
LEGISLATIVE ASSEMBLY OF THE
NORTHWEST TERRITORIES
7TH COUNCIL, 44TH SESSION

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GOVERNMENT OF THE NORTHWEST TERRITORIES
CANADA

PLEASE QUOTE

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TD # 11-44

Tabled on Feb. 1, 1971

Yellowknife, N.W.T.,
25 May 1970.

DEPUTY COMMISSIONER

Mackenzie River Crossing Study

Enclosed is the report on this study prepared by the New Brunswick Research and Productivity Council, together with our summary.

The report should provide the evidence needed to show that a bridge must be seriously considered. You may wish to send copies to the Minister, Deputy Minister, and other DIAND officials.

Enclosed in addition, is a brief discussion of alternatives to the bridge, also prepared by the Council. It was thought best not to confuse the main issue by including this material in the report.

(G. W. Graham)

E. Alan Ballantyne,
Director,
Industry & Development.

Encl.



PLEASE QUOTE

FILE.....

GOVERNMENT OF THE NORTHWEST TERRITORIES
CANADA

DEPARTMENT OF INDUSTRY AND DEVELOPMENT

Mackenzie River Crossing Study

The attached report was prepared during a brief study to review the need and justification for a bridge across the Mackenzie River at Fort Providence. The quantitative data are intended only as rough estimates.

The construction of a bridge is recommended. The cost would be of the order of \$8,000,000 and the justification is as follows:

1. A bridge would stimulate the economic growth of the area it would serve. An additional growth rate in gross domestic product of between one-quarter and one-half per cent per year would have a net present worth equal to the cost of the bridge.
2. The direct dollar saving would be close to \$400,000 per year at the present level of the economy, and could reasonably reach \$750,000 within a few years.
3. There is a social need for the bridge, and in spite of the relatively small population this will justify part of the cost. Highways and bridges in other parts of Canada are not built solely on the basis of economic cost-benefit analysis.


In addition to the major considerations above, some weight should also be given to the vulnerability of the ferry service to strike, fire, or shipwreck. A prolonged interruption would be an economic and social disaster for the region affected.

May 25, 1970.

MACKENZIE RIVER CROSSING STUDY

GOVERNMENT OF
NORTHWEST TERRITORIES

Job No. 7139
March 1970


T.B. Howard
D.S. Mann

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MACKENZIE RIVER CROSSING STUDY

INTRODUCTION

At the request of Mr. D.L. Stewart, Supervisor, Research and Planning Section, Government of the Northwest Territories, RPC has carried out a brief survey of the costs and benefits of a year-round crossing over the Mackenzie River at Ford Providence.

This report does not seek to measure the alternative priorities for expenditure either at Federal or Territorial level. It simply presents the costs and benefits of a bridge. The requirement for a bridge as a necessary factor in developing the territory is so overwhelming that all other incidental benefits are trivial in comparison.

Although the early discernible economic benefits, both tangible and intangible, are discussed in the report, and these alone virtually justify the expenditure on a bridge, it must be borne in mind that the primary reason for the bridge is to accelerate the rate of development of the area served by the Yellowknife staging post.

Consideration of the order of magnitude of the earning power of the area and the cost of the bridge reveals that it requires only a minimum advancement of the productivity of the territory to obtain a very favourable benefit/cost ratio for the project.

Throughout this report due regard is given to, but little emphasis is placed on, historic data. The decision, which is germane to the question "Should the development of the area be assisted, ignored or inhibited?", must be based on subjective and objective assessments of the project and potential economic value of the area.

A cursory examination was made of the possible alternatives for a permanent crossing. It was concluded that a bridge is the only realistic proposition. Thus, throughout the report

reference will be made to a bridge rather than using a more general term.

Many figures used in this report are based on estimates. When an estimate was made and it was felt that it was insufficiently reliable, it was not used as the basis of any recommendations. Thus the effect of the bridge on certain aspects of the economy has not been quantified. For example, the results of an increase in tourism have not been taken into account.

