Athabasca Oil Sands Multiple Use Corridor Stud

Corridor Selection Process

ATHABASCA OIL SANDS

MULTIPLE USE CORRIDOR STUDY

Corridor Selection Process

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Resource Planning Branch

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PREFACE

In a region such as the Athabasca Oil Sands, a major consequence of resource development is the need to transport people, materials and energy into and out of the region. While resource development has encouraged the establishment or upgrading of transportation infrastructure such as roads, a railroad and an airport, linear facilities such as pipelines and power transmission lines are also required to serve the various resource activities during the construction and processing phases.

To alleviate potential adverse effects placed upon the natural environment from the proliferation of linear facilities, the multiple use corridor concept has been accepted by the Department of Alberta Forestry, Lands and Wildlife, as a feasible remedy to such a situation.

This study completes a preliminary step in the development of such a corridor in northeastern Alberta. The corridor proposed in this document will be adjusted and more clearly defined as additional studies, including the department's integrated resource planning process, are undertaken in the region. Furthermore, the process used by the planning team, to select the proposed corridor is described throughout Chapter 2.

The study, when initiated, had been referred to as the "Lac La Biche-McClelland Lake Multiple Use Corridor Study". However, the revised name Athabasca Oil Sands Multiple Use Corridor Study more accurately depicts the corridors' provincial location and the natural resource that it primarily will serve.

LIST OF DEFINITIONS

Corridor

A continuous strip of land connecting two geographically separate points and containing two or more facilities for the conveyance of people, energy, information or materials. Such a definition covers railways, highways, pipelines, communication and power transmission facilities.

Crown Land

Public lands held by the Crown in right of Alberta.

Department

Unless otherwise specified this term identifies Alberta Forestry, Lands and Wildlife. This definition also applies to departmental.

Deputy Minister

Unless otherwise specified this term identifies the Deputy Minister of Forestry, Lands and Wildlife.

Energy Proponent

An applicant for the installation of linear facilities.

Green Area

The non-settled forest lands of the Province of Alberta which are managed primarily for forest production, watershed protection, fish and wildlife management, recreation and other multiple uses. Permanent settlement, except on legally subdivided lands and agricultural uses other than grazing are excluded.

Linear Facility

A specific utility such as a pipeline, power transmission line or highway etc., which occupies a right-of-way within a corridor.

Oil Sands

Sand and other rock materials which contain crude bitumen and the crude bitumen contained with those sands and rock materials.

Public Lands

See Crown lands.

Right-of-Way

A strip of land on, over or under which a highway, railway, power transmission line, pipeline or other linear facility is located.

Surface Mineable Area

An area in northeastern Alberta, identified by the Energy Resources Conservation Board as containing oil sands reserves recoverable by surface mining methods under current technology, and under present anticipated economic conditions.

1. INTRODUCTION

1.1 Historical Overview

In 1974, Alberta Environment commissioned a consultant to develop a plan whereby pipeline terminals, refining and petrochemical sites would be linked by a system of utility and transportation corridors to existing or projected oil sands production areas. Some alternative corridor alignments presented in the Athabasca Oil Sands Corridor Study, paralleled the Northern Alberta Railway and the existing pipeline built by Suncor Inc.[1] In 1979, Syncrude Canada Ltd., with the development of its oil sands mining operation, constructed a pipeline which, for the most part, paralleled both the Suncor pipeline and Highway 63.

Collectively, these linear facilities have become known as the Alberta Oil Sands Pipeline Corridor[2]. Although this corridor is similar to one of the alignments recommended by Alberta Environment's consultant, no formal acknowledgment of this has ever been given by the government of Alberta. Since additional oil sands developments were proposed, Alberta Environment again commissioned the same consultant to update and expand the original study. This revision, called the Oil Sands and Heavy Oil Corridor Development Study, was completed during 1980 when the Alberta economy was still very buoyant and optimism concerning oil sands development was prevalent. Two insitu oil sands pilot plants as well as the Alsands mega-project were planned. Such development activities would require a connection to the northern terminus of both the Syncrude and Suncor pipelines situated immediately south of the Syncrude lease. To examine the alignment for such a corridor in detail, Alberta Environment assembled a joint government-industry technical committee which, in 1980, recommended an alignment referred to as the Northeast Energy Corridor. The corridor extended

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[1]Suncor Inc. was formerly called the Great Canadian Oil Sands Company. This company has been mining oil sands deposits commercially near Fort McMurray since 1967.

[2]Alberta Oil Sands Pipeline Corridor is also called the Athabasca Tar Sands Corridor.

north from the Syncrude/Suncor pipeline terminus, through the Syncrude lease to a crossing on the Athabasca River immediately south of Fort MacKay. The corridor then continued north paralleling the cleared highway right-of-way until it reached the proposed Alsands new townsite, situated immediately northwest of McClelland Lake[3].

In spite of the endorsement given this corridor by the department, problems soon arose with the proposal for a pipeline in this corridor. Syncrude Canada Ltd., although originally in favour of the alignment across their lease, became increasingly concerned about the effects of such developments upon their mining operation. As a result of this and other concerns that became evident, the department conducted an in house study which designated a multiple use corridor on the eastern side of the Athabasca River, similar in some respects to the concept proposed in the Oil Sands and Heavy Oil Corridor Development Study. The main difference is that this corridor would connect the Northeast Energy Corridor (North Segment) to the existing Edmonton industrial complex via the Alberta Oil Sands Pipeline Corridor. This focus is feasible given the uncertainty over the status of the proposed industrial site situated at Hardisty.

The increase in industry's preliminary groundwork on future oil sands projects north of Fort McMurray is evidence that such a corridor will be required.

1.2 Purpose of the Study

The following benefits are expected from a multiple use corridor that is both environmentally and administratively acceptable to Alberta Forestry, Lands and Wildlife:

- avoidance of interference with the existing oil sands developments (Syncrude and Suncor) and associated land uses situated on the west side of the Athabasca River, north of Fort McMurray;

- avoidance of the necessity of having linear developments (particularly pipelines) cross the Athabasca River at two locations; and

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[3]A reservation (DRS 790122) for this corridor is on file at the Public Lands Division of Alberta Forestry, Lands and Wildlife

- avoidance of potential problems identified by the existing pipeline crossings on the House River.

1.3 Methodology: A General Overview

1.3.1 Participants in the Study

As outlined in the Terms of Reference document, a planning team consisting of divisional representatives from within Alberta Forestry, Lands and Wildlife was assembled to complete this study. The divisions were:

- Mineral Resources Division[4]
- Alberta Forest Service
- Fish and Wildlife Division
- Public Lands Division
- Resource Evaluation and Planning Division (REAP)

Under the co-ordination function of the Resource Planning Branch (REAP), the resource management concerns of the participating divisions and the concerns of other contributing government agencies[5] were considered.

The Resource Management Directors Committee's concern is for the interdivisional integration of resource policy in the department. It reviews and approves key documents[6] prepared by the planning team and provide information, advice and direction including the resolution of conflicts. Final approval from this committee must be endorsed by the Resource Management Division Heads Committee and the Deputy Minister.

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[4]The Mineral Resources Division remains within Alberta Energy. The other divisions listed here became part of Alberta Forestry, Lands and Wildlife, a new department named as a result of cabinet changes following the May 1986 provincial election.

[5]Alberta Culture, Alberta Environment, Alberta Municipal Affairs, Alberta Recreation and Parks, Alberta Transportation, Energy Resources Conservation Board.

[6]The Terms of Reference was approved March 31, 1983. Documents to be approved include the Corridor Selection Document and the Management Guidelines Proposal.

1.3.2 Constraints and Limitations

The Deputy Minister of Forestry, Lands and Wildlife directed that the study should be initiated with the understanding that only existing staff and budgets will be utilized and that other important work was not to be adversely affected. Thus, only existing information was utilized to complete the study.

The study was to be exclusively a government review and any results and recommendations were to be also considered by Alberta Environment before any contact is made with the public, including industry, ultimately the prime users of the corridor. The interests of this user group were provided through the Energy Resources Conservation Board, a designated consultant to the study.

The scope of the study focused on environmental and resource management concerns which are largely the jurisdiction of Alberta Forestry, Lands and Wildlife. Socio-economic and engineering matters were addressed cursorily.

1.3.3 Corridor Selection and Review Process

In a sequential manner, the corrider planning team completed the corridor selection process illustrated by (Fig. 1). Figure 1 also shows the various stages in the process where contributing agencies or committees assisted by providing data input or reviewing planning team corridor proposals. A more detailed discussion of the selection and review process is provided in the rest of this document, notably Chapter 2.

1.4 Description of the Study Area

The first task was to establish a study area. The corridor study area is in northeastern Alberta, immediately northwest of the Cold Lake (Primrose) Air Weapons Range (Fig. 2). It allowed the planning team to develop several alternatives. In addition to serving both existing or future energy developments in the surface mineable area, these corridor alternatives also take advantage of existing major transportation rights-of-way in the region. Finally, since Alberta Forestry, Lands and Wildlife maintains control over land use activities on public lands, the study area was confined to the Green Area managed by the Alberta Forest Service.

