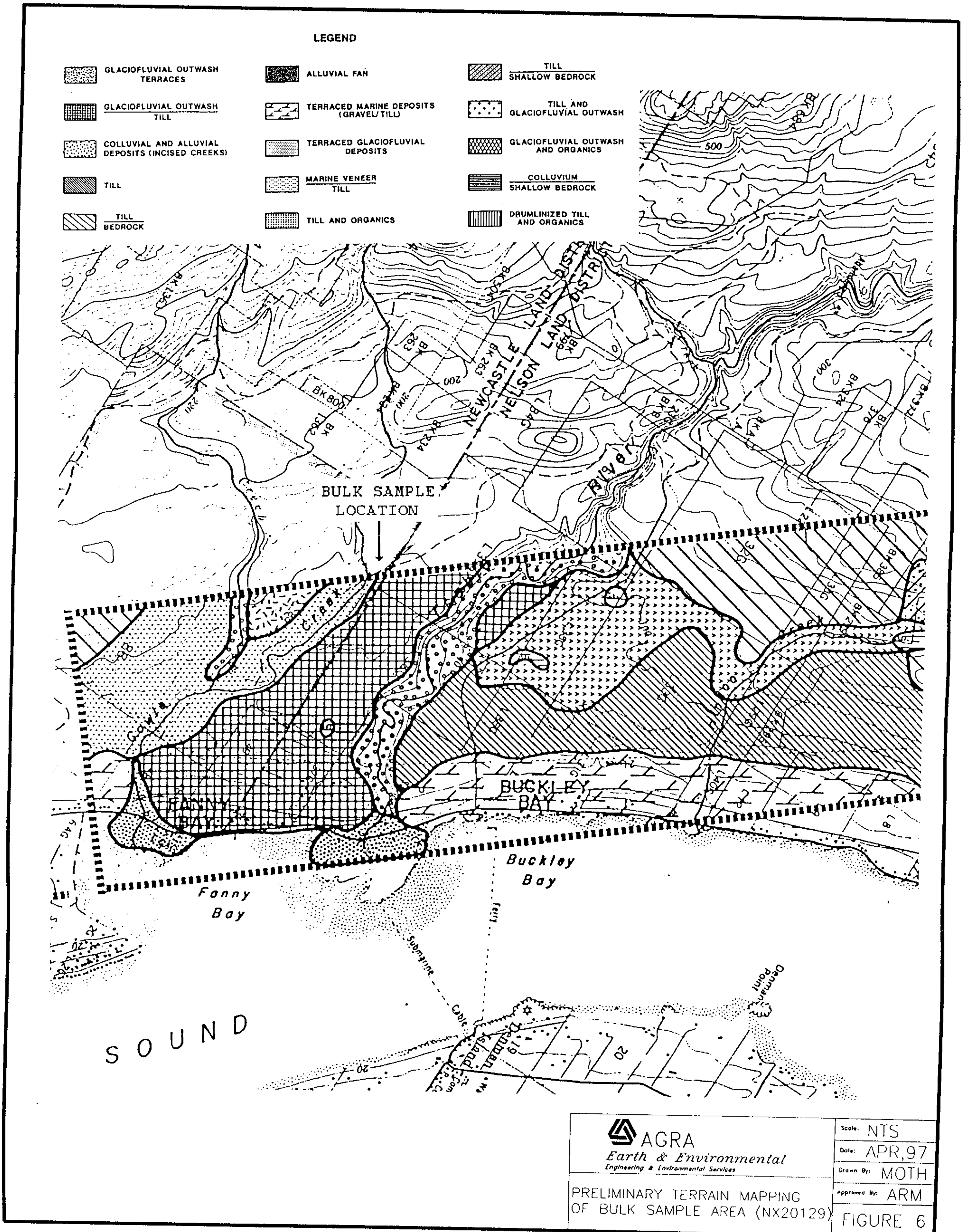
LEGEND

- SHORE, DELTAIC AND FLUVIAL DEPOSITS: sands, gravel, silt, clay, peat and alluvial fan deposits (Salish Sediments)
- VALLEY ALLUVIUM AND COLLUVIUM: boulders, gravel, stoney loam, sand, silt and clay (generally less than 2m)
- TERRACED FLUVIAL DEPOSITS: gravelly, sand and minor silt underlain by silt and clay (Capilano Sediments)
- MARINE DEPOSITS: silt, clay and stoney clay varying from 2 metres to over 10 metres in thickness
- GLACIOFLUVIAL DEPOSITS: gravel, sand, lenses of till; hummocky terraces, ridges (Vashon Drift)
- GROUND MORAINE DEPOSITS: till; lenses of gravel, sand and silt
- BEDROCK: outcrops or outcrops covered by thin overburden

Geology by J.G. Fyles, 1956-1957. Geological Survey of Canada



AGRA Earth & Environmental Engineering & Environmental Services	Scale: NTS
	Date: APR,97
	Drawn By: MOTH
	Approved By: ARM
PRELIMINARY SURFICIAL GEOLOGY OF BULK SAMPLE AREA (NX20129)	FIGURE 5


LEGEND
GLACIOFLUVIAL OUTWASH TERRACES
GLACIOFLUVIAL OUTWASH / TILL
COLLUVIAL AND ALLUVIAL DEPOSITS (INCISED CREEKS)
TILL
TILL / BEDROCK
ALLUVIAL FAN
TERRACED MARINE DEPOSITS (GRAVEL/TILL)
TERRACED GLACIOFLUVIAL DEPOSITS
MARINE VENEER / TILL
TILL AND ORGANICS
TILL / SHALLOW BEDROCK
TILL AND GLACIOFLUVIAL OUTWASH
GLACIOFLUVIAL OUTWASH AND ORGANICS
COLLUVIUM / SHALLOW BEDROCK
DRUMLINIZED TILL AND ORGANICS
BULK SAMPLE LOCATION
NEWCASTLE LAND DISTRICT
NELSON LAND DISTRICT
BUCKLEY BAY
FANNY BAY
Buckley Bay
Fanny Bay
SOUND
Submarine Cable
Denman Point
Denman Island
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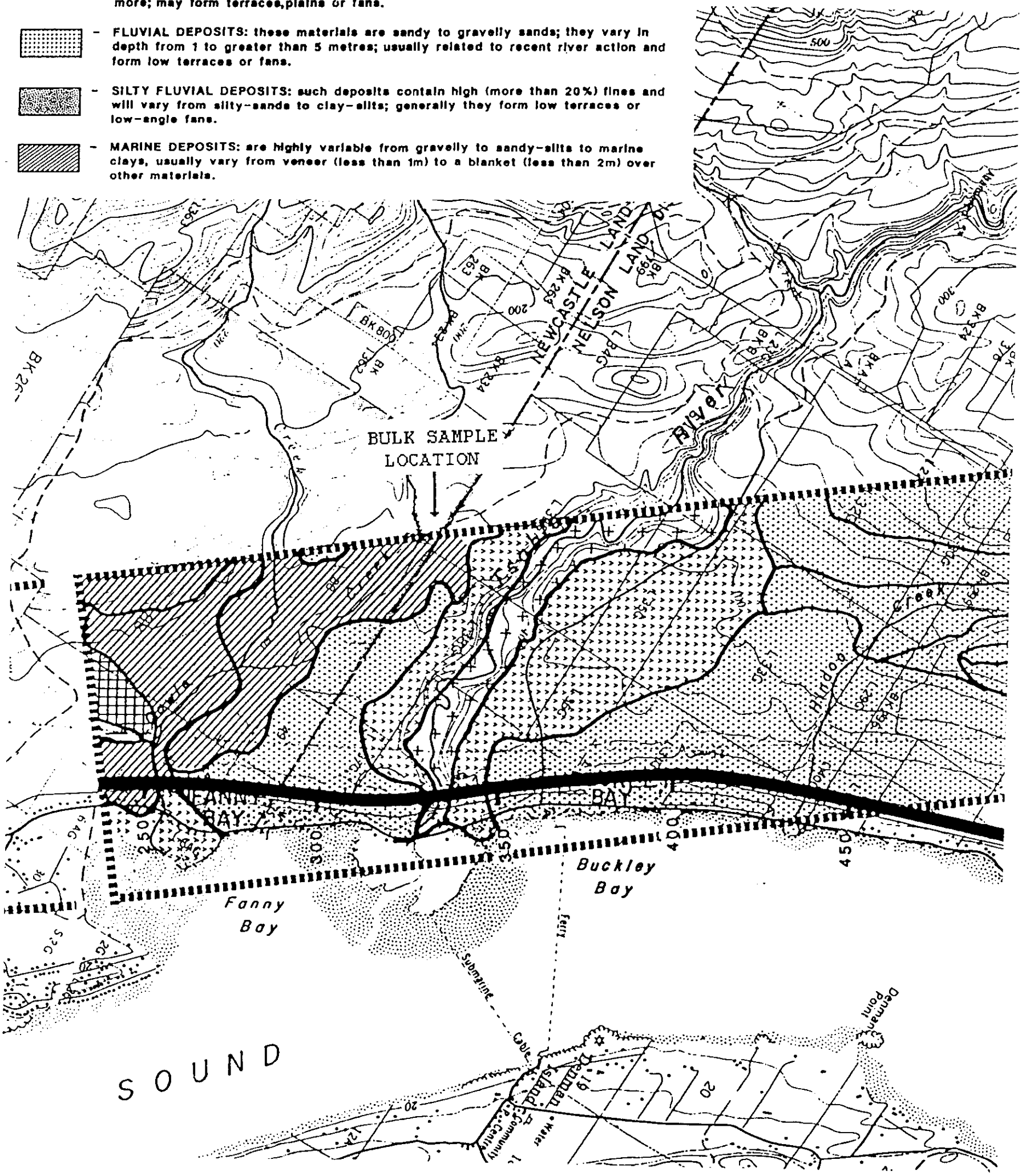
PRELIMINARY TERRAIN MAPPING OF BULK SAMPLE AREA (NX20129)
Scale: NTS
Date: APR,97
Drawn By: MOTH
Approved By: ARM
FIGURE 6

868

LEGEND

- GLACIOFLUVIAL DEPOSITS: they will vary from sands to sandy-gravels to coarse gravels; depths will vary from veneer of 1-2 metres to depths of 10 metres or more; may form terraces,plains or fans.
- FLUVIAL DEPOSITS: these materials are sandy to gravelly sands; they vary in depth from 1 to greater than 5 metres; usually related to recent river action and form low terraces or fans.
- SILTY FLUVIAL DEPOSITS: such deposits contain high (more than 20%) fines and will vary from silty-sands to clay-silts; generally they form low terraces or low-angle fans.
- MARINE DEPOSITS: are highly variable from gravelly to sandy-silts to marine clays, usually vary from veneer (less than 1m) to a blanket (less than 2m) over other materials.



AGRA Earth & Environmental Engineering & Environmental Services	Scale: NTS
	Date: APR,97
	Drawn By: MOTH
	Approved By: ARM
PRELIMINARY SOILS AND LANDFORM MAPPING OF BULK SAMPLE AREA (NX20129)	FIGURE 7

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APPENDIX B

TABLES

TABLE 1: SUMMARY OF APPLICABLE WATER QUALITY CRITERIA

QUINSAM COAL CORPORATION				
	PARAMETER		CDWG max. conconcentration (mg/L)	BCE max. concentration (mg/L)
	Conductivity (umhos/cm)			
	Total dissolved solids		500	
	Hardness			
	PH		6.5 - 8.5	6.5 - 9.0
	Total suspended solids			
	Alkalinity			
	Sulphate		500	100
	Ammonia Nitrogen			
	Kjeldahl Nitrogen			
	Nitrate Nitrogen		10	200
	Nitrite Nitrogen		1	0.06
	Dissolved Phosphorous			
	Total Phosphorous			
	Total Aluminum			
	Calcium			
	Copper		5	[0.094(hardness + 2)]
	Iron		0.3	0.3
	Lead		0.05	exp[1.273 ln(hardness) - 1.460] at hardness > 8 mg/L
	Magnesium			
	Manganese		0.05	100
	Zinc		5	0.03
	Diss. Aluminum		0.2	0.1 at pH > 6.5
	Calcium			
	Copper			
	Iron			
	Lead			
	Magnesium		100	
	Manganese			
	Zinc			

BCE: Approved and Working Criteria for Water Quality, 1994, BC Environment, (aquatic life)
CDWG: Canadian Drinking Water Guidelines

TABLE 2: SUMMARY OF WATER QUALITY DATA

QUINSAM COAL CORPORATION

TSABLE RIVER SITES

FOR THE MONTH OF JULY 1996

PARAMETER	COWIE CREEK				COUGAR C.@			
	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)	77.4				76.1			
Total dissolved solids	48				46			
Hardness	34.2				33.6			
PH	7.32				7.35			
Total suspended solids	4				1			
Alkalinity	38.1				37.4			
Sulphate	1.9				1			
Ammonia Nitrogen					<.005			
Kjeldahl Nitrogen	0.048							
Nitrate Nitrogen	0.05				<.005			
Nitrite Nitrogen	<.001				<.001			
Dissolved Phosphorous	0.002				0.002			
Total Phosphorous	0.002				0.002			
Total Aluminum	<.2				<.2			
Calcium	10.1				9.6			
Copper	<.01				<.01			
Iron	<.03				<.03			
Lead	<.05				<.05			
Magnesium	2.4				2.4			
Manganese	<.005				<.005			
Zinc	<.005				<.005			
Diss. Aluminum	<.2				<.2			
Calcium	9.57				9.57			
Copper	<.01				<.01			
Iron	<.03				<.03			
Lead	<.05				<.05			
Magnesium	2.37				2.37			
Manganese	<.005				<.005			
Zinc	<.005				<.005			
Oil and Grease								

Results expressed as milligrams per litre except where noted.

QUINSAM COAL CORPORATION

TSABLE RIVER SITES

FOR THE MONTH OF AUGUST 1996

PARAMETER	COWIE CREEK				TSABLE R.@				COUGAR C.U				COUGAR C.@			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)	89.0				536.0				96.2				86.8			
Total dissolved solids	52				278				62				60			
Hardness	34.9				49.9				34.8				35			
PH	7.66				7.62				7.75				7.76			
Total suspended solids	1				1				2				1			
Alkalinity	43.9				26.7				45.7				40.2			
Sulphate	2.1				24.9				1.7				<1			
Ammonia Nitrogen	<.005				<.005				<.005				<.005			
Kjeldahl Nitrogen	0.07								0.06				0.09			
Nitrate Nitrogen	0.066				<.005				0.098				0.065			
Nitrite Nitrogen	<.001				<.001				<.001				<.001			
Dissolved Phosphorous	<.001				<.001				0.004				0.001			
Total Phosphorous	0.001				0.003				0.004				0.003			
Total Aluminum	<.2				<.2				<.2				<.2			
Calcium	11.2				9.19				11.7				9.58			
Copper	<.01				<.01				<.01				<.01			
Iron	<.03				<.03				<.03				<.03			
Lead	<.05				<.05				<.05				<.05			
Magnesium	2.52				8.42				2.93				2.7			
Manganese	<.005				<.005				<.005				<.005			
Zinc	<.005				<.005				<.005				<.005			
Diss. Aluminum	<.2				<.2				<.2				<.2			
Calcium	10.1				7.85				9.77				9.58			
Copper	<.01				<.01				<.01				<.01			
Iron	<.03				<.03				<.03				<.03			
Lead	<.05				<.05				<.05				<.05			
Magnesium	2.34				7.35				2.53				2.7			
Manganese	<.005				<.005				<.005				<.005			
Zinc	<.005				<.005				<.005				<.005			
Oil and Grease																

Results expressed as milligrams per litre except where noted.

QUINSAM COAL CORPORATION

TSABLE RIVER SITES

FOR THE MONTH OF SEPTEMBER 1996

PARAMETER	COWIE CREEK				TSABLE R.@						COUGAR C.U				COUGAR C.@			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)	95.4		90.9		4380		40				79.7		87.3		83	
Total dissolved solids	52		53		2300		21				46		52		53	
Hardness	38.3		43.8		408		14.1				36.5		33.5		37.1	
PH	7.71		7.77		7.47		7.47				7.58		7.84		7.66	
Total suspended solids	1		<1		1		3				18		1		1	
Alkalinity	46.7		46.9		38.1		14.6				40.4		41.2		40	
Sulphate	3.1		1.5		162		2.8				<1		2.1		4	
Ammonia Nitrogen	<.005		<.005		<.005		<.005				0.015		<.005		<.005	
Kjeldahl Nitrogen	0.08				0.08								0.13			
Nitrate Nitrogen	0.078		0.041		0.101		0.047				0.084		0.061		0.058	
Nitrite Nitrogen	0.002		<.001		0.002		0.001				0.001		0.001		0.001	
Dissolved Phosphorous	0.004		<.001		0.003		0.005				0.005		0.006		0.007	
Total Phosphorous	0.004		0.001		0.003		0.005				0.027		0.007		0.007	
Total Aluminum	<.2		<.2		<.2		<.2				<.2		<.2		<.2	
Calcium	11.5		12.8		33.7		4.43				10.3		9.77		10.1	
Copper	<.01		<.01		<.01		<.01				<.01		<.01		<.01	
Iron	<.03		<.03		<.03		<.03				0.15		0.03		0.03	
Lead	<.05		<.05		<.05		<.05				<.05		<.05		<.05	
Magnesium	2.65		2.87		80.3		0.87				2.58		2.86		2.89	
Manganese	<.005		<.005		<.005		<.005				0.015		<.005		<.005	
Zinc	<.005		<.005		<.005		<.005				<.005		<.005		<.005	
Diss. Aluminum	<.2		<.2		<.2		<.2				<.2		<.2		<.2	
Calcium	11.1		12.8		33.1		4.29				10.3		9.01		10.1	
Copper	<.01		<.01		<.01		<.01				<.01		<.01		<.01	
Iron	<.03		<.03		<.03		<.03				<.03		<.03		<.03	
Lead	<.05		<.05		<.05		<.05				<.05		<.05		<.05	
Magnesium	2.58		2.87		79.1		0.83				2.58		2.67		2.89	
Manganese	<.005		<.005		<.005		<.005				<.005		<.005		<.005	
Zinc	<.005		<.005		<.005		<.005				<.005		<.005		<.005	

Results expressed as milligrams per litre except where noted.