In making estimates it has been considered appropriate to exercise caution. For example, the estimate made in 1958 of the cost of a bridge was \$6,200,000 and there have been no revisions to date. This cost has probably increased during the last twelve years notwithstanding improvements in structural steel techniques. The Chief of the Highways Division of the territorial government has presently brought up-to-date the cost estimates which were prepared for an engineering report for the bridge in 1958. The revised figure for a bridge is \$7,450,000. However, in comparing benefits, it has been considered advisable to use a higher figure than this to cover inflation to 1975 and other contingencies.

The reason for erring on the side of caution is that if any of the estimates used in this report are revised, it is unlikely that such a revision will reduce significantly the benefit/cost ratio. Thus, future cost revisions, unless of major dimensions, will not affect the conclusions in this report.

The source of the increase in gross domestic product is not discussed in this report. This is because to do so would involve the development of a detailed twenty-year plan for the Territories as an incidental part of the present study. The fact that it will increase is accepted as being part of government policy; the means by which it is achieved will have very little effect on the logic of the report.

A. CONCLUSIONS

1. It is government policy that sets the rate of economic development of the north. The justification for the bridge is based on long-term economic strategy rather than immediate cost/benefit considerations.
2. The objectives of the Government of Canada with regard to northern development are at present undefined. Given that there will be some encouragement to develop the territory, once started, the bridge will be a sound proposition by reason of accelerating the return on investment and so increasing the net present worth.

RECOMMENDATIONS

1. From the data available and estimates of probable development in the Territories, it is recommended that a bridge be built across the Mackenzie River near the Port Providence crossing.
2. Further consideration should be given to the bridge design. There is merit in using local labour and materials even though this results in a higher overall cost. The benefit would come from increased activity in the territory, which would reduce external input and afford an opportunity to develop local industry.

B. PRELIMINARY CONSIDERATIONS

Set out below are certain basic considerations which give the context of the present discussion concerning the bridge.

1. Significance of Yellowknife Staging Post.

By a combination of logistic considerations, opportunity and chance, Yellowknife has become the staging post for access to about half the area of the Northwest Territories.

This is because, if all other factors are equal, the cost of air transport is from three to five times as expensive as road haulage. Thus, most goods are transported by road or rail as near to their destination as possible before loading to aircraft. Yellowknife gives the most economical route for much of the traffic originating in the south and destined for a large part of the territory, including the western edge of the shield.

The increasing pace of geological exploration and mining activities in the Northwest Territories has provided the opportunity for the development of commercial charter airline services from Yellowknife. The recent decision of P.W.A. to base its Hercules fleet at Yellowknife is merely an indication of the trend which is growing and may be considered as the start of a new era in territorial development.

This development of Yellowknife has continued despite the inconvenience and expense caused by the closing of the crossing. Operators find it more profitable to work out of Yellowknife, gaining a saving of about \$2.86 per 100 lbs., than to work from the south side of the lake. At the time of the break in the crossing, operations are transferred to Hay River (including supporting activities).

The gross domestic product for the area served by Yellowknife as a staging point is estimated to be \$25,000,000. At present there are no accurate statistics to confirm this figure but it is unlikely that it is very different. The true benefit from the crossing will depend on how it will affect this figure. This may be accomplished in three ways:

- (1) provide a service which would encourage mining operators to widen their activities so that the added value to the product is increased. On the other hand, if easier access encouraged them to make their

operational base narrower, that is, to transport ore rather than transport concentrate from the territory. Then this would be regarded as a disadvantage.

- (2) encouragement of secondary manufacturing industries to develop in the area. It is doubtful if these would be based on metal produced in the area.
- (3) encouragement of service industries to locate in the area.

2. Yellowknife as a Commercial Centre

Yellowknife became the territorial capital because of the existence of two gold mines and because of its usefulness as a staging post for air transportation to a section of the middle-north of the territory. The table below giving employment figures clearly shows this. The table is based on estimates to January 15, 1970, and accounts for over three-quarters of the total number of persons employed.