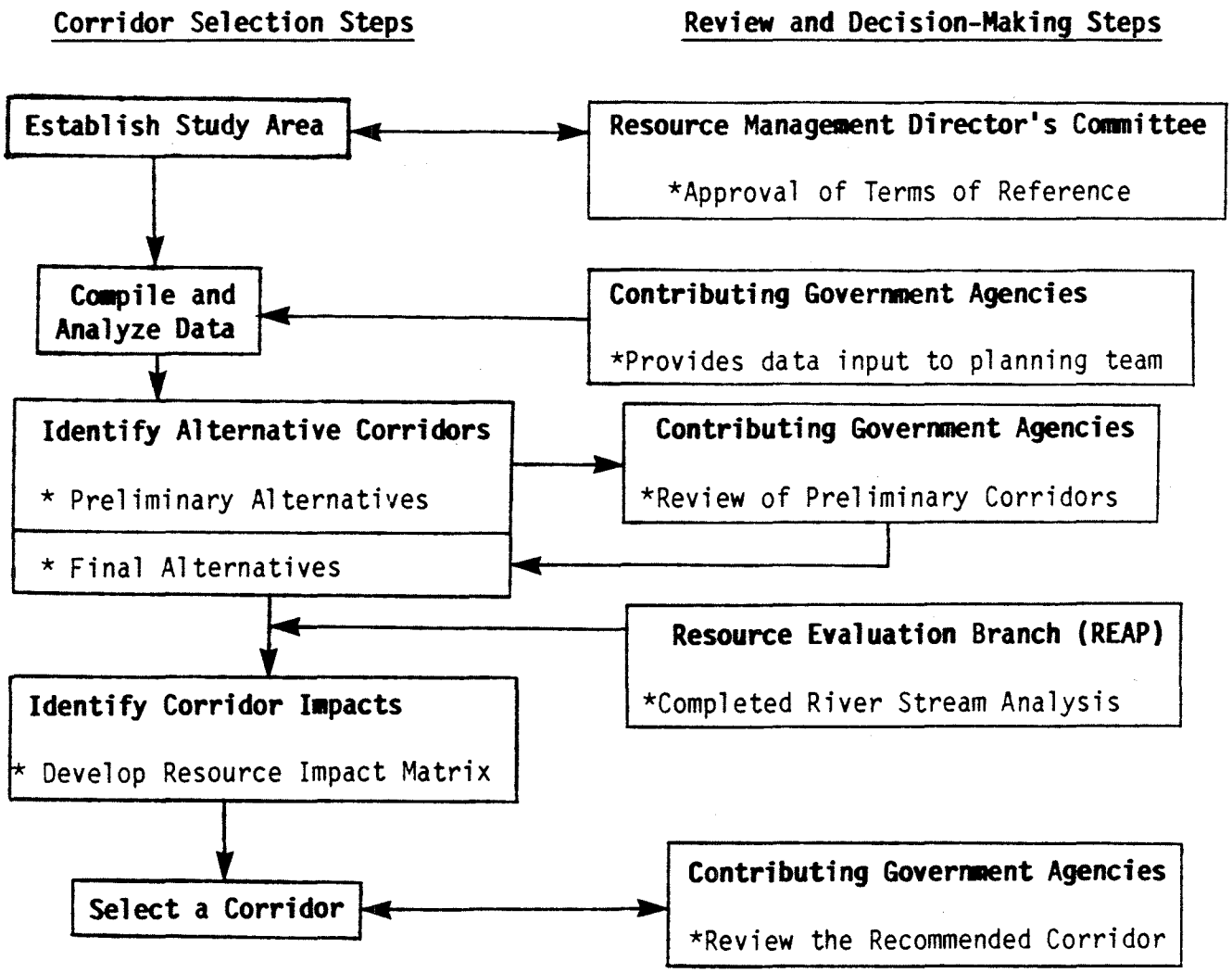

Fig. 1 Corridor Selection and Review Process

Note:(a)Contributing Government Agencies are Alberta Culture, Alberta Environment, Alberta Municipal Affairs, Alberta Recreation and Parks, Alberta Transportation and the Energy Resources Conservation Board. Line agencies in the field were represented by the Regional Resource Management Committee for the Northeast Region.

(b)Future review of the recommended corridor is expected to include members of industry and possibly the public once the recommendation receives further endorsement from the Resource Management Directors Committee and upper management within Alberta Forestry.

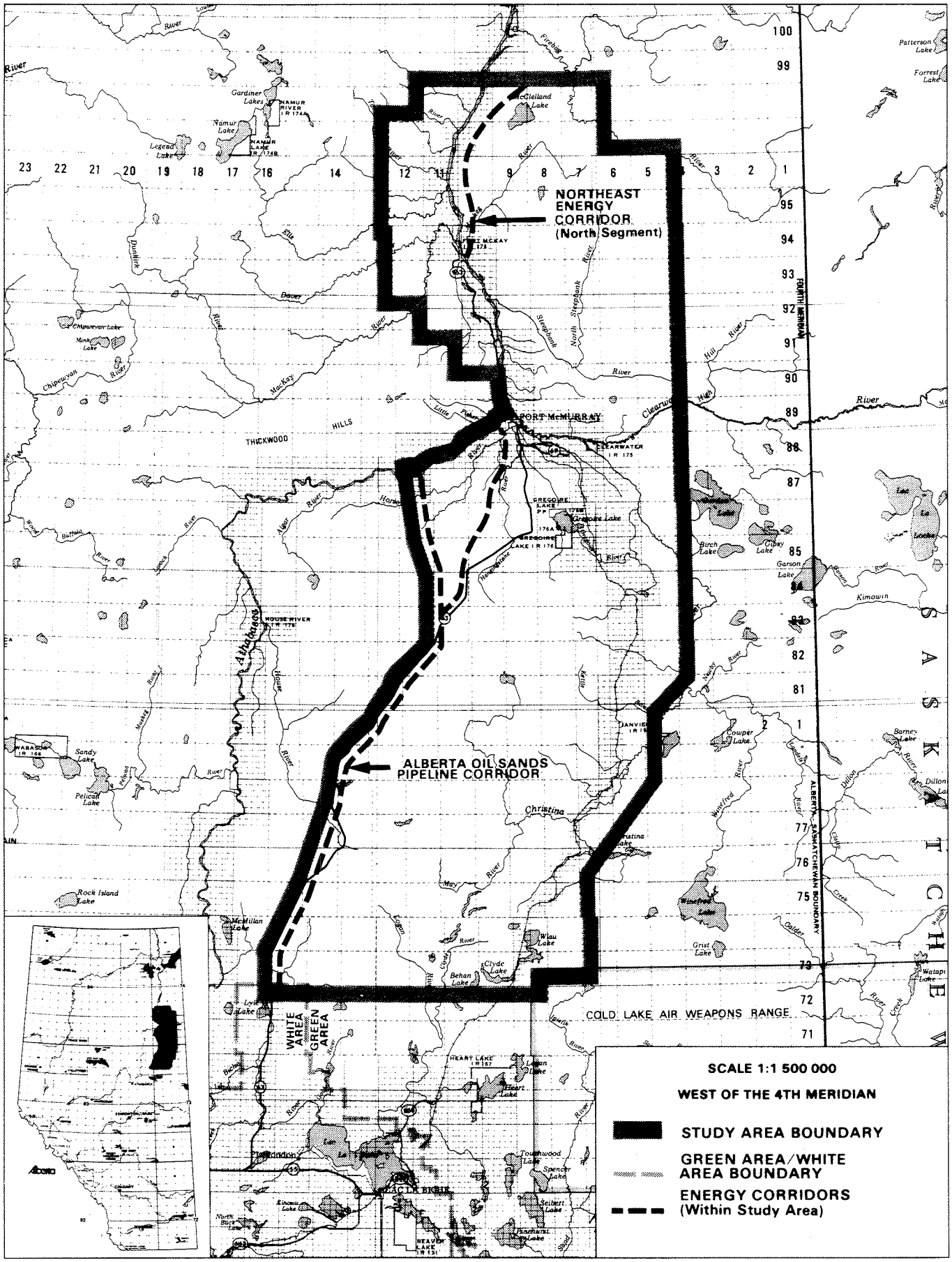

Fig. 2 LOCATION OF THE ATHABASCA OIL SANDS MULTIPLE USE CORRIDOR STUDY AREA

The study area, which reaches maximum dimensions of approximately 250 by 88 km, covers approximately 17 000 km^2 of largely undeveloped wilderness. The area is underlain by gently dipping shales and sandstone bedrock of Cretaceous age. The landscape has been reworked by post glacial action into several undulating plains with some upland areas, the highest being Stony Mountain south of Gregoire Lake. Surficial materials consisting of loamy glacial till often in association with clayey glacial lacustrine deposits are very common. These materials are often overlain by organic deposits. Varied amounts of coarse textured glaciofluvial and aeolian deposits are scattered across the landscape.

The vegetation of the study area consists largely of a mixed forest variety. Higher areas consist of white spruce, aspen poplar and jackpine. Lower wetland areas primarily consist of sphagnum moss and black spruce treed muskeg.

While economic activity in the area has historically depended on forestry, trapping and commercial fishing, employment opportunities have increased in the oil and gas industry. The most notable is the oil sands developments north of Fort McMurray. Situated at the junction of the Athabasca and Clearwater rivers, this city is the largest population centre in the study area. With the exception of Fort MacKay, most other communities in the study area are situated south of Fort McMurray along the Northern Alberta Railway.

1.5 Data Compilation

The information used to conduct the study can be divided into; (i) literature about linear development planning (see List of References) and, (ii) information on the land and resource base of the study area.

The linear development literature consisted of reports on multiple use corridor development and methodologies that can be used to determine the rights-of-way for linear facilities, particularly pipelines and power transmission lines.

Land and resource base information such as the locations of natural resources, human settlement and infrastructure such as transportation/communication facilities was collected and mapped at a scale of 1:250 000 (see Fig. 6, map pocket). The information on this map, supplemented with additional maps illustrating physical characteristics of the study area, provided the planning team with a suitable basis from which to designate corridor alignments. Field reconnaissance of these alignments was undertaken primarily from the air because of the extent and relative inaccessibility of the study area.

To determine the impact upon potential water crossings[7], the Land Classification Section of the department completed a summary analysis of the physical land, vegetative and drainage characteristics of approximately 130 river/stream crossings. Preliminary evaluations dealing with soil erodability, steepness of slopes, vegetation and their combined stability were documented[8]. Parts of this analysis pertaining to the recommended corridor are included in Appendix 1.

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[7]The term water crossings is also used in the text to refer to river/stream crossings.

[8]Ferguson, N. 1984. "Lac La Biche - McClelland Lake Multiple Use Corridor: River/Stream Analysis" Two information papers, Resource Evaluation Branch, Alberta Forestry, Lands and Wildlife.

2. CORRIDOR ALTERNATIVES: DEVELOPMENT AND REVIEW

The study area has been divided into two sectors, the origin and destination sectors. The division between these sectors is immediately south of the Clearwater River approximately in the middle of Township 88, just north of Lynton.

2.1 Preliminary Corridor Assessment

The first task in developing a set of alternative corridors was to identify an appropriate crossing of the Clearwater River. This was found to be immediately west of the confluence of the Clearwater and Christina Rivers. This location (Township 88, Range 7, W4M), identified in previous corridor studies, is suitable because points east of this location required an additional crossing on the Christina River while points west of this site could interfere with land uses, such as the airport and proposed country residential developments associated with Fort McMurray. The physical suitability of this site was confirmed in a detailed analysis of this crossing conducted by the Resource Evaluation Branch[9].

When planning for a multiple use corridor, the location parameters of the least flexible utility to be used must be considered. In this study, pipelines fall into this category since they are more sensitive to the characteristics of river and stream crossings. Therefore, the number of water crossings were minimized where possible when the preliminary corridor alternatives were defined. Other locational parameters considered in the study are:

- avoidance of surface mineable oil sands deposits;
- utilization of existing access within the study area;

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[9]For more detail about the Clearwater River crossing, see Appendix I, pages 29-30.

- avoidance of natural resources such as wildlife habitat, timber, sand and gravel deposits, etc.; and
- avoidance of existing or potential settlement areas and related infrastructure.

The preliminary corridor alternatives were reviewed by all contributing government agencies and department field staff[10]. Input from these sources, in addition to some field reconnaissance allowed deletion of some corridor segments because of:

- excessive corridor length;
- too distant from the Surface Mineable Area; and
- physical constraints (e.g., unstable water crossings[11], excessive slopes).

The remaining segments formed a final set of corridor alternatives which underwent a more detailed review.

