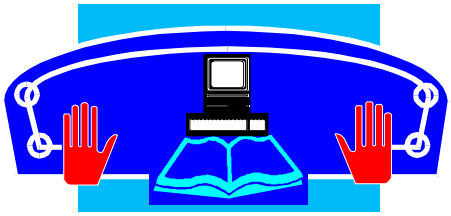

Possible Environmental Disruptions From An Arctic Islands Gas Pipeline - Preliminary Report

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Possible Environment Disruptions from an Arctic Islands Gas Pipeline

Preliminary Report 1977

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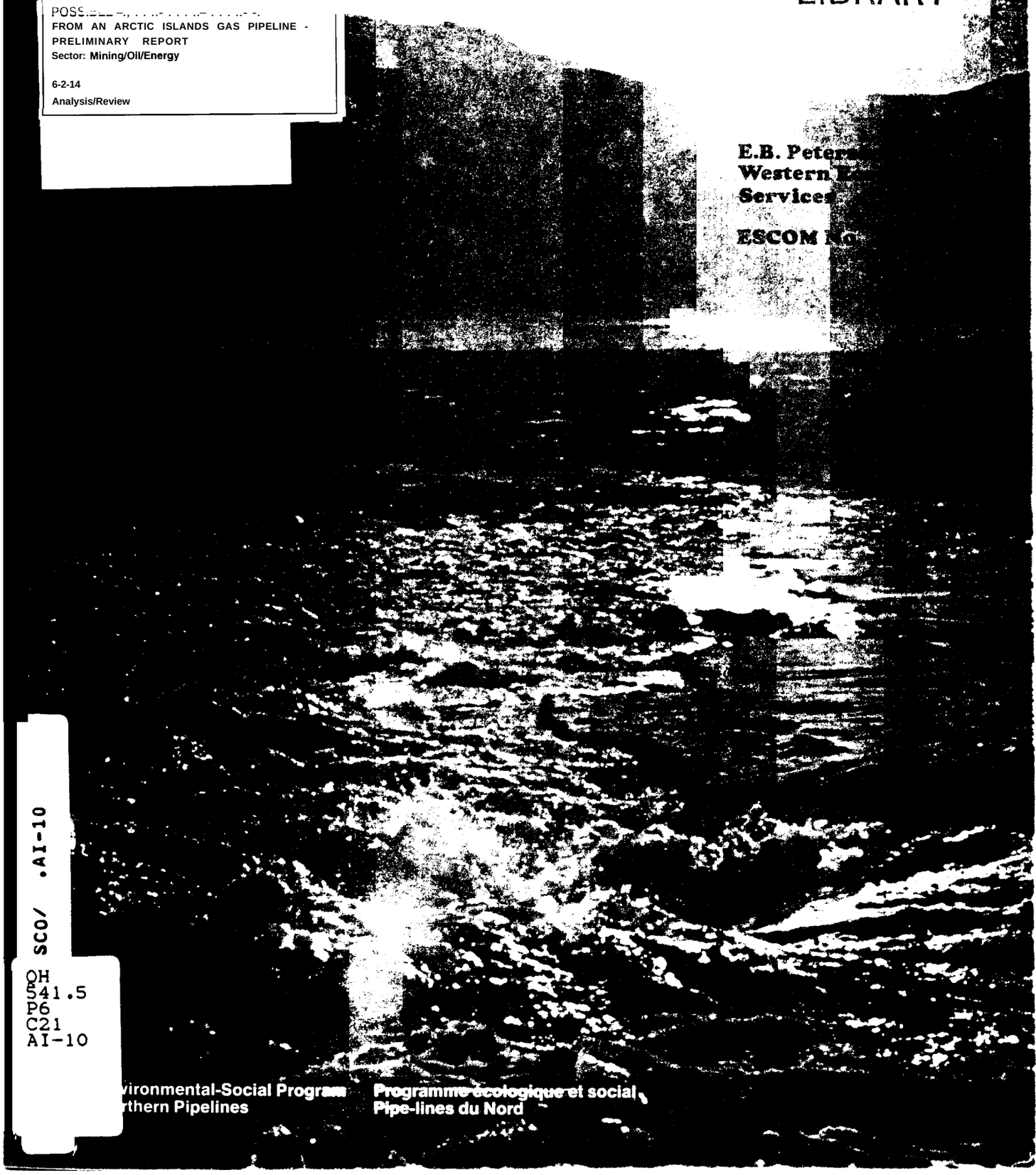

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AIPP PRELIMINARY REPORT 1977

Possible Environmental Disruptions from an Arctic Islands Gas Pipeline

Everett B. Peterson

Western Ecological Services Ltd.

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This report presents preliminary data and results obtained by Fisheries and Environment Canada for use by the Arctic Islands Pipeline Program. These investigations were carried out under the Environmental-Social Program, Northern Pipelines of the Government of Canada. While the studies and investigations were initiated to provide information necessary for the assessment of hydrocarbon transportation proposals, the knowledge gained is equally useful in planning and assessing other development projects.

Any opinions or conclusions expressed in this report are those of the author and are not necessarily shared by the Government of Canada.

POSSIBLE ENVIRONMENTAL DISRUPTIONS FROM AN ARCTIC ISLANDS GAS PIPELINE

PART I:

Arctic Islands to Longlac, Ontario - July 1976

PART II:

Spence Bay to Mansel Island, Northwest Territories - March 1977

PART I :
Arctic Islands to Longlac,
Ontario
July 1976

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1. General Purpose and Approach in this Study

The purpose of this study was to prepare maps and legends that could assist the planning of Environment Canada's (DOE) 1977 field studies along the proposed Polar Gas pipeline route from Ellef Ringnes and Melville islands to Longlac, Ontario. Route alternatives involving Prince of Wales Island, Southampton Island, Quebec and central Manitoba were not considered here. The first steps were to consider readily accessible existing information on terrain and wildlife characteristics along the route, and then to summarize the expected influences of a chilled gas pipeline upon these physical and biological features of the route. The next step involved a personal judgement on the possibility of avoiding the identified interactions between environmental features and pipeline activities. From this a list of predicted unavoidable consequences emerged. These remaining concerns were taken as the prime subject areas or geographic areas for additional research effort in 1977. In addition, some general criteria to aid identification of the most important environmental concerns are presented in the concluding part of this report. The specific terms of reference for this study are attached in Appendix I.

2. Assumptions Made About Proposed Pipeline Project

It was assumed that the proposed gas pipeline would be buried and would be chilled at least to the southern limit of continuous permafrost. It was also assumed that all inter-island crossings would involve tunneling that would avoid the immediate coastline and would bring the pipeline onto the sea bed at about 150 ft (45 m) below sea level; for some narrow channels a complete island-to-island tunnel would result. In making judgments about the potential to avoid problems at stream crossings it was assumed that such crossings could be either buried or bridged. Finally, it was assumed that the presently proposed prime route was not fixed, so that avoidance of

expected problems by route changes was a realistic opinion. The option of avoiding all expected environmental problems by shelving the entire project proposal was not considered in this task.

3. Sources of Information

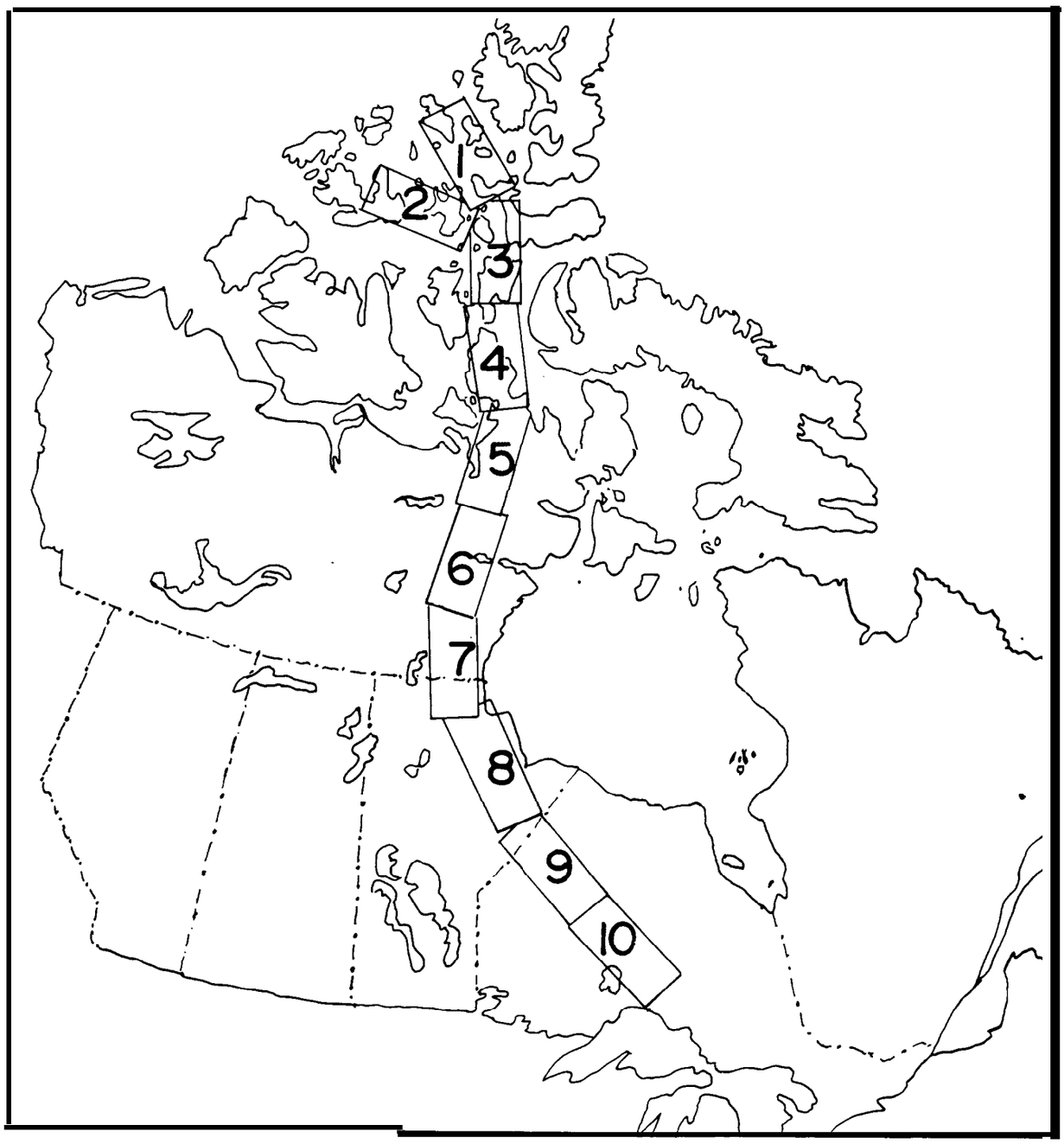
The presently proposed route was placed on maps from information recently provided to the Environmental Management Service by Polar Gas. From Ellef Ringnes and Melville islands to Spence Bay and from the Caribou River, Manitoba, to Longlac, Ontario, this route was taken from a Polar Gas map at a scale of 1:4,000,000. From Spence Bay to northern Manitoba a much more accurate route map was available from the 1:100,000 photomosaics used in the Corridor Terrain Maps, District of Keewatin, prepared for Polar Gas by R.M. Hardy and Associates Ltd.

For environmental information along the proposed route, primary emphasis was given to mapped information but a large number of technical reports were also checked. The latter included unpublished 1976 reports prepared by DOE researchers on the basis of 1975 pipeline-related studies between Spence Bay and the Sabine Peninsula.

All sources of information are listed at the end of this report, numerically in the order that they were used to compile maps 1 to 10. The second column of each map legend identifies by number the sources of information for any given row in the legend. Where no numbers appear in column 2 of the legend, the information in that row is based on the judgement or knowledge of the contractor.

4. Methods of Summarizing Available Information

The proposed prime route was divided into 10 segments (Figure 1) each approximately 250 mi (400 km) long and 125 mi (200 km) wide. On each map sheet the proposed pipeline route appears approximately as a centre line which was arbitrarily divided into 50-mi (80-km) segments, a common length of a pipeline spread during construction. These five 50-mi (80-km) segments on each map sheet coincide with five vertical columns in which the information is summarized.



1. Index map for maps of proposed gaspipelinefrom Arctic Islands to Longlac, Ontario.

The original request from the Arctic Islands Pipeline Study Board was to consider an assumed zone of influence 100 mi (160 km) wide (50 mi (80 km) on either side of the route). This was changed to include the entire map sheet as the "assumed zone of influence". In either case, this is a very arbitrary - "zone", especially for migratory species or for things that move with water or air masses. It must be stressed that the "zone of influence" considered here (the map width of about 125 mi (200 km) is not intended to imply that this is the expected zone of "biological influence" of the proposed project. In a broad sense, defining the zone of influence is itself a high priority research need in proposed projects of this kind.

For items 1.2, 1.3, 1.4, 1.6 and 1.7 in the first column of the legends the emphasis is upon features that are directly intersected by the route. Similarly, for items 2.2 to 2.6 under environmental concerns the emphasis is upon features directly in the path of the route. In contrast, the word "zonal" in item 1.5 refers to features that occur anywhere across the width of the map sheet for any given 50-mi (80 km) segment of route; item 1.8, special environmental features, can also be located anywhere across the width of a map sheet and in a few cases, such as the McConnell River Migratory Bird Sanctuary, features off the map sheet are also mentioned. Similarly items 1.1 (physiography), 2.1 (water quality), 2.7 (wildlife harassment), and 2.8 (resource-use conflicts) were considered more on a zonal basis rather than a right-of-way basis.

4.1 *Environmental features*

Environmental features could not be comprehensively described in tabular form for any given 50-mi (80 km) segment. Any environmental features, such as climatic parameters, that were unlikely to have distinct section-to-section variations were excluded. There was also an arbitrary decision to exclude marine environmental features because of the assumption that pipelines would either tunnel the channels or emerge onto the sea bed at a considerable depth. This does not mean that the project would result in no important changes to marine ecosystems; emphasis was simply placed on terrestrial ecosystems because there is no information available yet on marine and coastal locations that would be proposed for supply and staging facilities. Marine

mammals that interact with the land (polar bears, seals, seabirds) were considered in the immediate vicinity of the proposed route on land, but the geographic area of research interest for marine species should be broadened when locations of proposed marine industrial activities are known.

Within the categories used for portrayal of environmental features and environmental concerns, comments were limited to those items judged to be of most importance. The main criteria used in this judgement are outlined in Section 6 of this report. For example, loss of habitat used by muskoxen, migratory waterfowl, or polar bears is a feature that would have been identified, whereas loss of habitat important for lemmings or passerine would not have been listed.

For surficial materials (item 1.3) notes were restricted to those features thought to be most relevant to engineering activities. For example, in the first 50-mi (80-km) section of Map 2 (Melville Island) only the Christopher Shale is mentioned because it presents the greatest problems for summer travel; less sensitive sandstones that occur in the same area are not mentioned. From the Keewatin terrain analysis atlas, of the many landforms, materials, topographic units and drainage classes mapped the only ones singled out were the ones judged to be the most unstable or sensitive: active floodplains, colluvial complexes of slopewash and rillwash; talus and rockfall slopes; slumps; flow-slides; lake plains; dunes, all organic terrain; clay and clay-silt mixtures; patterned ground areas; highly dissected landscape resulting from surface run-off; areas that are wet most of the warm season; horesetail drainage pattern; actively eroding gullies; thermokarst depressions; and areas with a high water table. The more stable landforms mapped in the Polar Gas terrain atlas were not identified on these maps and legends.

In summary, the environmental features identified in items 1.1 to 1.8 of the legends were held down to a manageable level by a rigid, but often arbitrary, selection of only those features that were judged to be the basis of environmental concerns (second part of legend).

References are provided for most of the environmental features (column 2) and this section of the legend relied mainly on maps and reports, and very little on the personal experience of the contractor.

4.2. *Environments l concerns*

A selection similar to that described for environmental features was used to restrict the environmental concerns to those thought most important. These concerns were drawn from reports wherever possible but an increasing degree of judgement on the part of the contractor was involved in this part of the map legend.

4.3 *Potential for avoidance and residual impacts*

These two sections of the legend were based almost entirely on the judgement of the contractor from a general knowledge of responses presented by Canadian Arctic Gas Pipeline Ltd. to comparable environmental concerns in the western Arctic. The possibility of routing changes, engineering design changes, and stringent regulation by responsible agencies were the bases for considering that some environmental concerns could be avoided.

4.4 *Research needs*

Although this section of the legend is largely the contractor's judgement, it incorporates suggestions for research that have been identified in various reports. In many cases, the judgement required a decision on where along the pipeline route a particular research activity would best be focused.

Research suggestions contained in DOE reports from 1975 field work along the pipeline route no doubt influenced the judgments presented, but the contractor had no discussions with the authors of these DOE reports nor with Polar Gas consultants who are also conducting field studies along the proposed route. Research needs were listed without a knowledge of 1976 field work presently underway.

There were two guiding principles used to narrow down the potentially large number of pipeline-related research topics. The first was to assume that DOE personnel would be required to comment upon the adequacy of the

Polar Gas application with the benefit of only one more season of field work (1977-78). Therefore, primary emphasis was given to research suggestions that could be reasonably undertaken in one year. The second guiding principle was that certain geographic areas are of such biological importance, and have such a high potential of resource use conflicts, that pipeline-related studies should be focused there and should also include scientific investigations that are not going to yield much useful information at the end of one year. This latter principle seems to be the minimum compromise to counteract what Schindler has termed the "impact statement boondoggle" (see Appendix II). In some places, for example south of Baker Lake, it was also suggested that studies should be designed to consider interactions between the gas pipeline and other industrial projects such as mine facilities that could be stimulated by a nearby energy supply. This apparent broadening of research that is supposed to be pipeline-related seems justified in situations where broad geographic areas of biological importance are concerned such as the migration routes and summer range of the Kaminuriak caribou herd.

5. Generic Concerns that are not Geographically Specific

This study was based only on a knowledge of the currently proposed route; information on likely locations of compressor stations, logistics bases, camp sites, or coastal staging areas was not available. These related activities will result in additional environmental concerns that cannot yet be geographically specified. In addition, certain concerns or research needs cannot be pinned down geographically even if all locations of proposed facilities are known. Research needs associated with: (i) contingencies (summer repair, accidental spills of hazardous substances); (ii) aesthetics (noise levels or restoration of local disturbances); or (iii) air quality (SO_2 levels) are all examples of topics that have no predictable priority along any given segment of the pipeline route. Generic concerns of this kind were omitted from the information summarized on the maps and legends and need to be considered as complementary requirements by those planning comprehensive pipeline-related studies.

6. -Criteria for Identification of the Most Important Residual Impacts

The steps used to prepare the legends have already resulted in elimination of many potential environmental concerns. Potential problems that were thoughtto be avoidable are not listed in the part of the legend that summarizes residual impacts. However, the lists of residual impacts do contain many predictions of water quality changes, drainage alteration, terrain disturbance, wildlife disturbance, and land-use conflicts. Such lists will be refined and amended as further studies are carried out but even more refined lists of predicted residual impacts at some stage face the question of whether the predicted effect is important enough to warrant an expensive research program.

The answer to this "So what?" question is as much political as it is scientific and it is difficult to identify research that would help answer this question. Probably the best approach in planning a research program in response to this question is to consider the external criteria that give particular environmental concerns more urgency. The following criteria were the main ones used to arrive at the judgments presented in the accompanying set of maps and legends.

(i) *International treaty obligations* - for example, it could be argued that more research effort should be devoted to the habitats-and populations of species for which Canada has treaty obligations (e.g. polar bears, migratory waterfowl) than to other species such as caribou, even though the latter may be of great economic importance locally.

(ii) *Interference with harvesting of biological resources* - for example, resource harvesting areas around Resolute, Spence Bay and Baker Lake create areas of more environmental concern than would be expressed for a comparable level of environmental disruption far from a settlement .

(iii) *Rarity of particular species* - rare and endangered species, as opposed to populations, and the habitats on which they depend are readily accepted criteria for extra concern and research effort.

(iv) *Habitat that is locally critical to the survival of particular species and, in some cases, populations* – for example the well-publicized high productivity of lowland meadows in the High Arctic and the importance of these areas of primary production in the entire food web make such ecosystems of above-average concern. Thus, destruction of 10 acres (4 ha) of lowland meadow vegetation would be highly significant in terms of the productivity base for the region but destruction of a comparable area of upland vegetation would not likely be judged as important.

(v) *Factors that influence the reproductive capability of populations* - just as chemical contaminants are judged to be more dangerous if they weaken the reproductive potential of a species so also should above-average concern be expressed for habitats that are necessary for reproductive phases of fish and wildlife life cycles. Thus, siltation of a stream, by itself, would likely be judged as an unimportant residual impact, but if the siltation damaged a freshwater habitat in which fish spawned it would obviously be considered important. For similar reasons, it is easier to answer the "So what?" question in cases where caribou calving grounds or goose nesting areas are involved than it is for habitats that are used only sporadically by these species for non-reproductive activities.

7. Summary of Research Needs as Presented on Maps and Legends

Users of the accompanying maps and legends should take them as an elementary inventory of possible environmental changes that could accompany the construction of a gas pipeline from the Arctic Islands. A critical review of this preliminary inventory is now needed from others who are familiar with the details of field conditions along various segments of the

route. To aid such a critical review the sections below summarize the contractor's opinion on geographic areas that deserve the most attention during the remainder of the study program.

7.1 *Geographic areas along route where most significant and controversial conflicts with biological values expected.*

Map 1	None
Map 2	Area between Sherard Bay and Eldridge Bay; Polar Bear Pass from Bracebridge Inlet to Goodsir Inlet.
Map 3	Stanwell-Fletcher basin and Creswell Bay area.
Map 4	Bellot Strait to Amituryouak Lake; Kangikjuke to Netsilik Lake.
Map 5	Inglis Bay to Franklin Lake
Map 6	Thelon River to Pitz Lake
Map 7	Maguse River crossing; Tha-anne River crossing; Seal River crossing.
Map 8	None
Map 9	None
Map 10	None

7.2 Geographic areas where inventory data should reobtained over a wider zone in anticipation of route alternative questions

Map 1	None
Map 2	Route alternatives that would avoid Polar Bear Pass.
Map 3	Route alternatives that would avoid Union River Peninsula.
Map 4	Route alternatives across Bellot Strait and past Spence Bay.
Map 5	Route alternatives in Inglis Bay to Hayes River area.
Map 6	Route alternatives that would avoid biologically important areas along Thelon River.
Map 7	Route alternatives that would result in least disturbance to Kaminuriak caribou herd.
Map 8	None
Map 9	None
Map 10	None

7.3 Geographic areas that call for special attention by some of the specific research *disciplines within Environment Canada.*

Hydrologic studies -

Map 5 – Sections from Inglis Bay to Franklin Lake.

Terrain and vegetation studies –

Maps 2, 3, 5 - Most sensitive terrain types with high content of fine textured material.

Wildlife inventory studies -

Maps 2, 3, 4 - Polar bear denning and summer sanctuaries;
Map 6 – Rare and endangered species.
Map 2 –Wildlife inventory for route alternative north of Polar Bear Pass.

Wildlife behavior studies –

Map 5 - Waterfowl harassment in Inglis Bay - Hayes River area;
Map 7 – Caribou behavioral responses to projected pipeline route.

Fisheries Studies –

Map 3 – Creswell Bay and Stanwell-Fletcher Lake area,
Map 4 – Spence Bay area.
Map 5 – Inglis Bay to Franklin Lake area.
Map 6 – Baker Lake area.

Marine Mammal Studies –

Map 3 - Aston Bay, Cunningham Inlet, Gamier Bay, Creswell Bay areas.
Map 4 - Bellot Strait area.
Map 7 – Seal River area.

Integrated long-term scientific studies, including water quality & hydrology baseline data collection -

Map 2 - Polar Bear Pass area.
Map 3 - Creswell Bay and Stanwell-Fletcher Lake area.
Map 6 - Thelon River - Pitz Lake area.

8. Associated Activities Beyond the Pipeline Route

Some of the most serious environmental disruptions and most pressing research needs are apt to arise from associated activities which are not yet known for the Polar Gas Project. Most questions of disruption to marine ecosystems and populations were omitted from this analysis because no details were available on likely industrial staging areas. Obviously if Aston Bay were to be a staging area, concerns for seal populations would be greater than expressed in this analysis; the same would apply to beluga in Cunningham Inlet.

Planning of research priorities and study locations for marine ecosystems requires, as a starting point, a prediction of the likely centres of industrial activity. Polar Gas has done this for the terrestrial part of the route but not for the staging and transport facilities that would occur at the land-sea interface. When such information can be obtained from the pipeline proponents, a comparable analysis should be done for marine habitats and populations.