<u>Sector</u>	<u>Number Employed</u>
Primary industry - gold mining	636
hunting & fishing	50
Public sector	660
Transportation & communications	155
Service industry	643

The published reserve figures of Giant Yellowknife Mine indicate that if present conditions obtain, they will continue their local operation for at least five years. Cominco Mine have unstated reserves, probably adequate for ten years. The present conditions relate to continuance of Emergency Gold Mining Assistance (EGMA) which both mines now receive, steady labour costs, and world gold prices remaining at present or higher levels. There is serious doubt concerning the indefinite continuance of EGMA, especially when regard is paid to the apparent success of Special Drawing Rights (SDR), a recent introduction to assist international liquidity. Labour costs have been rising at a disproportionate rate in Canada over recent years and the pay scales quoted at the mine are not in the upper range for wage earners; thus it is probable that labour rates will increase. Stability in the price of gold is related closely to those factors which would influence the phasing out of EGMA.

It is probable that variations in any of the above factors are likely to adversely affect the profits of the two mines. The ore grading of .71 oz. gold per ton is not sufficiently high to absorb substantial additional costs.

If the Carter Commission proposals are put into effect, it is very probable that there will be severe cutbacks on exploration. Consequently, it is unlikely that future mines will replace those running to the end of their lives. For the same reason the transport and communications sector will substantially diminish.

Industrially, the Mackenzie area of the Northwest Territories may be broadly divided into three sections which have growth potential:

- (1) the Mackenzie Valley, including the Delta, and the oil-rich triangle to the south bounded by Fort Nelson, Fort Simpson and Fort Providence. This area is served by winter roads to Fort Simpson, where there is an airfield, and an open road off the Alaska Highway east of Dawson.
- (2) the Pine Point and Hay River areas which have road access.
- (3) the area which extends north of Yellowknife and is contained by approximately longitude 105° to 120°. The effects of the bridge on the economy will diminish going northwards beyond the Arctic Circle. It may be noted that there is likely to be an out-migration from the Koevalin to this area over the next few years.

Development in the Mackenzie Valley will depend primarily on oil exploration and production which would not require a large labour force. The Pine Point and Hay River areas are responsible for the substantial increase in mining during the last ten years. The output of the Northwest Territories increased from \$15 million in 1960 to \$73 million in 1968.

The area to the north of Yellowknife is where the next substantial mining development is likely to take place. It must be borne in mind that whereas oil production requires practically no labour, other than in its initial phase, mineral production employs a relatively large labour force.

The population and ethnic group of the area served by the crossing is shown in Appendix 1. The effect of the crossing will have different results both in nature and magnitude on different settlements. The nature of the effect will broadly fall into two classes: reduction in cost of living and increased rate of economic development. The size of the effect will depend largely on geographical location. It must be emphasized that certain settlements, for example, Liard, will only be marginally affected.

3. Indigenous Peoples

There are about 4,300 Indians and 2,400 Eskimos living in the area affected by the closing of road access. Some are directly affected, for example, those living in Yellowknife or Rae; others in Rae Lakes are indirectly affected, whereas most Eskimos are only remotely affected. It is this segment of the population which suffers most from isolation. The effect of the semi-annual increases in food prices on a well-paid government official in Yellowknife may be disregarded; the effect of an 8¢ increase on a can of beans for a poor Indian family cannot be ignored. To these poor people there exists twice a year a situation whereby many staple foods, particularly perishables, become unattainable luxuries.

Government measures during the last few years have included building permanent homes and providing health services for indigenous people. In the past the people were mobile and able to move to new hunting grounds if the local resource diminished. The bands are no longer inclined to move from their permanent locations. The population is currently increasing at a rate greater than ever before in the history of the people. Thus the balance between population and adequate local food resources is being upset and projections into the future indicate a rapidly deteriorating situation.

A generation ago an Indian or Eskimo could be self-sufficient and variations in food prices did not cause undue hardship. Today he is becoming increasingly dependent on imported goods for a substantial part of his nutrition. As there are practically no opportunities for an indigenous person to increase his income, it is essential to his welfare that there is price stability. There is no realistic alternative to these people at present.