2.2 Final Corridor Assessment

As part of the detailed review, the final corridor alternatives were mapped at a scale of 1:50 000[12]. Although the proposed corridor width is not expected to exceed a 0.8 km (1/2 mi.), the corridor alternatives were illustrated at a width of 1.6 km (1 mi.). This width allowed assessment of potential impacts upon the terrain and resources in the immediate vicinity of corridor alternatives. This width provided leeway to alter the corridor should unforeseen obstacles become evident when the actual route selection process for specific linear facilities takes place.

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[10]Primarily staff from the Alberta Forest Service and the Fish and Wildlife Division.

[11]The most notable of these, identified by the Alberta Forest Service, is the House River (Twp. 78, Rge. 15, W4M) where an existing pipeline ruptured in 1975. Subsequent review of this area by the Resource Evaluation Branch resulted in the corridor alignment being shifted to the east side of Highway 63 in Townships 76 through 78. For further details see River/Stream Analysis Destination Sector June 1984, pages 47-48.

[12]See example in Appendix IV.

The surface area of most natural resources affected by the corridor alternatives was estimated. This information, including corridor length, oil sands reserves and data provided by the detailed river/stream analysis, was plotted on a resource impact matrix.

It is important to emphasize that the final corridor assessment did not use mathematical formulae or weighting systems to determine the preferred alignment. The opinion of the planning team was that such techniques might be open to criticism since too many subjective assumptions were required which could not be substantiated. Further, such techniques would be difficult to explain to individuals not familiar with them.

Therefore, a general approach was used which would encourage discussion of the facts concerning the corridor alternatives as opposed to arguing about un-substantiated weightings.

2.2.1 Origin Sector

The final alternatives in this sector are illustrated in Figure 3. The resources potentially affected by each of these nine alternatives are summarized in Table 1. By referring to both the matrix and the origin sector portion of the river/stream analysis, the various alternatives were eliminated through the following process.

Step 1

Since there was little or no variance in the impact of each corridor alternative upon gravel/sand deposits and merchantable timber, these resources were no longer considered in this particular assessment.

Step 2

Corridor alternatives which individually have excess impact upon the remaining resources were eliminated as follows:

Alternative	Reason for Elimination
A	Greatest number of main and secondary water crossings affected (13)
B	Longest corridor length (97 km)
B_2	Greatest volume of oil sands affected ($1117 \times 10^6 m^3$)

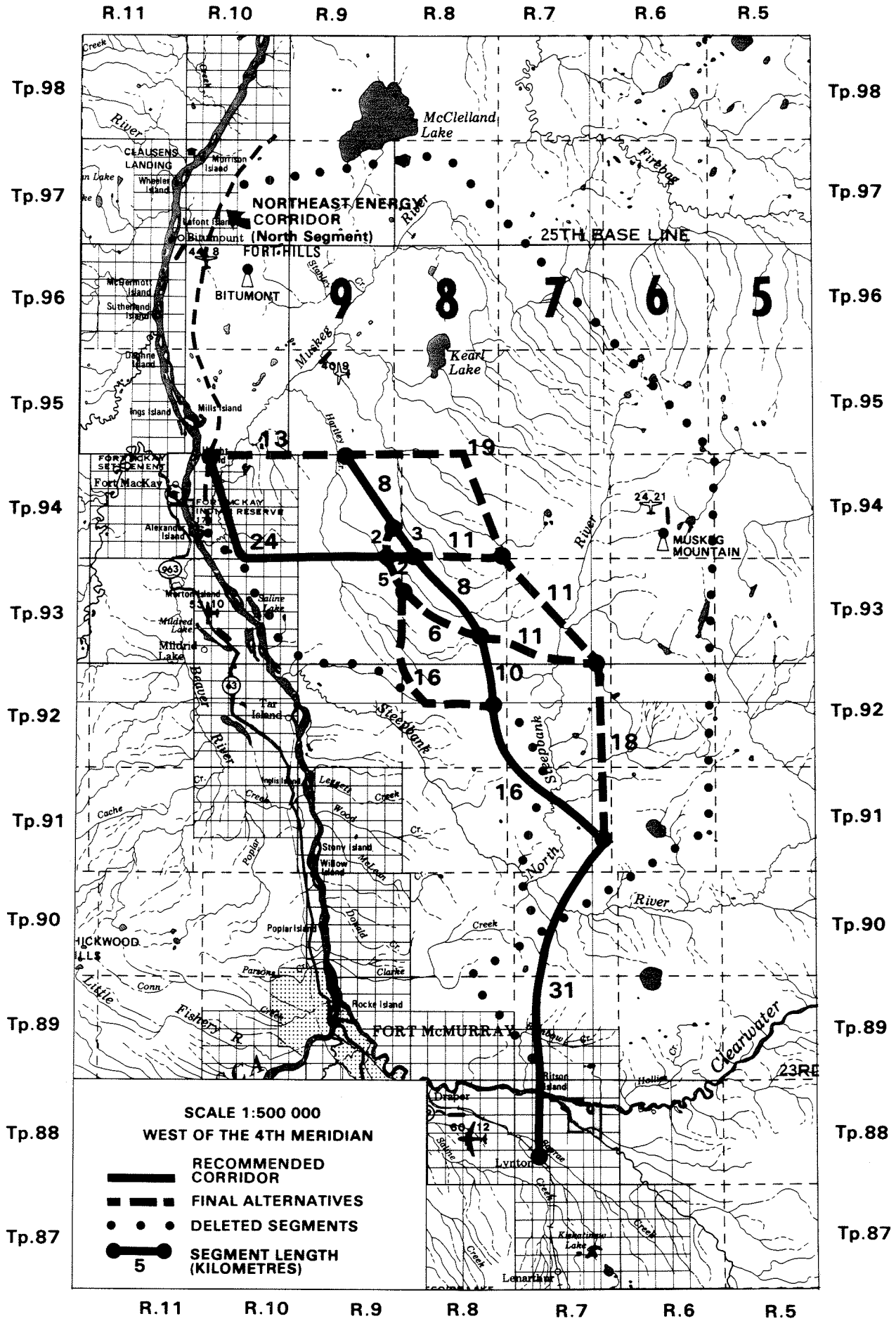

Fig. 3 ORIGIN SECTOR CORRIDOR ALTERNATIVES

Table 1
RESOURCE IMPACT MATRIX FOR THE ORIGIN SECTOR CORRIDOR ALTERNATIVES

Corridor Alternatives	Length (km)	Volume of Initial In-Place Crude Bitumen ($10^6 m^3$)	Estimated Surface Area (ha)			Number of River/Stream Crossings			
			Sand and Gravel Deposits	Moose Winter Habitat	Merchantable Timber	Main Water-course	Secondary Water-course	Major Inter-mittent	Total Crossings
Alternative A (13+19+11+18+31)	92	956	477	983	232	6	7	4	17
Alternative A1 (13+8+3+8+10+16+31)	89	952	477	983	232	5	3	3	11
Alternative A2 (13+8+2+5+6+10+16+31)	91	1035	477	983	232	5	3	3	11
Alternative A3 (13+8+2+5+16+16+31)	91	959	477	983	232	7	3	3	13
Alternative B (24+2+11+11+18+31)	97	921	446	1278	232	6	5	5	16
Alternative B1 (24+2+8+10+16+31)	**91**	**947**	**446**	**1278**	**232**	**5**	**4**	**4**	**13**
Alternative B2 (24+5+6+11+18+31)	95	1117	446	1278	232	6	5	5	16
Alternative B3 (24+5+6+10+16+31)	92	973	446	1278	232	5	2	4	11
Alternative B4 (24+5+16+16+31)	92	897	446	1278	232	7	2	4	13

NOTES:

1) Corridor alternatives - The figures within the brackets denote the length of corridor segments (kilometres) as illustrated in Figure 2. The bold type identifies the recommended corridor.

2) All resource impact estimates are based upon information mapped at a 1:50 000 scale, assuming a mile wide corridor. The information was provided by the Department divisions represented on the corridor planning team.

3) River/Stream information was provided by the Resource Evaluation Branch for the detailed river/stream analysis (January 1984).

4) Estimated surface area is indicated in hectares (ha).

Step 3

It was assumed the six remaining alternatives have relatively the same length; on the basis of this assumption the next round of elimination took place, by focusing on excessive impacts:

Alternative	Reason for Elimination
A_2	Greatest volume of oil sands impacted ($1035 \times 10^6 m^3$)
A_3	Greatest number of main and secondary water crossings affected (10)

Step 4

The four remaining alternatives were reviewed as follows:

Alternative	Reason for Elimination
B_3	Greatest volume of oil sands impacted ($973 \times 10^6 m^3$)
B_4	Greatest number of main watercourse crossings affected (7)

Step 5

The final two candidates (A_1 and B_1) were compared. The planning team selected A_1. Although this choice slightly affects more oil sands ($952 \times 10^6 m^3$) and sand/ gravel deposits (477 hectares), it is approximately 2 km shorter. Further, there is less impact on moose winter habitat (983 hectares) and fewer water crossings are affected (11).

The same government agencies which reviewed the preliminary corridor alternatives were requested to express any concerns that they have had with the "proposed" recommendation (A_1). With the exception of the Energy Resources Conservation Board (Oil Sands Department), there were no major concerns with the proposed alignment. The Energy Resources Conservation Board's prime concern was the value of the additional oil sands deposits sterilized by the proposed alignment as opposed to the second choice alignment (B_1). They estimated that if A_1 is developed to a maximum width of 0.8 km, then oil sands deposits valued at approximately $4 billion (if converted to synthetic crude oil) could be sterilized. Since most of the additional moose winter habitat would be affected by oil sands developments, with or

without a corridor, and potential problems associated with additional water crossings could be mitigated, the planning team recommended Alternative B_1.

2.2.2 Destination Sector

The resources which are potentially affected by each of the six final alternatives illustrated in Figure 4 are summarized in Table 2. These alternatives can be divided into two categories, the C and D options. The C options (Alternatives C, C_1, C_2) follow more westerly alignments which primarily use existing access created by both Highway 63 and the Alberta Oil Sands Pipeline Corridor. The D options (Alternatives D, D_1, D_2) all initially follow an easterly alignment which parallels the Northern Alberta Railway. These alignments eventually join the Alberta Oil Sands Pipeline Corridor and Highway 63 at various locations, after crossing expanses of muskeg through the interior of the study area.

Since the orientation of these two categories differs considerably, each category was assessed separately. It became apparent that the potential resource impacts of the individual alternatives in each category were similar. Given the significant number of water crossings affected by the alternatives in this sector (approximately 112), the destination sector portion of the river/stream analysis was used extensively, to assist the assessment.

Step 1 -- C Option Alternatives

Alternative C was eliminated first because it had greater impact on the sand/gravel deposits (391 hectares). More significantly however, the Horse River (Twp. 84, Rge. 11, W4M) was identified in the river/stream analysis as having unstable valley walls caused by an existing pipeline[13].