QUINSAM COAL CORPORATION

TSABLE RIVER SITES

FOR THE MONTH OF OCTOBER 1996

PARAMETER	COWIE CREEK				TSABLE R.@				COUGAR C.U				COUGAR C.@			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)	92.3		77.8		81.9		30.8		89.9		66.7		87		79.3	
Total dissolved solids	56		46		47		22		54		30		51		33	
Hardness	43.8		27.1		22.5		11.6		42.6		20.7		37.5		27.5	
pH	7.71		7.56		7.58		7.28		7.79		7.48		7.69		7.52	
Total suspended solids	<1		<1		4		<1		3		<1		5		4	
Alkalinity	45		25.6		23.3		11.6		43.7		20.4		39.1		25.6	
Sulphate	2.6		1.5		6.4		1.7		2.6		<1		2.2		2.6	
Ammonia Nitrogen	<.005		<.005		<.005		<.005		<.005		<.005		<.005		<.005	
Kjeldahl Nitrogen			0.151				0.06				0.084				0.124	
Nitrate Nitrogen	0.045		0.001		0.065		0.001		0.044		0.001		0.024		0.001	
Nitrite Nitrogen	0.001		0.004		0.001		0.005		0.001		0.004		0.001		0.009	
Dissolved Phosphorous	0.004		0.004		0.004		0.005		0.004		0.004		0.005		0.01	
Total Phosphorous																
Total Aluminum	<.2				<.2				<.2				<.2			
Calcium	12.8				6.62				12.6				12.8			
Copper	<.01				<.01				<.01				<.01			
Iron	<.03				0.05				<.03				<.03			
Lead	<.05				<.05				<.05				<.05			
Magnesium	2.88				1.55				2.84				2.88			
Manganese	<.005				<.005				<.005				<.005			
Zinc	<.005				<.005				<.005				<.005			
Diss. Aluminum	<.2		<.2		<.2		<.2		<.2		<.2		<.2		<.2	
Calcium	12.8		7.96		6.54		3.42		12.4		6.18		10.1		7.6	
Copper	<.01		<.01		<.01		<.01		<.01		<.01		<.01		<.01	
Iron	<.03		<.03		<.03		<.03		<.03		<.03		0.03		<.03	
Lead	<.05		<.05		<.05		<.05		<.05		<.05		<.05		<.05	
Magnesium	2.88		1.75		1.49		0.74		2.83		1.28		2.96		2.06	
Manganese	<.005		<.005		<.005		<.005		<.005		<.005		<.005		<.005	
Zinc	<.005		<.005		<.005		<.005		<.005		<.005		<.005		<.005	
Oil and Grease																

QUINSAM COAL CORPORATION

TSABLE RIVER SITES

FOR THE MONTH OF NOVEMBER 1996

PARAMETER	COWIE CREEK				TSABLE R.@				COUGAR C.U				COUGAR C.@				UPPER COWIE CREEK			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)	35.0		50.0		21.0		76.0		29.0				36.0		55.0					
Total dissolved solids	16		28		10		23		13				16		25					
Hardness	14.6		20.6		8.28		13.8		12.6				14.7		21.1					
PH	7.14		7.3		6.98		7.18		7				7.08		7.26					
Total suspended solids	4		<1		25		5		8				27		2					
Alkalinity	14.1		21		7.1		13		11.6				13.4		23					
Sulphate	1.8		1		2.5		3		1.3				2.1		2					
Ammonia Nitrogen	<.005		<.005		0.005		<.005		0.005		I		0.005		0.007					
Kjeldahl Nitrogen											N									
Nitrate Nitrogen	0.079		0.075		0.049		0.056		0.084		A		0.113		0.162					
Nitrite Nitrogen	0.002		0.002		0.005		0.002		0.003		C		0.004		<.001					
Dissolved Phosphorous	0.001		0.002		0.001		0.004		0.005		C		0.008		0.002					
Total Phosphorous	0.009		0.003		0.03		0.006		0.014		E		0.029		0.002					
Total Aluminum	<.2		<.2		0.5		<.2		0.3		S		0.4		<.2					
Calcium	4.42		6.08		2.61		3.93		4.05		S		4.53		5.86					
Copper	<.01		<.01		<.01		<.01		<.01		I		<.01		<.01					
Iron	0.11		<.03		0.68		<.03		0.27		B		0.48		<.03					
Lead	<.05		<.05		<.05		<.05		<.05		L		<.05		<.05					
Magnesium	0.95		1.32		0.7		0.97		0.79		E		1.1		1.56					
Manganese	0.008		<.005		0.033		<.005		0.01				0.02		<.005					
Zinc	<.005		0.009		<.005		<.005		<.005				<.005		0.006					
Diss. Aluminum	<.2		<.2		<.2		<.2		<.2				<.2		<.2					
Calcium	4.35		6.08		2.44		3.93		<.01				4.29		5.86					
Copper	<.01		<.01		<.01		<.01		<.01				<.01		<.01					
Iron	0.03		<.03		0.05		<.03		0.06				0.08		<.03					
Lead	<.05		<.05		<.05		<.05		<.05				<.05		<.05					
Magnesium	0.92		1.32		0.53		0.97		0.7				0.97		1.56					
Manganese	<.005		<.005		<.005		<.005		<.005				<.005		<.005					
Zinc	<.005		<.005		<.005		<.005		<.005				<.005		<.005					
Oil and Grease													<5							

Results expressed as milligrams per litre except where noted.

QUINSAM COAL CORPORATION

TSABLE RIVER SITES

FOR THE MONTH OF DECEMBER 1996

PARAMETER	COWIE CREEK				TSABLE R.@				COUGAR C.U				COUGAR C.@				UPPER COWIE CREEK			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity	39		44		40		440						43		39		25			
Total dissolved solids	17		19		17		220						18		18		10			
Hardness	15.4		17.9		12.2		55.6						17.8		18.7		9.72			
PH	7.32		7.35		7.19		7.09						7.31		7.38		7.26			
Total suspended solids	1		1		1		4						1		1		7			
Alkalinity	16		19		12		10						16		16		10			
Sulphate	1		<1		2		18						1		<1		<1			
Ammonia Nitrogen	<.005		<.005		0.007		<.005						<.005		<.005		<.005			
Kjeldahl Nitrogen			0.08				0.11								0.09					
Nitrate Nitrogen	0.086		0.078		0.078		0.033						0.175		0.115		0.065			
Nitrite Nitrogen	0.004		0.011		0.002		0.009						0.006		0.002		0.001			
Dissolved Phosphorous	0.002		<.001		0.002		<.001						0.002		<.001		0.002			
Total Phosphorous	0.003		<.001		0.003		0.004						0.003		0.001		0.002			
Total Aluminum	<.2		<.2		<.2		<.2						<.2		<.2		<.2			
Calcium	4.46		5.19		3.71		7.42						5		5.38		2.94			
Copper	<.01		<.01		<.01		<.01						<.01		<.01		<.01			
Iron	<.03		<.03		0.04		0.03						0.06		<.03		<.03			
Lead	<.05		<.05		<.05		<.05						<.05		<.05		<.05			
Magnesium	1.04		1.2		0.88		8.99						1.33		1.3		0.63			
Manganese	>.005		<.005		<.005		<.005						<.005		<.005		<.005			
Zinc	<.005		<.005		<.005		<.005						<.005		<.005		<.005			
Diss. Aluminum	<.2		<.2		<.2		<.2						<.2		<.2		<.2			
Calcium	4.46		5.19		3.52		7.42						4.95		5.38		2.87			
Copper	<.01		<.01		<.01		<.01						<.01		<.01		<.01			
Iron	<.03		<.03		<.03		<.03						0.04		<.03		<.03			
Lead	<.05		<.05		<.05		<.05						<.05		<.05		<.05			
Magnesium	1.04		1.2		0.84		8.99						1.32		1.29		0.62			
Manganese	<.005		<.005		<.005		<.005						<.005		<.005		<.005			
Zinc	<.005		<.005		<.005		<.005						<.005		<.005		<.005			

Results expressed as milligrams per litre except where noted.

TSABLE RIVER SITES

FOR THE MONTH OF JANUARY 1997

PARAMETER	COWIE CREEK				UPPER COWIE CREEK				COUGAR C.@				KM 4 CREEK				JANUARY CREEK			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)	34.0		34.0				34.0		37.0		36.0		19.0		19.0		28.0		27.0	
Total dissolved solids	22		15				15		30		17		10		<10		18		12	
Hardness	15.2		13.9				12.1		15.3		14.8		7.4		6.58		11		11	
PH	7.24		7.03				7.19		7.18		7.12		6.94		6.79		7.01		6.86	
Total suspended solids	4		<1				<1		<1		1		<1		1		<1		<1	
Alkalinity	15		14				15		15		15		6		7		12		11	
Sulphate	1		1				1		1		2		1		1		1		1	
Ammonia Nitrogen	0.008		<.005				<.005		<.005		<.005		0.008		<.005		<.005		<.005	
Kjeldahl Nitrogen																				
Nitrate Nitrogen	0.059		0.048				0.035		0.119		0.121		0.036		0.033		0.029		0.024	
Nitrite Nitrogen	0.001		0.001				0.001		0.001		0.003		0.002		0.003		0.001		0.001	
Dissolved Phosphorous	0.002		<.001				0.003		0.001		<.001		0.003		0.003		0.002		0.001	
Total Phosphorous	0.014		0.019				0.005		0.004		<.001		0.006		0.005		0.003		0.004	
Total Aluminum	<.2		<.2				<.2		<.2		<.2		<.2		<.2		<.2		<.2	
Calcium	4.48		4.17				3.57		4.69		4.29		1.97		1.76		3.11		3.36	
Copper	<.01		<.01				<.01		<.01		<.01		<.01		<.01		<.01		<.01	
Iron	0.09		<.03				<.03		0.05		0.06		0.13		0.08		0.04		0.05	
Lead	<.05		<.05				<.05		<.05		<.05		<.05		<.05		<.05		<.05	
Magnesium	0.97		0.94				0.77		1.18		1.05		0.6		0.53		0.8		0.82	
Manganese	0.005		<.005				<.005		<.005		<.005		<.005		<.005		<.005		<.005	
Zinc	0.009		<.005				<.005		<.005		<.005		0.009		<.005		<.005		<.005	
Diss. Aluminum	<.2		<.2				<.2		<.2		<.2		<.2		<.2		<.2		<.2	
Calcium	4.48		4.1				3.56		4.31		4.19		1.97		1.76		3.11		3.12	
Copper	<.01		<.01				<.01		<.01		<.01		<.01		<.01		<.01		<.01	
Iron	<.03		<.03				<.03		<.03		<.03		0.06		0.08		<.03		0.03	
Lead	<.05		<.05				<.05		<.05		<.05		<.05		<.05		<.05		<.05	
Magnesium	0.97		0.9				0.77		1.11		1.04		0.6		0.53		0.8		0.77	
Manganese	<.005		<.005				<.005		<.005		<.005		<.005		<.005		<.005		<.005	
Zinc	<.005		<.005				<.005		<.005		<.005		<.005		<.005		<.005		<.005	
Oil and Grease																				

Results expressed as milligrams per litre except where noted.

TSABLE RIVER SITES

FOR THE MONTH OF JANUARY 1997

PARAMETER	TSABLE R. @				SAMMY CREEK				GRADE CREEK 1				GRADE CREEK 2			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)	29.0		30.0				59.0				16.0				18.0	
Total dissolved solids	24		13				26				<10				<10	
Hardness	10.6		10.1				24.4				5.11				5.6	
PH	7.1		6.95				7.31				6.61				6.73	
Total suspended solids	<1		<1				2				2				1	
Alkalinity	10		11				27				6				7	
Sulphate	1		2				1				1				<1	
Ammonia Nitrogen	<.005		<.005				<.005				<.005				0.027	
Kjeldahl Nitrogen																
Nitrate Nitrogen	0.058		0.056				<.005				<.005				<.005	
Nitrite Nitrogen	0.001		0.001				0.002				0.003				0.002	
Dissolved Phosphorous	0.002		<.001				0.003				0.003				0.007	
Total Phosphorous	0.003		0.002				0.004				0.005				0.01	
Total Aluminum	<.2		<.2				<.2				<.2				<.2	
Calcium	3.15		2.96				7.55				1.35				1.61	
Copper	<.01		<.01				<.01				<.01				<.01	
Iron	0.04		<.03				<.03				0.04				0.1	
Lead	<.05		<.05				<.05				<.05				<.05	
Magnesium	0.72		0.66				1.46				0.42				0.49	
Manganese	<.005		<.005				<.005				<.005				<.005	
Zinc	<.005		<.005				<.005				<.005				<.005	
Diss. Aluminum	<.2		<.2				<.2				<.2				<.2	
Calcium	3.09		2.96				7.39				4.1				1.47	
Copper	<.01		<.01				<.01				<.01				<.01	
Iron	<.03		<.03				<.03				<.03				0.06	
Lead	<.05		<.05				<.05				<.05				<.05	
Magnesium	0.7		0.66				1.44				0.9				0.47	
Manganese	<.005		<.005				<.005				<.005				<.005	
Zinc	<.005		<.005				<.005				<.005				<.005	
Oil and Grease																

TSABLE RIVER SITES

FOR THE MONTH OF FEBRUARY 1991

PARAMETER	COWIE CREEK				UPPER COWIE CREEK				COUGAR C.@				KM 4 CREEK				JANUARY CREEK			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)			45.0				44.0				47.0				24.0				34.0	
Total dissolved solids			20				19				20				9				13	
Hardness			19				20.1				19.5				8.91				14.2	
PH			7.45				7.41				7.43				7.09				7.08	
Total suspended solids			1				<1				<1				3				<1	
Alkalinity			20				20				20				8				14	
Sulphate			1				<1				1				1				<1	
Ammonia Nitrogen																				
Kjeldahl Nitrogen																				
Nitrate Nitrogen			0.038				0.034				0.084				0.027				0.038	
Nitrite Nitrogen																				
Dissolved Phosphorous			<.001				<.001				0.001				0.003				0.001	
Total Phosphorous																				
Total Aluminum			<.2				<.2				<.2				0.3				<.2	
Calcium			6.78				6.07				6.48				2.5				4.14	
Copper			<.01				<.01				<.01				<.01				<.01	
Iron			<.03				<.03				<.03				0.22				0.03	
Lead			<.05				<.05				<.05				<.05				<.05	
Magnesium			1.28				1.24				1.38				0.73				0.99	
Manganese			<.005				<.005				<.005				<.005				<.005	
Zinc			<.005				<.005				<.005				<.005				<.005	
Diss. Aluminum			<.2				<.2				<.2				<.2				<.2	
Calcium			5.56				6.02				4.07				2.41				4.07	
Copper			<.01				<.01				<.01				<.01				<.01	
Iron			<.03				<.03				<.03				0.07				<.03	
Lead			<.05				<.05				<.05				<.05				<.05	
Magnesium			1.23				1.23				0.97				0.7				0.87	
Manganese			<.005				<.005				<.005				<.005				<.005	
Zinc			<.005				<.005				<.005				<.005				<.005	
Oil and Grease																				

Results expressed as milligrams per litre except where noted.

TSABLE RIVER SITES

FOR THE MONTH OF FEBRUARY 1991

PARAMETER	TSABLE R. @				SAMMY CREEK				GRADE CREEK 1				GRADE CREEK 2			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)			37.0				90.0				20.0				21.0	
Total dissolved solids			15				52				10				<1	
Hardness			12.6				40.7				7				7.91	
PH			7.25				7.69				6.97				7.03	
Total suspended solids			1				1				2				7	
Alkalinity			12				44				8				8	
Sulphate			3				11				<1				1	
Ammonia Nitrogen																
Kjeldahl Nitrogen																
Nitrate Nitrogen			0.049				<.005				<.005				0.008	
Nitrite Nitrogen																
Dissolved Phosphorous			0.002				<.001								0.002	
Total Phosphorous																
Total Aluminum			<.2				<.2				0.2				<.2	
Calcium			3.82				12.4				2				1.91	
Copper			<.01				<.01				<.01				<.01	
Iron			<.03				<.034				0.13				0.07	
Lead			<.05				<.05				<.05				<.05	
Magnesium			0.79				2.37				0.59				0.6	
Manganese			<.005				<.005				0.006				<.005	
Zinc			<.005				<.005				<.005				<.005	
Diss. Aluminum			<.2				<.2				<.2				<.2	
Calcium			3.73				12.4				1.88				2.1	
Copper			<.01				<.01				<.01				<.01	
Iron			<.03				<.03				<.03				0.05	
Lead			<.05				<.05				<.05				<.05	
Magnesium			0.8				2.35				0.56				0.65	
Manganese			<.005				<.005				<.005				<.005	
Zinc			<.005				<.005				<.005				<.005	
Oil and Grease																

Results expressed as milligrams per litre except where noted.

TSABLE RIVER SITES

FOR THE MONTH OF MARCH 1997

PARAMETER	COWIE CREEK				UPPER COWIE CREEK				COUGAR C.@				KM 4 CREEK				JANUARY CREEK			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)		38.0				38.0				42.0				22.0				31.0		
Total dissolved solids		18				17				18				<10				14		
Hardness		17.8				18.1				18.3				8.51				13.9		
PH		7.26				7.59				7.36				6.9				7.28		
Total suspended solids		<1				<1				<1				3				<1		
Alkalinity		18				18				18				9				14		
Sulphate		1				<1				<1				1				<1		
Ammonia Nitrogen		0.007				<.005				0.011				<.005				0.007		
Kjeldahl Nitrogen																				
Nitrate Nitrogen		0.042				0.04				0.09				0.031				0.035		
Nitrite Nitrogen		0.003				0.002				0.002				0.003				0.002		
Dissolved Phosphorous		0.001				<.001				0.002				0.002				0.001		
Total Phosphorous		0.004				<.001				0.003				0.007				0.004		
Total Aluminum		<.2				<.2				<.2				<.2				<.2		
Calcium		5.33				6.37				5.18				2.31				4.02		
Copper		<.01				<.01				<.01				<.01				<.01		
Iron		0.03				<.03				0.03				0.13				0.03		
Lead		<.05				<.05				<.05				<.05				<.05		
Magnesium		1.15				1.15				1.31				0.68				0.95		
Manganese		<.005				<.005				<.005				<.005				<.005		
Zinc		<.005				<.005				<.005				<.005				<.005		
Diss. Aluminum		<.2				<.2				<.2				<.2				<.2		
Calcium		5.24				5.37				5.18				2.29				3.98		
Copper		<.01				<.01				<.01				<.01				<.01		
Iron		0.03				<.03				0.03				0.13				<.03		
Lead		<.05				<.05				<.05				<.05				<.05		
Magnesium		1.15				1.14				1.31				0.68				0.95		
Manganese		<.005				<.005				<.005				<.005				<.005		
Zinc		<.005				<.005				<.005				<.005				<.005		
Oil and Grease																				

Results expressed as milligrams per litre except where noted.

TSABLE RIVER SITES

FOR THE MONTH OF MARCH 1997

PARAMETER	TSABLE R. @				SAMMY CREEK				GRADE CREEK 1				GRADE CREEK 2			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conductivity (umhos/cm)		39.0				70.0				18.0				19.0		
Total dissolved solids		17				34				<10				<10		
Hardness		13.7				34.5				6.81				7.44		
PH		7.38				7.54				7.08				7.28		
Total suspended solids		<1				<1				5				2		
Alkalinity		13				36				7				7		
Sulphate		2				<1				1				1		
Ammonia Nitrogen		<.005				<.005				<.005				0.008		
Kjeldahl Nitrogen																
Nitrate Nitrogen		0.047				<.005				<.005				<.005		
Nitrite Nitrogen		0.002				0.001				0.003				0.002		
Dissolved Phosphorous		0.002				0.001				<.001				0.001		
Total Phosphorous		0.003				0.002				0.005				0.003		
Total Aluminum		<.2				<.2				<.2				<.2		
Calcium		4				10.5				1.85				1.97		
Copper		<.01				<.01				<.01				<.01		
Iron		0.03				<.03				0.08				0.12		
Lead		<.05				<.05				<.05				<.05		
Magnesium		0.91				2.01				0.54				0.61		
Manganese		<.005				<.005				<.005				<.005		
Zinc		<.005				<.005				<.005				<.005		
Diss. Aluminum		<.2				<.2				<.2				<.2		
Calcium		4				10.5				1.85				1.97		
Copper		<.01				<.01				<.01				<.01		
Iron		0.03				<.03				0.06				0.08		
Lead		<.05				<.05				<.05				<.05		
Magnesium		0.91				2				0.53				0.61		
Manganese		<.005				<.005				<.005				<.005		
Zinc		<.005				<.005				<.005				<.005		
Oil and Grease																

Results expressed as milligrams per litre except where noted.