It may be noted that the rate of population increase, excluding that caused by immigration, is between 3.0% and 4.0% per annum. Unless some action is taken soon, the problems associated with the indigenous people will become of unmanageable proportions.

4. Traffic Volume on Edmonton-Yellowknife Route

The justification for an all-weather crossing does not depend on historical need. The requirement depends largely on future development which, in turn, will be affected by the existence of the bridge.

There is very little information available relating to traffic patterns or volumes in the past and there is no reasonable way in which these figures can be obtained with any degree of confidence. The only figures which have a factual base are those summarized from the ferry boat log (Appendix II). These figures relate to the summer crossing only. In order to obtain a figure which may be used, it has been assumed that:

- (1) commercial vehicle activity will remain constant through summer and winter. This was indicated during conversations with the two principal truckers.
- (2) approximately half the vehicles classes as commercial will be haulage trucks. The rest will include small trucks and pick-up wagons.
- (3) private vehicles will be about half the peak in the summer.
- (4) buses will remain constant throughout the year.

From the data given and accepting the above assumptions, it can be inferred that the volume of traffic throughout the year will be:

Commercial and buses	-	900	per month other than
			at freeze-up
Private motor vehicles	-	400 ²⁰⁰⁰	per month other than
			at freeze-up

Assuming 20 tons per truck and a 5% back haul, the weight of freight moved will be about 45,000 tons per year. It must be emphasized that these figures are only estimates. It is recommended that a more comprehensive traffic census be maintained in future.

5. Tourism

The effect of a bridge on the revenue to be obtained from tourism has not been taken into account in this report, as it is not possible to do so with any degree of accuracy.

The principal effect of a bridge on tourism is that it would extend the season and allow caravans across which would otherwise be discouraged due to the low-transport capacity of the ferry. There is little doubt that the number of tourists to visit Yellowknife would be substantially increased if a bridge were built. Their total impact on the economy is, however, equivocal.

C. BENEFITS

The benefits to be derived from a permanent crossing are directly related to the rate of growth of the Territories. It must be emphasized that the dominant requirement for a bridge is the need for reducing operating and expansion costs in developing the Territories.

For every additional family locating in the area, there is a need to transport from 200 to 300 tons of freight, whereas once they are settled, their in-bound freight is no more than 2 or 3 tons per person per annum.

In assessing the benefits, it has been assumed that there will be some expansion of the economy. The most significant contribution which a bridge would make is that it would increase incomes by assisting in the development of the economy. Other benefits, such as reducing the cost of living, are substantial but are insignificant compared with other factors.

For simplicity, the benefits have been described under three headings: (1) increased income from the development of the economy (2) gain in real income by cutting costs (3) intangible benefits.

The precise relationship between national betterment and the outcome of a bridge construction can never be determined. The proximate criteria which are used in this report can only measure the magnitude of the benefits.

I. Increased Income from Development of the Economy

A bridge is an essential part of the communications network, which is just part of the infrastructure necessary to develop a broad-based economy.

The rate of increase of real income from primary industry depends on three factors: the existence of exploitable resource, the profitability of its exploitation, and the nature of the forward and backward linkages. The purpose of developing infrastructure is to improve the profitability of operations. Thus the existence of an adequate infrastructure is an essential consideration of companies planning to invest in an area.

As the effect of infrastructure on the decision process cannot be determined, the allocation of funds to such a project as a bridge must be based on a business judgement. That is, it will depend on whether or not the expenditure would result in sufficiently increased income to the area. Increased income is more likely to occur by encouraging companies to increase "added value" to products than by assisting them merely to extract more raw materials. The higher the added value within the territory, the greater the contribution will be.

The business judgement described above cannot be isolated from the total situation. It is entirely dependent on the answers to two questions: first, whether the area has exploitable potential and, second, if there is a serious intention on the part of the government to assist in its development. Given an affirmative to both these questions, it is simply a decision of not whether to build a bridge but when.

It may be noted that about 40% of the U.S. foreign aid programme is devoted to improving transportation facilities. It is generally acknowledged that good transportation facilities are a prerequisite to the growth of under-developed areas.