Of the remaining alternatives, C_1 was selected by the planning team because it was a straighter alignment than C_2, a feature more advantageous to the development of transmission lines. In addition to being approximately 3 km shorter, this alignment impacts less caribou winter habitat (8 959 hectares) and slightly fewer oil sands deposits (700 X $10^6 m^3$).

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[13]Lac La Biche-McClelland Lake Multiple Use Corridor River/ Stream Analysis Destination Sector, June 1984, pages 19-20.

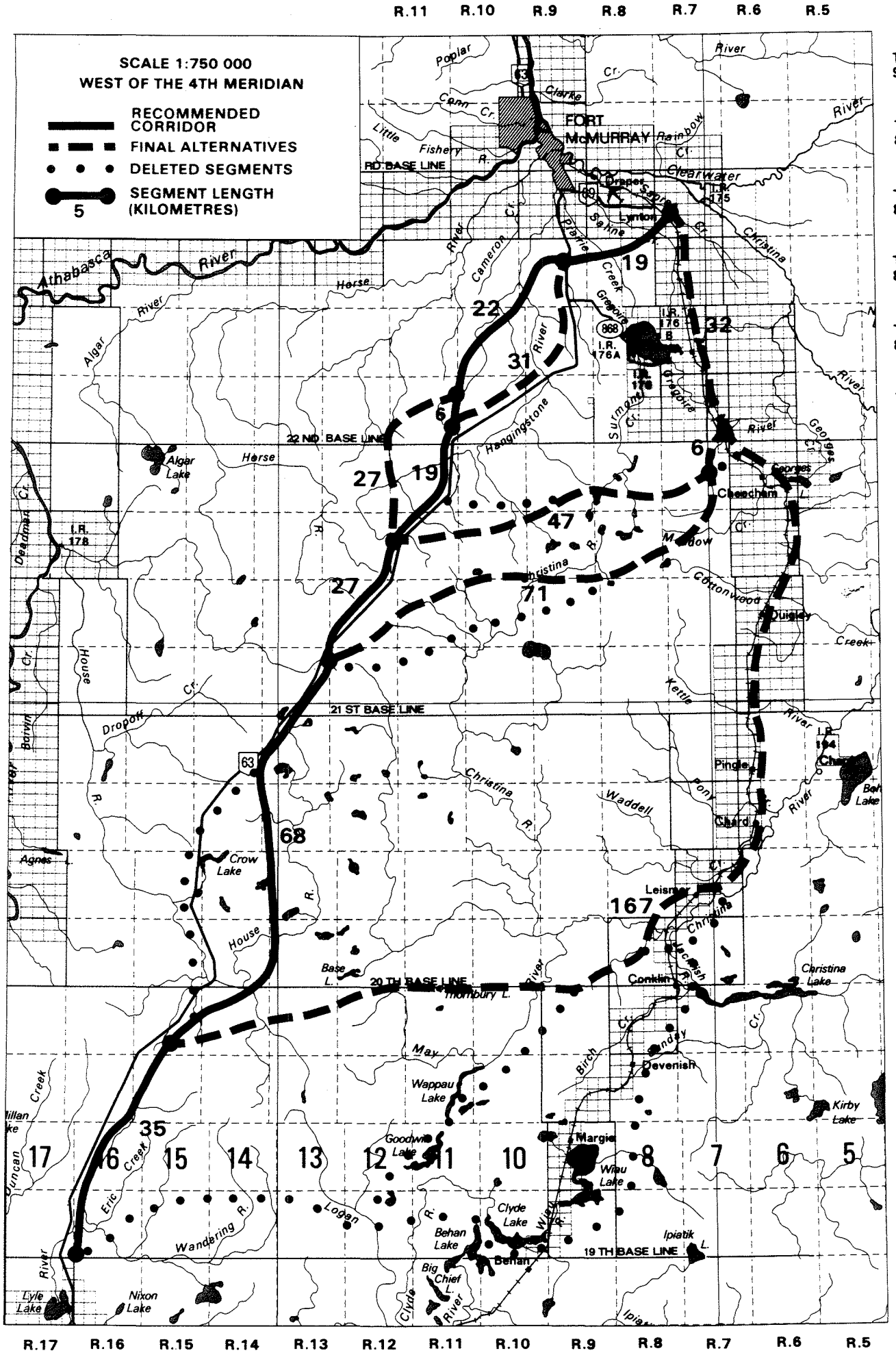

Fig.4 DESTINATION SECTOR CORRIDOR ALTERNATIVES

Table 2
RESOURCE IMPACT MATRIX FOR THE DESTINATION SECTOR CORRIDOR ALTERNATIVES

Corridor Alternatives	Length (km)	Volume of Initial In-Place Crude Bitumen ($10^6 m^3$)	No. of Gas Well-sites	Estimated Surface Area (ha)				Number of River/Stream Crossings			
				Sand and Gravel Deposits	Moose Winter Habitat	Caribou Winter Habitat	Merchantable Timber	Main Water-course	Secondary Water-course	Major Inter-mittent	Total Crossings
lternative C 19+22+27+27+68+35)	198	629	11	391	-	8990	146	4	27	19	50
Alternative C1 **19+22+6+19+27+68+35)**	**196**	**646**	**12**	**310**	**-**	**895**	**146**	**4**	**25**	**22**	**51**
lternative C2 19+31+19+27+68+35)	199	700	12	310	-	10440	-	4	22	27	53
lternative D 32+6+47+27+68+35)	215	1190	15	88	-	12780	-	3	21	27	51
lternative D1 32+6+71+68+35)	212	1201	14	88	-	13727	-	3	24	13	40
lternative D2 32+167+35)	234	1359	17	88	298	3724	975	5	32	18	55

NOTES:

) Corridor alternatives - The figures within the brackets are the length of corridor segments (kilometres) as illustrated in Figure 3. The bold type identifies the recommended corridor.

2) All resource impact estimates are based upon information mapped at a 1:50 000 scale assuming a mile wide corridor. The information was provided by the Department divisions represented on the corridor planning team.

3) River/Stream information was provided by the Resource Evaluation Branch while completing the detailed river/stream analysis (June 1984).

4) Estimated surface area is indicated in hectares (ha).

Step 2 -- D Option Alternatives

Alternative D_2 was eliminated first. In addition to its excessive length (234 km), it had the potential to affect more resources, particularly the main and secondary water crossings (37).

In spite of the fact that D_1 is approximately 3 km shorter than D, it was not favoured because it crosses a wider expanse of muskeg. The river/stream analysis indicated potential problems at the water crossings affected. Meadow Creek (Twp. 84, Rge. 6, W4M), for example, was identified as being prone to significant seepage from the upper banks. There is potential for slope failure once the vegetation is removed during pipeline construction[14]. Alternative D was selected as the favourable candidate in this category.

Step 3 -- Comparison of the C and D Option Candidates

Given the information available, C_1 was selected for this sector. In addition to being approximately 19 km shorter in length, this more accessible alternative affected considerably less caribou habitat (8 959 hectares) and oil sands deposits ($646 \times 10^6 m^3$).

Before the final recommendation was determined, the contributing agencies were asked to review the two finalists for this sector in addition to the recommended origin sector alignment. On the basis of the responses received, the planning team upheld its initial endorsement of C_1.

2.3 Recommended Corridor

The corridor recommended by the planning team is a combination of the origin and destination sector alignments (Fig. 5). It is the view of the planning team that this corridor can be both environmentally and administratively acceptable to the department if it is properly managed during the implementation and development processes. For the most part, the issues which originally initiated this study will be alleviated.

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[14]River/Stream Analysis Destination Sector, June 1984, pages 24-25.

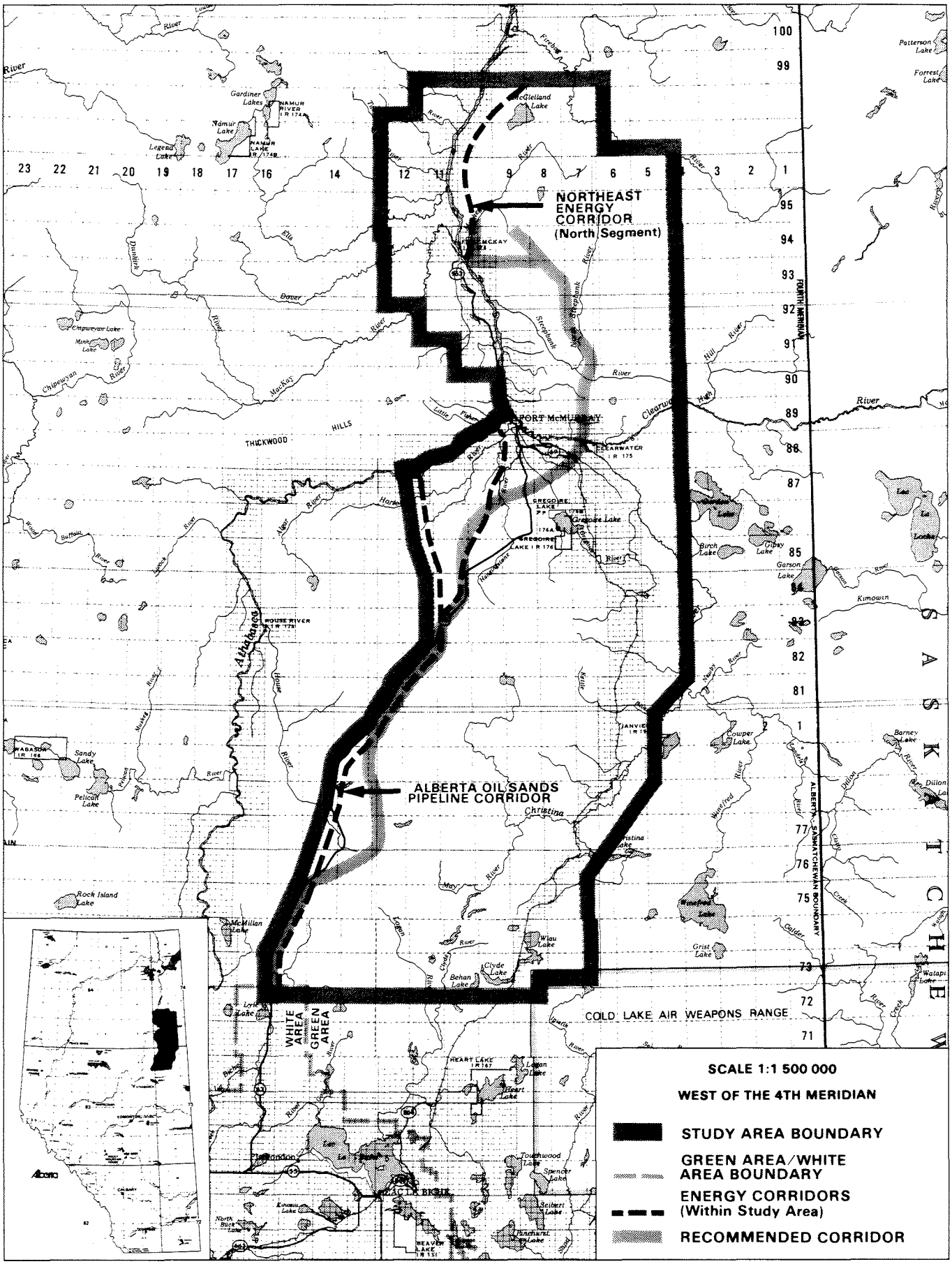

Fig. 5 ATHABASCA OIL SANDS MULTIPLE USE CORRIDOR STUDY
Recommended Corridor

The following discussion provides a description of this corridor alignment as it crosses the study area a distance of approximately 290 kilometres.