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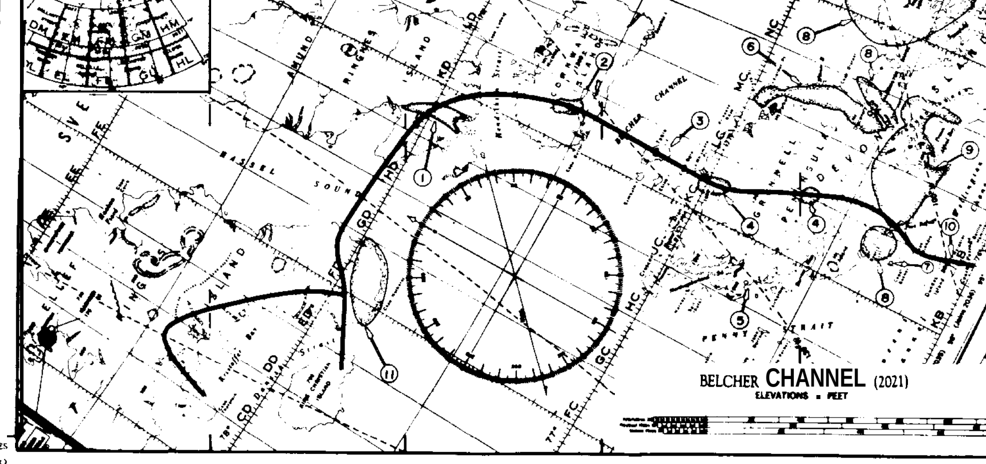
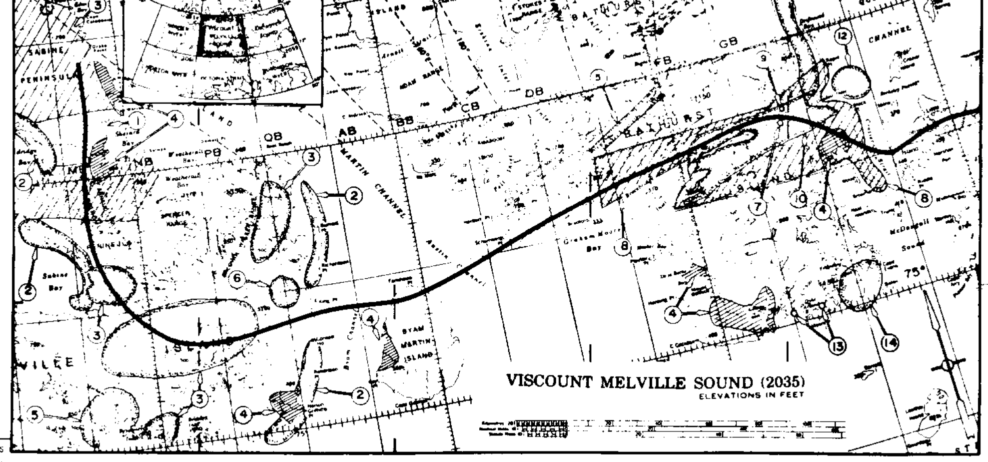


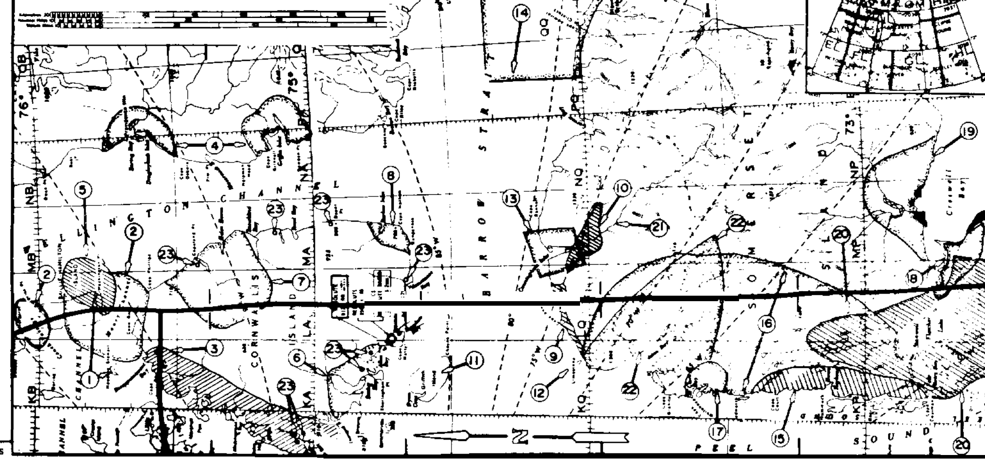
ENVIRONMENTAL FEATURES	REFERENCES (see text)					
... Physiography	1, 2	.owlands except for crossing on idge of Dome Bay anticline on Illef Ringnes	King Christian is scarped plain with coastal fringe of lowland plains; coastal lowland plain along route on Ellef Ringnes	Route crosses lowland plain on Amund Rin gnes; Cornwall coast .. flat with mudbanks; rest of Cornwal , hilly upland	Norwegian " , Lowlands for first 8 mi on Grinnell, then uplands with char. north-south orientat -	Upland with char. north-south orientation
Ground ice Potent ial (on route)	2, 3, .	'olygon pattern on most flat reas; massive ground ice 'ecorded in Isachsen area	Patterned ground evident on Ellef Ringnes section; such lowlands underlain by up to 55 cm massive ice	Ice content . . . . ..4 from slight to abundant on terrain sensitivit maps	High ice content in unstable slope S side of Ta ble Is (3), high ice content in colluvial - - - . Grinnell (,)	High ice content in colluvial are at north end of this section
: , Surfic ial n.,.,.,.,. (on route)	2	.ow broad interfluves develop. on hale; soft shale on Thor Is. 'ith colluvial coastal margin; arthflows in Isachsen area	Till rel. rare on Ellef Ringnes; in places up to 30 cm silt overlying grd. ice; coalescent floodplains along coast	Few firm rock outcrops on Amund Ringnes; several igneous dykes crossed on Cornwall; sensitive terrain crossed on Amund Ring. (1) and Cornwall (2)	Steep to gentle slopes of silt, sand and clay (4) and	Part of Cornwallis-Grinnell upland - intermittent colluvial areas; coastal cliff on Dundas Is.
. . River (on route)	1, 2	'ast Transection River crossing .s typical of several floodplains ubject to flooding and shifting hannels	Series of crossings over wide, braided, coalesced floodplains; streams have rounded banks; subject to flooding & shifting channels	Amund Ringnes crossing on broad braided floodplains; some Cornwal relief of 500 ft where streams cu ridges of upturned strata	Main crossing involves tributaries of Lyall R.	No major river crossings in this section
1 5 Fish & Wildlife (zonal)	5, 6, 7, 8,	nly 9 mammal species & 12 bird pecies listed for Ellef Ringnes s.	Very sparse wildlife on King Christian & Ellef Ringnes	Very sparse wildlife on - Ringnes and Cornwall	Gull colony at Hungry Bay (5) muskox on better vegetated areas of Okse Bay Formation around Fielder Pt. (6)	Muskox on vegetated Okse Bay Formation from Arthur Fiord North (6); gull colony near Cape Becher (7); polar bear areas (8)
1 6 Fish & Wildlife (on r-t.)	8, 9	o known wildlife concentrations n route	No known wildlife concentrations on route	No known wildlife concentrations on route	No known wildlife concentrations on route; polar bear range along south Cornwall coast; Caribou range on Table Is.	Port Refuge imp for beluga & harp seals & is edge of caribou range(9 gull colonies on Dundas and Margaret Is.
1 Vegetation (on ....)	1, 5, . 10 11, 12	.ll of Ellef Ringnes very parsely vegetated except in sachsen area	Any vegetation is localised in wet lowland pockets on Ellef Ringnes; max plant cover on King Christian about 50%	Some tundra cover mapped on sensitive silt-clay plain on Amund Ringnes (1)	No lush vegetation on route; Okse Bay Formation on E coast is best vegetated area on Grinnell	No lush vegetation intersected by route
1.8 Special Envir Features (incl. IBP sites, sanctuaries)	1, 13,14	outh bdry. of prop. IBP Site 1-1 une from Louise Bay to Louise 'iord; Isachsen Dome about 5 mi N f route	Malloch Dome on Kristoffer Bay about 3 mi SW of route: Hoodoo Dome 7 mi NE. Both are gypsum intrusions	Rare occurrence of pingos on central Amund Ringnes		
ENVI R CONCERNS						
2.1 Water	2, 11	Streams naturally silt laden creating deltas and mud flats; significant extra silt from project unlikely	Natural earthflows along streambanks common on Ellef Ringnes significant extra silt from project unlikely	atural siltat ion abundant; ignif icant extra silt from project ulikely	atural siltation abundant; ignificant extra silt from roject unlikely	Natural siltation abundant; significant extra silt from projec unlikely
2 2 Drainage Alterat -		Braided channels esp. on East Transection River, subject to flooding & channel shifting; disruption of braided streams possible	Project may disrupt natural geomorphic events in braided stream channels	sp. under t-,. soils are aterlogged . . near-sur face rainage disruption likely	odern delta and short alluvial loodplain of Lyall River likely be disturbed by route	No major drainage alterations expected
3 Terrain Disturbance	2, 10, 11,	Terrain difficult & sensitive when wet; significant terrain dist. possible where massive grd ice occurs	Signif. terrain disturbance possible where massive grd. ice occurs	ummer softening of fine-grained ubstrates is main terrain problem xpected	'innell has numerous scarps that rould maps identify for route voidance	Slope stability problems expected if Dundas Is. is crossed
2.4 Vegetati on Disturbance	10, 11, 12	In few pl . . . . *... vegetati - does occur on * U . , u,n . , Amund Rin and where vege tation is 10% or more cover it indica tes enough moistur horizontal ice I.,.,.,.; therefore such vegetated r..., indicate ., " . if ground ice exposed; vegetated usually under 100 ft² so " . .		es and King Christian for segregation of potential disturbance avoid	o significant vegetation isturbance expected	No significant vegetation disturbance expected
2.5 Migrat ion Disruption (fish , wildlife)		No signif. populations to disturb	No signif. populations to disturb	No signif. populations to disturb	o signif. populations to disturb	No significant disruption expected
, Habitat Loss (fish wildlife)		No signif. habitats present	Winter polar bear denning on South Ellef Ringnes is near proposed route (11)	No signif. habitats present	otential loss of caribou habitat ble Is.	No significant habitat loss expected
, Wildl ife Harrassment		No signif. populations to disturb	No signif. populations to disturb	No signif. populations to disturb	signif. populations to disturb	Potential harrassment of gull colonies
8 Resou rce Use Conflicts		None expected	None expected	None expected	ne expected	None expected
OTENTIAL FOR VOIDANCE						
.1 Water Quality		Increased siltation unavoidable if any construction during part of summer when soils are wet	Increased siltation unavoidable if any construction during part of summer when soils are wet	Increased siltation unavoidable if any construction during part of summer when soils are wet	ncreased siltation unavoidable f any construction during part f summer when soils . . . wet	Increased siltation unavoidable if any construction during part of summer when soils are wet
2 Drainage Alteration		Crossing of floodplains likely unavoidable	Crossing of floodplains likely unavoidable	Crossing of f loodplains likely unavoidable	yall River dra - alterati - ikely unavoidable	Significant drainage alteration should be avoidable
.3 .,.,.,.," , Vegetation		Difficult terrain when wet on Thor Is. prob. unavoidable by construction activities	Ellef Ringnes section gives more choice than Thor & King Christian to avoid soils that are difficult when wet	Unstable slopewash area on Cornwall (2) could be avoided by re-route	f Table I e . m., be .,.."d, carp and unstable slope on outh side unavoidable	Dundas Is. sensi tive terrain avoidable only if entire island . by-passed
. 4 Fish & Wildlife		Not applicable (....)	....	n.a.	n.a.	Edge of caribou range and gull colonies could be avoided by re-route if needed
.5 Resource ... Conflicts		||||	||||	n.a	n.a	.a.
SIDUAL IMPACTS						
, Wate r Quality		nil or low	nil . . low	nil or low	nil o rlow	nil or low
2 Drainage Alteration		Crossing of braided f loodplains will likely result in drainage alteration	Crossing of braided floodplains will likely result in dra inage alteration	Crossing of bra - floodplai ns will likely resul t in drainage alteration	nil or low	nil or low
3 Terrain ".8.,., ion		Soft shales and their waterlogged soils unavoidable if activity in wet season	Soft shales and their waterlogged soils unavoidable if activity in wet season	Soft h.,.,, and their waterlogged soils unavoidable if activity in	ble Is. south side likely . idable terrain disturbance	undas tes. side likely avoidable terrain d isturbance
4 Fish & Wildl ife		likely nil	likely nil	likely nil	likely nil	ikely impact on gull colonies n Margaret and Dundas Islands
5 Resource Use Conflicts		nil	nil	nil	nil	nil
SEARCH NEEDS		Verify if any wildlife concentrations on route; obtain present biological inventory as a record of changes on these immature ecosystems. inventory of subsurface ice at any locations where summer activities likely; moisture relations of soils derived from soft shales; further inventory of areas of natural instability such as earthflows on streambanks; field check accuracy of existing terrain sensitivity maps				s in previous 4 sections; plus ield work to determine consequences f crossing Dundas and Margaret slands

2

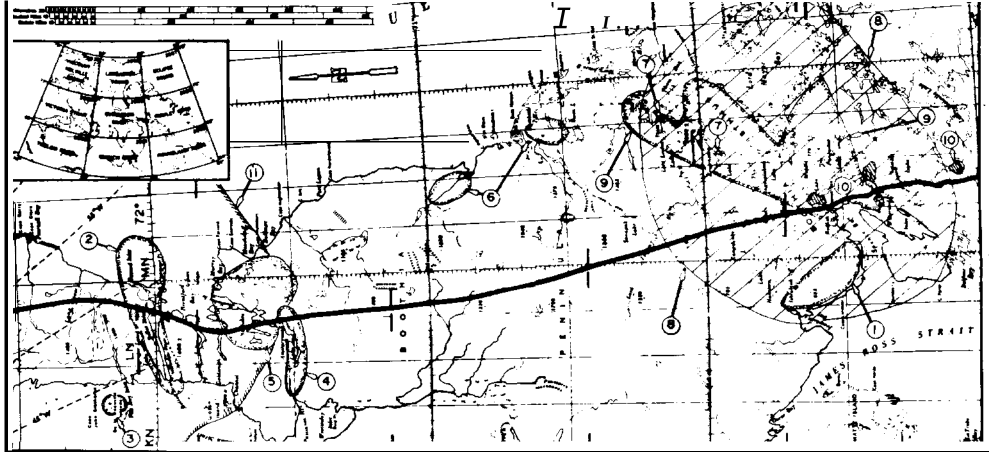


ENVIRONMENTAL FEATURES	REFERENCES (see text)					
1.1 Physiography	15	Sabine Pen is part of Sverdrup Lowland; poorly drained lowlands along coast; dissected hilly plateau.	ently undulating lowland	Bathurst Is. is ridged upland with E-W trend.	Part of Parry Plateau; low hills ... ridged ...... with E-W trend .	Predominantly raised marine beaches
1.2 Ground Ice Potential (on route)	15, 18	Many grd ice lenses in Basin M-2 W of Weatherall Bay.	hermal niching noted in s...., M-1 . . . King Point with grd ice xposed in eroding ,.C...	Medium to high ice content in colluvial deposits of Byam Martin	Marine ..... of silt ' clay .... grdice.	Little grd. ice in beach deposits
1.3 Surficial Materials (on route)	2, 1515,6 16	Sherwood& Eldridge Bay is most sensitive (1) Christopher Shale between	nconsolidated fine materials over edrock; considerable gullying , ill . ash; moraine with patterned rd.	Except for .... fringe of beach deposits .... of Byam Martin is on slopewash ' solifluction slopes; silt, bedro ck . colluvium on Bathurst	Polar Bear ,..., crossing over marine ...... fine material; unsuitable for .. nstruction; several colluvial slopes . . . . crossed	Much of Little .... is beach deposits with low sensitivity rating; same for east . „ . of Bathurst ,..
1 4 River Crossings (on route)	m . 15	lowe & slides recorded in basin M-3 E of Sabine Bay and M-4 . of Warren Point; slumping stream banks . . Sherard ..,.	o major .,... *., several minor	Many minor channels traversed on Byam Martin; several . . Bathurst 1; Basin BT-5 generally unstable terrain near Schomberg Pt.	No large streams crossed b., all .,..., " , . critical because of biolog. imp. of wetlands in Polar Bear	No large streams ....
1.5 Fish , Wildlife (zonal)	8, 9, 17	Critical brant ' eider habitat (2); critical .... along Mecham River (5) ..... Christopher m.,. ...... at Sherard (1)	alcons near route (6); high ensity caribou range W. of Burnett t. (3); imp. waterfowl areas on ast coast (2)	All coastal areas of Bathurst. sed by caribou.	All coastal ..... of Bathurst used by caribou; muskox in , lowlands N of route (5), polar bear movements . . . possible denning.	Arctic fox ..... E ..... (11) Freemans Cove winter caribou area , walrus winter conc. of beluga , Brooman Pt; Goodsir Inlet polar bear , walrus (12)
,.' Fish· Wildlife (on route)	9	High density caribou range [3), E and SE of Sabine Bay and entir .,.. from St. Arnaud Hills N to Eden Bay.	igh density caribou range on oute W of King Pt. (3)	High density caribou range on all of Byam Martin I.	High density muskox winter range, caribou range & nesting & foraging for waterfowl in Polar Bear Pass (10)	E. Bathurst and Little .... both used as ... ibou range
1.7 Vegetation (on route)	9, 15	Isolated wet meadows (4) at Drake Pt & Sherard Bay; Terraces of Basin M-2 (West herall Bay) well vegetated.	solated wet meadows .... Nelson riffiths Pt . on W side of Byam artin (,)	Very sparse veg. cover (10-15%); no meadows near route in this section; veg. above average on Griper Bay Formation	Lush vegetation , tundra ponds in Polar Bear P." (10) and at Allison Inlet , De la Beche Bay (4)	Lush vegetation in area north of Wood I (4)
1.8 Special Envir Features (incl. IBP sites, sanctuaries)	14, 18	-			Nat. Museum Res. Stn. (7); proposed IBP site (6); pingo which is rare in High Arctic & unusual reef knolls (9)	Proposed IBP Site (8), Thule sites on Brooman Pt.
ENVIR. CONCERNS						
2.1 Water Quality	15	High natural levels susp. sediment in Basin M-2 W of Weatherall Bay; no signif increase likely	Rel. high natural siltation; significant extra silt from project unlikely	Rel. high natural siltation; significant extra silt from project unlikely	Entire .... in Pola Bear Pass very dependen , . . . nchanged quality , supply of surface water	No water quality problems expected where beach ridge land types crossed
2.2 Drainage Alteration		No major drainage alternatives expected	Signif drainage alterat - possible where thermal niching occurs naturally	No major drainage alterations expected	Drainage alteration could be crucial to various biological features in Pol ar Bear Pass	No major drainage alterations expected
2.3 Terrain Disturbance	2, 16	Christopher Shale areas will pose very serious problems for summer activities	Ground moraine common on E. Bathurst; generally poor construction because of ice content & fine texture	Critical summer sensitivity and impassable in summer . . colluvial slopes of Byam Martin	Unless ..... follows limestone . . sandstone E-W ridge, then many unstable ,,,,,,, . . . " ., ...4	Beach deposits , felsenmeer on Little Cornwallis generally good construction sites
2.4 Vegetation Disturbance		No areas of exceptionally lush vegetation are traversed but close to one at Sherard Bay	No .,." of exceptionally lush vegetation ." crossed	No areas of exceptionally lush vegetation are crossed	Mar ine plain in Polar Bear ,.,. i. ,"., vegetation that should not be disturbed; above ."..," ".,. on Stuart Bay Form.	Route crosses edge of area mapped as lush vegetation (4) , of ·' ,..
2.5 Migration Disruption (fish & wildlife)		No well established migration routes for caribou . . muskox	No well established migration routes . . . caribou or muskox	No well established migration routes for caribou or muskox	Polar bear (spring ' .-,) caribou . muskox all "....... local movements would be disturbed in some sea sons	No well established migration routes for caribou or muskox
2.6 Habitat Loss (fish · wildlife)		, . ," . of high density caribou "o. arecr..... (3)... muskox range w of Sherard Bay (1)	No significant loss of caribou habitat expected	No significant loss of caribou habitat expected	Potential loss of tundra ponds & lush vegetation if route crosses lowland	Possible .... of imp habitat . ,. and at ,,,, S . . . Pass in -- . . . . . No of W , . .
2.7 Wildlife Harrassment		Imp. waterfowl areas at Sabine Bay & Eldridge Bay within expected zone of disturbance	If falcons nest W of King Pt harassment from project likely	No significant concentrations of wildlife traversed by this section of proposed route	Aircraf tharassment .... critical for muskox in June	Potential harassment of muskox, polar bear and caribou depending on timing of activities
2.8 Resource Use Conflicts	19	None expected	None expected	None expected	Route through Polar Bear Pass incompatible with Research Stn. & imp. of biolog. prod. for Inuit harvest; serious conflict	Potential conflict with archaeological sites on Brooman Pt; Fishing lakes near Dyke Ackland Bay (13)
POTENTIAL FOR AVOIDANCE						
3.1 Water Quality		In 1975, Bathurst Basins M- considerable sediment load; significant changes to wate	11 showed a poor natural water qua avoidable additions if activities uality should be avoidable	; late summer rains crea te ummer, but othe rwise	Crossing of . . . part of watershed ... uld cause signif. . . . . . quality h..,.. in ponds of Polar ,..., Pass	Signif. changes to water quality should be ....
3.2 Drainage Alterati -		Majo rdrainage alteration avoidable by routing and des ign if summer activity avoided	Ma jor drainage alteration avoidab ,. by ,..,,,, . . . design if summer activity .voided	Major drainage alteration avoidable by routing ... design if summer activity . ...,,,	Major route change ...... to avoid .... of drainage imp. for wetlands in	Major drainage alteration avoidable by routing and design if summer activity avoided
3.3 Terrain & Vegetation	2	No potential to avoid crossing Christopher shale if route originates on Sabine Peninsula	Grd moraine (Sproule's label Gm) widespread along route so prob unavoidable in this . ection	Impossible to avoid severe disturbance(f ..,1. vial ..... must be c,....", in summer : unstable Eids ..... likely unavoidable	Unstable colluvial areas prob. avoidable by routing on bedrock ridges; unstable Eids shale likely unavoidable	No major problem areas to avoid except small meadow area N of Wood Is.
3.4 Fish & Wildlife	19, 31	Routing changes or seasonal limitations on activities may solve problems but winter muskox area Sherard Bay to Warren Pt unavoidable	Rou ting changes.. seasona , limitations may ...... most problems	N half of Byam Martin . Schomberg Pt . . . . ,.,. for polar bear with unavoi dable disturbance if present route used	Even if only winter activity, muskox disturbance expected; caribou crossing to N in June & to S in August could be disturbed	Probable pola r bear denning area on S. Bathurst avoided by trunk line but perhaps . . . by all related act ivit ies
3.5 Resource Use Conflicts	18, 26, 31	Not applicable (n.a.)	n.a.	n.a.	Res. use conflicts greatly reduced if Polar Bear Pass not crossed: scientifically documented special features should be avoided	Baker Is. . . . . . imp. hunting .,.. or seals and bears ·· avoidable · project; caribou hunted from I.... , . Cape Cockburn
RESIDUAL IMPACTS						
4.1 Water Quality	29	Biologically imp. tundra ponds occur on Christopher shale near Sherard Bay; imp. water quality changes expected in these ponds	nil or low	nil or low	If Polar Bear Pass .... not entirely .... some ,,, effects expec ted	Numerous but minor flow slides on sediments below the marine limit and over limestones & siltstones · Bjard & Eids formations - extra siltation expected
4.2 Drainage Alteration	15	Lateral instability observed in streams of Basins M-2, M-3, & M-4 may result in unavoidable alteration	nil o low	k., inage alteration from crossing .... stream .... in Basin M-5 may be unavoidable	If Polar Bear Pass watersheds not entirely avoidable some imp. effects expected	nil or low
4.3 Terrain Vegetation	30	Christopher shale will have unavoidable disturbances in mid summer after rainfall, but less if activities above the marine limit	Griper Bay Form. which is crossed on Byam Martin & on N. side of Graham Moore Bay has above average vegetation - disturbance prob. unavoidable	Potential for accelerated erosion . . slopewash colluvial slopes	Few remaining impacts if Polar Bear Pass not cross . . .otherwise serious .... expected; route .... avoid Eids shale	nil or low
4.4 Fish & Wildlife		Expected biological impact very unpredictable because of knowledge gaps re fidelity to specific areas & behavioural responses	Expected biological impact very unpredictable because of knowledge gaps re fidelity to specific areas & behavioural responses	Likely impact on imp. polar bear areas	Because imp . winter habitat is involved, simply restricting activities to winter may be l.....".<. major impact expected	Expected biological impact very unpredictable because of knowledge gaps re fidelity to specific areas & behavioral responses
4.5 Resource Use Conflicts	26	likely nil	likely nil	likely nil	Inuit use of eider in winter open water at head of Bracebridge Inlet & Inuit use of fish from lakes in Polar Bear Pass may be disrupted	Inuit harvest of caribou and fishing near Dyke Acland Bay may be disrupted; same for August hunt of caribou in Pollen Strait area
RESEARCH NEEDS		Consequences of summer activities on Christopher shale; hydrologic research to define circumstances when summer activity is allowable; check if mapped areas of biological imp. are within zone of influence of trunk line route	Through all 5 of these sections need more precise definition of when the 10 to 20 day annual runoff period occurs; research to predict consequences of accelerated sheet & gully erosion needed for all 5 sections of this map	Document the hydrologic effects of disturbances to colluvial slopes that have natural slopewash & solifluction (Sproule's terrain unit Cs)	Hydrologic consequences of crossing areas mapped on sensitivity maps as "unsuitable", "critical", or "impassable"; research to catalogue consequences of crossing Polar Bear Pass; consequences of summer activities on Eids shale;	Evaluate Scoresby Hills route as alternative to Polar Bear Pass crossing; check for polar bear denning areas in this section & in hills north of Polar Bear Pass; detailed inventory of proposed IBP site (8)