The value of an increased rate of growth of gross domestic product is easily calculated. It may be noticed that for normal growth, that is exponential expansion, an increased rate of growth is equivalent to bringing forward the time when the asset yields a return.

In order to quantify the effects of the value of increased rate of growth, certain assumptions have been made. In the absence of statistical data, an estimate of the gross domestic product of the area served through Yellowknife has been made, and it would appear that \$25,000,000 is a reasonable figure.

The net present worth of the benefits which will accrue from the effect of a bridge on the development of the area has been calculated. For this, the relatively simple model shown in Appendix III has been devised. The current government discount rate of 8-7/16% has been used, a figure considerably higher than that which would be used to justify public works either by the U.S. EDA or the World Bank. The latter agencies use 5% and 4 1/4% respectively. A high discount rate lowers the net present worth of the benefits from a project and thus places a much more stringent test on the benefit to cost ratio.

The model develops the relationship between the benefit to be derived from the bridge and the increased rate of development of the area directly or indirectly affected by the construction. The bridge will have a persistent effect on the area for at least 20 years; circumstances of the area after 40 years are unpredictable. The calculations have therefore been confined to 20- and 40-year expected useful life spans.

It can be readily shown that a one-half per cent additional growth rate in the g.d.p. of \$25,000,000 within the area affected by the bridge has a net present worth of \$9,671,000 if discounted at 8-7/16% over 20 years and \$16,936,000 over 40 years. Thus, if it is considered a worthwhile expenditure of public funds to obtain a dollar for dollar improvement in g.d.p. from an infrastructure investment, the modest increase of one-half per cent per annum described above will justify the expenditure. It should be noted that if a discount rate for a public works project of this type were to be set at 5%, then the effect on the rate of development would not need to be more than one-quarter per cent to justify the expenditure.

2. Gain in Real Income by Cutting Costs

Although these gains are the smallest of the three sections under consideration, they are the most easily identified. There are two broad categories: first, savings which are calculable and, second, those which can only be estimated.

Using Yellowknife as a basis, the directly calculable annual recurrent cost savings are about \$400,000 per year. The basis of this figure is given in Appendix IV. It will be noticed that although there are certain elements of fixed costs in this figure, that is, no variation with small changes in population, these elements will not remain fixed for substantial changes in population. Thus, this figure may be prorated to a population of 12,000 to about \$750,000 per annum.

However, there are certain other cost savings which must be added to this figure. These are savings of costs that are non-recurrent and unpredictable but are nevertheless substantial. One example of such costs is the case of a ball mill trunnion on order for Con Mine this year. It is due to arrive at about the time of the break-up. If the present trunnion fails when the crossing is closed, the mine will stop production, which would result in a cost of \$120,000 if it were out for 20 days. Historical data are not available to estimate the probability of such occurrences, yet some account must be taken of difficulties of this type.

A further example of occasional costs which arise is the ten apartments being built for mine staff and which will be completed at the time of the break-up. They will have to remain vacant until new staff can move their possessions up. Meanwhile the staff will have to be maintained in hotels.

Local businessmen cited other instances of occasional additional costs. Johnson's had a claim for \$800 for broken glass as a result of being brought in by air because delivery was late and freeze-up had started; Giant Yellowknife Mines nearly ran out of cement used for stabilizing hydraulic fill in slopes and was close to mining waste rock for fill; Northwest Territorial had to fly in an aero engine. These and other small expenses could be eliminated if firms improved their planning and scheduling, but firms are inevitably going to schedule incorrectly at some time. The effect of the break-up and freeze-up is to increase substantially the effect of small errors.

The costs of transfer of support functions for aircraft maintenance which are moved to Hay River twice a year are not considered because the effect on the Northwest Territories is practically the same whether the work is done at Yellowknife or Hay River.

There is another hazard which must be taken into account, namely, that ferrymen may decide to withdraw their labour. If this were to happen, or if the ferry were wrecked, the cost to the city would be very substantial. A four-week strike might cost the city \$100,000 in air freight.

