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Canada

Travaux publics
Canada

Western Region

Région de l'Ouest



D003061

MACKENZIE HIGHWAY, N.W.T.
MILE 586 TO MILE 631(S)

PRELIMINARY SUBMISSION - DETAIL DESIGN DATA

Government
of CanadaGouvernement
du Canada

MEMORANDUM

NOTE DE SERVICE

TO
A

Mr. W. R. Binks
Program Manager (Civil)
Design & Construction
OTTAWA, Ontario

FROM
DE

F. E. Kimball
Project Manager NWT Roads
Western Region

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE - N/RÉFÉRENCE

9305-52-300

YOUR FILE - V/RÉFÉRENCE

DATE
April 23, 1974SUBJECT
OBJET

PRELIMINARY DESIGN SUBMISSION - MILE 586 TO MILE 631(S)
MACKENZIE HIGHWAY

Enclosed are 24 copies of the narrative portion of the above-noted Design Submission. Two sepia copies of the plans have been forwarded under separate cover.

Six copies of the narrative and a sepia of the plans have been forwarded to Mr. J. Hamilton of D.I.N.A. in Yellowknife. Single copies of the narrative and a single set of prints have been forwarded to D.O.E., in Edmonton and Winnipeg and E.M.R. in Calgary.

Every attempt has been made to provide all information required in a Preliminary Design Submission. It would be appreciated if you could obtain an early response identifying any omissions or additional information requirements relative to this Preliminary Design Submission.


F. E. Kimball
Project Manager NWT Roads
Western Region

Encl.

MACKENZIE HIGHWAY

PRELIMINARY DESIGN DATA

MILE 586 - MILE 631(S)

Department of Public Works
of Canada
Western Region
EDMONTON, Alberta

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INTRODUCTION

The general design criteria used by the Department of Public Works design teams in preparing the preliminary and final designs of the Mackenzie Highway are outlined in the General Design Data Report, Section "C", Mile 544 to Mile 725 published on January 29, 1974 by the Public Works of Canada, Western Region. Narratives on specific concerns for this Design Submission are contained in this Report, Preliminary Design Data, Mile 586 to Mile 631(S).

The reader should note that this Report forms part of a total Design Submission, the major portion of which is contained in separate plan form.

Attention is also drawn to the fact that the drawings contain complete notes of design and assessment for hydrology, culverts and environmental impact.

CHAPTER 1

OVERLAND DRAINAGE

From Fort Norman to Norman Wells the Highway route traverses the base of the Norman Range and crosses numerous drainage channels with headwaters in the adjacent mountains. Surficial soils are predominantly silts and silty clays with some sandy gravels. Bedrock consisting primarily of shales, sandstones and limestones has been found at shallow depths in many locations, while organic cover is generally from 1 to 4 feet thick.

From Mile 586 to 590 the R.O.W. crosses tertiary and paleozoic bedrock covered with a thin veneer of glaciolacustrine silts and clays interspersed with coverings of till plain remnant. The presence of well-defined cross-drainage, draining toward the Great Bear River, and the inclusion of additional culverts in areas where a potential for upslope ponding has been recognized, will minimize drainage problems for this area. The R.O.W. from Mile 590 to 599 ascends an area of alluvial slope wash forming a thin covering over paleozoic bedrock and interspersed with the occasional piedmont remnant. The Highway follows the higher ground through this area and the general slope direction falls to either side of the Highway. The possibility for overland flow is remote in this area, however, in those areas where distinct drainage channels are lacking, additional culverts have been included in the design. From Mile 599 to Mile 608 the local drainage characteristics are dominated

by Jungle Ridge and Jungle Ridge Creek. The relief afforded by the ridge line and the presence of the creek indicate that few drainage problems will be encountered in this section. From Mile 603 to Mile 623 the drainage is dominated by a series of eight major creeks which flow down from the adjacent Norman Range. The alignment crosses these creeks perpendicularly and generally the areas between the creeks are well drained. The creeks: Nota, Mile 604.9; Vermilion, Mile 605.3; Prohibition, Mile 612.5; Unnamed, Mile 614.2; Christina, Mile 615.8; Helava, Mile 616.4; Francis, Mile 617.9; and Canyon, Mile 620.4 generally have braided channels with boulder and gravel beds. The R.O.W. from Mile 623 to Mile 628 gradually rises with locally well-defined drainage running to the Mackenzie River. At Mile 628 the Highway climbs up onto Kee Scarp. The nature of the material (mostly bedrock) and the gentle sideslope, combine to offer an area with no drainage problems.

