

BASE DATA VOLUME 3
FISH STUDY

1972-73

MACKENZIE HIGHWAY

Mile 300 to 550

DEPARTMENT OF PUBLIC WORKS
EDMONTON, CANADA

January 1974

PART 1



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F.F. SLANEY & COMPANY LIMITED

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ABSTRACT

The study, under a contract to the Department of Public Works, Edmonton, was designed to determine areas of potential impact to fisheries by identifying the aquatic resources of streams. Basic information was obtained from field studies conducted during the period September 1972 to November 1973.

One hundred and three creeks crossed by the proposed right-of-way were sampled. Forty-one of these were found to support fish and generally indicated a moderate to high stream potential. Streams with fish populations were distributed throughout the study area. The greatest concentrations of fish streams occurred between Willowlake River and Mount Gaudet. An area of least concentration occurs between the Camsell crossing and Willowlake River.

Sources of potential physical impacts on each stream were identified and recommendations were proposed to minimize impacts on the aquatic systems.

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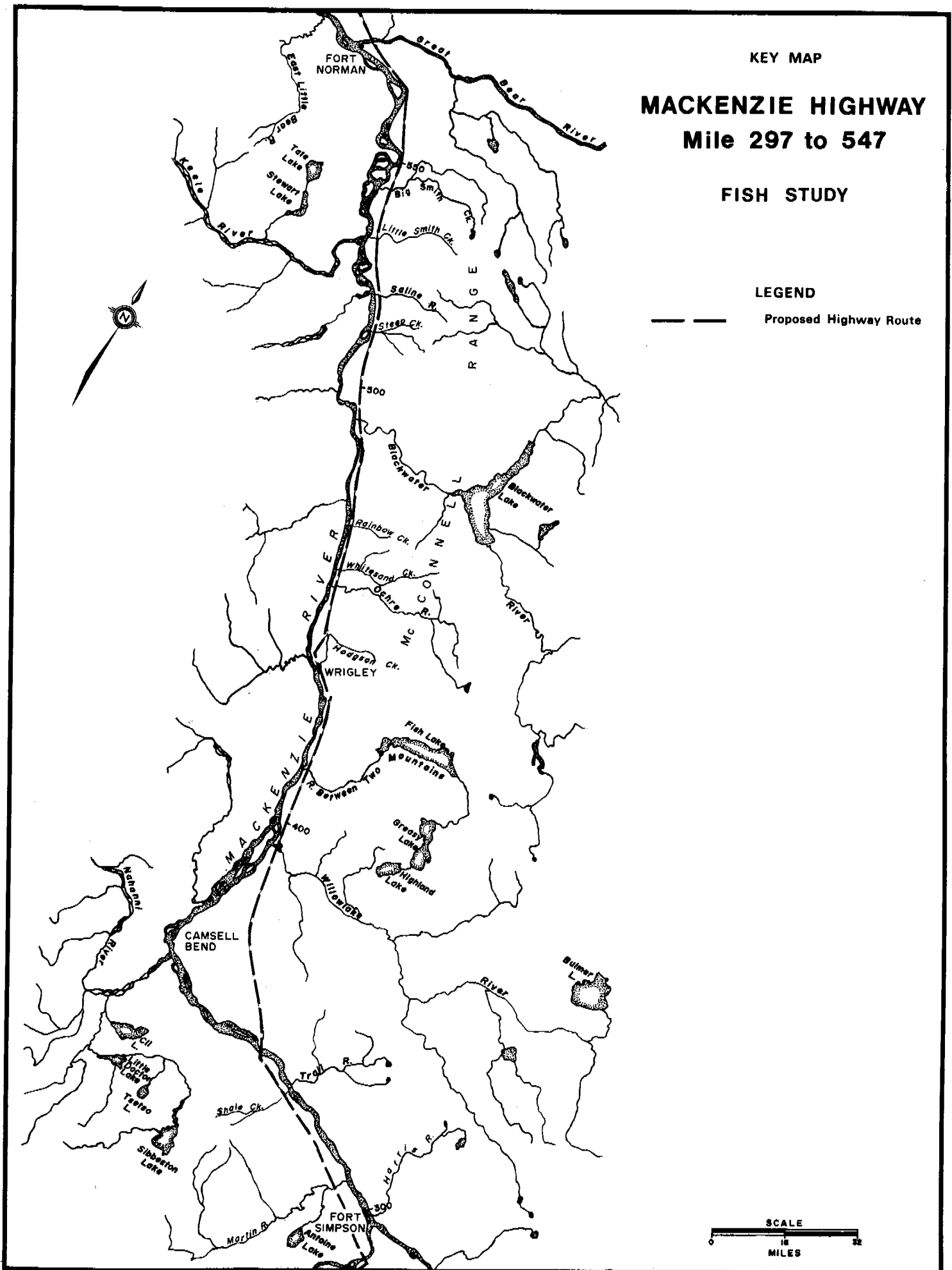
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MACKENZIE HIGHWAY
Mile 297 to 547

LEGEND



PART 1

INTRODUCTION

1.1 STUDY AREA

The study area encompasses a 250 mile section of the proposed Mackenzie Highway from Fort Simpson (Mile 297) to Mile 551 north of Big Smith Creek. The highway route lies predominantly on ancient terraces of the Mackenzie River.

1.2 STUDY OBJECTIVES

The stream sampling program was designed primarily to identify streams utilized by fish and to evaluate the fishery potentials of individual creeks. This report comprises base data for each creek crossed by the proposed right-of-way, assesses individual stream potentials and recommends construction guidelines to minimize impact on aquatic systems.

PART 2
METHODS AND MATERIALS

2.1 FISH SAMPLING

The permit issued by Canada Fisheries Service required minimal fish mortalities so techniques favouring high fish survival were used. Intensive fish analysis was limited to accidental mortalities. A copy of the permit is included in Appendix 203.

2.1.1 Sampling Techniques

Data for each creek was compiled into individual stream base data sheets for evaluation of stream potentials and future reference. (Refer to Appendix 202).

2.1.1.1 Beach Seining

Beach seining was employed to sweep gravel bars of the larger rivers and in conjunction with electrofishing techniques in the small creeks. A mesh size of 1/4 inch was used. Where a typical beach seine haul was made, a brail pole was held on shore while the other was walked out to make a downstream sweep of 50 to 100 feet. A uniform bottom type of gravel, silt or small rocks was selected to reduce snagging and fouling of the lead line. Since the majority of drainages surveyed were very small, beach seining was the least utilized sampling technique.

2.1.1.2 Electrofishing

The electrofishing equipment included a Smith Root Type VI variable - voltage pulsating unit with a maximum output of 425 volts. The advantages of electrofishing were high catch efficiency in small creeks, light-weight, ease of handling in brush covered or debris laden streams and low relative fish mortalities. Seines with a 1/4 in. bar were used in conjunction with the shocking techniques. The seine length used depended on the creek width. (Many creeks had widths of 3 ft. or less).

The seine was generally situated approximately 100 to 200 feet downstream from the initial point of electrofishing. A sweeping motion with the anode (electrode) while walking toward the stationary seine gave a good coverage of creek surface area. Stunned fish, often pulled toward the anode pole by a galvanotaxic response, were either dip-netted by a second man or carried into the seine by the stream current. Fish specimens were identified as to species, measured for fork length, sexed, and rated as to maturity. Only accidental mortalities were preserved for a more detailed analysis.

Electrofishing was the most widely used form of sampling.

2.1.1.3 Gillnetting

In the deeper streams where flow allowed, and where fish could not be sampled by any other techniques, gillnets were set over 24 to 48 hour periods. A multigang monofilament net (six 10 ft. gangs) with meshes ranging from 1/2 in. to 3-1/2 in. were placed in a criss-cross manner across the creeks. Scarcity of good netting sites and high fish mortality limited the use of gillnetting as a fish sampling technique.

2.1.1.4 Fry Netting

Fry nets were constructed on 1 ft. x 2 ft. frames supporting a 2 ft. conical bag of FIBU-GLASS with a 1/10 in. mesh size. These nets were utilized in intensive study streams to monitor fry movements and to sample streams which revealed no fish by other methods. Duration of each set was generally 24 hours.

2.1.1.5 Angling

Angling was used where access was difficult or the water body was too deep or the bottom too soft for wading. Both lures and dry flies were used. Lures were changed systematically to improve success.

Both a fly rod and a spin casting rod were used. Fishing effort was recorded and correlated to catch efficiency.

2.1.1.6 Observation

Visual observations of fish in a creek was also a means of verification of fish populations. In most cases, alternate sampling methods produced fish specimens in creeks where fry or adults were observed.

2.1.2 Specimen Analysis

Because of the anticipated low populations, and the numerous aquatic surveys in progress in this region of Mackenzie drainage, fish samples were measured and released alive wherever possible. Accidental mortalities were preserved for detailed analysis. Field measurements were limited to fork length, species identification, sex and maturity.

2.1.2.1 Fork Length

Fork length was measured to the nearest millimeter.

2.1.2.2 Species Identification

Younger stages of cyprinids and coregonids, are often very difficult to speciate by means other than dissection and magnification of anatomical features. For this reason, any accidental mortalities which were of doubtful classification, were preserved in a 10% formalin solution and sent to the University of British Columbia for verification by Dr. J. D. McPhail, Institute of Animal Resource Ecology.

Field identification was made wherever possible using "Fresh Water Fishes of Northwestern Canada and Alaska", McPhail and Lindsay, 1970.

2.1.2.3 Sex and Maturity

Sex and maturity determination of live fish precluded the normal techniques of dissection and direct gonad observation. Suspected adult fish were "milked" to gently squeeze out either milt or eggs. Failure to produce visible gametes resulted in the specimens being classified as either immature or spent, depending on fork length and known spawning times.

2.2 PHYSICO-CHEMICAL PARAMETERS

Physical and chemical parameters of each creek were recorded. Temperature of both air and water, pH, alkalinity, dissolved oxygen and conductivity were ascertained using Hach water analysis and dissolved oxygen and conductivity meters. Turbidity measurements were made with a 6 in. diameter secchi disc.

Physical parameters such as velocity, discharge, depth, width, bottom type and colour were also measured.

2.2.1 Chemical Parameters

2.2.1.1 Temperature ($^{\circ}\text{C}$)

Temperature was measured using a YSI Model 51A dissolved oxygen meter (temperature scale).

2.2.1.2 Dissolved Oxygen

Dissolved oxygen was measured on YSI Model 51A dissolved oxygen meter in parts per million (P.P.M.).

This instrument measures dissolved oxygen on a 0 to 15 P.P.M. scale and temperature on a -5°C to $+45^{\circ}\text{C}$ scale.

2.2.1.3 Conductivity

Conductivity was measured on a YSI-S-C-T portable, direct reading water quality meter. Conductivity readings (estimates of total dissolved solids) are read from a 0 to 50,000 μ mhos/cm scale @ $^{\circ}\text{C}$ of water.

2.2.1.4 pH

Determined by standard Hack Kit methods using wide range pH solution.

2.2.1.5 Alkalinity

Determined by standard Hack Kit method and measured in grains/gallon.

2.2.2 Physical Parameters

2.2.2.1 Method of Survey

Creek surveys were made by two methods:

a. Ground Surveys

Ground surveys were made on or as near as possible the site of right-of-way crossings of the creeks being studied. In some of the large creeks several sample sites were chosen above and below the proposed right-of-way. Ground surveys involved detailed analysis of both the physical and chemical parameters of the creeks.

b. Aerial Surveys

Aerial surveys were utilized to classify drainage areas, potential entrances into the Mackenzie River, channel types, bottom materials and possible migration obstacles up to and beyond the right-of-way.

A few minor drainage courses were checked only from the air. Such seepages had characteristic extreme shallowness, diffuse flow over moss, or obscure drainage systems.

2.2.2.2 Length of Stream Surveyed

On site stream surveys were concentrated in the general vicinity of the right-of-way. Aerial surveys extended for several miles above and below the right-of-way.

2.2.2.3 Drainage Area Classification

Distinct types of wetlands are seldom found in easily definable units. Fens often give way to bogs, or marshes to fens to produce a number of transitional types of wetlands. Wetlands normally classified by muskeg have been classified into more specific categories.

The following methods of categorizing land types were employed. Biophysical land classes were divided into five categories, three of which are described by the Department of Fisheries and Forestry, "Guidelines for Biophysical Land Classifications" and two categories are general descriptions of boreal forest type classifications. These categories are:

1. Bog

A peat covered area or peat-filled depression with a high water table and a surface carpet of mosses, chiefly Sphagnum. The water table lies at the surface in the spring and slightly below the moss carpet during the summer and fall of the year, but there is little standing water except for ponds. The mosses often form raised hummocks separated by low wet interstices. Upper peat and bog waters are surprisingly alkaline. Oxygen saturation is very low. Bogs may be covered by shrubs or trees such as larch and black spruce.

2. Marsh

Grassy wet areas, periodically inundated up to a depth of 2 meters or less with standing or slowly moving water. Surface waters occur seasonally or persist for long periods. Water levels may fluctuate, but the water table remains within the rooting zone of the plants during at least part of the growing season. The substratum usually consists of mineral or organic soils with a high mineral content, but there is little peat accumulation. Waters are usually neutral to alkaline, and there is a relatively high oxygen saturation. Grass and sedge sods may be anchored or floating, but usually are not consolidated, and are frequently interspersed with small areas of open water. The vegetation consists of a variety of emergent non-woody plants such as rushes, reeds, reed grasses and sedges often growing in the center of the basin. Where open water areas occur, a variety of submerged and floating aquatic plants flourish.

3. Swamp

Forested wetlands where standing to gently flowing waters occur seasonally. The bottom soils are usually continually waterlogged. Waters are often stained, and are neutral to slightly acid in reaction, with little deficiency in oxygen or other nutrients. The substrate consists of mixtures of transported mineral and organic sediments with little peat accumulation. Usually the peat, when present, is well-decomposed but there is no continuous moss carpet and Sphagnum is not abundant. The understory vegetation usually consists of mosses, ferns, grasses, rushes and sedges. Tree cover includes tall shrub, hardwoods and conifers. Swamp type usually occurred along the margins of bogs, open waters and streams.

4. High Relief Boreal Forest

Boreal forests on well-drained landforms such as eskers, drumlins, moraines, terraces and mountain slopes. The dominant trees on this higher ground are aspen, pine, birch and white spruce.

5. Low Relief Boreal Forest

Boreal forests of primarily coniferous species, black spruce, larch and white spruce associated with balsam poplar and willow, occupy poorly drained, boggy areas of low slope gradient with predominantly acidic organic soil.

2.2.2.4 Distance of Right-of-Way (R/W) from the Mackenzie

The lower sections of creeks immediately adjacent to their confluence with the Mackenzie are generally more favourable for fish. Lower sections obviously have a smaller probability of debris jams and beaver dams than have upper sections since effects from obstructions are compounded along the stream length. Drainage gradients, bottom type and vegetation also affect potential fish utilization.

2.2.2.5 Creek Entrance into the Mackenzie River

Lack of a defined entrance from the Mackenzie either permanently or during periods of low runoff would seriously limit utilization of such streams by resident species of the Mackenzie River. Drainages with no apparent access to the Mackenzie may still be utilized by resident species which would be dependent on suitable overwintering areas such as connecting lakes, marshes or stream ponds.

2.2.2.6 Accessibility for Fish at Mackenzie Entrance

Accessibility for fish into the many tributaries entering the Mackenzie River was given five ratings: good, fair, poor, nil and unknown. Accessibility ratings were based on water depth of the tributaries at the confluence, creek gradient and velocity, duration of flow and the possible migration obstacles such as debris and falls.

2.2.2.7 Channel Type

Creeks were classified into three river channel patterns as follows:

1. Well-defined - channel with distinct banks and the stream well-contained between banks.
2. Braided - channels successively divide and rejoin between accompanying islands.
3. Poorly-defined - channel banks are indistinct resulting in a diffuse flow over the landscape.

Note: All three categories of channel patterns may contain meanders.

2.2.2.8 Bottom Type

The adoption of a standard terminology for bottom types is a major need in limnology. Creek substrate classifications are arbitrary and often indistinct. We have used the following very broad bottom type classification system.

A. Inorganic:

1. Bedrock - solid rock
2. Boulders - rocks more than 12 in. in diameter
3. Rocks - 3 - 12 in. in diameter
4. Gravel - 1/8 - 3 in. in diameter
5. Sand - particles which readily precipitate out
6. Silt - fine particles that take more than one minute to settle from suspension

B. Organic:

Debris - Detritus, coarse plant material fragmented and decayed
Peat - Fibrous or pulpy decayed plant remains

2.2.2.9 Duration of Flow

Monitoring of duration of flow is valuable in determining potential for fish utilization of individual creeks. If flow is ephemeral, creek potential as far as spawning, feeding and nursery areas is greatly reduced. Spot samplings during the winter and fall provided a general estimate of the characteristics of various types of streams. Long-term periodic observation and evaluation of width, depth, discharge, bottom type and channel features would be necessary to better define respective creek flow characteristics.

As an aid to estimating duration of flow, information regarding winter flow was gathered from local sources and from two winter surveys. A survey in March, 1973, involved an aerial reconnaissance of the complete study area and ice drillings on various rivers. A similar survey was repeated in November, 1973, but on this occasion, there was more emphasis on the smaller streams.

Selected sampling does not give winter flow data to a high degree of accuracy, but it does provide a baseline for general classification.

2.2.3 Mileage

Creek mileage references correspond to mileages on the design packages submitted by F.F. Slaney & Co. in the fall of 1973.

Final Design Submission:	1 Mile 348-390	17, Sept. 1973
	2 Mile 390-428	1, Oct. 1973
	3 Mile 428-470	14, Oct. 1973
	4 Mile 470-490	7, Nov. 1973

Preliminary Design Submission:	5 Mile 495-521	11, Dec. 1973
	6 Mile 521-547.7	28, Dec. 1973

2.2.4 Intensive Study Streams

Six streams were selected for intensive examination in each highway section. These streams were selected for accessibility and physical attributes representative of creeks in the study section.

Frequent sampling provided a broad base data to understand local species complement, seasonal fish utilization and water quality characteristics.

The six intensive study streams are indicated in Figure 3.1-1 and all data is included in Appendix 202.

2.2.5 Rating of Stream Potential

All streams surveyed were classified by the accompanying criteria, into one of four possible categories of apparent capacity to support fish. The classification was based upon biological and physical parameters. Evaluation of individual stream potentials were prepared as an aid to designing adequate culverts and bridges. (Figure 3.1-1 illustrates individual stream potentials).

1. High Potential Streams

- . High fish catch per unit effort
- . High species diversity
- . Good entrance to the Mackenzie
- . Good accessibility for migrating fish
- . Probable year-round flow
- . Channel often braided
- . High ratio of spawning substrates

2. Moderate Potential Streams

- . Fish captured but relatively few for sampling effort expended
- . Drainage area often contains ponds or marsh-like complexes
- . Good entrance to the Mackenzie
- . Adequate depth, width and gradient with few migration barriers
- . Adequate flow of water for fish throughout the summer
- . High ratio of good spawning substrates

3. Low Potential Streams

- . With few exceptions no fish captured or observed
- . Entrance to the Mackenzie identified but poor
- . Accessibility for fish possible but limited
- . Channel generally poorly defined
- . Spawning substrate limited

4. Minimal Potential

- . No fish captured or observed
- . Drainage area small with few moderating effects on flow
- . Entrance to the Mackenzie not apparent
- . Minimal or no accessibility for fish from the Mackenzie
- . Poorly defined channels with diffuse flows
- . Bottom type generally of poor spawning substrate

PART 3

RESULTS

3.1 DISTRIBUTION OF IDENTIFIED FISH STREAMS

Fish streams were most frequent in the area from Willowlake River to Mount Gaudet. Elsewhere fish streams occur with less frequency and are basically a function of the size of drainage area; bottom substrate and access to the Mackenzie. There is a direct relationship between size of drainage and fish potential.

As indicated in Figure 3.1-1, most of the smaller stream between Fort Simpson and Camsell Bend had low to minimal potentials. The larger streams which originate in the Martin Hills rate as moderate to high fishery potential.

The Camsell Bend crossing to Willowlake River section is characterized by streams with low potential associated with bogs, marshes and poor access to the Mackenzie. Areas of significant fish potential occurred in stream reaches close to the Mackenzie at the ends of the section.

The Willowlake River to Mount Gaudet section showed the greatest abundance of fish streams, a factor related to well developed drainage courses with good access from the Mackenzie.

North of Mount Gaudet to the Blackwater River, the right-of-way route follows either the upper or lower Mackenzie terraces. Except for the major drainages which have moderate to high ratings the majority of the streams have minimal potential.

The section of the study area from Mile 492 to Mile 551 north of Big Smith Creek contains 10 streams of moderate to high fish resource

value and 18 of low to minimal potential. The majority of the moderate to high potential streams are major drainages usually associated with lakes. Poor access and steeper gradients from the Mackenzie were the primary factors in classifying streams as low or minimal.

3.2 SPECIES COMPLEMENT

A total of 15 fish species were identified throughout the 250 mile study area during the 1973 summer field survey. Included in the species identified were: humpback whitefish, grayling, pike, lake chub, spottail shiner, finescale dace, longnose dace, longnose sucker, trout-perch, burbot, slimy sculpin, spoonhead sculpin, brook stickleback, arctic cisco and flathead chub.

The most frequently captured species were: grayling, longnose sucker, lake chub, and slimy sculpin.

Eight additional species had been previously identified in our study area by the Fisheries Service, Northern Engineering Services, and Interdisciplinary Systems Ltd. These additions are: round and broad whitefish, char sp., white sucker, lake cisco, emerald shiner, inconnu and walleye.

It should be noted that previous samplings were conducted primarily in major drainage systems only and often near the confluence of the stream with the Mackenzie.

Assessment of the total species complement of the individual creeks is biased because sampling ceased after presence of fish was verified. Sampling to ascertain diversity of species was not continued in most drainages and a greater diversity of species is expected than the sampling indicates.

Species complements of survey samples for individual streams are listed in Figure 3.1-1.