APPENDIX C

CLIMATE DATA

CAMPBELL RIVER A
49° 57'N 125° 16'W 105 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE
Daily Maximum Temperature	3.6	6.1	8.7	12.6	16.9	19.6	22.2	22.7	18.9	13.0	7.6	5.0	13.3	
Daily Minimum Temperature	-3.1	-1.5	-1.1	1.6	4.7	8.0	10.0	9.9	6.8	3.2	0.4	-1.4	2.1	
Daily Temperature	0.4	2.9	3.9	7.1	10.8	13.8	16.3	16.3	12.8	8.1	4.0	1.8	8.3	
Standard Deviation, Daily Temperature	2.1	1.5	0.9	0.8	0.8	1.7	1.1	1.5	1.2	0.6	1.1	2.0	0.5	4
Extreme Maximum Temperature	16.1	19.0	20.8	27.2	28.3	36.9	37.2	37.8	30.0	22.8	17.0	13.3	37.8	
Years of Record	18	18	18	18	18	18	18	18	18	15	14	18		
Extreme Minimum Temperature	-23.9	-17.8	-12.8	-5.6	-2.2	-0.6	2.2	1.7	-2.8	-7.8	-12.2	-18.9	-23.9	
Years of Record	18	18	18	18	18	18	18	18	18	15	14	18		
Rainfall	144.8	120.0	123.6	87.1	63.0	47.7	37.4	50.1	96.9	153.2	185.8	209.2	1256.8	0
Snowfall	46.3	23.9	12.8	2.1	0.0	0.0	0.0	0.0	0.0	0.0	13.9	36.2	140.9	0
Total Precipitation	190.8	143.7	136.7	89.1	63.0	47.7	37.4	50.1	96.9	153.2	200.3	246.0	1406.9	0
Standard Deviation, Total Precipitation	74.8	54.9	61.5	32.3	26.8	27.9	23.7	33.9	43.9	76.9	90.5	78.2	314.9	4
Greatest Rainfall in 24 hours	78.7	62.7	60.5	44.9	42.2	37.3	43.7	36.4	42.6	43.7	75.9	84.8	84.8	
Years of Record	15	18	18	18	18	18	18	18	18	15	14	14		
Greatest Snowfall in 24 hours	53.3	25.4	36.1	11.4	0.0	0.0	0.0	0.0	0.0	1.3	43.2	43.2	53.3	
Years of Record	18	18	18	18	18	18	18	18	18	18	15	15		
Greatest Precipitation in 24 hours	78.7	62.7	60.5	44.9	42.2	37.3	43.7	29.4	42.6	43.7	75.9	84.8	84.8	
Years of Record	18	18	18	18	18	18	18	18	18	15	14	13		
Days with Rain	14	14	15	12	10	10	7	8	10	16	17	17	150	6
Days with Snow	6	3	2	0	0	0	0	0	0	0	1	4	16	6
Days with Precipitation	19	16	16	12	10	10	7	8	10	16	18	20	162	0

COURTENAY
49° 41'N 125° 2'W 24 m

Daily Maximum Temperature														
Daily Minimum Temperature														
Daily Temperature														
Standard Deviation, Daily Temperature														
Extreme Maximum Temperature														
Years of Record														
Extreme Minimum Temperature														
Years of Record														
Rainfall	179.4	145.2	130.1	73.1	44.9	46.2	33.7	48.9	83.5	156.7	227.9	231.2	1381.8	0
Snowfall	43.7	16.4	11.5	0.1	0.0	0.0	0.0	0.0	0.0	0.3	10.7	27.8	112.3	0
Total Precipitation	225.8	161.9	141.3	73.3	47.8	46.2	33.7	48.9	83.5	157.0	238.8	259.0	1502.8	0
Standard Deviation, Total Precipitation	124.3	97.8	83.4	36.1	18.8	27.9	24.6	38.7	26.4	62.8	112.4	96.2	396.8	6
Greatest Rainfall in 24 hours	102.1	90.3	78.7	74.9	36.1	34.5	37.1	31.3	61.8	81.0	95.1	102.9	102.9	
Years of Record	30	30	30	30	30	30	30	30	30	27	27	30		
Greatest Snowfall in 24 hours	81.3	90.8	30.5	2.5	0.0	0.0	0.0	0.0	0.0	7.4	48.7	43.2	81.3	
Years of Record	30	30	30	30	30	30	30	30	30	30	27	27		
Greatest Precipitation in 24 hours	102.1	90.3	78.7	74.9	36.1	34.5	37.1	31.3	61.8	81.0	95.1	102.9	102.9	
Years of Record	30	30	30	30	30	30	30	30	30	27	27	30		
Days with Rain	17	15	18	14	11	11	8	8	10	18	18	18	162	6
Days with Snow	4	2	1	0	0	0	0	0	0	0	1	3	11	6
Days with Precipitation	19	16	17	14	11	11	8	8	10	18	19	19	168	0

QUALICUM R FISH RESEARCH
49° 24'N 124° 37'W 8 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE
Daily Maximum Temperature	4.9	7.2	9.9	12.5	16.4	19.1	22.0	21.4	16.1	13.0	9.2	6.2	13.2	6
Daily Minimum Temperature	-0.4	0.9	1.3	2.4	5.8	9.9	11.4	11.3	8.9	6.5	2.6	1.1	5.2	6
Daily Temperature	2.3	4.1	5.9	8.9	11.8	14.8	16.7	16.4	13.4	9.3	6.6	3.7	9.2	6
Standard Deviation, Daily Temperature	1.9	1.2	0.8	0.8	0.7	1.2	0.9	1.0	1.1	0.7	1.0	1.7	0.4	4
Extreme Maximum Temperature	14.4	16.1	18.9	22.3	26.1	30.0	31.1	31.1	27.2	22.8	17.8	15.0	31.1	
Years of Record	18	19	19	17	17	19	19	19	19	19	19	19		
Extreme Minimum Temperature	-15.5	-7.8	-6.5	-2.8	0.0	2.8	5.0	4.4	0.0	-2.8	-7.8	-14.4	-15.5	
Years of Record	19	19	19	17	17	19	19	19	19	19	19	19		
Rainfall	190.4	140.5	153.2	81.4	44.5	30.3	26.2	41.0	94.8	137.9	203.4	219.9	1273.5	0
Snowfall	21.4	0.3	2.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	2.0	12.1	47.4	0
Total Precipitation	204.5	191.0	210.2	81.7	44.5	30.3	26.2	41.4	94.8	137.9	204.4	232.0	1317.2	0
Standard Deviation, Total Precipitation	119.2	96.0	49.1	34.9	16.8	18.4	22.9	29.9	40.3	81.3	97.9	79.3	219.9	4
Greatest Rainfall in 24 hours	117.3	81.7	99.9	29.5	27.7	34.2	25.4	36.1	31.8	72.9	96.1	66.4	117.3	
Years of Record	18	18	19	17	18	19	19	19	19	19	19	19		
Greatest Snowfall in 24 hours	48.0	48.7	12.7	4.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	48.7	48.0	
Years of Record	18	18	18	17	19	19	19	19	19	19	19	19		
Greatest Precipitation in 24 hours	117.3	81.7	99.9	29.5	27.7	34.2	25.4	36.1	31.8	72.9	96.1	66.4	117.3	
Years of Record	18	18	19	17	18	19	19	19	19	19	19	19		
Days with Rain	15	15	18	12	10	9	6	6	10	15	17	19	153	6
Days with Snow	4	1	1	0	0	0	0	0	0	0	1	2	9	6
Days with Precipitation	19	16	18	12	10	9	6	6	10	15	19	20	138	0

ATMOSPHERIC ENVIRONMENT SERVICE
SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
INTENSITE, DUREE ET FREQUENCE DES PLUIES

DATA INTEGRATION DIVISION
LA DIVISION DU TRAITEMENT DES DONNEES

GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

****

TABLE 1 COMOX AIRPORT B.C. 1021830

LATITUDE 4943 LONGITUDE 12454 ELEVATION/ALTITUDE 24 M

****

YEAR ANNEE	5 MIN	10 MIN	15 MIN	30 MIN	1 H	2 H	6 H	12 H	24 H
1963	5.1	5.6	6.3	8.9	10.9	13.7	26.4	39.6	63.8
1964	2.0	4.1	5.3	7.4	8.1	11.7	29.7	36.3	46.9
1965	4.1	5.1	6.6	11.7	16.8	17.3	37.6	50.0	53.1
1966	2.5	4.6	5.3	6.6	8.1	11.7	27.2	42.9	63.5
1967	1.8	3.0	3.6	5.6	10.9	14.0	36.3	53.3	56.6
1968	5.1	9.4	11.9	11.9	12.4	16.5	36.1	55.1	85.3
1969	3.8	4.3	4.6	5.3	8.9	12.2	26.2	50.0	64.8
1970	1.5	2.8	4.1	7.1	11.4	18.0	26.7	32.5	47.0
1971	2.0	2.8	3.3	5.6	7.9	11.9	21.1	33.0	57.4
1972	1.3	2.3	3.3	5.6	7.9	13.0	27.7	46.7	62.0
1973	1.8	2.8	4.1	7.1	11.7	18.3	33.8	41.4	72.4
1974	2.5	4.6	5.3	6.9	8.6	15.7	29.2	44.7	72.6
1975	4.3	4.8	5.1	5.3	8.4	14.7	31.2	41.9	59.7
1976	1.8	3.6	4.1	5.8	6.9	9.9	19.6	29.5	41.9
1977	2.3	3.3	3.3	4.8	7.4	11.2	25.9	40.6	49.0
1978	1.9	2.9	3.7	4.9	7.8	11.6	20.3	34.1	47.0
1979	5.0	6.0	7.0	9.3	9.9	14.1	30.0	44.8	62.7
1980	4.8	5.6	6.2	7.7	11.4	18.6	24.8	36.2	46.2
1981	2.3	3.5	4.9	8.4	15.0	20.4	37.2	42.2	51.1
1982	6.0	6.7	7.0	7.0	8.7	13.6	27.0	37.4	71.0
1983	3.1	5.7	7.5	11.4	16.8	24.8	36.2	60.2	89.6
1984	2.0	3.6	4.2	5.4	9.8	13.9	26.1	38.2	54.3
1985	1.8	2.5	2.7	3.8	6.5	10.7	23.2	39.0	40.0
1986	3.0	5.4	7.2	8.4	11.2	16.8	38.0	67.3	105.6
1987	1.8	2.7	4.0	6.3	8.6	12.1	28.9	34.3	46.8
1988	3.7	6.2	8.3	10.4	10.8	15.4	32.3	43.6	55.3
1989	2.9	4.0	5.1	8.6	10.8	12.9	25.3	37.0	39.3
1990	1.4	2.3	3.1	4.7	7.0	13.4	26.8	50.6	85.8
# YRS. ANNEES	28	28	28	28	28	28	28	28	28
MEAN MOYENNE	2.9	4.3	5.3	7.2	10.0	14.6	29.0	42.9	60.4
STD. DEV. ECART-TYPE	1.4	1.6	2.0	2.2	2.7	3.3	5.3	8.8	16.2
SKEW DISSYMETRIE	0.81	1.13	1.46	0.74	1.16	1.22	0.23	0.98	1.0
KURTOSIS KURTOSIS	2.68	5.03	6.32	3.01	4.28	5.04	2.52	4.19	4.1

NOTE:-99.9 INDICATES MSG DATA
DONNEES MANQUANTES

WARNING / AVERTISSEMENT
YEAR 1968 HAD VALUE GREATER THAN 100 YEAR STORM.
EN 1968 L'INTENSITE DE LA PLUIE A DE PASSE

CELLE POUR UNE PERIODE DE RETOUR DE 100 ANS
DATA/LA VALEUR = 11.9 100 YEAR/ANNEE = 11.5

NOTE: -99.9 INDICATES LESS THAN 10 YEARS OF DATA AVAILABLE
INDIQUE MOINS DE 10 ANNEES DE DONNEES DISPONIBLES

ATMOSPHERIC ENVIRONMENT SERVICE
SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
INTENSITE, DUREE ET FREQUENCE DES PLUIES

GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

TABLE 2 COMOX AIRPORT B.C. 1021830

LATITUDE 4943 LONGITUDE 12454 ELEVATION/ALTITUDE 24 M

RETURN PERIOD RAINFALL AMOUNTS (MM)
PERIODE DE RETOUR QUANTITIES DE PLUIE (MM)

DURATION DUREE	2 YR/ANS	5 YR/ANS	10 YR/ANS	25 YR/ANS	50 YR/ANS	100 YR/ANS	# YEARS ANNEES
5 MIN	2.7	3.9	4.7	5.7	6.4	7.2	28
10 MIN	4.0	5.5	6.4	7.7	8.6	9.4	28
15 MIN	4.9	6.7	7.9	9.3	10.4	11.5	28
30 MIN	6.8	8.8	10.1	11.7	13.0	14.2	28
1 H	9.6	12.0	13.6	15.6	17.1	18.6	28
2 H	14.0	17.0	18.9	21.4	23.2	25.0	28
6 H	28.1	32.8	35.9	39.8	42.7	45.6	28
12 H	41.5	49.3	54.4	60.9	65.7	70.5	28
24 H	57.7	72.0	81.6	93.6	102.5	111.3	28

RETURN PERIOD RAINFALL RATES (MM/HR)-95% CONFIDENCE LIMITS
INTENSITE DE LA PLUIE PAR PERIODE DE RETOUR (MM/H)-LIMITES DE CONFIANCE DE

DURATION DUREE	2 YR/ANS	5 YR/ANS	10 YR/ANS	25 YR/ANS	50 YR/ANS	100 YR/ANS
5 MIN	32.3	46.7	56.2	68.2	77.1	85.9
	+/- 5.5	+/- 9.3	+/- 12.6	+/- 16.9	+/- 20.1	+/- 23.6
10 MIN	24.1	32.8	38.6	45.9	51.1	56.7
	+/- 3.4	+/- 5.6	+/- 7.6	+/- 10.3	+/- 12.3	+/- 14.3
15 MIN	19.7	26.7	31.4	37.3	41.7	46.0
	+/- 2.7	+/- 4.6	+/- 6.2	+/- 8.3	+/- 10.1	+/- 11.6
30 MIN	13.7	17.6	20.2	23.5	25.9	28.3
	+/- 1.5	+/- 2.5	+/- 3.4	+/- 4.6	+/- 5.5	+/- 6.5
1 H	9.6	12.0	13.6	15.6	17.1	18.6
	+/- 0.9	+/- 1.6	+/- 2.1	+/- 2.9	+/- 3.5	+/- 4.0
2 H	7.0	8.5	9.5	10.7	11.6	12.5
	+/- 0.6	+/- 1.0	+/- 1.3	+/- 1.7	+/- 2.0	+/- 2.4
6 H	4.7	5.5	6.0	6.6	7.1	7.6
	+/- 0.3	+/- 0.5	+/- 0.7	+/- 0.9	+/- 1.1	+/- 1.3
12 H	3.5	4.1	4.5	5.1	5.5	5.9
	+/- 0.2	+/- 0.4	+/- 0.6	+/- 0.8	+/- 0.9	+/- 1.1

24 H	2.4	+/-	3.0	+/-	3.4	+/-	3.9	+/-	4.3	+/-	4.6	
	0.2		0.4		0.5		0.7		0.8		1.0	

ATMOSPHERIC ENVIRONMENT SERVICE
SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
INTENSITE, DUREE ET FREQUENCE DES PLUIES

GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

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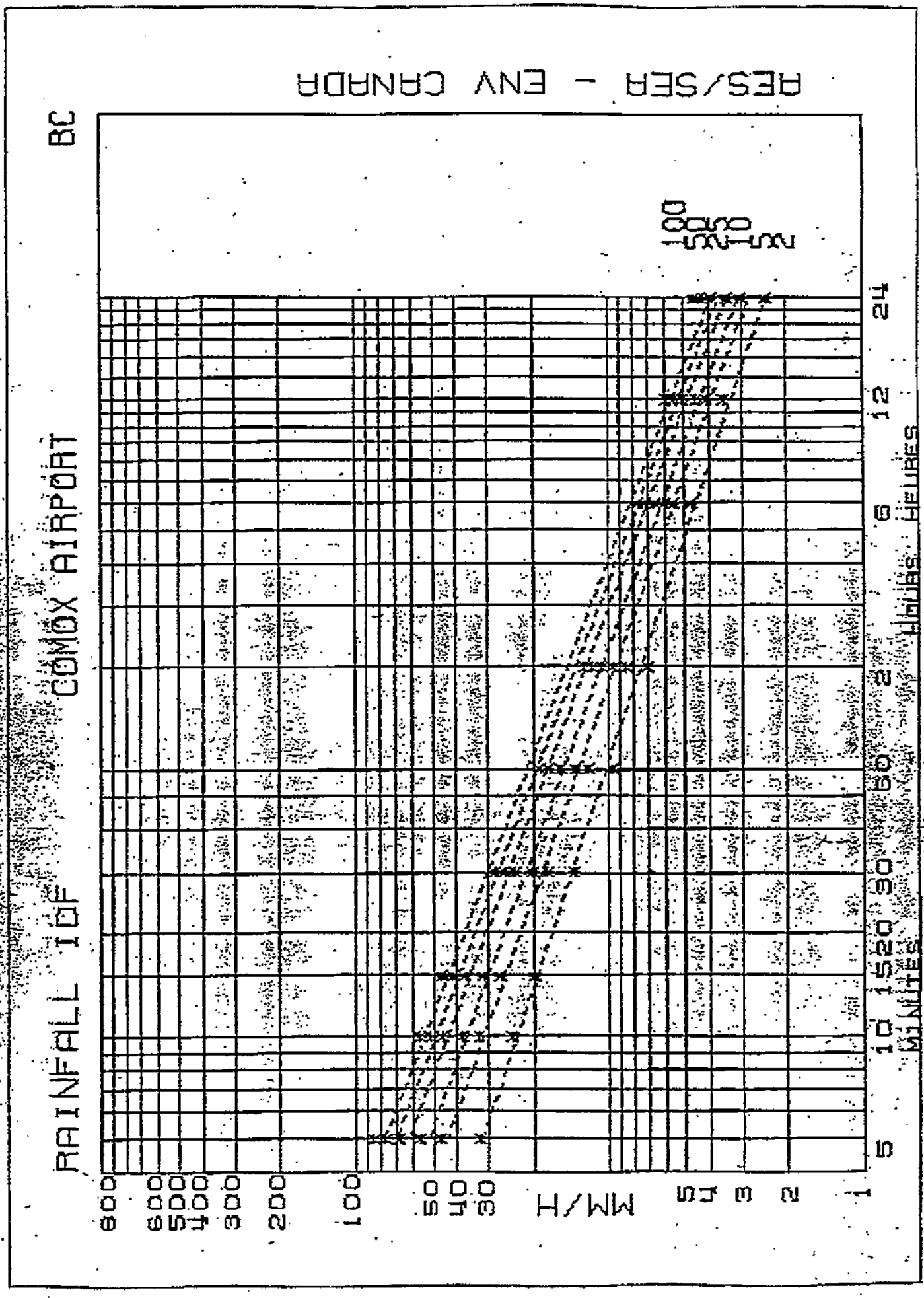
TABLE 3 COMOX AIRPORT B.C. 1021830