2.3.1 Description of the Corridor

Originating along the Northeast Energy Corridor (Twp. 94/95, Rge. 10), the recommended corridor (Fig. 6 in map pocket) and the eastern arm (originating in Twp. 95, Rge. 9) follow an alignment from the Surface Mineable Area which minimizes the potential sterilization of mineable oil sands deposits. The corridor continues southeasterly using wherever possible, access created by existing seismic lines cut through the relatively flat, treed, muskeg. After crossing the North Steepbank River (Twp. 91, Rge. 7, Sec. 10), the corridor turns south toward the Clearwater River, avoiding that part of the Steepbank River which has excessively steep and erodible banks.

The proposed crossing on the Clearwater River (Twp. 88, Rge. 7, Sec. 32) was identified in the previous Oil Sands and Heavy Oil Development Study as a suitable crossing for such a corridor. This location avoids the necessity of crossing the Christina River. The crossing is situated far enough east to avoid potential conflicts with land uses associated with Fort McMurray, particularly the airport.

After crossing the river, the corridor turns southwest (Twp. 88, Rge. 7, Sec. 16) avoiding some high grade gravel deposits. It continues southwest passing between two sulfur handling plants (Sulmar Resources Limited, Burza Enterprises) situated along Highway 69. The corridor crosses more muskeg flatlands until it joins the existing Suncor pipeline right-of-way (Twp. 86, Rge. 10). By following this alignment, stands of merchantable timber immediately north of the proposed corridor and west of Highway 63 have been avoided.

With the exception of bypassing existing pipeline crossings on the House River (Twp. 76/77, Rge. 15), the rest of the proposed corridor maximizes the availability of existing access. By paralleling Highway 63 and absorbing the Syncrude and Suncor pipeline rights-of-way, the corridor continues southwesterly until it reaches the Wandering River.

The bypassing of the existing pipeline crossings on the House River, west of Highway 63, was due to slope failures which ruptured the Suncor pipeline in 1975. The bypass begins just below Mariana Lake (Twp. 80, Rge. 13/14) following an alignment due south and east of the candidate ecological reserve at Crow Lake. At Township 76, the corridor follows a southwesterly direction until it again joins and parallels, Highway 63 (S 1/2 Twp. 76).

2.3.2 Corridor Impact

The degree to which the corridor affects the social and natural environments will vary according to the responsibility accepted by government staff and energy proponents during the placement of utilities within their respective rights-of-way. The following is a summary of those components of the study area which are most likely to be affected when the corridor is developed.

Surface Mineable Oil Sands Deposits

While the alignment selected in the Surface Mineable Area minimizes the sterilization of oil sands deposits, the proposed 0.8 km (1/2 mi.) wide corridor is expected to affect 17.1 x $10^6 m^3$ (107.6 x 10^6 barrels) of crude bitumen with an estimated value of $2.9 billion.[15]

Wildlife Habitat

This impact is expected to occur primarily where the corridor crosses the Muskeg and Clearwater rivers. Here, the banks provide good winter range for moose and a few deer. The impact could be slightly more severe along the Muskeg River since the proposed corridor also parallels the river somewhat after crossing it. However, the corridor also serves as a buffer from potential mining activities situated in the oil sands deposits east of the river (Twp. 94, Rge. 10).

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[15] All oil sands figures were provided by the Energy Resources Conservation Board. The dollar value is based upon $38 per barrel of synthetic crude oil plant gate price and a 30 per cent recovery loss.

Potential impact upon caribou habitat is expected to occur in the vicinity where the corridor connects with the Suncor pipeline right-of-way (Twp. 86, Rge. 10) until it crosses Highway 63 in Township 81, Range 12. The impacts are not expected to be too severe since access has already been established in the area from existing linear developments.

Water Crossings

Approximately 65 rivers, associated tributaries and streams in the study area, are expected to be affected by the development of the corridor. Major crossings are proposed on the Muskeg, North Steepbank, Clearwater, Hangingstone, House and Wandering Rivers which contain a variety of fish species. These include arctic grayling, goldeye, northern pike, mountain whitefish, walleye, suckers, yellow perch and lake whitefish. Detail on many of these crossings is provided in Appendix 1.

Existing Infrastructure

While most infrastructure, which includes settlement areas and industrial activities (existing or proposed), are not expected to be adversely affected by the corridor, other infrastructure such as the existing railway, highway and pipelines will be affected by the corridor. Although these impacts are not expected to be severe, these infrastructure (including communication facilities) should continue to operate undisturbed.

Visual Amenities

The visual impact of the corridor will primarily occur where the corridor comes in contact with settled areas or existing access routes. While negative effects are not yet severe, the use of the corridor by major power transmission lines, particularly where the corridor crosses and parallels Highway 63, could create the most significant visual impact. Also, the view of the Clearwater River valley, from the upper banks, could be obstructed by such a facility.

3. ENVIRONMENTAL PROTECTION

Protection of the social and natural environments in the study area has always been a concern throughout the selection process. Another concern has been to ensure that the integrity of the potential linear facilities using such a corridor is not placed in jeopardy.

By adhering largely to a philosophy of mitigation versus avoidance throughout the development and review of the various corridor alternatives, a corridor alignment is recommended which alleviates these concerns to the greatest extent possible. However, it should be understood that certain types of environmental impacts (i.e., pipelines through moose winter range) can be mitigated regardless of the corridor alignment. The degree to which such impacts can be mitigated was also considered as a criterion in the routing assessment.

It is important to emphasize that this study is only an initial stage in the overall development of a multiple use corridor. Protection of the environment will be the responsibility of the government agencies and energy proponents involved with the specific location, construction, operation and eventual abandonment of utilities placed within the corridor.

4. CONCLUSION

This study only goes so far as to identify a location for a multiple use corridor which is both environmentally and administratively acceptable to Alberta Forestry, Lands and Wildlife. The corridor, as it develops, is expected to be used primarily to serve future oil sands developments situated in the Surface Mineable Area of the Athabasca Oil Sands Deposits. However, other industrial developments should be encouraged to use the corridor.

While the management of this corridor will continue to be the responsibility of this department, actual corridor development, in terms of the placement and maintenance of specific linear facilities will largely be in the hands of the energy proponents. The alignment that these facilities take upon leaving the Green Area will no longer be a direct concern to the department. From this point, the proponent will be expected to negotiate (with various landowners) and select a continuing alignment that is amenable to private and government concerns alike.

The first proponent of a linear facility will play a significant role in determining the actual right-of-way for the specific type of utility within the corridor. It is assumed that the energy proponents recognize that it is in their best interest to ensure that mutual co-operation, both between themselves and the government agencies involved, is undertaken to ensure that the placement of linear facilities can be accomplished orderly and efficiently.

With this objective in mind, it should be emphasized that this study has not proposed the establishment of additional agencies or legislation to exclusively manage this corridor. The Alberta government has the staff, legislation and procedures in place to evaluate and review specific linear facilities. Given the multiple use aspect of the corridor and the unique situations which can be expected to occur, the department is preparing a management guidelines proposal to assist individuals involved with its development. These guidelines, in addition to the anticipated mutual co-operation between those involved with the development of this corridor, should help to ensure that it is successfully implemented.

APPENDIX 1

River/Stream Crossings in the Recommended Corridor

Introduction

In the winter of 1984, the Resource Evaluation Branch of Alberta Forestry, Lands and Wildlife was assigned the task of producing two background papers which analyse the various river/stream crossings which are impacted by the final corridor alternatives. These two papers entitled Lac La Biche - McClelland Lake Multiple Use Corridor River/Stream Analysis were completed for both the origin (January 1984) and the destination (June 1984) sectors of the study area.

The summary presented here is a compilation of these papers pertaining oly to those river/stream crossings which are affected by the recommended corridor. The numerous maps (1:50 000 scale) accompanying these papers are on file with the Land Classification Section, Resource Evaluation Branch, Alberta Forestry, Lands and Wildlife.

The discussion begins with the most northerly water crossing affected and proceeds south.

Origin Sector River/Stream Analysis

Muskeg River Crossing - Twp. 94, Rge. 10, Wet of the 4th

The Muskeg River in the area of the proposed crossing appears to flow through dominantly coarse-textured glaciofluvial materials. Significant amounts of organic sediments can also be found in the area. With the level to gently undulating nature of the landscape (0.5 - 5 percent), slope failure does not appear to be of major concern. The poorly drained nature of some areas adjacent to the stream may pose minor problems, but would appear to be easily dealt with.

The lack of significant meandering by the stream in the area will make approaches to the stream course much easier and provide a greater choice of sites where the corridor can cross the stream.

Most of the vegetation in the area is aspen/willow shrubland which is very common in the area. Overall, the site looks very good as a possible crossing.

Hartley Creek Crossing - Twp. 94, Rge. 9, West of the 4th

This portion of the stream cuts through a low-lying eolian plain with deposits consisting of organic blankets overlying sandy eolian materials. Willow shrubland vegetation appears to dominate much of the landscape and indicates some impediment to drainage. Much of the area is very wet, thus muskeg and its associated drainage restrictions will be the main concern of any activities taking place within the proposed corridor.

Hartley Creek Crossing - Twp. 94, Rge. 9, West of the 4th

This section of the stream meanders through organic/muskeg which appears to overlie fine textured glaciolacustrine deposits which is impeding drainage. Much of the terrain is level and lowlying with the stream not actively downcutting. Vegetation in this area consists of willow shrubland and minor components of closed white spruce forest. With the exception of muskeg and its associated drainage conditions, no other major problems can be seen with this crossing.

Hartley Creek Crossing - Twp. 93, Rge. 8, West of the 4th

In this area the stream has formed a small gorge across the gently sloping landscape. The topography slopes to the northwest at roughly 3 - 10 per cent and surficial deposits consist of undulating glaciofluvial veneers overlying fine textured till. Vegetation across the landscape consists of aspen/white spruce with willow shrubland associated with areas where organic deposits appear.