TABLE 3.1-1
SUMMARY OF AQUATIC RESOURCE POTENTIAL

Design Pkg. Mileages	Total Creeks Sampled	Total With Fish	% With Fish	Predominant Fish Potential of Area	Major Aquatic Areas Of Concern
297-347	27	9	33	Low	Major drainages between Mile 305 and Mile 350.
374-390	16	5	31	Low	Creeks north of Camsell crossing between Miles 348 and 363.
390-428	13	9	69	Moderate	Major rivers and smaller marsh or lake drainages.
428-470	16	6	38	Minimal	Restricted to major streams.
470-490	13	3	23	Minimal	Restricted to larger streams.
490-495	3	1	33	Low	Blackwater River.
495-521	17	4	24	Low	Major rivers. Lake complex at Mile 504.5.
521-547.7	8	4	50	Moderate	Major rivers. Cleaver Lake complex.

TABLE 3.2-1

SPECIES OCCURENCE ACCORDING TO SIZE OF
DRAINAGE SYSTEMS BETWEEN MILE 300 TO 551

<u>Species Identified To Date In Major Drainages Only</u>	<u>Species Found in Smaller, Ephemeral Creeks And Major Drainages</u>
Board Whitefish	Grayling
Humpback Whitefish	Lake Chub
Round Whitefish	Finescale Dace
Arctic Cisco	Longnose Sucker
Emerald Shiner	Trout-Perch
White Sucker	Slimy Sculpin
Burbot	Longnose Dace
Spoonhead Sculpin	Spottail Shiner
Char sp.	
Inconnu	
Walleye	
Pike	

PART 4

SUMMARY AND RECOMMENDATIONS

4.1 SUMMARY OF DATA

4.1.1 Stream Potentials Throughout the Study Area

The fishery resource potential of most small, often ephemeral, bog drainages appears to be low throughout the entire 250 mile study area. All major rivers tend to be areas of moderate to high potential and thus are important areas of concern.

The stream classifications are designed primarily to aid authorities in arriving at competent decisions regarding the installation of appropriate culvert structures where biological and economic considerations are rationalized.

4.1.2 Fish Support Capabilities of Streams Surveyed

The fish support capabilities of a stream are correlated with such physical parameters as size, gradient, obstructions, duration and depth of flow. No chemical factors were identified as limiting the fishery resource of any stream in this region.

4.1.3 Recommended Culvert Designs by Stream Potential

Fishery regulations indicate that fish passage through crossing structure be provided with a maximum allowable velocity of five f.p.s. Recent studies (Dr. D. R. Jones, 1973) indicate that velocities as low as two f.p.s. may be required in strata along the base or sides of the passageway to insure fish passage. Flows in other portions of the culvert could be greater. The use of bottom spoilers and conventional baffles is being studied at the Federal hydraulic laboratory in Burlington, Ontario.

4.1.3.1 High and Moderate Potential Streams

Significant fish populations were proved to be present in these streams. Provision for fish passage should have a high priority rating.

4.1.3.2 Low Potential Streams

The biological justification for incurring a major cost to construct a crossing structure to accommodate fish is marginal. The need for such fish passage structures should be identified before large expenditures are considered.

4.1.3.3 Minimal Potential

Fishery requirements in all creeks rated minimal potential should be satisfied by installation of normal culvert designs.

4.1.4 Species Complement of Drainages Within the Study Area

Twenty-three fish species have been identified, by various sources, within the 250 mile study section. Individual creek species complements varied from creek to creek and region to region. All species observed in the smaller intermittent drainages also frequented the major systems.

Grayling, lake chub, longnose sucker and slimy sculpin were the most predominantly sampled species in the smaller, intermittent creeks. These species apparently utilize small streams from about mid-May to September as feeding, spawning and nursing areas, but migrate to winter refuges (usually the Mackenzie) prior to freeze-up.

Char, inconnu and walleye were not found in the drainages investigated.

Pike and burbot are not abundant in the smaller drainages but are relatively abundant in the major streams, with good access to the Mackenzie and relatively stable flow.

All whitefish species appear to frequent only the major drainages such as Willowlake, Ochre, Whitesand and Blackwater Rivers. Stream utilization by these fall spawners would be intimately correlated with fall water levels and accessibility from the Mackenzie.

4.1.5 Fish Life Cycles and Sensitive Periods

The species of fish found in the Mackenzie River system can be divided into two major groups with respect to spawning habits: spring-summer or fall-winter spawners. Spring-summer spawners include such species as grayling, pike, chub, suckers, trout-perch, walleye, sculpins, and mooneyes. Whitefish spp., burbot and arctic char are classed as fall-winter spawners. Knowledge of periods of significant fish utilization in the survey area is essential for scheduling construction in order to minimize impacts on aquatic resources.

The timing of reproductive phases of fish life cycles are presented in Table 4.1-1. Life histories, swimming performance data and illustrations of the major fish species of the Mackenzie River system are included in Appendix 201.

4.1.5.1 Spring-Summer Spawners

Migrations from overwintering areas in the Mackenzie and major tributaries to headwater drainages and lakes commence during the spring break-up. Eggs are deposited in varying grades of substrates depending on the species. Eggs generally take from one to three weeks to hatch and alevins may remain within the gravel for several weeks. Fry tend to remain in nursery areas until early fall at which time they migrate to overwintering areas in the Mackenzie or other large rivers and lakes.

Adults and fry are forced to leave smaller tributary streams in the fall because of low water levels, ice formation and reduced oxygen levels.

TABLE 4.1-1

TIMING OF REPRODUCTIVE PHASES
OF MAJOR FISH SPECIES OF THE
MACKENZIE RIVER SYSTEM

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
<u>Flathead Chub</u>												
Migration											
Spawning						=====						
Eggs in gravel								
Fry in stream								
<u>Lake Chub</u>												
Migration					=====							
Spawning						=====						
Eggs in gravel								
Fry in stream							
<u>Longnose Dace</u>												
Migration					=====							
Spawning						=====						
Eggs in gravel								
Fry in stream							
<u>Finescale Dace</u>												
Migration					=====							
Spawning						=====						
Eggs in gravel								
Fry in stream							
<u>Emerald Shiner</u>												
Migration					=====							
Spawning						=====						
Eggs in gravel								
Fry in stream							
<u>Spottail Shiner</u>												
Migration					=====							
Spawning						=====						
Eggs in gravel								
Fry in stream							

NOTE: Dotted lines indicate data gaps and postulated times.

TABLE 4.1-1 (cont.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
<u>Brook Stickleback</u>												
Migration											
Spawning						=====						
Eggs in gravel						=====					
Fry in stream						=====				
<u>Arctic Char</u>												
Migration								=====				
Spawning									=====			
Eggs in gravel	=====								=====	=====		
Fry in stream						=====						
<u>Arctic Grayling</u>												
Migration						=====						
Spawning						=====						
Eggs in gravel						=====						
Fry in stream							=====	=====				
<u>Walleye</u>												
Migration						=====						
Spawning						=====						
Eggs in gravel						=====						
Fry in stream							=====					
<u>Northern Pike</u>												
Migration						=====						
Spawning						=====						
Eggs in gravel							=====	=====				
Fry in stream							=====	=====				
<u>Burbot</u>												
Migration											=====	=====
Spawning	=====										=====	=====
Eggs in gravel	=====	=====	=====	=====							=====	=====
Fry in stream					=====	=====	=====					

TABLE 4.1-1 (cont.)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
<u>Broad Whitefish</u>												
Migration							—————	—————				
Spawning							—————	—————	—————	—————		
Eggs in gravel	—————	—————	—————	—————			—————	—————	—————	—————		
Fry in stream				—————	—————	—————	—————	—————	—————	—————		
<u>Round Whitefish</u>												
Migration										—————	—————	
Spawning										—————	—————	
Eggs in gravel	—————	—————	—————	—————						—————	—————	
Fry in stream				—————	—————	—————	—————	—————	—————	—————		
<u>Lake Cisco</u>												
Migration										—————	—————	
Spawning										—————	—————	
Eggs in gravel	—————	—————	—————	—————						—————	—————	
Fry in stream				—————	—————	—————	—————	—————	—————	—————		
<u>Arctic Cisco</u>												
Migration					—————	—————			—————	—————		
Spawning					—————	—————	—————	—————	—————	—————		
Eggs in gravel	—————	—————	—————	—————			—————	—————	—————	—————	—————	
Fry in stream				—————	—————	—————	—————	—————	—————	—————		
<u>Trout-Perch</u>												
Migration					—————	—————						
Spawning					—————	—————	—————	—————	—————	—————		
Eggs in gravel						—————	—————	—————	—————	—————	—————	
Fry in stream						—————	—————	—————	—————	—————	—————	

4.1.5.2 Fall-Winter Spawners

Fall spawning species include most anadromous species such as whitefish.

In anadromous populations, gradual upstream migrations of adults occur from mid-summer to early autumn. Spawning usually occurs in clear headwater streams and lakes in early autumn. Burbot spawn beneath winter ice. Eggs hatch the following spring.

Fry of fall-winter spawners typically remain in spawning streams for extensive periods of time (up to 6 years for arctic char) before migrating to coastal feeding areas.

4.1.6 Limitation of Data

Data on complete species complements of individual creeks was not pursued in this study designed to identify creeks which support fish. Sampling was terminated in most cases after verification of the presence of fish.

Sampling during high water periods was difficult and determination of fish utilization at peak flows is tentative.

Sampling frequency was variable from creek to creek due to cessation of sampling upon verification of fish, inaccessibility due to weather or terrain and interrupted sampling schedules. The data collection was essentially limited to obtaining specific information for decision making of highway crossing sites and was not intended for in depth analysis of aquatic systems. Several in depth research studies are being carried out by government agencies.

4.2 RECOMMENDATIONS

4.2.1 General Construction Guidelines

A general assessment of current or potential construction impacts was made at each creek crossing to facilitate recommendation of appropriate construction guidelines to minimize further disturbances. At crossing sites where no serious disturbances were obvious, overall general construction guidelines were recommended to minimize most foreseeable construction impacts. Where a specific disturbance such as a prominent ice lens, solifluction, channel barriers, or excessive siltation was noted specific recommendations were included to facilitate adequate control measures. General and specific construction guidelines are referred to in the individual creek data sheets listed in Appendix 202.

1. Borrow Material

- . Granular borrow material for highway grade equipment pads or camp installations should be sought primarily from terrestrial deposits. Limited supplies of granular substrate may possibly be removed from turbid streams upon Fishery Service approval.
- . Borrow areas in creeks should be confined to the lower reaches to minimize overall effects of increased suspended sediments and to improve the chances of recolonization of the disturbed area by drifting organisms.
- . Stream gravel borrows should be of moderate volumes and surficial in nature to minimize scouring and "drawdown" of upstream substrates.
- . Known or suspected overwintering, spawning, and nursery areas would preclude the use of such habitat as a gravel source.

- . Gravel operations from abandoned water courses should be no closer than 100 feet from active river channels.
- . Removal of large boulders that armour active creek bottoms should be avoided.

2. Siltation

- . Surface runoff in construction areas near creeks or lakes should be prevented or diverted to settling basins to prevent siltation of streams. Cofferdams, settling ponds, revegetation and ditching are methods recommended to reduce suspended sediments.
- . Stabilization of banks and creek channels to prevent erosion after culvert or bridge installation should be an integral part of the project to limit post-construction disturbances.
- . Adequate vegetation zones around lake shores and river banks should be left to reduce disturbance of the aquatic environment.

3. Blasting

- . Permission is required in writing for any blasting in or near streambeds of "waters frequented by fish".
- . Blasting operations should be scheduled according to fish migration or rearing periods.

4. Installation of River Crossings

- . The design and construction of all stream crossings are subject to the approval of Department of Environment Fisheries Service.
- . Winter construction of culverts and bridge crossings is recommended wherever possible, (November to April), as ground and bank substrates are more stable, due to ground ice, and better able to support heavy machinery and excessive vehicle travel.

- . Wherever possible prefabricated steel or wooden coffer dam structures should be used in preference to fills that disrupt surrounding substrate.
- . All temporary crossing structures, coffer dams, piers, platforms and obstructions should be removed before the freshet period.
- . Temporary stream crossing should be constructed using the natural ice cover, where possible, or adding to the thickness of that cover by using snow and pumped water to form an ice bridge. Unlimbed trees, roots, stumps, slash or other road building or land clearing materials are prohibited as a binding to form ice bridges. A channel must be maintained under the ice bridge which will permit the flow of water if water continues to flow throughout freeze-up.
- . Where fill is required for the crossing of dry or frozen creeks, where feasible, compacted snow should be used; dirt fill should not be used unless specifically authorized by the Land Use Inspector.
- . Rip-rap around piers and stream banks should be clean material and not removed from the stream bed or river bank.
- . Trees should be felled away from stream beds and any debris accidentally introduced into the water removed immediately.
- . Particularly sensitive crossing sites and banks should be hand cleared so as to leave roots intact for added bank stability.

5. Culvert Installation

- . The slope of the stream bed at proposed crossings should be as flat as possible. The stream reach should be of a similar alignment for several hundred feet above and below the culvert. Channelization of the stream bed should be minimal.
- . The width and depth of the culvert should approximate that of the natural stream with provision for periods of increased water volume and velocity during the freshet.

- . Large structures should have a "natural" bottom with the inclusion of natural stream bed material wherever possible. The rocks should not be large enough to cause potential traps for free drifting debris during high water.
- . The width of the river should not be reduced thereby increasing the velocity of water flow beyond 5 f.p.s.
- . The culvert should not be installed in such a way as to promote erosion of the stream banks or a discharge of particulate material into the river, potentially filling in natural passageways to fish migration.
- . The structure should provide a strata with maximum velocities of 1 to 2 feet per second to permit passage of the slower swimming fishes. The length of the culvert is a major factor in estimating the ability of a fish to pass up through a culvert.

6. Toxic Chemicals

- . Stationary fuel storage locations should be carefully selected and prepared to avoid pollution of streams and to minimize the lateral flow of spilled fuel on the land surface. Stationary fuel storage facilities should be enclosed by an impermeable dyke of sufficient volume capacity to contain spilled fuel.
- . All stationary fuel storage facilities should be clearly marked with flags, posts or similar devices so they are plainly visible to local traffic regardless of snow cover, weather or daylight conditions.

7. Sewage Disposal

- . Domestic sewage treatment systems should be installed at all temporary construction sites preferably at the secondary or tertiary treatment levels.
- . Garbage should be incinerated and buried.

8. Fishing Regulations

- . All construction personnel must be familiar with local fishing regulations and acquire necessary fishing permits.
- . Construction personnel should avoid interfering with fish movements or local domestic fisheries.

LITERATURE CITED

Lacate, D.S., Chairman
Guidelines for Bio-physical Land Classification for Classification of
Forest Lands and Associated Wildlands. Department of Fisheries and
Forestry, Canadian Forestry Service, Publication No. 1264. Ottawa, 1969.

OTHER SOURCES OF INFORMATION

Hatfield, C.T., J.N. Stein, M.R. Falk and C.S. Jessop. 1972.
Fish Resources of the Mackenzie River Valley, Interim Report 1. Vol. 1
of 2. Department of the Environment, Fisheries Service, Winnipeg, Man.

Interdisciplinary Systems Ltd., Winnipeg, Manitoba.
Fish Survey Base Data Report 1973.

Jones, D.R. 1973.
An Evaluation of the Swimming Performance of Several Fish Species from
the Mackenzie River. Manuscript (In Press).

McPhail, J.D. and C.C. Lindsey.
Freshwater Fishes of Northwestern Canada and Alaska, Bulletin 1973.
Fisheries Research Board of Canada, Ottawa. 1970.

Renewable Resources Consulting Services Ltd., Edmonton, Alberta.
Mackenzie Highway Environmental Overview Study. January, 1973.
Volume 1 of 2.

Slaney, F.F. and Co. Ltd., Vancouver.
Basic Environmental Data for Sections of Mackenzie Highway. November,
1972 to January, 1973. Folio 2 (4 volumes).

Slaney, F.F. and Co. Ltd., Vancouver.
Environmental Impact Mackenzie Highway. Preliminary Assessment.
Mile 297 - 551. October, 1972.

Slaney, F.F. and Co. Ltd., Vancouver.
Preliminary Basic Environmental Data, Mackenzie Highway Bridges, Mile 297
to Mile 551. January, 1973.

Stein, J.N., C.S. Jessop, T.R. Porter and K.T.J. Chang-Kue. 1973.
An Evaluation of the Fish Resources of the Mackenzie River Valley as
Related to Pipeline Development, Vol. 1 of 2. Department of the Environ-
ment, Fisheries Services, Winnipeg, Manitoba.

APPENDIX 201

Life Histories, Performance Data and
Illustrations of the Major Fish Species
of the Mackenzie River and Tributaries

Source of Data

All performance data for Arctic Fish species was supplied through the courtesy of Dr. D. R. Jones, Zoology, University of British Columbia.

Illustrations of Arctic Fish species were reproduced from originals contained in Fisheries Research Board of Canada Bulletin 173 "Fresh-water Fishes of Northwestern Canada and Alaska" by J. D. McPhail and C. C. Lindsey.

Definition of Terms

Throughout this appendix the word "mature" denotes sexual maturity or physiological capability to reproduce. These observations were made on the basis of dissections of all fishes used to accumulate the performance data enclosed in this section. Swimming velocities are expressed in both centimeters (cm)/second and feet/second. "Critical Velocity" refers to the maximum velocity the fish can maintain for a period of time not greater than 10 minutes before becoming fatigued. Specimens were subjected to controlled increments in water velocity until the critical velocity (velocity at which the fish fatigued) was attained. Suitable recuperation periods were scheduled between each velocity increment experiment. The 10 minute time period was selected on the assumption that the greatest culvert length would be approximately 300 feet, and that a fish must travel at least 0.5 feet/second faster than the water flow to make upstream progress, hence 10 minutes to travel 300 feet.

THE MINNOWS

Family - CYPRINIDAE

Flathead Chub

Lake Chub

Longnose Dace

Finescale Dace

Emerald Shiner

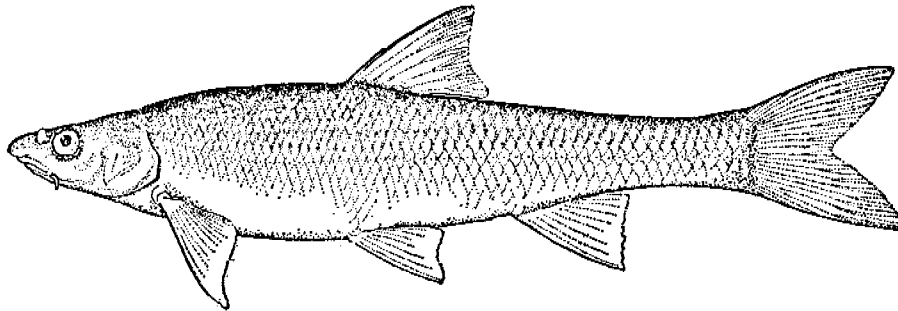
Spottail Shiner

Flathead Chub (Platygobio gracilis Richardson)

The flathead chub occurs in muddy rivers over the Mackenzie system rarely being found in clear water. Little is known of the life history or spawning habits of this minnow. Spawning probably begins in early June and lasts through until early August. A mature fish is considered 8.5 cm in length.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
*25	9.84	61.5	2.05

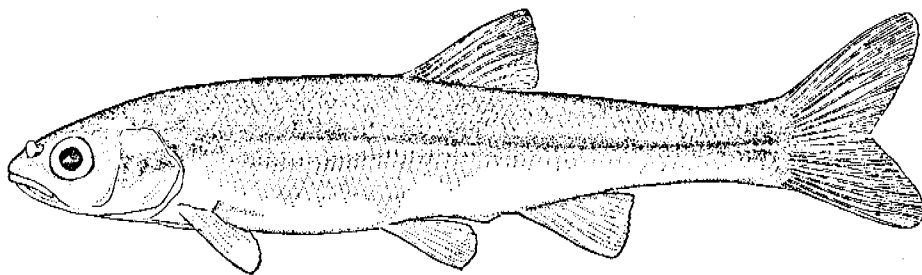
* Considered Mature



Lake Chub (*Couesius plumbeus* Agassiz)

The lake chub is a widespread cyprinoid frequenting lakes and streams in both clear and muddy waters. It is essentially bottom dwelling and in B.C. waters matures in its 3rd or 4th year. Spawning information is spotty and begins in late May or early June and may continue through August.

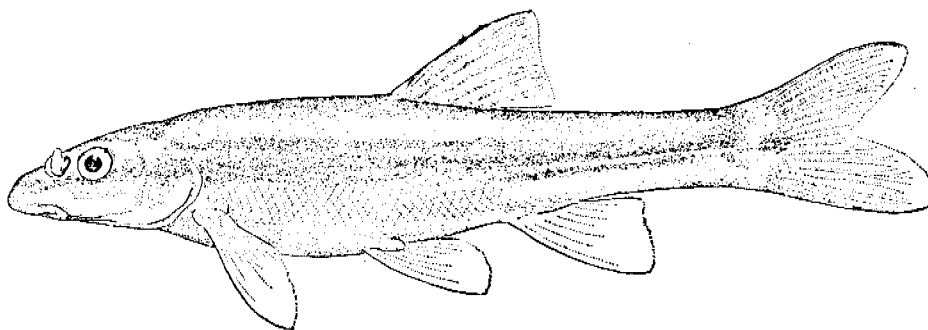
* No performance data available on this species.



Longnose Dace (Rhinichthys cataractae Valenciennes)

The longnose dace is a bottom dwelling fish, found in clear and turbid streams. Spawning is thought to occur in the summer months, with eggs laid among stones. Eggs hatch in 7 - 10 days, and following absorption of the yolk sac (approximately 1 week) they migrate to the shallows of river margins. About 4 months after hatching, they seek the faster, deeper waters. Sexual maturity is believed to occur in 3 years.

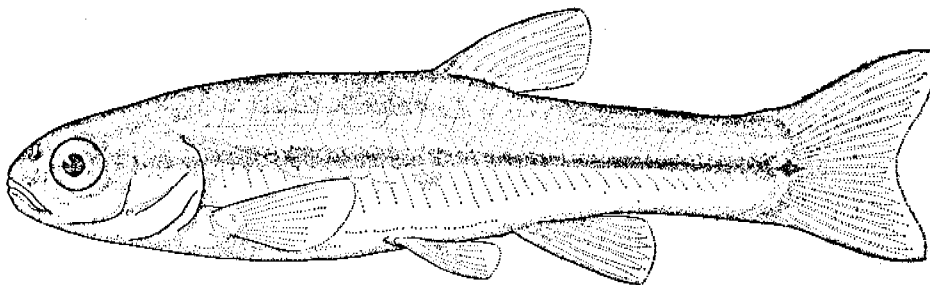
* No performance data available on this species.