3



ENVIRONMENTAL FEATURES	REFERENCES (see text)					
1.1 Physiography	1, 4, 15	Rolling upland mantled by gravels & silts	Upland with folded rocks eroded down to a dome-shaped peneplain; very thin mantle of weathered debris	Mainly consolidated bedrock with thin mantle of weathered debris; badland topog. S. of Cape Anne	Plateau of flat sedim. strata, except vertical beds of limestone at Aston Bay; relief up to 500 ft along gorges of incised streams	Lowland area with sensitive fine-textured marine silts E of Stanwell-Fletcher Lake
1.2 Ground Ice Potential (on route)	15, 20, 21	No particularly high abundance of ground ice reported	Rel. low grd. ice potential because of predom. bedrock; ice wedge polygons rare on plateau of Cornwallis	Some ice-rich areas along coasts of Cornwallis & Somerset	Ice wedge polygons rare on plateau	E side of Stan-Fletch L. is ice-rich sensitive ice-rich area traversed by route (18); also ice-rich area at NW end of Stan-Fletch Lake
1.3 Surficial Materials (on route)	20, 23, 24	General unconsolidated mantle of gravel & silts; generally stable area; several offshore spits near route at Cape Austin	Generally stable area with mantle of debris over bedrock	Cape Anne coastal strip is sensitive ice-rich fine marine silts (9); sensitive Eureka Sound sandstone along Cunningham River (10)	N. of Stan. Fletch L. upland is almost devoid of rock outcrops	Area S of Lake is predom. grd. moraine with patterned grd & many intervening areas of slopewash; numerous dykes & sills near route for 30 M. from Union R.
1.4 River Crossings (on route)	15, 25	Slides reported on stream edges of Basin C-6 near Cape Gill; but no significant river crossings in this section	Tributary streams of Eleanor, Taylor, Bacon, Allen & Mecham rivers would all be crossed	1 major crossing S. of Cape Anne	At least 5 significant crossings in this section; valley walls of talus and rubble	Union R. crossing is major one in section; several other Creswell Bay drainages crossed; massive grd.ice near Union R.
1.5 Fish & Wildlife (zonal)	8, 9, 27	Seabird colonies on Baillie-Hamilton & Houston Stewart Is. (1); seals & polar bear in Couch Passage year round & in Maury Channel (2)	Seabird colonies at Read Bay, Cape Hotham, Sophia L, Barlow Inlet & Browne Is; caribou range from Pioneer Bay to Cape Austin (3); muskox range at Becher Bay (6)	Barrow Str. imp. feeding area for Pr. Leopold seabirds esp. close to Somerset coast. Polar bear & murres on Griffith Is (11); murres on Limestone Is (12)	Polar bear concentrate along W. coast of Somerset; Aston Bay concentration area for beluga & seals; goose nesting on coast from Cape Court to C. Coulman (15)	Arctic char in Stan-Fletch Lake; goose nesting along W coast from Cape Coulman north
1.6 Fish & Wildlife (on route)	9, 26	Route traverses muskox & caribou range near coast at Cape Austin (3); caribou winter range off route on west Devon Is (4)	Arctic char run inland from Copeland Pt; caribou & muskox range west of Copeland Pt (7)	Muskox range between Aston Bay and Cunningham Inlet; known polar bear denning on north coast of Somerset	Caribou range along this entire section of route (16)	Creswell Bay area very imp. for geese muskox, fox, narwhal, seals, beluga, polar bear(19); caribou range from Otrick Is. north
1.7 Vegetation (on route)	22, 25, 28	Cornwallis extremely barren except for meadows along NW coast	Cornwallis extremely barren except for meadows along NW coast	Lush vegetation in valley of Cunningham Inlet but not on route	Lush vegetation around M'Clure Bay but not on route (17)	Good veg. cover in Union R. area; entire Stanwell-Fletcher basin well vegetated
1.8 Special Envir Features (incl. IBP sites, sanctuaries)	14, 28	Proposed IBP Site on Baillie-Hamilton Is. (5)	Critical polar bear denning habitat year round near Cape Hotham (8) Char Lake Study Site should be protected for remeasurement'	Proposed IBP Sites at Cunningham Inlet (13) and around Prince Leopold Is. (14)	—	Prominent elevated strand line; proposed IBP site around Stan-Fletch Lake (20); muskox in 1975 near Stan-Fletch Lake were first seen there this century
ENVIR. CONCERNS						
2.1 Water Quality	1, 4	Sheetwash and rillwash are important geomorphic agents wherever veg. cover is sparse; these natural processes expected to be accelerated esp. if any summer activity		All streams on N. Somerset are clear except those around Cape Anne which are murky, therefore signif. extra silt load likely	No lakes and very few ponds near route in this section so no major water quality changes expected	Stan-Fletch L is one of largest fresh water lakes in Archipelago - also imp. biologically - therefore water quality concerns are great
2.2 Drainage Alteration	15	If project creates any additional concentration of spring runoff it will be highly erosive where there is little vegetation cover		Deeply entrenched meander systems as in Basin S-5 (Cunningham R) not easily changed by engineering activities	Imp. not to disrupt extensive areas of small ponds associated with thermokarst in Creswell River lowland and at head of Stanwell-Fletcher Lake	
2.3 Terrain Disturbance	2, 23	Coastal spits at Cape Austin may be disturbed by construction activities	No major terrain disturbance expected	Intermittant slopewash colluvial slopes crossed in this section esp. along stream channels; predominant cover is grd. moraine with high ice content (poor to fair construction site)		Areas of sensitive terrain near Union R may experience serious disturbance
2.4 Vegetation Disturbance	20, 21	Very little vegetation to disturb	Very little vegetation to disturb	Valley of Cunningham Inlet is lush veg. because of high soil organic content from lignite - deep marine clays & high ice content make this lush area very sensitive (21). This is the only area on N. Somerset with continuous vegetation of sedge meadows		Potential for great veget.disturbance in low areas of Union R valley and Stan-Fletch Basin
2.5 Migration Disruption (fish & wildlife)	9, 28	Polar bear area from Cape Phillips to mid Baillie-Hamilton Island (2), possible disturbance	No major migration routes suspected in this section	No major migration routes suspected in this section	Seasonal movements of caribou not yet known for Somerset Is.	Seasonal movements of major species conc. in Creswell Bay area
2.6 Habitat Loss (fish & wildlife)	25, 32, 33, 34	Route intersects most densely vegetated part of Cornwallis Is. near Cape Austin	No major habitat loss expected in this section	If Cunningham valley avoided no major loss of terrestrial habitat; major beluga conc. & calving in Cunningham Inlet; also conc. in Garnier Bay	High seal lair densities in Aston Bay area could be threatened if this became a staging area	Beluga conc. in Creswell Bay would be threatened if this becomes an industrial staging area; this is one of few productive areas on entire island
2.7 Wildlife Harrassment		Potential harrassment of seabirds, polar bear, muskox & caribou but specific effects poorly known	Limited harrassment expected in this section	Specific effects of harrassment that could occur in these two sections are poorly known		Very high potential for harrassment because of relative abundance of animals but specific effects unknown
2.8 Resource Use Conflicts	26, 35	Domestic fishing at Eleanor L near Copeland Pt.(23)	Domestic fishing at Pioneer, Becher Allen & Assistance bays & at Depot Point & Sophia Lake(23)	Northern Somerset hunted for polar bears so some potential conflict in Cape Anne area	Aston Bay area extensively harvested in 1969-71 is crossed by proposed route (22)	Imp. archaeological sites at mouth of Union R.; the entire section hunted for bear,seal,caribou,fish,beluga, narwhal & fox by Inuit who camp at Creswell Bay
POTENTIAL FOR AVOIDANCE						
3.1 Water Quality	37	Little chance to avoid water quality changes associated with any man-made acceleration of sheetwash & rillwash, but no localised or intense water quality problems expected			Little chance to avoid water quality changes in Stanwell-Fletcher Basin if present route followed esp. since few confining banks in headwater streams with result that sheet flow during snowmelt (& any contained pollutants) would be spread widely	
3.2 Drainage Alteration		Project design and routing should be able to avoid major drainage changes in these sections		If accurate info. available on snowmelt runoff period and if activities restricted at that time drainage alterati ns could be minimized		Drainage changes likely unavoidable if logistics base established at Creswell Bay
3.3 Terrain & Vegetation	15, 21	Major terrain and vegetation problems should be avoidable in these 3 sections			Very deeply incised valley in Aston R about 2 mi E of route so very little room for route alteration in this section; little chance to avoid colluvial slopes	Earth hummocks & ice wedge polygons in peninsula of Union R.should be avoided
3.4 Fish & Wildlife	31	Present route suggests unavoidable disturbance to sea birds, polar bear, caribou and perhaps muskox	Probable polar bear denning area from Resolute to Intrepid Bay avoided by present route but perhaps not by related activities	If polar bear denning confirmed in this section, present route suggests unavoidable disturbance	Present route seems to avoid the more important areas on the west coast	Fall migration of caribou & fall movement of char could be avoided by careful timing of activities
3.5 Resource Use Conflicts	36	Areas mapped as Inuit resource harvest areas could be avoided by appropriate routing or timing of pipeline-related activities				Trapping areas used in 1965-68 study period unavoidable by presently proposed route
RESIDUAL IMPACTS						
4.1 Water Quality		Most potential water quality problems seem avoidable except in Stanwell-Fletcher Basin			Serious water quality problems expected in Stanwell-Fletcher Basin if route traverses this basin	
,.2 Drainage Alterat ion	28	No "j.. drainage alterat - expected except in Union River drainage				If there is disruption of seepage slopes that support willow, there will be . navoidable ,.,. of importar . . . . . . habitat
. . . Terrain Vegetat ion	21	Some loss of meadow habitat inevitable on NW Cornwallis if present route followed	nil or low	Valley ., Cunningham , will have unavoidable loss of good habitat if l . . . . acti vity the re	nil or low	Union R . . . . . very sensiti ve . . . . pre sent route wi , , result in . . . . disturbances to terrain ' vegetation
4.4 Fish . Wildlife	31	If winter d.".,., ... known ,., polar b... residual imp . . . . . could be		Probable ,.",1., .". on N.Somerset intersected by route with expected adverse impact	Careful routing could avoid major wildlife impacts in this . . . . ion	wildlife ".. of ,.,. ?.,., lowland potentially decreased if Creswell Bay s,.",", area . . . .
4.5 Resource Use Conflicts		nil . . low	nil . . low	Potentially significant . . north coast of Somerset	Potentially significant in Aston Bay resource harvesting	Severe resource use ..' lict expected
RESEARCH NEEDS		Focus on this section for surveys of polar bear denning	Further checks on potential summer sanctuaries for polar bear between Resolute and Intrepid Bay	Focus on this section for more surveys of polar bear denning or summer sanctuaries; focus here for identif. of feeding areas for Prince Leopold seabirds; from Fig 2, Pg 7 of Nettleship (1976) re currents test whether disruption of nutritionally rich areas in Barrow Strait would have biological effects on E coast of Somerset	If hypothesis on Pg 20 of Stirling, Schweinsburg & Kiliaan 1976 supported then research should focus more on disturbances expected on E coast of Somerset than on W coast; for example, further seal studies should perhaps focus on Pr. Regent Inlet side rather than Peel Sound side; also in these 2 sections for more surveys of polar bear denning or summer sanctuaries; beluga and narwhal studies such as conducted in Pond Inlet area should be focused in Cunningham Inlet, Aston Bay, Creswell Bay and Bellot Strait regions; research to define regulations needed for restriction of activities on marine sediments with moderate slopes	



ENVIRONMENTAL FEATURES	REFERENCE (see text					
1.1 Physiography	4, 38, 39, 41	Precambrian upland, more rugged & gullied than plateau on N. Somerset; fiord type coast along Bellot Str.; Murchison Prom. sheer cliffs 900 ft	Upland (part of Boothia-Somerset Arch); very dissected & characterized by E-W valleys; lowland along Wrottesley R.	Upland but less rugged than section to the north	illing hills & broad valleys, it steep slopes in sand & ravel areas	mall protected lowland N of Sp . . . . lay; some marine deposits; Cape Andeesris unique high . . . . . , tronglysorted . . . . ed(1)
1.2 Ground ice Potential (on route)	15, 21, 39	Evident grd.ice features in Basin S-1 on Lang R.; numerous ice wedge polygons on marine sediments S of Creswell Bay	Cryoturbated soils common; grd. ice abundance uncertain	Cryoturbated soils common; grd. ice abundance uncertain	itensive cryoturbation evident ctive layer max. depth of 1 m ecorded in till	Numerous frost cracks, mud boils, sorted circles in this section; patterned grd. on marine deposits W of Netsilik L.
1.3 Surficial Materials (on route)	2, 24, 38, 39, 41	Soils developed on calcareous till; some marine sediments S of Creswell Bay; route mainly on grd. moraine with patterned grd.	Soils developed on calcareous till, but unconsolidated deposits absent on much of the rugged upland	Soils developed on calcareous till; extensive boulder fields on upland	ore till here than in 2 sections to the north (esp. heavy rift cover on Boothia Isthmus); ce-contact sand & gravel common (kames, terraces, eskers)	Till to 10 . . . . . . many drumlins marine . . ", . . , gravels common; steep talus rock fall crossed . . . . Spence Bay; eskers crossed
1.4 River Crossings (on route)	24, 42	At least 4 major river crossings in this section plus Bellot Strait	Deeply entrenched river systems; numerous crossings of headwater areas; headwater erosion is char. of many streams on the Boothia upland		rossing of Lord Lindsay R. may e crucial because of down-tream domestic harvest from ord Lindsay Lake; this upland rained by large rivers	No river crossings in this section: , crossings of Sri.. wetlands with high . . . . . table . . . . Willerated Inlet
1.5 Fish & Wildlife (zonal)	3, 9, 14, 42	Bellot St. is feeding site for sea birds & is suspected conc. area for sea mammals incl. narwhal;(2) sea bird colony on De la Roquette Is.(3)	Suspected polar bear summer sanctuaries on coastal parts of Boothia Pen.	Suspected polar bear summer sanctuaries on coastal areas; caribou range & caribou hunting areas near coast E of route (6)	ull colonies at Thom Bay and rusenstern L.(7); Lord Lindsay . camping area for fishing & ealing by Spence Bay people; aribou harvest W of Hansteen L	Large area intensively used for resource harvest in 1968-71 (8)
1.6 Fish & Wildlife (on route)	9, 35, 36, 42	Good fox population & fox denning on N. side of Bellot St.; suspected polar bear denning	Amituryouak L. is designated camping area for fishing & sealing (4) arctic char & lake trout in area intersected by route (5)	No known wildlife conc. on route in this section. KNOWLEDGE GAP?	ox habitat from Pagnikto L. orth to Kangikjuke L.; area ntensively used for resource arvest in 1968-71 crossed by oute (8)	Route passes through edges of caribou area mapped in 1975 ITC project (9); route passes near lakes used for ice fishing (10)
1.7 Vegetation (on route)	15, 39, 40, 41	Continuous veg.cover only in small wet areas; sparse veg. in Basin S-6 near Macgregor L.; 50% veg.cover in Lang River Basin S-1	In Basin B-5 rocky hilltops are bare but till in lowlands is vegetated	Continuous veg. cover only in small wet areas	Extensive veg.cover on terraces along Lord Lindsay R.; black lichen cover is char.of slopes where solifluction common	Extreme coastal strips generally unveg.; outliers of low arctic veg. on southerly slopes in more moderate lowland N of Spence Bay
1.8 Special Envir Features (incl. IBP sites, sanctuaries)	14, 24	Proposed IBP Site at Bellot St(2); open water pools in winter in Bellot St.;remains of Fort Ross on NE shore of strait	Wrottesley R. valley filled with many small lakes	—	Lozenge-shaped plain extending 40 mi N from Spence Bay contains Jekyll, Hansteen, Kangikjuke, Angmaluktok, Middle and Krusenstern Lakes, the largest water bodies on the Boothia ,." 1.....	
ENVIR. CONCERNS						
2.1 Water Quality	—	Biological signif. of . . . . . . open water . . . . in Bellot Strait uncertain; . . . . qual there ", be imp.	Water quality changes would be of particular concern in vicinity of Nudtukta L. & Amituryouak L.	No expected water quality problems in this section	Above-average w a t e r quality concerns for k-, 40 mi. from Spence Bay because of many relat ively large lakes in this region	
2.2 Drainage Alteration	.	No major drainage changes expected in rugged terrain	If project caused drainage alterations they would be partic . imp. in this . . . . because of fishing values	No signif. drainage alterations expected in this section	rainage alteration of Lord Lindsay . could be imp. because of ownstream fishery	Marine deposits W of Netsilik L. have high water table in summer so any summer activity could easily change drainage
2.3 Terrain Disturbance	2, 21, 39	Massive grd. ice in marine sediments , of Creswell . . .; many r. . . . f . lopewash colluvium cr. . sed by route	Uncertain 4 . . . ". . grd. ice abundance is not well known	Uncertain t., ... grd. ice abundance is not well known	olifluction is common in low-igle slopes in this area, so errain quite susceptible to isturbance	Marine deposits area of main concern in this section
2.4 Vegetation Disturbance	41	None expected	None expected	None expected	None expected	This section is near northern limit of low arctic veg. of nearly continuous ericaceous cover; outlie of continuous veg. cover of concern because of rarity from here north
2.5 Migration Disruption (fish & wildlife)		Potentially serious disruption of movements through Bellot Str. if industr.activities concentrate there	None expected	None expected	elatively high " , . . m . harvest . . . . . . in these two sections add to the oncern for even small disruptions of migration routes	
2.6 Habitat Loss (fish & wildlife)		Potential loss of habitat for sea birds & sea mammals if industr. activities concentrated here	Important freshwater habitats are in path of route in this section	Little habitat loss expected in, this section	otential loss of fish habitat	High potential for loss of habitat "e. . . . " for maintenance of domestic fishery
2.7 Wildlife Harrassment		If polar bear denning confirmed potential harrassment in this section	None expected	None expected	n small amount of harrassment by aircraft or other means could be sign re because of the regular resource harvesting in these sections	
2.8 Resource Use Conflicts	14, 26, 35, 36, 42	Creswell Bay Inuit use Bellot St. area for resource harvest; old Inuit stone houses on N shore of Hazard Inlet	Area north of line through Amituryouak L. is resource harvest area for Creswell Bay Inuit (11). Amituryouak L. registered as protected camping area for fishing & [illegible]	Winter hunting of caribou east of route (6); west coast of Boothia Pen. hunted for polar bear S to James Ross Strait	ow Bay & Lord Mayor Bay are main esource harvest areas; route arallels trap line from Middle L. Mangikjuke L. seals & fish arvested in Lord Lindsay L. area	Ice fishing locations near route (1(trapline on S side of Middle L.; protected archeol. site at Pagnutol; traditional camping areas at Wilkers Inlet
POTENTIAL FOR AVOIDANCE						
3.1 Water Quality		Unknown	Topography & lake-shore configuration make it difficult to select a route away from shores of Nudlukta & Amituryouak lakes	—	Unknown	Unknown
3.2 Drainage Alteration	37	—	Hydrologic problems prob. avoidable if activities restricted during period of active snowmelt	—	ydrologic problems prob. avoidable f accurate info. available on now melt	Drainage alteration likely unavoidable in areas of high water table
3.3 Terrain , Vegetation	21	Undesirable cal . . . . 0". till on S. Somerset avoidable if route stays . toof plain		—	ateral channel shifting is dominant . . . . . . of instability e LordLindsayR.	The Bay rockfall slope E of Spence should be avoidable
3.4 Fish Wildlife		Unknown	Loss of , . 9 . fish habitat - unavoidable unless route can be located . . . . from key areas	—	ong term impacts (increased) hunting & fishing pressure) probably unavoidable	Long term impacts (increased hunting & fishing pressure) probably unavoidable
3.5 Resource Conflicts	35	Conflicts unavoidable in resource harvest areas t . . . ". . very few route alternatives i. this section	Route passage near resource harvest area " unavoidable	—	—	Rivers suitable for commercial ha fishing occur near Spence Bay; avoidance of . . . . . of future . . . . imp. ". . . . be possible in all . ases
RESIDUAL IMPACTS						
4.1 Water Quality		Unknown	Unknown	nil or low	[illegible]	Unknown
4.2 ainage Alteration		nil or low	—	Nil or low	Possibly serious impact	Possibly serious impact
4.3 Terrain Vegetation		Terrain disturbance expected in . . . " of . siveice. . . . when terrain i. wet	Unknown	Nil or low	Nil or low	Nil . . low
4.4 Fish , Wildlife		.	Potentially high	Nil or low	Potentially high	Potentially high
4.5 Resource Conflicts		Potentially high	Potentially high	Nil or low	ry disturbances in Thom Bay area ould interfere that has been imp. s. harvest area	Netsiksiavik Inlet & Netsilik L. imp. camp area for fishing, sealing & caribou hunting; serious disruptions inevitable
RESEARCH NEEDS		Check biological importance if any of shallow water in shoal area in east entrance of Strait; check for polar bear denning; gather inventory data for proposed IBP site	If route alternatives limited by topography in this section and the one to the north of it, what are requirements for restricting activit to reduce disturbance to imp. lakes this section?	Imp. sources of gravel in upper Wottesley R.- consequences for fish if this gravel used for industrial purposes?; north of about 70° limestone uplands contain more fine material than limestone till further south (signif. for land use regs.	Further identification of locations of marine clays & consequences of disturbances to these clay areas; research needed to [illegible] an optimal route through this region to achieve least disruption of traditional land use in Netsilik L. area. research to test Savile hypothesis that snowmelt progr. later from Churchill to Baker L. but spring earlier at Spence Bay & even earlier on S. Somerset Is. than at Baker [illegible] imp. for setting land use regs.)	