No evidence of slope failure is visible. However, there appears to be significant movement of both surface and groundwater seepage downslope. This could pose slope failure problems along the stream valley walls if disturbed. It also appears that the stream is not actively downcutting (presence of numerous beaver dams) at present. Hence, where groundwater seepage is not extensive, the valley walls may be reasonably stable. However, it is suggested that routing the corridor up or downstream from the present gorge should avert possible slope failure problems in the area of the corridor.

North Steepbank River Crossing - Twp. 91, Rge. 7, West of the 4th

At this location the North Steepbank River appears to flow in a small relic glacial meltwater channel with a distinctive U-shaped valley. The present stream slowly meanders within the valley and does not appear to be actively downcutting moraine deposits.

These fine textured deposits have impeded drainage to some extent and give rise to significant amounts of organic/muskeg deposits found in the area. Along the valley, slopes range up to 30 percent and may be prone to failure because of the high angle. However, no evidence of slope failure or groundwater seepage from upland positions was observed.

Vegetation in the area consisted of closed white spruce forest with significant amounts of black spruce on much better sites. The vegetation appears well established along the valley walls and may attribute to the lack of seepage along these slopes.

The northern sector of the corridor seems more favourable as the area for a potential stream crossing. At this point valley slopes are not as steep and appear very stable. It is recommended that special attention should be paid to any disturbance of the vegetation cover since there appears to be a correlation between the amount of cover and presence of groundwater seepage.

Steepbank River Crossing - Twp. 90, Rge. 7, West of the 4th

Along this sector of the proposed corridor, the river has downcut into coarse glaciofluvial deposits overlying fine textured lacustro-moraine material. On the level to undulating upland position, significant amounts of organic/muskeg are found where internal drainage has been impeded by the underlying fine textured materials. Along the valley walls where slopes range from 15 - 45 percent, there appears to be no slope failure. However, minor stream erosion on the outside of meander bends within the valley may lead to oversteepening of valley walls and possible failures in future. It is suspected that groundwater seepage from upland positions may be occurring and this could also lead to slope failure. Vegetation cover consists of open to closed aspen/white spruce forest on dryer upland positions and along sections of the valley slopes. The majority of the wet organic materials appear to be covered with willow shrubland which is a result of impeded drainage in these areas. The site where a former forestry trail crosses the stream looks promising as a possible crossing. Slopes appear stable and are not steep at this point. Seepage from upland positions appears minor at this point and with proper mitigation could be controlled.

Rainbow Creek Crossing - Twp. 89, Rge. 7, West of the 4th

Along this sector of the corridor the stream has downcut into coarse textured glaciofluvial materials overlying fine textured glaciolacustrine deposits and flows in a small entrenched valley. On the

undulating upland positions adjacent to the valley, significant amounts of organic/muskeg deposits overlie the glaciolacustrine materials. Vegetation over much of the area consists of closed white spruce forest with wet shrubland and sedge vegetation found on wetter sites and along the stream course. Along the valley slopes where slopes range from 5 - 30 percent no visible evidence of slope failure was observed. There may be possible groundwater seepage along the valley slopes from organic deposits located on upland positions and this will require field checking. In general, a crossing in this area appears feasible. It should be noted that proper mitigation procedures will be required to deal with possible problems associated with potential groundwater seepage along valley slopes.

Clearwater River Crossing - Twp. 88, Rge. 7, West of the 4th

The upland position on both north and south sides of the valley appear relatively stable with deposits consisting of significant amounts of thin organic/muskeg deposits overlying a strategraphic complex of coarse glaciofluvial material over fine textured lacustro-moraine deposits. In the organic areas, water tolerant sedge and shrubland vegetation is present with closed white spruce/aspen species found on much better drained sites. The moisture regime on the north side of the valley appears much better drained than that found on the south side. The presence of numerous minor, well treed tributaries along the northern valley edge seems to enhance the drainage characteristics of this area. On both north and south sides of the valley, limitations to possible disturbance appear slight with the exception of areas in which higher proportions of poorly drained materials (organic/muskeg) are found. No evidence of slope failure or abnormal groundwater seepage has been observed, and with proper mitigation methods for muskeg this area should be acceptable for use associated with a multiple use corridor.

The valley slopes along the Clearwater River are mantled by veneers of colluvial materials overlying lacustro-moraine on upper slope positions, with lower slopes having a thin cover of colluvium over very unstable bedrock. The bedrock exposed on these slopes is the McMurray Formation and consists of oil impregnated shales in association with quartzose sandstone and siltstone. This formation breaks down to sand when the bitumen is removed or exposed. Thus, the rock is very unconsolidated and is easily prone to failure. Slope failure due to the fragile bedrock has occurred and the process appears to be on-going. Groundwater seepage along the slopes appears present at the interface zones between colluvial veneers over fine textured lacustra moraine on upper slope positions and at the bedrock interface at lower

slope positions. Vegetation along the valley walls appears to reflect these variations in drainage with a closed spruce/aspen forest dominating. Spruce appear to occupy the areas of major seepage with aspen on the much dryer sites. The south-facing slopes are much more dominated by aspen and this may be the result of aspect. A large percentage of the area has slopes exceeding 30 per cent; this, with the combination of groundwater seepage and the character of the stratigraphic material, may induce slope failure and gullying from slope wash which will severely limit these sections to economically feasible multiple use corridor development. It is suggested that the area in the vicinity of Ritson Island could be a possible location for a major crossing. Steepness of slopes, seepage and slope failure appear less severe in this area and with proper mitigation methods employed, maintenance of the proposed Multiple Use Corridor in this area should be feasible.

Along the valley bottom, materials consist of fluvial deposits associated with floodplain development. A significant amount of organic deposits overlie these fluvial deposits in areas where relic channels and old ox-bow like lakes exist. The vegetation reflects the wet/dry moisture regime with aspen/white spruce dominating well drained sites and poplar/black spruce occupying poorly drained positions. With the exception of some limitations due to poorly drained organic deposits the valley bottom appears very stable. However, it appears that frequent flooding occurs within the floodplain zone and may pose a hazard to corridor activities. Indications are that flooding is seasonal. Hence, with proper planning and mitigation measures being employed this hazard may be controlled and not adversely affect activities within the multiple use corridor.

Destination Sector River/Stream Analysis

Saprae Creek - Twp. 88, Rge. 7, West of the 4th

The corridor crosses the creek in three locations. Along this section, the stream appears very sluggish as it flows through the low lying organic/muskeg deposits which dominate most of the area. The organic materials overlie fine textured lacustro moraine which has impeded drainage. The landscape is level to gently undulating and imperfect to poorly drained.

The poor drainage is reflected in the vegetation cover which consists of mainly moisture tolerant willow/black spruce. Areas in

which veneers of glaciofluvial sands and gravel overlie the fine textured deposits have a vegetation cover of black/white spruce. This indicates some improvement in drainage but these areas are not extensive. In general, this sector of the corridor appears stable and the poorly drained muskeg in the vicinity appear to pose the only problems. Several beaver ponds were noted along portions of the streams and these may be of some concern.

Saline Creek and Tributaries - Twp. 87, Rge. 8, West of the 4th

Along this sector of the corridor five minor crossings of Saline Creek and its tributaries will have to be considered. These streams are very small and appear to be intermittent. The terrain is very similar to that found in the vicinity of Saprae Creek and slopes gently (<5 per cent) to the north. Deposits in the area consists of organic/muskeg overlying both fine textured lacustro moraine and coarser textured glaciofluvial deposits. The muskeg appears much thinner in this area and drainage seems improved. This is reflected in the vegetation which consists of dominantly black/white spruce. Willow shrubland is the dominant vegetation along the stream courses where drainage is much poorer.

The streams are not very active and slowly meander within the low lying landscape. There would appear to be only minor problems associated with the crossings.

Prairie Creek and Tributaries of Hangingstone River - Twp. 87, Rge. 8, 9, West of the 4th

Potentially seven stream crossings may have to be considered along this sector of the corridor. These streams are of a minor nature and do not appear to be actively downcutting the landscape. The terrain consists of gently undulating to level glaciofluvial sands and/or gravels often overlying lacustro moraine. Large expanses of organic/muskeg are common and may be the results of seepage from more upland positions located to the south. The fine textured materials which underlies much of the area has impeded drainage along these long gently sloping north-facing slopes. The streams do not appear to be seasonal and the ponding of water along the water course (beaver ponds, depressions, etc.) indicate a steady movement of water across the landscape.

Vegetation in the area appears to reflect the poor to imperfect drainage. Black/white spruce in association with aspen dominates much of the long slopes. In the vicinity of the streams moisture tolerant

willow shrubland is common. Minor areas of dominantly coarse textured glaciofluvial deposits appear well drained and some pine/white spruce can be found, reflecting the improved drainage conditions.

The individual crossings of the streams do not appear to pose significant problems since little downcutting has occurred, hence slumping and gullying along stream banks is minor. Some seepage problems may occur, however, it is felt that the muskeg will be the main concern. Extensive ponding along present stream courses has occurred and appears to be the result of beaver activity. This may be of concern; however, many of these areas can be avoided. Slopes across the sector are gentle (0.5 - 5 percent); hence the removal of vegetation would not necessarily promote slope erosion.

Hangingstone River - Twp. 87, Rge. 9, West of the 4th

Along this sector of the proposed corridor, the river has downcut into the fine textured lacustro moraine deposits to form a small indented valley in which the river slowly meanders (downcut 20 m). On the level to undulating upland position, large expanses of organic/muskeg are found where internal drainage has been impeded by the underlying fine textured materials.

Along the stream valley walls where slopes range from 10 - 30 per cent, there appears to be no significant slope failure. However, the stream appears to be still actively eroding the outside of meander bends within the valley and this may lead to oversteepening and possible failures. It is suspected that groundwater seepage from muskeg/organic deposits on upland positions may be extensive along the valley wall and will have to be assessed during construction.

Vegetation cover consists of open to closed aspen/white spruce on imperfectly drained upland positions and along sections of the valley slopes. The present river valley proper is dominated by open white spruce/aspen stands. The majority of the poorly drained organic/muskeg deposits are covered with willow shrubland in association with black spruce. This reflects the impeded drainage in these areas.

In general terms, a crossing in this area appears feasible, slopes are stable and not overly steep. Seepage appears to be the main concern but with proper mitigation could be controlled.

Tributary of the Hangingstone River - Twp. 86, Rge. 10, West of the 4th

The stream along this sector of the proposed corridor meanders slowly through level to undulating landscape dominated by organic/

muskeg deposits overlying both coarse textured glaciofluvial and fine textured lacustro moraine. Much of the landscape is imperfect to poorly drained and this is reflected in the present vegetation cover. Willow shrubland in association with black spruce is dominant, in some locations where coarse glaciofluvial deposits are dominant white spruce/aspen appear to dominate.

The stream meanders a great deal across the landscape and appears to have very little erosive power. The presence of muskeg appears to be the only concern at this location.