Finescale Dace (Pfrittle neogaea Cope)

The finescale dace is found in cool lakes and streams, and spawning is believed to occur in June and July. Little is known of the reproductive and migratory behaviour of this species.

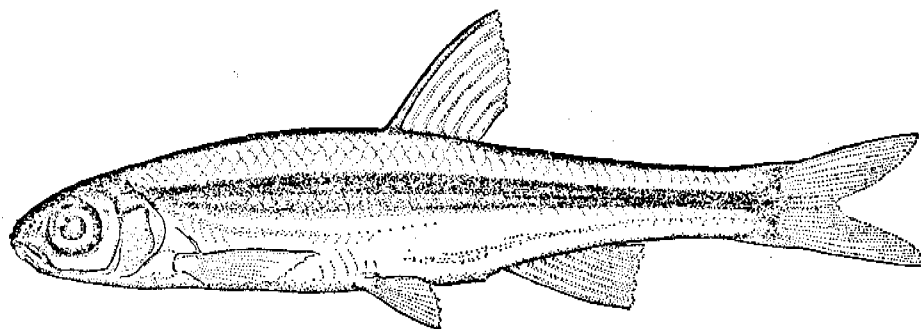
* No performance data available on this species.



Emerald Shiner (Notropis atherinoides Rafinesque)

An inhabitant of lakes and large rivers, the emerald shiner has been observed to be a late spring and summer spawner in shallow on-shore waters. Eggs hatch rapidly, usually 1 to 2 days after laying. Mature fish may spawn several times each summer. Fish over 6 cm (approximately 2.4 inches) are considered mature.

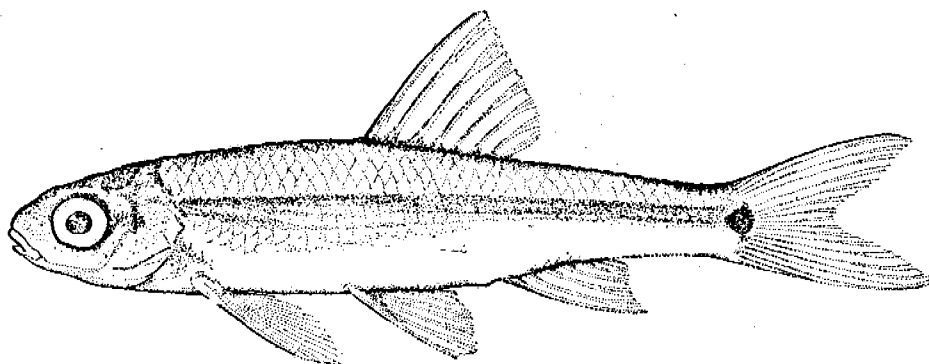
<u>Body Length</u>		<u>Critical Velocity</u>	
(cm.)	(in.)	(cm./sec.)	(ft./sec.)
6.5	2.56	59.0	1.94



Spottail Shiner (Notropis hudsonius Clinton)

The species is abundant in the shallows of large, clear northern lakes and larger turbid rivers. Spawning begins in June and July over sandy shoals and creek mouths, but little is known of reproductive histories.

* No performance data available on this species



THE STICKLEBACKS

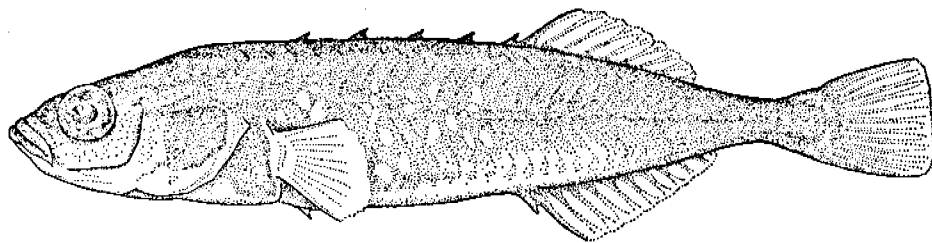
Family - GASTEROSTEIDAE

Brook Stickleback

Brook Stickleback (Culaea inconstans Kirtland)

The brook stickleback is an inhabitant of slow streams or shallow lakes in areas of dense aquatic vegetation. Spawning occurs in the spring (May to July) and the eggs are protected in a nest constructed by the male. The emergant fry are also protected in this dwelling until they become self-sufficient.

* No performance data available for this species.



THE CHARS

Family - SALMONIDAE

Arctic Char

THE CHARS

Family - SALMONIDAE

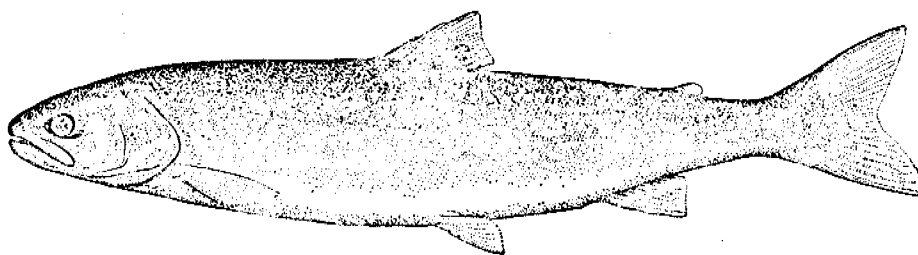
Arctic Char

Arctic Char (*Salvelinus alpinus* Linnaeus)

Arctic char occur as both anadromous and landlocked populations in arctic systems. The sea-going varieties begin to migrate in late July and continue through September. Spawning occurs in the gravel beds of lakes and small streams, with eggs being spawned in the fall months, and overwintering in the gravel. The fry emerge around breakup time in May and June, about the same time as the spawning adults from the previous autumn begin to return to sea.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
*35.5	13.98	100.2	3.29

* Considered Mature



THE GRAYLINGS

Family - THYMALLIDAE

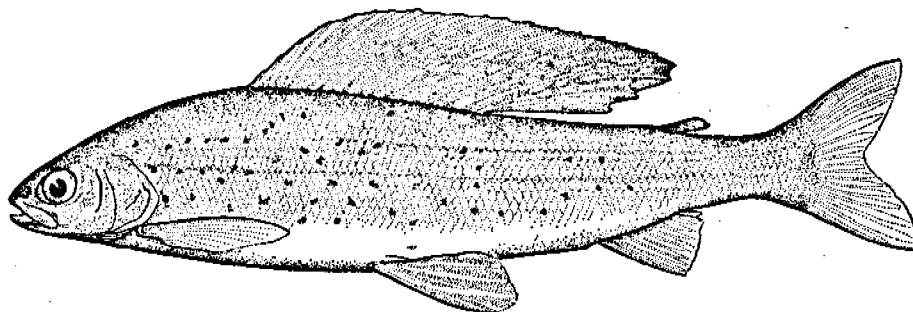
Arctic Grayling

Arctic Grayling (Thymallus arcticus Pallus)

In most arctic waters grayling mature by their 5th year and obtain lengths of 30 to 40 cm (12 to 16 inches). Spawning occurs in small gravel bottomed streams beginning in early May and carrying through until mid-July. The fry emerge 16-18 days after they spawn depending upon temperature and are prevalent in these rearing waters from July through to mid-October.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
10	3.94	54.3	1.78
20	7.87	64.0	2.10
*30	11.81	70.5	2.31
*40	15.75	76.0	2.49

* Considered Mature



THE PERCHES

Family - PERCIDAE

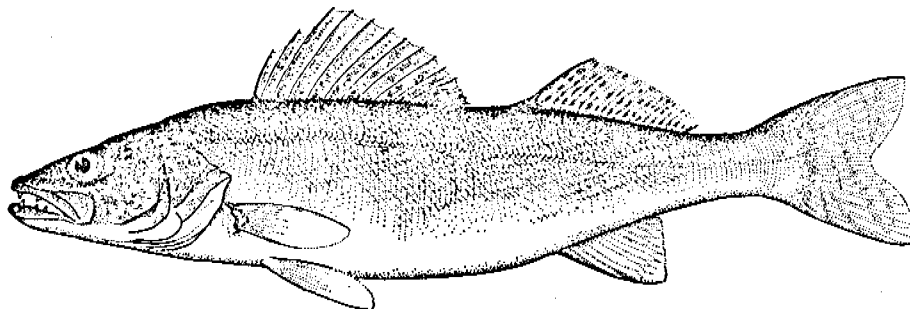
Yellow Walleye

Walleyed Pike (Stizostedion vitreum vitreum Mitchill)
(Yellow Walleye)

The walleye is abundant in the southern arctic areas, preferring warmer lakes and streams (south end of Mackenzie Basin), and in lakes are found in shallow shoreline areas. Adults are mature in their 5th and 6th years, but may be only 20 cm in length. Spawning begins just before ice-out in June and may last until mid-July. The walleyes migrate to their spawning beds upon rocky shoals in lakes or gravel beds in streams, and deposit eggs over the months of June until the end of September. Eggs hatch in 12-18 days depending upon temperature.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
*25-30	9.8-12	59.75	1.99

* Considered Mature



THE PIKES

Family - ESOCIDAE

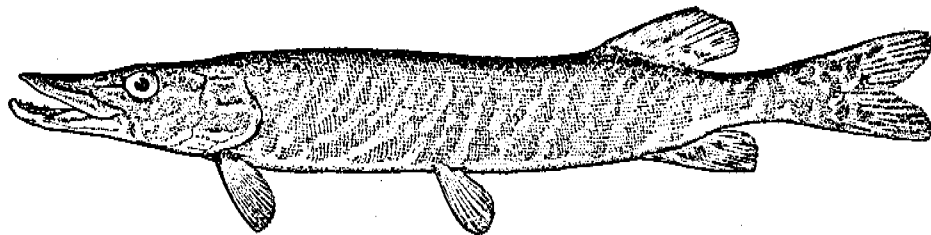
Great Northern Pike

Great Northern Pike (Esox lucius Linnaeus)

Pike are typically a brackish water inhabitant of quiet rivers and lakes, showing little migratory tendency. They mature in 5 to 6 years and spawn in the spring months (mid-June to mid-July), shortly after breakup. Eggs are laid in muddy and often flooded areas of the shoreline with eggs attached to submerged vegetation. The fry emerge in 12-14 days and the fry remain in the spawning areas from July to mid-October.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
10	3.94	13.9	0.46
20	7.87	34.5	1.15
30	11.81	44.5	1.48
*40	15.75	53.5	1.78
*50	19.70	61.5	2.05
*60	23.62	69.0	2.30

* Considered Mature



THE CODS

Family - GADIDAE

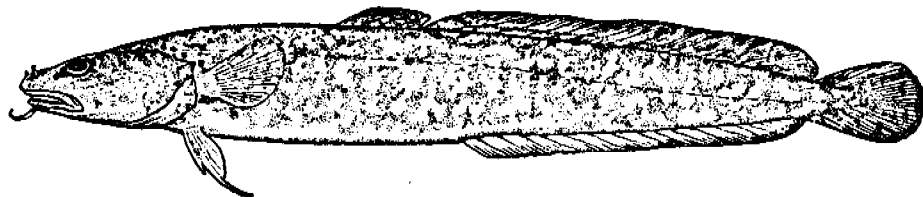
Burbot

Burbot (Lota lota Linnaeus)

The freshwater cod occurs in quiet areas of large streams and rivers as well as lakes and ponds in the arctic. The burbot is a bottom dwelling fish and capable of spawning in about its 6th year. Spawn is deposited in stream bottoms or shallow lake bottoms under the cover of ice in the later winter months. The young hatch in the early spring before break-up and reach a length of approximately 5.8 inches in their first year.

<u>Body of Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
10	3.94	28.2	0.94
30	11.81	40.5	1.35
*50	19.70	47.75	1.59
*70	27.58	53.0	1.77

* Considered Mature



THE SCULPINS

Family - COTTIDAE

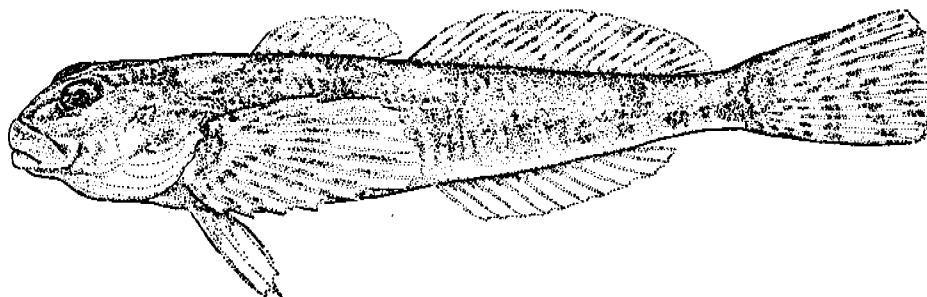
Slimy Sculpin

Spoonhead Sculpin

Slimy Sculpin (Cottus cognatus Richardson)

The slimy sculpin is an extremely widespread species found in rivers and streams and less typically in lakes. It is generally found in rocky areas subject to currents or wind action. At maturity it may be only 2.5 to 3 inches in length. This sculpin spawns in May but reproductive data is sketchy and little is known of its growth and life history.

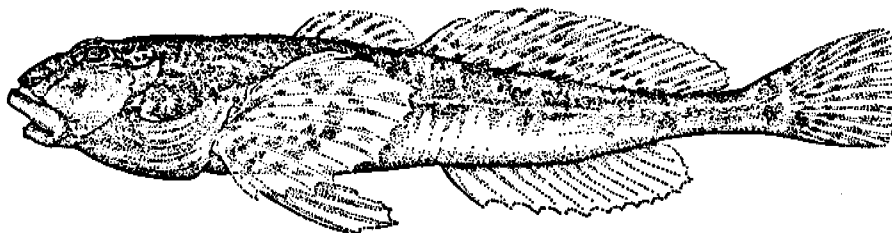
* No performance data available on this species.



Spoonhead Sculpin (Cottus ricei Nelson)

This sculpin is generally found in the shallows of large muddy rivers. The species probably spawn in the spring but the reproductive and life history is not known.

* No performance data available on this species.



THE SUCKERS

Family - CATOSTOMIDAE

Longnose Sucker

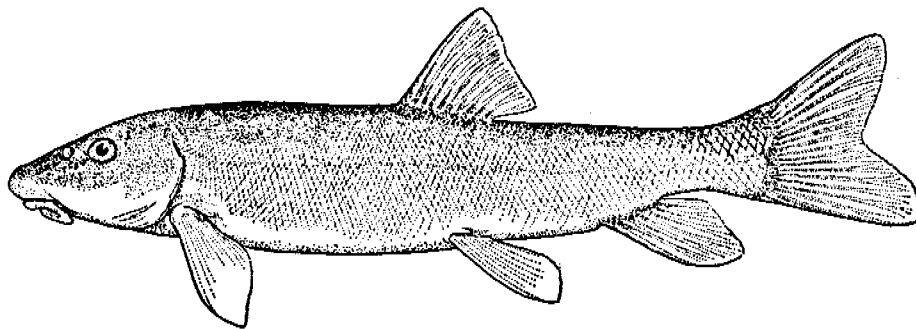
White Sucker

Longnose Sucker (Catostomus catostomus Forster)

This species is a very migratory fish, abundant in brackish waters around river mouths and tributary streams. The longnose sucker matures between 5-7 years and spawns in the late spring after break-up (mid-June to mid-July). The eggs hatch in 8 days (depending upon water temperature) and may be found in the ground from mid-June to the end of July. After hatching the fry remain in the gravel for 7-14 days before emerging to migrate.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
20	7.87	55.0	1.83
30	11.81	84.0	2.80
*40	15.75	80.0	2.67

* Considered Mature

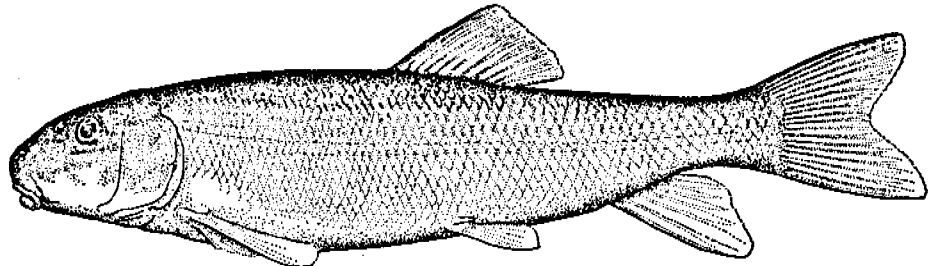


White Sucker (Catostomus commersoni Lacepede)

The distribution of this fish is limited by the temperature of its waters, much more so than other members of the genera. Adults are sexually mature at 5-7 years, and spawn in the inlet or outlet streams along lake shores from mid-May to mid-June, in the same general area as the longnose sucker. Gravel spawning beds are preferred, and the onset of the spawn is thought to be temperature dependant. Incubation of the eggs lasts about 8 days and the fry remain in the gravel for 7-14 days before migrating.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
*17-21	6.7-8.3	65.5	2.18

* Considered Mature



THE WHITEFISHES

Family - COREGONIDAE

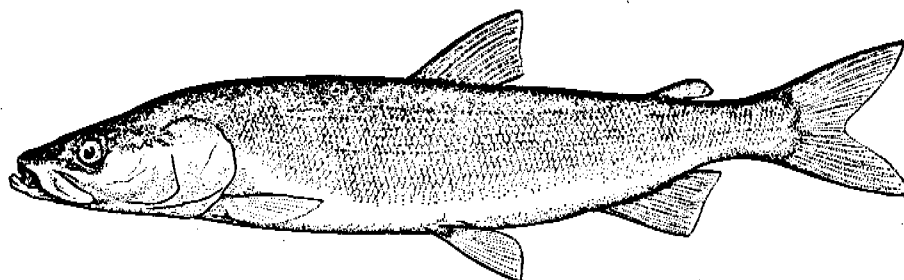
Inconnu
Humpback Whitefish
Broad Whitefish
Round Whitefish
Lake Cisco
Arctic Cisco

Inconnu (Stenodus leucichthys nelma Pallas)

The inconnu is abundant in the muddy northern rivers and lakes and some inconnu are anadromous, although do not stray far from the river mouths (i.e. lower Mackenzie). They migrate upstream in large tributary rivers in the late summer and the migration may take 2-3 months. Spawning occurs in the late summer and early fall months in the riffled areas of streams. Inconnu mature in 7-10 years, and little is known of their spawning behaviour.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
*31	10.3	73	2.43

* Considered Mature

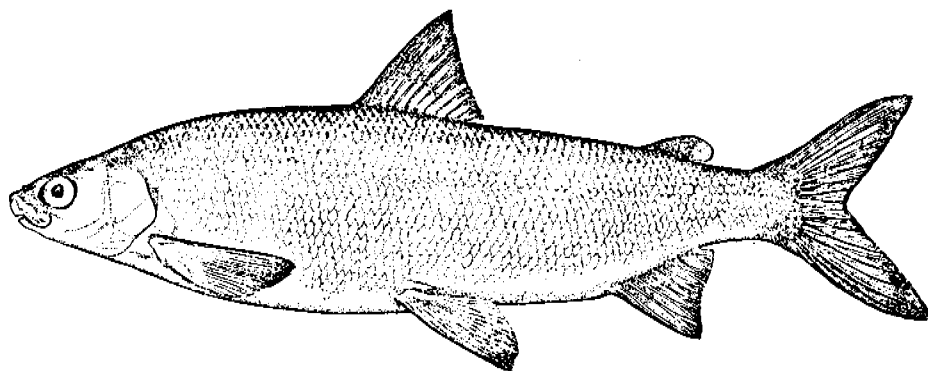


Humpback Whitefish (Coregonus clupeaformis Mitchill)

Humpbacks occur in arctic lakes and large rivers and migrate to spawning areas in the months of late August to the end of October. This whitefish matures in its 8th year (about 2 to 2.5 pounds), and spawning takes place in the late summer months until November or December. Eggs are laid on rocky reefs in lakes or shallow rivers and the fry emerge in the late winter and early spring months with some emergence through to mid-September.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
10	3.94	59.5	1.98
20	7.87	64.0	2.13
*30	11.81	66.5	2.22
*40	15.75	68.5	2.28

* Considered Mature

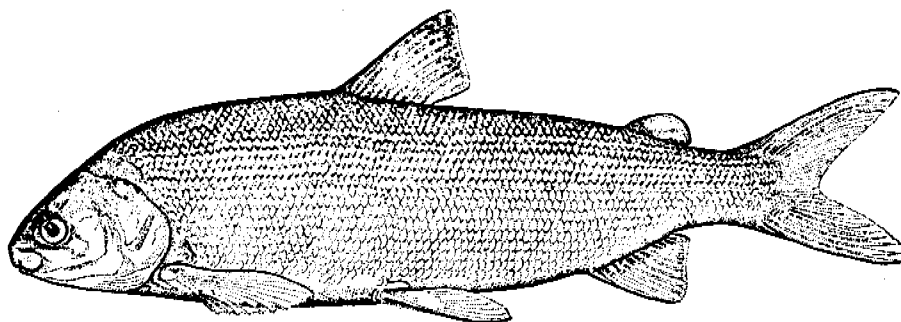


Broad Whitefish (Coregonus nasus Pallas)

This whitefish occurs in rivers and lakes in the arctic region and is sometimes anadromous. Migrations begin in July and August and 'broad's' spawn in small tributary streams in September through October.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
10	3.94	28	0.92
20	7.87	38	1.25
*30	11.81	48	1.57

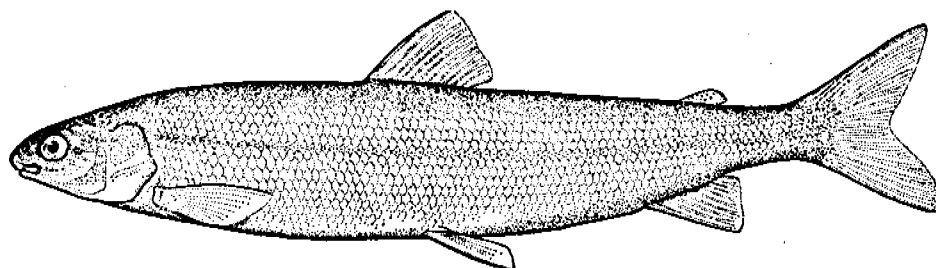
* Considered Mature



Round Whitefish (Prosopium cylindraceum Pallas)

The round whitefish is abundant in the shallow, clear streams and lakes of the Mackenzie system. They mature at 6-7 years, attaining lengths in excess of 50 cm. Upstream migrations begin in late October and eggs are laid in gravelled beds. Again little is known of spawning behaviour.