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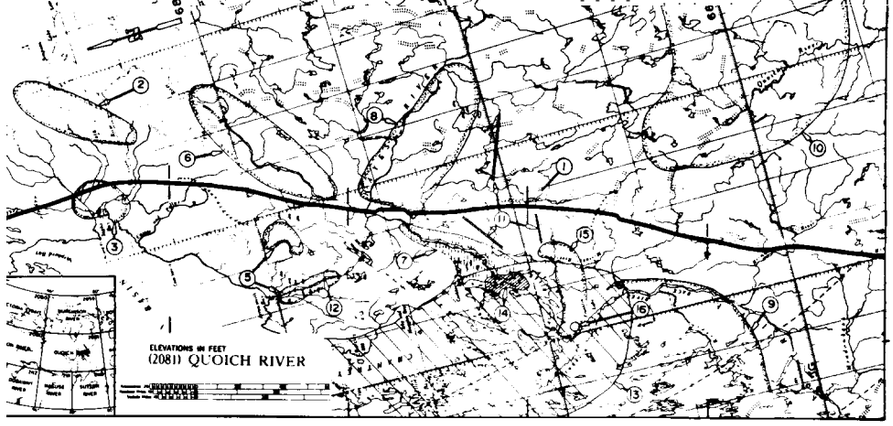
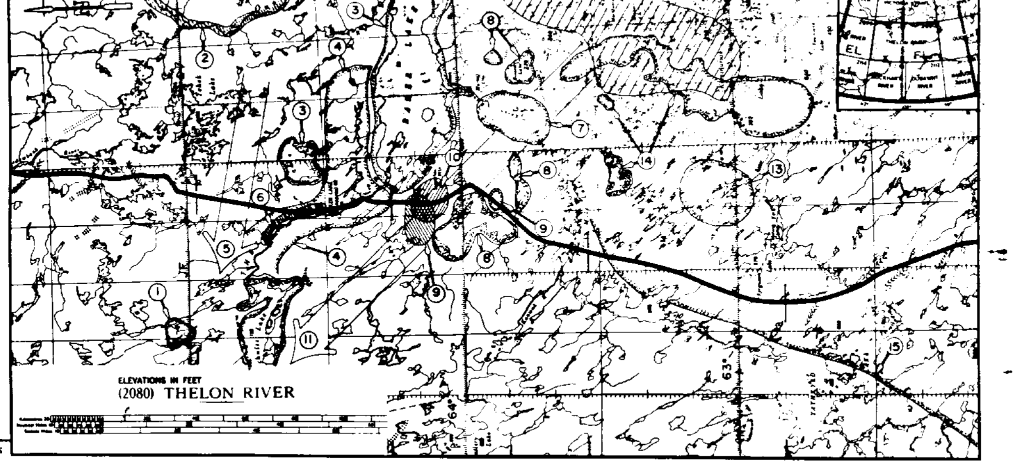
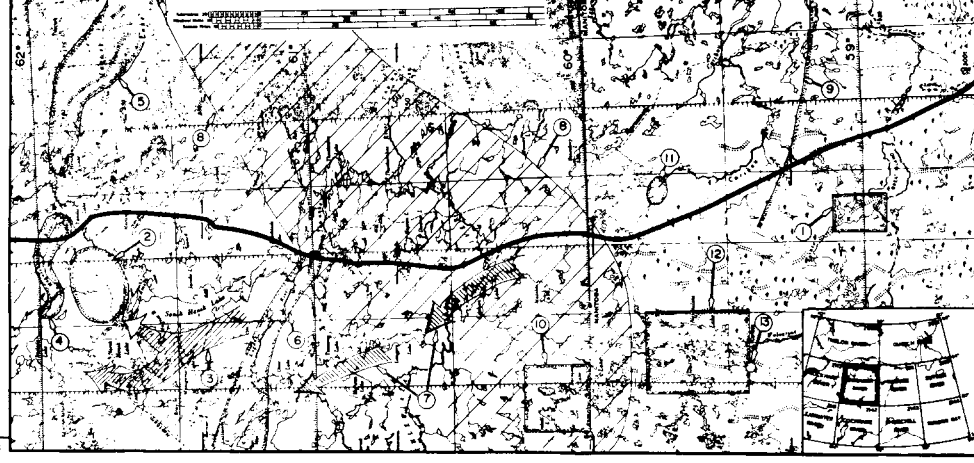


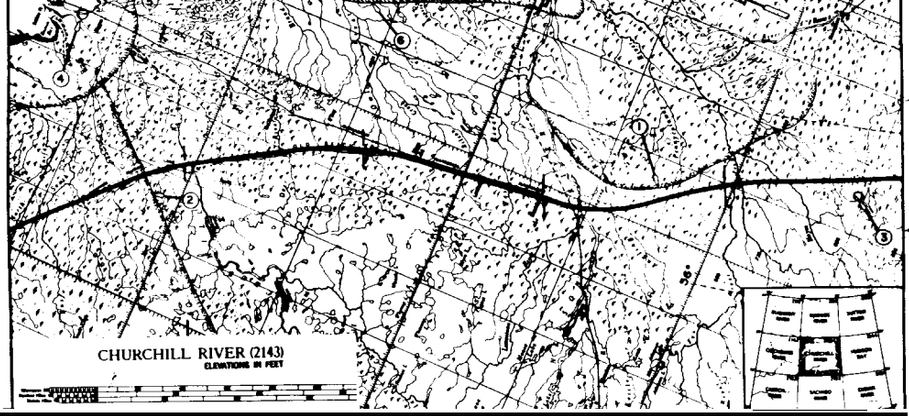
ENVIRONMENTAL FEATURES	REFERENCES (see text)					
1.1 Physiography	4, 38, 43, 45	Marine plain; several prominent elevated strand lines in region	Major area of marine sands & silts; much of coast from Spence Bay to Chantrey Inlet is flat sedimentary with heavy mantle of drift	Major end moraines near mouth of Hayes R. mark the inland marine limit at about 150 m a.s.l.	Mostly a low zone with fine marine deposits, some rock outcrops, eskers & drumlins; at western edge of Wager Plat.	Mostly low zone withfine marine de posits, some rock outcrops, eskers, drumlins, western edge of Wager Plateau
1.2 Ground Ice Potential (on route)	38	Large area of patterned grd. between Netsilik L.& Murchison R.; patterned grd.less	Patterned grd. microrelief for about 5 mi on W & S sides of Castor & Pollux R., many thaw lakes on marine silts of coastal lowland	Very little patterned grd. evident in this section	Some patterned grd. on moraine, glaciofluvial & marine sediments through entire section	Patt... for 20 .. on either side of Herman R.
1.3 Surficial Materials (on route)	4, 38, 45	Mostly sandy marine plain; 1 esker crossed & one parallel to route	Major esker S of Castor & Pollux R., about 1/2 of section is silty marine plain and 1/2 massive bedrock	Large alluvial plain with deep sediments from mouth of Hayes R. to Murchison R.; 1/2 of section is massive bedrock; route crosses sand & gravel lacustrine basin at (1)	Conspicuous end moraine at N end of this section & in section to north; about 25 mi of hummocky moraine combined with frost-churned mass wasting colluvial complex	Most of section is ground moraine hummocky moraine
1.4 River Crossings (on route)	38	2 major crossings (Inglis & Murchison rivers); gentle slopes at both crossings	3 major crossings (Castor & Pollux R. & 2 tributaries of Murchison R.); mass-wasting colluvial slopes on N side of trib. to Murchison	2 crossings in this section; steep colluvial slope on S side of Hayes R.; Hayes R. crossing very imp. because of downstream features	At least 5 smaller stream crossings in this section; downstream effects could be imp. for Franklin L. & lower Back R.	4 crossingsinthis ... tion, none with steep vall ey walls
1.5 Fish & Wildlife (zonal)	8, 9, 35	Polar bear denning areas east of route (2)	Caribou are hunted along Murchison R.; wintering area for caribou along Murchison R.(6)	Canada geese plentiful on lakes in lower Hayes R region (7); ice-fishing at mouth of Hayes R.	Back R.area said to have potential for commercial fishery; Franklin L. very productive char, whitefish & lake trout	Caribou & muskox occur in area on W side of Back R. (9); caribou winter range east of route (10)
1.6 Fish & Wildlife (on route)	8, 9	Route crosses waterfowl staging area at Inglis Bay (3)	Murchison R. harvested commercially for Pelly Bay char fishery	Estimated 500 caribou winter near route along Hayes R.; muskox also reported there (8)	Muskox sightings reported along Back River; summer & winter hunting of caribou between Franklin L. and Mistake R.	No known wildlife conc. on route in this section; KNOWLEDGE GAP?
1.7 Vegetation (on route)	41, 45	Boundary line marks northern limit of low arctic ericaceous veg of essentially continuous cover except on bedrock & eroding surfaces (4)	Northerly continuous deposits fen peat without mineral layers; veg. hummocks on silt & clay; org. terrain 2 mi on W & S sides Castor & Pollux R.; 2 areas of lush meadow	On rocky areas black lichen cover in char. of this area	Sporadic areas of organic terrain	Sporadic areas of organic terrain
1.8 Special ENVIR Features (incl. IBP sites, sanctuaries)	4, 43	Various special geomorphic features in these 2 sections: several prominent elevated strandlines, major conc. of thaw lakes and numerous oriented lakes		Major end moraines extend from Chantrey Inlet to Committee Bay(11); dunes occur at mouth of Hayes R.	Fishing lodge (Camp Chantrey) on Franklin Lake(6)	
ENVIR. CONCERNS						
2.1 Water Quality		Waterfowl staging area near route (3) makes water quality maintenance esp. important	Murchison River fishery raises water quality concerns	Use of Hayes R. area by geese & ice fishing at mouth of Hayes R. raise water quality concerns	Crossing of streams that drain into Franklin L. which is important fish production area raise water quality concerns	
2.2 Drainage Alteration	4, 36	Major concentration of thaw lakes in this area suggests high potential for drainage alteration; most of coast from Spence Bay to Chantrey Inlet is covered by drift that has ponded drainage giving waterlogged character to area			These 2 sections may have less potential for drainage alteration than 3 sections to the north but if drainage is altered it could have biologically imp. effects on Back R. and Franklin L. ecosystems	
2.3 Terrain Distur bance	4, 38, 45	Grd. ... is massive & widespread in this section, low angle earth flows, common along river valleys; signif. terrain disturbance expected	Grdice ... 4, 4, earthflows pr ... insouthern part of section route crosses ... unstable silty colluvial slopes; erosi problems expected	Fine texture in parts of alluvial plain leads to many land slips ... solifluction phenomena in this section; additional terrain disturbance expected	No signif. terrain disturbance expected in these 2 sections	
2.4 Vegetation Disturbance	4	Signif. veg. disturbance possible because there is large r... of high grd. water table in wetlands from Netsilik L. to Murchison R.	Signif. veg. disturbance possible whereroute cr... ses organic terrain	No signif. veg. disturbance expected	No signif. terrain disturbance expected ... these 2	
... Migration Disruption (fish ... wild ...)		No major migration ... reported ... this section; KNOWLEDGE GAP?	Fish movements ... winter movement of cari bou could be disturbed in this ... ection	Winter caribou movements could be influenced ... this section	No known migration routes crossed b... route in these 2 sections; KNOWLEDGE GAP?	
2.6 Habitat Loss (fish & wildlife)		Signif. goose habitat loss possible in Inglis Bay area	No direct crossing of critical habitat in this section; KNOWLEDGE GAP?	Signif. stream damage could threaten imp. fish habits on lower Hayes R.	No signif. habitat lose expected directly on route, but careless stream crossing practices could result in damage to important downstream habitat	
2.7 Wildlife Harrassment		Possible harrassment of geese if summer activity on project	Possible winter harrassment of caribou	Possible harrassment of geese if summer activity; possible winter harrassment of caribou	No wildlife harrassment expected in these 2 sections; KNOWLEDGE GAP?	
2.8 Resource Use Conflicts	35	No direct conflict with resource harvesting areas in this section	2 winter caribou hunting areas (5) are near route; trapline in valley leading S from Arrowsmith Bay (12).	Resource area intensively harvested in 1969-71 (13); winter ice fishing at mouth of Hayes R.(14)	Resource area intensively harvested in 1969-71 (13); winter ice fishing at mouth of Hayes R. (14)	No direct resource use conflicts expected in this section
POTENTIAL FOR AVOIDANCE						
3.1 Water Quality			Potential to avoid serious water quality problems in all 3 sections of this map sheet is difficult to predict; this seems to be a significant KNOWLEDGE GAP			
3.2 Drainage Alteration			Potential to avoid significant drainage alteration in these 5 sections is difficult to predict; KNOWLEDGE GAP?			
3.3 Terrain & Vegetation		This is one of the largest areas of marine sands and silts crossed by proposed route north of 60°; there is also a unique abundance of thaw lakes here along with massive ice; for these reasons major terrain disturbance probably unavoida...			Significant terrain & vegetation disturbance should be avoidable in these 2 sections	
3.4 Fish & Wildlife			Wildlife disturbances directly on the route (excluding possible water quality changes that may have more impact downstream from route) should be controllable by regulation of timing of industrial activities			
3.5 Resource Use Conflicts			Appropriate route selection and timing of activities could probably reduce most resource-use conflicts in these 3 sections			
RESIDUAL IMPACTS						
4.1 Water Quality			Presence of several different freshwater ecosystems (deltas of Murchison & Hayes rivers, numerous thaw lakes, Back River, Franklin Lake), presence of significant fish and waterfowl populations, plus presence of massive grd. ice & likely terrain disturbances all suggest that water quality problems could be significant in this region			
4.2 Drainage Alteration		Unavoidable drainage alteration is not likely to occur in areas underlain by marine silts and massive ice			Probably low	Probably low
4.3 Terrain Vegetation		Significant terrain & vegetation disturbances seem unavoidable by present routing in these 2 sections		nil or low	nil or low	nil or low
4.4 Fish & Wildlife		Potentially low if well regulated	Potentially low if well regulated	Potentially low if well regulated	Probably low	Probably low
4.5 Resource Use Conflicts		nil or low	If there are unavoidable resource-use impacts they would most likely occur in these three sections			nil or low
RESEARCH NEEDS		Determine if the northern limit of continuous veg. cover is a useful boundary for geographic stratification of various land use regulations i.e. are different reqs. needed north and south of this line?; check whether polar bear denning area ...ertains alongline route	All 5 sections on this map sheet are areas where water quality maintenance seems to be of above-average concern so consider extra research effort in this region. research related to massive ice in marine deposits should conc. in this section & the one to the north of it	No research needs specific to these 2 sections except for water quality concerns expressed in previous columns, also a need to check whether signif. fish or wildlife populations or habitats are directly in path of proposed route		No obvious needs for research in this section except to check whether signif. fish or wildlife populations or habitats are directly in path of proposed route



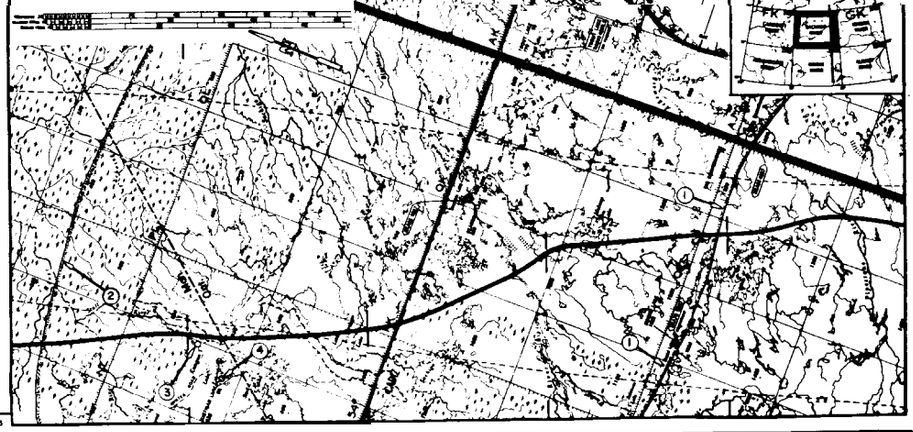
ENVIRONMENTAL FEATURES	REFERENCES					
1.1 Physiography	38, 44	No marine overlap in this section; bedrock of Wager Plateau & glacial drift	Area of marine overlap from Baker L. north to about Tehek L.	Area of marine overlap from Baker south to about Thirty Mile L.: very little bedrock except for 6 mi area N of Thirty Mile L.	Kazan Upland with glacial drift	Kazan Upland with glacial drift
1. 2 Groundice ......1.. (on route)	38	Patterned grd. present in centre of section between 2 mapped eskers	Patterned grd. microrelief occurs in valley 5 mi S of Thelon R. at southern end of this section	Patterned grd. in valley bottoms near S end of Pitz Lake	Patterned grd. in moraine along all of section from Forde Lake southwards	Patterned grd. occurs throughout this entire section
, 3 Surficial Materials (on route)	38, 46, 48	Unbroken till for 35 mi S from Meadowbank R. crossing; bedrock in most southerly 15 mi of section; 3 eskers crossed	Northern 25 mi of section mainly massive bedrock; bold west-facing scarps on Half Way Hills along Thelon R.	Wetlands, organic terrain & unstable colluvium on route W of Sugarloaf Mt colluvial slopes NE & SE of Pitz L.	Section about 1/2 till and 1/2 massive bedrock; unstable colluvial slope crossed by line W of Ferguson L.	Most of section is till with fluted moraine from Kogtok R. to Maguse R.; 1 esker crossed, several near route; mass-wasting colluvium crossed NE of Tyrrell Arm
1.4 River Crossings (on route)	38	2 minor crossings in section	3 minor crossings in section and 1 major crossing of Thelon R. where terrain mapped as frost-churned mixture of mass-wasting forms	1 major crossing of Kazan R.; 4 smaller crossings in areas with patterned grd. or colluvium, or organic terrain	Only 3 minor stream crossings in this section	Several small crossings and one major one at Kogtok R.
1.5 Fish , Wildlife (zonal)	8, 9, 49, 50, 51, 52, 53	Goose nesting & moulting area & fishing lakes W of route (1); goose moulting area along Quoich R. (2)	Fishing areas (3) including all of Baker L.	Geese & gulls at Kazan Falls; rare and endangered sp. along Kazan R. (7); fishing lakes (8)	Major calving area of Kamin. caribou herd is E of route (12); post-calving conc. E of Kazan & S of Baker L., fox denning area (13); fishing areas (14)	Entire map area E of Yathkyed L. is summer range for caribou; milling area is 15 mi E of Tyrrell Arm is very close to route
1.6 Fish . Wildlife (on route)	8, 9, 49, 50, 51, 52	No known wildlife conc. on route; KNOWLEDGE GAP?	Rare & endang. sp. along Thelon R. (4); historical caribou crossing route? (5); Aug-Sept caribou movement along Thelon R.(6)	Rare & endang. sp. W of Sugarloaf & E of Pitz L. (9); Goose nesting area W of Sugarloaf (10); historical spring caribou crossing?(11)	No wildlife conc. on route but summer range of caribou E of mapped line (15); milling area during post-calving migration on route E of Forde L.	No wildlife concs. directly on route but E side of Yathkyed L. imp. southward migr. route for caribou in August
1.7 Vegetation (on route)	38, 48	Mainland tundra with sedge meadows in wet areas and lichen-heath on drier sites	From this section S to Padlei organic terrain begins to occur in enough frequency to cause engineering problems	Organic terrain for about 10 mi N, from Pitz L. & at S end of lake; lichen-heath on drier sites	Mainland tundra with sedge meadows or peatland in wet areas and lichen-heath on drier sites	Mainland tundra with sedge meadows or peatland in wet areas and lichen-heath on drier sites
1.1 Special Envir Features (incl. IBP sites, sanctuaries)	', 14	—	-	Prominent elevated strandlines between Pitz L. & Thelon R., Tebesjuak L. camp on Kunwak drainage about 90 mi SW of Baker L.	IBP Site proposed from S. shore of Baker L. along W side of Kazan R. including Kazan Falls then along E side of Parker L. & Kaminuriak L. to the S end of Kaminak L.	
ENVIR. CONCERNS						
2.1 Water Quality	38	No major concerns	Unstable colluvial ..,." , of Thelon . . h." potential to signif.extrasilt load if disturbed	Water quality maintenance . . . . '.. .. this section because of wetlands ' goose nesting W of Sugar loaf Mt.(10)	No major wate r qualit y concerns in these 2 sections	
2.2 Drainage Alteration	38	No signif. drainage alteration expected	Thelon is of large enough size to make drainage alteration unlikely	Signif. drainage alteration could occur in wetlands W of Sugarloaf Mt	No signif. drainage alteration expected	
2.3 Terrain Disturbance		No terrain problems expected	Colluvial complex of mass-wasting microforms for about 5 mi on S side of Thelon R. crossing may create terrain disturbance	Signif. terrain disturbance expected in organic terrain & on unstable colluvial areas	No signif. terrain disturbance expected	
2.4 Vegetation Disturbance		No signif. vegetation disturbance expected		Signif. veg. changes possible if construction . . . water table in wetland	No signif. veg. disturbance expected	
2.5 Migration Disruption (fish & wildlife)	49	None expected in this section	Aug-Sept route of caribou in restricted band between Half w.., Hills , Thelon R. (6) i, intersected by pipeline; major concern	Pitz L. is imp. fishing lake & route crosses drainage between Pitz. L. , Baker L.	Potential disruption of critical caribou migrations	
..6 Habitat (fish , ****,..		No signif. habitat loss expected • this • tion	Large habitat occupied by rare endang. • • • • • • • • (4) is intersected; major concern	Fish habitat, • • • • • nesting habitat (10) , habitat for rare • endang. species (9) all cr • • sed by route: major concern	No signif. habitat ,0,. expected directly . . route, but harr . . sment may keep caribou away from some traditionally, . sed habitat	
2.7 Wildlife Harrassment		expected in this section	Pot ential harrassmen t ,• • • • • • • (4) (6) if summer construction activities	Potent ,•, harrassment in • • • • • • (9) and (10) if summer cons truction activit ies	No obvious harrassment problems but interactions between pipeline activities (construction, inspection & repair) and caribou migration routes, milling areas & summer range need to be considered	
2.8 - - - Use Conflicts		Areas of importance to Baker L. residents were documented in their land freeze p[...]osal & these indicate future conflict locations; fishing areas used by Baker L. people (1), (3), (8) & (14) may be con[...]ct areas: Baker Lake Tourist Lodge may depend on areas that could be disturbed; possible future interaction between pip[...]ne & hydro sites proposed for Kazan R., Thirty Mile L., Dubawnt L., Grant L., Beverly L., and Lower Thelon R.; possible [...]ure interaction with uranium mine sites				
POTENTIAL FOR AVOIDANCE						
3.1 Water Quality			Major water quality changes avoidable if Thelon . . . .* well designed	Prob . . . d - w . . if present ..... maintained		
3.2 Drainage Alteration			Appropriate design for Thelon . . crossing . . . . . e L,..." signif. drainage alteration	Prob. unavoidable if present route maintained		—
3.3 Terrain Vegetation		—	Signif. terrain disturbance ,. unstable colluvial a r e a s prob. ."." 0,.....,. if . ...". route maintained	Terrain & "... disturbance unavoidable if present route maintained		
3.4 Fish & Wildlife		. -	,•,, = unavoidable biological effects if present route maintained	Serious unavoidable biological c . . . ."... if present route ",,,,,,,,	Adverse effects on Kaminuriak h.,. likely avoidable by appropriate timing of industrial activities	
3.5 Resource Use Conflicts		Route changes and engineering design may avoid resource conflicts that are predictable				
RESIDUAL IMPACTS						
4.1 Water Quality		Nil	nil or low	Unless route changed, serious water quality disturbances likely in this section	nil or low	nil or low
4.2 Drainage Alteration		Nil	nil or low	Unless route changed, serious drainage alterations likely .. in this section	nil or low	nil or low
4.3 Terrain Vegetation		Nil	low	Expected to be severe unless better route found	nil or low	nil or low
4.4 Fish & Wildlife		Nil	Expected to be severe unless better route found	Expected to be severe unless better route found	Residual impacts . . . aminuriak herd difficult to predict; KNOWLEDGE GAPS?	
4. . Resource Use Conflicts		Nil	Expected to be severe unless better route found	Expected to be severe unless better route found	Probably low	Probably low
RESEARCH NEEDS		No obvious research needs in this section	Check importance of historically reported caribou crossing areas (5) & (11); detailed documentation of biological consequences of present route proposals and inventory to allow judgment of alternative routes in Baker L. area: consideration of geographic areas likely to be influenced by other industrial activities that could interact with pipeline (e.g. gas supply lines to mine sites)		Signif. of known caribou milling areas that occur on or near proposed route & fidelity of caribou to specific milling areas; more specific definition of geographic areas deserving outright avoidance by industrial activities or seasonal restrictions on industrial activities; more detailed inventory of proposed IBP site and consideration of whether the proposed boundaries are appropriately located	