To put a dollar figure on the occasional elements would require substantial statistical data. It is customary in cost/benefit studies to put a minimum figure on such costs. This may be merely a fraction of the actual cost but it is the only way to compare several projects. A minimum figure would be no less than \$20,000; the actual figure may be substantially higher.

3. Intangible Benefits

The intangible benefits cannot be quantified into dollar terms. They include all those items which have a sociological or psychological impact on the community. There are quite evident social costs in not having continuous road access to the south. For example, the irritation and hostility of citizens towards merchants for raising prices may or may not be justified but it is still there.

There are additional constraints on planning family holidays which probably have no adverse effect. However, if the constraints are related to feelings of neglect, there will be some social cost involved.

The effects of isolation during the freeze-up and break-up period are difficult to evaluate. Discussions with personnel and local managers of mines and stores indicate that little cognizance has been taken of this factor in setting salary levels.

Perhaps the reason is that new staff frequently do not know of the semi-annual, six-week break in road communications and, as one manager expressed it, "after they have been here for a year they have got used to it". The uncertainty of the crossing restricts the times of taking leave.

There appears to be no salary compensation for the period of isolation, nor does any appear necessary. There is no lack of applicants for posts in Yellowknife. For example, the hospital, which does not have a physiotherapy department, has had four inquiries during the last six months from physiotherapists. Hospitals in other areas are having to close down their physiotherapy departments because of difficulties in procuring staff.

Labour turnover in the public sector would be a measure of dissatisfaction with conditions. The high rate of recruitment, however, makes it difficult to make a useful assessment of turnover.

There is a further benefit which is not easily defined but which will have a definite effect on the economy and the development of the area. The ratio of the size of the service industry to the population is at present lower than is desirable to many residents. As the quality of life is to a large extent dependent upon adequate services, it is of considerable importance to any area desirous of attracting industry or settlers that it should have a satisfactory ratio.

D. BRIDGE DESIGN

The preliminary design study was based on standard steel through-spans. There is little question that the design suggested has advantages of simplicity, economy and ease of construction. Before any decision is taken to proceed with a project of this size, it is suggested that the Government of the Northwest Territories should consider using local labour materials.

There is no foreseeable possibility of iron or steel production in the Territories but there does appear to be a possibility for the manufacture of portland cements. The raw materials, limestone shale and fuel, are available in reasonable proximity. Cement is currently used by the mines in back-filling stopes. The oil industry uses substantial quantities in both exploratory and production wells. In addition, a cement plant located in the Great Slave Lake area would benefit from attractive back-haul rates to northern Alberta markets. Local manufacture of cement could substantially reduce construction costs.

Use of precast concrete beams could provide an initial market for a local plant and also provide the possibility of upgrading local skills through establishment of an on-site pre-casting plant in the Fort Providence area.

A study in 1958 by Structural Engineering Services Ltd. showed a price of about \$6.2 million. A cursory examination of the estimates suggests that some of these costs may be too high. For example, the estimate per cu. yard of concrete is \$110. It is not clear how such a high figure was obtained.

The 1958 report limits the location of the bridge to a region close to the existing ferry and ice bridge crossing. The only argument against taking advantage of the shorter span and higher banks at Fort Providence appears to be the ice speed and height. It would appear that the ice reaches 15 - 20 feet in height and local opinion suggested a 30-foot height was possible. However, it is desirable that the bridge should be 75 feet to allow passage of boats without having to dip their radar antennae.

Additional strengthening of the piers would be costly for this location as it could not be covered by a single span. The 1958 report does not make any estimate of the difference in cost of the Fort Providence route.

The route through Fort Providence would increase the road distance by about 7 miles but would direct the traffic to a less winding route. The cost of the extra distance based on 1969 ferry crossing figures would be:

$$\begin{array}{rcl}
 7 \times 900 \times 22\phi & = & \$1,386 \\
 + \quad 7 \times 1000 \times 15\phi & = & \underline{1,050} \\
 & & \$2,436.
 \end{array}$$

that is, about \$2,500 per ^{month} ~~year~~.