Generally, this entire design section has very few areas where overland flow and possible upslope ponding may be present. The alignment follows higher ground for the most part in this section and often bisects the local drainage pattern. The presence of the numerous creeks also aids in more clearly defining local drainage characteristics.

CHAPTER 2

SOURCES OF BORROW

With the availability of bedrock material at shallow depths throughout this section, it was considered advantageous to use the rock material for the construction of the highway embankment. The number of pits were limited and longer hauls proposed, for wastage of overburden in too many borrow areas, would have been more costly.

Mile 586 - 593

The material required for this section of the Highway will be obtained from a borrow pit at Mile 591. The bedrock material, limestone with 5 - 10% moisture content, will provide good construction material.

Mile 593 - 600

The R.O.W. cut at Mile 598 to 599 is through limestone with approximately 8 feet of overlying till. The limestone from this cut will provide construction material for this section.

Mile 600 - 605

The highly plastic clay shale with a moisture content of 25% as found in the borrow area at Mile 602 will provide the construction material for this section of the Highway.

Mile 605 - 619

The R.O.W. cut at Prohibition Creek, Mile 612, provides shale for construction material for this section. The shale has a moisture content of 15 - 18%.

Mile 619 - 626

The borrow area at Mile 624.8 will provide shale at 5 - 10% moisture content for this section of the Highway. The shale in this borrow area is under approximately 7 feet of clay till.

Mile 626 - 631(S)

R.O.W. cuts in areas of limestone and shale have provided balanced cuts and fills through this section.

CHAPTER 3

SPECIAL DITCH TREATMENT

The following special treatment for planned ditches has been identified in accordance with Section B-9 of the Mackenzie Highway General Design Data, Mile 544 to Mile 725.

<u>MILE</u>	<u>STATION</u>	<u>% SLOPE</u>	<u>ESTIMATED DISCHARGE IN C.F.S.</u>	<u>DITCH PRO- TECTION DITCH CHECK SPACING</u>
590-591	471- 476	7.7	3	Cobbles
604-605	1201-1210	2.9	3	60'
605-606	1238-1247	4.5	4	Coarse Gravel
620-621	2027-2038	3.7	6	40'
621-622	2063-2066	4.0	3	Coarse Gravel
621-622	2074-2076	3.7	4	40'
621-622	2080-2086	3.0	2	60'
622-623	2123-2127	1.3	8	100'
623-624	2163-2167	5.0	6	Cobbles
623-624	2194-2201	1.5	3	80'
626-627	2339-2344	1.8	9	70'
626-627	2369-2372	0.8	6	160'
628-629	2459-2463	1.3	5	130'
628-629	2468-2472	1.6	4	110'
630S-631S	2572-2578	1.2	10	90'

CHAPTER 4 Summary of Environmental Data,
Miles 586 to 631(S)

Prepared by: Lombard North Group
Environmental Consultants

Information presented on the Environmental Data and Litten sheets is the result of many months of intensive field work, literature review, and air photo analysis. Within the portion of alignment under discussion, there is a limited number of potentially significant conflicts of alignment vs. environment. Key areas of concern have been identified and, in most cases, suggestions for amelioration of impact or special precautions are presented.

Following are brief discussions of Miles 586 to 631(S) of the proposed alignment under each of the assessment categories:

VEGETATION	ARCHAEOLOGY
FISH	LANDSCAPE ARCHITECTURE
BIRDS	RECREATION
MAMMALS	CONSTRUCTION
TERRAIN ANALYSIS	ENVIRONMENTAL ASSESSMENT

A short synopsis appears at the end of this account.