ENVIRONMENTAL FEATURES	REFERENCES (see text)					
1.1 Physiography	38, 47, 57	Bedrock of Kazan Upland with glacial drift; large area of fluted moraine between Maguse R. and Kogtok R.	Bedrock of Kazan Upland with glacial drift; small area of marine overlap traversed at Roseblade L.	Bedrock of Kazan Upland with glacial drift; generally low relief with shallow till & many water-filled depressions	Bedrock controlled relief with extensive drift mantle	Broad rolling hills of boulder till with cores of bedrock
1.2 Ground Ice Potential (on route)	38, 47, 55, 56	Patterned grd. along Maguse R., & for 6 mi N; ice-wedge polygons common around North & South Henik Lakes	Patterned grd. abundant for 9 mi N & 7 mi S of Tha-anne R.; patterned grd. intermittent on colluvial complexes through entire section	Grd. ice still common except in coarsest soils	Southern limit of continuous permafrost in this general area but ice-wedge polygons abundant around Nejanilini L.	Areas of soil instability in Ritchie's study area (1) but surface frost phenomena rare
1.3 Surficial Materials (on route)	38, 47, 48, 55, 56, 57	Mostly moraine & massive bedrock; no eskers crossed but many between Harling L. & Noomut R., unstable colluvial complex for 6 mi N of Maguse R. & for 1 mi S	Predom drumlinoid & grd. moraine; between Savard L. & Roseblade L. many areas of unstable colluvial complex; 2 eskers crossed	Entire section is drumlinoid moraine or grd. moraine; from this general area S to about North Caribou L. in Ontario is region of most abundant peatlands	2 eskers crossed, plus intermit. bedrock, sand plains, or peat mantle but seldom, pattern less drift plains; large boulder fields near Caribou R.	Predom. patternless drift; route passes near small areas of deep peat mantle & hummocky disintegration moraine; but no signif. peat plateau S of North Knife R.
1.4 River Crossings (on route)	34, 38, 47	6 significant crossings (esp. Maguse R. which is imp. fishery) plus several smaller crossings	Tha-anne R. crossing is major one in this section; headwaters of McConnell R. crossed	Thlewiaza R. crossing is major one in this section; thick ice, prob. result of ice jam, reported near Hopton L. on 18 July 1971	Caribou R. is the major crossing in this section	Seal R. crossing extremely imp. because of calving beluga at mouth; North Knife R. crossing also of major imp.
1.5 Fish & Wildlife (zonal)	8, 52, 53, 60	Milling area during caribou post-calving migration (2); critical caribou migration route between North & South Henik Lakes (3)	Suspected goose breeding area on Kognak R. (6); spring migration of caribou past Longpre L. (7)	Spring migration of Kaminuriak caribou herd on both E & W sides of route (7 and 8)	No apparent conc. of wildlife in this zone; KNOWLEDGE GAP?	Seal R. imp. for beluga (est. pop. of 1500 in summer) & harbour seals imp. delta at mouth of North & South Knife rivers
1.6 Fish & Wildlife (on route)	8, 52, 53, 58	Imp. goose breeding area on Maguse R. (4); imp. char production on Maguse R. (5)	Spring migration route (major) for Kaminuriak herd is crossed by pipeline in this section esp. from Roseblade L. southwards (8)	Spring migration route (major) for Kamin. herd through all of this section (8)	Northern limit of winter range for Kaminuriak herd just S of Caribou R. (9)	Winter r..., of [illegible], uriakcaribou herd through all of this . . . .
1.7 Vegetation (on route)	38, 47, 55, 59	Padlei reported as northern limit of isolated clumps of spruce; Boreal Section B.32 with stunted spruce only along shores of lakes & rivers	Organic terrain common for 9 mi N & 7 mi S of Tha-anne R.; Boreal Section B.32 spruce only along lake & river shores	This section . transiti onal from tundra to boreal zone; organic terrain	Progressing southward this is prob. first section where . deep peat mantle . ould be encountered	North Knife . is about northern limit of significant peat plateaus
1.8 Special Envir Features (incl. IBP sites, sanctuaries)	14, 38, 54, 61	Arctic Lodge is at 61 39 N, 92 23 W on E side of caribou water crossing between North & South Henik Lakes	McConnell Rver Migratory Bird Sanctuary and proposed IBP Site at mouths of McConnell & Tha-anne rivers	Proposed IBP Site at Baralzon L west of route (10)	Unusual patterned boglands on sandy delta & lacustrine deposits around lake 8 mi E of route (11). proposed IBP sites-Nejanilini L., 540 mi² (12), and Little Duck L., 30 mi² (13)	Proposed IBP Site . " Knife R delt off map Seal , estuary very imp biogically; at ls . . . . Are . (Ritchie) should be left and ist urbed . future remeasurement
ENVIR. CONCERNS						
... Water Quality		Major water quality . . . . Maguse R. because of downstream fishery	Water quality maintenance imp. . . . . . . of downstream "h. . on McConnell R.	No major concerns	No ",.. concern	Major water quality concerns . . Seal R. & North Knife R.
2.2 Drainage Alteration		Drainage alteration . ould be imp. for Maguse, goosenest ing	No maj	4, .*.... alt erat ion co ncerns		Drainage alteration should be . . oided to protect estuarine , delta . . . . Seal . Knife rivers
9*9 ,.",. Disturbance	38	Stream banks of Maguse . . may . . . . particular care during construction	Lacustrine plain crossed for about 1 mi N of Tha-anne R., may be sens itive to . . . . disturbance	No major concerns	. . . . concerns	Stream banks of s . . . R. & North Knife. may need particular c a r e during construction
Disturbance	56		No 1'..	. . . .		Unique . . . features inside Ritchie Study area should be pr . . . . ed (NE limit of . . . pine . . . . . in Man. ; unusual combination of . . . . . ringe . . . . near to each . ier
2.5 Migration Disrupt ,'. (fish , wildlife)		Potentialfor . . . . . dis rupt ion of cri ti cal caribou migr			No major migration disruption expected 1. this section	Serious changes to s.., ... possible in this . . ..,.,
2.6 Habitat Le.. (fish & wildlife)	.	Potential loss of fish and Canada . habitat	Potential loss of goose . ting habitat	Noma ,0, hab itat y.. . expected		..., .. mouth is second most imp. beluga calving area . . west Hudson I.. (after Nelson River estuary)
2.7 Wildlife Harrassment		Waterfowl harrasment ,,,,,,,. ," these , sections		No major concern	No major concern	No major concerns
2.8 Resource U..	62	nil or low	Keewa tin Arctic Camp west of route . . . . . . 30 mi "0 res-use confl ict expected	. eutlin L.. Treeline Lodge about 90 mi . of route no . . . . conflict expected	nil or low	Potential hydro site on Seal R. below Great Island; potential conflict with pipeline undetermined
POTENTIAL FOR AVOIDANCE						
3.1 Water Quality		Unknown	?	—	—	Crossing of Seal . . is . navoidable but special design of crossing may a void problems
3.2 Drainage Alteration				—	—	
3.3 Terrain . Vegetation			—	—	Some large boulder fields near Caribou R. may be unavoidable; eroding peat banks at margins of some streams may be unavoidable	
..' Fish , Wildlife				1	-	Unknown
3.5 Resource Use Conflicts		Not applicable	. . .	n.a.	[illegible]	[illegible]
ESIDUAL IMPACTS						
.1 Water Quality	.	Possibly serious				Sergeant & Brodie suggest Seal R. be left a wild river: unless it is avoided entirely some signif. water quality changes likely
.2 Drainage Alteration		Unknown	Unknown	Nil or low	If eroding peat b.".. trenched some drainage alterati . likely	
.3 Terrain Vegetation		Nil or low	Nil or low	Unknown whether ice accumulation observed near Hopton L. is a possible threat to pipeline with resulting need for summer repair	May be heavy demand for select backfill where boulder fields are crossed	Trenching ,... sandy eskers . . . . . initiate wind . rosion
.4 r... , Wildlife		Possibly serious	Possibly serious	Nil o rlow	Nil ■ ■ low	If winter construction some inter - tion with ......,", ... likely
.5 Resource Use Conflicts		Nil or low	Nil or low	Nil orlow	Nil ■ ■ low	Nilor low
ESEARCH NEEDS		Research to aid prediction of whether proposed pipeline route and construction activities would allow continuation of spring and fall migrations of Keminuriak herd			Determine whether any terrain problems would result from construction through continuous stone fields or peat polygon complexes such as occur between Seal R. & Caribou R.	aselineinfoalready . . . . for tchie study area should be . . . . to lectlocations....", foll owing onitoring of veg. or terrai n sturbance



ROMMENTAL	REFERENCES					
	55, 57	Hudson Bay Lowlands; scattered bedrock outcrops; sedimentary bedrock overlain with marine clays	Hudson Bay Lowlands; scattered bedrock outcrops; sedimentary bedrock overlain with marine clays	Hudson Bay Lowlands; scattered bedrock outcrops; sedimentary bedrock overlain with marine clays	Hudson Bay Lowlands; scattered bedrock outcrops; sedimentary bedrock overlain with marine clays	Lowland occurs in this section; limit of marine deposition just east of route (1); shield
Potential (on route)	47, 48	Organic soils predominate the landscape and many of them have associated grd. ice	Organic soils predominate the landscape and many of them have associated grd. ice	Organic soils predominate the landscape and many of them have associated grd. ice	Organic soils predominate the landscape and many of them have associated grd. ice	Only sporadic occurrence of grd. ice this far south
Materials (on route)	47, 48, 62	Raised beach; calcareous clays deposited in sea water; large areas of post-glacial organic deposits; knob and kettle moraine west of route from canyon in Churchill R. south to 57° near Whitmire L.			& Fox R. mineral area of marine deposition (1)	drift with poorly drained depressions between parallel
Crossings (on route)		Many small stream crossings in area of poor drainage; South Fork R. is major crossing in section	Churchill R. is major crossing; many small crossings in poorly drained areas	No major streams to cross in this section	Major crossing of Nelson R. Imp. because of downstream use by beluga & fish	Numerous small crossings in this section
Wildlife (annual)	34	Belugs are harvested in the estuary of the Churchill R.	No known wildlife concs. in this section; KNOWLEDGE GAP?	No known wildlife concs.; KNOWLEDGE GAP?	5000 beluga est. to congregate in mouth of Nelson R. during calving	No known wildlife concs.; KNOWLEDGE GAP?
Wildlife (on route)	64, 65	Northern limit of moose & southern limit of winter range for Kaminuriak caribou occurs in	No known wildlife conce.; KNOWLEDGE GAP?	No known wildlife concs.; KNOWLEDGE GAP?	Sturgeon are commercially fished in Nelson R.	Fish plant located at Whitefish L. very close to route (3)
Vegetation (on route)	55, 57	Boreal Section B-3; immense areas of peat plateau, fen & palsa complex; mesic & fibric peat	As in section to the north except route mainly on old beach deposit with open spruce & lichen-scrub	As in section to the north except route mainly on old beach deposit with open spruce & lichen-scrub	Entire section is deep peat mantle, with associated scrub forest, open spruce forest, and larch	Entire section is deep peat mantle, with associated scrub forest, open spruce forest and larch
Features (incl. IBP sites)	47, 61, 63	Goose Creek proposed IBP site near Churchill (4); Twin Lakes Hill proposed IBP site near			"Gillam Little Barren Lands" just W of Gillam suggested as an IBP site but not proposed yet	Man. Govt. is considering a park development along Hayes R. in vicinity of pipeline route
Quality		Main areas of water quality concern would be crossings of Churchill and Nelson Rivers				
		No major concerns directly on route but undesirable downstream effects possible				
Alteration		Disturbance of riverbank levees could alter drainage of large area of adjacent wetland; disruption of damming effect of prominent				
		strandline (old beach on map) could also alter drainage on a large area of surrounding lowland				
Disturbance		No major concerns				
Disturbance	64	No major concerns			Gillam, differential settlement over ice-rich varved clay but problem avoidable by appropriate	
Disruption (fish & wildlife)		Delta of N & S Knife rivers imp. biologically	If Churchill R. crossing poorly designed downstream effects could be very signif. biologically	nil or low		Unknown
Loss (fish &		Potential overlap with polar bear habitat to the NE of proposed right-of-way	Potential interaction with winter polar bear denning area (6) if activities on E side of CHR or near	No major concerns directly on route but undesirable		
Harrassment		Winter construction could be in vicinity of wintering caribou of	No major concerns			
Use Conflicts	63	Presumption of major beach line by pipeline may limit future options for use of aggregate from this landform		esort area at Limestone Lake is prob. beyond zone of influence of pipeline	Spruce Rapids and Lower Limestone Rapids	water from Lake Winnipeg through Hayes River Basin to Nelson River
Quality						
Alteration		Pipelines elsewhere have been constructed with suitable crossings for rivers comparable to the Churchill and Nelson and areas of organic terrain are crossed by pipelines elsewhere so proper design could prob. avoid all hydrologic terrain, and vegetation problems				
Vegeta on						
Use Conflicts						
Quality			Nil or low if major river crossings well designed			
Alteration			Nil or low if major river crossings well designed			
Vegetation			It may be impossible to avoid accelerated erosion of peat banks at edges of water bodies where they are trenched for a mineline			
Wildlife			Nil or low if major river crossings well designed			
Use Conflicts		nil or low	nil or low	nil or low	nil or low	nil or low
RESEARCH NEEDS		Further field investigation of specific proposed route to identify potential problem areas on each of the main physiographic types (till & moraine, rivers, beaches & other sand deposits; alluvium; and peat); sections that contain the Churchill and Nelson river crossings should receive most attention for field work in this map area to ensure that undesirable downstream effects are minimized; research to assess where refrigerated gas line no longer needed in the event that chilling of line proposed as far south as this map sheet				



ENVIRONMENTAL FEATURES	REFERENCES (see text)					
1.1 Physiography	44, 62	Precambrian shield with mantle of glacial drift	Precambrian Shield with mantle of glacial drift	Precambrian Shield overlain by lacustrine deposits	Precambrian Shield overlain by lacustrine deposits	Precambrian Shield: rel. level plateau with low rocky outcrops
1.2 Ground Ice Potential (on route)	48	Only sporadic ground ice in these three sections			Southern limit of discontinuous permafrost mapped in this area (1)	nil
3 Surficial Materials (on route)	55	Pred. unconsolidated material over bedrock; rocky parallel ridges with intervening poorly drained depressions	Pred. unconsolidated material over bedrock; rocky parallel ridges with intervening poorly drained depressions	Lacustrine deposition in southern part of this section	Lacustrine deposition in northern part of this section	Pred. unconsolidated material over bedrock with intervening poorly drained depressions
4 River Crossings (on route)		Many stream crossings but no major ones	Many stream crossings but no major ones	Many stream crossings but no major ones	Many stream crossings but no major ones	Many stream crossings but no major ones
5 Fish & Wildlife (zonal)	65, 66	Woodland caribou (low density) rach as far north as this section (2); sturgeon are fished in God's R.	Low density woodland caribou all the way to Longlac; also low density of moose and deer from Man-Ont border to Longlac			
6 Fish & Wildlife (on route)	65, 66	No known fish or wildlife concentrations directly on route; KNOWLEDGE GAP?				
7 Vegetation (on route)	48, 55	Boreal Section B.22a (Northern Coniferous); black spruce dominant with poorly drained areas peat filled; still a high frequency of peatland this far S	Boreal Section B.22a (Northern Coniferous); black spruce dominant with poorly drained areas peat filled; still a high frequency of peatland this far S	Boreal Section B.22a (Northern Coniferous); black spruce dominant with poorly drained areas peat filled; still a high frequency of peatland this far S	Boreal Section B.22a; black spruce dominant; medium frequency of peat from here southwards	Boreal Section B.22a; black spruce dominant; medium frequency of peat from here southwards
8 Special Envir Features (incl. IBP sites, sanctuaries)	61		-	Proposed IBP site near Sandy L. in Severn R. drainage basin, off map SW of Sachigo L.	-	Proposed IBP site on S side of Wunnumin L. about 70 mi E of North Caribou L.
ENVIR. CONCERNS						
1 Water Quality			No major concerns			
2 Drainage Alteration			No major concerns			
3 Terrain Disturbance			No major concerns			
4 Vegetation Disturbance			No major concerns			
5 Migration Disruption (fish & wildlife)			No major concerns; KNOWLEDGE GAPS?			
6 Habitat Loss (fish & wildlife)			No major concerns; KNOWLEDGE GAPS?			
7 Wildlife Harrassment			No major concerns			
8 Resource Use Conflicts	44, 65, 66	Nil	Fish packing plants at Kistigan L.(3) & Rorke L. (4) but no resource use conflicts expected	Nil	Nil	Nil
POTENTIAL FOR AVOIDANCE						
1 Water Quality				Not applicable		
2 Drainage Alteration				Not applicable		
3 Terrain & Vegetation				Not applicable		
4 Fish & Wildlife				Not applicable		
5 Resource Use Conflicts				Not applicable		
RESIDUAL IMPACTS						
1 Water Quality			No major impacts expected beyond those observable along buried pipelines in similar surficial materials and vegetation types in northern Alberta or on the Trans-Canada pipeline in Ontario.			
2 Drainage Alteration			No major impacts expected beyond those observable along buried pipelines in similar surficial materials and vegetation types in northern Alberta or on the Trans-Canada pipeline in Ontario			
3 Terrain Vegetation			No major impacts expected beyond those observable along buried pipelines in similar surficial materials and vegetation types in northern Alberta or on the Trans-Canada pipeline in Ontario			
4 Fish & Wildlife			No major impacts expected beyond those observable along buried pipelines in similar surficial materials and vegetation types in northern Alberta or on the Trans-Canada pipeline in Ontario			
5 Resource Use Conflicts						
RESEARCH NEEDS		No obvious need for research except for more detailed documentation of environmental changes along well established pipelines in similar terrain, vegetation and climate in Ontario or in northern Alberta; review of existing biological information, if not fieldwork, to check whether any concentrations of fish or wildlife occur within zone of influence of proposed route				

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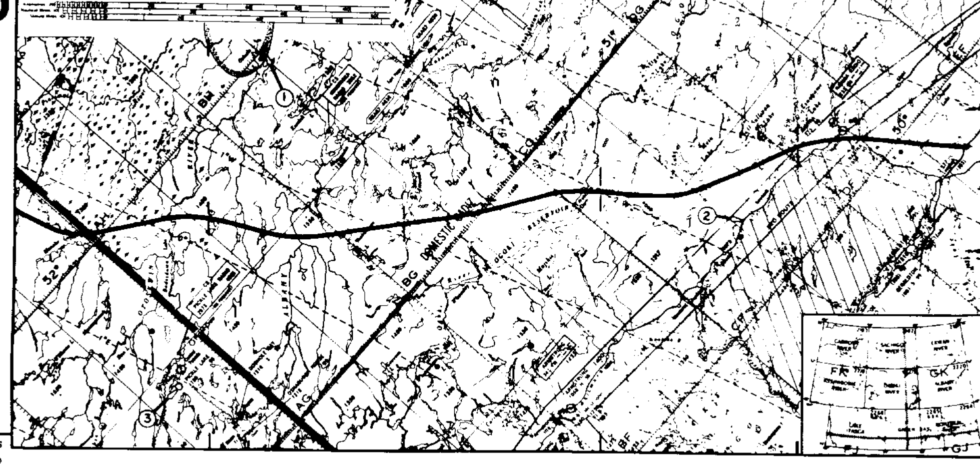

ENVIRONMENTAL FEATURES	REFERENCES (see text)					
1.1 Physiography	44, 62	Precambr ian Shield rel. level plateau with low rocky outcrops; many poorly dra ined dep ress ions nar	Prec ambrian Shield: rel. level plateau with low rocky . . . . many poorly dra ined depressions . narrow	Precambrian Shield ; . . . level plateau with low rocky outcro ps; many poorly drained . . . . , narrow lakes	Precamb rian Shield; rel. leve l P. . . . . . with low rocky outcrops; many poor.y drained depressi ons narrow . . . "	Precambr ian Shield; rel level plateau with low rocky outcrops; many poorly drained depressions rocky lakes
1.2 Ground Ice Potential (on route)		nil	nil	nil	nil	.
1.3 Surficial Materials (on route)	62	Major end mora ine in vicin ity of Menako L. medium frequency of muskeg; . . . . equal area of bedrock & uncons olidated material	Shallow soil over bedrock; medi - frequency of muskeg; ext ens ive sand & gravel deposits; drumlinized till uplands	Shallow soil over bedrock; medium frequency of muskeg	These 2 sections on lacustrine deposits with intermittent drift . . . . . . and	
1.4 River Crossings (on route)		Otoskwin R. is main crossing; numerous m. . ., inge of small slow-flowing streams	Albany R. is ". . . . . . " , ; numerous cross ing of small . . - flowing streams	Ogoki R. is main crossing; crossings of small slow-flowing streams	No major river crossings in these 2 sections; numerous small stream crossings	
1.5 Fish & Wildlife (zonal)	66	Deer density recorded . . rare from Man. border to Longlac; moose also rare (1 moose/10-25 mi²) in most sections except for . , " of moderate density from Ozhiski L (1) . eastwards towards Lansdowne House (off map) and moderate moose density (1 moose/5-10 mi² from Nakina to Longlac; woodl and caribou range continuous from Man . . . . to				
1.6 Fish & Wildlife (on route)	66	. .	known fish or wildlife concentrations directly		on route; ___ CAP?	
1.7 Vegetation (on route)	55	Boreal Section B.22a (Northern Coniferous); predom. black spruce	Boreal Section B.8 (Central Plateau); jack pine, black spruce, with intervening bog, muskeg & rock barren	Boreal Section B.8 (Central Plateau); jack pine, black spruce, with intervening bog, muskeg & rock barren	Boreal Section B.8 (Central Plateau); jack pine, black spruce, with intervening bog, muskeg & rock barren	Boreal Section B.8 (Central Plateau); jack pine, black spruce, with intervening bog, muskeg & rock barren
1.8 Special Envir Features (incl. IBP sites, sanctuaries)			—	—	.	Nipigon-Onaman Game Preserve (2)
ENVIR. CONCERNS						
2.1 Water Quality			No major concerns			
2.2 Drainage Alteration			No major concerns			
2.3 Terrain Disturbance			No major concerns			
2.4 Vegetation Disturbance	67	The volume of unsaturated soil available for tree growth in forested wet lands is limited by the relatively high water table; in such cases small but pro longed rises in the water table . . . saturate the rooting . . . . In In-" there . -,., documented examples of pipeline cons truction resulting . . blocked drainage with subseq uent timber loss This could be of local concern in some pu. - harvest . . . . . near the proposed route				
2.5 Migration Disruption (fish & wildlife)			No major concerns			
2.6 Habitat Loss (fish & wildlife)			No major concerns			
2.7 Wildlife Harrassment			No major concerns			
2.8 Resource Use Conflicts	44, 66	ish processing plant at Pickle L. ut no resource use conflict xpected (3)	nil	Sawmill at Fort Hope but no resource use conflicts expected	Longlac Pulp & Paper concessions traversed in these 2 sections; non-agricultural soils even in these 2 most southerly sections; sawmills at Nakina & Geraldton; no resource use conflicts expected	
POTENTIAL FOR AVOIDANCE						
3.1 Water Quality				Not applicable		
3.2 Drainage Alteration	67		Cross-drai nage and other ..s,..,.,., di,,c.tie". for pipeline . . . . of forested wet lands have been effective in preventing raised . . . . . tables, timber . . . . hab itat changes in the wetlands			
3.3 Terrain & Vegetation				Not applicable		
				Not applicable		
Resource Conflicts				Not applicable		
RESIDUAL IMPACTS						
1 Water Quality			No major impacts expected beyond those observable along buried pipelines in similar surficial materials and vegetation types in northern Alberta or on the Trans-Canada pipeline in Ontario			
2 Drainage Alteration			No major impacts expected beyond those observable along buried pipelines in similar surficial materials and vegetation types in northern Alberta or on the Trans-Canada pipeline in Ontario			
3 Terrain Vegetation			No major impacts expected beyond those observable along buried pipelines in similar surficial materials and vegetation types in northern Alberta or on the Trans-Canada pipeline in Ontario			
4 Fish & Wildlife			No major impacts expected beyond those observable along buried pipelines in similar surficial materials and vegetation types in northern Alberta or on the Trans-Canada pipeline in Ontario			
5 Resource Use Conflicts				nil		
RESEARCH NEEDS			No obvious need for research except for more detailed documentation of environmental changes along pipelines that have been in place for a number of years in similar terrain, vegetation and climate elsewhere in Ontario or in northern Alberta; review of existing information, if . . . field work, to check whether any concentrations of fish or wildlife occur within zone of influence of proposed route			

APPENDIX I

Specific terms of reference for this study

To prepare a detailed "discussion paper", primarily in the form of maps and legends, to be used by the Arctic Islands Pipeline Study Board for definition of the 1977-1978 Environment Canada field program for studies along the prime route now studied by Polar Gas.

The material would identify and summarize:

(i) the main features of terrain, vegetation and wildlife along the prime route;

(ii) the expected impact of the proposed construction upon the terrain, vegetation and wildlife;

(iii) the estimated potential for mitigation of the expected impact through alteration of project design;

(iv) concerns remaining even if appropriate mitigation steps were taken during project planning and construction;

(v) knowledge gaps and recommended subjects for further field checking in 1977-1978.