APPENDIX IPOPULATION AND SETTLEMENT
AFFECTED BY BRIDGE

<u>DIRECTLY AFFECTED</u>	<u>Population 1970</u>	<u>Ethnic Group</u>
Rae	1150	I
Yellowknife	5785	W
Yellowknife Indian Village	60	I
Fort Providence	460	I
 <u>INDIRECTLY AFFECTED</u>		
Resolute	159	E
Gjoa Haven	243	E
Bathurst Inlet	50	E
Cambridge Bay	654	E
Contwoyto Lake	25	E
Coppermine	553	E
Hyslop Lake	50	I
Holman Island	70	E
Lac La Martre	168	I
Pelly Bay	179	E
Rae Lakes	80	I
Shane Lake	50	I
Trout Rock	30	I
Spence Bay	350	E
Thom Bay	60	E
Echo Bay	100	W
Coppermine	197	W (itinerant)
 <u>MARGINALLY AFFECTED</u>		
Wrigley	170	I
Fort Liard	156	I
Jean Marie River	50	I
Nahanni Butte	68	I

APPENDIX 1
(Cont'd.)

<u>MARGINALLY AFFECTED</u>	<u>Population</u> <u>1970</u>	<u>Ethnic</u> <u>Group</u>
Colville Lake	100	I
Ft. Franklin	249	I
Fort Good Hope	354	I
Fort Norman	236	I
Fort Simpson	750	I/W
Norman Wells	287	W
Paulatuk	57	E
Reindeer Station	79	I/E
Sach Harbour	60	E

APPENDIX IIVEHICLES CROSSING MACKENZIE RIVER1963

<u>Month</u>	<u>Private</u>	<u>Commercial</u>	<u>Buses</u>	<u>Miscellaneous</u>
May	272	123	10	15
June	833	258	26	90
July	1156	264	26	122
August	1158	296	27	169
September	783	277	25	71
October	548	318	27	72
November	<u>168</u>	<u>80</u>	<u>14</u>	<u>20</u>
	4918	1616	155	565

Grand Total 7254 vehicles

1966

<u>Month</u>	<u>Private</u>	<u>Commercial</u>	<u>Buses</u>	<u>Miscellaneous</u>
May	102	40	0	19
June	1009	367	28	76
July	1524	387	30	171
August	1495	439	26	167
September	1244	378	26	145
October	801	545	22	95
November	<u>8</u>	<u>42</u>	<u>0</u>	<u>0</u>
	6183	2198	132	673

Grand Total 9186 vehicles

1969

	<u>Private</u>	<u>Commercial</u>	<u>Buses</u>	<u>Miscellaneous</u>
May	223	102	1	15
June	1631	898	31	208
July	2321	793	33	318
August	2224	817	28	230
September	1573	1034	28	136
October	1277	1172	30	111
November	<u>195</u>	<u>363</u>	<u>8</u>	<u>27</u>
	9444	5179	159	1045

Grand Total 15,827 vehicles

APPENDIX III

BENEFIT DERIVED FROM ENHANCED UTILITY
OF EXISTING RESOURCE

- G = gross domestic product for the area affected
- B_n = benefit obtained in year n
- $B_{\bar{n}}$ = benefit in year n discounted to net present value
- r = rate of increase in gdp directly attributable to bridge
- d = current discount rate - 8-8/16%

then $B_n = C \left[(1+r)^n - 1 \right]$

$B_{\bar{n}} = C \left[\frac{(1+r)^n}{(1+d)^n} - \frac{1}{(1+d)^n} \right]$ total benefit = $\sum_0^{n=n} B_{\bar{n}}$

from which may be derived the following values:

r =	1%	3/4%	1/2%	1/4%	
20 yrs.	\$ 19,874,500	14,704,300	9,671,180	4,770,800	d=8-7/16%
40 yrs.	35,511,500	26,007,300	16,936,600	8,274,710	C=\$25,000,000
indefinite	43,279,100	31,402,200	20,274,300	9,827,610	
20 yrs.			14,274,300		d=5%
40 yrs.			33,302,200		C=\$25,000,000
indefinite			58,329,800		
20 yrs.	7,949,800				d=8-7/16%
40 yrs.	14,204,600				C=\$10,000,000
indefinite	17,311,600				