VEGETATION

The forest cover in the area traversed by Miles 586 to 631, as in all of Section C of the Mackenzie Highway, is dominated by black spruce. Some areas of mixed forest with white spruce, birch, and aspen occur on well-drained ridges such as Jungle Ridge (Mile 598 to 600) and Kee Scarp (Mile 626 to 631) and along creekbanks. Larch is prominent in muskeg areas. Areas of mixed forest and of open muskeg with scattered larch provide welcome visual relief from the routine black spruce forest.

Impacts on forest cover will be primarily a result of alteration in natural drainage patterns. Clearing of forests for the right-of-way, borrow areas and access roads, and for visual improvements will create local impacts. These will be reflected in utilization of the affected areas by wildlife; however, the impacts will not necessarily be negative as wildlife will soon invade regenerating areas. Generally, vegetation will not be a critical consideration within this section.

FISH

There are eight major streams within this portion of the Mackenzie Highway. These include:

Jungle Ridge Creek	M602.1
Nota Creek	M605.0
Vermilion Creek	M605.4
Prohibition Creek	M612.4
Christina Creek	M615.8
Helava Creek	M616.4
Francis Creek	M617.9
Canyon Creek	M620.4

In addition to these, one major lake, Trout Lake (Bear Rock Lake) was sampled.

A general description of the respective drainage basins and physical and chemical characteristics of the streams have been noted on the Environmental Data sheets. In addition, fish seen or caught during sampling periods, and fishery potential have been indicated. "Fishery potential" denotes the assessed capability for sport fishing. Graphic symbols have been used on the Environmental Data sheet mosaics to indicate presence or absence of fish in streams, and the direction of flow.

Generally, the streams within this area have braided channels with boulder and gravel beds. Dissolved oxygen concentrations approached saturation in all creeks, while values for carbon dioxide concentration and turbidity were low. Trout Lake (Bear Rock Lake) appeared to have a gravel-silt bed. Its waters were also high in oxygen content and low in carbon dioxide and turbidity readings. All streams drain the southwest facing slope of the Norman Range and empty into the Mackenzie River. Very few lakes are found in these drainages.

Only one of the eight creeks, Christina Creek, contained no fish. This was due to the fact that the creek drained into a large fen before reaching the Mackenzie River. All other creeks contained arctic grayling. Other species including slimy sculpin, lake chub and pike were also found. The use of bridges to cross the creeks will help to minimize the potential detrimental effects of the highway on these grayling spawning areas.

Trout Lake (Bear Rock Lake) harbours a substantial population of lake trout and lake chub. Since the lake is land-locked, stringent control measures on fishing must be instituted to maintain viable fish populations.

Generally, streams in this portion of the alignment appear to perform a support function, acting as spawning areas for arctic grayling. Since water levels drop considerably over the summer, some creeks drying up completely, the sport fishery potential of the area is rated as generally fair to poor.

BIRDS

Waterfowl habitat within the area of Miles 586 to 631 is poor to non-existent. Although migrating waterfowl do utilize the Mackenzie River nearby, the possible affects of the Mackenzie Highway on waterfowl are considered to be negligible. A good variety of habitats for terrestrial birds does exist; however, the adaptability of most of these species, and availability of similar habitats nearby, suggests that the highway's impact on most terrestrial species will be low.

The key environmental concern within this portion of the highway alignment relates to the Peregrine Falcon. Two areas of suitable Peregrine habitat (Jungle Ridge, Miles 598 to 600; Kee Scarp, Miles 626 to 631) were found. A pair of Peregrines nested on Kee Scarp during the summer of 1973, while evidence of past usage was found at Jungle Ridge.