The contractor agrees that:

1. Each of the nine (9) 1:1,000,000 maps will be provided on a mylar base suitable for reproduction and will delineate relevant DOE areas of concern and reference same to the attached legend;
2. The report will include a discussion of scope of the study, methods employed, references used and a brief review of the concerns and knowledge gaps portrayed on the maps and legends;
3. Arctic Islands Pipeline Study Board personnel will be provided the opportunity to meet with the contractor to review and discuss -
   a) the format of map legends prior to tabulation of information
   b) drafts of the nine maps, legends and report prior to finalization.

APPENDIX II

7 May 1976, Volume 192, Number 4239 SCIENCE

The Impact Statement Boondoggle

The demand for "impact statements" evaluating the environmental consequences of human activities in natural ecosystems seemed a natural outgrowth of the rise in ecological awareness of the 1960's. This idea, designed to protect our natural resources, has to some extent pacified the demands of ecologically concerned citizens. These citizens should have another look. Having seen the results of many of these impact studies, and evaluated proposals for second-generation studies. I believe that the idea has backfired.

Many politicians have been quick to grasp that the quickest way to silence critical "ecofreaks" is to allocate a small proportion of funds for any engineering project for ecological studies. Someone is inevitably available to receive these funds. conduct the studies regardless of how quickly results are demanded, write large, diffuse reports containing reams of uninterpreted and incomplete descriptive data, and in some cases. construct "predictive'" models, irrespective of the quality of the data base. These reports have formed a "gray literature'" so diffuse, so voluminous. and so limited in distribution that its conclusions and recommendations are never scrutinized by the scientific community at large. Often the author's only scientific credentials are an impressive title in a government agency, university, or consulting firm. This title. the mass of the report. the author's salary, and his dress and bearing often carry more weight with the commission or study board to whom the statement is presented than either his scientific competence or the validity of his scientific investigation. Indeed. many agencies have found it in their best interests to employ a "traveling circus" of "scientists" with credentials matching these requirements. As a result, impact statements seldom receive the hard scrutiny that follows the publication of scientific findings in a reputable scientific journal.

The advancement of the scientific method is also in jeopardy. First-rate natural scientists are finally learning to set and test hypotheses and to study mechanisms and processes that are important in natural systems, rather than simply to survey and catalog the systems. They are, however, usually not attracted to the undefined scientific problems, complex committee hierarchy. and unrealistic time constraints that are usually attached to ire-pact studies. Instead. such studies are often done by scientists who cannot successfully compete for funding from traditional scientific sources. In general, their methods are ancient. descriptive "textbook" techniques, which do not reflect either the many scientific advances of the past decade or the problems unique to the study undertaken. The same tired old bag of tricks is applied to studies of every type, regardless of the type of impact anticipated. The type of data generated cannot usually be extrapolated from one ecosystem to another. because studies were not planned with that as a major objective. As a result, each new study begins with little or no logical background, and no master plan for studying environmental processes is emerging. How well a particular study is funded is a direct function of the value of the resource to be affected. with no consideration given to (he amenability of the system to study or to the quality of science which might result. Enormous sums are therefore spent with little or no scientific return.

The continued application of such studies can have several effects. including increased prices for natural resources; a declining credibility for environmental science and scientists; a reduction in the overall quality of scientific personnel; and the degradation of our natural resources, not as the result of the direct activities of industry and government, but because of the ineffectual groping of environmental scientists.

If we are to protect both our resources and scientific integrity, environmental scientists must seek to put their studies on a scientifically credible basis—to see that problems, terms of reference. funding, time constraints, reports. and conclusions are all within a bona fide scientific framework.—D. W. SCHINDLER, *Leader, Experimental Limnology Project, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba, Canada*

PART II:

Spence Bay to Mansel Island,
Northwest Territories
March 1977

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1. General Purpose and Approach in this Study

The purpose of this study was to prepare maps and legends that could assist the planning of Environment Canada's 1977 field studies along a potential Polar Gas pipeline route from Spence Bay to Mansel Island, enroute to Nouveau-Québec. A previous report prepared by Western Ecological Services Ltd. in July 1976 provided similar information for the proposed Polar Gas pipeline route from Ellef Ringnes and Melville islands to Longlac, Ontario.

The first steps were to consider readily accessible existing information on terrain, hydrology, fisheries, wildlife and land-use along the route, and then to summarize the expected influences of a chilled gas pipeline upon these physical and biological features of the route. The next step involved a personal judgement on the possibility of avoiding the identified interactions between environmental features and pipeline activities. From this a list of predicted unavoidable consequences emerged. These remaining concerns were a guide to the suggested subject areas or geographic areas for additional research effort in 1977. In addition, some general criteria that aided identification of the most important environmental concerns are summarized in the concluding part of this report.

The specific terms of reference for this study, and for the study that preceded it in July 1976 for the Arctic Islands to Longlac proposed route, are attached in Appendix I.

2. Assumptions Made About Proposed Pipeline Project

Unlike the fairly specific proposed route from the Arctic Islands to Longlac, Ontario, a detailed route proposal was not available for the alternative that would extend southeastward from Spence Bay towards Kovik Bay in Nouveau-Québec. However, the latter alternative has been shown in generalized maps publicly distributed by Polar Gas. The approximate route shown on such general maps was taken as a broad corridor, about 15 mi. (24 km) wide, on the three map sheets that accompany this report. It was assumed that a route proposed by Polar Gas southeastwards from Spence Bay would fall somewhere within this mapped corridor. It was also assumed that this mapped corridor is not fixed so that avoidance of identified problems by route changes is a realistic option. If comparisons are made between this report and its earlier counterpart for the Arctic Islands to Longlac route, it is important to realize that the earlier report identified environmental concerns in relation to a fairly specific route proposal whereas the present report identifies such concerns in relation to a wider zone in which a specific pipeline route might be proposed later.

It was assumed for this report that the proposed gas pipeline would be buried and would be chilled at least to the southern limit of continuous permafrost. It was also assumed that all inter-island crossings would involve tunneling that would avoid the immediate coastline and bring the pipeline onto the sea bed at about 150 ft. (45 m) below sea level. In making judgments about the potential to avoid problems at stream crossings it was assumed that such crossings could be either buried or bridged.

3. Sources of Information

For environmental information along the proposed route, primary-emphasis was given to mapped information but a large number of technical reports were also checked. Although there was some reference to unpublished reports prepared by Environment Canada researchers on the basis of 1975 pipeline-related studies, most of these referred to areas north of Spence Bay. Interviews were not held with involved researchers in Environment Canada because one objective of this task was to present an opinion on priorities for 1977 research independent of opinions that may be held by the researchers themselves.

Atlas information from the Inuit Land Use and Occupancy Project (see reference 26) was available for the analysis from Spence Bay to Mansel Island but was not available in July 1976 when the analysis was carried out for the route from the Arctic Islands to Longlac. Appendix II shows two examples, for the Pelly Bay and Southampton Island areas, of the kind of mapped" information that is now available for the analysis from Spence Bay to Mansel Island. Similar information compiled by the Boreal Institute for Northern Studies for Inuit Tapirisat of Canada (reference 5) was available for both this analysis and the July 1976 analysis. However, it must be stressed that if there are to be comparisons between the three map sheets of this report (sheets 5a, 6a and 7a) and map sheets 5, 6 and 7 of the July 1976 report then the latest published " information from the Inuit Land Use and Occupancy Study (references 25 and 26) must be considered in conjunction with what is already shown on map sheets 5, 6 and 7.

All sources of information are listed at the end of this report, numerically in alphabetical order. The second column of each map legend identifies by number the sources of information for any given row in the legend. Where no numbers appear in column 2 of the legend, the information in that row is based on the judgement or knowledge of the contractor.

4. Methods of Summarizing Available Information

The potential pipeline route was divided into three segments (Fig. 1) each approximately 250 mi. (400 km) long and 125 mi. (200 km) wide. On each map sheet the potential pipeline route appears as a zone about 15 mi. (25 km) wide and this zone is arbitrarily divided into 50-mi. (80-km) segments, a common length of a pipeline spread during construction. These five 50-mi. (80-km) segments on each map sheet coincide with five vertical columns in the legend below in which information is summarized.

The original request from the Arctic Islands Pipeline *Program Study Board, for the work completed in July 1976, was to consider an assumed zone of influence 100 mi. (160 km) wide (50 mi. [80 km] on either side of the route). This was changed to include the entire map sheet as the "assumed zone of influence". In either case, this is a very arbitrary "zone", especially for migratory species or for things that move with water or air masses. It must be stressed that the "zone of influence" considered here (the map width of about 125 mi. [200 km]) is not intended to imply that this is the expected zone of "biological influence" of the proposed project. In a broad sense, defining the zone of influence is itself a high priority research need in proposed projects of this kind.

For items 1.2, 1.3, 1.4, 1.6, and 1.7, in the first column of the legends the emphasis is upon features that would be directly intersected by an assumed pipeline route. Similarly, for items 2.2 to 2.6 under environmental concerns the emphasis is upon features that would be directly in the path of an assumed route. In contrast, the word "zonal" in item 1.5 refers to features that occur anywhere across the width of the map sheet for any given 50-mi. (80-km) segment of route; item 1.8, special environmental features, can also be located anywhere across the width of a map sheet. Similarly, item 1.1 (physiography), 2.1 (water quality), 2.7 (wildlife harassment), and 2.8 (resource-use conflicts) were considered on a zonal basis rather than a right-of-way basis. In a few cases, features off the map sheet are also mentioned, such as the core area for polar bears on the east coast of Southampton Island.

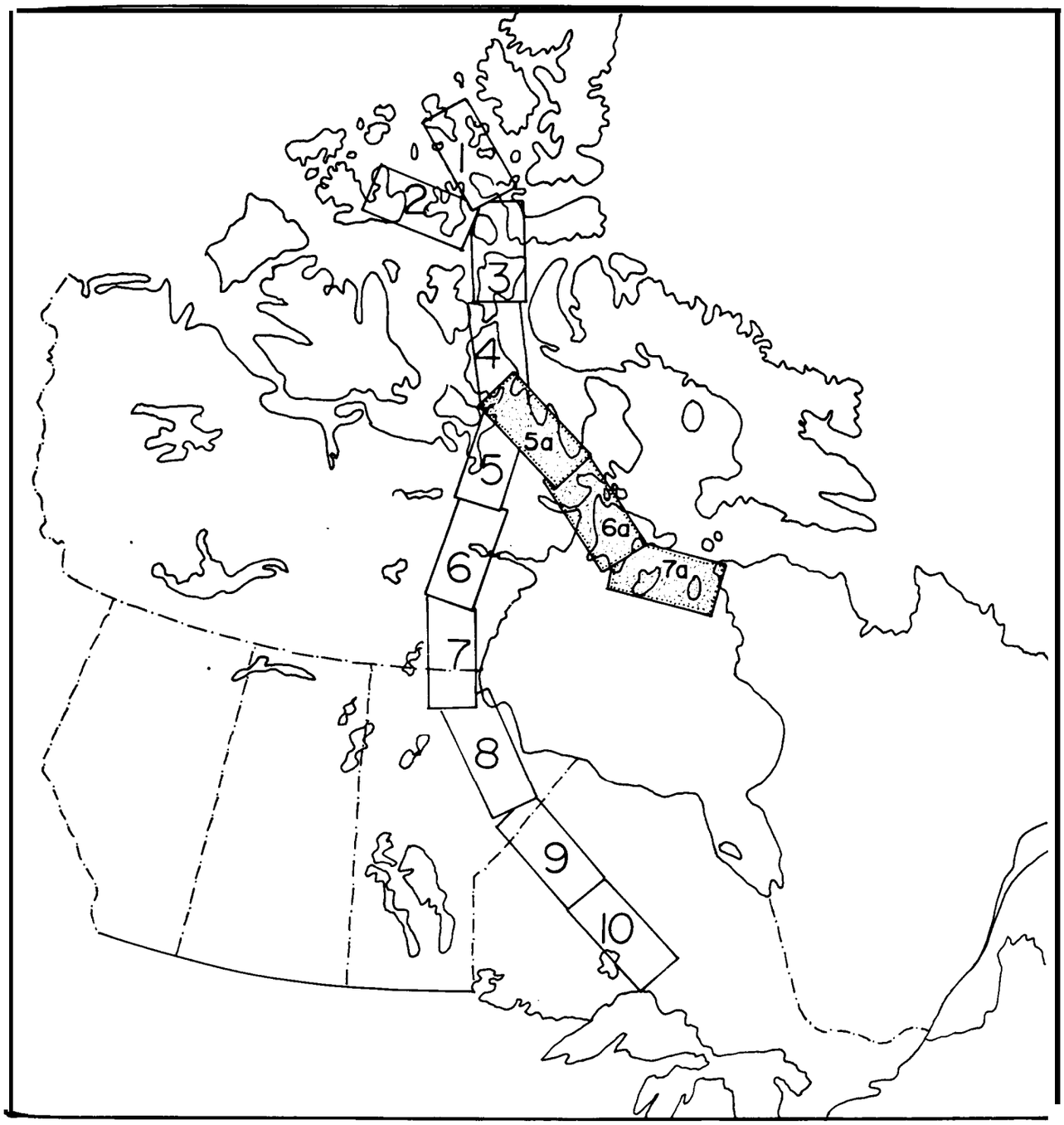

Fig. 1. Index map of potential gas pipeline route from Spence Bay to Mansel Island, N.W.T. (maps 5a, 6a, and 7a) and potential route from Arctic Islands to Longlac, Ontario (maps 1 to 10)

4.1 Environmental features

Environmental features could not be comprehensively described in tabular form for any given 50-mi. (80-km) segment. Any environmental features, such as climatic parameters, that were unlikely to have distinct section-to-section variations were excluded. This analysis gave more attention to features on land than to marine features near the proposed route. This was not meant to imply that such a project would not result in important changes to marine ecosystems; emphasis was simply placed on terrestrial ecosystems because there is no publicly available information yet on marine and coastal locations that would be proposed for supply and staging facilities for such a project. Marine mammals that interact with the land (polar bears, seals, seabirds) were considered in the vicinity of the proposed route on land, but the geographic area of research interest for marine species should be broadened when locations of proposed marine industrial activities are known. In many cases this would require an analysis well beyond the geographic area portrayed on map sheets 5a, 6a and 7a.

In the section entitled environmental concerns, comments were limited to those items judged to be of most importance. For example, loss of habitat used by muskoxen, migratory waterfowl, or polar bears is a feature that would have been identified, whereas loss of habitat important to lemmings or passerine birds would not have been listed. The main criteria used in these judgments are outlined in Section 6 of this report.

For surficial materials (item 1.3) notes were restricted to those features thought to be most relevant to engineering activities. In general, the environmental features identified in items 1.1 to 1.8 of the legends were kept to a manageable level by a rigid, but often arbitrary, selection of only those features that were judged to be the basis of environmental concerns (second part of legend).

References are provided in column 2 for most of the environmental features and this section of the legend relied mainly on maps and reports, and very little on the personal experience of the contractor.

4.2 Environmental concerns

A selection similar to that described for environmental features was used to restrict the environmental concerns to those thought most important. These concerns were drawn from reports wherever possible but an increasing degree of judgement on the part of the contractor was involved in this part of the map legend.

4.3 Potential for avoidance and residual impacts

These two sections of the legend were based almost entirely on the judgement of the contractor. The possibility of routing changes, engineering design changes, and stringent regulation by responsible agencies were the bases for considering that some environmental concerns could be avoided.

4.4 Research needs

Although this section of the legend is largely the contractor's judgement, it incorporates suggestions for research that have been identified in various reports. In many cases, the judgement required a decision on where along the potential pipeline route a particular research activity would best be focussed.

There were two guiding principles used to reduce the potentially large number of pipeline-related research topics. The first was to assume that Environment Canada personnel would be required to comment upon the adequacy of the Polar Gas application with the benefit of only one more season of field work (1977-78). Therefore, primary emphasis was given to research suggestions that could be reasonably undertaken in one year. The second guiding principle was that certain geographic areas are of such biological importance, and have such a high potential of resource use conflicts, that pipeline-related studies should be focused there and, if necessary, should also include scientific investigations that may require more than one year to yield useful information. In some places, for example in the part of Southampton Island that seems to have some

potential for oil shale development or the Murchison Lake area where there is a high uranium content in the glacial drift, it was also suggested that studies should be designed to consider interactions between the gas pipeline and other industrial projects that could be stimulated by a nearby energy supply.

5. Generic Concerns that are not Geographically Specific

This study was based only on a knowledge of the currently proposed route; information on likely locations of compressor stations, logistics bases, camp sites, or coastal staging areas was not available. These related activities will result in additional environmental concerns that cannot yet be geographically specified. In addition, certain concerns or research needs cannot be geographically precise even if all locations of proposed facilities are known. Research needs associated with: (i) contingencies (summer repair, accidental spills of hazardous substances); (ii) aesthetics (noise levels or restoration of local disturbances) ; or (iii) air quality ($S0_2$ levels) are all examples of topics that have no predictable priority along any specific segment of an assumed pipeline route. Generic concerns of this kind were omitted from the information summarized on the maps and legends and need to be considered as complementary requirements by anyone planning comprehensive pipeline-related studies.

6. Criteria for Identification of the Most Important Residual Impacts

Potential problems that were thought to be avoidable were not listed in the part of the legend entitled, residual impacts. For most of the area from Spence Bay to Mansel Island, existing information left no choice but to indicate that the residual impacts on water quality and drainage alteration are unknown. For terrain disturbance, wildlife disturbance, and land-use conflicts there was more information available to indicate where problems seemed inevitable. It was realized that even more refined lists of predicted residual impacts must, at some stage, face the question of whether the predicted effect is important enough to warrant an expensive research program. The answer to this question is as much political as it is scientific and it is difficult to identify research that would help answer this question. Probably the best approach in planning a research program in response to this question is to consider the external criteria that give particular environmental concerns more urgency. The following criteria were the main ones used to arrive at the judgments presented in the accompanying set of maps and legends.

(i) *International treaty obligations* - it was assumed in this analysis that more research effort should be devoted to the habitats and populations of species for which Canada has treaty obligations (polar bears, migratory waterfowl) than to other species such as caribou, even though the latter may be of great economic importance locally.

(ii) *Interference with harvesting of biological resources* - resource harvesting areas around Pelly Bay, Repulse Bay and Coral Harbour create areas of more environmental concern than would be expressed for a comparable level of environmental disruption outside of the intensively harvested zones.

(iii) *Rarity of particular species* - rare and endangered species and the habitats on which they depend are readily accepted criteria for extra concern and research effort.

(iv) *Habitat that is locally critical to the survival of particular species and in some cases populations* - for example, harassment in the vicinity of a walrus hauling-out area was judged to be more significant than a comparable amount of activity in other parts of this species range.

(v) *Factors that influence the reproductive capability of populations* - just as chemical contaminants are judged to be more dangerous if they weaken the reproductive potential of a species so also should above-average concern be expressed for habitats that are necessary for reproductive phases of fish and wildlife life cycles. For example, greater emphasis was given to caribou calving grounds or goose nesting areas than to habitats that are used only sporadically by these species for non-reproductive activities.

7. Summary of "Research Needs as Presented on Maps and Legends

Users of the accompanying maps and legends should take them as general background information on the possible environmental changes that could accompany the construction of a gas pipeline from Spence Bay to Mansel Island. A critical review of this preliminary inventory is now needed from others who are familiar with field conditions along various segments of the potential route. To aid such a critical review the sections below summarize the contractor's opinion on geographic areas that deserve research attention during the remainder of the study program.

7.1 Geographic areas along route where most significant and controversial conflicts with biological values are expected

Map 5a -- Becher River, Arrowsmith River and Kellett River area near Pelly Bay.

Map 6a -- Hansine Lake-Thomsen River-Duke of York Bay on Southampton Island.

Map 7a -- Fisher Strait, Walrus Island, Bencas Island and all of Coats Island.

7.2 Geographic areas where inventory data should be obtained over a wider zone in anticipation of route alternative questions

Map 5a -- research to determine least disruptive crossings of Becher, Arrowsmith and Kellett rivers.

Map 6a -- resource harvest area on mainland between Christie Lake and Snowbank River; Hansine Lake-Thomsen River-Duke of York Bay area on Southampton Island; Coral Harbour-Mount Saorre-Bear Cove Point area of Southampton Island

Map 7a -- research to determine whether any part of Coats Island is acceptable as a route alternative.

7.3 Geographic areas that call for special attention by some-of the specific research disciplines within the Department of Fisheries and Environment

Hydrologic studies -

Map 5a -- areas of marine deposits from Simpson Lake past Pelly Bay to Curtis River

Terrain and vegetation studies -

Map 5a -- areas of marine deposits from Simpson Lake past Pelly Bay to Curtis River

Map 6a -- headwater area of Boas River southeastwards to Bear Cove Point on Southampton Island

Wildlife inventory studies

Map 5a -- peregrine falcon inventory between Simpson Lake and Ellice Hills; inventory to obtain more detail on caribou and muskoxen habitats between Arrowsmith River and Christie Lake area

Map 6a -- wildlife inventory for route alternative questions in Duke of York Bay area

Map 7a -- general wildlife inventory of Mansel Island to determine if any significant habitats or populations have been overlooked during cursory visits in the past

Wildlife behaviour studies -

Map 6a -- marine mammal harassment in Repulse Bay and Roes Welcome Sound; waterfowl harassment between Duke of York Bay and Bear Cove Point

Map 7a -- marine mammal harassment in Fisher Strait; polar bear harassment on Mansel Island if inventory indicates significant polar bear population on this island

Fisheries studies -

Map 5a -- Simpson Lake, Becher River, Arrowsmith River, Kellett River
Map 6a -- Hansine Lake', Thomsen River, Cleveland River, Salmon Pond, Sutton River

Marine mammal studies

Map 6a -- Repulse Bay and north end of Roes Welcome Sound with emphasis on winter inventory
Map 7a -- Fisher Strait

If budget constraints or requirements for shared logistic support dictate that several agencies within the Department of Fisheries and the Environment are to work from one location between Spence Bay and Mansel Island, the Pelly Bay area seems to be the part of the route most in need of integrated scientific studies. Questions of potential terrain and vegetation disturbance, water quality changes, and drainage disruption are logically focussed in this area because of the relatively large area of fine-textured marine deposits. Fishery and wildlife questions also tend to be focussed in the Pelly Bay area because of the productivity of the Becher, Arrowsmith and Kellett drainage systems, the harvest of fish through facilities of the Pelly Bay Co-operative, and the nearby presence of important populations of polar bears, caribou, muskoxen and raptorial birds.

Although seals are important in the economy of Pelly Bay residents, studies of marine mammals would be more logically centred in either the Repulse Bay area or the Coral Harbour area instead of Pelly Bay because Fisher Strait, Roes Welcome Sound and Repulse Bay are areas of more uncertainty regarding migrations and seasonal distributions of a relatively great variety of marine species. In relation to marine resources, it is stressed that some of the most serious environmental disruptions and most pressing research needs are apt to arise from associated marine activities which are not yet known for the Polar Gas Project. Questions of disruption to marine ecosystems and populations will need to be considered in detail as more information becomes available on likely shipping lanes and off-loading areas for industrial equipment.

8. Comparison of Spence Bay - Mansel Island Potential Route with Spence Bay-Manitoba Border Potential Route

It was not the purpose of this study to compile the relative merits of the two route alternatives within the Northwest Territories, southwards from Spence Bay. However, departmental officials may wish to use this background information for such a comparison. To assist those wishing to make such a comparison, some of the obvious differences and similarities between environmental and land-use features shown on maps 5a, 6a and 7a versus maps 5, 6 and 7 can be summarized as follows:

Spence Bay to Manitoba Border (maps 5, 6 and 7)	Spence Bay to Mansel Island (maps 5a, 6a and 7a)
Predominantly lowland	Predominantly lowland, except if route would pass over north-east corner of Wager Plateau (Ellice Hills area)
Relatively high proportion over bedrock and glacial till	Relatively high proportion over limestone terrain of Hudson Bay lowland
Significant areas of problematic marine deposits involved (ground ice problems comparable between two alternatives)	Significant areas of problematic marine deposits involved (ground ice problems comparable between two alternatives)
Greater number of major river crossings; no marine crossings	Relatively few major river crossings; four marine crossings involved
Little or no focus on marine mamma 1s	Major focus on marine mammals and settlements dependent on harvest of marine mammals

Spence Bay to Manitoba border (maps 5, 6 and 7)	Spence Bay to Mansel Island (maps 5a, 6a and 7a)
Major focus on migratory routes of caribou	Little focus on migratory routes of caribou
Potential route some distance from internationally important goose breeding areas (McConnell River)	Potential route very close to internationally important goose breeding areas (Boas River and Bear Cove)
Potential route near one settlement (Baker Lake)	Potential route near three settlements (Pelly Bay, Repulse Bay, Coral Harbour)
Relatively few archaeological sites recorded near potential route (although many undiscovered sites may be present)	Relatively large number of important archaeological sites already recorded near potential route
Mainland offers considerable geographic latitude for route alternatives around biologically important areas	Coats Island, all of which is biologically important, offers little choice for route alternatives

Detailed study of the accompanying maps and legends along with those submitted in a separate report in July 1976 will reveal many additional points of difference between the two route alternatives.