APPENDIX IV
SUMMARY OF GAINS IN REAL INCOME
TO BE EXPECTED AT PRESENT LEVELS

<u>Sector</u>	<u>Description</u>	<u>Savings</u>	
		<u>Annual Basis</u>	<u>All Time Basis</u>
Primary industry	Giant: stores	\$ 7,200	
Mines	Con: stores	1,920	
Service industries	Additional warehousing		
Retail	space		360,000
	Additional air freight costs	21,375	
	Additional inventory costs	10,000	
Transport	Grimshaw	40,000	
	Byers Transport	15,000	
	Byers additional claims	3,000	
	Cost of Grimshaw/Byers bridge	1,000	
Exploration	Additional charges for 50 days	142,500	
Cost of maintaining ferry		108,526	
Cost of ice bridge		<u>1,000</u>	
		351,521	
Warehouse savings - \$360,000 at 10% capital cost		<u>36,000</u>	
		<u>\$ 387,521</u>	

APPENDIX IV (Cont'd.)

The following gains in real income are based solely on Yellowknife. It would be unwise to attempt to prorate these figures for other areas because conditions may vary considerably. However, the figure of \$350,000 derived from the foregoing calculations should be regarded as a minimum figure.

PRIMARY INDUSTRY - MINES

Discussions were held with the general managers and storemen of the two major mines close to Yellowknife. The average total inventory of stores was determined and also the build-up of inventory prior to the two periods when access by road is not possible. The cost of holding the excess inventory for the period of the interrupted crossing was calculated at a discount rate of 10%.

On this basis the cost of carrying excess inventory at the mines is: Giant Yellowknife - \$7,200 and Con Mine \$1,920 per annum.

COST OF ADDITIONAL RETAIL SPACE TO CARRY STOCK

Sales per square foot are probably about \$60.00 per annum and the estimated total actual selling space about 300,000 sq. ft. The stores will not increase their inventories in direct proportion to sales requirements over the "no access" period for this, in effect, would mean 100% extra stock. Holding stock figures were not available from merchants. Therefore an estimate of 20% was used. This assumes that there exists in the town about 30,000 sq. ft. of warehouse space at a capital cost of \$12.00 per sq. ft., equivalent to an investment of \$360,000.

ADDITIONAL AIR FREIGHT COSTS

This figure is based on the tonnage expected to be shipped during the road closure and which is freighted by air.

ADDITIONAL INVENTORY COSTS AT RETAIL LEVEL

This has been calculated on the assumption that retail stores will carry an additional 20% of inventory in the spring and fall.

APPENDIX IV
(Cont'd.)

TRANSPORT COSTS

Crimshaws

This company shuttled 650 tons across their own bridge between November 22, 1969, and January 12, 1970. The rate was \$6.63 per 100 lbs. compared with their Edmonton-Yellowknife charge of \$4.00 per 100 lbs. Thus the cost over and above regular transport methods was:

$$\$(650 \times 2.63 \times 22.4) = \$38,293 - \text{say, } \$40,000$$

Byers

The general manager of this company estimated their charges at \$15,000. This figure is probably low.

EXPLORATION

A discussion was held with Mr. Engle of N.W.T.A. He estimated that about two and a half loads per day, on an average, had to be shipped by Hercules aircraft from Hay River instead of from Yellowknife at break-up and freeze-up. If this period is about 50 days, the additional cost of \$2.69 per 100 lbs. by aircraft amounts to \$142,500. This takes into account the difference in mileage by air and road and assumes a one-way haul by Hercules.

It should be noted that these figures refer to loads not destined for Yellowknife.

FERRY COSTS

As shown - \$108,526.

It should be noted that the charges have been slightly underestimated due to:

- (1) the ferry costing only \$162,500 as it was secondhand.
- (2) the return on debt being based on historical figure of 5.37%.

APPENDIX IV
(Cont'd.)

(3) the "equity" return being set at 7.5%.

NOTE: The costs do not include the preparation and maintenance of the ice bridge.