LATITUDE 4943 LONGITUDE 12454 ELEVATION/ALTITUDE 24 M

****

INTERPOLATION EQUATION / EQUATION D'INTERPOLATION: R = A * T ** B
R = RAINFALL RATE / INTENSITE DE LA PLUIE (MM /HR)
T = TIME IN HOURS / TEMPS EN HEURES

STATISTICS / STATISTIQUES	2 YR ANS	5 YR ANS	10 YR ANS	25 YR ANS	50 YR ANS	100 YR ANS
MEAN OF R / MOYENNE DE R	12.9	17.4	20.3	24.0	26.8	29.5
STD. DEV. R / ECART-TYPE	10.3	15.0	18.1	22.1	25.0	27.9
STD. ERROR / ERREUR STANDARD	0.5	1.3	1.9	2.6	3.1	3.7
COEFF. (A) / COEFFICIENT (A)	10.2	13.1	15.0	17.4	19.2	20.9
EXPONENT (B) / EXPOSANT (B)	-0.456	-0.486	-0.500	-0.513	-0.520	-0.527
MEAN % ERROR / % D'ERREUR	3.5	5.5	6.7	7.8	8.5	9.0


RES/SEA - ENV CANADA
BC
COMOX AIRPORT
RAINFALL IDF
MM/H
MINUTES
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1

ATMOSPHERIC ENVIRONMENT SERVICE
SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
INTENSITE, DUREE ET FREQUENCE DES PLUIES

GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

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TABLE 2 COURTENAY PUNTLEDGE BCHPB.C. 1021990

LATITUDE 4941 LONGITUDE 12502 ELEVATION/ALTITUDE 24

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RETURN PERIOD RAINFALL AMOUNTS (MM)
PERIODE DE RETOUR QUANTITIES DE PLUIE (MM)

DURATION DUREE	2 YR/ANS	5 YR/ANS	10 YR/ANS	25 YR/ANS	50 YR/ANS	100 YR/ANS	# YEARS ANNEES
5 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	0
10 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	0
15 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	0
30 MIN	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	6
1 H	10.3	12.8	14.6	16.7	18.3	19.9	27
2 H	15.5	18.6	20.6	23.2	25.1	27.0	27
6 H	33.1	40.5	45.4	51.6	56.2	60.8	27
12 H	49.2	61.6	69.8	80.2	87.9	95.5	27
24 H	70.1	91.4	105.5	123.3	136.5	149.6	27

RETURN PERIOD RAINFALL RATES (MM/HR)-95% CONFIDENCE LIMITS
INTENSITE DE LA PLUIE PAR PERIODE DE RETOUR (MM/H)-LIMITES DE CONFIANCE DE

DURATION DUREE	2 YR/ANS	5 YR/ANS	10 YR/ANS	25 YR/ANS	50 YR/ANS	100 YR/ANS
5 MIN	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0
10 MIN	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0
15 MIN	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0
30 MIN	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0	-99.9 +/- 0.0
1 H	10.3 +/- 1.0	12.8 +/- 1.7	14.6 +/- 2.3	16.7 +/- 3.1	18.3 +/- 3.7	19.9 +/- 4.3
2 H	7.7 +/- 0.6	9.3 +/- 1.0	10.3 +/- 1.4	11.6 +/- 1.9	12.5 +/- 2.2	13.5 +/- 2.6
6 H	5.5 +/- 0.5	6.7 +/- 0.8	7.6 +/- 1.1	8.6 +/- 1.5	9.4 +/- 1.8	10.1 +/- 2.1
12 H	4.1 +/- 0.4	5.1 +/- 0.7	5.8 +/- 0.9	6.7 +/- 1.2	7.3 +/- 1.5	8.0 +/- 1.7
24 H	2.9 +/- 0.3	3.8 +/- 0.6	4.4 +/- 0.8	5.1 +/- 1.1	5.7 +/- 1.3	6.2 +/- 1.5

ATMOSPHERIC ENVIRONMENT SERVICE
SERVICE DE L'ENVIRONNEMENT ATMOSPHERIQUE

ATMOSPHERIC ENVIRONMENT SERVICE
SERVICE DE L"ENVIRONNEMENT ATMOSPHERIQUE

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
INTENSITE, DUREE ET FREQUENCE DES PLUIES

DATA INTEGRATION DIVISION
LA DIVISION DU TRAITEMENT DES DONNEES

GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

TABLE 1 COURTENAY PUNTLEDGE BCHPB.C. 1021990

LATITUDE 4941 LONGITUDE 12502 ELEVATION/ALTITUDE 24

YEAR ANNEE	5 MIN	10 MIN	15 MIN	30 MIN	1 H	2 H	6 H	12 H	24
1964	-99.9	-99.9	-99.9	4.3	7.1	13.7	31.5	41.1	62.
1965	-99.9	-99.9	-99.9	5.8	10.4	12.2	27.9	36.8	55.
1966	-99.9	-99.9	-99.9	8.6	16.0	16.0	31.0	49.0	79.
1967	-99.9	-99.9	-99.9	5.3	9.4	15.2	30.7	44.4	51.
1968	-99.9	-99.9	-99.9	9.9	9.9	14.0	39.4	69.6	124.
1969	-99.9	-99.9	-99.9	4.8	7.1	14.2	36.6	55.9	77.
1970	-99.9	-99.9	-99.9	-99.9	8.4	13.7	30.7	37.6	58.
1971	-99.9	-99.9	-99.9	-99.9	7.1	14.2	30.5	46.5	82.
1972	-99.9	-99.9	-99.9	-99.9	8.6	12.2	25.1	41.4	62.
1973	-99.9	-99.9	-99.9	-99.9	14.2	15.0	28.2	44.2	80.
1974	-99.9	-99.9	-99.9	-99.9	6.9	12.7	23.9	37.8	68.
1975	-99.9	-99.9	-99.9	-99.9	8.1	15.5	31.0	48.8	63.
1976	-99.9	-99.9	-99.9	-99.9	5.8	9.7	21.8	33.5	45.
1977	-99.9	-99.9	-99.9	-99.9	9.7	12.7	31.2	41.1	46.
1978	-99.9	-99.9	-99.9	-99.9	13.2	17.2	27.7	45.2	64.
1979	-99.9	-99.9	-99.9	-99.9	10.8	11.8	28.0	47.6	65.
1980	-99.9	-99.9	-99.9	-99.9	14.0	23.8	33.4	43.2	56.
1981	-99.9	-99.9	-99.9	-99.9	12.4	17.6	38.0	45.6	64.
1982	-99.9	-99.9	-99.9	-99.9	9.0	17.2	34.4	53.8	63.
1983	-99.9	-99.9	-99.9	-99.9	12.4	21.2	53.6	86.8	120.
1984	-99.9	-99.9	-99.9	-99.9	11.6	17.7	37.4	51.4	70.
1985	-99.9	-99.9	-99.9	-99.9	11.6	17.8	32.0	43.4	47.
1986	-99.9	-99.9	-99.9	-99.9	12.4	18.4	41.4	69.4	112.
1987	-99.9	-99.9	-99.9	-99.9	12.8	23.0	53.0	80.8	112.
1988	-99.9	-99.9	-99.9	-99.9	11.8	21.0	51.8	68.8	87.
1989	-99.9	-99.9	-99.9	-99.9	17.4	17.8	35.4	53.4	56.
1990	-99.9	-99.9	-99.9	-99.9	12.2	17.8	44.4	72.6	121.

NOTE:-99.9 INDICATES MSG DATA
DONNEES MANQUANTES

# YRS. ANNEES	0	0	0	6	27	27	27	27	27
MEAN MOYENNE	-99.9	-99.9	-99.9	-99.9	10.8	16.0	34.4	51.5	74.
STD. DEV. ECART-TYPE	-99.9	-99.9	-99.9	-99.9	2.9	3.5	8.4	14.0	24.
SKEW DISSYMETRIE	-99.90	-99.90	-99.90	-99.90	0.30	0.52	1.03	1.14	1.
KURTOSIS KURTOSIS	-99.90	-99.90	-99.90	-99.90	2.93	3.18	3.87	3.69	3.

NOTE: -99.9 INDICATES LESS THAN 10 YEARS OF DATA AVAILABLE
INDIQUE MOINS DE 10 ANNEES DE DONNEES DISPONIBLES

RAINFALL INTENSITY-DURATION FREQUENCY VALUES
INTENSITE, DUREE ET FREQUENCE DES PLUIES

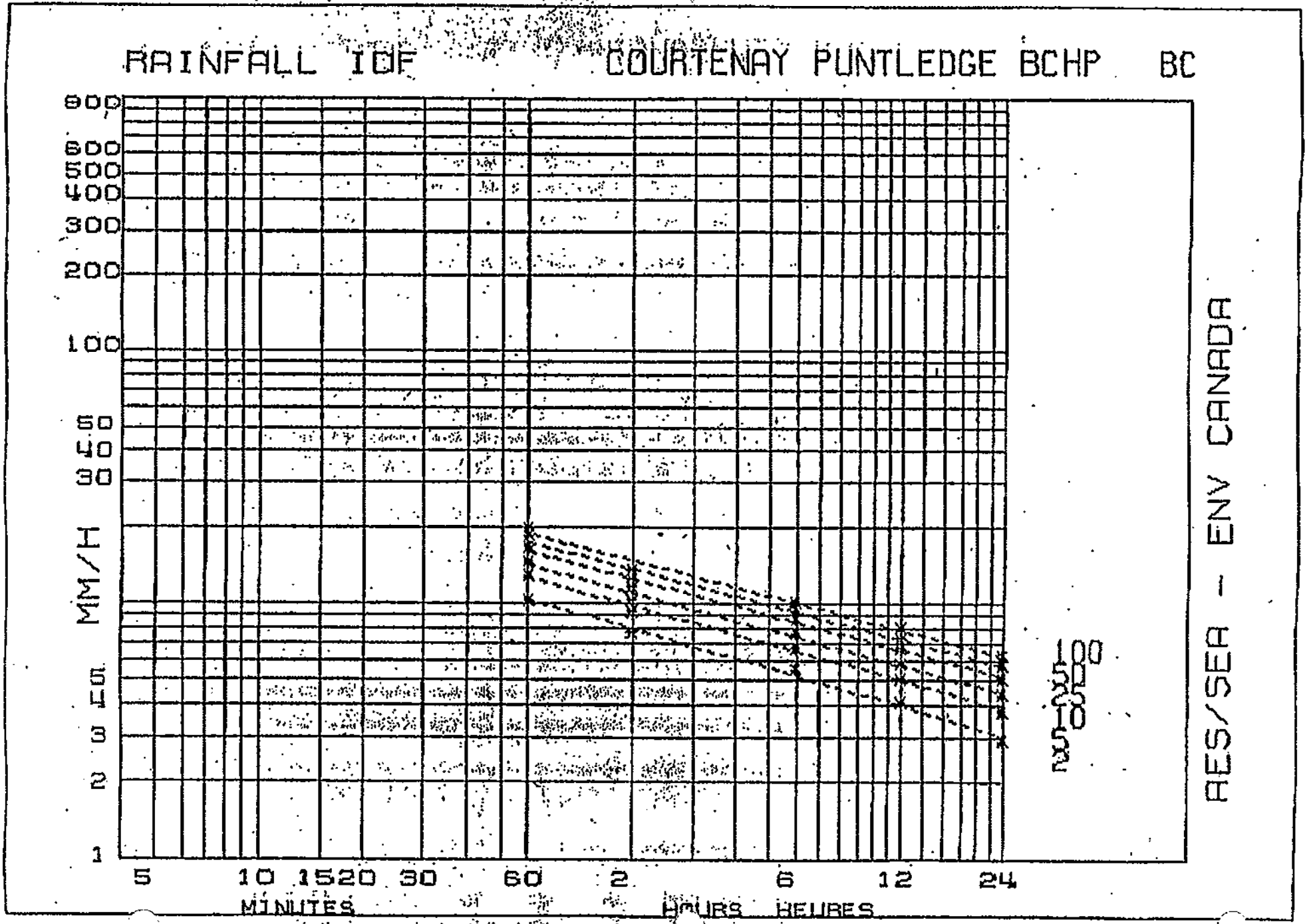
GUMBEL - METHOD OF MOMENTS/METHODE DES MOMENTS - 1990

TABLE 3 COURTENAY PUNTLEDGE BCHPB.C. 1021990

LATITUDE 4941 LONGITUDE 12502 ELEVATION/ALTITUDE 24 M

INTERPOLATION EQUATION / EQUATION D'INTERPOLATION: R = A * T ** B
R = RAINFALL RATE / INTENSITE DE LA PLUIE (MM /HR)
T = TIME IN HOURS / TEMPS EN HEURES

STATISTICS STATISTIQUES	2 YR ANS	5 YR ANS	10 YR ANS	25 YR ANS	50 YR ANS	100 YR ANS
MEAN OF R. MOYENNE DE R	6.1	7.5	8.5	9.7	10.6	11.5
STD. DEV. R. ECART-TYPE	2.9	3.5	4.0	4.5	4.9	5.3
STD. ERROR ERREUR STANDARD	0.2	0.3	0.4	0.6	0.8	0.9
COEFF. (A) COEFFICIENT (A)	10.3	12.6	14.0	15.9	17.3	18.7
EXPONENT (B) EXPOSANT (B)	-0.384	-0.369	-0.362	-0.355	-0.351	-0.348
MEAN % ERROR % D'ERREUR	3.2	2.9	3.0	3.1	3.2	3.4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COURTENAY PUNTLEDGE BCHP
BC
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200
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MM/H
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20
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60
2
6
12
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MINUTES
HOURS
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AES/SEA - ENV CANADA
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25
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2

APPENDIX D

ANALYTICAL DATA

RESULTS OF ANALYSIS File No. G2832

		NNO	242 Portal	Iron River #1	Cowie Creek	Cougar Smith Creek
		96 07 08	96 07 08	96 07 08	96 07 08	96 07 08
Physical Tests						
Conductivity (umhos/cm)		-	53.4	87.3	77.4	76.1
Total Dissolved Solids		-	36	62	48	46
Hardness	CaCO3	-	21.7	38.5	34.2	33.6
pH		-	7.10	7.35	7.32	7.35
Total Suspended Solids		4	2	1	4	1
Dissolved Anions						
Alkalinity - Total	CaCO3	-	13.6	38.0	38.1	37.4
Sulphate SO4		15.5	9.6	4.9	1.9	1.0
Nutrients						
Ammonia Nitrogen	N	-	<0.005	<0.005	0.048	<0.005
Nitrate Nitrogen	N	-	0.011	0.023	0.050	<0.005
Nitrite Nitrogen	N	-	<0.001	0.001	<0.001	<0.001
Total Dissolved Phosphate	P	-	0.001	<0.001	0.002	0.002
Total Phosphorus	P	-	0.003	<0.001	0.002	0.002

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G2832

		242 Portal 96 07 08	Iron River #1 96 07 08	Cowie Creek 96 07 08	Cougar Smith Creek 96 07 08
Total Metals					
Aluminum	T-Al	<0.2	<0.2	<0.2	<0.2
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	0.03	0.01	0.01	<0.01
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1
Boron	T-B	<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	6.49	13.7	10.1	9.60
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe	0.62	<0.03	<0.03	<0.03
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg	1.34	1.07	2.36	2.40
Manganese	T-Mn	0.050	<0.005	<0.005	<0.005
Molybdenum	T-Mo	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	<2	<2	<2	<2
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	2.00	2.43	4.11	4.34
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	<2	<2	<2	<2
Strontium	T-Sr	0.013	0.051	0.023	0.021
Thallium	T-Tl	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03
Zinc	T-Zn	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G2832

		242 Portal 96 07 08	Iron River #1 96 07 08	Cowie Creek 96 07 08	Cougar Smith Creek 96 07 08
Dissolved Metals					
Aluminum	D-Al	<0.2	<0.2	<0.2	<0.2
Antimony	D-Sb	<0.2	<0.2	<0.2	<0.2
Arsenic	D-As	<0.2	<0.2	<0.2	<0.2
Barium	D-Ba	0.03	0.01	0.01	<0.01
Beryllium	D-Be	<0.005	<0.005	<0.005	<0.005
Bismuth	D-Bi	<0.1	<0.1	<0.1	<0.1
Boron	D-B	<0.1	<0.1	<0.1	<0.1
Cadmium	D-Cd	<0.01	<0.01	<0.01	<0.01
Calcium	D-Ca	6.49	13.6	9.90	9.57
Chromium	D-Cr	<0.01	<0.01	<0.01	<0.01
Cobalt	D-Co	<0.01	<0.01	<0.01	<0.01
Copper	D-Cu	<0.01	<0.01	<0.01	<0.01
Iron	D-Fe	0.07	<0.03	<0.03	<0.03
Lead	D-Pb	<0.05	<0.05	<0.05	<0.05
Lithium	D-Li	<0.01	<0.01	<0.01	<0.01
Magnesium	D-Mg	1.34	1.08	2.29	2.37
Manganese	D-Mn	0.038	<0.005	<0.005	<0.005
Molybdenum	D-Mo	<0.03	<0.03	<0.03	<0.03
Nickel	D-Ni	<0.02	<0.02	<0.02	<0.02
Phosphorus	D-P	<0.3	<0.3	<0.3	<0.3
Potassium	D-K	<2	<2	<2	<2
Selenium	D-Se	<0.2	<0.2	<0.2	<0.2
Silicon	D-Si	2.00	2.43	4.04	4.33
Silver	D-Ag	<0.01	<0.01	<0.01	<0.01
Sodium	D-Na	<2	<2	<2	<2
Strontium	D-Sr	0.013	0.050	0.023	0.021
Thallium	D-Tl	<0.1	<0.1	<0.1	<0.1
Tin	D-Sn	<0.03	<0.03	<0.03	<0.03
Titanium	D-Ti	<0.01	<0.01	<0.01	<0.01
Vanadium	D-V	<0.03	<0.03	<0.03	<0.03
Zinc	D-Zn	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G4265

		Cougar Smith Upstream 96 08 19	Tsable River 96 08 19	Argonaut Mine Pit 96 08 19	Ditch 1 96 08 19	Ditch 2 96 08 19
Physical Tests						
Conductivity (umhos/cm)		96.2	536	177	-	-
Total Dissolved Solids		62	278	102	-	-
Hardness	CaCO3	34.8	49.9	-	-	-
pH		7.75	7.62	8.30	-	-
Total Suspended Solids		2	1	-	-	-
Dissolved Anions						
Alkalinity - Total	CaCO3	45.7	26.7	72.4	-	-
Sulphate SO4		1.7	24.9	17.0	2060	1770
Nutrients						
Ammonia Nitrogen	N	<0.005	<0.005	<0.005	-	-
Total Kjeldahl Nitrogen	N	0.06	0.07	-	-	-
Nitrate Nitrogen	N	0.098	0.085	<0.005	-	-
Nitrite Nitrogen	N	<0.001	<0.001	<0.001	-	-
Total Dissolved Phosphate	P	0.004	<0.001	<0.001	-	-
Total Phosphate	P	0.004	0.002	0.003	-	-

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G4265

		Cowie Creek	Sump @ 3 Mains
		96 08 19	96 08 19
Physical Tests			
Conductivity (umhos/cm)		89.0	3930
Total Dissolved Solids		52	-
Hardness	CaCO3	34.9	-
pH		7.66	7.55
Total Suspended Solids		1	6
Dissolved Anions			
Alkalinity - Total	CaCO3	43.9	415
Sulphate SO4		2.1	1760
Nutrients			
Ammonia Nitrogen	N	<0.005	-
Total Kjeldahl Nitrogen	N	0.07	-
Nitrate Nitrogen	N	0.066	-
Nitrite Nitrogen	N	<0.001	-
Total Dissolved Phosphate	P	<0.001	-
Total Phosphate	P	0.001	-