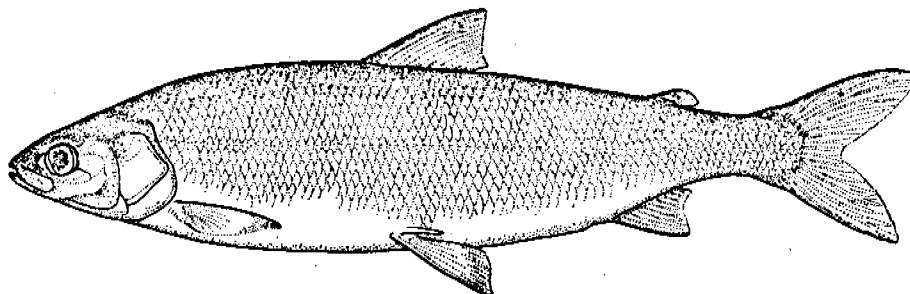
<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
30.4	11.97	42.5	1.39



Lake Cisco (Coregonus artedii LeSueur)

This cisco is a lake inhabitant and spawns on sand and gravel areas in the late autumn. Lake cisco are thought to mature in their 5th or 6th year, but may not spawn actively each year after maturity.

* No performance data available for this species.

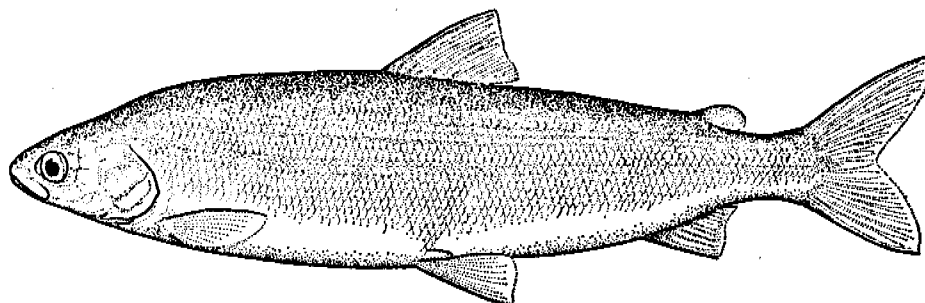


Arctic Cisco (Coregonus autumnalis Pallas)

The arctic cisco is abundant in the lower reaches of large muddy rivers and brackish waters of the Mackenzie system. This cisco is anadromous ascending the Mackenzie in early spring and spawning in the late summer and early fall months. Arctic cisco spawn in gravel beds under very fast water with their eggs scattered loosely over the gravel surface. A distinct downstream migration follows but little is known of the actual spawning ethology.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
*42.1	16.57	80.8	2.65

* Considered Mature



THE TROUT-PERCHES

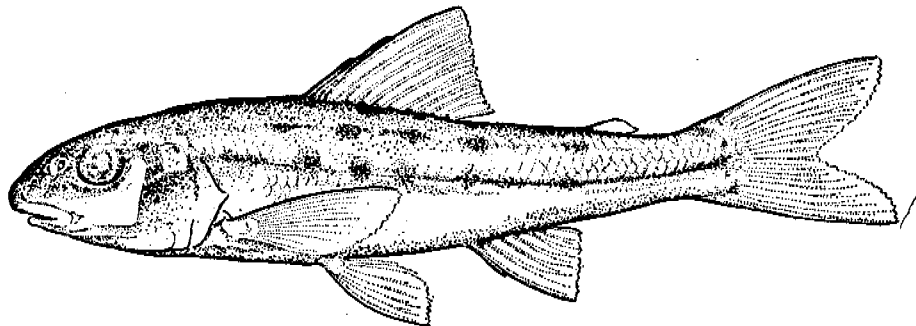
Family - PERCOPSIDAE

Trout-Perch

Trout-Perch (Percopsis omiscomaycus Walbaum)

The trout-perch are typical of backwater areas of muddy rivers and shallow sandy beaches in lakes. Spawning occurs in late spring and early summer in slow streams of lake beaches and usually nocturnally. Eggs are laid freely and may adhere to submerged objects. Fry emerge in approximately 1 week and remain in deeper waters.

<u>Body Length</u>		<u>Critical Velocity</u>	
(cm)	(in.)	(cm/sec.)	(ft./sec.)
7.2	2.83	55.7	1.83



LIST OF REFERENCES

Lacate, D.S., Chairman

Guidelines for Bio-physical Land Classification for Classification of Forest Lands and Associated Wildlands. Department of Fisheries and Forestry, Canadian Forestry Service, Publication No. 1264. Ottawa, 1969.

OTHER SOURCES OF INFORMATION

Hatfield, C.T., J.N. Stein, M.R. Falk and C.S. Jessop. 1972.
Fish Resources of the Mackenzie River Valley, Interim Report 1. Vol. 1 of 2. Department of the Environment, Fisheries Service, Winnipeg, Man.

Interdisciplinary Systems Ltd., Winnipeg, Manitoba.
Fish Survey Base Data Report 1973.

Jones, D.R. 1973.
An Evaluation of the Swimming Performance of Several Fish Species from the Mackenzie River. Manuscript (In Press).

McPhail, J.D. and C.C. Lindsey.
Freshwater Fishes of Northwestern Canada and Alaska, Bulletin 1973. Fisheries Research Board of Canada, Ottawa. 1970.

Renewable Resources Consulting Services Ltd., Edmonton, Alberta.
Mackenzie Highway Environmental Overview Study. January, 1973. Volume 1 of 2.

Slaney, F.F. and Co. Ltd., Vancouver.
Basic Environmental Data for Sections of Mackenzie Highway. November, 1972 to January, 1973. Folio 2 (4 volumes).

Slaney, F.F. and Co. Ltd., Vancouver.
Environmental Impact Mackenzie Highway. Preliminary Assessment. Mile 297 - 551. October, 1972.

Slaney, F.F. and Co. Ltd., Vancouver.
Preliminary Basic Environmental Data, Mackenzie Highway Bridges, Mile 297 to Mile 551. January, 1973.

Stein, J.N., C.S. Jessop, T.R. Porter and K.T.J. Chang-Kve. 1973.
An evaluation of the Fish Resources of the Mackenzie River Valley as Related to Pipeline Development, Vol. 1 of 2. Department of the Environment, Fisheries Services, Winnipeg, Manitoba.

APPENDIX 202

INDIVIDUAL CREEK DATA SHEETS

MILE: 305.1 NAME: McPherson Creek
CHAINAGE:

PHOTO NOS:
M26K118-14
M26K197-36,36A
M26K207-21
M26E104-29
M26E124B-5-9
M26E192-12-14
M26E130-36

A. GENERAL DATA

Method of Survey: Aerial and ground surveys

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: Drains low relief spruce and deciduous to Mackenzie via Martin River. (Drainage area - approx. 5.0 sq. miles)

Distance of R/W from Mackenzie: 2 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Poorly defined

Bottom Type (General): Silt and organic

Duration of Flow: Still flowing October 2, 1973. Probably frozen to bottom in mid-winter at R/W

B. DESCRIPTION: - DISTURBANCES

The creek at Mile 305.1 is a slow running stream draining a low relief spruce and deciduous area above the R/W. The entrance to the Mackenzie is poor and there are a number of potential migration obstructions in the form of beaver dams above and below the R/W. The channel is poorly defined, often with marsh grasses along the edge.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 10	June 24	Aug. 14
Location:	R/W-Aerial	R/W	R/W-Aerial
Depth (ft.):		0.3	
Width (ft.):		7.0	
Bottom Type (%):		90% Silt 10% Organic	
Colour:		Clear	Muddy-culvert being installed

TEMPERATURE

Air ($^{\circ}\text{C}$):	22.0
Water ($^{\circ}\text{C}$):	13.9

WATER
ANALYSIS

Vel. (fps):	0.5
Disc. (cfs):	2.0
Secchi (cm):	Clear
D.O. (ppm):	10.4
Conductivity ($\mu\text{mhos @ } ^{\circ}\text{C}$):	310@13.9
PH:	7.75
Alkalinity (grains/gal):	12

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 24	a) Observation			
	- Below Beaver Dam	2 unknown	Imm.	
	- In Beaver Pond	9 unknown	Imm.	
		Finescale dace-1	Imm.	35
		-2	Imm.	30
		-3	Imm.	25
		-4	Imm.	25
		Lake chub -1	Imm.	
		-2	Imm.	
		-3	Imm.	
		-4	Imm.	
		-5	Imm.	
		-6	Imm.	

E. FISH POTENTIAL

The samplings done on McPherson Creek indicate the presence of at least three and possibly four species of fish, two of them unidentified. Small cyprinids, notably, lake chub and finescale dace seem to be most predominant, with the possibility of some sucker fry being present. The immature forms present indicate a moderate spawning potential. The fishery potential of this stream is moderate.

F. POTENTIAL HIGHWAY IMPACTS

A geoterrain survey indicates a high impact area at Mile 305.05. Steep banks and some evidence of instability (tilting trees) suggest the possibility of debris accumulation and siltation.

G. RECOMMENDATIONS

Follow general construction guidelines and monitor bank stability after culvert installation to limit more sediment input into the channel.

MILE: 306.6 NAME: MARTIN RIVER
CHAINAGE:

PHOTO NOS:
M26E104-7,21
M26E107-17
M26E111-30,33,35,36,37
M26K104-20
M26K108-11
M26K172-28,30,34,36,37
M26K181-18A,19A
M26K185-16

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 200 Ft.

Drainage Area Classification: Originates in the Martin hills, flowing through mixed spruce and deciduous forest, as well as areas of bog and marsh, before flowing into the Mackenzie. (Drainage area - 1,127 sq. miles).

Distance of R/W from Mackenzie: 3 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined, meandering

Bottom Type (General): Boulder and gravel

Duration of Flow: Flow under ice recorded November 23, 1973. Year-round flow indicated.

B. DESCRIPTION: - DISTURBANCES

The Martin River originates on the southwestern slopes of the Martin Hills, meandering through large marsh areas before entering Mackenzie River. The upper reaches of this river are characterized by tortuous meanders which become less extreme in the mid and lower reaches. Antoine Lake feeds a large tributary of the Martin River system. The vast swamp and bog areas tend to stabilize river discharges and may contribute to the year-round flow. No visible migration obstructions are evident. Fort Simpson residents maintain a small sport and subsistence fishery on the lower reaches of the Martin River.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: September 29

Location: R/W

Depth (ft.): 1.0

Width (ft.): 5.0

Bottom Type (%): 75% Boulder
25% Gravel

Colour:

TEMPERATURE Air ($^{\circ}\text{C}$): 7.0Water ($^{\circ}\text{C}$): 6.0WATER
ANALYSIS

Vel. (fps): 2.6

Disc. (cfs): 127

Secchi (cm): 140

D.O. (ppm): 12.4

Conductivity
(umhos @ $^{\circ}\text{C}$): 162 @ 6.0

PH: 8.75

Alkalinity
(grains/gal): 8

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
------	---------------------	---------	----------	-------------

The Fisheries Service, in their 1973 report, list a total of 9 fish species captured over two sampling seasons (1971-72): pike, char species, broad whitefish, trout-perch, white sucker, goldeye, spottail shiner, slimy sculpin and grayling. The majority of these were immature forms.

E. FISH POTENTIAL

The Martin River has a high fishery potential, a relatively stable year-round flow, good access to the Mackenzie, good spawning substrate and no evident migration obstructions which indicate a high fishery potential.

The Fisheries Service indicates that the Martin system serves as both a spawning ground and nursery area for grayling, northern pike, yellow walleye, longnose sucker, and burbot and as a nursery for whitefish. The river also provides an overwintering area for pike.

F. POTENTIAL HIGHWAY IMPACTS

A geoterrain survey indicates that the R/W crossing, in particular the north side, is a high impact zone subject to solifluction flows and erosion. Such flows could cause extensive siltation and result in disruption of both spawning and nursery areas.

G. RECOMMENDATIONS

The proximity to Fort Simpson as well as facilitated access for resident fishermen, necessitates strict monitoring of sport and domestic catches to prevent overharvesting. Extensive slumping on the west bank, although partially checked, requires adequate diversion of mud and debris away from the river. Winter construction is recommended at such sites of active thermal erosion.

MILE: 315.2 NAME: Spruce Creek
CHAINAGE:

PHOTO NOS:
M26K110-2,3
M26K118-10
M26K122-1
M26K167-1-3
M26K213-9,10
M26E100-13,14
M26E132B-14,28
M26E133-17-19

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: originates at the base of the Martin Hills before flowing through rolling spruce-deciduous flatland to Mackenzie. (Drainage area - approximately 22 sq. miles)

Distance of R/W from Mackenzie: 1.5 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined

Bottom Type (General): Silt and organic

Duration of Flow: Flow under ice recorded November 23, 1973

B. DESCRIPTION: - DISTURBANCES

Spruce Creek follows a well defined, meandering channel from the base of the Martin Hills to the Mackenzie. The area drained is mainly low relief, spruce bog.

Although the bottom substrate at the R/W is almost 100% mud-silt, the presence of rocks one foot beneath the silt layer suggests the presence of rock substrate in other reaches of the creek. The predominant silt substrate indicates a high seasonal silt content and subsequent channel instability.

No major migration obstructions are evident.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	May 2	June 7	June 10
Location:	R/W	R/W	R/W
Depth (ft.):	4.0	5.0	2.9
Width (ft.):	20.0	25.0	18.0
Bottom Type (%):	Undetermined	90% silt 10% organic	80% silt 10% organic 10% rock (under silt)
Colour:	Muddy	Muddy	Muddy

TEMPERATURE

Air ($^{\circ}\text{C}$):	6.0	13.5	22.0
Water ($^{\circ}\text{C}$):	0.1	14.0	16.0

WATER
ANALYSIS

Vel. (fps):	1.25	2.2	1.7
Disc. (cfs):	100	278	86
Secchi (cm):	30	26.5	17.5
D.O. (ppm):	14.0	8.7	8.2
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	62@0.1	171@14.0	180@16.0
PH:	7.5	7.9	7.9
Alkalinity (grains/gal):	Less than 1	8	6

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
May 2	Beach Seine	Nil		
June 7	E.F./Seine	Nil		
June 10	E.F./Seine	Trout-perch		45

E. FISH POTENTIAL

Relatively stable flow, good entrance to the Mackenzie, the possibility of a suitable bottom substrate above and below the R/W and the presence of fish suggest a moderate fishery potential. Fishery potential would be limited by excessive silt loads and incapacitation of optimal spawning areas by high silt accumulation.

F. POTENTIAL HIGHWAY IMPACTS

A surficial geology study has noted an extreme impact zone at the Spruce Creek crossing. There is a danger of both siltation and debris accumulation at this site.

G. RECOMMENDATIONS

Contingency plans should be available for possible bank erosion or soil slumps on the R/W adjacent Spruce Creek. Cofferdams and settling ponds may be required to direct surface runoff away from the creek channel.

MILE: 318.9 NAME:
CHAINAGE:

PHOTO NOS:
M26K167-5
M26K184-23A, 26A
M26K213-8
M26K214-1, 2
M26E132B-20

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: Drains low relief spruce and deciduous areas
(Drainage area - Approximately 15 sq. miles)

Distance of R/W from Mackenzie: 2.5 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined

Bottom Type (General): Silt and organic

Duration of Flow: Still flowing October 4, 1973

B. DESCRIPTION: - DISTURBANCES

The creek at Mile 318.9 is a well defined deep stream with stable banks on both sides of the R/W. It drains a slightly rolling spruce and deciduous area. Colour varied from a dark tea colour at the beginning of May to clear to a muddy brown by the end of June. Similarly, the turbidity was initially quite low, then increased beginning in the later part of June. The bottom type at the R/W was primarily silt and organic. Below the R/W several gravel bars and riffle areas were apparent.

Debris from the winter road created a possible migration block.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	May 2	June 7	June 10
Location:	R/W	R/W	R/W
Depth (ft.):	3.5	1.7	
Width (ft.):	10.0	12.6	
Bottom Type (%):		80% silt 20% organic	90% silt 10% organic
Colour:	Dark Tea		Clear

TEMPERATURE

Air ($^{\circ}\text{C}$):	14.0	11.5	22.5
Water ($^{\circ}\text{C}$):	0.5	10.5	8.9

WATER
ANALYSIS

Vel. (fps):	2.2	1.2	1.4
Disc. (cfs):	77	27	
Secchi (cm):	90		Clear
D.O. (ppm):	13.2	10.0	9.6
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	60@0.5	175@10.5	163@8.9
PH:	7.5	7.5	7.75
Alkalinity (grains/gal):	4	7	

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 24	July 2	August 14
Location:	R/W	R/W	R/W
Depth (ft.):	5.0	2.7	1.8
Width (ft.):	13.0	17.0	
Bottom Type (%):	90% silt 10% organic	90% silt 10% organic	90% silt 10% organic
Colour:		Muddy	

TEMPERATURE

Air ($^{\circ}\text{C}$):	22.0	14.0	
Water ($^{\circ}\text{C}$):	14.0	11.5	10.2

WATER
ANALYSIS

Vel. (fps):	2.0	0.8	Minimal
Disc. (cfs):	130	34	Minimal
Secchi (cm):	62.5	31	
D.O. (ppm):	9.3	10.8	9.1
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	160@14.0	150@11.5	270@10.2
PH:	8.9	8.1	7.75
Alkalinity (grains/gal):	7	8	13

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
May 2	No sampling	Nil		
June 7	E.F./Seine	Nil		
June 10	E.F./Seine	Nil		
June 24	E.F./Seine	Nil		
July 2	E.F./Seine	Nil		
August 14	Observation	Grayling	-1 Imm.	25
	Observation	Unknown	-5 Imm.	

E. FISH POTENTIAL

A good entrance to the Mackenzie, a deep channel, good duration of flow, gravel base and presence of at least one species of fry suggests a moderate fishery potential. Grayling fry were positively identified.

F. POTENTIAL HIGHWAY IMPACTS

A large slump one half mile south of the Mackenzie entrance indicates the possibility of bank instability in this area, though there is no direct evidence of bank failures at the R/W itself. Because of the steepness of the banks in some areas, the possibility of siltation and/or debris accumulation is high.

G. RECOMMENDATIONS

A culvert design facilitating fish passage is recommended due to a high fishery potential with good spawning and nursery areas.

MILE: 320.3 NAME: Secret Creek
CHAINAGE:

PHOTO NOS:
M26K110-6
M26K213-6,7

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 2.5 miles

Drainage Area Classification: Martin Hills to low relief spruce and deciduous, occasional bog and marsh areas in drainage. (Drainage area - 71 sq. miles).

Distance of R/W from Mackenzie: Approximately 1 mile

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined, slightly meandering

Bottom Type (General): Boulders and silt

Duration of Flow: Still flowing August 14, 1973.

B. DESCRIPTION: - DISTURBANCES

Secret Creek is a moderately flowing stream, tea coloured, with alternating pool and riffle areas. It originates in the Martin Hills, flowing through a rolling low relief spruce and deciduous area intermixed with bog and marsh areas. It is a well defined stream with a few meanders and good accessibility for fish from the Mackenzie. The bottom at the R/W is primarily boulders and silt or sand.

D. FISH DATA

The Fisheries Service monitored Secret Creek throughout the summer. The species found were collected over five sampling days beginning June 30 and ending August 9. The creek was sampled at 5 different locations.

The following lists the species found and total captured. Sampling methods used were gill net, beach seine and fry drift net.

Longnose sucker	198
Catostomus (sucker) spp.	88
Arctic grayling	65
Burbot	3
Longnose dace	3
Coregonus (whitefish) spp.	2
Slimy sculpin	1
Trout-perch	1
Humpback whitefish	1
Cottus (sculpin) spp.	1
Whitefish spp.	1

E. FISH POTENTIAL

The success of the samplings done on Secret Creek would indicate a high fishery potential. This is probably due to a combination of factors - good entrance from the Mackenzie, adequate bottom type, low flow velocity, a high relief drainage area (Martin Hills), pool and riffle areas and clear water.

The presence of fall spawners (whitefish) and late winter spawners (burbot) necessitates rapid winter installation of the culvert preferably from December to end of February.

F. POTENTIAL HIGHWAY IMPACTS

A geoterrain survey (see Preliminary Design Folio - December, 1972) has indicated that the Secret Creek vicinity is a high impact area, with evidence of or possibilities of solifluction flows at various points. Appropriate care should therefore be taken to ensure that bank stability is not impaired. Particular attention should be paid to the south bank of the creek at the upstream end of the culvert.

G. RECOMMENDATIONS

The highest standards of construction are recommended to protect this productive system.

H. DATA SOURCES

Secret Creek was not sampled in the field by F.F. Slaney. The majority of the above data was obtained from J. N. Stine, Head, Northern Pipeline Project for Environment Canada.

MILE: 324.4 NAME:
CHAINAGE:

PHOTO NOS:
M26K167-6,7
M26K172-25
M26E100-15

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: Drains low relief spruce and deciduous stands
(Drainage area - approximately 20 sq. miles)

Distance of R/W from Mackenzie: Approximately 2 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Well defined, meandering

Bottom Type (General): Boulder and gravel

Duration of Flow: Flowing September 26, 1973. November 21, 1973 ice drillings showed no flow.

B. DESCRIPTION: - DISTURBANCES

Mile 324.4 flows via a gully cut into the Mackenzie terrace through a low relief spruce-deciduous forest. The stream is characterized by meanders throughout its length and has a boulder and gravel bottom at the R/W. The Mackenzie entrance, although present, was poor and almost dry on August 14th. At that time there were also several riffle areas below the R/W that appeared dry. The pool-riffle ration was 2:1.