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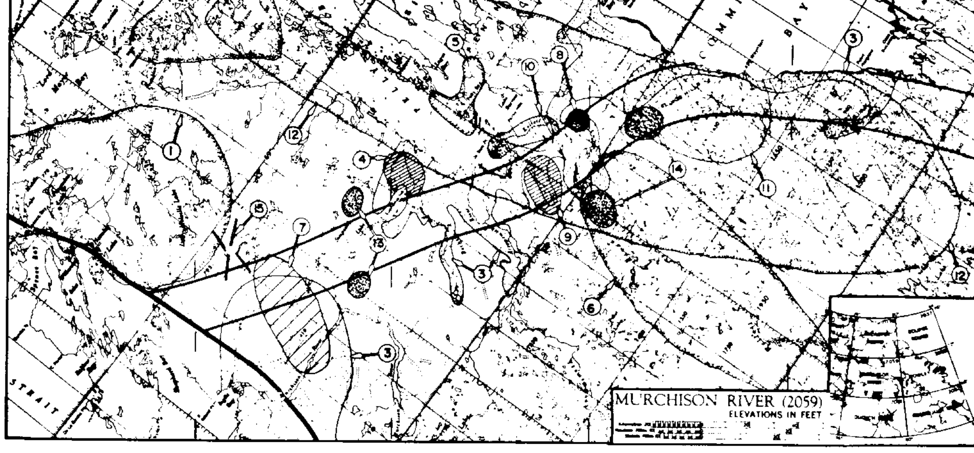
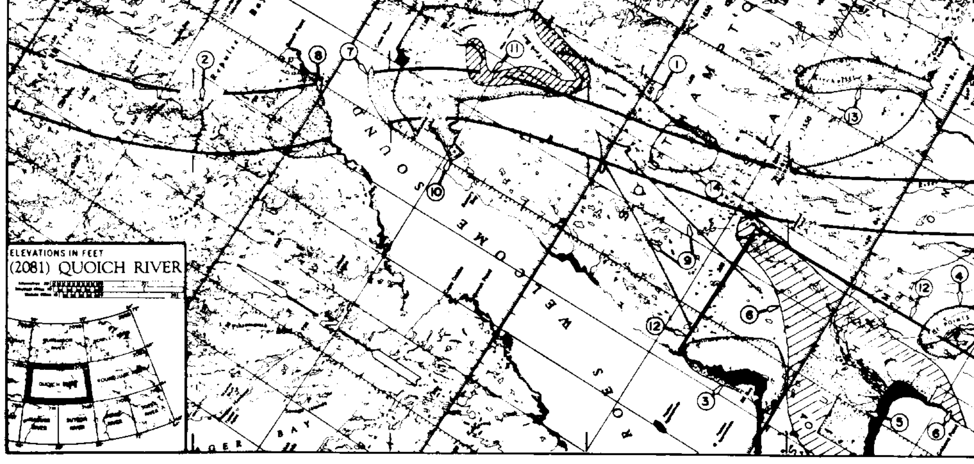
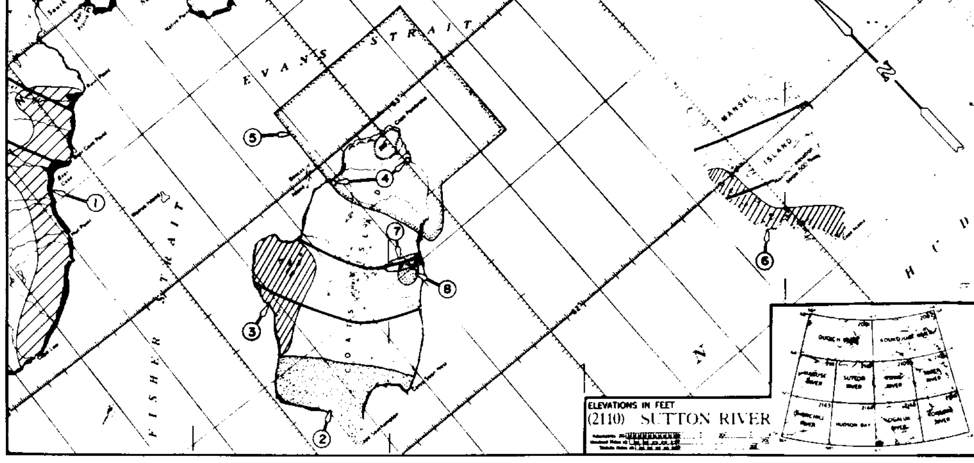


ENVIRONMENTAL FEATURES	EFERENCES see text)					
1.1 Physiography	4,6,17,47	Netsilik Lowland dominated by drumlinoid forms that give linear orientation to drainages & lakes	Precambrian bedrock (mainly granite & gneiss); Boothia upland erosion surface between Simpson L & Pelly Bay	Predominantly rock outcrops with intervening areas of till plain	Land on west side of Committee Bay is low until rise of Ellice Hills; rough topography of Boothia-Somerset Arch in vicinity of Ellice Hills	Rolling uplands with some drift cover except for narrow coastal fringe
1 2 Ground ice Potential (on route)	4,6,41,42	Numerous frost cracks, mud boils, sorted circles in this section; patterned grd on marine deposits W of Netsilik L.	High potential for grd ice in nearby marine sediments [3]; in these sediments active layer is so shallow there is no subsurface drainage	Between Committee Bay & Rasmussen Basin, ice-rich marine silt plain & extend well up entrenched valleys from Arrowsmith Ri permafrost table within 1 m in these 3 sections; massive len ice in marine deposits; shallow thermokarst lakes on sand pl		ary lower parts of coastal SE to Curtis River [3]; blocky veins of ground
1.3 Surficial Materials (on route)	4,6,17,47	Eskers in Ross Hills area & many drumlinoid landforms around Netsilik L; drumlinoid drift reworked by waves into strandlines	Generally discontinuous veneer of granitic till, except for area of fine-grained marine sediments [3]; area of drumlinized landforms along route S of Lady Melville L.	Discontinuous veneer of granitic till; some outwash deposits near Simpson L & towards Pelly Bay; badland topog in dissected marine silts near Pelly Bay	Large drumlins (uncommon in Cdn. Arctic) are common in drumlin fiel of Committee Bay; some eskers near route E of Kellett R	Very little mantle of glacial deposits over bedrock around head Committee Bay; ice-rafted boulders in areas of marine submergence
. . River Crossings (on route)		No major river crossings	Headwaters of Inglis R & Murchison R	Becher & Arrowsmith Rivers	Kellett River	Curtis River
1.5 Fish 6 Wildlife (zonal)	5,11,26 33 . .	Netsilik L imp. . . lake . . trout 6 whitefish [1]; Polar bear d . . ". ".area . . . . . . Harrison Is [2]; Spence Bay residents . . . area to S end of Netsilik L.	[E] . . . caribou harvest . . . Lady Melville L to vicinity of Pelly Bay; major summer caribou range S . W of head of Pelly Bay; sandhill cra ne area [4]	Former wolf . wolver . . . narves t areas along proposed route in Becher R area; Kugajuk is imp arctic char river [5]; waters around Pelly Bay rich in seals	Pelly 8 . . . Keith Bay primary habitat for bearded , ringed seals; all of Simpson . . . . critical for polar bear denning; wintering area for barren ground caribou [6]	ribou h . , " . . , ... from Curtis area SE to Snowbank , area; suspec wintering of caribou . . Prince Alb Hills on , shore of Committee Bay
, 6 Fish , Wildlife (on route)	,11,25,26	Waterfowl harvest area . . W from Netsilik L; fish harvest area from . side of Willersted L to Pelly Bay; ice fishing at N ' , ends of Netsilik L	Intensive caribou huntings S of Netsilik L, along Inglis , Murchison Rivers; some polar bear denning [7]	Route would intersect fish harvest areas along . . . . . . & Arrowsmith Rivers; muskox area crossed by route S of Pelly Bay; sandhill crane area [9]	Route would intersect whitefish harvest . . . . along Kellett R [10]; Ellice " , . . . imp for . . . . . . some muskoxen [11]	Fish harvest . . . . Point Hargra small herds of muskoxe " at the head of Committee Bay
1. 7 Vegetation (on route)	,16,23,41	Near northern limit of low arctic ericaceous vegetation; nearly continuous cover . . . . & eroding surfaces	50 to 80% cottongrass tussock tundra on poorly drained marine silts; . . . . Alectoria on rocky upland	Earth , . . geta tion hummocks with 10 to 30 cm relief dominate the marine silts ● clays, making ground travel . . . . ", summer . . . . , strong bedrock relief with parse . . . . in areas not inundated by marine deposits		Alectoria -Hier chloe . . . . "d, up.ar flats; Saxifraga- Silene in rock fields; Carex-Eriophorum on lower slopes; . ?, ... veg. in scattered low meadows & near late snow patche
1.8 Special Envir Features (incl. IBP sites, sanctuaries)	!5,26,35		Former muskox hunting area centering around Simpson Lake; two peregrine falcon areas near Simpson L [13]	Former muskox hunting areas near headwaters of Becher, Arrowsmith & Kellett R; very ancient Palaeo-Eskimo sites between mouth of Kellett R & Pelly Bay settlement	Two peregrine falcon areas in headwater areas of Kellett R.[14]	
ENVIR. CONCERNS						
!.1 Water Quality		aterfowl . taging area in Inglis Bay makes water quality intenance especially important	Biologically imp. . . . ", downstream . . Inglis ● Murchison Rivers requi re maintenance of present water quality	Becher, Arrowsmith ' Kellett Rivers are all very imp. biologically so water quality changes are . major concern		Water quality changes in vicinity of Point Hargrave , ishing . . . . or
!.2 Drainage Alteration		Marine deposits W of Netsilik L. have high water table in summer so any summer construction could disrupt drainage	Probably no major concerns except if route would pass through fine-textured marine deposits with high water table	High potential for drainage alteration where route would cross ice-ri marine silts between Arrowsmith R & Curtis R; Canada geese & snow gee use margins of some parts of Kellett & Arrowsmith Rivers so drainage changes there could be critical		No obvious major concerns
!.3 Terrain Disturbance	6	Any areas with fine-textured marine deposits have high potential for terrain disturbance	Murchison R - Simpson L valley system infilled with marine silts & clays 10-15 thick with high potential for dist. because of ground ice	High potential for terrain disturbance if route would pass through ice-rich marine silts between Arrowsmith R & Curtis R; low-angle earthflows common along river channels		No major terrain problems expected except in marine sediments near Curtis R
.4 Vegetation Disturbance		Significant vegetation disturbance possible because there is a large area with high ground water table from Nitsilik L. to Murchison R	Significant veg. disturbance possible in areas where high content of ground ice; no problems expected on rocky uplands	Significant veg. disturbance possible in areas where high content of ground ice; no problems expected on rocky uplands	Significant veg. disturbance possil in areas where high content of ground ice; no problems expected o rocky uplands	Significant veg. disturbance possib: in areas where high content of ground ice; no problems expected on rocky uplands
!.5 ☐ isr. tm. Disruption (fish & wildlife)	2.	Relatively intense resource harvest pressure around Spence Bay so even small migration disruption could be significant here	Traditional caribou crossings at Oatliirq (a lake NE of Simpson L) & Ibjurtuuq (a lake NE of Murchison L)	Becher R. fished during spring down-stream run of char; Kellett & Arrowsmith R. also fished for char; disruption of these runs should be avoided	Potential disruption of whitefish that are harvested along the Kellett R.	Potential disruptions of migration routes because of caribou in area
!.6 Habitat Loss (fish . wildlife)	25	Because of domestic fisheries in this section any habitat loss would be significant	Trapping areas S of Lady Melville L. [15] indicate that habitat loss in this area could be of considerable local concern	Main caribou area is now south of headwaters of Kellett & Arrowsmith Rivers, so proposed route may not pose any threat	Main concern in this section would be potential loss of habitat used by peregrine falcon	No significant habitat losses expected in this section
!.7 Wildlife Harrassment	25,40	Relatively intense resource harvest pressure around Spence Bay so even relatively minor harrassment may be significant	Polar bear denning area near proposed route [7] & falcon areas[13] are main regions of potential harrassment in this section	Main muskox area is now further SW from head of Pelly Bay, in upper Hayes R. area; area of known polar bear kills is in N 1/2 of Pelly Bay	If route passed near areas used by peregrine falcon significant harrassment possible	If muskoxen present near proposed route, harrassment is major concern
!.8 Resource Use Conflicts	26,37,38 44,47	Since 1969, southern part of Boothia Peninsula & mainland S of Spence Bay are areas most intensively hunted	Former trapline routes on S side of Simpson L and around lake S of Lady Melville L [15]; High uranium values in tills of Simpson L - Murchison R. area	Kellett R. used for fishing (incl. ice-fishing [8]; near-shore areas of Pelly Bay hunted for seal; avge. annual harv. of 12 polar bears & 333 foxes at Pelly Bay	Resource harv. areas most intensivel used by Pelly Bay residents (1969-7 along proposed route is between Arrowsmith R & Curtis R [2]	oapstone area N of Stewart Lake & ishing area around Point Hargrave re main areas of possible esource-use conflict
OTENTIAL FOR VOIDANCE						
..1 Water		Unknown	Local route changes could not avoid crossing of tributaries of Murchison R & Simpson L. drainage system, so some water quality changes are likely	If route must cross areas of ice-rich marine sediments, surface erosion & siltation are likely unavoidable; Becher, Arrowsmith & Kellett R are all very imp. biologically & routing changes would not eliminate crossings of these rivers		Unknown
.2 Drainage		Drainage alterations likely . . . . ," areas of marine deposits with high . . . . . table	Unknown	Changes to local drainage patterns . . . likely unavoidable if route must • • • • • ". . . ofice-rich marine sediments		No obvious problem areas to avoid
3 Terrain . Vegetation		Significant . . , . . . ," disturbance unavoidable . . ice-rich marine deposits	Any areas below altitude of 228m that are overlain with marine sediments h . . . high potential for disturbance, especially " h . . . earth and vegetation hummocks are prominant			Probably no significant terrain or vegetation problem areas to avoid in this section
. 4 Fish . Wildlife		Long-term changes through increased hunting . fishing pressure likely unavoidable	Proper routing may be able to avoid polar b . . . denning . . ". . . . . sed by peregrine	The relatively great variety of wildlife and fishery resources in the Pelly Bay region " . . . complete avoidance of all biologically important . . . . likel .		C . . . . . . routing , scheduling ", be able to . . . . fish or wildlife problems in this section
.5 Resource " . . Conflicts	33	Avoid . . . . of area s of future resource h . . . . ". importance may not be possible , ... cases	Local adjustments to routing may be able to . . . . . r • • • used for trapping	Pelly Bay hunters tend to prefer hunting along E coast of Pelly Bay as far E as Keith Bay for seals; route would miss these imp. hunting	Unless diverted far to the SW, proposed route would not be able avoid crossing area that is intensively used by Pelly Bay residents	No major problem areas that could not be avoided by appropriate routing
SIDUAL IMPACTS						
, Water Quality		Unknown	Unknown	Unknown	Unknown	nknown
2 Drainage Alteration		Possibly . . . ous impact	Unknown	Possibly serious	Possibly serious	Nil o r.o.
3 Terrain Vegetation		Nil or low, except on fine-textured marine deposits	Nil or low, except on fine-textured marine deposits	Potentially serious . . . . and vegetation . . . . if route is to cross areas of earth and vegetation hummocks		Nil . . low
4 Fish & Wildlife		. . . . high	Could be rel. low impact . . fish . wildlife if proper routing	Potentially serious impact, especially on . fishery	Potentially serious impact, especially . . fishery resource	robably low, depending on istribution & abundance of caribou muskoxen
5 Resource Use Conflicts		Major resource-use conflicts likely inevitable in Netsilik L harvest areas	Nil or low if . . . . rout ing	Major resource -use conflicts likely inevitable in areas used for , " . . . . harvesting by Pelly Bay residents		Nil or low
SEARCH NEEDS		Further studies of locations of marine clays & consequences of disturbances to these clay areas; research to assist optimal route selection to achieve least disruption to traditional land uses in Netsilik L area	Presence of areas used by peregrine falcon suggests that more detailed inventory of falcon habitat should be undertaken unless recent, unreported information already exists	More detailed assessment of potential for polar bear denning around S en of Pelly Bay; inventory to determine consequences of crossing areas of earth & vegetation hummocks; major fishery & wildlife studies would be needed to accurately predict consequences of various route alternatives through region intensively harvested by Pelly Bay residents [2]; Becher Arrowsmith & Kellett Rivers all deserve special attention in areas of potential river crossings; more detailed inventory of areas used by peregrine falcon		his . . . tion . . . . to be of lower riority for , ield studies except . obtain better understanding , caribou and muskoxen opula tions in this . . . .



ENVIRONMENTAL FEATURES	REFERENCES see cont)					
1.1 Physiography	2,3,4,7	Mainly Precambrian rock (mainly granite & gneiss); small area of post-glacial marine submergence at W end of Repulse Bay	Exhumed sub-Paleozoic rock surface with rel. little drift cover on W side of Roes Welcome Sound and S of Repulse Bay	Low topography of Hudson Bay Lowland; within area of post-glacial marine submergence; underlain by nearby level limestone strata; conspicuous meltwater channel N of Hansine L	Rolling topography of Hudson Bay Lowland; Mt. Saorre marks W edge of Precambrian rock [1]; W half underlain by limestone strata	Low topography of Hudson Bay Lowla entire route across Southampton Is would remain below 250 ft contour routing W of Precambrian rocks
1.2 Ground ice Potential (on . ...)	4,15,32	Small area of marine sands and silts at W end of Repulse Bay [2] is potentially ice-rich	Little potential for ground ice because of predominant bedrock	Frost-shattered limestone as a result of mechanical weathering in active layer which can be as much as 8-9 ft deep on higher limestone plateaus, ranging down to a few inches deep in low marshy areas near coast of Southampton Is.		Well-veg. polygons near lakes on S Southampton Is; icings have been mapped on Boas R; thaw lakes along Boas R.
1.3 Surficial Materials (on route)	2,4,7,23	Area of druminized landforms between Repulse Bay & Committee Bay; eskers on route W of Repulse Bay: ice-rafted boulders in area of marine submergence	Rock outcrops common, with some sand & gravel in depressions, along water courses and between points on rock knob coastline of Roes Welcome Sound	Many prominent elevated strandlines; limestone coastlines; weathering of limestone is so intense that rock outcrops are difficult to find; fluted pattern (grooves 10 to 15 ft deep) in limestone ground moraine on W sid of Is; rel. large druminized moraine near headwaters of Cleveland R [14]; major eskers and druminized moraine near Sutton R.		
L,. "..., Crossings (on route)		No major river crossings on Rae Isthmus	No major river crossings	"■ , (drainingHansineL)	Headwater tri butaries of Cleveland R and Boas R	Sutton ,
1.5 Fish , Wildlife (zonal)	11,25,26 31,34,36	Caribou harvest area from Curtis R SE to Snowbank R; wolf denning area near Christie Lake	Beluga, harbour seals, bowhead whales migrate through Roes Welcome Sd; fish, whale, seal, waterfowl harv; summer narwhal conc. in Repulse Bay and along NE Southampton	Whistling swans & Canada geese scattered through all of Hudson Bay Lowland; whales, walrus, seals & polar bear harvested in Duke of York Bay at various times in the past	Route is along W edge of mapped polar bear harvest area; Canada geese & whistling swans scattered over all of Hudson Bay Lowland; Atlantic Brant breeding at Ell Bay[3]	Critical polar bear denning on The Points [4]; large breeding colony (snow geese in Harry Gibbons Bird Sanctuary [5] & critical waterfowl feeding area beyond sanctuary [6]
... Fish , Wildlife (on route)	11,14,22, 25,26,30	Christie L, N Pole Lake & Miles L are major char & trout fishing areas; many local fox denning areas between Christie L & Snowbank R.	Former seal harv. area near Cape Munn [7]; caribou harv. area on coast in Snowbank R. area [8]; major seal conc. area at mouth of Snowbank R.	Mouths of Thomsen & Cleveland R & Hansine L area fished for char in fall, plus lake trout and whitefish	Migration area & summer sanctuary for polar bear [9]; good summer range for caribou along Boas & Cleveland R, but S Bay Lowland most imp. part of Is. for caribou	1 of 14 main breeding concentration of blue-snow geese in Canada is on Boas R (25,000 birds); Salmon Pond imp. for char & lake trout
1.7 Vegetation (on m m.)	1,2,7,11 23,30,32	Irregular terrain results in late-summer snowbanks at bases of cliffs with lush veg. near snow-banks; in general, more lush veg. near Repulse B than further inland	Veg. between Wager Bay & Repulse Bay rel. abundant compared to that on Southampton Island	Slightly greater density of veg. in more damp hollows in fluted limestone ground moraine; richer flora at Duke of York Bay than at Bears Cove Pt.	Rel. lush sedge & willow areas along Cleveland R in contrast to predominant *Dryas* & *Saxifraga* barrens elsewhere; lake margins well vegetated	Except for good lichen winter range W of Kirchoffer R, sparse veg. on limestone terrain around Coral Harb further NE on more acidic rocks almost continuous vegetation
1.8 Special Envir ,".,.... (incl. IBP	2,4,29	---	- - -	Stone house ruins on S side of Thomsen R near its mouth & many other archeol. locations in prop. IBP site 6-4 [10]; peregrine falcon breeding around Duke of York Bay [11]	Distinctive fault-line scarp between limestone & crystalline rocks E of Cleveland R; Proposed IBP site 6-5 around Boas R [12]	End moraines rare on Southampton Is one occurs at The Points; Harry Gibbons Bird sanctuary [5]; peregr falcon breed along Kirchoffer R [1
ENVIR. CONCERNS						
2.1 Water Quality	25	Between North Pole L. and Snowbank R nine arctic char streams or lakes are known (mostly near the coast), therefore water quality maintenance in these areas is very important		Hansine L & Thomsen R imp. for char, & marshy area at S end of Duke of York Bay is biologically imp; all of these could be disrupted by water quality changes	Cleveland River is important char stream, therefore water quality maintenance important	Sutton R is important char stream, therefore water quality maintenanc important
2.2 Drainage Alteration	3,4,7, 15,47	Any drainage alterations in Christie L. area would be of concern because of importance of freshwater fisheries NW from Repulse Bay	Significant concerns in rel. wide area of ponded drainage with water-logged pattern of shallow lakes & meandering streams in deeper glacial drift along Roes Welcome Sound	Drainage effects are unpredictable because many streams disappear beneath frost-shattered limestone regolith	Important not to cause drainage changes to lower reaches of Boas R. with braided channels & marshes that provide a vast nesting area for waterfowl	Zone of thaw lakes mapped in Boas area, with potential for drainage disruption if disturbed
2.3 Terrain Disturbance	2, 47	No major terrain disturbances expected except if route would pass through small area of marine deposits	Muddy underwater flats extend a considerable distance offshore on Roes Welcome Sound with potential for signif. disturbance during construction	Solifluction not observed in the lowlands except in some asymmetrical valleys near Coral Harbour; mass movement of materials in the limestone part of Southampton is limited; lack of good harbours & shallow, difficult approaches to coasts of Southampton would make staging of equipment difficult; marine clays on Southampton are restricted to deep valleys on east side of island and route would not likely cross any areas of ice-rich marine clays.		
2.4 Vegetation Disturbance	1,7	No major concern	In early summer, relatively abundant vegetation south of Repulse Bay but no major disturbances expected	Distinctive flat prairie-like area east of Cleveland R near Duke of York Bay may be worthy of special protection	South Bay Lowland (most important range for caribou) is well separated from proposed route, so no major concerns	No major concerns except for marsh areas important for waterfowl
2.5 Migration Disruption (fish & wildlife)	25	Recent increase in caribou in coastal areas around Repulse Bay, so there is potential for migr. disruption	Harp seals, harbour seals, white whales, narwhals & walrus migrate along coastal areas in this section with potential for disruption	Thompsen R is important char migration area that could be disrupted	Cleveland R is important char migration area that could be disrupted; some polar bear movements may be disrupted [9]	Sutton R is important char migratio area that could be disrupted
2.6 Habitat Loss (fish . wildlife)	25,39	A v e r a g eharvestof971 foxes /yr by Repul se Bay reside nts indicates that there would be local . oncern for . . . . of fox denning areas	Major conc ern „ this · ection „ pote ntial habitat disturbance during constructionis . . . . of . . . . concen-tration . . . mouth of Snowbank R.	W'cco'a'a't of Sout hampton never used for. amps....... of...... wildlife so main concern is wit h falcon hab . (Duke of York) · fishery in Hansine Lake-Thomsen River	Major f·xdenningarea··route in char fishing morainal upland north of Mt. Saorre [14]	Salmon Pond , . most .... fall . . . . island; potential loss of important feeding habi tat for waterfowl if marshes disturbed in limestone lowland
2.7 Wildlife Harrassment	24,27,39	Deep waters of Repulse Bay would favour it . . an off-loading port, with pote ntial for disturbance to marine wildlife, ... ringed seals & narwhal	Concern for . . . . . mammal disturb . . . . of their harvest by Repulse Bay . . . . (mean annual harvest of 669 ringed seal, 20 narwhal, 25 walrus ' 65 beluga)	migration area. perhaps over-wintering area for — whales; if latter true, high potential for	Core area for polar bears . . Southampton Island . also the "," r . . . of winter . . . by caribou ., to the E, well away from proposed route; waterfowl harrassment would be the main c o n cerns in these two . . . . ions	
2.8 Resource Use Conflicts	25,26,28,48	Major concentration of traplines on " side of Repulse Bay & extend S to Snowbank R; still some summer . . . of camps but . . . . all Inuit of region live in Repulse B.	Seal . . . . . harvesting . . . . route in Roes Welcome Sound; harbour . . . . intensively hunted near mouth of Snowbank	. of proposed route from Hans ine L. to Salmon Pond is , of , small areas mapped to be outside of area of Inuit land . . .	Several fox trapline routes between Salmon Pond Γ.. 6 Duke of . . . . Bay would be crossed by route; 99 oil h . ,. locat ions recorded between Duke of York Bay & South Bay	Greatest concentration of fox trap-line routes . . all of Southampton Island i. between Coral Harbour ' Salmon Pond; concentration of oil shale deposits in this area
POTENTIAL FOR AVOIDANCE						
3.1 Water Quality		Routing further inland would avoid some of the areas used by arctic char	Potential to avoid significant water quality changes in Roes Welcome Sound unknown	Disruption of Thomsen R could be avoided by routing south of Hansine L. area	Crossing of headwaters of Boas R. unavoidable by any route that remains W of igneous upland, so some water quality changes likely	Water quality changes likely becau crossing of Sutton R. unavoidable without re-routing to important habitat either E or W
3.2 Drainage Alteration		Unknown, but likely that local adjustments to route ", be able to . . ." undesirable effect in Christie L . ,"	Unknown	Some drainage changes " , not be . voidable b..."., of unpredictable nature of disappearing streams in limestone	Some drainage changes ... probably unavoidable in headwa ter areas of Boas River	Because Sal mon Pond area ,. importa for fishing harvesting, it " , be difficult to avoid significant drainage d , ... thi s vicini
3.3 Terrain ' Vegetation		Most problems should be avoidable by routing far enough inland to miss area of marine depos its	Probab ly major problems to avoid	. robably no major problems to avoid	If significant diffe rences in terrain sensiti vity . . limestone .. gneiss . . . " . avoidance of probl ems maybe diffic ult here because of indistinct boundaries between the two	No obv ious major terrain or vegetation problems to avoid
..4 Fish , Wildlife		Many of the important wildlife areas on land in this section are site specific (denning areas, specific lakes etc) so routing may avoid some problems	Use of Roes Welcome Sound & Repulse Bay for shipping & off-loading would result in unavoidable disturbances to marine species	Routing south of Hansine L. & some distance from Duke of York Bay could avoid habitat important for fisheries & for rare & endangered species	Large area used by polar bears & waterfowl so total avoidance of this habitat probably impossible; fox denning area may be avoidable	Some disturbances to fish habitats in Salmon Pond & Sutton R areas see unavoidable
3.5 Resource Use Conflicts	25	Because there is an intensively harvested area around Repulse Bay some resource-use conflicts unavoidable	Some unavoidable resource-use conflicts because of relatively intensive use by residents of Repulse Bay	No major resource use conflicts to avoid in this section	Not possible to avoid intersection of trapline routes between Salmon Pond area & Duke of York Bay without re-routing into important waterfowl habitat further west	Very important trapping routes & fishing areas between Coral Harbour & Salmon Pond are unavoidable by proposed pipeline route
RESIDUAL IMPACTS						
4.1 Water Quality		Unknown	Unknown	Unknown	Unknown	Unknown
4.2 Drainage Alterat .		Unknown	Unknown	Unknown	Boas R. has broad, ill-defined channel, so difficult to avoid some drainage disruption	Potentially serious because of importance of fish resources in Salmon Pond area
4.3 Terrain Vegetation		Nil or low	Nil or low	Nil or low	Unknown, but probably low level of disturbance to terrain and vegetation	The only major esker on the entire Island in vicinity of the Sutton R is nearly 40 mi long & would be unavoidably altered
4.4 Fish & Wildlife		Unknown, but likely nil or low for wildlife on land	Major concern for marine species in Roes Welcome Sound and Repulse Bay	Nil or low if no disturbance to Hansine L, Thomsen R and W coast of Duke of York Bay	Some unavoidable disturbance to area used by waterfowl for feeding & loafing	Potentially serious habitat changes in Sutton R-Salmon Pond drainage system
4.5 Resource . "		Inevitable resource-use conflicts because of relatively intensive use of area by Repulse Bay residents	Inevitable resource-use conflicts in portion of area used by Repulse Bay residents	Nil or low if no disturbances to Hansine L, Thomsen R & W coast of Duke of York Bay	This section is near enought to Coral Harbour so that there will be unavoidable resource-use conflicts	Great concentration of traplines & fish harvesting in this area makes serious resource-use conflicts inevitable
RESEARCH NEEDS		Detailed field studies justified in these two sections in anticipation of need to recommend best route alternatives through area intensively used for resource harvesting by Repulse Bay residents; research into consequences for marine species of any major shipping use of Repulse Bay		Little is known of present Hudson Bay stocks of bowhead whales & the imp. of Roes Welcome Sound in their life cycle & migrations; research to determine if bowheads overwinter in Roes Welcome Sound; studies to provide information on best route alternatives to avoid Hansine Lake-Duke of York Bay area	Some field reconnaissance probably needed to advise on best route alternative in headwater area of Boas R.	Any proposed wildlife, ... terrain or hydrology studies should focus on area of oil shale potential (triangle formed by Coral Harbour-Mt. Saorre-Bear Cove Point) which is also in vicinity of proposed pipeline route