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G4265

		Cougar Smith Creek 96 08 19	Cougar Smith Upstream 96 08 19	Tsable River 96 08 19	Argonaut Mine Pit 96 08 19	Cowie Creek 96 08 19
Total Metals						
Aluminum	T-Al	<0.2	<0.2	<0.2	<0.2	<0.2
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	<0.01	<0.01	<0.01	<0.01	0.01
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	T-B	<0.1	<0.1	0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	9.58	11.7	9.19	31.2	11.2
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe	<0.03	<0.03	<0.03	<0.03	<0.03
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg	2.70	2.93	8.42	1.45	2.52
Manganese	T-Mn	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	T-Mo	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	<2	<2	2	<2	<2
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	6.27	5.26	2.01	2.98	4.65
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	3	2	75	<2	2
Strontium	T-Sr	0.027	0.028	0.070	0.054	0.028
Thallium	T-Tl	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	T-Zn	<0.005	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G4265

		Cougar Smith Creek 96 08 19	Cougar Smith Upstream 96 08 19	Tsable River 96 08 19	Argonaut Mine Pit 96 08 19	Cowie Creek 96 08 19
Dissolved Metals						
Aluminum	D-Al	<0.2	<0.2	<0.2	<0.2	<0.2
Antimony	D-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	D-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	D-Ba	<0.01	<0.01	<0.01	<0.01	<0.01
Beryllium	D-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	D-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	D-B	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	D-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	D-Ca	9.58	9.77	7.85	30.0	10.1
Chromium	D-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	D-Co	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	D-Cu	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	D-Fe	<0.03	<0.03	<0.03	<0.03	<0.03
Lead	D-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	D-Li	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	D-Mg	2.70	2.53	7.35	1.42	2.34
Manganese	D-Mn	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	D-Mo	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	D-Ni	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus	D-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	D-K	<2	<2	2	<2	<2
Selenium	D-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	D-Si	6.27	5.26	2.01	2.94	4.65
Silver	D-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	D-Na	3	2	66	<2	2
Strontium	D-Sr	0.027	0.024	0.055	0.054	0.027
Thallium	D-Tl	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	D-Sn	<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	D-Ti	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	D-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	D-Zn	<0.005	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G4265

		SPS	LLO	NNO	QRD	Cougar Smith Creek
		96 08 19	96 08 19	96 08 19	96 08 19	96 08 19
Physical Tests						
Conductivity (umhos/cm)		-	143	-	-	86.8
Total Dissolved Solids		-	-	-	-	60
Hardness	CaCO3	-	-	-	-	35.0
pH		7.47	7.15	-	-	7.76
Total Suspended Solids		-	13	1	1	1
Dissolved Anions						
Alkalinity - Total	CaCO3	-	-	-	-	40.2
Sulphate SO4		865	42.8	18.4	13.1	<1.0
Nutrients						
Ammonia Nitrogen	N	-	-	-	-	<0.005
Total Kjeldahl Nitrogen	N	-	-	-	-	0.09
Nitrate Nitrogen	N	-	-	-	-	0.065
Nitrite Nitrogen	N	-	-	-	-	<0.001
Total Dissolved Phosphate	P	-	-	-	-	0.001
Total Phosphate	P	-	-	-	-	0.003

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G4889

		Road #1	Road #2	Cougar Smith Creek	Cowie Creek	Tsable River
		96 09 09	96 09 09	96 09 09	96 09 09	96 09 09
Physical Tests						
Conductivity (umhos/cm)		-	-	87.3	95.4	4380
Total Dissolved Solids		-	-	52	52	2300
Hardness	CaCO3	-	-	33.5	38.3	408
pH		-	-	7.84	7.71	7.47
Total Suspended Solids		-	-	1	1	1
Dissolved Anions						
Alkalinity - Total	CaCO3	-	-	41.2	46.7	38.1
Sulphate SO4		3.1	1510	2.1	3.1	162
Nutrients						
Ammonia Nitrogen	N	-	-	<0.005	<0.005	<0.005
Total Kjeldahl Nitrogen	N	-	-	0.13	0.08	0.08
Nitrate Nitrogen	N	-	-	0.061	0.078	0.101
Nitrite Nitrogen	N	-	-	0.001	0.002	0.002
Total Dissolved Phosphate	P	-	-	0.006	0.004	0.003
Total Phosphate	P	-	-	0.007	0.004	0.003

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G4889

		IRU	IRD	242 Portal Pond	Cougar Smith Creek	Cowie Creek
		96 09 09	96 09 09	96 09 09	96 09 09	96 09 09
Total Metals						
Aluminum	T-Al	<0.2	<0.2	1.8	<0.2	<0.2
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	<0.01	<0.01	0.03	<0.01	<0.01
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	T-B	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	13.1	14.1	12.6	9.77	11.5
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	0.02	<0.01	<0.01
Iron	T-Fe	<0.03	<0.03	1.78	0.03	<0.03
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg	1.07	1.23	1.94	2.86	2.65
Manganese	T-Mn	<0.005	<0.005	0.115	<0.005	<0.005
Molybdenum	T-Mo	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	<2	<2	<2	<2	<2
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	2.38	2.44	3.54	6.43	4.71
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	<2	3	<2	3	3
Strontium	T-Sr	0.048	0.053	0.032	0.026	0.026
Thallium	T-Tl	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01	0.05	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	T-Zn	<0.005	<0.005	0.015	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

		Tsable River 96 09 09
Total Metals		
Aluminum	T-Al	<0.2
Antimony	T-Sb	<0.2
Arsenic	T-As	<0.2
Barium	T-Ba	0.02
Beryllium	T-Be	<0.005
Bismuth	T-Bi	<0.1
Boron	T-B	0.4
Cadmium	T-Cd	<0.01
Calcium	T-Ca	33.7
Chromium	T-Cr	<0.01
Cobalt	T-Co	<0.01
Copper	T-Cu	<0.01
Iron	T-Fe	<0.03
Lead	T-Pb	<0.05
Lithium	T-Li	0.01
Magnesium	T-Mg	80.3
Manganese	T-Mn	<0.005
Molybdenum	T-Mo	<0.03
Nickel	T-Ni	<0.02
Phosphorus	T-P	<0.3
Potassium	T-K	25
Selenium	T-Se	<0.2
Silicon	T-Si	1.92
Silver	T-Ag	<0.01
Sodium	T-Na	643
Strontium	T-Sr	0.505
Thallium	T-Tl	<0.1
Tin	T-Sn	<0.03
Titanium	T-Ti	<0.01
Vanadium	T-V	<0.03
Zinc	T-Zn	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G4889

		LLO	IRU	IRD	242 Portal Pond	Cougar Smith Creek
		96 09 09	96 09 09	96 09 09	96 09 09	96 09 09
Dissolved Metals						
Aluminum	D-Al	-	<0.2	<0.2	<0.2	<0.2
Antimony	D-Sb	-	<0.2	<0.2	<0.2	<0.2
Arsenic	D-As	-	<0.2	<0.2	<0.2	<0.2
Barium	D-Ba	-	<0.01	<0.01	0.02	<0.01
Beryllium	D-Be	-	<0.005	<0.005	<0.005	<0.005
Bismuth	D-Bi	-	<0.1	<0.1	<0.1	<0.1
Boron	D-B	-	<0.1	<0.1	<0.1	<0.1
Cadmium	D-Cd	-	<0.01	<0.01	<0.01	<0.01
Calcium	D-Ca	13.7	12.7	13.8	10.2	9.01
Chromium	D-Cr	-	<0.01	<0.01	<0.01	<0.01
Cobalt	D-Co	-	<0.01	<0.01	<0.01	<0.01
Copper	D-Cu	-	<0.01	<0.01	<0.01	<0.01
Iron	D-Fe	-	<0.03	<0.03	<0.03	<0.03
Lead	D-Pb	-	<0.05	<0.05	<0.05	<0.05
Lithium	D-Li	-	<0.01	<0.01	<0.01	<0.01
Magnesium	D-Mg	1.77	1.03	1.21	1.61	2.67
Manganese	D-Mn	-	<0.005	<0.005	0.066	<0.005
Molybdenum	D-Mo	-	<0.03	<0.03	<0.03	<0.03
Nickel	D-Ni	-	<0.02	<0.02	<0.02	<0.02
Phosphorus	D-P	-	<0.3	<0.3	<0.3	<0.3
Potassium	D-K	-	<2	<2	<2	<2
Selenium	D-Se	-	<0.2	<0.2	<0.2	<0.2
Silicon	D-Si	-	2.38	2.44	2.69	6.41
Silver	D-Ag	-	<0.01	<0.01	<0.01	<0.01
Sodium	D-Na	-	<2	3	<2	3
Strontium	D-Sr	-	0.047	0.052	0.026	0.024
Thallium	D-Tl	-	<0.1	<0.1	<0.1	<0.1
Tin	D-Sn	-	<0.03	<0.03	<0.03	<0.03
Titanium	D-Ti	-	<0.01	<0.01	<0.01	<0.01
Vanadium	D-V	-	<0.03	<0.03	<0.03	<0.03
Zinc	D-Zn	-	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G4889

		Cowie Creek 96 09 09	Tsable River 96 09 09
Dissolved Metals			
Aluminum	D-Al	<0.2	<0.2
Antimony	D-Sb	<0.2	<0.2
Arsenic	D-As	<0.2	<0.2
Barium	D-Ba	<0.01	0.02
Beryllium	D-Be	<0.005	<0.005
Bismuth	D-Bi	<0.1	<0.1
Boron	D-B	<0.1	0.4
Cadmium	D-Cd	<0.01	<0.01
Calcium	D-Ca	11.1	33.1
Chromium	D-Cr	<0.01	<0.01
Cobalt	D-Co	<0.01	<0.01
Copper	D-Cu	<0.01	<0.01
Iron	D-Fe	<0.03	<0.03
Lead	D-Pb	<0.05	<0.05
Lithium	D-Li	<0.01	0.01
Magnesium	D-Mg	2.58	79.1
Manganese	D-Mn	<0.005	<0.005
Molybdenum	D-Mo	<0.03	<0.03
Nickel	D-Ni	<0.02	<0.02
Phosphorus	D-P	<0.3	<0.3
Potassium	D-K	<2	24
Selenium	D-Se	<0.2	<0.2
Silicon	D-Si	4.71	1.92
Silver	D-Ag	<0.01	<0.01
Sodium	D-Na	2	636
Strontium	D-Sr	0.026	0.499
Thallium	D-Tl	<0.1	<0.1
Tin	D-Sn	<0.03	<0.03
Titanium	D-Ti	<0.01	<0.01
Vanadium	D-V	<0.03	<0.03
Zinc	D-Zn	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G5313

		IRD	242 Pond	242 Well	Tsable River	Cougar Creek Upstream
		96 09 23	96 09 19	96 09 23	96 09 18	96 09 18
Physical Tests						
Conductivity (umhos/cm)		-	-	-	40.0	79.7
Total Dissolved Solids		-	-	-	21	46
Hardness	CaCO3	-	-	-	14.1	36.5
pH		-	7.40	7.69	7.47	7.58
Total Suspended Solids		<1	19	3	3	18
Dissolved Anions						
Alkalinity - Total	CaCO3	-	72.7	195	14.6	40.4
Sulphate SO4		7.4	44.8	20.9	2.8	<1.0
Nutrients						
Ammonia Nitrogen	N	-	-	-	<0.005	0.015
Nitrate Nitrogen	N	-	-	-	0.047	0.084
Nitrite Nitrogen	N	-	-	-	0.001	0.001
Total Dissolved Phosphate	P	-	-	-	0.005	0.005
Total Phosphate	P	-	-	-	0.005	0.027

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G5313

		Cougar Creek @ Bridge 96 09 18	Cowie Creek 96 09 18	4S Sump 96 09 17	2N Highwall Seep 96 09 12	Ditch 1 96 09 23
Physical Tests						
Conductivity (umhos/cm)		83.0	90.9	-	4130	-
Total Dissolved Solids		53	53	-	3800	-
Hardness	CaCO3	37.1	43.8	-	1490	-
pH		7.66	7.77	7.93	7.03	-
Total Suspended Solids		1	<1	-	9	-
Dissolved Anions						
Alkalinity - Total	CaCO3	40.0	46.9	-	97.2	-
Sulphate SO4		4.0	1.5	366	2610	2150
Nutrients						
Ammonia Nitrogen	N	<0.005	<0.005	-	0.093	-
Nitrate Nitrogen	N	0.058	0.041	-	0.335	-
Nitrite Nitrogen	N	0.001	<0.001	-	0.001	-
Total Dissolved Phosphate	P	0.007	<0.001	-	0.003	-
Total Phosphate	P	0.007	0.001	-	0.009	-

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G5313

		Tsable River 96 09 18	Cougar Creek Upstream 96 09 18	Cougar Creek @ Bridge 96 09 18	Cowie Creek 96 09 18	2N Highwall Seep 96 09 12
Total Metals						
Aluminum	T-Al	<0.2	<0.2	<0.2	<0.2	0.3
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	<0.01	<0.01	<0.01	<0.01	0.01
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	T-B	<0.1	<0.1	<0.1	<0.1	1.2
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	4.43	10.3	10.1	12.8	445
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe	<0.03	0.15	0.03	<0.03	0.25
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01	<0.01	<0.01	0.04
Magnesium	T-Mg	0.87	2.58	2.89	2.87	95.7
Manganese	T-Mn	<0.005	0.015	<0.005	<0.005	0.555
Molybdenum	T-Mo	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02	<0.02	0.02
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	<2	<2	<2	<2	6
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	1.57	4.42	6.22	4.11	5.19
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	2	<2	3	2	516
Strontium	T-Sr	0.017	0.027	0.031	0.031	3.91
Thallium	T-Tl	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01	<0.01	<0.01	0.02
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	T-Zn	<0.005	<0.005	<0.005	<0.005	0.007

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G5313

		Tsable River 96 09 18	Cougar Creek Upstream 96 09 18	Cougar Creek @ Bridge 96 09 18	Cowie Creek 96 09 18	4S Sump 96 09 17
Dissolved Metals						
Aluminum	D-Al	<0.2	<0.2	<0.2	<0.2	<0.2
Antimony	D-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	D-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	D-Ba	<0.01	<0.01	<0.01	<0.01	0.06
Beryllium	D-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	D-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	D-B	<0.1	<0.1	<0.1	<0.1	0.3
Cadmium	D-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	D-Ca	4.29	10.3	10.1	12.8	143
Chromium	D-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	D-Co	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	D-Cu	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	D-Fe	<0.03	<0.03	<0.03	<0.03	<0.03
Lead	D-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	D-Li	<0.01	<0.01	<0.01	<0.01	0.01
Magnesium	D-Mg	0.83	2.58	2.89	2.87	15.0
Manganese	D-Mn	<0.005	<0.005	<0.005	<0.005	0.930
Molybdenum	D-Mo	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	D-Ni	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus	D-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	D-K	<2	<2	<2	<2	<2
Selenium	D-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	D-Si	1.55	4.42	6.22	4.11	5.66
Silver	D-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	D-Na	2	<2	3	2	26
Strontium	D-Sr	0.016	0.027	0.031	0.031	0.834
Thallium	D-Tl	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	D-Sn	<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	D-Ti	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	D-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	D-Zn	<0.005	<0.005	<0.005	<0.005	0.010

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G5846

		IRU	IRD	Upper Cougar	T River	Cougar @ Hwy
		96 10 07	96 10 07	96 10 03	96 10 03	96 10 03
Physical Tests						
Conductivity (umhos/cm)		95.1	102	89.9	81.9	87.0
Total Dissolved Solids		49	67	54	47	51
Hardness	CaCO3	41.1	44.6	42.6	22.5	37.5
pH		7.63	7.70	7.79	7.58	7.69
Total Suspended Solids		1	2	3	4	5
Dissolved Anions						
Alkalinity - Total	CaCO3	37.2	40.5	43.7	23.3	39.1
Sulphate SO4		6.2	7.2	2.6	6.4	2.2
Nutrients						
Ammonia Nitrogen	N	<0.005	<0.005	<0.005	<0.005	<0.005
Total Kjeldahl Nitrogen	N	0.12	0.11	-	-	-
Nitrate Nitrogen	N	0.014	0.013	0.044	0.065	0.024
Nitrite Nitrogen	N	0.001	0.002	0.001	0.001	0.001
Total Dissolved Phosphate	P	0.004	0.005	0.004	0.004	0.005
Total Phosphate	P	0.004	0.005		-	-

Results are expressed as milligrams per litre except where noted.
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RESULTS OF ANALYSIS

File No. G5846

		Lab Road 96 10 07	Cowie @ Upper Bridge 96 10 03
Physical Tests			
Conductivity (umhos/cm)		8300	92.3
Total Dissolved Solids		-	56
Hardness	CaCO3	2800	43.8
pH		2.46	7.71
Total Suspended Solids		-	<1
Dissolved Anions			
Alkalinity - Total	CaCO3	<1.0	45.0
Sulphate SO4		3790	2.6
Nutrients			
Ammonia Nitrogen	N	-	<0.005
Total Kjeldahl Nitrogen	N	-	-
Nitrate Nitrogen	N	-	0.045
Nitrite Nitrogen	N	-	0.001
Total Dissolved Phosphate	P	-	0.004
Total Phosphate	P	-	-

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G5846

		242 U/G Sump 96 10 04	242 U/G Sump 96 10 07	IRU 96 10 07	IRD 96 10 07	Upper Cougar 96 10 03
Total Metals						
Aluminum	T-Al	<0.2	<0.2	<0.2	<0.2	<0.2
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	0.08	0.07	0.01	0.01	0.01
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	T-B	0.1	0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	63.2	53.5	14.7	15.7	12.6
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe	0.30	0.14	<0.03	<0.03	<0.03
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg	5.77	5.47	1.18	1.32	2.84
Manganese	T-Mn	0.150	0.127	<0.005	<0.005	<0.005
Molybdenum	T-Mo	0.18	0.14	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	2	<2	<2	<2	<2
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	3.38	2.84	2.54	2.61	4.37
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	5	8	2	3	2
Strontium	T-Sr	0.112	0.118	0.053	0.058	0.030
Thallium	T-Tl	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn	<0.2	<0.2	<0.03	<0.2	<0.2
Titanium	T-Ti	0.01	0.01	<0.01	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	T-Zn	0.011	<0.005	0.007	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G5846

		IRU	IRD	Upper Cougar	T River	Cougar @ Hwy
		96 10 07	96 10 07	96 10 03	96 10 03	96 10 03
Dissolved Metals						
Aluminum	D-Al	<0.2	<0.2	<0.2	<0.2	<0.2
Antimony	D-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	D-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	D-Ba	0.01	<0.01	0.01	<0.01	<0.01
Beryllium	D-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	D-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	D-B	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	D-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	D-Ca	14.5	15.7	12.4	6.54	10.1
Chromium	D-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	D-Co	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	D-Cu	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	D-Fe	<0.03	<0.03	<0.03	<0.03	0.03
Lead	D-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	D-Li	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium	D-Mg	1.16	1.31	2.83	1.49	2.96
Manganese	D-Mn	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	D-Mo	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	D-Ni	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus	D-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	D-K	<2	<2	<2	<2	<2
Selenium	D-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	D-Si	2.52	2.61	4.31	1.83	6.18
Silver	D-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	D-Na	<2	3	2	8	3
Strontium	D-Sr	0.053	0.058	0.030	0.025	0.029
Thallium	D-Tl	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	D-Sn	<0.03	<0.2	<0.2	<0.2	<0.2
Titanium	D-Ti	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	D-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	D-Zn	<0.005	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G5846