Both areas also have significant visual qualities and provide excellent roadbed conditions, thereby eliminating the necessity for borrow pits and haul roads in their respective areas. As there is no evidence of present usage of Jungle Ridge by Peregrine Falcons, it may be possible to maintain the present alignment, providing no access to the scarp face or pull-off facilities on the ridge are allowed. The present alignment over Kee Scarp lies downslope and approximately three quarters of a mile from the scarp face. The lake below the scarp (Hodgeson Lake) is now used as a recreation area for Norman Wells residents. Also, there is an existing access road from Norman Wells to the scarp edge, also used by residents of Norman Wells for recreational purposes. If this road were blocked and no other forms of access provided from the highway alignment to the scarp edge, the present alignment should have little or no added impact on the Peregrine nesting area.

MAMMALS

Moose and black bear are found throughout the area under discussion. Three caribou were also sighted. As suitable aquatic habitat for beaver and muskrat is very limited, these species do not constitute a concern here. Although little evidence of mink and marten was found, it is thought that they inhabit the spruce forests and stream channels. Wolf dens were found in three locations. Very little commercial trapping is done in the area traversed by Miles 586 to 631 of the alignment.

The only serious consideration here is the destruction of potential denning areas. These are found particularly on sand and gravel ridges and along creekbeds. Since only three borrow pits have been designated for this section, the destruction of denning sites via borrow area development should not constitute a major problem. Limited access along streams and minimal disturbance of streambed and margins are priority items.

TERRAIN ANALYSIS

The region covered by Miles 586 to 631 of the Mackenzie Highway can be divided, geologically, into four sub-segments. These are described below.

The area from Mile 586 to Bear Rock (Mile 592 approx.) is characterized by varied topography with gentle to moderate slopes (0 to 12 per cent). There are local scarps along the route. The upland areas are generally flat with gentle to moderate slopes forming the scarps. Several streamlets and rills cross the alignment. Some thermokarst lakes are present south of the alignment near Bear Rock. Trout Lake, at the base of Bear Rock, is mainly fault controlled. Any construction problems will be related to the variations in topography.

The Norman Range Crossing (Mile 592 to Mile 594 approx.) lies in an area of carbonate bedrock of relatively low relief. Some sink holes and karst lakes are present near the highway, but no major drainage features occur. Construction difficulties relate mainly to differentials in topographic relief.

Miles 594 to 596 (approx.) cross hill and valley terrain resulting from drumlinoid features and runoff channels. Gentle to moderate slopes, a local scarp, and a mudslide area comprise the main construction difficulties.

The final sub-segment (Miles 596 to 631) comprises ridge and valley, and hillside topography. Gentle to moderate slopes, interrupted by local gentle to steep sloping scarps, are present. Broad valleys separate the ridges and hills, while narrow V to

U-shaped rivulet and stream valleys cut across the ridges. The route crosses eight major streams, five of which have associated flood plains. Numerous streamlets, gullies, rills, and wash areas, and two mudslide areas are present. Construction difficulties arise from stream, rivulet, mudslide, and slump area crossings. The alignment also traverses several small muskeg areas and moderate to high relief scarps.

ARCHAEOLOGY

Three archaeological sites were found within this portion of the highway alignment. Two historic sites (recent camps) were found on the shores of Trout Lake at Bear Rock. A prehistoric site was found at the confluence of Nota and Vermilion Creeks. The prehistoric material found at the latter location had probably washed down along one of the creek channels from a location upstream. None of the sites represent excavation priorities.

Although no other sites were found, they may exist, particularly along creekbeds and on ridges and scarps in the area. For this reason, it is suggested that particular attention be given to archaeological surveillance during highway construction at these locations.

LANDSCAPE ARCHITECTURE

Topics dealt with under the category of Landscape Architecture include borrow areas and associated access roads, selective clearing for visual variety, and other practices to enhance the visual

potential of the highway alignment. Recommendations have been included on the appropriate Environmental Data sheets. In addition, Litten comment and evaluation sheets depicting intensity of interest, sequential notation, scale and proportion, and alignment profile and diagrammatic vegetation types have been included in the submission.