No major obstructions were observed along the channel.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	May 2	June 7	Aug. 14	Sept. 26
Location:	R/W	R/W	R/W	R/W
Depth (ft.):	2.0	1.9	0.3	0.3
Width (ft.):	15	18.5	20.0	17.0
Bottom Type (%):		60% boulder 40% gravel	90% boulder 10% gravel	90% boulder 10% organic
Colour:	Tea			Clear

TEMPERATURE

Air ($^{\circ}\text{C}$):	13.0	12.0	10.5	
Water ($^{\circ}\text{C}$):	0.5	12.0	10.75	3.0

WATER
ANALYSIS

Vel. (fps):	2.1	1.0	Minimal	1.5
Disc. (cfs):	62	36		7.3
Secchi (cm):	180 approx.	Clear	Clear	Clear
D.O. (ppm):	13.7	9.0	9.8	12.8
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	5000.5	120012.0	216010.75	15003.0
PH:	7.5	7.9	8.5	8.75
Alkalinity (grains/gal):	4	6	10	9

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./Seine	Grayling	Imm.	69
August 14	E.F./Seine	Grayling - 1	Imm.	57
		- 2	Imm.	60
Sept. 28	Observation	50 Grayling	Imm.	Varying lengths
	E.F./Seine			
	a) Above R/W	Grayling - 1	Imm.	75
		- 2	Imm.	60
		- 3	Imm.	55

E. FISH POTENTIAL

In spite of the relatively short duration of flow and poor entrance to the Mackenzie, this stream appears to have a moderate first potential. Grayling fry were present throughout the sampling season, indicating a good nursery and/or spawning potential. Spawning adults probably swam upstream during the spring high water period, returning to the Mackenzie or at least to feeding areas before the water dropped. Low water levels in late summer tend to limit spawning potentials for such autumn-winter spawners as whitefish and burbot.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 326.0 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Aerial and ground surveys

Length of Stream Surveyed: 200 ft.

Drainage Area Classification: Drains low relief spruce and deciduous stands
(Drainage area - approximately 20 sq. miles)

Distance of R/W from Mackenzie: 1.5 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Poorly defined

Bottom Type (General): Boulders and gravel

Duration of Flow: Probably intermittent. November 21, 1973 - one drilling through ice showed no flow.

B. DESCRIPTION: - DISTURBANCES

Mile 326.0 is an extremely small drainage with alternating shallow pools and dry rocks in the riffle areas. Basic flow percolates through the boulders. The stream drains mostly low relief spruce and aspen. No major disturbances were visible.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 10	August 14
Location:	R/W-Aerial	R/W
Depth (ft.):		0.2
Width (ft.):		5.0
Bottom Type (%):		80% boulder 20% gravel
Colour:		Clear

TEMPERATURE

Air ($^{\circ}\text{C}$):	
Water ($^{\circ}\text{C}$):	10.75

WATER
ANALYSIS

Vel. (fps):	Minimal
Disc. (cfs):	
Secchi (cm):	Clear
D.O. (ppm):	8.9
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	270@10.75
PH:	7.5
Alkalinity (grains/gal):	15

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
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No fish sampled due to creek size.

E. FISH POTENTIAL

Limited flows of short duration and poor entrance to the Mackenzie, indicate that the fishery potential is minimal.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 326.4 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 200 ft.

Drainage Area Classification: Drains low relief spruce-deciduous forest, bog and marsh. (Drainage area - approximately 2.5 sq. miles)

Distance of R/W from Mackenzie: Approximately 1.5 miles

Creek Entrance into Mackenzie: Not apparent

Accessibility for Fish at Mackenzie Entrance: Minimal

Channel Types: Well defined

Bottom Type (General): Boulder and gravel

Duration of Flow: Almost dry August 14, 1973

B. DESCRIPTION: - DISTURBANCES

This small drainage flows through low relief spruce-deciduous forest and marsh-bog areas. No definite entrance to the Mackenzie is apparent. The channel is well defined with alternating pools and riffles. The bottom type is boulder and gravel.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 7
Location:	R/W
Depth (ft.):	0.8
Width (ft.):	4.0
Bottom Type (%):	95% boulder 5% gravel
Colour:	Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):	14.0
Water ($^{\circ}\text{C}$):	8.2

WATER
ANALYSIS

Vel. (fps):	3.1
Disc. (cfs):	9.8
Secchi (cm):	Clear
D.O. (ppm):	11.6
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	9208.2
PH:	7.2
Alkalinity (grains/gal):	4

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./Seine	Nil		

E. FISH POTENTIAL

The stream has minimal fishery potential because of low flows, lack of entrance to the Mackenzie and short duration of flow.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 326.6 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: Drains low relief spruce and deciduous forest
(Drainage area - approximately 8 sq. miles)

Distance of R/W from Mackenzie: 1.5 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Well defined

Bottom Type (General): Silt and organic

Duration of Flow: Probably intermittent - still flowing August 14, 1973

B. DESCRIPTION: - DISTURBANCES

The stream at Mile 326.6 is characterized by a well defined channel enclosed by high organic banks. The basic bottom substrate is silt and organic matter. Debris from the winter road obstructs the channel.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 7
Location:	R/W
Depth (ft.):	0.8
Width (ft.):	4.0
Bottom Type (%):	60% silt 40% organic
Colour:	Clear

TEMPERATURE

Air (°C):	12.0
Water (°C):	10.0

WATER
ANALYSIS

Vel. (fps):	1.2
Disc. (cfs):	3.8
Secchi (cm):	Clear
D.O. (ppm):	11.0
Conductivity (µmhos @ °C):	100@10.0
PH:	
Alkalinity (grains/gal):	

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./Seine	Nil		

E. FISH POTENTIAL

Fishery potential is low because of low flows and lack of an entrance to the Mackenzie.

F. POTENTIAL HIGHWAY IMPACTS

Possibility of siltation due to solifluction flows or slumping.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 327.1 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 Ft. on ground, 2 miles by air

Drainage Area Classification: Drains low relief spruce and deciduous forest, flows through marshes between R/W and Mackenzie. (Drainage area - approximately 2.5 sq. miles).

Distance of R/W from Mackenzie: 2 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Well defined

Bottom Type (General): Boulder and Gravel

Duration of Flow: Still flowing September 27, 1973

B. DESCRIPTION: - DISTURBANCES

The stream at Mile 327.1 on lowest Mackenzie terrace is a well defined, slightly meandering watercourse which drains a low relief spruce and deciduous forested area. The bottom substrate is predominantly boulder and gravel. No major disturbances were observed in the area surveyed.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	May 2/73	June 7	June 10
Location:	R/W	R/W	R/W
Depth (ft.):	3.0	0.5	1.3
Width (ft.):	10	8	13
Bottom Type (%):	Undetermined	95 boulder 5 gravel	60 gravel 40 rock
Colour:		tea	tea

TEMPERATURE

Air ($^{\circ}\text{C}$):	21.5	12.0	21.0
Water ($^{\circ}\text{C}$):	1.0	9.0	9.9

WATER
ANALYSIS

Vel. (fps):	2.2	2.6	0.8
Disc. (cfs):	65.1	10	13
Secchi (cm):	180	Clear	Clear
D.O. (ppm):	12.4	11.5	12.4
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	55 @ 1.0	112 @ 9.0	105 @ 9.9
PH:	7.5	7.9	7.9
Alkalinity (grains/gal):	4	4	4

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	August 14	September 27
	Location:	R/W	R/W
	Depth (ft.):	0.4	0.3
	Width (ft.):	10	8
	Bottom Type (%):	80 Gravel 20 Boulder	90 Rock 20 Gravel
	Colour:	Clear	Clear
TEMPERATURE	Air ($^{\circ}\text{C}$):	10.0	2.0
	Water ($^{\circ}\text{C}$):	10.0	0.3
WATER ANALYSIS	Vel. (fps):		0.5
	Disc. (cfs):		1.5
	Secchi (cm):	Clear	Clear
	D.O. (ppm):		13.9
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	260 @ 10.0	136 @ 0.3
	PH:	7.75	8.75
	Alkalinity (grains/gal):	12.0	10

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./seine	Nil		
June 10	E.F./seine	Nil		
August 14	E.F./seine	Grayling	Imm.	
September 27	E.F./seine	Grayling	Imm.	80
	Observation		2-4 Imm.	Approx. 80

E. FISH POTENTIAL

The presence of fry in August and September suggest the use of this creek as a nursery area by grayling. The good bottom substrate (boulder and gravel), duration of flow and presence of an entrance to the Mackenzie indicate a moderate fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

Surficial geology reports classify this crossing as one of high impact, possibly subject to solifluction and slumping.

G. RECOMMENDATIONS

Control of siltation by diversion and surface stabilization measures is important at this site.

MILE: 327.8 NAME:

CHAINAGE:

INTENSIVE STUDY STREAM

PHOTO NOS:

M26K167-9, 10, 10A, 11A, 12A, 14A

M26K184-19A, 20A

M26E100-18

M26E104-8, 12, 13

M26E129-5, 7

A. GENERAL DATA

Method of Survey: Ground surveyLength of Stream Surveyed: 400 Ft.

Drainage Area Classification: Stream originates at base of Martin Hills and flows through low-high relief spruce-deciduous forest. (Drainage area - approximately 30 sq. miles).

Distance of R/W from Mackenzie: 2 milesCreek Entrance into Mackenzie: Definite entranceAccessibility for Fish at Mackenzie Entrance: PoorChannel Types: Well defined, highly meandering within a "U" shaped valley.Bottom Type (General): Predominantly boulder and gravel

Duration of Flow: Still flowing September 27, 1973. November 23 - 3 inches of water flowing under ice at R/W. Deeper pools may not freeze to the bottom.

B. DESCRIPTION: - DISTURBANCES

Originates at the base of the Martin Hills. This stream flows across the Mackenzie terrace. It meanders through a flat bottom valley with steep side slopes. The bottom type is boulders and gravel.

Degradation of a visible ice lens on the east bank resulted in slumps into the stream channel.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	May 2/73	June 7	June 10
Location:	R/W	R/W	R/W
Depth (ft.):	2.5		1.5
Width (ft.):	25		31
Bottom Type (%):	75% Boulder	50% Boulder 50% Gra. & Silt	80% Boulder 20% Sandy Silt
Colour:			Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):	20.2	12.5	22.5
Water ($^{\circ}\text{C}$):	0.5	10.0	9.0

WATER
ANALYSIS

Vel. (fps):	6.7		1.1
Disc. (cfs):	417		50
Secchi (cm):	57.5	Clear	Clear
D.O. (ppm):	11.6	11.0	10.8
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	38 @ 0.5	140 @ 10.0	160 @ 9.0
PH:	7.5	8.5	7.9
Alkalinity (grains/gal):	3	4	6

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 24	July 2	Aug. 14	Sept. 27
Location:	R/W	R/W	R/W	R/W
Depth (ft.):	1.0	1.6	1.0	0.8
Width (ft.):	35	32		28
Bottom Type (%):	90% Boulder 10% Gravel	75% Boulder 10% Organic 15% Silt	80% Boulder 10% Gravel 10% Sand	80% Boulder 10% Gravel 10% Sand
Colour:	Tea	Muddy tea	Tea	Light Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):	23.0		10.2	7.1
Water ($^{\circ}\text{C}$):	12.5		10.0	0.3

WATER
ANALYSIS

Vel. (fps):	0.4	2.5	Minimal	0.7
Disc. (cfs):	12.6	128		15.4
Secchi (cm):	Clear		Clear	Clear
D.O. (ppm):	10.6			14.2
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	125 @ 12.5		292 @ 10.0	180 @ 0.3
PH:	8.5		8.9	8.75
Alkalinity (grains/gal):	6		12	11

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./seine	Nil		
June 10	E.F./seine	Nil		
	Below R/W			
June 24	Spincasting	Grayling - 1		
	Fly Fishing	- 2		
July 2	No sampling			
August 14	Observation	Slimy Sculpin		
September 27	a) E.F. seine	Slimy Sculpin - 1		40
		- 2		36
	b) Observed	Grayling - 1	Imm.	80
	c) Beach Seine-	- 2-5	Imm.	70-80
	Upper Side R/W	Nil		

E. FISH POTENTIAL

The fishery potential of this stream is moderate. Specimens were captured on 3 out of 5 samplings varying from fry to yearling size. The stream is likely utilized for both spawning and rearing, particularly by grayling.

F. POTENTIAL HIGHWAY IMPACTS

The presence of the slump and ice lens at the crossing site increases the probability of both siltation and debris accumulation and possible velocity barriers due to channel obstruction.

G. RECOMMENDATIONS

Overburden should be laid on this portion of the R/W to check soil erosion. Adequate barriers should be used to limit further introduction of debris and silt.

MILE: 328.3 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: Drains low relief spruce and deciduous forest.
(Drainage area - approximately 0.5 sq. miles).

Distance of R/W from Mackenzie: 2 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Poorly defined

Bottom Type (General): Silt and organic

Duration of Flow: Probably intermittent flow due to shallow depth

B. DESCRIPTION: - DISTURBANCES

This drainage is very shallow with a silt and organic substrate. At the R/W, a debris jam has created a silty pool where water flows under the winter road crossing. Both the winter road and shallowness of the channel are effective fish barriers. No entrance to the Mackenzie is evident.

MILE: 328.3 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: Drains low relief spruce and deciduous forest.
(Drainage area - approximately 0.5 sq. miles).

Distance of R/W from Mackenzie: 2 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Poorly defined

Bottom Type (General): Silt and organic

Duration of Flow: Probably intermittent flow due to shallow depth

B. DESCRIPTION: - DISTURBANCES

This drainage is very shallow with a silt and organic substrate. At the R/W, a debris jam has created a silty pool where water flows under the winter road crossing. Both the winter road and shallowness of the channel are effective fish barriers. No entrance to the Mackenzie is evident.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: June 24/73

Location: R/W

Depth (ft.): 0.25

Width (ft.): 2-3

Bottom Type (%): 80% silt
20% organic

Colour: Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):

Water ($^{\circ}\text{C}$):

WATER
ANALYSIS

Vel. (fps):

Disc. (cfs):

Secchi (cm):

D.O. (ppm):

Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$):

PH:

Alkalinity
(grains/gal):

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
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Not sampled due to shallow flow.

E. FISH POTENTIAL

Minimal fishery potential results from no Mackenzie entrance, shallow flow and obstruction at the winter road.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 329.1 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 200 ft.

Drainage Area Classification: Drains low and high relief spruce and deciduous stands. Quite hilly above R/W. (Drainage area - approximately 1.5 sq. miles)

Distance of R/W from Mackenzie: 1.5 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined

Bottom Type (General): Organic and rock

Duration of Flow: Still flowing October 4, 1973

B. DESCRIPTION: - DISTURBANCES

The creek at Mile 329.1 is well defined, and deep for its size (5 ft. wide and 3.0 ft. deep). The bottom is composed mainly of organic debris, rock and gravel, with organic banks. Winter road debris accumulated at mid R/W form several level drops which may be fish barriers.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:

June 24

July 2

Location:

R/W

R/W

Depth (ft.):

3.0

1.2

Width (ft.):

3.5

4.4

Bottom Type (%):

90% rock
10% organic60% organic
40% gravel

Colour:

Tea

Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):

25.5

17.5

Water ($^{\circ}\text{C}$):

12.0

8.0

WATER
ANALYSIS

Vel. (fps):

2.0

3.6

Disc. (cfs):

21.0

19.1

Secchi (cm):

Clear

Clear

D.O. (ppm):

9.1

11.8

Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$):

100@12.0

90@8.0

PH:

7.5

7.4

Alkalinity
(grains/gal):

5

5

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 24	E.F./Seine Above mid-R/W	Nil		
	Fry net-17.5 hrs.	Nil		
July 2	E.F./Seine	Nil		

E. FISH POTENTIAL

Although the stream is deep enough to support fish and the Mackenzie entrance is relatively deep, the poor bottom type and narrow channel lower overall fishery potential. This creek was rated at low fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 330.9 NAME: Shale Creek
CHAINAGE:

PHOTO NOS:

M26K157-4A
M26K172-22
M26K207-6
M26E100-19

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: Originates on north slope of Martin Hills, flows down to Mackenzie through low relief spruce and deciduous forests.
(Drainage area - approximately 48 sq. miles)

Distance of R/W from Mackenzie: 1.5 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined, wide meanders

Bottom Type (General): Boulders, shale, gravel

Duration of Flow: Still flowing Nov. 23, 1973 (3 ft. of water flowing slowly under ice, above R/W). Previous winter surveys March 8, 1972 indicates Shale Creek does freeze to the bottom.

B. DESCRIPTION: - DISTURBANCES

Shale Creek is a major watercourse south of Camsell Bend, originating on the north slope of the Martin Hills. The stream flows through a small valley with steep to gently sloping banks. The channel meanders mostly angular rather than rounded. Many gravel bars occur throughout its length. No major disturbances are evident.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 7	Sept. 27
	Location:	R/W	R/W
	Depth (ft.):	1.9	1.2
	Width (ft.):	46	35
	Bottom Type (%):	50% boulder 50% gravel	75% boulder 25% gravel
	Colour:	Tea	Tea
TEMPERATURE	Air ($^{\circ}\text{C}$):	11.0	7.5
	Water ($^{\circ}\text{C}$):	11.0	2.0
WATER ANALYSIS	Vel. (fps):	1.5	33.4
	Disc. (cfs):	133.0	37.7
	Secchi (cm):	Clear	Clear
	D.O. (ppm):	10.0	13.4
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	110@11.0	113@2.0
	PH:	7.9	8.75
	Alkalinity (grains/gal):	4	7

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	No fish sampled			
September 27	Beach seine 100 ft. above R/W	Grayling - 1	Imm	220
		- 2	"	210
		- 3	"	210
		- 4	"	190
		- 5	"	190
		- 6	"	150
		- 7	"	150
		- 8	"	160
		- 9	"	130
		- 10	"	50
		Slimy sculpin	Imm	35

E. FISH POTENTIAL

A high fishery potential is indicated. Grayling probably use this stream for both spawning and nursery. Other species are likely present but were not observed during the one sampling. The creek contains clear water, boulder and gravel substrate and a high pool-riffle ration.

F. POTENTIAL HIGHWAY IMPACTS

There is the possibility of solifluction flows causing siltation on either side of the river or the R/W crossing.

G. RECOMMENDATIONS

Anticipate slumps and/or increased siltation and plan contingency measures such as cofferdams and settling ponds.

MILE: 333.2 NAME:
CHAINAGE:

PHOTO NOS:
M26K207-4
M26E107-3

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 200 ft.

Drainage Area Classification: Drains bog above the R/W and flows through low relief spruce and deciduous forest below. (Drainage area - approx. 2.5 sq.miles)

Distance of R/W from Mackenzie: 1.5 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Well to poorly defined

Bottom Type (General): Rock and gravel

Duration of Flow: Still flowing October 4, 1973

B. DESCRIPTION: - DISTURBANCES

This drainage is well defined at the R/W, but flows through remains of the winter road. Bottom substrate is primarily rock and gravel however increased silt and organic substrates are evident near the R/W. At least one debris jam, 2 ft. high, is a possible migration block.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 7	June 10	August 16
Location:	R/W	R/W	R/W
Depth (ft.):	0.5	0.5	0.3
Width (ft.):	9.0	7.0	8.0
Bottom Type (%):	95% gravel and rocks	90% rocks 10% silt	80% boulder 10% gravel 10% silt
Colour:	Tea	Mud Brown	

TEMPERATURE

Air ($^{\circ}\text{C}$):	12.0	22.5	8.0
Water ($^{\circ}\text{C}$):	8.0	8.0	9.1

WATER
ANALYSIS

Vel. (fps):	1.6	1.7	1.4
Disc. (cfs):	7.1	7.5	2.8
Secchi (cm):		32.5	Clear
D.O. (ppm):	12.2	11.6	11.8
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	8008.0	13008.0	21709.1
PH:	7.7	7.9	8.5
Alkalinity (grains/gal):	4		10

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./Seine	Nil		
June 10	E.F./Seine	Nil		
	Above R/W			
August 16	E.F./Seine	Nil		

E. FISH POTENTIAL

The fish potential of this stream is low. Although the bottom type is conducive to spawning, neither the size nor accessibility to the stream from the Mackenzie are favourable.

F. POTENTIAL HIGHWAY IMPACTS

Possibility of siltation.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 334.2 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 200 ft.

Drainage Area Classification: Drains low relief spruce and deciduous forest
(Drainage area - approximately 0.5 sq. miles)

Distance of R/W from Mackenzie: 1.5 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Well defined

Bottom Type (General): Gravel, sand and organic

Duration of Flow: October 4, 1973. Trickle

B. DESCRIPTION: - DISTURBANCES

Considerable debris has accumulated the R/W and siltation of stream substrate has occurred. A two ft. vertical drop at the dam may act as a fish barrier. The small drainage area of this creek suggests extremely variable and intermittent flow.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: June 7

Location: R/W

Depth (ft.): 0.9

Width (ft.): 4.0

Bottom Type (%): 50% gravel
50% organic

Colour:

TEMPERATURE

Air ($^{\circ}\text{C}$): 12.0

Water ($^{\circ}\text{C}$): 7.0

WATER
ANALYSIS

Vel. (fps): 1.2

Disc. (cfs): 4.2

Secchi (cm): Clear

D.O. (ppm): 12.4

Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$): 11007.0

PH: 7.9

Alkalinity
(grains/gal): 3.

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./Seine	Nil		

E. FISH POTENTIAL

The creek at Mile 334.2 was rated as having a low fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

The presence of the silted area at the R/W suggests further siltation may result from R/W construction.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 334.8 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: R/W

Length of Stream Surveyed: 400 ft.

Drainage Area Classification: Drains low relief spruce forest above R/W and marsh below. (Drainage area - approximately 3.6 sq. miles).

Distance of R/W from Mackenzie: 1.5 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined

Bottom Type (General): Boulder, rock and organic

Duration of Flow: Still flowing October 4, 1973.