		Lab Road 96 10 07	Cowie @ Upper Bridge 96 10 03
Dissolved Metals			
Aluminum	D-Al	369	<0.2
Antimony	D-Sb	<0.4	<0.2
Arsenic	D-As	4.2	<0.2
Barium	D-Ba	0.07	0.01
Beryllium	D-Be	0.02	<0.005
Bismuth	D-Bi	<0.2	<0.1
Boron	D-B	1.6	<0.1
Cadmium	D-Cd	0.05	<0.01
Calcium	D-Ca	634	12.8
Chromium	D-Cr	0.69	<0.01
Cobalt	D-Co	6.17	<0.01
Copper	D-Cu	21.9	<0.01
Iron	D-Fe	1820	<0.03
Lead	D-Pb	<0.1	<0.05
Lithium	D-Li	0.57	<0.01
Magnesium	D-Mg	296	2.88
Manganese	D-Mn	71.0	<0.005
Molybdenum	D-Mo	<0.06	<0.03
Nickel	D-Ni	10.1	<0.02
Phosphorus	D-P	8.6	<0.3
Potassium	D-K	7	<2
Selenium	D-Se	<0.4	<0.2
Silicon	D-Si	48.5	4.40
Silver	D-Ag	<0.02	<0.01
Sodium	D-Na	91	2
Strontium	D-Sr	4.06	0.030
Thallium	D-Tl	<0.2	<0.1
Tin	D-Sn	<0.06	<0.2
Titanium	D-Ti	<0.02	<0.01
Vanadium	D-V	<0.06	<0.03
Zinc	D-Zn	16.0	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G6253

		Cowie Creek 96 10 17	Cougar Creek @ Bridge 96 10 17	Cougar Creek Upstream 96 10 17	Tsable River @ Bridge 96 10 17	4S Under 96 10 18
Physical Tests						
Conductivity (umhos/cm)		77.8	79.3	66.7	30.8	859
Total Dissolved Solids		46	33	30	22	323
Hardness	CaCO3	27.1	27.5	20.7	11.6	421
pH		7.56	7.52	7.48	7.28	6.80
Total Suspended Solids		<1	4	<1	<1	167
Dissolved Anions						
Alkalinity - Total	CaCO3	25.6	25.6	20.4	11.6	19.0
Sulphate SO4		1.5	2.6	<1.0	1.7	388
Nutrients						
Ammonia Nitrogen	N	<0.005	<0.005	<0.005	<0.005	0.042
Nitrate Nitrogen	N	0.151	0.124	0.084	0.060	0.236
Nitrite Nitrogen	N	0.001	0.001	0.001	0.001	0.004
Total Dissolved Phosphate	P	0.004	0.009	0.004	0.005	0.003
Total Phosphate	P	0.004	0.010	0.004	0.005	0.018

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G6253

		Cowie Creek 96 10 17	Cougar Creek @ Bridge 96 10 17	Cougar Creek Upstream 96 10 17	Tsable River @ Bridge 96 10 17	4S Under 96 10 18
Dissolved Metals						
Aluminum	D-Al	<0.2	<0.2	<0.2	<0.2	<0.2
Antimony	D-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	D-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	D-Ba	<0.01	<0.01	<0.01	<0.01	0.04
Beryllium	D-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	D-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	D-B	<0.1	<0.1	<0.1	<0.1	0.1
Cadmium	D-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	D-Ca	7.96	7.60	6.18	3.42	142
Chromium	D-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	D-Co	<0.01	<0.01	<0.01	<0.01	0.08
Copper	D-Cu	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	D-Fe	<0.03	<0.03	<0.03	<0.03	<0.03
Lead	D-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	D-Li	<0.01	<0.01	<0.01	<0.01	0.01
Magnesium	D-Mg	1.75	2.06	1.28	0.74	16.2
Manganese	D-Mn	<0.005	<0.005	<0.005	<0.005	4.07
Molybdenum	D-Mo	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	D-Ni	<0.02	<0.02	<0.02	<0.02	0.11
Phosphorus	D-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	D-K	<2	<2	<2	<2	<2
Selenium	D-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	D-Si	2.46	3.83	2.44	1.71	2.37
Silver	D-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	D-Na	<2	<2	<2	<2	11
Strontium	D-Sr	0.019	0.023	0.015	0.012	0.657
Thallium	D-Tl	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	D-Sn	<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	D-Ti	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	D-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	D-Zn	<0.005	<0.005	<0.005	<0.005	0.119

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G7039

			Upper Cougar Creek 96 11 08	Cougar Creek @ Bridge 96 11 08	Cowie Creek 96 11 08	Tsable @ Bridge 96 11 08
Physical Tests						
Conductivity	(umhos/cm)		29.0	36.0	35.0	21.0
Total Dissolved Solids			13	16	16	10
Hardness	CaCO3		12.6	14.7	14.6	8.28
pH			7.00	7.08	7.14	6.98
Total Suspended Solids			8	27	4	25
Dissolved Anions						
Alkalinity - Total		CaCO3	11.6	13.4	14.1	7.1
Sulphate	SO4		1.3	2.1	1.8	2.5
Nutrients						
Ammonia Nitrogen		N	0.005	0.005	<0.005	0.005
Nitrate Nitrogen		N	0.084	0.113	0.079	0.049
Nitrite Nitrogen		N	0.003	0.004	0.002	0.005
Total Dissolved Phosphate		P	0.005	0.008	0.001	0.001
Total Phosphate		P	0.014	0.029	0.009	0.030

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G7039

		Upper Cougar Creek 96 11 08	Cougar Creek @ Bridge 96 11 08	Cowie Creek 96 11 08	Tsable @ Bridge 96 11 08
Total Metals					
Aluminum	T-Al	0.3	0.4	<0.2	0.5
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	<0.01	<0.01	<0.01	<0.01
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1
Boron	T-B	<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	4.05	4.53	4.42	2.61
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe	0.27	0.48	0.11	0.68
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg	0.79	1.10	0.95	0.70
Manganese	T-Mn	0.010	0.020	0.008	0.033
Molybdenum	T-Mo	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	<2	<2	<2	<2
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	2.08	2.48	1.83	1.98
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	<2	<2	<2	<2
Strontium	T-Sr	0.011	0.011	0.013	0.013
Thallium	T-Tl	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti	0.02	0.02	<0.01	0.03
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03
Zinc	T-Zn	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G7039

		Upper Cougar Creek 96 11 08	Cougar Creek @ Bridge 96 11 08	Cowie Creek 96 11 08	Tsable @ Bridge 96 11 08
Dissolved Metals					
Aluminum	D-Al	<0.2	<0.2	<0.2	<0.2
Antimony	D-Sb	<0.2	<0.2	<0.2	<0.2
Arsenic	D-As	<0.2	<0.2	<0.2	<0.2
Barium	D-Ba	<0.01	<0.01	<0.01	<0.01
Beryllium	D-Be	<0.005	<0.005	<0.005	<0.005
Bismuth	D-Bi	<0.1	<0.1	<0.1	<0.1
Boron	D-B	<0.1	<0.1	<0.1	<0.1
Cadmium	D-Cd	<0.01	<0.01	<0.01	<0.01
Calcium	D-Ca	3.87	4.29	4.35	2.44
Chromium	D-Cr	<0.01	<0.01	<0.01	<0.01
Cobalt	D-Co	<0.01	<0.01	<0.01	<0.01
Copper	D-Cu	<0.01	<0.01	<0.01	<0.01
Iron	D-Fe	0.06	0.08	0.03	0.05
Lead	D-Pb	<0.05	<0.05	<0.05	<0.05
Lithium	D-Li	<0.01	<0.01	<0.01	<0.01
Magnesium	D-Mg	0.70	0.97	0.92	0.53
Manganese	D-Mn	<0.005	<0.005	<0.005	<0.005
Molybdenum	D-Mo	<0.03	<0.03	<0.03	<0.03
Nickel	D-Ni	<0.02	<0.02	<0.02	<0.02
Phosphorus	D-P	<0.3	<0.3	<0.3	<0.3
Potassium	D-K	<2	<2	<2	<2
Selenium	D-Se	<0.2	<0.2	<0.2	<0.2
Silicon	D-Si	1.82	2.14	1.76	1.50
Silver	D-Ag	<0.01	<0.01	<0.01	<0.01
Sodium	D-Na	<2	<2	<2	<2
Strontium	D-Sr	0.010	0.011	0.013	0.013
Thallium	D-Tl	<0.1	<0.1	<0.1	<0.1
Tin	D-Sn	<0.03	<0.03	<0.03	<0.03
Titanium	D-Ti	<0.01	<0.01	<0.01	<0.01
Vanadium	D-V	<0.03	<0.03	<0.03	<0.03
Zinc	D-Zn	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G7352

			Before 4S	QRD	Cougar Creek	Cowie Creek	Tsable River
			96 11 25	96 11 25	96 11 21	96 11 21	96 11 21
Physical Tests							
Conductivity	(umhos/cm)		606	-	55	50	76
Total Dissolved Solids			-	-	25	28	23
Hardness	CaCO3		-	-	21.1	20.6	13.8
pH			7.14	-	7.26	7.30	7.18
Total Suspended Solids			21	2	2	<1	5
Dissolved Anions							
Alkalinity-Total		CaCO3	-	-	23	21	13
Sulphate	SO4		275	47	2	1	3
Nutrients							
Ammonia Nitrogen		N	-	-	0.007	<0.005	<0.005
Total Kjeldahl Nitrogen		N	-	-	-	-	-
Nitrate Nitrogen		N	-	-	0.162	0.075	0.056
Nitrite Nitrogen		N	-	-	<0.001	0.002	0.002
Total Dissolved Phosphate		P	-	-	0.002	0.002	0.004
Total Phosphate		P	-	-	0.002	0.003	0.006

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G7352

		Cougar Creek	Cowie Creek	Tsable River
		96 11 21	96 11 21	96 11 21
Total Metals				
Aluminum	T-Al	<0.2	<0.2	<0.2
Antimony	T-Sb	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2
Barium	T-Ba	<0.01	<0.01	<0.01
Beryllium	T-Be	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1
Boron	T-B	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01
Calcium	T-Ca	5.86	6.08	3.93
Chromium	T-Cr	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01
Iron	T-Fe	<0.03	<0.03	<0.03
Lead	T-Pb	<0.05	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01	<0.01
Magnesium	T-Mg	1.56	1.32	0.97
Manganese	T-Mn	<0.005	<0.005	<0.005
Molybdenum	T-Mo	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3	<0.3
Potassium	T-K	<2	<2	<2
Selenium	T-Se	<0.2	<0.2	<0.2
Silicon	T-Si	4.00	2.65	2.11
Silver	T-Ag	<0.01	<0.01	<0.01
Sodium	T-Na	<2	<2	7
Strontium	T-Sr	0.019	0.015	0.015
Thallium	T-Tl	<0.1	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03	<0.03
Zinc	T-Zn	0.006	0.009	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G7352

		Cougar Creek 96 11 21	Cowie Creek 96 11 21	Tsable River 96 11 21	Middle Point Sump 96 11 18
Dissolved Metals					
Aluminum	D-Al	<0.2	<0.2	<0.2	-
Antimony	D-Sb	<0.2	<0.2	<0.2	-
Arsenic	D-As	<0.2	<0.2	<0.2	-
Barium	D-Ba	<0.01	<0.01	<0.01	-
Beryllium	D-Be	<0.005	<0.005	<0.005	-
Bismuth	D-Bi	<0.1	<0.1	<0.1	-
Boron	D-B	<0.1	<0.1	<0.1	-
Cadmium	D-Cd	<0.01	<0.01	<0.01	-
Calcium	D-Ca	5.86	6.08	3.93	21.7
Chromium	D-Cr	<0.01	<0.01	<0.01	-
Cobalt	D-Co	<0.01	<0.01	<0.01	-
Copper	D-Cu	<0.01	<0.01	<0.01	-
Iron	D-Fe	<0.03	<0.03	<0.03	-
Lead	D-Pb	<0.05	<0.05	<0.05	-
Lithium	D-Li	<0.01	<0.01	<0.01	-
Magnesium	D-Mg	1.56	1.32	0.97	1.57
Manganese	D-Mn	<0.005	<0.005	<0.005	-
Molybdenum	D-Mo	<0.03	<0.03	<0.03	-
Nickel	D-Ni	<0.02	<0.02	<0.02	-
Phosphorus	D-P	<0.3	<0.3	<0.3	-
Potassium	D-K	<2	<2	<2	-
Selenium	D-Se	<0.2	<0.2	<0.2	-
Silicon	D-Si	3.79	2.61	1.98	-
Silver	D-Ag	<0.01	<0.01	<0.01	-
Sodium	D-Na	<2	<2	7	-
Strontium	D-Sr	0.019	0.015	0.015	-
Thallium	D-Tl	<0.1	<0.1	<0.1	-
Tin	D-Sn	<0.03	<0.03	<0.03	-
Titanium	D-Ti	<0.01	<0.01	<0.01	-
Vanadium	D-V	<0.03	<0.03	<0.03	-
Zinc	D-Zn	<0.005	<0.005	<0.005	-

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G7765

			Cowie Creek 96 12 06	Upper Cowie Creek 96 12 06	Cougar Creek @ Bridge 96 12 06	Tsable River 96 12 06
Physical Tests						
Conductivity	(umhos/cm)		39	25	43	40
Total Dissolved Solids			17	10	18	17
Hardness	CaCO3		15.4	9.72	17.8	12.2
pH			7.32	7.26	7.31	7.19
Total Suspended Solids			1	7	1	1
Dissolved Anions						
Alkalinity-Total		CaCO3	16	10	16	12
Sulphate	SO4		1	<1	1	2
Nutrients						
Ammonia Nitrogen		N	<0.005	<0.005	<0.005	0.007
Nitrate Nitrogen		N	0.086	0.065	0.175	0.078
Nitrite Nitrogen		N	0.004	0.001	0.006	0.002
Total Dissolved Phosphate		P	0.002	0.002	0.002	0.002
Total Phosphate		P	0.003	0.002	0.003	0.003

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

ASL

RESULTS OF ANALYSIS

File No. G7765

		Cowie Creek 96 12 06	Upper Cowie Creek 96 12 06	Cougar Creek @ Bridge 96 12 06	Tsable River 96 12 06
Total Metals					
Aluminum	T-Al	<0.2	<0.2	<0.2	<0.2
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	<0.01	<0.01	<0.01	<0.01
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1
Boron	T-B	<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	4.46	2.94	5.00	3.71
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe	<0.03	<0.03	0.06	0.04
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg	1.04	0.63	1.33	0.88
Manganese	T-Mn	<0.005	<0.005	<0.005	<0.005
Molybdenum	T-Mo	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	<2	<2	<2	<2
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	2.24	1.72	3.20	2.20
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	<2	<2	<2	3
Strontium	T-Sr	0.014	0.011	0.015	0.014
Thallium	T-Tl	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03
Zinc	T-Zn	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G7765

		Cowie Creek 96 12 06	Upper Cowie Creek 96 12 06	Cougar Creek @ Bridge 96 12 06	Tsable River 96 12 06
Dissolved Metals					
Aluminum	D-Al	<0.2	<0.2	<0.2	<0.2
Antimony	D-Sb	<0.2	<0.2	<0.2	<0.2
Arsenic	D-As	<0.2	<0.2	<0.2	<0.2
Barium	D-Ba	<0.01	<0.01	<0.01	<0.01
Beryllium	D-Be	<0.005	<0.005	<0.005	<0.005
Bismuth	D-Bi	<0.1	<0.1	<0.1	<0.1
Boron	D-B	<0.1	<0.1	<0.1	<0.1
Cadmium	D-Cd	<0.01	<0.01	<0.01	<0.01
Calcium	D-Ca	4.46	2.87	4.95	3.52
Chromium	D-Cr	<0.01	<0.01	<0.01	<0.01
Cobalt	D-Co	<0.01	<0.01	<0.01	<0.01
Copper	D-Cu	<0.01	<0.01	<0.01	<0.01
Iron	D-Fe	<0.03	<0.03	0.04	<0.03
Lead	D-Pb	<0.05	<0.05	<0.05	<0.05
Lithium	D-Li	<0.01	<0.01	<0.01	<0.01
Magnesium	D-Mg	1.04	0.62	1.32	0.84
Manganese	D-Mn	<0.005	<0.005	<0.005	<0.005
Molybdenum	D-Mo	<0.03	<0.03	<0.03	<0.03
Nickel	D-Ni	<0.02	<0.02	<0.02	<0.02
Phosphorus	D-P	<0.3	<0.3	<0.3	<0.3
Potassium	D-K	<2	<2	<2	<2
Selenium	D-Se	<0.2	<0.2	<0.2	<0.2
Silicon	D-Si	2.25	1.69	3.13	2.13
Silver	D-Ag	<0.01	<0.01	<0.01	<0.01
Sodium	D-Na	<2	<2	<2	2
Strontium	D-Sr	0.014	0.011	0.015	0.014
Thallium	D-Tl	<0.1	<0.1	<0.1	<0.1
Tin	D-Sn	<0.03	<0.03	<0.03	<0.03
Titanium	D-Ti	<0.01	<0.01	<0.01	<0.01
Vanadium	D-V	<0.03	<0.03	<0.03	<0.03
Zinc	D-Zn	<0.005	<0.005	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS

File No. G7764r

		Cougar Creek @ Bridge 96 12 06	2 Sump 96 12 05	2 Sump 96 12 09	3 Sump 96 12 05	3 Sump 96 12 09
Dissolved Metals						
Aluminum	D-Al	-	<0.2	<0.2	<0.2	<0.2
Antimony	D-Sb	-	<0.2	<0.2	<0.2	<0.2
Arsenic	D-As	-	<0.2	<0.2	<0.2	<0.2
Barium	D-Ba	-	0.02	0.02	0.02	0.02
Beryllium	D-Be	-	<0.005	<0.005	<0.005	<0.005
Bismuth	D-Bi	-	<0.1	<0.1	<0.1	<0.1
Boron	D-B	-	0.4	0.4	0.4	0.3
Cadmium	D-Cd	-	<0.01	<0.01	<0.01	<0.01
Calcium	D-Ca	-	286	282	259	183
Chromium	D-Cr	-	<0.01	<0.01	<0.01	<0.01
Cobalt	D-Co	-	<0.01	<0.01	<0.01	<0.01
Copper	D-Cu	-	<0.01	<0.01	<0.01	<0.01
Iron	D-Fe	-	<0.03	<0.03	<0.03	<0.03
Lead	D-Pb	-	<0.05	<0.05	<0.05	<0.05
Lithium	D-Li	-	0.01	0.01	<0.01	<0.01
Magnesium	D-Mg	-	25.7	24.7	22.8	15.6
Manganese	D-Mn	-	0.077	0.134	0.083	0.068
Molybdenum	D-Mo	-	<0.03	<0.03	<0.03	<0.03
Nickel	D-Ni	-	<0.02	<0.02	<0.02	<0.02
Phosphorus	D-P	-	<0.3	<0.3	<0.3	<0.3
Potassium	D-K	-	<2	<2	<2	<2
Selenium	D-Se	-	<0.2	<0.2	<0.2	<0.2
Silicon	D-Si	-	1.95	1.87	1.30	0.89
Silver	D-Ag	-	<0.01	<0.01	<0.01	<0.01
Sodium	D-Na	-	58	63	74	47
Strontium	D-Sr	-	2.46	2.47	2.38	1.54
Thallium	D-Tl	-	<0.1	<0.1	<0.1	<0.1
Tin	D-Sn	-	<0.03	<0.03	<0.03	<0.03
Titanium	D-Ti	-	<0.01	<0.01	<0.01	<0.01
Vanadium	D-V	-	<0.03	<0.03	<0.03	<0.03
Zinc	D-Zn	-	<0.005	<0.005	<0.005	<0.005
Extractables						
Oil and Grease		<5	-	-	-	-