ENVI..... RONMENTAL FEATURES	REFERENCES (see text)					
,., Physiography	4,8,30,32	Low topography on S Southampton Is; coastal area has many old beaches of limestone with shale cap	Low, rolling topography on Coats Is; limestone of Hudson Bay Lowland except for granite ridge at NE end of island		ry low topography on Mansel Is; inly horizontally-bedded limestone rt of Hudson Bay Lowland; nspicuous meltwater channel near ica	- - -
1.2 Ground ice Potential (on route)	32	Well-vegetated polygons near lakes on S Southampton Is. indicate presence of ground ice	No detailed ground ice studies on Coats Is.		No detailed ground ice studi es ▪ ▪ Mansel ▪	▪ ▪ ▪
1.3 ,",',.... Materials (on route)	4,8,15,32	Loose frost-shattered debris on limestone plains; low plain near coast covered by series of beaches separated by lagoons & marsh; limestone coastline	Till modified by marine transgressio many limestone gravel strandlines; drumlinized landforms in central part of island; limestone coastlines		> ", frost-sha ttered debris on rface; .",....... ridges of " m . . shingle on coastli nes	
1.4 River Crossings (on route)		No major river crossings in Bear Cove Point area	No river crossings		No river crossings	
1.5 Fish & Wildlife (zonal)	9,11,18,19,25, 26,30,38	Seals are harvested in waters between Bear Cove Pt. & Walrus Is; walrus harvest area between Bear Cove Pt. & Coats Is; char in Sutton R.	Est. 2000 caribou on Coats Is; all of Is. is imp range for caribou ; summer sanctuary for polar b.... caribou calving area [2]; NE Coats imp. walru hauling-out locations	rge pelagic concent rat ions of abirds in July-August in waters of Coat s Is and N of Mansel Is	rge pelagic concentrations of abirds in Sept-October off NE tip Mansel Is; suspected polar bear nning N end of Mansel ...	- - -
1.6 Fish & Wildlife (on route)	10,11,14, 21,25,26	Whales are harvested along coast from Coral Harbour to Bear Cove Pt; 1 of 14 main breeding areas in Canada for blue-snow geese is at Bear Cove [1]	Polar bear, walrus and seal harvest areas mapped along NE coast of Coats Is; caribou winter range intersected [3]; very few foxes on Coats Is; goose nesting near coastlines	- - -	June & July SW part of island is nctuary for polar bears [6]	- - -
1........... (on route)	2,8,20, 30,32	Marshy area at mouth of Sutton R at Ruin Pt; ... & ... dominant on beach ridges; Walrus Is mainly rock outcrop, with patches of ...	Rel. good lichen range of South Bay Lowland of Southampton is absent from Coats Is; Rel. lush veg. in low marshes inland from Carys Swan Nest	- - -	ry sparse veg (... & ...) h a few more productive areas of Arctagrostis & Eriophorum	- - -
1.8 Special Envir Features (incl. IBP ......)	4,9,12,13, 15,29,43	Dorset artifacts recovered from archaeological site on Walrus Is; caves in limestone coast are rare on Southampton but do occur at Nunar iak . of Ruin Pt	Imp. Sadlermiut archaeological sites on Bencas Is & on Coats Is [4]; IBP site 6-1 [5] enclosing 2 murre colonies, polar bear denning, peregrine	pectacular bird cliffs 150m high t Cape Pembroke	least 6 Dorset culture chaeological sites known on N half Mansel Is	- - -
ENVIR. CONCERNS						
2.1 Water Quality	25, 45	Any water quality changes that disrupted goose breeding area at Bear Cove would be of concern	Char stream on E side of Coats Is in path of potential pipeline route [7] and would be vulnerable to water quality changes	- - -	, murre feeding area between nsel Is. and Ivugivik, therefore intenance of water quality & rine productivity important	- - -
2.2 Drainage Alteration	.	Any drainage alterations that disrupted goose breeding area at Bear Cove would be of concern	Large irregular lake occupies centr of Coats Island with likelihood of disturbance from presently proposed route.	- - -	sufficient information to judge ether drainage alteration ild be a concern on Mansel Is.	- - -
2.3 Terrain Disturbance		No marine clays expected along proposed route in this section so no major concern	No marine clays expected along proposed route in this section so no major concern		marine clays expected along oposed route in this section no major concern	- - -
2.4 Vegetation Disturbance		No major concern	Concern if there is significant disturbance to caribou winter range on NW side of Coats Is.		No major concern	- -
2.5 Migration Disruption (fish & wildlife)	25, 39	Major concern if disruption to wildlife resources traditionally harv (mean annual harv. of 132 walrus, 1121 ringed seas, 50 beluga, 88 polar bear & 1492 foxes	Concern if there is disruption to spring-summer caribou movements across proposed route along E coast of Coats Is.		Not likely . . . major concerns for migration disruption	
2.6 Habitat Loss (fish & wildlife)	25, 29	Bear Cove Point is major spring hunting area for waterfowl, so habitat loss there would be imp	Concern if loss of critical habitat in caribou calving area on S Coats Is.[2] or in fox denning area on SE coast [8]	- - -	Possible concern in relation to polar bear	- - -
*.7 Wildlife Harrassment	,18,25,46	Harrassment of concern in main harv. area for marine mammals between S Bay & Coats Is; beluga, harp seal, walrus & Greenland whale move thru Fisher Strait	Bencas Is & north coast of Coats Is imp. as hauling-out areas for est. 3000 walrus; such concentrations easily subject to harrassment	- - -	Possible concern in relation to polar bear	- - -
* . S - " Use Conflicts	25, 26	Above average concentration of fox traplines along coast at Bear Cove Pt; most former winter camps are between Native Pt & Bear Cove Pt.	Greatest concentration of trapline routes on Coats Is. is on NW coast; former winter camps on N coast; geese & eggs of ducks & seabirds harv. from N part of island	rrow coastal zone from Cape mbroke to Cape Southampton is of 3 small areas mapped to be tside of area of Inuit land use	tween Spence Bay & Nouveau-Québec, nsel Is. is 1 of 3 small areas pped to be outside of area of uit land use	- - -
POTENTIAL FOR AVOIDANCE						
>.* Water Quality		Unknown	"...0.,"		Unknown	
3.2 Drainage Alteration		Unknown	Any route across centre of Coats Is. would not be able to avoid drainage of the island's central lake		Unknown	- - -
3.3 Terrain & Vegetation		No expected problems to avoid	Probably not possible to avoid veg. disturbance on caribou winter range because routing N or S would involve other imp. habitats	- - -	expected problems to avoid	- - -
3.4 Fish & Wildlife	18	General disturbance of marine mammals likely unavoidable; peak walrus calving is in mid-May (construction scheduling could avoid disturbances then)	All of Coats Is. is critical habitat for at least one wildlife species and various coastal areas critical for sev. species, so impossible to avoid disturbance if Is. crossed		sufficient information to judge tential to avoid problems with lar bear population of Mansel	- - -
3.5 Resource Use Conflicts	25	Bear Cove Point area remains important for spring camp use & conflict unavoidable without major route changes	All of Coats Is. considered a good trapping area by Coral Harbour residents & proposed routing would cross some trapping areas		major resource use conflicts to void in this section	
RESIDUAL IMPACTS						
Quality		Unknown	Unknown	- -	Unknown	
4.2 Drainage Alteration		Unknown	Unknown		Unknown	
.... Vegetation		.', or low	Potentially high impact in area of caribou winter range		nil or low	
4.4 Fish & Wildlife	18	Early spring seal harvest on edge of land-fast ice from Bear Cove Pt to Native Pt would be disrupted by construction; disturbance to marine mammals expected	Potentially high impact on NW & SE coasts, in caribou winter range & along char stream on SE coast		Unknown, but l nil or l	- - -
4.5 Resource Use Conflicts	18, 19	South Bay is only sheltered harbour on southern Southampton & a likely industrial staging area, so conflict with traditional land uses seems inevitable	Unavoidable resource-use conflicts if any industrial development on Coats Is. which is a traditional caribou & walrus hunting area for Southampton Is residents		nil ...	- - -
RESEARCH NEEDS		Little is known of present status of Hudson Bay stocks of bowhead whal importance of Fisher Strait in their life-cycle & migrations; in view responses of Coral Harbour residents to industrial activity, research where renewable resource harvesting & industrial development are incom wildlife studies on southern Southampton, emphasis should be on ringed which have been the mainstay of Southampton Is. subsistence; for wildl Coats Is. emphasis should be on caribou & polar bear management questi relation to potential disturbances of proposed pipeline route; stringe needed to keep NE Coats Is free of any disturbances and, if necessary, be research to back up such a position		... evious ...fine areas ...ble;... , & walrus udies . . in egulations re should	search needed to more accurately fine suspected wintering areas of luga in NW Hudson Bay & suspected lar bear denning on Mansel; in neral, Mansel Is. very little udied biologically (more detailed ventory justified)	- - -

Appendix I

Specific terms of reference for this study
(as defined for July 1976 study of proposed pipeline route
from Arctic Islands to **Longlac,** Ontario)

To prepare a detailed "discussion paper", primarily in the form of maps and legends, to be used by the Arctic Island Pipeline Study Board for definition of the 1977-78 Environment Canada field program for studies along the prime route now studied by Polar Gas.

The material would identify and summarize:

(i) the main features of terrain, vegetation and wildlife along the prime route;

(ii) the expected impact of the proposed construction upon the terrain, vegetation and wildlife;

(iii) the estimated potential for mitigation of the expected impact through alteration of project design;

(iv) concerns remaining even if appropriate mitigation steps were taken during project planning and construction;

(v) knowledge gaps and recommended subjects for further field checking in 1977-78.

The contractor agrees that:

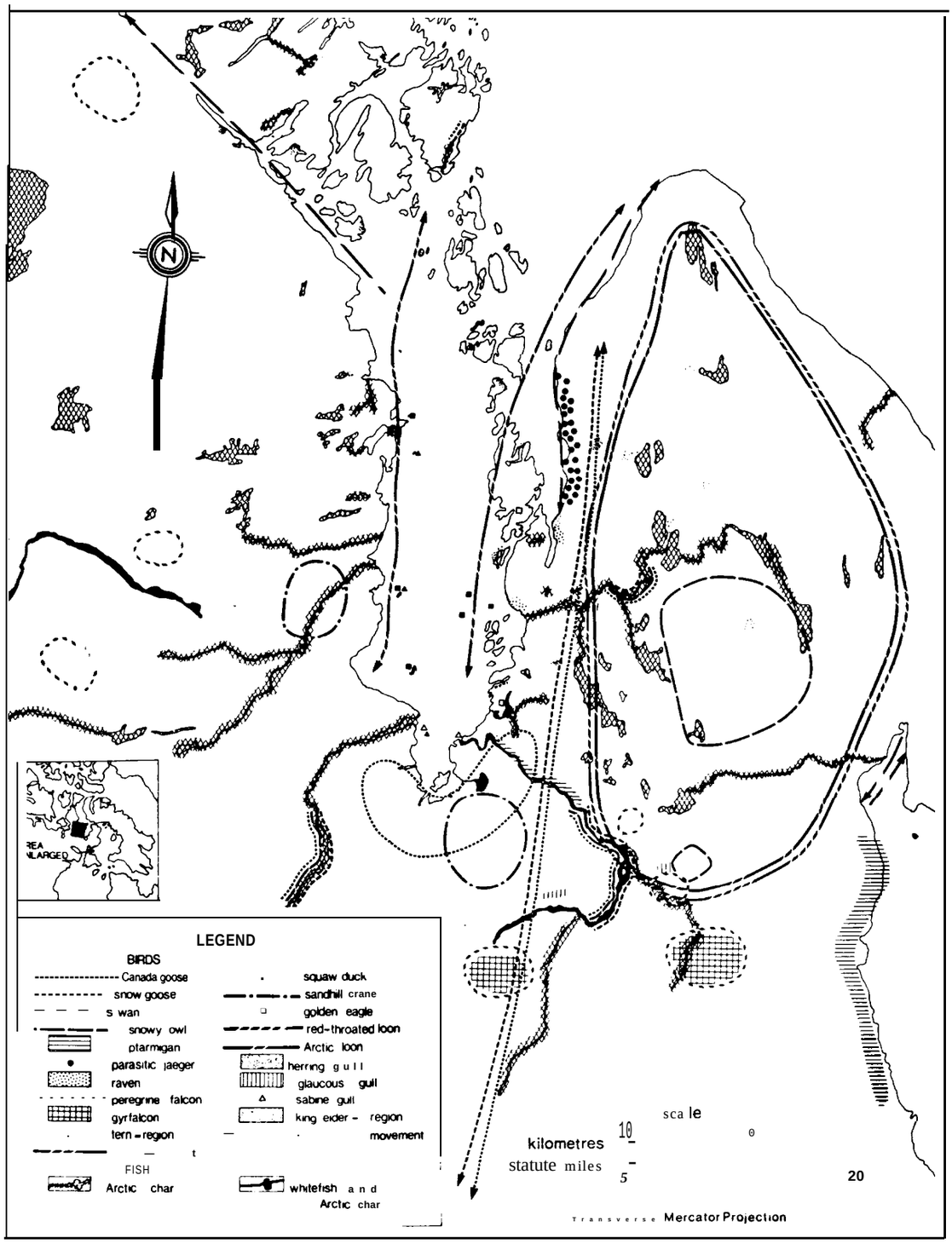
1. each of the nine (9) 1:1,000,000 maps will be provided on mylar base suitable for reproduction and will delineate relevant DOE areas of concern and reference same to the attached legend;
2. the report will include a discussion of scope of the study, methods employed, references used and a brief review of the concerns and knowledge gaps portrayed on the maps and legends;
3. Arctic Islands Pipeline Study Board personnel will be provided the opportunity to meet with the contractor to review and discuss -

a) the format of map legends prior to tabulation of information

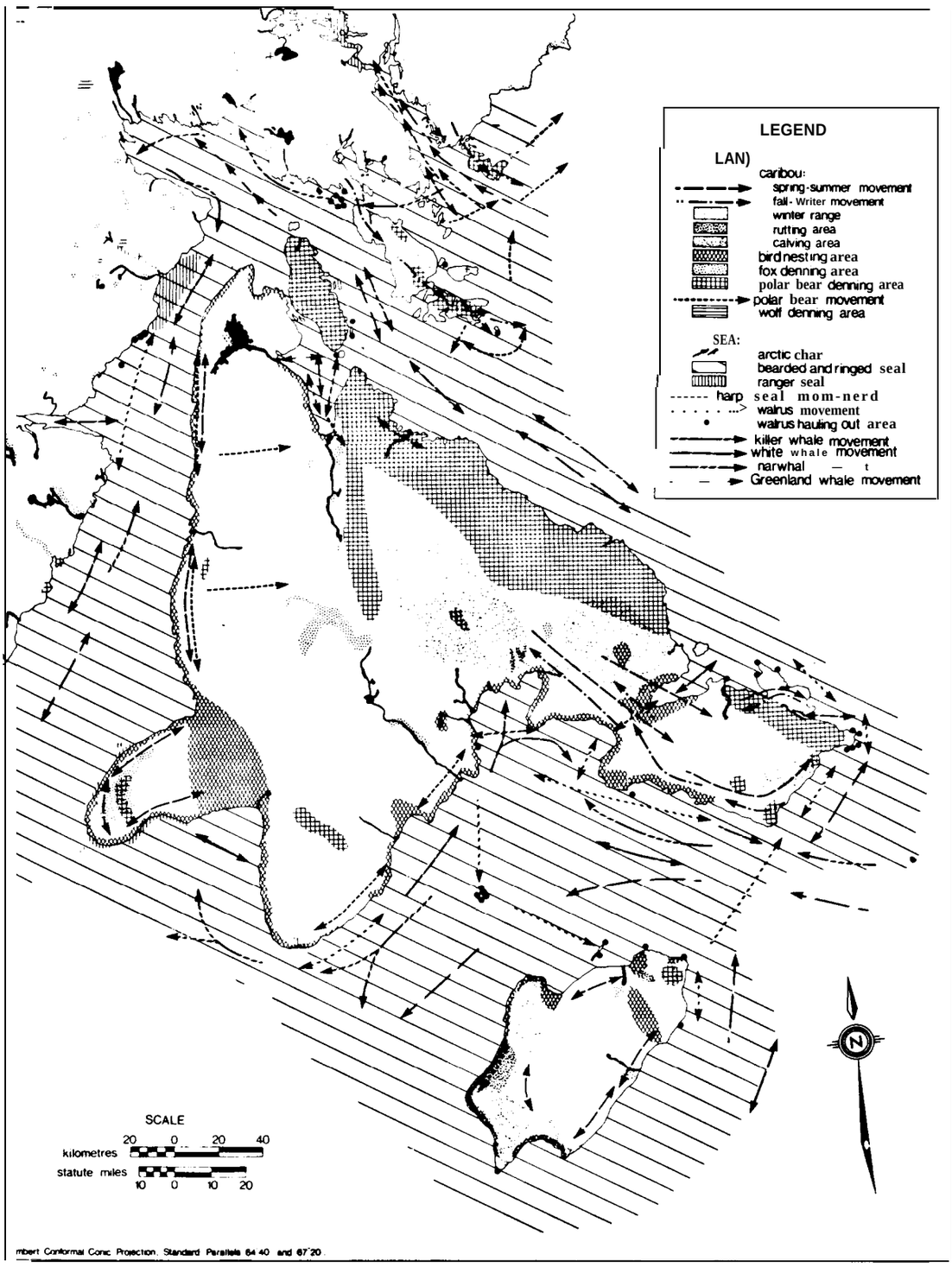
b) drafts of the nine maps, legends and report prior to finalization.

Appendix II

Sample maps from reports of Inuit Land
Use and Occupancy Project (from reference 25)



Pelly Bay: Distribution of fish and birds.



Southampton Island: Distribution and movement of wildlife.