B. DESCRIPTION: - DISTURBANCES

Mile 334.8 has a small, well defined channel with low banks except where it runs through a small gorge. Intermittent riffle areas occur and the pool: riffle ratio is 2:1. Debris from the R/W and bank slumping have accumulated to form a two foot deep pool. The jam may obstruct fish migration.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 7	June 10	June 24
	Location:	R/W	R/W	R/W
	Depth (ft.):	0.5	0.9	0.9
	Width (ft.):	5	6.5	5
	Bottom Type (%):	50% silt-clay 50% boulder	40% silt 40% gravel 20% rock	60% rock 40% gravel and sand
	Colour:		Tea	Tea
TEMPERATURE	Air ($^{\circ}\text{C}$):	10.0	20.0	25.0
	Water ($^{\circ}\text{C}$):	7.0	8.0	10.9
WATER ANALYSIS	Vel. (fps):	1.8	1.4	Approx. 2
	Disc. (cfs):	4.6	8.1	Approx. 9
	Secchi (cm):	37.5	Clear	Clear
	D.O. (ppm):	12.0	12.8	11.2
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	110@7.0	110@8.0	106@10.9
	PH:	7.8	8.25	7.5
	Alkalinity (grains/gal):	4	4	5

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	July 2	July 8	August 16	October 4
Location:	R/W	R/W	R/W	R/W
Depth (ft.):	0.8	0.4	0.75	0.3
Width (ft.):	5.6	5.5	5.3	8.5
Bottom Type (%):	75% gravel 10% sand 15% organic	80% rock/ gravel 20% organic	60% rock 40% gravel	75% rock 25% organic
Colour:	Tea			

TEMPERATURE

Air ($^{\circ}\text{C}$):	20.0	7.2	12.5	
Water ($^{\circ}\text{C}$):	8.0	6.7	6.0	2.0

WATER
ANALYSIS

Vel. (fps):	2.2	1.0	1.7	0.2
Disc. (cfs):	9.9	2.2	6.8	0.5
Secchi (cm):	Clear	Clear	Clear	Clear
D.O. (ppm):	12.6	12.1	12.3	13.4
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	8908.0	11606.7	14406.0	19802.0
PH:	7.5	7.75	8.5	8.25
Alkalinity (grains/gal):	6	6	7	9

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./Seine	Nil		
June 10	E.F./Seine	Nil		
June 24	E.F./Seine	Nil		
July 2	E.F./Seine	Nil		
July 8	E.F./Seine	Nil		
October 4	E.F./Seine	Nil		

E. FISH POTENTIAL

This stream has a suitable spawning substrate, good entrance to the Mackenzie and moderated duration of flow. Six samplings however, failed to yield fish, suggesting a low fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

Slumping at the R/W indicates further siltation and/or debris accumulation is possible.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 334.9 NAME:
CHAINAGE:

PHOTO NOS:
M26K112-11, 14

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 250 Ft.

Drainage Area Classification: Drains low relief spruce forest. (Drainage area - approximately 3.6 sq. miles).

Distance of R/W from Mackenzie: 1.5 miles

Creek Entrance into Mackenzie: Doubtful

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Poorly defined above R/W, well defined below R/W

Bottom Type (General): Silt and organic

Duration of Flow: Dry as of August 16, 1973

B. DESCRIPTION: - DISTURBANCES

The stream flows from a marshy area above the R/W into a slight gully with silt and organic substrate. Heavy silting and debris deposition has occurred at the R/W, probably as a result of winter road breakup. Several one to two-foot debris jams may obstruct fish migration.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 7	June 24	July 2
	Location:	R/W	R/W	R/W
	Depth (ft.):	0.7	0.25	0.6
	Width (ft.):	8	Approx. 2	4
	Bottom Type (%):	90% silt 10% org.	70% silt 30% org.	75% organic 25% gravel
	Colour:			Tea
TEMPERATURE	Air ($^{\circ}\text{C}$):	15.8		
	Water ($^{\circ}\text{C}$):	10.0		
WATER ANALYSIS	Vel. (fps):	1.2		0.9
	Disc. (cfs):	7.0		2.3
	Secchi (cm):	Clear		
	D.O. (ppm):	11.8		
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	109@10.0		
	PH:	7.5		
	Alkalinity (grains/gal):	4		

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
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No Sampling Done

E. FISH POTENTIAL

The short duration of flow, organic and silt bottom substrates, marsh origin, low flow and absence of Mackenzie entrance suggest a stream of intermittent flow. Extensive debris in the channel limits fish potential to minimal.

F. POTENTIAL HIGHWAY IMPACTS

Further heavy siltation and debris accumulation are likely.

G. RECOMMENDATIONS

Limit debris introduction into creek channel.

Follow general construction guidelines.

MILE: 336.1 NAME:
CHAINAGE:

PHOTO NOS:

M26K157-7A

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 Ft.

Drainage Area Classification: Above R/W drains marshes and low to high relief spruce. Below R/W runs into marsh. (Drainage area - approximately 9.3 sq. miles).

Distance of R/W from Mackenzie: 2 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Well defined, slight meanders and poorly defined sections

Bottom Type (General): Boulder, silt, organic

Duration of Flow: Still flowing October 4, 1973

B. DESCRIPTION: - DISTURBANCES

A well defined channel flowing over boulders, silt and organic material is characteristic of this stream. The channel meanders slightly with banks to 5 feet high. Although there does not appear to be a clear passage between the upper reaches and the Mackenzie, very high water may open up the area to fish migration. Debris jams below the R/W may act as migration blocks.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	May 2	June 7	June 10	June 25
Location:	R/W	R/W	R/W	R/W
Depth (ft.):	1.0	1.3	0.8	1.0
Width (ft.):	8	7	7.5	8
Bottom Type (%):	Undetermined	60% silt 20% gravel 20% boulder	70% broken 30% bould.	70% broken 30% bould.
Colour:	Tea	Tea	Tea	Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):	21.0	12.0	18.0	17.0
Water ($^{\circ}\text{C}$):	1.0	8.0	9.5	10.5

WATER
ANALYSIS

Vel. (fps):	3.8	1.6	2.2	0.6
Disc. (cfs):	30.8	14.4	13.9	4.4
Secchi (cm):	30	Clear	Clear	Clear
D.O. (ppm):	11.9	11.0	12.2	11.2
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	35@1.0	98@8.0	92@9.5	105@10.5
PH:	7.2	7.8	7.5	7.3
Alkalinity (grains/gal):	3	3	6	6

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	July 2	July 8	October 4
Location:	R/W	R/W	R/W
Depth (ft.):	0.6	0.3	0.1
Width (ft.):	12	8.5	6
Bottom Type (%):	95% Bould. 5% Organic	60% Bould. 40% Shale	50% Rock 25% Organic 10% Silt 25% Broken Shale
Colour:	Tea	Tea	Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):	22.1	12.0	
Water ($^{\circ}\text{C}$):	10.8	10.2	1.0

WATER
ANALYSIS

Vel. (fps):	2.4	1.8	0.6
Disc. (cfs):	18	4.6	0.5
Secchi (cm):	Clear	Clear	Clear
D.O. (ppm):	11.6	11.4	13.9
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	83@10.8	122@10.2	225@1.0
PH:	7.9	7.9	8.75
Alkalinity (grains/gal):	5	6	11

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./Seine	Nil		
June 10	E.F./Seine	Nil		
June 25	E.F./Seine	Nil		
	Fry net below mid R/W-8 hrs.	Nil		
	Fly fishing- 30 min. on R/W	Nil		
July 2	E.F./Seine	Nil		
July 8	E.F./Seine	Nil		

E. FISH POTENTIAL

Negative results from successive samplings, an extremely diffuse marsh area just above the Mackenzie and no obvious entrance to the Mackenzie make fish presence unlikely. Fishery potential is low.

F. POTENTIAL HIGHWAY IMPACTS

Surficial geology of the area indicates a high impact zone, with some sections subject to solifluction.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 337.3 NAME:
CHAINAGE:

PHOTO NOS:

62.

M26K157-9A
M26K161-15A
M26K162-13

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 Ft.

Drainage Area Classification: Drains low relief spruce and deciduous forest before entering a marsh below the R/W. (Drainage area - approximately 4.3 sq. miles).

Distance of R/W from Mackenzie: 2 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Well defined

Bottom Type (General): Boulder, gravel, silt, organic

Duration of Flow: Still flowing October 4, 1973. November 23 - 2 inches of standing water under ice. Stream probably frozen to bottom in mid November at R/W.

B. DESCRIPTION: - DISTURBANCES

The small drainage flows from a low relief spruce and deciduous forest across the R/W to the broad marsh which parallels the Mackenzie at this point. There is no visible connection between the creek's entrance to the marsh and the exit into the Mackenzie. The substrate although predominantly boulders and rock also contains gravel, silt and organic debris. The stream is well defined by high organic banks. The amount of debris in the channel resulting from R/W clearing is low. The pool:riffle ratio is 3:1.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 7	June 10	August 16	October 4
	Location:	R/W	R/W	R/W	R/W
	Depth (ft.):	0.6	0.8	0.8	0.5
	Width (ft.):	7.6	4.5	7.0	7.0
	Bottom Type (%):	80% Bould. 10% Gravel 10% Silt		50% Bould. 45% Gravel 5% Debris	70% Rock 10% Silt 10% Gravel 10% Organic
	Colour:	Tea		Tea	
TEMPERATURE	Air ($^{\circ}\text{C}$):	11.0		6.0	7.0
	Water ($^{\circ}\text{C}$):	6.0		5.5	0.5
WATER ANALYSIS	Vel. (fps):	2.7	2.6	1.0	0.23
	Disc. (cfs):	13.2	9.8	5.6	0.83
	Secchi (cm):	Clear		Clear	Clear
	D.O. (ppm):	11.0		11.9	14.2
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	100@6.0		110@5.5	141@0.5
	PH:	7.8		8.0	8.25
	Alkalinity (grains/gal):	5		7	8

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./seine	Nil		
June 10	E.F./seine	Nil		
August 16	E.F./seine	Nil		
October 4	E.F./seine	Nil		

E. FISH POTENTIAL

Apart from the lack of a clear connection to the Mackenzie, the stream has many of the characteristics of a good fish stream--clear water, boulder and gravel bottom and good flow. The presence of the marsh above the Mackenzie, however, makes fish passage uncertain and fishery potential low.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 338.6 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 100 ft.

Drainage Area Classification: Drains low relief spruce and deciduous stands before flowing through a large marsh above the Mackenzie. (Drainage area - approximately 1 sq. mile).

Distance of R/W from Mackenzie: 2.5 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Well defined

Bottom Type (General): Organic and silt

Duration of Flow: Still flowing October 4, 1973

B. DESCRIPTION: - DISTURBANCES

Mile 338.6 is one of a series of small drainages in this section which appears to be impounded in a large marsh on the river terrace. No entrance to the Mackenzie is evident. Bottom is primarily organic and silt.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: October 4

Location: R/W

Depth (ft.): 0.3

Width (ft.): 4.5

Bottom Type (%): 60% organic
40% silt

Colour: Clear

TEMPERATURE

Air ($^{\circ}\text{C}$):Water ($^{\circ}\text{C}$): 1.0WATER
ANALYSIS

Vel. (fps): 0.32

Disc. (cfs): 0.52

Secchi (cm): Clear

D.O. (ppm): 14.5

Conductivity
($\mu\text{mhos } 0^{\circ}\text{C}$): 11601.0

PH: 7.75

Alkalinity
(grains/gal): 8

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
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No fish sampled

E. FISH POTENTIAL

Fishery potential is minimal.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 338.8 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 200 ft.

Drainage Area Classification: Drains low relief, spruce and deciduous forest
(Drainage area - approximately 1 sq. mile).

Distance of R/W from Mackenzie: 2 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined

Bottom Type (General): Silt, sand, organic

Duration of Flow: Almost dry October 4, 1973

B. DESCRIPTION: - DISTURBANCES

The creek is confined to a definite channel and contains periodic debris jams. The entrance to the Mackenzie is good however debris jams may act as barriers to fish movement.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 7	October 4
Location:	R/W	R/W
Depth (ft.):	0.9	0.8
Width (ft.):	4	5
Bottom Type (%):	90% silt, sand	100% organic
Colour:	Tea	Clear

TEMPERATURE

Air ($^{\circ}\text{C}$):	14.9	3.0
Water ($^{\circ}\text{C}$):	8.0	2.0

WATER
ANALYSIS

Vel. (fps):	2.5	Nil
Disc. (cfs):	8.9	Nil
Secchi (cm):	Clear	Clear
D.O. (ppm):	11.5	14.2
Conductivity ($\mu\text{mhos } 0^{\circ}\text{C}$):	930@8.0	220@2.0
PH:	7.4	6.75
Alkalinity (grains/gal):	4	

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 7	E.F./Seine	Nil		

E. FISH POTENTIAL

Although this stream has an entrance to the Mackenzie, the short duration of flow and extensive debris jams suggest a low fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 340.2 NAME:
CHAINAGE:

PHOTO NOS:
M26K158-1A

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 200 feet

Drainage Area Classification: Drains low relief spruce forest and bog above the R/W and marsh below the R/W. (Drainage area - approx. 1.5 sq. miles)

Distance of R/W from Mackenzie: 1 mile

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Well defined

Bottom Type (General): Silt, gravel, boulders

Duration of Flow: Almost dry October 4, 1973

B. DESCRIPTION: - DISTURBANCES

This is the first of four small drainages within this mile of R/W and has a small, well defined channel with 1 to 2 foot banks. There are several jams and scattered debris which probably resulted from R/W clearing, and which may serve as migration blocks.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 8	June 25	July 2
Location:	R/W	R/W	R/W
Depth (ft.):	0.6-1.6	1.1	0.6
Width (ft.):	2-8 approx.	7	9
Bottom Type (%):	Silt, organic and boulder	60% silt 35% organic 5% gravel	70% silt 30% gravel
Colour:	Tea	Tea	

TEMPERATURE

Air ($^{\circ}\text{C}$):	13.0	23.0
Water ($^{\circ}\text{C}$):	5.5	10.5

WATER
ANALYSIS

Vel. (fps):	0.5-2.0	1.5
Disc. (cfs):	Approx. 5	8.5
Secchi (cm):	Clear	Clear
D.O. (ppm):	12.0	11.0
Conductivity ($\mu\text{mhos } 0^{\circ}\text{C}$):	115@5.5	120@10.5
PH:	7.7	7.5
Alkalinity (grains/gal):	6	5

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	July 7	October 4
Location:	Aerial R/W	R/W
Depth (ft.):		0.4
Width (ft.):		3.5
Bottom Type (%):		100% organic
Colour:		Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):	7.0
Water ($^{\circ}\text{C}$):	1.0

WATER
ANALYSIS

Vel. (fps):	0.28
Disc. (cfs):	0.42
Secchi (cm):	Clear
D.O. (ppm):	13.9
Conductivity ($\mu\text{mhos } 0^{\circ}\text{C}$):	160@1.0
PH:	8.75
Alkalinity (grains/gal):	9

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 8	E.F./Seine	Nil		
June 25	E.F./Seine	Nil		
July 2	E.F./Seine	Nil		
October 4	E.F./Seine	Nil		

E. FISH POTENTIAL

The bog drainage, poor entrance into the Mackenzie, and short duration of flow give this stream a low fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

Substrate indicates already high siltation levels. Increments are probable.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 340.4 NAME:
CHAINAGE:

PHOTO NOS:
M26K112A-5
M26K158-1A

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: Drains low relief spruce and deciduous forest above R/W and marsh and bog below the R/W (Drainage area - approx. 1 sq. mile)

Distance of R/W from Mackenzie: 1 mile

Creek Entrance into Mackenzie: Good

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined

Bottom Type (General): Silt and organic

Duration of Flow: Still flowing October 4, 1973

B. DESCRIPTION: - DISTURBANCES

Substrates are primarily silt and organic. The entrance from the Mackenzie is good. Siltation and debris accumulation combine to create several blockages at the R/W. Though these debris jams probably result from the winter road and R/W clearing, other blockages are probably the result of natural accumulation.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 8	June 25	June 30
	Location:	R/W	R/W	R/W
	Depth (ft.):	0.4		1.5
	Width (ft.):	2.0		2.6
	Bottom Type (%):	20% organic 80% silt	80% sand-silt 20% organic	90% silt 10% organic
	Colour:	Murky Tea		
TEMPERATURE	Air ($^{\circ}\text{C}$):	13.0	23.0	9.0
	Water ($^{\circ}\text{C}$):	6.5	12.0	8.5
WATER ANALYSIS	Vel. (fps):	1.5		3.7
	Disc. (cfs):	1.5		11.7
	Secchi (cm):	2.5	120.0	59.0
	D.O. (ppm):	12.0	8.6	11.6
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	110@6.5	125@12.0	100@8.5
	PH:	7.7	7.75	7.7
	Alkalinity (grains/gal):	7	7	5

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	July 2	July 7
Location:	R/W	R/W Aerial
Depth (ft.):	0.8	
Width (ft.):	6.0	
Bottom Type (%):	75% sand-silt 25% organic	
Colour:	Muddy	

TEMPERATURE

Air ($^{\circ}\text{C}$):	21.5
Water ($^{\circ}\text{C}$):	10.5

WATER
ANALYSIS

Vel. (fps):	3.8
Disc. (cfs):	14.2
Secchi (cm):	2.5
D.O. (ppm):	11.2
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	100@10.5
PH:	7.75
Alkalinity (grains/gal):	5

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 8	Observation	Nil		
June 25	E.F./Seine Mid-R/W	Nil		
June 30	E.F./Seine	Nil		

E. FISH POTENTIAL

Due to the bog drainage, silt and organic bottom and debris jams along the stream channel the fishery potential of this drainage is probably low.

F. POTENTIAL HIGHWAY IMPACTS

Siltation and debris accumulation as a result of solifluction and run-off are possible here.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 340.8 NAME:
CHAINAGE:

PHOTO NOS:
M26K213-4

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 200 ft.

Drainage Area Classification: Drains low relief spruce forest
(Drainage area - approximately 1 sq. mile)

Distance of R/W from Mackenzie: 1 mile

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Fair

Channel Types: Well defined

Bottom Type (General): Organic and silt at R/W. Boulders below R/W

Duration of Flow: Still flowing October 4, 1973

B. DESCRIPTION: - DISTURBANCES

This stream flows across the Mackenzie terrace through spruce and deciduous stands. The area appears well drained. The substrate is mixed rock and silt except at the R/W where it is predominantly silt. Numerous debris jams litter the channel, causing vertical drops up to 2 feet which probably act as migration barriers.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 25	June 30	July 2
	Location:	R/W	R/W	R/W
	Depth (ft.):	0.7	0.9	0.6
	Width (ft.):	10.0	5.5	7.0
	Bottom Type (%):	70% organic 30% rock	30% rock 70% organic	100% organic
	Colour:	Tea		Tea
TEMPERATURE	Air ($^{\circ}\text{C}$):	25.2	11.0	
	Water ($^{\circ}\text{C}$):	12.1	9.0	
WATER ANALYSIS	Vel. (fps):	1.6	1.4	
	Disc. (cfs):	6	6.9	
	Secchi (cm):	Clear	Clear	
	D.O. (ppm):	9.4	1.4	
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	152@12.1	130@9.0	
	PH:	7.75	7.6	
	Alkalinity (grains/gal):	6	6	

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:

July 7

October 4

Location:

Aerial R/W

R/W

Depth (ft.):

0.3

Width (ft.):

2.0

Bottom Type (%):

Colour:

Clear

TEMPERATURE

Air ($^{\circ}\text{C}$):

3.0

Water ($^{\circ}\text{C}$):

1.0

WATER
ANALYSIS

Vel. (fps):

0.18

Disc. (cfs):

0.09

Secchi (cm):

Clear

D.O. (ppm):

14.4

Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$):

178@1.0

PH:

8.25

Alkalinity
(grains/gal):

11

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
July 2	E.F./Seine	Nil		

E. FISH POTENTIAL

Several factors contribute to the low fishery potential of this stream. The entrance from the Mackenzie is only fair and there are numerous debris piles at the R/W with evidence of similar obstructions downstream. The water level is low and the gradient steep indicating intermittent flow.

F. POTENTIAL HIGHWAY IMPACTS

Siltation and debris accumulation as a result of solifluction and run-off erosion are probable.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 340.9 NAME:
CHAINAGE:

PHOTO NOS:

83.

M26K112A-4

A. GENERAL DATA

Method of Survey: Ground survey

Length of Stream Surveyed: 300 Ft.

Drainage Area Classification: Drains low relief spruce and deciduous forest.
(Drainage area - approximately 2.5 sq. miles).

Distance of R/W from Mackenzie: 1 mile

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Fair

Channel Types: Well defined

Bottom Type (General): R/W - silt, organic. Below R/W - boulders.

Duration of Flow: Still flowing October 4, 1973

B. DESCRIPTION: - DISTURBANCES

No lakes or ponds are evident. Two channels which drain a large diffuse marsh and bog converge at the center of the R/W and form a well defined channel below that point. A two to three-foot vertical drop occurs at the R/W. The entrance to the Mackenzie, although fair for fish, is debris laden and passes through marsh.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 25	June 30	July 2
Location:	R/W	R/W	R/W
Depth (ft.):	1.0	1.5	0.6
Width (ft.):	7	4.5	8.5
Bottom Type (%):	90% Silt & Sand 10% Organic	65% Boulder 35% Silt	70% Gravel 30% Organic
Colour:		Tea	Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):	19.0		20.2
Water ($^{\circ}\text{C}$):	12.0		10.7

WATER
ANALYSIS

Vel. (fps):	1.0	2.1	1.5
Disc. (cfs):	7.2	14.2	7.65
Secchi (cm):	Clear	Clear	Clear
D.O. (ppm):	10.8		12.0
Conductivity ($\mu\text{mhos @ } ^{\circ}\text{C}$):	120@12.0		105@10.7
PH:	7.5		7.25
Alkalinity (grains/gal):	7		6

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: July 7 October 4

Location: R/W aerial R/W

Depth (ft.): 0.2

Width (ft.): 3.5

Bottom Type (%):

Colour: Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):Water ($^{\circ}\text{C}$): 1.5WATER
ANALYSIS

Vel. (fps): 0.48

Disc. (cfs): 0.32

Secchi (cm): Clear

D.O. (ppm): 13.8

Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$): 125@1.5

PH: 8.25

Alkalinity
(grains/gal): 9

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 25	E.F./seine	Nil		
June 30	E.F./seine	Nil		

E. FISH POTENTIAL

Fishery potential is rated low because of the Mackenzie entrance, debris at and below the R/W and the bog and marsh drainage. The lower reaches could serve as a nursery area if enough invertebrates are present for feeding. Few substrates are suitable for spawning.