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G8247

			Tsable River 96 12 27	Cowie Creek 96 12 27	Cougar Smith Creek 96 12 27
Physical Tests					
Conductivity	(umhos/cm)		440	44	39
Total Dissolved Solids			220	19	18
Hardness	CaCO3		55.6	17.9	18.7
pH			7.09	7.35	7.38
Total Suspended Solids			4	1	1
Dissolved Anions					
Alkalinity-Total		CaCO3	10	19	16
Sulphate	SO4		18	<1	<1
Nutrients					
Ammonia Nitrogen		N	<0.005	<0.005	<0.005
Total Kjeldahl Nitrogen		N	0.11	0.08	0.09
Nitrate Nitrogen		N	0.033	0.078	0.115
Nitrite Nitrogen		N	0.009	0.011	0.002
Total Dissolved Phosphate		P	<0.001	<0.001	<0.001
Total Phosphate		P	0.004	<0.001	0.001

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G8247

		Cowie Creek 96 12 27	Cougar Smith Creek 96 12 27
Dissolved Metals			
Aluminum	D-Al	<0.2	<0.2
Antimony	D-Sb	<0.2	<0.2
Arsenic	D-As	<0.2	<0.2
Barium	D-Ba	<0.01	<0.01
Beryllium	D-Be	<0.005	<0.005
Bismuth	D-Bi	<0.1	<0.1
Boron	D-B	<0.1	<0.1
Cadmium	D-Cd	<0.01	<0.01
Calcium	D-Ca	5.19	5.38
Chromium	D-Cr	<0.01	<0.01
Cobalt	D-Co	<0.01	<0.01
Copper	D-Cu	<0.01	<0.01
Iron	D-Fe	<0.03	<0.03
Lead	D-Pb	<0.05	<0.05
Lithium	D-Li	<0.01	<0.01
Magnesium	D-Mg	1.20	1.29
Manganese	D-Mn	<0.005	<0.005
Molybdenum	D-Mo	<0.03	<0.03
Nickel	D-Ni	<0.02	<0.02
Phosphorus	D-P	<0.3	<0.3
Potassium	D-K	<2	<2
Selenium	D-Se	<0.2	<0.2
Silicon	D-Si	2.83	3.54
Silver	D-Ag	<0.01	<0.01
Sodium	D-Na	<2	<2
Strontium	D-Sr	0.013	0.016
Thallium	D-Tl	<0.1	<0.1
Tin	D-Sn	<0.03	<0.03
Titanium	D-Ti	<0.01	<0.01
Vanadium	D-V	<0.03	<0.03
Zinc	D-Zn	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G8247

		Cougar Smith Creek 96 12 27
Total Metals		
Aluminum	T-Al	<0.2
Antimony	T-Sb	<0.2
Arsenic	T-As	<0.2
Barium	T-Ba	<0.01
Beryllium	T-Be	<0.005
Bismuth	T-Bi	<0.1
Boron	T-B	<0.1
Cadmium	T-Cd	<0.01
Calcium	T-Ca	5.38
Chromium	T-Cr	<0.01
Cobalt	T-Co	<0.01
Copper	T-Cu	<0.01
Iron	T-Fe	<0.03
Lead	T-Pb	<0.05
Lithium	T-Li	<0.01
Magnesium	T-Mg	1.30
Manganese	T-Mn	<0.005
Molybdenum	T-Mo	<0.03
Nickel	T-Ni	<0.02
Phosphorus	T-P	<0.3
Potassium	T-K	<2
Selenium	T-Se	<0.2
Silicon	T-Si	3.66
Silver	T-Ag	<0.01
Sodium	T-Na	<2
Strontium	T-Sr	0.016
Thallium	T-Tl	<0.1
Tin	T-Sn	<0.03
Titanium	T-Ti	<0.01
Vanadium	T-V	<0.03
Zinc	T-Zn	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G8247

		WD	WB	LLO	Tsable River	Cowie Creek
		96 12 30	96 12 30	96 12 30	96 12 27	96 12 27
Total Metals						
Aluminum	T-Al	<0.2	<0.2	<0.2	<0.2	<0.2
Antimony	T-Sb	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	T-As	<0.2	<0.2	<0.2	<0.2	<0.2
Barium	T-Ba	0.04	<0.01	<0.01	<0.01	<0.01
Beryllium	T-Be	<0.005	<0.005	<0.005	<0.005	<0.005
Bismuth	T-Bi	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	T-B	1.1	<0.1	<0.1	<0.1	<0.1
Cadmium	T-Cd	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium	T-Ca	282	10.9	3.75	7.42	5.19
Chromium	T-Cr	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	T-Co	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	T-Cu	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	T-Fe	2.20	0.05	0.05	0.03	<0.03
Lead	T-Pb	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	T-Li	0.02	<0.01	<0.01	<0.01	<0.01
Magnesium	T-Mg	56.3	2.02	0.69	8.99	1.20
Manganese	T-Mn	1.16	0.008	<0.005	<0.005	<0.005
Molybdenum	T-Mo	<0.03	<0.03	<0.03	<0.03	<0.03
Nickel	T-Ni	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus	T-P	<0.3	<0.3	<0.3	<0.3	<0.3
Potassium	T-K	4	<2	<2	2	<2
Selenium	T-Se	<0.2	<0.2	<0.2	<0.2	<0.2
Silicon	T-Si	3.29	2.90	3.33	1.50	3.01
Silver	T-Ag	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	T-Na	484	9	<2	69	<2
Strontium	T-Sr	2.92	0.070	0.019	0.065	0.013
Thallium	T-Tl	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	T-Sn	<0.03	<0.03	<0.03	<0.03	<0.03
Titanium	T-Ti	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	T-V	<0.03	<0.03	<0.03	<0.03	<0.03
Zinc	T-Zn	0.022	<0.005	0.009	<0.005	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

RESULTS OF ANALYSIS File No. G8247

		WD	WB	WP	LLO	Tsable River
		96 12 30	96 12 30	96 12 30	96 12 30	96 12 27
Dissolved Metals						
Aluminum	D-Al	<0.2	-	-	-	<0.2
Antimony	D-Sb	<0.2	-	-	-	<0.2
Arsenic	D-As	<0.2	-	-	-	<0.2
Barium	D-Ba	0.03	-	-	-	<0.01
Beryllium	D-Be	<0.005	-	-	-	<0.005
Bismuth	D-Bi	<0.1	-	-	-	<0.1
Boron	D-B	1.0	-	-	-	<0.1
Cadmium	D-Cd	<0.01	-	-	-	<0.01
Calcium	D-Ca	265	10.9	-	3.75	7.42
Chromium	D-Cr	<0.01	-	-	-	<0.01
Cobalt	D-Co	<0.01	-	-	-	<0.01
Copper	D-Cu	<0.01	-	-	-	<0.01
Iron	D-Fe	<0.03	-	<0.03	-	<0.03
Lead	D-Pb	<0.05	-	-	-	<0.05
Lithium	D-Li	0.02	-	-	-	<0.01
Magnesium	D-Mg	54.1	2.02	-	0.69	8.99
Manganese	D-Mn	0.211	-	-	-	<0.005
Molybdenum	D-Mo	<0.03	-	-	-	<0.03
Nickel	D-Ni	<0.02	-	-	-	<0.02
Phosphorus	D-P	<0.3	-	-	-	<0.3
Potassium	D-K	4	-	-	-	2
Selenium	D-Se	<0.2	-	-	-	<0.2
Silicon	D-Si	2.76	-	-	-	1.46
Silver	D-Ag	<0.01	-	-	-	<0.01
Sodium	D-Na	459	-	-	-	69
Strontium	D-Sr	2.80	-	-	-	0.065
Thallium	D-Tl	<0.1	-	-	-	<0.1
Tin	D-Sn	<0.03	-	-	-	<0.03
Titanium	D-Ti	<0.01	-	-	-	<0.01
Vanadium	D-V	<0.03	-	-	-	<0.03
Zinc	D-Zn	<0.005	-	-	-	<0.005

Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

APPENDIX E

REFERENCES

REFERENCES

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21. *Guidelines for the Design and Operation of Settling Ponds Used for Sediment Control in Mining Operations, Preliminary Draft,* Ministry of Environment, 1980.

3. MINE PLAN

3.1 Mine Plan Overview

Surface drilling in 1991, 1996 and 1997 confirmed in situ coal resources of 39,000,000 tonnes in measured, indicated and inferred categories, located 50 to 500 metres below surface.

A high resolution reflection seismic survey in 1997 identified structural conditions and coal seam, defined the faults and coals seams dislocation along faults zones.

Washability tests of the coal core were conducted in the Loring Laboratories in Calgary.

Samples for water quality analysis and acid rock drainage potential were collected and evaluated.

There are no underground workings at the site.

A bulk sample, approximately 90,000 tonnes, is required to confirm the washability of the coal and establish quantities of metallurgical and thermal coal that can be produced. Evaluation of mining conditions and economics of mining will proceed concurrently.

It is estimated that 90,000 tonnes will yield ±60,000 tonnes of clean coal. This quantity will provide enough product for both thermal and metallurgical burn tests in customers plants.

In order to obtain the bulk sample an underground exploration and test mining plan is submitted. No open pit operations are planned at this time.

All coal will be transported to the Quinsam Coal Preparation plant for processing.

Due to the thin nature of the No. 4 Seam (less than 1.5 metres) it is not considered economic to mine in this area. Due to high ash and sulphur content in the No. 3 Seam, the economics of underground mining in this zone are questionable. A 20 tonne sample will be removed from the No. 3 Seam for further quality testing and evaluation.

The bulk sample will be extracted from No. 1 Seam. (Please refer to the Geological Section of this submission, Drawing No. 97-B-68 and 69.)

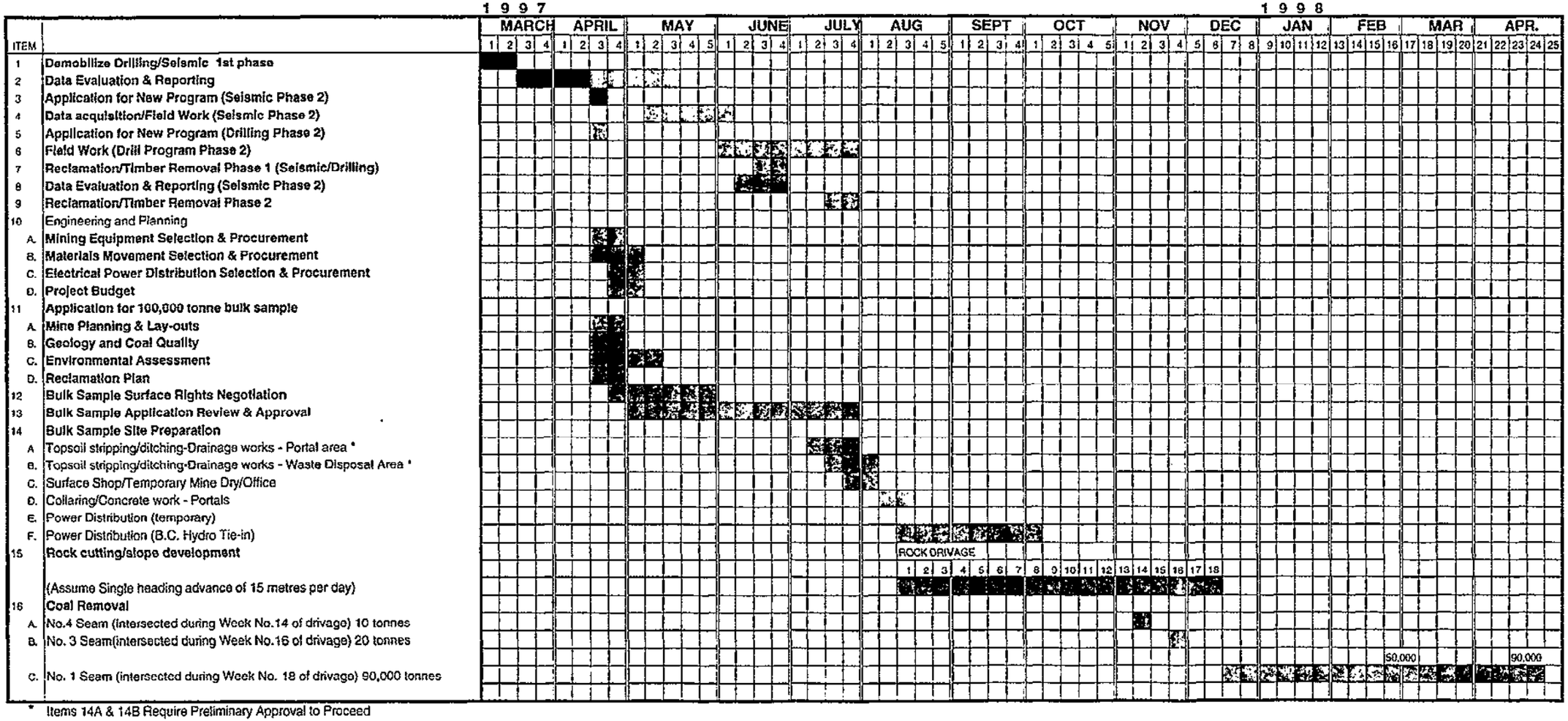
The initial development will be in the sandstone and siltstone by twin declines until No. 1 coal seam is reached. The workings in coal will comprise mains, section development and partial depillaring.

The sizes of the underground openings in coal, pillars and roof support method will be evaluated during the bulk sample program for the final design of future mining.

3.2 Development Schedule

The excavation in the sandstone is expected to take 3 months. The bulk sample will proceed at the rate of 1,000 tonnes per day. Please refer to T'Sable River Project Schedule.

TSABLE RIVER PROJECT SCHEDULE



* Items 14A & 14B Require Preliminary Approval to Proceed

SCHED2.WK4 issued 04/25/97

3.3 Existing and Projected Surface and Underground Development (Drawing No. 97-D-075 and 97-D-076)

Surface Facilities

In order to minimize the surface disturbance, only portable surface facilities necessary for the project will be set-up.

They comprise mine dry, office and first aid complex, mechanical shop, warehouse trailer and electrical power distribution grid.

The area for the surface facilities will be stripped of topsoil and till, at an estimated combined thickness of 1 metre. In the immediate area of the portals as much as 3 metres of glacial till/weathered bedrock will be removed in order to collar the openings in competent rock.

Sandstone and siltstone from the underground excavation will be stored near the portal and serve as coal stockpile pad. The water management system, including a settling pond and polishing pond, will have minimum retention time of 10 hours.

All surface facilities will be of temporary nature and will be removed from site after the completion of the program.

Access to the Coal Seam

Two parallel declines, conveyor road and supply road, excavated at -18% were designed to access No. 1 Seam.

The conveyor road will be cut 2.5 m high and 6 m wide. The supply road will be cut 2.5 m high and 5 m wide.

Connecting crosscuts will be excavated at 100 m intervals. Two temporary sumps will be cut in the supply road.

The sandstone has a compressive strength of 49 to 90 MPa (7,000 to 13,000 psi). Roof support will be 1.8 m long mechanical bolts installed on 1.5 m x 1.5 m pattern. Screen and/or straps will be used as required.

Excavation in the Coal Seam (Drawing No. 97-D-076)

The excavation in the coal seam will consist of the mains (supply, conveyor and return air roads), and mining one panel (section).

The main entries will be cut 5 metres wide and 2.5 metres high, leaving 30 metre pillars between the entries.

Connecting crosscuts will be cut at 42 m intervals. The panel will be excavated as shown on Drawing No. 97-B-073. Underground sump will be cut in coal and will have minimum retention capacity of 10 hours.

Underground water will be discharged from the underground sumps into the settling pond on surface, will flow to the polishing pond and from there into the tributary of the T'Sable River, as shown on Drawing No. 97-D-075.

Ventilation will be provided by a main fan located on surface near the portal and auxiliary ventilation fans underground.

The seam is expected to liberate 3 m^3 of methane per tonne of coal mined. With an anticipated production of 100 tonnes/hour, air movement of 60,000 cfm will be needed to dilute methane concentrations to 0.3%. Approximately 15,000 cfm will be needed to operate LHD equipment. A 75HP main exhausting fan will be installed to provide ventilation. This fan

is capable of producing 180,000 cfm which is more than adequate for the 90,000 tonne bulk sample mined.

The excavation will be by cutting. Drilling and blasting will be employed in the initial stage of the declines in the sandstone.

The initial excavation work, trench in the sandstone, ventilation raise, collars and the first part of the entries will be by drilling and blasting, until the conveyor system and the ventilation is established.

A separate application, as per the Health, Safety and Reclamation Code for Mines in British Columbia for permission to store and use explosives, will follow.

The equipment will be:

- Continuous miner (roadheader, Dosco or Alpine) 1
- Joy shuttle cars 2
- Stamler feederbreaker 1
- Roofbolter 1
- Conveyors 2

The Company is finalizing the selection for the roadheader.

Applications for certification to operate the equipment underground will be submitted under separate cover.

The strength of the sandstone and acid rock drainage potential were established from the drill core.

Furthers tests and evaluation will be conducted during the underground excavation:

Acid Rock Drainage Potential

Samples will be taken every 60 linear metres and evaluated. The quality of the discharge water will be monitored and remedied if required.

Pillar Stability During Depillaring

Two stress cells will be installed in the pillar in the depillaring area.

Roof Support

Multiple extensometers will be installed in the roof at the junction of the main and crosscut area.

3.4 Access and Transportation

The surface plant is located on Province of British Columbia land. The ownership and under-surface rights are shown on Drawing No. 96-D-034.

The plant is situated 3 km west of the Island Highway. Access to the site is 600 metres south of the T'Sable River bridge via the Holiday Main Road, last 2 km located on MacMillan Bloedel land.

Only 200 metres of new road (bypass) will be constructed.

The traffic density, based on 12 hour/day transportation, will be 3 trucks per hour.

Twenty-eight (28) people will be employed per day. Maximum shift crew will be 9 miners and supervision.

3.5 Processing Plant Description

A processing plant will not be built. All coal will be hauled to the Quinsam Mine for processing.

Tailings will not be produced.

3.6 Waste Rock and Topsoil Storage

Waste rock is estimated to be <20,000 m^3 of sandstone and siltstone. This waste rock will be excavated and placed immediately in front of the portals and will serve as a raw coal storage pad for the bulk coal sample as well as a truck loop base for the haul trucks. The pad will average 2 metres (6.5 feet) deep over a rectangular compacted area measuring approximately 170 metres by 80 metres. The sides will be sloped less than 2:1. The pad will be sloped to the North and East of Cowie Creek to facilitate proper drainage.