Tributary of Hangingstone River - Twp. 86, Rge. 10, West of the 4th

The stream in this area of the corridor meanders slowly through low-lying organic/muskeg deposits which overlies fine textured lacustro moraine deposits. The level to gently undulating terrain is covered by dominantly open to closed black spruce/willow vegetation which reflects the imperfect to poorly drained conditions which prevail due to the underlying fine textured materials. Some areas of white spruce are present and may indicate that organic deposits are much shallower at these locations.

The present pipeline corridor in the area seems relatively stable. The stream does not appear to be actively downcutting, hence, slope failure and seepage are of minor concern. The poorly drained muskeg may pose problems, however, proper mitigation should alleviate these.

Tributaries of Hangingstone River - Twp. 85, Rge. 10-11, West of the 4th

Along this sector of the proposed corridor several minor stream crossings will have to be assessed. The area slopes gently toward the northeast and the present streams slowly meander across the landscape and do not appear to be actively downcutting. In some instances the streams appear intermittent and beaver activity has limited their flow.

Much of the topography consists of level to gently undulating (0.5 - 5 percent) glaciofluvial veneers overlying fine textured lacustro moraine deposits. These fine textured deposits have impeded internal drainage to some extent and have given rise to significant amounts of organic/muskeg materials throughout the area. These muskeg deposits vary in depth across the landscape, with deeper materials being found adjacent to the present stream course and other low-lying areas scattered across the terrain.

This imperfect to poorly drained landscape is dominated by black spruce vegetation with isolated areas of aspen/white spruce/ black spruce being found on drier sites. Adjacent to the stream course black spruce/willow is present, reflecting the very poor drainage conditions in these areas.

Isolated pockets of coarse glaciofluvial materials are scattered in the area and could provide a source for construction aggregate. These areas are covered with aspen/white spruce and indicate improved drainage conditions.

No significant slopes (valley walls) were noted along the stream course hence slope failure and groundwater seepage will be of minor concern. The poorly drained muskeg will provide the main problems. A pipeline corridor exists in the area and no major problems have occurred where it crosses the above streams. A multiple use corridor in this area would appear workable.

Horse River - Twp. 84, Rge. 11, West of the 4th

At this crossing of the Horse River, a pipeline and highway corridor both exist within the proposed multiple use corridor. These crossings both appear to be very stable at present.

Additional crossings in the area would appear to be feasible. The main concerns will be seepage from upper slope positions along the valley walls (slope 10 - 30 percent) causing possible slope failure. This does not appear to have occurred with the present crossings. The river does not appear to be actively downcutting in this area, thereby eliminating another area of concern.

Unknown Tributary - Twp. 83, Rge. 11, West of the 4th

At this location the stream, in the past, has formed a small gorge across the gently sloping landscape. The topography slopes to the northwest at roughly 0.5 - 5 percent and surficial deposits consist of undulating coarse textured glaciofluvial veneers/blankets overlying fine textured till. The surrounding area on both sides of the stream is dominated by poorly drained organic/muskeg which also overlies till.

The gorge, possibly formed by glacial meltwaters, is approximately 15 - 25m deep and shows no evidence of slope failure. The stream appears intermittent and is not actively downcutting

within the valley. Groundwater seepage along the valley walls may be present but the dense vegetation in the area obscures any evidence.

Vegetation on upland areas consists of open to closed black spruce forest where poorly drained organic/muskeg deposits are found. On drier sites (imperfectly drained) where coarse glaciofluvial materials are found, reasonably dense cover of pine/aspen/white spruce forests are present. Within the gorge, dense white spruce/shrub is present and perhaps indicates that seepage from upper slopes is not extensive.

In the area, a pipeline and highway cross the stream. At this point there appears to be very little evidence of instability where these corridors exist. Slopes are stable and seepage does not appear to be present. This would indicate that additional activity (i.e. multiple use corridor) is feasible in the area.

Unknown Tributaries - Twp. 83, Rge. 11, West of the 4th

In this area, along the corridor, several small tributaries will be crossed. These streams are intermittent in nature and often difficult to trace in the landscape. Dominant materials in this area is a complex of organic/muskeg veneers/blankets overlying level to gently undulating moraine and glaciofluvial deposits. The area is very poorly drained with open black spruce/tamarack forest cover. Along the small stream course where drainage is slightly improved (possibly due to underlying coarse glaciofluvial materials) a complex of white spruce/pine/black spruce/willow can be found.

These streams have not downcut into the landscape hence slope failure with accompanying groundwater seepage will not be a concern. The poorly drained muskeg poses the main construction problem and this can be handled using proper mitigation procedures.

Numerous Unknown Tributaries of Horse River - Twp. 82, Rge. 12-13, West of the 4th

Along this section of the proposed corridor several small intermittent streams flow from a dissected glaciofluvial terrace onto a gently undulating to level till plain. This former terrace is coarse textured and appears well drained with a closed to open pine/aspen forest. In the locations where the streams have downcut into the terrace, slopes appear stable and no groundwater seepage is evident. Slopes along these small valley walls range from 10 - 30 percent. The

streams do not appear to be actively downcutting due largely to their intermittent nature.

The till plain located downslope is made up of fine textured moraine often overlain by veneers and blankets of poorly drained muskeg. Vegetation in these areas consists of black spruce/pine indicating much poorer drainage conditions. Along the stream courses white spruce/aspen/willow is present, reflecting improved drainage. No evidence of slope failure along the stream banks was observed. There may be seepage in this area but it would appear to pose no major problems.

The present corridors (pipeline/highway) in the area run along the terrace and the stream crossings appear very stable. Increased activity in this sector of the corridor seems feasible.

Intermittent Streams - Twp. 82, Rge. 12-13, West of the 4th

Covering several kilometres of the proposed corridor this area is crossed by numerous small intermittent drainage courses. These streams drain a topography made up of level to gently undulating moraine in association with extensive areas of poorly drained organic/ muskeg. The landscape gently slopes to the northwest at approximately 2.5 - 6 percent. These slopes are covered in dense white spruce/black spruce/pine forest cover which appear imperfectly to moderately well drained. The poorly drained organic area appears to be covered by open black spruce/white spruce vegetation.

The streams have not extensively downcut into the landscape hence slope failure does not appear to be of concern. Seepage along these long slopes may pose some minor problems which should be considered. Disturbance of the terrain and vegetation cover may cause gully erosion if proper mitigation is not used. This should be monitored carefully. The pipeline/highway corridor in the area appears relatively stable. This indicates that construction activity in the area will not adversely affect the sensitivity of the landscape.

Unknown Tributaries - Twp. 81, Rge. 12-13, West of the 4th

The two streams in this area of the corridor meander slowly through low-lying organic/muskeg deposits which overlie level to gently undulating glaciofluvial deposits. The level to gently undulating glaciofluvial deposits. The level nature of the landscape appears to impede local drainage to some extent. This is reflected in the vege-

tation cover which consists of mainly black/white spruce forest with isolated areas of pine located on imperfectly to moderately well drained glaciofluvial deposits. Stream crossings in this area should pose no major problem other than those associated with construction in a muskeg environment.

House River - Twp. 77, Rge. 13, West of the 4th

In this area the House River appears to be flowing within a much large relic glacial meltwater channel with several levels of what are perhaps former glaciofluvial terraces on both sides of the present river valley. The stream slowly meanders within the valley and does not appear to be actively downcutting. The presence of numerous meander scars, however, does indicate that the stream valley is prone to flooding with the stream actively changing its course during these periods of flooding.

The topography along the stream course consists of level to gently inclined (0.5 - 3 percent) fluvial and organic deposits. These materials are generally imperfectly drained and appear to support willow shrubland vegetation with minor occurrences of pine found on well drained coarse textured fluvial terraces.

The stream itself flows through a landscape dominated by undulating to hummocky ablation till in association with coarse textured glaciofluvial deposits. Scattered throughout are extensive deposits of organic/muskeg which has resulted from underlying fine textured moraine impeding drainage to some extent. This has given rise to groundwater seepage occurring along the valley walls. At present, there appears to be no significant evidence of slumping along the valley slopes, however, the presence of seepage will have to be considered during construction in order that slope failure does not occur. The valley slopes in the area are inclined to undulating (2.5 - 9 percent) generally appear stable.

Vegetation appears to be dominantly close pine stands with significant amounts of aspen/pine and white spruce/aspen stands. Much of the area is imperfectly drained indicating that an active groundwater flow is occurring along the valley walls. Black spruce can also be found on wetter sites along the valley where seepage appears very active.

In this area care will be required in moving down the slopes to the stream crossing. The present of seepage from upland muskeg deposits may cause active erosion and/or slumping if vegetation is

removed. The river flats themselves seem very stable and should only cause some minor problems. A crossing could be considered here under proper mitigation procedures. Seepage will be the main concern and this should be carefully studied.

Tributary of House River - Twp. 76-77, Rge. 13, West of the 4th

At this sector of the corridor two small tributaries occupy the valleys of relic meltwater channels. The streams are intermittent in nature and display little erosive power. The former valleys have infilled with organic/muskeg deposits which are poorly drained and support a willow shrubland vegetation. Much of the valley bottom is level to gently undulating (0.5 - 2.5 percent slope) and several beaver dams restrict stream flow.

The upper slopes of the stream valleys appear to be dominantly coarse textured glaciofluvial deposits intermingled with organic/muskeg veneers. Vegetation on this undulating to rolling topography consists of aspen/white spruce/pine on drier sites and pine/white spruce/black spruce on more imperfectly drained deposits.

Groundwater seepage appears to be present in those areas where organic deposits are found at upper slope positions adjacent to stream valley. In some locations the valley walls have slopes approaching 30 percent and may be prone to failure due to groundwater seepage. This will have to be checked since no evidence of slope failure was observed.

The vegetation appears well established along the south-facing slopes which appear much drier than north-facing slopes. It is recommended that attention be paid to any disturbance of the vegetation cover since there appears to be a small correlation between the amount of vegetation cover and the presence of seepage along both north/south facing slopes. The stream crossings themselves appear to pose no major problems in this area, however, the valley walls will require more attention.

Caribou Creek - Twp. 76, Rng. 14, West of the 4th

In the vicinity of Round Lake the proposed corridor crosses Caribou Creek. This stream flows within a valley formed by past glacial meltwaters which have downcut into coarse textured moraine. Caribou Creek flows as a misfit stream and meanders (sluggishly) quite extensively within the generally U-shaped valley.

On the undulating upland position above the valley floor, organic/muskeg complexes are very common where drainage has been impeded by underlying fine textured till. This slow drainage has contributed to significant seepage along the steeper sections of the stream valley walls. However, there does not appear to be any major erosion now. Vegetation on these upland positions consists of a varied closed/open forest of aspen/white spruce/pine on dry sites to black spruce/pine on more imperfectly drained locations. Much of the organic areas are dominated by willow shrubland.