F. POTENTIAL HIGHWAY IMPACTS

Like the other streams in this section, siltation and debris accumulation are possible due to solifluction and erosion runoff.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 342.5 NAME:
CHAINAGE:

PHOTO NOS:

87.

A. GENERAL DATA

M26K110-15
M26K112A-1, 2, 3

Method of Survey: Ground survey

Length of Stream Surveyed: 100 Ft.

Drainage Area Classification: Drains sparse spruce forest intermixed with deciduous brush and small trees. (Drainage area - 2.2 sq. miles).

Distance of R/W from Mackenzie: 1 mile

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Fair

Channel Types: Well defined

Bottom Type (General): Gravel, sand and organic

Duration of Flow: Still flowing October 4, 1973

B. DESCRIPTION: - DISTURBANCES

An elaborate system of tributaries above the R/W, drains a spruce and deciduous region. Below the R/W, the creek is contained by a "U" shaped gully until reaching the Mackenzie. Substrate is sand and gravel with some organic material. A debris jam at the R/W has caused some silt deposition.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 8	August 16
Location:	R/W	R/W
Depth (ft.):	3.0	0.6
Width (ft.):	4.4	8.8
Bottom Type (%):	75% gravel 25% organic	70% sand 30% organic
Colour:	Tea	Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):	14.5	6.0
Water ($^{\circ}\text{C}$):	7.0	6.0

WATER
ANALYSIS

Vel. (fps):	0.6	1.2
Disc. (cfs):	8.4	6.4
Secchi (cm):	clear	clear
D.O. (ppm):	13.1	10.6
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	129 @ 7.0	170 @ 6.0
PH:	7.8	7.8
Alkalinity (grains/gal):	6	9

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 8	E.F./seine	Nil	Nil	Nil

E. FISH POTENTIAL

The fishery potential is rated low because of debris jams and low water in some areas.

F. POTENTIAL HIGHWAY IMPACTS

High gully walls increase the possibility of siltation from solifluction or slumping.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 348.2 NAME:
CHAINAGE:

PHOTO NOS:

90.

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: From R/W to Mackenzie by air

Drainage Area Classification: Drains bog above R/W through low relief spruce forests to Mackenzie. (Drainage area - 30.5 sq. miles).

Distance of R/W from Mackenzie: 1/8 mile

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined, deep meandering, organic banks.

Bottom Type (General): Peat, organic debris and silt

Duration of Flow: Still flowing October 4, 1973, November 23 - 28 inches of water. Flowing slowly at R/W. Water may be present under ice in mid-winter due to depth.

B. DESCRIPTION: - DISTURBANCES

The creek at Mile 348.2 is a clear, deep and well channeled meandering stream draining predominantly bog and low relief spruce stands. The overall substrate is rock and gravel. At the R/W a concentration of organic material and silt has resulted from R/W clearing.

Banks are generally of an organic (peat) texture with considerable riparian debris.

Between the R/W crossing and the Mackenzie River there are two active beaver dams which may act as fish barriers. Accessibility to the Mackenzie is good due to the channel depth, width and discharge.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 8	October 4
Location:	R/W	R/W M349.1
Depth (ft.):	3.1	0.51
Width (ft.):	14.0	2.5
Bottom Type (%):	70% organic 30% silt	100% organic
Colour:	Tea	Clear

TEMPERATURE

Air ($^{\circ}\text{C}$):	11.0	2.0
Water ($^{\circ}\text{C}$):	8.0	1.0

WATER
ANALYSIS

Vel. (fps):	0.7	0.9
Disc. (cfs):	30.3	1.2
Secchi (cm):	Clear	Clear
D.O. (ppm):	11.0	14.4
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	14008.0	6401.0
PH:	7.7	7.25
Alkalinity/ (grains/gal):	5	7

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 8	E.F./Seine	Grayling	Imm.	

E. FISH POTENTIAL

Mile 348.2 has a moderate potential due to available spawning gravel, minimal turbidity, and a good entrance from the Mackenzie.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

Minimize creek gravel disturbance.

FILE: 355.9 NAME:
CHAINAGE:

PHOTO NOS:

93.

A. GENERAL DATA

M26K166-04
M26E114-13
M26E114-14

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 300' at R/W

Drainage Area Classification: Drains low relief spruce stands, bog and marsh.
(Drainage area - 12.5 sq. miles).

Distance of R/W from Mackenzie: Approx. 7 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined, meandering

Bottom Type (General): Mainly boulders and small amounts of organics and debris.

Duration of Flow: Still flowing October 3, 1973. November 23 - moderate flow under ice at R/W. Due to depth, water may be present at R/W mid winter.

B. DESCRIPTION: - DISTURBANCES

This is a wide (20 ft.) and relatively deep (2.7 ft.) stream occupying a well defined meandering channel through alternate areas of spruce stands, bog and marsh. Suspended sediments are minimal (visibility clear to bottom). Bog drainage is indicated by a tea colour. No obvious barriers to fish migration were recorded.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: June 6
Location: R/W
Depth (ft.): 2.7
Width (ft.): 20
Bottom Type (%): 90% Boulder

Colour: Tea

TEMPERATURE

Air ($^{\circ}\text{C}$): 21.0
Water ($^{\circ}\text{C}$): 11.5

WATER
ANALYSIS

Vel. (fps): 0.5
Disc. (cfs): 27
Secchi (cm): Clear
D.O. (ppm): 12
Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$): 100 @ 11.5
PH: 7.4
Alkalinity
(grains/gal): 5

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 6	Gillnet	Grayling	Immature	263

E. FISH POTENTIAL

Potential spawning substrates, good entrance to the Mackenzie, water clarity, slow velocities and a wide deep channel as well as the presence of grayling indicate a moderate fisheries potential. The aesthetically, poor drainage relief and bog areas as well as low catch frequencies would tend to limit recreational potential.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Minimize creek gravel disturbances.

Follow general construction guidelines.

MILE: 362.5 NAME:
CHAINAGE:

PHOTO NOS:

M26E117-1,12,22
M26E119-7

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 200 ft. at R/W - Aerial

Drainage Area Classification: Drains low relief forest - marsh and bog
(Drainage area - 10.4 sq. miles)

Distance of R/W from Mackenzie: Approximately 12 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: The channel is generally poorly defined above and below
R/W and well defined and meandering at R/W

Bottom Type (General): Organic and silt

Duration of Flow: Still flowing October 3, 1973. November 23 - minimum
of 18 inches of water flowing slowly under ice at R/W.

B. DESCRIPTION: - DISTURBANCES

Mile 362.5 drains an area of low relief spruce stands and bog (muskeg) on either side of the R/W. Intermittent marshes occur at the R/W.

At the sample site (R/W), the creek forms a deep channel through organic soil with marsh areas on either side. It is one of several drainages connected to one major drainage which flows across a swampy terrace before entering the Mackenzie. There is a definite entrance to the Mackenzie for this system, but accessibility for fish of the individual tributaries is uncertain.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 6, 1973	October 2, 1973
	Location:	At R/W	At R/W
	Depth (ft.):	6.7	3.0
	Width (ft.):	12	12
	Bottom Type (%):	70% Organic 30% Silt	100% Organic
	Colour:	Tea	Light tea
TEMPERATURE	Air ($^{\circ}\text{C}$):	21.5	7.0
	Water ($^{\circ}\text{C}$):	10.5	3.0
WATER ANALYSIS	Vel. (fps):	3.4	0.08
	Disc. (cfs):	273.3	3.0
	Secchi (cm):	Clear	Clear
	D.O. (ppm):	9.0	13.4
	Conductivity (umhos @ $^{\circ}\text{C}$):	100@10.5	92@3.0
	PH:	7.2	7.5
	Alkalinity (grains/gal):	3	5

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 6	E.F./Seine	Nil		
	Gillnet 45 hours	Nil		
October 3	E.F./Seine	Lake chub		est'd. 25

E. FISH POTENTIAL

Although a lake chub was observed in a large pond above the beaver dam on the R/W, the absence of adequate spawning material and presence of extensive bog and marsh indicate a low fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 363.6 NAME:
CHAINAGE:

PHOTO NOS:
M26K214-19

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 200 ft. at R/W

Drainage Area Classification: Drains low relief spruce forest above R/W,
and bog below. (Drainage area - 20.0 sq. miles)

Distance of R/W from Mackenzie: Approx. 11 miles

Creek Entrance into Mackenzie: Definite

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Well defined, boggy meander

Bottom Type (General): Primarily organic material and large rocks

Duration of Flow: Still flowing October 3, 1973

B. DESCRIPTION: - DISTURBANCES

This meandering stream forms a small tributary to a major drainage. The low gradient of the surrounding area and impoundment by marshes suggest poor and uncertain flow rates, dependent on spring runoff and local weather conditions.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 6	June 11	October 3
	Location:	Above R/W	Below R/W	R/W
	Depth (ft.):	2.4	2.3	1.2
	Width (ft.):	9.4	9.0	8.0
	Bottom Type (%):	60% organic 40% boulder	65% organic 35% boulder	40% organic 30% boulder 30% sand
	Colour:			Tea
TEMPERATURE	Air ($^{\circ}\text{C}$):	25.0		
	Water ($^{\circ}\text{C}$):	10.7		2.0
WATER ANALYSIS	Vel. (fps):	.9		.7
	Disc. (cfs):	20.2		6.5
	Secchi (cm):	Clear	Clear	Clear
	D.O. (ppm):	10		13.6
	Conductivity ($\mu\text{mhos } 25^{\circ}\text{C}$):	147@10.7		120@2.0
	PH:	7.7		8.5
	Alkalinity (grains/gal):	4		5

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 6	E.F./Seine	Nil	Nil	Nil
June 11	E.F./Seine	Nil	Nil	Nil
October 3	E.F./Seine	Grayling	Imm	88

E. FISH POTENTIAL

A grayling fry was capture in October but the distance from the Mackenzie, the marsh drainage, and variable channel depth, indicate a low fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Winter installation of culvert to prevent disturbances.

MILE: 365.5 NAME:
CHAINAGE:

PHOTO NOS:

102.

M26E117-3
M26E117-4

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 300' at R/W

Drainage Area Classification: Drains low relief spruce forest and through a marsh. (Drainage area - 15.0 sq. miles).

Distance of R/W from Mackenzie: Approx. 18 miles

Creek Entrance into Mackenzie: Yes

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined at and above R/W. Poorly defined below R/W.

Bottom Type (General): Primarily rock and gravel bottom

Duration of Flow: Still flowing October 3, 1973

B. DESCRIPTION: - DISTURBANCES

This is a small stream consisting of alternating pools and areas of faster flow. The channel is well defined above and below the R/W. It drains an area of low relief spruce stands, flowing eventually through marsh and bog areas.

The entrance to the Mackenzie provides good fish passage due to the combined flows of 363.6, 362.5 and 365.5. The substrate is 80% rock and gravel. Disturbances at or near the R/W are minimal.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: June 6
Location: R/W
Depth (ft.): 2.5
Width (ft.): 15.0
Bottom Type (%): 80% Rock & Gravel

Colour: Tea

TEMPERATURE Air ($^{\circ}\text{C}$): 16.2

Water ($^{\circ}\text{C}$): 12.0

WATER
ANALYSIS

Vel. (fps): 0.8

Disc. (cfs): --

Secchi (cm): 152

D.O. (ppm): 9.4

Conductivity
($\mu\text{mhos } (1^{\circ}\text{C})$): 92@12.0

PH: 7

Alkalinity
(grains/gal): 4

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 6	E.F./seine and gillnet	Nil	Nil	Nil

E. FISH POTENTIAL

The fish potential of this stream is low due to the presence of marsh and bog areas below the R/W and the distance of the R/W crossing from the Mackenzie.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 140' at R/W

Drainage Area Classification: Drains low relief spruce and poplar forest.
(Drainage area - 3.2 sq. miles).

Distance of R/W from Mackenzie: Approx. 20 miles

Creek Entrance into Mackenzie: Unknown

Accessibility for Fish at Mackenzie Entrance: Unknown

Channel Types: Well defined channel with steep organic bank

Bottom Type (General): Rock and gravel

Duration of Flow: Still flowing October 3, 1973

B. DESCRIPTION: - DISTURBANCES

This creek apparently splits into two individual creeks above the R/W. The creek with the lower mileage (367.85) is probably ephemeral as the substrate is moss and wood similar to the surrounding forest floor. Winter flow is absent due to icing to the bottom. (Sampled March/73). At the R/W this creek is braided across the winter road fill of wood chips and organic matter.

The northern creek has well defined organic banks and gravel substrate. Just below the R/W a debris jam was caused by the removal of the winter bridge which could obstruct fish.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 29	July 3	July 7	October 3
	Location:	R/W	R/W	R/W	R/W
	Depth (ft.):	1.1	0.8	1.9	1.1
	Width (ft.):	2.5	2.5	7.25	5
	Bottom Type (%):	90% Org.	100% Org.	80% Rock 20% Gravel	75% Rock 25% Org.
	Colour:	Tea	Tea	Tea	Tea
TEMPERATURE	Air ($^{\circ}\text{C}$):	18.0	13.5	19.5	12
	Water ($^{\circ}\text{C}$):	9.0	8.5	12.0	2.0
WATER ANALYSIS	Vel. (fps):	1.0	0.7	1.1	1
	Disc. (cfs):	2.75	1.4	15.2	5.5
	Secchi (cm):	Clear	Clear	Clear	Clear
	D.O. (ppm):	8.65	10.4	9.8	13.4
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	115@9.0	130@8.5	160@12.0	123@2.0
	PH:	7.0	7.0	7.6	8.5
	Alkalinity (grains/gal):	4	4	4	6

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 29	E.F./seine	Nil		
July 3	E.F./seine	Nil		
July 7	E.F./seine	Nil		
October 3	E.F./seine	Nil		

E. FISH POTENTIAL

The southern channel has minimal fishery potential. It is shallow and diffuse, meandering through moss and wood chips, and is choked by natural debris jams.

The northern channel has a moderate fish potential due to clear water, loose gravel bottom and riffle and pool areas. The many debris jams may be fish barriers.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 200' at R/W

Drainage Area Classification: Drains a lake, through high relief spruce and into a bog. (Drainage area - 14.2 sq. miles).

Distance of R/W from Mackenzie: Approximately 12 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Well defined

Bottom Type (General): Boulders and organic material

Duration of Flow: Still flowing October 3, 1973

B. DESCRIPTION: - DISTURBANCES

This clear, deep and wide creek is situated in a 50-foot deep gorge and flow is contained by 4-foot banks until the bog area. Debris jams are common, with one near the upstream side of the R/W. Substrate is peat with some boulders and no entrance to the Mackenzie is evident.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 6	August 22	October 3
	Location:	R/W	R/W	R/W
	Depth (ft.):	2	2.2	1.0
	Width (ft.):	8	14	13
	Bottom Type (%):	55% Boulder 45% Organic	75% Silt 25% Organic	100% Organic
	Colour:	Tea	Tea	Tea
TEMPERATURE	Air ($^{\circ}$ C):	13.5	13.0	
	Water ($^{\circ}$ C):	11.0	7.4	2.0
WATER ANALYSIS	Vel. (fps):	0.7	1.1	0.56
	Disc. (cfs):	11.2	34.1	7.3
	Secchi (cm):	152.4	Clear	Clear
	D.O. (ppm):	11.2	11.4	13.5
	Conductivity (μ mhos @ $^{\circ}$ C):	150@11.0	149@7.4	175@2.0
	PH:	8.0	8.0	8.75
	Alkalinity (grains/gal):	6	7	8

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 6	E.F./seine	Nil		
June 11	E.F./seine	Nil		
August 22	E.F./seine	Spottail shiner		Approx. 100
October 3	E.F./seine	Nil		

E. FISH POTENTIAL

Poor spawning substrates, natural debris jams and the distance from the Mackenzie indicate that fishery potential is low.

F. POTENTIAL HIGHWAY IMPACTS

The location of the creek in a deep gorge may create problems from bank instability, during culvert installation.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 373.8 NAME:
CHAINAGE:

PHOTO NOS:

111.

A. GENERAL DATA

Method of Survey: Ground survey at R/W and on seismic line approx. $\frac{1}{2}$ mile downstream.

Length of Stream Surveyed: 200' along R/W

Drainage Area Classification: Bog drains into large marsh-lake complex.
(Drainage area - 3.8 sq. miles).

Distance of R/W from Mackenzie: Approx. $\frac{1}{2}$ mile

Creek Entrance into Mackenzie: Unlikely

Accessibility for Fish at Mackenzie Entrance: Unknown

Channel Types: Well defined

Bottom Type (General): Silt, sand and organic

Duration of Flow: Still flowing October 3, 1973

B. DESCRIPTION: - DISTURBANCES

This boggy meander of approximately 1.3 feet in depth is well confined to its channel by 4-foot high banks. It has clear, tea coloured water which flows at a low velocity. The bottom type is mainly organic consisting of peat and silt with some sand. Very few riffle areas or pools occur. Minimal bank disturbance was caused by the crossing of a tracked vehicle at the R/W sampling site.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 5	June 11
Location:	R/W	Seismic line
Depth (ft.):	1.3	1.2
Width (ft.):	9.0	8.0
Bottom Type (%):	50% Sand 50% Peat	
Colour:	Light Tea	

TEMPERATURE

Air ($^{\circ}\text{C}$):	13.5
Water ($^{\circ}\text{C}$):	10.5

WATER
ANALYSIS

Vel. (fps):	1.0	Approx. 1.0
Disc. (cfs):	11.7	Approx. 10
Secchi (cm):	Clear	
D.O. (ppm):	8	
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	200@10.5	
PH:	7.5	
Alkalinity (grains/gal):	6	

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 5	E.F./seine	Nil		
June 11	E.F./seine	Nil		

E. FISH POTENTIAL

The bog drainage area and predominantly organic and silt bottom indicate minimal fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 376.8 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 200-300' at R/W

Drainage Area Classification: Drains low relief spruce forest into marsh and lakes below R/W. (Drainage area - 24 sq. miles).

Distance of R/W from Mackenzie: Approx. 10 miles

Creek Entrance into Mackenzie: Unknown - appears to flow into bog

Accessibility for Fish at Mackenzie Entrance: Unknown

Channel Types: Well defined, meandering above R/W

Bottom Type (General): Mainly gravel

Duration of Flow: Still flowing October 3, 1973

B. DESCRIPTION: - DISTURBANCES

This meandering stream empties into a bog area about 3/4 miles below the R/W. This channel has alternating pool and riffle areas and a 95% gravel substrate but shows a potential for rapid volume changes. A beaver dam downstream could obstruct fish migration.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 6	June 11	Aug. 22	October 3
	Location:	R/W	R/W	Below R/W	Below R/W
	Depth (ft.):	1.5	0.5	0.5	.19
	Width (ft.):	15.0	12.0	11	2.5
	Bottom Type (%):	95% Gravel	95-100% Gravel	90% Rock 10% Silt	65% Rock 25% Org. 10% Silt
	Colour:	Tea	Tea	Tea	Clear
TEMPERATURE	Air ($^{\circ}\text{C}$):	10.8		14.0	8.5
	Water ($^{\circ}\text{C}$):	9.0		8.0	2.0
WATER ANALYSIS	Vel. (fps):	3.5	Approx. 3	1.9	2.6
	Disc. (cfs):	90	Approx. 30	10.5	1.2
	Secchi (cm):	3	Clear	Clear	Clear
	D.O. (ppm):	10.8		11.4	13.5
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	150@9.0		155@8.0	225@2.0
	PH:	8		8.0	8.5
	Alkalinity (grains/gal):	6		7	10

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 6	E.F./seine	Nil		
June 11	E.F./seine	Nil		
August 22	E.F./seine	Nil		
October 3	E.F./seine	Nil		

E. FISH POTENTIAL

The bottom, channel type and water velocity suggest good spawning potential. The extensive bog and marsh areas and the distance from the Mackenzie indicate a low fishery potential.

F. POTENTIAL HIGHWAY IMPACTS

Potential impacts due to highway construction are minimal.

G. RECOMMENDATIONS

Install culvert during winter to minimize silting and disturbance of banks.
Minimize removal of riparian vegetation.

MILE: 378.5 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey on seismic line

Length of Stream Surveyed: 50' at seismic line

Drainage Area Classification: Bog. (Drainage area - approx. 1.5 sq. miles).

Distance of R/W from Mackenzie: Approximately 0.5 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Braided

Bottom Type (General): Gravel and organic

Duration of Flow: Reduced to trickle June 5, 1973. No flow - October 3 -
standing water at R/W.

B. DESCRIPTION: - DISTURBANCES

This creek originates in a bog and terminates in a bog-marsh-lake area. Flow is diffuse between moss hummocks with organic and grassy banks. Substrate is peat with scattered gravel patches. Many debris dams and level drops occur throughout drainage.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: June 5

Location: Seismic line

Depth (ft.): 1.5

Width (ft.): 6.0

Bottom Type (%): 40% Gravel
60% Organic

Colour: Tea

TEMPERATURE

Air ($^{\circ}\text{C}$): 19.0

Water ($^{\circ}\text{C}$): 9.0

WATER
ANALYSIS

Vel. (fps): 0.2

Disc. (cfs): 1.8

Secchi (cm): Clear

D.O. (ppm): 8.15

Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$): 14009.0

PH: 7.2

Alkalinity
(grains/gal): 6

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 5	E.F./seine	Nil	Nil	Nil

E. FISH POTENTIAL

The fish potential is minimal as indicated by the creek distance from the Mackenzie, debris jams, level drops, diffuse and intermittent flow.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 378.8 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground-landed at R/W

Length of Stream Surveyed: 200' at R/W

Drainage Area Classification: Drains primarily, white spruce and pine on flank of Ebbutt Hills. (Drainage area - 4.8 sq. miles).

Distance of R/W from Mackenzie: 9.5 miles

Creek Entrance into Mackenzie: Unknown

Accessibility for Fish at Mackenzie Entrance: Unknown

Channel Types: Well defined

Bottom Type (General): Gravel with some silt

Duration of Flow: Still flowing June 5, 1973. October 3 - no flow, standing water at R/W.

B. DESCRIPTION: - DISTURBANCES

The stream enters a marsh-bog region about $\frac{1}{2}$ mile below the R/W and becomes poorly defined. The substrate is gravel with some silt. No entrance to the Mackenzie is evident.