Areas having good potential for selective clearing, after sub-grade construction, have been identified. They are often associated with borrow areas.

Selective clearing may be done for the following purposes:

1. Integrating tangent cuts at curves with general right-of-way.
2. Emphasizing small bogs, ponds, and open spaces.
3. Integrating trail cuts with general right-of-way and accentrating trails with views to ponds, lakes etc.
4. Minimizing right-of-way widths through mixed vegetation.
5. Deflecting views away from C.N.T. line.
6. Breaking monotony of long stretches of black spruce.
7. Increase right-of-way at high points. Integrate clearing with cuts.

The proposed alignment from Miles 586 to 631 crosses a variety of terrain and offers excellent opportunities for visual highlights in some locations, but poor potential in others. Bear Rock is a key feature in this section. Views to Bear Rock are

possible from several locations along the alignment. In addition, panoramic views to the main body of the Norman Range may become possible through some selective clearing. The use of bridges at creek crossings will definitely increase the visual impact of the crossings.

In addition to Bear Rock, other topographic prominences which may be used to good advantage include Jungle Ridge and Kee Scarp, although the Peregrine Falcon influence must be considered in these areas. Kee Scarp, particularly, would provide excellent opportunities for panoramic views of the Mackenzie Valley with the Mackenzie Mountains in the background and Norman Wells and the Mackenzie River in the middle ground.

RECREATION

Recreation potential in this section is related to scenic overlooks and landscape views, hiking, rest stops and campgrounds with related activities and fishing.

A prime location for a scenic overlook exists on the scarp at Mile 591. Other possible locations include Jungle Ridge and Kee Scarp; however, use of these ridges by Peregrine Falcons precludes their use as scenic overlook stops. The ridges would nonetheless, present good panoramic landscape views if the alignment were to remain in its present location.

The frequency and placement of campgrounds and rest stops is dependent upon the decision of certain government agencies.

Hiking trails could be located in conjunction with the overlook site at Mile 591 and with a possible rest stop or campground at

Trout Lake (Mile 588) or at Vermilion Creek (Mile 605.4). Each of these areas has good multiple use potential.

The only place where sport fishing could present a viable recreation pursuit is at Trout Lake (Mile 588). The lake appears to harbour a reasonable population of lake trout within the three to four pound range. Trout Lake, however, is not exceptionally large, nor does it have a defined inlet and outlet. For these reasons, if fishing is to be allowed, stringent regulations regarding removal of fish from the lake should be instituted. No motor boats should be allowed on Trout Lake.

CONSTRUCTION

This category has been used to indicate cut selections and balanced earthwork situations, recommended culvert types, and the location of borrow areas. It is assumed that, except in cut situations, overlay construction methods will be employed. Also, it is assumed that clearing along creekbeds at crossings will be done by hand. Bridge crossings are planned for all streams except Nota Creek, Mile 605.0, Helava Creek, Mile 616.4 and Francis Creek, Mile 617.9 which will require fish passage design culverts. No fish were observed in Christina Creek, therefore, a normal culvert design will be adequate.

ENVIRONMENTAL ASSESSMENT

This category has been used to highlight particular considerations which must be taken into account within the area covered by the respective mosaic. The comments are relatively general and relate to comments in other categories above. Within the

section under discussion in this submission, the major environmental constraint relates to the use of Jungle Ridge and Kee Scarp by Peregrine Falcons. Other considerations include the use of Trout Lake for sport fishing, the importance of streams and streamcourses to fish and wildlife, and the visual and recreation potential along the existing alignment.

SYNOPSIS

The highway alignment from Miles 586 to 631 presents few serious environmental or construction difficulties. The Peregrine Falcon, an endangered species, has a considerable influence on recommendations within relevant areas such as Jungle Ridge and Kee Scarp. Streams and streamcourses are important areas for fish and wildlife. The use of bridge crossings and minimal disturbance upstream and downstream from the crossings should alleviate most concerns.