Acid/base analysis will be done every 60 metres of advancement in each roadway, and at other locations, based on lithology changes. Photo documentation of placement will be done to delineate material location in the event of potential ARD. Analysis will be in accordance with established procedure and criteria outlined in Permit C-172 (issued to Quinsam Coal).

Soil storage will be above (west) the portals. The volumes are estimated to be 26,000 m^3 using a swell factor of 1.3. The placement will be 4.5 to 5 metres deep over a rectangular area measuring 140 m x 50 m. The slopes will be less than 2:1 and will be stabilized immediately after placement with fall rye or winter wheat. Soil horizons will be professionally evaluated prior to removal to determine growth potential. An ICP of the soil to determine metal presence will also be done.

Substrate and glacial till/weathered bedrock will be placed separately beside the topsoil storage area. The volume will consist of approximately 4,500 m^3, 2 metres deep in a rectangular area of 2,400 m^2. Acid/base analysis will be conducted on the material as well as an ICP to identify metals.

3.7 Additional Minesite Infrastructures (Drawing No. 97-D-075)

There will not be accommodation on site. The mine personnel will be accommodated in the Courtenay and Cumberland area, 20 km from the minesite. The following temporary structures will be erected:

- dry/first aid/office complex
- Weatherhaven-type repair shop
- warehouse trailer
- 2 generators
- stacker conveyor
- concrete foundations will be constructed for the main underground conveyor drive and for the stacker conveyor
- electric power distribution system (Drawing No. 97-B-71)
- tank farm

The portable electric generating sets will be trailer mounted, with auxiliary double-walled fuel storage tanks. A tank farm, consisting of double-walled fuel tanks and a double-walled waste oil collection tank, will be installed as shown on the plan.

The warehouse trailer/repair shop will provide storage for consumable items and a covered area for equipment repairs. A good supply of bagged limestone dust will be stored on site at all times.

All mobile and stationary equipment will conform to the Health, Safety and Reclamation Code for Mines in British Columbia.

3.8 Domestic Water

Domestic water needs will be satisfied by a well, as shown on Drawing No. 97-D-075. The water will be used for underground dust suppression, as well as showers and washrooms in the mine dry. Surplus water from underground will be pumped to the settling pond system. Gray water from the mine dry will be disposed of in a drain field. Sewage will be contained in a below-ground holding tank(s) and trucked as needed to authorized disposal facilities.

Domestic water volume requirements will be about 4,000 litres, while dust suppression is expected to need <3,000 litres (550 gal). Total needs will be less than 8 m^3 per day. There will be a reservoir tank between the well site and the end use points. Manual chlorination may be necessary and will involve placing tablets into the reservoir on a regular basis. Domestic water will meet health regulations.

Seepage into the mine from strata will be handled by 58HP submersible pumps and 8" discharge line capable of forcing about 500 U.S. gallons (initially) to the surface settling ponds. Subsurface sumps will be installed to store and settle water before it is transferred to surface.

3.9 Water Management

Water quality will be monitored in the underground sumps for pH, total and dissolved metals, sulfate and alkalinity. Discharge from the polishing pond will also be monitored for total suspended solids, pH, conductivity, alkalinity, sulfate, dissolved and total metals. Discharge volumes will be measured by an installed weir at the outlet of the polishing pond. A sonic or dipping device may also be installed for continuous measurements.

Monitoring frequency will be weekly and during events. Water quality will conform to Provincial water quality objectives. Cowie Creek will be monitored above and below the project for the same parameters as the polishing pond.

Diversion ditches, as shown on the surface map, will divert clean water away from the working areas and around the project. The polishing pond discharge will combine with the clean diverted water. From there the water will flow in an established broad wetland channel to the T'Sable River which is approximately 1 km distance from the project.

Catchment ditches will collect surface runoff from the topsoil and till storage areas, as well as the working yard area and be conveyed to the settling pond for 10 hours retention time before release to the polishing pond.

The settling pond will accommodate a 1 in 200 year flood event. Flocculation facilities can be installed in either or both ponds should water quality require it. Liming facilities can also be installed as above should ARD develop.

Tsable River Coal Project

Geotechnical Assessment for Bulk Sample Application

1.0 Lithology

A typical geological cross-section in the area of the proposed access tunnels and bulk sample workings, as shown in the Drawing No. 97-D-076, can be seen in the exploration hole TS 96-06C (Figure 1.1). The overburden above the targetted No. 1 seam consists mainly of interbedded sandstones and siltstones, with minor intervals of coal, shales and mudstones. The access tunnels will intersect several fault zones which may range from a single fault plane to a "troubled ground" zone ten or more meters wide.

Lithology of the immediate roof above the No.1 Seam is relevant for roof support in development entries and for depillaring test in a small panel designed for acquisition of the bulk sample. The exploration holes located near the area of the proposed bulk sample panel show the following rock intervals above the No.1 seam.

Hole No.	Depth to Seam No.1 (m)	Mudstone/Siltstone thickness above seam (m)	Sandstone thickness (m)
TS 96-05-C	158.0	13.0	11.0
TS 96-06-C	227.0	5.0	17.0
TS 96-13-C	261.0	6.9	15.3
TS 96-16-C	306.0	7.0	18.5
TS 96-17-C	84.2	6.2	20.6
TS 96-23-C	100.0	4.0	32.9
TS 96-24-C	120.4	2.4	32.0
TS 96-25-C	173.0	27.0	36.5
TS 91-10	113.2	10.0	15.6
TS 91-12	114.9	4.2	9.3
TS 91-13	203.8	11.0	8.3
Averages		8.8	19.7

The mudstone/siltstone formation overlying the seam ranges from less than 3 m to nearly 30 m, with average thickness of about 9 m. It is overlain by a massive sandstone which is on average about 20 m thick.

2.0 Pillar design for Bulk Sample Panel.

Because in some places the sandstone can be close to the No.1 seam, it is not possible to accurately predict the caving characteristic of the overburden. For this reason, the bulk sample panel is proposed with only a partial pillar recovery. With the sandstone formation in a proximity of the seam, it is important to avoid panel-wide caving and maintain a long term support of overburden, particularly in a new mining situation. Pillars left in the mined-out area should be sized to provide such support. Please note that rock properties used below are based on the test performed on Qunsam rock samples as outlined in the 1996 CANMET study entitled "Design Methods to Optimize Underground Layout and Support at the Quinsam Coal Mine".

Design Parameters.

1. Depth of overburden.....up to 200 m
2. Average uniaxial strenth of coal.....20.0 MPa
3. In situ uniaxial strength of coal pillars.....7.0 MPa
4. Unit weight of rock mass.....25.0 kNm^{-3}

Mining Layout.

The proposed mining layout is shown in the attached Drawing No. 97-B-03. Because of the seam dip in the proposed Bulk Sample Pannel, the angle of intersections will be at 60^0. In order to reduce the span at intersections, the width of the development entries has been set at 5 m, 1 m less than at Quinsam mine.

Please refer to Drawing No. 97-B-03 for the minimum dimensions of pillars, represented by inscribed circles. The small remnant pillars will have a width to height (W/H) ratio at 4.2m / 3.0m = 1.4, while the large bearing pillars will have W/H a ratio of 16m / 3m = 5.3.

Areal extraction:	100% * {1 - (16m * 30m - 5 * 8m * 3.5m - 2 * 11.5m * 3.5m) / [(16m + 5m) * (30m + 5m)]} = 65%
Maximum lithostatic stress:	25.0 kNm^{-3} * 200m / 1000 = 5.0 MPa
Tributary stress:	5.0 MPa / (1 - 0.65) = 14.3 MPa

The average strength of pillars can be calculated according to Bieniawski's formula. For the large pillars:

$$7.0 \text{ MPa} * (0.64 + 0.36 * W / H) =$$

$$7.0 \text{ MPa} * (0.64 + 0.36 * 16\text{m} / 3\text{m}) = 17.9 \text{ MPa}$$

For the small pillars:

$$7.0 \text{ MPa} * (0.64 + 0.36 * 4.2\text{m} / 3.0\text{m}) = 8.0 \text{ MPa}$$

Load balance:

$$(16\text{m} * 16\text{m} * 17.9 \text{ Mpa} + 4 * 4.2\text{m} * 4.2\text{m} * 8.0 \text{ MPa}) / (21\text{m} * 35\text{m} * 5.0 \text{ MPa}) = 1.4$$

Load capacity of pillars exceeds the maximum lithostatic load by about 40%. This safety margin is considered sufficient to provide a global support for the mined out area of the Bulk Sample Panel. Only local caving between the pillars will occur, which will not affect the overall panel stability.

3.0 Roof Support.

Lithology and structural geology of the bulk sample area is similar to that of the Quinsam Mine, where extensive studies and tests of roof support resulted in a reliable support system. Roof support conditions at Quinsam are very similar to those that are anticipated in the Bulk Sample Panel at Tsable River mine.

The attached summary from the 1996 CANMET study of Quinsaqm mining methods and practices outlines rock conditions and roof support methods used at Quinsam. Table 1 in the CANMET Report shows average values of rock mechanical properties and Table 2 includes a typical rockmass classifications.

3.1 Roof Support in good and fair ground conditions.

Most of the rock interval intercepted in the Access Tunnels will be competent siltstone or sandstone, offering fair to good ground conditions with RMR rock classification of 54 to 69 (Table 2 in CANMET Report). According to Bieniawski (Figure 3.1), in these ground conditions, standard ¾" mechanically anchored rock bolts 1.5 m to 1.8 m long, installed on 1.5 m x 1.5 m pattern, are required. It is recommended to use ¾" x 1.8 m mechanical rockbolts throughout.

3.2 Roof Support in poor ground conditions.

In some parts of the Access Tunnels. i.e. in and around the coal seams, in weak siltstone and in "troubled ground" around the faults, it is anticipated that rock conditions will be fair to poor, with RMR rock classification at 40 to 20. In these conditions, it is recommended to utilize the rock support system developed and successfully used at Quinsam Coal mine, which is more conservative then that recommended by Bieniawski (Figure 3.1). Please refer to the Quinsam drawing No. 96-A-019 for the 2 North Mine roof support rules which will be utilized where poor rock conditions exist in Access Tunnels.

As the lithology of the roof in the Bulk Sample Panel will be nearly the same as in the 2 North mine of Quinsam, it is recommended that these roof support rules are adapted in development of Bulk Sample Panel at Tsable River mine. As shown in the Drawing 97-A-040, the width of entries has been reduced to 5 m with intersections at 60^0.

4.0 References

Cullen, M., Design Methods to Optimize Underground Layout and Support at the Quinsam Coal Mine, CANMET, DSS File Number: 002SQ.23440-3-9105, 1996

Bieniawski, Z. T., Rock Mechanics Design in Mining and Tunneling, A.A.Balkema, Rotterdam, Netherlands, 1984

April 21, 1997

Dennis Z. Mraz, P.Eng.

TSABLE RIVER COAL PROJECT
LITHOLOGY LOG
(DRILLERS LOG)

HOLE NUMBER : TS 96-06C
CO-ORDINATES : 5484920.1 N. - 364378.7 E.
ELEVATION : 112.8 m
DATE DRILLED: July 7, 1996
DRILLER: Hi-Rate Drilling

DEPTH (m)		DESCRIPTION
From	To	
0.0	3.3	Glacial till
3.3	85.0	Siltstone; medium grey; mudstone interbeds
85.0	100.0	Sandstone, medium grey; hard
100.0	118.0	Siltstone; fine sandy
118.0	142.0	Sandstone; siltstone interbeds
142.0	143.0	Mudstone; carbonaceous
143.0	144.0	COAL, No 5 Seam?
144.0	145.0	Mudstone; sandstone interbeds
145.0	167.0	Sandstone; medium to coarse; hard
167.0	181.0	Sandstone; siltstone/mudstone interbeds
181.0	183.0	COAL; shaly; No. 4 Seam?
183.0	199.0	Siltstone; grading to sandstone. STarted coring 182.9
199.0	201.0	COAL, some shale; No. 3 Seam
201.0	201.5	Shale; soft
201.5	202.0	COAL; No. 3 Seam
202.0	205.5	Mudstone; silty
205.5	222.0	Sandstone; medium grey; hard; massive
222.0	226.0	Mudstone; siltstone interbeds
226.0	227.0	Mudstone; coaly
227.0	230.0	COAL: No. 1 Seam; some shale
230.0	231.3	Mudstone; silty
231.3	237.3	Sandstone; Siltstone interbeds
		END of HOLE

FIGURE 1.1

Roof-support design chart for coal mining – Entry width: 20-ft

ROOF ROCK CLASS	ROCK MASS RATING (RMR)	ROCK LOAD HEIGHT H_T (FT)	SUPPORT SPECIFICATIONS: MECHANICAL BOLTS	SUPPORT SPECIFICATIONS: RESIN BOLTS	ALTERNATE SUPPORT PATTERNS: MECHANICAL BOLTS/POSTS	ALTERNATE SUPPORT PATTERNS: RESIN BOLTS/POSTS	SPECIFICATIONS FOR POSTS
I VERY GOOD	90	2.0	L : 2.5' S : 5' x 5' G : 40 ϕ : 5/8" C : 6.2 tons			Not economical	
	80	4.0	L : 2.5" S : 5' x 4.5' G : 60 (40) ϕ : 3/4" (7/8") C : 11 tons	L : 2.5' S : 5' x 5' G : 60 ϕ : 3/4" C : 12 tons			
II GOOD	70	6.0	L : 3.0' S : 4' x 4' G : 60 ϕ : 3/4" C : 10 tons	L : 3.0' S : 5' x 5' G : 60 ϕ : 3/4" C : 18 tons			
	60	8.0	L : 4.0' S : 5' x 5' G : 60 ϕ : 5/8" C : 9 tons	L : 4.0' S : 5' x 5' G : 60 ϕ : 1" C : 23.7 tons			ϕ_p = 5.5" S_p = 10'
III FAIR	50	10.0	L : 5.0' S : 5' x 5' G : 40 ϕ : 3/4" C : 8 tons	L : 4.0' S : 5' x 4' G : 60 ϕ : 1" C : 23.7 tons			ϕ_p = 6.5" S_p = 10'
	40	12.0	L : 6.0' S : 5' x 5' G : 40 ϕ : 3/4" C : 7 tons	L : 4.0' S : 4' x 4' G : 60 ϕ : 1" C : 23.7 tons			ϕ_p = 6.5" S_p = 7.5'
IV POOR	30	14.0	L : 7.0' S : 5' x 5' G : 40 ϕ : 5/8" C : 6 tons	L : 5' S : 5' x 5' G : 60 ϕ : 3/4" C : 12 tons			ϕ_p = 5.5" S_p = 5'
	20	16.0	L : 8.0' S : 4' x 4.5' G : 40 ϕ : 5/8" C : 5 tons	L : 5' S : 5' x 5' G : 60 ϕ : 3/4" C : 12 tons	S_p = 4.5'	S_p = 5'	ϕ_p = 6.0"

L = bolt length
S = bolt spacing
G = grade of steel

ϕ = bolt diameter
c = bolt capacity

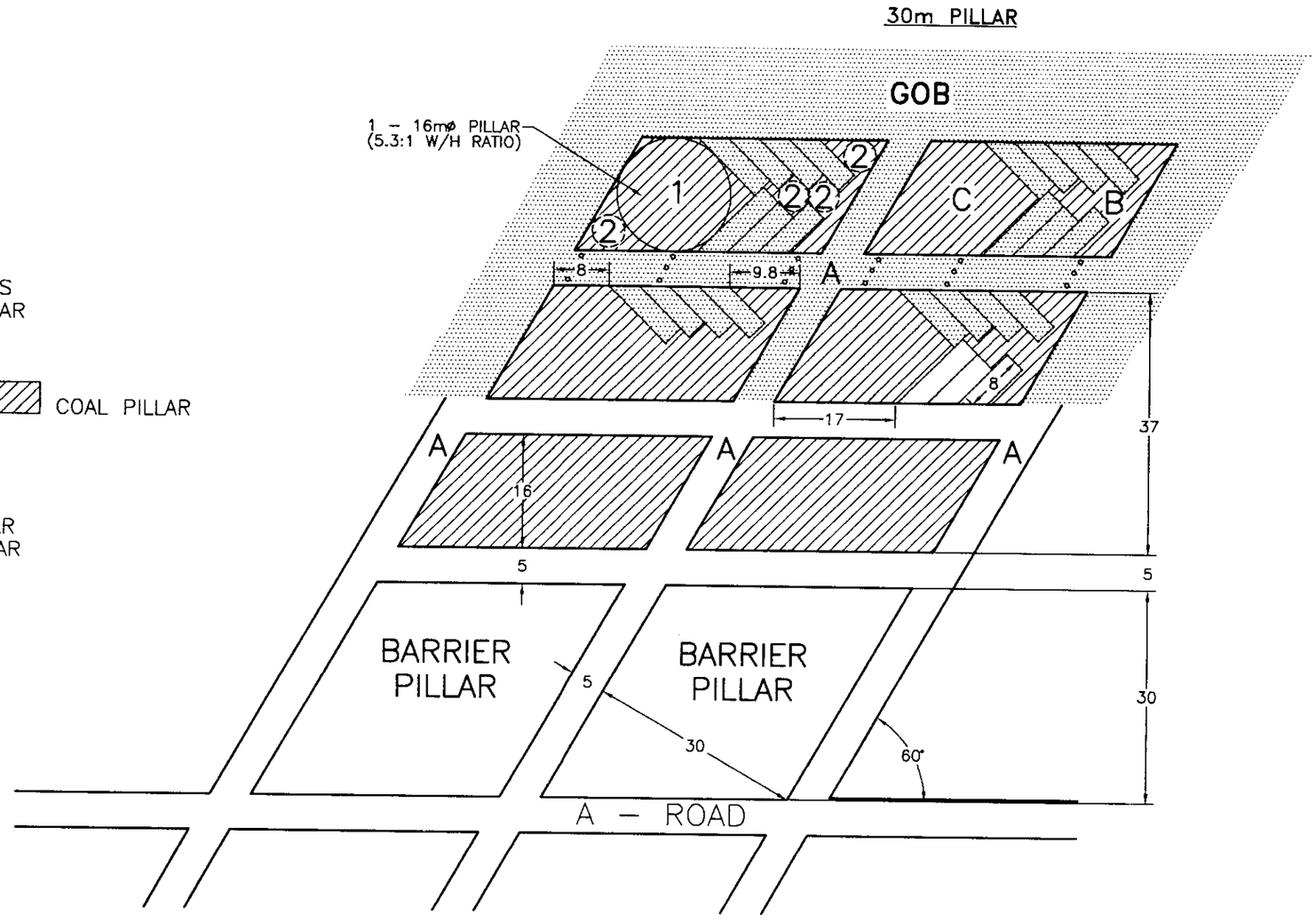
ϕ_p = post diameter
S_p = post spacing

FIGURE 3.1

o – POSTS
A – ROADWAY
B – STUMP PILLARS
C – SUPPORT PILLAR

GOB COAL PILLAR

1 – 16M ø PILLAR
2 – 4.50Mø PILLAR



SCALE: 1:750	DATE	T'SABLE RIVER	T'SABLE RIVER COAL CORPORATION
DESIGNED:	23/04/97	BULK SAMPLE PROGRAM	
DRAWN: BDP	97-04-20	PARTIAL DEPILLARING SEQUENCE	DWG. NO. 97-B-073 REV. 1
CHECKED:			
APPROVED:			