A three-foot vertical fall on the west side of the R/W could obstruct fish migration.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: June 5
Location: R/W
Depth (ft.): 2.0
Width (ft.): 5.0
Bottom Type (%): 70% Gravel
30% Silt
Colour: Tea

TEMPERATURE

Air ($^{\circ}\text{C}$): 17.5
Water ($^{\circ}\text{C}$): 11.0

WATER
ANALYSIS

Vel. (fps): 1.1
Disc. (cfs): 11.0
Secchi (cm): Clear
D.O. (ppm): 10.6
Conductivity
(umhos @ $^{\circ}\text{C}$): 120@11.0
pH: 7.9
Alkalinity
(grains/gal): 6

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 5	E.F./seine	Nil	Nil	Nil

E. FISH POTENTIAL

The size, distance from the Mackenzie and bog area below the R/W indicate a low potential fish. The three-foot fall below the R/W may limit fish access.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 378.9 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Landed on R/W

Length of Stream Surveyed: 200' at R/W

Drainage Area Classification: Drains low relief spruce forest and into marsh complex. (Drainage area - 3.2 sq. miles).

Distance of R/W from Mackenzie: Approximately 9.5 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Well defined

Bottom Type (General): Gravel & organic debris

Duration of Flow: Still flowing June 4, 1973. October 3, 1973 - no flow, standing water at R/W.

B. DESCRIPTION: - DISTURBANCES

Like 378.8, 378.9 drains an area of low relief spruce, crosses the R/W and exits into a bog-marsh area with no apparent entrance into the Mackenzie. This well channelled creek has a predominantly gravel substrate with some organic debris. Some siltation occurs along the edges. Also a build-up of logs from the debris accumulations at the winter road crossing has formed shallow (2' deep) pools and may obstruct fish migration.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: June 4
Location: R/W
Depth (ft.): 2.0
Width (ft.): 10.0
Bottom Type (%): 60% Gravel
40% Organic
Colour: Clear

TEMPERATURE

Air ($^{\circ}\text{C}$): 23.5
Water ($^{\circ}\text{C}$): 10.0

WATER
ANALYSIS

Vel. (fps): --
Disc. (cfs): --
Secchi (cm): Clear
D.O. (ppm): 8.0
Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$): 120@10.0
pH: 8
Alkalinity
(grains/gal): 5

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 4	E.F./seine	Nil	Nil	Nil

E. FISH POTENTIAL

The distance from the Mackenzie River, the lack of spawning areas, flow rates, obstructions, and a poor entrance into the Mackenzie make fisheries potential minimal.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 379.9 NAME:
CHAINAGE:

PHOTO NOS:

128.

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 300' on either side of R/W

Drainage Area Classification: Flows from Ebbutt Hills through willow, aspen and spruce forests. (Drainage area - 2.2 sq. miles).

Distance of R/W from Mackenzie: Approximately 9 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Well defined

Bottom Type (General): Over 300' surveyed: rock, silt, organic, sand, boulders, and gravel.

Duration of Flow: August 22, 1973 - no flow - standing water at R/W.

B. DESCRIPTION: - DISTURBANCES

Above the R/W the creek is well defined by organic banks. The water riffles over sand, rock and gravel with very few pools or disturbances. Flow across the R/W is diffuse with organic substrates and a small vertical drop on the downstream side.

Below the R/W the creek once again becomes well channelled, with characteristics similar to above the R/W. Flow is impounded in a marsh area with no apparent exit to the Mackenzie.

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	June 5	June 26	June 30
	Location:	R/W	R/W	R/W
	Depth (ft.):	1	0.8	1.1
	Width (ft.):	5	5.1	8.1
	Bottom Type (%):	50% Silt 50% Organic	50% Rock 40% Sand 10% Debris	75% Sand & Gravel 25% Debris
	Colour:	Tea	Tea	Tea
TEMPERATURE	Air ($^{\circ}\text{C}$):	14.0	13.0	11.0
	Water ($^{\circ}\text{C}$):	8.0	10.5	8.0
WATER ANALYSIS	Vel. (fps):	1.4	2.2	2.2
	Disc. (cfs):	7.0	8.4	19.6
	Secchi (cm):	Clear	Clear	Clear
	D.O. (ppm):	12	11.2	12.7
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	90@8.0	115@10.5	85@8.0
	PH:	8	7.7	7.5
	Alkalinity (grains/gal):	4	5	4

C. SAMPLE LOCATION DATA (cont'd)

LOCATION DATA	Date:	July 3	July 7	October 3
	Location:	Above R/W	At R/W	R/W
	Depth (ft.):	.6	.6	.1
	Width (ft.):	5.5	5.0	1.5
	Bottom Type (%):	95% Sand & Boulders 5% Organic	20% Sand 20% Organic 60% Debris	65% Rock 20% Gravel & Sand 15% Organic
	Colour:	Tea	Tea	Light Tea
TEMPERATURE	Air (°C):	10.0		7.0
	Water (°C):	10.0		1.5
WATER ANALYSIS	Vel. (fps):	2.7	1.7	1.3
	Disc. (cfs):	9.7	5.1	.24
	Secchi (cm):	Clear		Clear
	D.O. (ppm):	11.2		14.0
	Conductivity (µmhos @ °C):	100@10.0		183@1.5
	PH:	8		8.75
	Alkalinity (grains/gal):	5		9

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 5	E.F./seine	Nil	Nil	Nil
June 26	E.F./seine	Nil	Nil	Nil
June 30	E.F./seine	Nil	Nil	Nil
July 3	E.F./seine	Nil	Nil	Nil
July 7	E.F./seine	Nil	Nil	Nil
October 3	E.F./seine	Nil	Nil	Nil

E. FISH POTENTIAL

The fishery potential is low. The bog below the R/W, debris jams and the uncertain entrance to the Mackenzie limit the possibility of finding fish. Substrate could support spawning in clear riffle areas.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Re-establish unobstructed flow at the R/W.

MILE: 380.3 NAME:
CHAINAGE:

PHOTO NOS:

132.

A. GENERAL DATA

Method of Survey: Ground survey on R/W

Length of Stream Surveyed: 200 Ft.

Drainage Area Classification: Low relief coniferous forests (spruce) - empties into marsh below R/W. (Drainage area - 4.0 sq. miles).

Distance of R/W from Mackenzie: Approx. 8 miles

Creek Entrance into Mackenzie: Nil

Accessibility for Fish at Mackenzie Entrance: Nil

Channel Types: Well defined

Bottom Type (General): Organic and gravel

Duration of Flow: Still flowing October 3, 1973

B. DESCRIPTION: - DISTURBANCES

The stream has a small channel with well defined organic banks and tea coloured water. One small debris jam at the R/W causes minimal disturbance.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 5	June 10
Location:	CNT	R/W
Depth (ft.):	1.6	
Width (ft.):	4	
Bottom Type (%):	80% Silt 20% Sand	No chemistry done
Colour:	Tea	

TEMPERATURE

Air ($^{\circ}\text{C}$):	20.0
Water ($^{\circ}\text{C}$):	8.0

WATER
ANALYSIS

Vel. (fps):	1.4
Disc. (cfs):	9.0
Secchi (cm):	Clear
D.O. (ppm):	11.2
Conductivity (umhos @ $^{\circ}\text{C}$):	6508.0
pH:	7.6
Alkalinity (grains/gal):	3

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 5	E.F./seine	Nil	Nil	Nil
June 10	E.F./seine	Nil	Nil	Nil

E. FISH POTENTIAL

The probability of fish being found in this creek is minimal as it flows into a pond with no apparent access to the Mackenzie. The bottom type is of poor spawning material with few riffle or pool areas evident.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 388.2 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Aerial survey

Length of Stream Surveyed: Origin to termination

Drainage Area Classification: Flows from Ebbut Hills through low relief deciduous and spruce forest. Very marshy (Drainage area - 3.9 sq. miles)

Distance of R/W from Mackenzie: Approx. 6 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Poorly defined - diffuse flow

Bottom Type (General): Organic

Duration of Flow: Still flowing October 3, 1973

B. DESCRIPTION: -- DISTURBANCES

The stream at Mile 388.2 is very poorly defined, flowing mainly through marshes in a low relief area adjacent the Ebbut Hills. It is located in a high impact zone of glacial till containing numerous other drainage channels.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: June 5

Location: Aerial

Depth (ft.): 1 - 2

Width (ft.): 3 - 4

Bottom Type (%): Primarily organic

Colour: Light Tea

TEMPERATURE

Air ($^{\circ}\text{C}$):Water ($^{\circ}\text{C}$):WATER
ANALYSIS

Vel. (fps):

Disc. (cfs):

Secchi (cm):

D.O. (ppm):

Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$):

PH:

Alkalinity
(grains/gal):

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
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No data taken

E. FISH POTENTIAL

The fish potential is minimal due to the poorly defined low flow and organic bottom, which both suggest an ephemeral stream.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 389.0 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 200' either side of R/W

Drainage Area Classification: Drains bog and low relief spruce. (Drainage area - 0.9 sq. miles).

Distance of R/W from Mackenzie: Approx. 6 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Poor

Channel Types: Poorly defined - diffuse flow

Bottom Type (General): Organic

Duration of Flow: Still flowing June 5, 1973. October 3 - no flow, standing water at R/W.

B. DESCRIPTION: - DISTURBANCES

Mile 389.0 has a shallow flow over organic material. It is a diffuse flow through grass hummocks in spruce stands. The remains of the winter road cause some disturbance. At the R/W the flow is over wood chips and debris. Its poorly defined channel, the organic bottom and diffuse flow indicate an intermittent flow.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date: June 5

Location: R/W

Depth (ft.): 0.5

Width (ft.): 12.0

Bottom Type (%): 90% Organic
10% Silt

Colour: Tea

TEMPERATURE

Air ($^{\circ}\text{C}$): 12.0

Water ($^{\circ}\text{C}$): 9.0

WATER
ANALYSIS

Vel. (fps): 1.0

Disc. (cfs): 6.0

Secchi (cm): Clear

D.O. (ppm): 6

Conductivity
($\mu\text{mhos @ }^{\circ}\text{C}$): 75@9.0

PH: 6.9

Alkalinity
(grains/gal): 4

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 5	E.F./seine	Nil	Nil	Nil

E. FISH POTENTIAL

The fish potential for this creek is low since it has poor spawning areas, very shallow depth and extremely diffuse flow.

Natural debris accumulations may be fish barriers.

F. POTENTIAL HIGHWAY IMPACTS

None evident.

G. RECOMMENDATIONS

Follow general construction guidelines.

MILE: 392.0 NAME:
CHAINAGE:

PHOTO NOS:

A. GENERAL DATA

Method of Survey: Ground survey at R/W, and at a seismic line below R/W

Length of Stream Surveyed: 300 ft.

Drainage Area Classification: Drains bog, pond and lake area
(Drainage area - 20 sq. miles)

Distance of R/W from Mackenzie: Approximately 3 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined

Bottom Type (General): At R/W mud and peat. Above and below R/W gravel and sand

Duration of Flow: Still flowing October 3, 1973. November 24 - stream frozen to bottom at mouth. Due to depth, water may be present at R/W in mid-winter.

B. DESCRIPTION: - DISTURBANCES

The stream is a wide slough with a slow, constant flow of murky tea coloured water. Potential fish migration obstructions result from clearing debris at the R/W and seismic line and beaver dam construction downstream. The lower reaches of the creek have a gravel and sand substrate and are relatively shallow.

The exit into the Mackenzie is wide and deep and accessible for fish. The creek is well contained within high organic banks.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 3	June 10	June 26	June 30
Location:	R/W	R/W	R/W	R/W
Depth (ft.):	3.0		3.0	3.0
Width (ft.):	20.0		20.0	18.0
Bottom Type (%):	75% silt 25% bould.	50% silt 50% peat	75% silt 25% peat	30% bould. 40% silt 30% debris
Colour:	Murky Tea	Tea	Tea	Muddy Brown

TEMPERATURE

Air ($^{\circ}\text{C}$):	18.0		13.0	11.5
Water ($^{\circ}\text{C}$):	8.0		13.0	9.5

WATER
ANALYSIS

Vel. (fps):	1.9		2.1	1.4
Disc. (cfs):	114.0		123.0	75.6
Secchi (cm):	120		Clear	45
D.O. (ppm):	12.0		10.5	12.0
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	175@ 8.0		80@13.0	65@9.5
PH:	8.0		7.5	7.5
Alkalinity (grains/gal):	4		5	4

C. SAMPLE LOCATION DATA

LOCATION DATA	Date:	July 3	July 8	August 22	October 3
	Location:	R/W	Seismic	Seismic	Seismic
	Depth (ft.):	2.1	1.1	0.6	0.7
	Width (ft.):	18.1	11.2	11.2	7.0
	Bottom Type (%):	70% silt 30% debris	85% Gravel	Same	50% bould. 50% organic
	Colour:	Tea	Tea	Tea	Tea
TEMPERATURE	Air ($^{\circ}\text{C}$):	18.5			6.0
	Water ($^{\circ}\text{C}$):	12.5	11.1	9.0	1.5
WATER ANALYSIS	Vel. (fps):	2.2	4.0	2.8	0.9
	Disc. (cfs):	83.6	49.2	19.0	4.5
	Secchi (cm):	75	58	Clear	Clear
	D.O. (ppm):	10.8	10.9	11.3	13.6
	Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	710@12.5	81@11.1	89@9.0	98@1.5
	PH:	7.6	7.5	8.0	7.75
	Alkalinity (grains/gal):	4	4	5	6

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 3	E.F./Seine	Nil	Nil	Nil
June 10	E.F./Seine	Nil	Nil	Nil
June 26	E.F./Seine	Nil	Nil	Nil
June 30	E.F./Seine	Nil	Nil	Nil
July 3	E.F./Seine	Nil	Nil	Nil
July 8	E.F./Seine	Grayling	Imm.	Fry
August 22	E.F./Seine	Grayling	1 Imm.	70
			2 Imm.	63
			3 Imm.	72
October 3	E.F./No seine	Nil		

E. FISH POTENTIAL

Fish were observed at or above the highway crossing site and captured downstream. The presence of grayling fry suggests that the stream is a spawning and nursery area. The absence of fish in the earlier samplings may be due to downstream migration barriers, inefficient sampling procedures due to channel depth, poor visibility, hazardous bottom conditions and submerged debris or to sampling after spawning fish left the stream. A moderate fishery potential is indicated.

F. POTENTIAL HIGHWAY IMPACTS

High levels of silt and organic debris at the R/W indicate unstable bank conditions. Additional siltation could disrupt spawning habits.

G. RECOMMENDATIONS

Provide fish migration passage through culvert.

Install culvert during winter to prevent siltation and disturbance of spawning beds.

Control removal of riparian vegetation to ensure bank stability.

MILE: 394.7 NAME: Willowlake River
CHAINAGE:

PHOTO NOS:

M26K166-6A
M26K169-19, 20, 21
M26E109-14, 15
M26E117-7, 8
M26E133-3

A. GENERAL DATA

Method of Survey: Aerial and ground survey

Length of Stream Surveyed: From mouth to approx. 3 miles up - 32 miles surveyed by Fisheries Service in 1972.

Drainage Area Classification: Horn Hills through spruce-bog plateau behind McConnell Range and through low bog (bench area) west of McConnell Mtns. (Drainage area - 7,899 sq. miles).

Distance of R/W from Mackenzie: 0.5 miles

Creek Entrance into Mackenzie: Good

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Single well defined channel. River shows little meander.

Bottom Type (General): Mainly gravel and boulder. Sand and silt concentrations around bar areas.

Duration of Flow: Appears to flow, to some degree, all year round. Flow under ice reported March 10, 1973.

B. DESCRIPTION: - DISTURBANCES

Previous surveys by the Fisheries Service report that Willowlake River has excellent spawning gravel along the entire length surveyed. Many pools and intermittent rapids were noted. The river banks are generally low (5+ feet) however, there are two regions near the river mouth approx. 30 feet high on a 50° to 60° slope which display some minor flow slides into the river. Water clarity varies with degree of runoff from heavy silt colour to a light rust (tea coloured) water. Water samples taken on March 13, 1973 indicated a sub-ice flow in the area of the D.P.W. camp pumphouse. Willowlake River supports a moderate domestic fisheries. A small settlement is located at the mouth of the river.

MIle: 394.7 NAME: Willowlake River
CHAINAGE:

PHOTO NOS:

M26K166-6A
M26K169-19, 20, 21
M26E109-14, 15
M26E117-7, 8
M26E133-3

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C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	March 10	March 13	Sept. 27
Location:	3/4 mi. upstream from R/W	D.P.W. pumphouse	R/W
Depth (ft.):	1.5		
Width (ft.):			
Bottom Type (%):			60% Bould. 40% Sand
Colour:			Clear

TEMPERATURE

Air ($^{\circ}\text{C}$):			13.5
Water ($^{\circ}\text{C}$):	1.0	1.0	6.0

WATER
ANALYSIS

Vel. (fps):			≤ 1
Disc. (cfs):			
Secchi (cm):			150
D.O. (ppm):		10.6	10.0
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	1080@1.0	1020@1.0	380@6.0
PH:	7.2	7.5	8.75
Alkalinity (grains/gal):	8	8	7

Sampled by
F.F. Slaney

D. FISH DATA

Studies conducted by the Fisheries Service, Department of the Environment and by Interdisciplinary Systems Ltd. (Gas Arctic Study) during 1971 and 1972 have shown the following species to be present in Willowlake River: lake cisco, humpback whitefish, round whitefish, Arctic grayling, northern pike, spottail shiner, emerald shiner, white sucker, longnose sucker, trout perch and walleye.

E. FISH POTENTIAL

Willowlake River has a high fisheries potential. It has extensive spawning grounds and to date a high species diversity has been observed. The river supports both domestic and sport fisheries.

Of the species encountered in this river, only whitefish are fall spawners. However, both inconnu, another fall spawner, and burbot, a late winter spawner must be assumed to be present due to the size of the river and extent of spawning grounds.

F. POTENTIAL HIGHWAY IMPACTS

Berms or cofferdams during bridge installation may cause velocity increments in the resultant confined channel.

G. RECOMMENDATIONS - BRIDGE INSTALLATION

Bridge installation would here be best carried out during the winter period (beginning of December to end of February). Assuming that construction of the bridge will be extended over a longer period of time, those facets of construction which may be particularly injurious to the spawning cycle (e.g. pier and abutment construction) should be restricted to this period. Abutments and cofferdams must allow for adequate drainage with proper culvert installations. Safeguards should also be observed with regard to preservation of bank vegetation.

REFERENCES

The report is based primarily on data compiled from the following sources:

1. Dryden, R.L., B.G. Sutherland and J.N. Stein. 1973. An evaluation of the fish resources of the Mackenzie River Valley as related to pipeline development. Volume II. Information Canada.
2. Hatfield, C.T., J.V. Stein, M.R. Falk, C.S. Jessop and D.N. Shepherd. 1972. Fish Resources of the Mackenzie River Valley. Interim Report I. Volume II. Information Canada.
3. Shotton, R. 1973. Fish Survey 1972. Base Data Report for the Environment Protection Board. Inter-Disciplinary Systems Ltd., Winnipeg.

MILE: 396.2 NAME: Hot Springs Creek
CHAINAGE:

PHOTO NOS:

M26K166-12A, 13A
M26K173-23, 24, 25

A. GENERAL DATA

Method of Survey: Ground survey at R/W

Length of Stream Surveyed: 400' at R/W

Drainage Area Classification: Originates in hot springs and flows through bog and spruce stands to the Mackenzie. (Drainage area - 0.5 sq. miles).

Distance of R/W from Mackenzie: Approximately 2 miles

Creek Entrance into Mackenzie: Definite entrance

Accessibility for Fish at Mackenzie Entrance: Good

Channel Types: Well defined

Bottom Type (General): Silt and debris

Duration of Flow: Still flowing October 3, 1973. March 1972 survey - open water.

B. DESCRIPTION: - DISTURBANCES

Unusually high conductivity greater than 50,000 μ mhos, high water temperatures in winter (6.5°C), slow velocity, and light tea coloured water are characteristics of this hot spring drainage. The width and depth remains constant with no riffle or pool sections. The flow is interrupted at the CNT line by debris from the winter road, and siltation has resulted. This debris does not block migration since fish were sighted above the CNT line. Low organic banks contain the flow on either side of the R/W.

C. SAMPLE LOCATION DATA

LOCATION
DATA

Date:	June 3	March 11
Location:	R/W	Below R/W at inlet to hotspring pool
Depth (ft.):	0.8	
Width (ft.):	10	
Bottom Type (%):	100% Debris	
Colour:	Light Tea	

TEMPERATURE

Air ($^{\circ}\text{C}$):	14.0	5.0
Water ($^{\circ}\text{C}$):	10.0	13.0

WATER
ANALYSIS

Vel. (fps):	1.0	
Disc. (cfs):	8.1	
Secchi (cm):	Clear	Clear
D.O. (ppm):	9	6.6
Conductivity ($\mu\text{mhos @ }^{\circ}\text{C}$):	Greater than 5,000@10.0	3,500@13.0
PH:	7.9	7.2
Alkalinity (grains/gal):	7	12

D. FISH DATA

DATE	SAMPLE TECHNIQUE	SPECIES	MATURITY	LENGTH (mm)
June 3	Observation	Grayling	--	--

E. FISH POTENTIAL

The hot springs and resulting creek at M397 remain ice free year-round. Grayling have been observed and caught in both the pool and creek in March 1973 while all surrounding streams were frozen solid. This creek, therefore, is utilized by grayling and possibly other species as an overwintering area. While Creek 396.2 is not crossed by the highway R/W, the uniqueness and close proximity of such a drainage system to the proposed highway warrants special attention.

Sport fishery capacity of M396.2 should be low due to an expected poor resilience of fish populations in such a small drainage system. The hot springs may be potential stops of interest along the highway. Fishery potential is moderate.

F. POTENTIAL HIGHWAY IMPACTS

Overfishing, if access from the highway is made possible, is expected if strict surveillance is not maintained.

G. RECOMMENDATIONS

Control clearing and disposal of debris and litter in and around the hot springs.

Regulate sport fishing in the hot springs and creek.

Incorporation of system into the recreational design for highway.