Drainage is generally good throughout and no serious terrain-related construction difficulties are anticipated. Although three archaeological sites were found within this section, none appear to warrant further intensive investigation.

Some recommendations have been made related to the landscape architecture and recreation categories. Selective clearing in some areas, often in association with borrow areas, could be used to advantage for visual improvement. Recreation potential within this section, related to campgrounds, rest stops, scenic overlooks, and sport fishing, is generally limited, although opportunities do exist.

CHAPTER 5

BORROW AREA DEVELOPMENT

- Prepared by: Lombard North Group,
Environmental Consultants.

Borrow pits are a necessity in highway construction, however, poorly planned, haphazard borrow areas will detract from the general appearance of the landscape. Even if borrow pits are hidden from the motorist's view, they will remain visible to those flying overhead. This may be a significant point since the Mackenzie Valley provides a rather narrow, well-used flight corridor.

It should be practical to design borrow areas which will provide necessary construction material, yet still blend into the landscape. Some borrow areas may be used for other purposes after highway construction. They may serve as parking areas for rest stops, as emergency pull-offs and recreation areas, as interpretive features depicting natural vegetation succession, and as wildlife viewing areas since various species of wildlife will undoubtedly invade these clearings. Such potential uses must be taken into account as the borrow pits are excavated.

At present, the general consensus appears to be that borrow areas should be hidden from the highway alignment. It must be borne in mind that natural landscape variety and features of interest are not uniformly distributed along the Mackenzie Highway route. Thus, it may be advantageous, in some instances,

to develop borrow areas which are open to the alignment. These would provide open space and, with proper contouring and re-vegetation measures, would improve rather than detract from the visual properties of the landscape.

Methods of excavating borrow material may require that the original pit shape be rectangular. The original boundaries may then be expanded by excavating material, to a lesser depth, in tongues from the rectangle and by accessory dozing and contour grading. Principles of selective clearing applied along the right-of-way can apply equally to borrow areas. Clearing may be used to modulate the vegetation edge, to accentuate certain vegetation types by isolating them, and to accentuate landscape features such as lakes, bogs, and ridges by providing visual access to them.

Conceptual designs for borrow areas are convenient in that they can be easily identified and may be applied to level or otherwise uniform terrain. In most areas, including those designated as borrow sites along the Mackenzie Highway alignment, it would be difficult, if not impossible, to construct a borrow pit which would totally conform to a predetermined shape. The final shape, size, and contours of a borrow area must be determined by the amount of material to be taken, location and shape of suitable deposits, local topography and drainage, and potential future use of the borrow area. Borrow areas will take one of two very general shapes: linear where the material

lies in ridges, or amoeboid where the material is found in irregular deposits below flat or undulating terrain. Working designs will be prepared following site inspections during the summer of 1974. Final decisions must be made, on site, by agreement between the environmental consultant and the construction engineer to insure an amenable balance between environmental and aesthetic factors and engineering suitability.

CHAPTER 6

HYDROLOGY DATA FOR CULVERT DESIGN
MILE 586 TO MILE 631(S)

The Hydrology Summary sheets contained in this chapter were prepared by the Hydrology Consultant, Bolter, Parish, Trimble. Detailed methods and references for determining these summaries are found in Bolter, Parish, Trimble's publication of Mackenzie Highway Hydrology Study and Design of Culverts, Mile 297 to Mile 345, November, 1972 and modified as outlined in their subsequent reports on:

- Mile 403.1 and Mile 407.5, June 12, 1973
- Mile 406.2, September 20, 1973
- Modified Rational Formula, Mile 545 - 725, February, 1974.

Three creeks, Christina, Mile 615.8, Helava, Mile 616.4, and Francis, Mile 617.9, were originally scheduled for bridges. Because of the minor drainage areas involved in these areas it is now considered that culverts at these sites will be adequate.

HYDROLOGY SUMMARY

PRELIMINARY - SUBJECT TO REVISION

MILE 586 TO MILE 631

Part 2

MILE	Christina 615.8	Helava 616.4	Francis 617.9
Drainage Area (A) TOTAL (sq. miles)	7.5	8.5	10.0
Q _{hwm} (c.f.s.)	460	387	700
Drainage Area (A _e) EFFECTIVE (sq. miles)	7.5	8.5	10.0
Relief (feet)	2650	2900	3125
(100 - L) Water Retained for Runoff	.31	.32	.34
Rainfall (inches in 24 hours)	4.5	4.5	4.5
M Ratio	3.69	3.61	3.5
Q _e (c.f.s.)	1030	1180	1430
Drainage Area (A _{lc}) LAKE CONTROL (sq. mile)	-	-	-
Relief (feet)	-	-	-
(100 -L)	-	-	-
Rainfall (inches in 24 hours)	-	-	-
M Δ	-	-	-
Q _{lc} (c.f.s.)	-	-	-
Drainage Area (A _m) MUSKEG (sq. miles)	-	-	-
Q _m (c.f.s.)	-	-	-
Q rational (c.f.s.) (Q _e + Q _{lc} + Q _m)	1030	1180	1430
Q design (c.f.s.)	1100	1200	1500

HYDROLOGY SUMMARY

PRELIMINARY - SUBJECT TO REVISION

MILE 586 to MILE 631
Part I

MILE	605.0	607.6	607.8	610.3	614.2	617.6	619.1
Drainage Area (A) TOTAL (sq. miles)	37.0	2.3	2.5	2.2	4.0	1.3	3.5
Qhwm (c.f.s.)	2400	△	△	151	△	△	210
Drainage Area (Ae) EFFECTIVE (sq. miles)	37.0	2.0	0.5	1.4	4.0	1.3	2.5
Relief (feet)	1875	450	250	200	1250	575	525
(100 - L) Water Retained for Runoff	.27	.21	.20	.20	.24	.22	.21
Rainfall (inches in 24 hours)	4.5	3.5	3.5	3.5	3.5	3.5	3.5
M Ratio	3.14	4.12	4.5	4.17	3.96	4.18	4.08
Qe (c.f.s.)	3769	162	42	109	355	112	200
Drainage Area (Alc) LAKE CONTROL (sq. mi.)	-	0.3	2.0	0.8	-	-	1.0
Relief (feet)	-	250	550	500	-	-	350
(100 - L)	-	.20	.22	.21	-	-	.21
Rainfall (inches in 24 hours)	-	3.5	3.5	3.5	-	-	3.5
M △	-	2.6	2.6	2.6	-	-	2.6
Qlc (c.f.s.)	-	15	107	41	-	-	51
Drainage Area (Am) MUSKEG (sq. miles)	-	-	-	-	-	-	-
Qm (c.f.s.)	-	-	-	-	-	-	-
Q rational (c.f.s.) (Qe + Qlc + Qm)	3769	175	150	150	355	112	251
Q design (c.f.s.)	3800	175	150	150	355	115	250

- △ Modified M for lake control, Ref. Modified Rational Formula, Mile 545 - 725
February, 1974
- △ Qhwm not assessed at this crossing, requires field inspection prior to
final design.

CHAPTER 7

CONTENTS OF PRELIMINARY DESIGN SUBMISSION
MILE 586 - MILE 631(S)

<u>TITLE</u>	<u>NUMBER OF SHEETS</u>
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1 in. 250,000 Land Use Maps	4
1 in. 50,000 Topographic Maps	3
1 in. = 1,000' Mosaics	13
Environmental Consultant's Folio	
Environmental Data Sheets	
Mile 586 - Mile 631(S)	12
Landscape Architectural Evaluation Sheets, Mile 586 - Mile 631(S)	4
Legend Sheet	1
Typical Section Sheets	2
Plan Profile Mile Sheets	45
Hydrologist Drawings	
115-3-79 -----	1
88 -----	1
148 -----	1
149 -----	1
150 -----	1
151 -----	1
152 -----	1
153 -----	1
154 -----	1
155 -----	1
156 -----	1
157 -----	1
Total	97