Along sections of the valley walls where slopes range from 10-30 percent, there appears to be no significant slope failures occurring. However, the presence of relatively steep angles and areas of significant seepage may pose failure problems if vegetation were removed. Most of the vegetation along the valley walls consists of open to closed aspen/white spruce forest on drier positions and black spruce/aspen on more imperfectly drained sites. There are significant amounts of pine in the area as well, which appears to correspond to sites where sandy glaciofluvial materials dominate. It also appears that areas along the valley have been subjected to slope wash in the past. If vegetation were removed, gullying problems are possible.

Materials within the valley consist of organic veneers overlying both glaciofluvial and fluvial deposits. The vegetation on this level terrain consists of willow/sedge shrubland with inclusions of black spruce. The stream appears very sluggish and meanders extensively within the valley. With the exception of some limitations due to poorly drained organic deposits, the valley bottom appears stable.

The tributaries to the main stream in the area show similar conditions as mentioned above. Valley bottoms within the reaches of these small tributaries are not as well developed.

The primary concern within this sector will be the steepness of the valley walls being perhaps prone to some slope failure due to groundwater seepage. This should be considered carefully before construction.

Tributaries of House River - Twp. 76, Rge. 15, West of the 4th

The two small tributaries in this area flow through an undulating landscape made up of glaciofluvial and moraine deposits which in most locations is overlain by varied depths of organic/muskeg materials. The low lying nature of the terrain and the presence of fine/medium textured sediments has restricted drainage across much of the

landscape. As a result, streams tend to be very sluggish and show minor erosional activity as they meander through the muskeg filled depressions.

Most of the vegetation along this sector is black spruce/willow in the immediate vicinity of the streams. On better drained sites a combination of aspen/white spruce/pines appear to dominate.

Slopes in the area are very minor (0.5-5 percent) and no evidence of erosion or slope failure was observed. Possible seepage along long, gentle slopes in the area may be present but should pose no problems.

The area of the stream crossings appear stable. Organic/muskeg deposits appear to pose the main concern.

Tributary of the Wandering River - Twp. 74-75, Rge. 15, West of the 4th

The stream in this area crosses the proposed corridor at several locations. It has downcut into coarse textured glaciofluvial materials approximately 20 - 25 metres and flows in a small entrenched U-shaped valley. The stream meanders slowly within the valley and does not appear to be actively eroding its bed. On the upland positions adjacent to the stream valley the undulating glaciofluvial materials are complexed with significant amounts of poorly drained organic/muskeg deposits. Much of the landscape slopes gently to the southwest at approximately 2.5 - 5 percent.

Vegetation over much of this section consists of an association of closed aspen/pine/white spruce on moderately well drained glaciofluvial deposits to open black spruce/willow shrubland on imperfect to poorly drained muskeg. Vegetation within the valley bottom is open white spruce/willow and seems well established.

Along the valley walls where slopes range from 10 - 45 percent no major evidence of slope failure was observed. Minor failure has occurred on the outsides of meander bends where the stream has eroded and oversteepened the valley walls. There appears to be seepage, from the upland muskeg deposits, occurring along sections of the valley and this should be taken into account when considering specific crossing areas.

In general, due to the narrowness of the stream valley and the steepness of the valley walls, crossings along this sector of the corridor may pose some problems. It is suggested that the corridor be moved to the immediate west of the stream valley in the vicinity of the highway corridor. This would perhaps avoid potential slope failure problems. By moving the corridor to the west, muskeg would appear to be the only concern and this can be dealt with using proper mitigation procedures.

Wandering River - Twp. 73, Rge. 16-17, West of the 4th

The river along this sector of the corridor meanders through a very low-lying landscape dominated by organic/muskeg deposits which often overlies glaciofluvial sediments. The area is gently undulating to level and is poorly to imperfectly drained. Much of the vegetation consists of white spruce/black spruce on poorer drained areas.

Because of very low-lying nature of the terrain, the river has not downcut into the landscape extensively. It does appear to be actively meandering and periodic flooding may be of concern. The highway and pipeline corridors appear relatively stable and additional crossings in the area would seem to have minimum impact on the environment. There is evidence that seepage is occurring along the small valley slope but does not appear to pose sensitivity problems. No slope failures were noted, although there is some minor erosion on meander bends.

APPENDIX 2

Potential Athabasca River Crossings

Introduction

As part of the origin sector river/stream analysis, an assessment was also made of four potential corridor crossings on the Athabasca River, north of Fort McMurray. A brief field reconnaissance was conducted to the various sites during the summer of 1983, to assess their feasibility as potential crossings, along the Athabasca River, in order to link-up the corridor with the western portion of the surface mineable area. This summary is brief and its nature is to determine whether the specific areas should be considered for further detailed analysis or eliminated from additional evaluation.

Muskeg River Confluence - Twp. 94, Rge. 10, Sec. 7, West of the 4th

This crossing is used as a transportation and pipeline corridor. From a brief field inspection, the landscape has not been extensively disturbed by present activities. This crossing has potential for additional multiple use without upsetting the sensitivity of the landscape.

Mills Island Crossing - Twp. 95, Rge. 10, Sec. 6/7, West of the 4th

After field inspection, this potential crossing was assessed as not feasible as a part of the multiple use corridor. Exposed unstable bedrock along the eastern valley walls would pose significant engineering problems and the very steep valley slopes appear prone to failure.

Tar River Confluence - Twp. 96, Rge. 11, Sec. 11, West of the 4th

Inspection of this potential site revealed similar problems as the Mills Island site. However, the sensitivity of this site is not as great and it is recommended that the potential of this crossing should be evaluated in detail before a final decision is made.

Pierre River Confluence - Twp. 97, Rge. 10, Sec. 27, West of the 4th

Field inspection of this potential crossing revealed no immediate problems with unstable bedrock or excessive slopes. The site appears very feasible as a crossing, however, detailed analysis will be required to ensure the landscape is stable and can support those activities associated with a multiple use corridor.

APPENDIX 3

Oil Sands Agreements Crossed by the Recommended Corridor

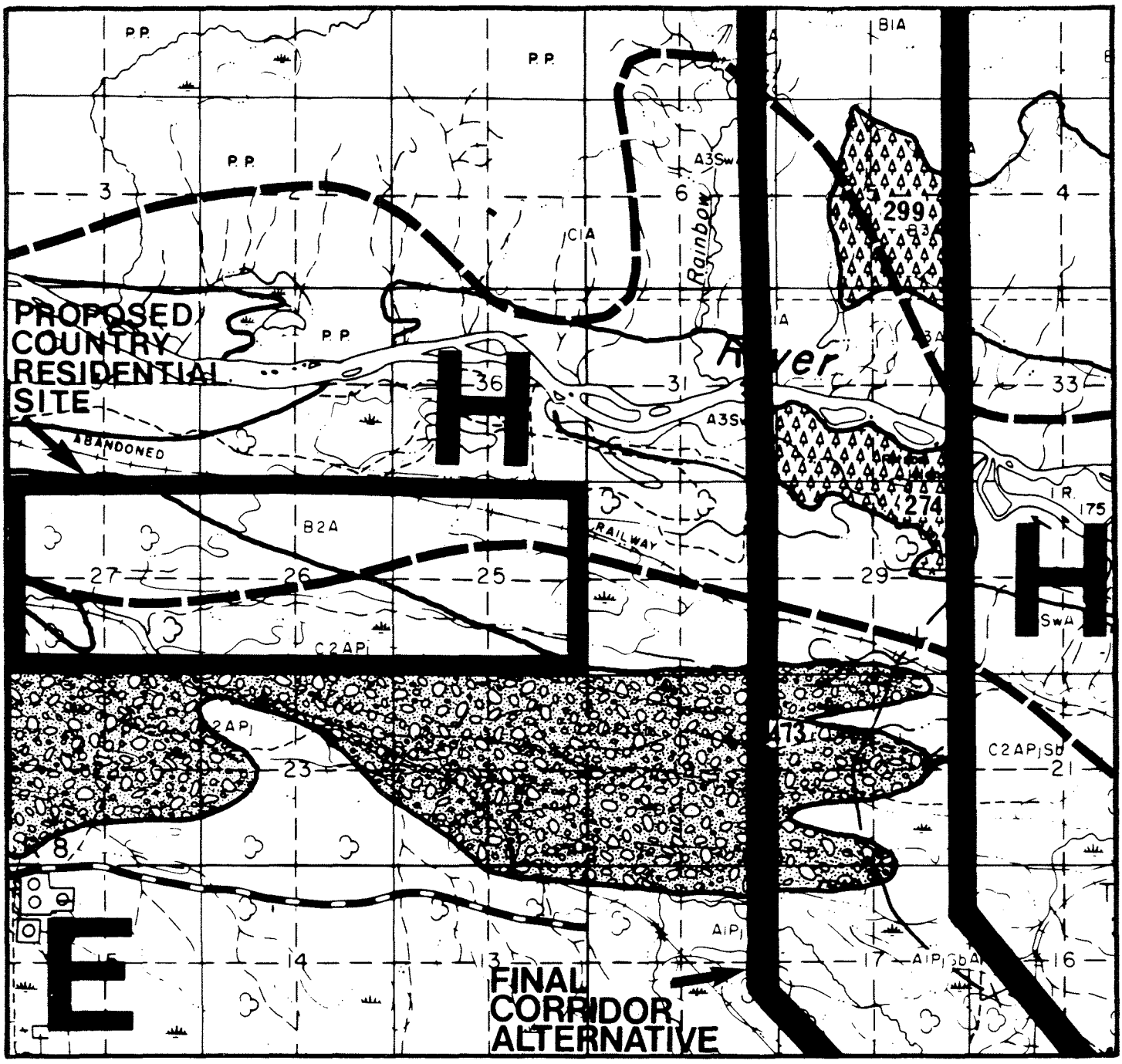
(as of February 15, 1985)

Lease Number	Principal Leaseholder	Year of Expiry
0980090001	Home Oil Company Limited	2001
0980090002	Esso Resources Canada Limited	2001
0980100001	Esso Resources Canada Limited	2001
0980100003	Union Oil Company of Canada Limited	2001
0981010005	Mobil Oil Canada, Ltd.	2002
0979060001	Mobil Oil Canada, Ltd.	2000
0980120001	Husky Oil Operations Ltd.	2001
0981020003	Total Petroleum Canada Ltd.	2002
0981030008	Texaco Canada Resources Ltd.	2002
0981080006	Petro-Canada Exploration Inc.	2002
0982010005	Texaco Canada Resources Ltd.	2003
0982010003	Petro-Canada Exploration Inc.	2003
0982010010	Amoco Canada Petroleum Company Ltd.	2003
0982060001	Petro-Canada Exploration Inc.	2003
0981070002	Dome Petroleum Limited	2002
0982080003	Petro-Canada Exploration Inc.	2003
0982060015	Petro-Canada Exploration Inc.	2003

Source: Mineral Support Branch, Alberta Energy and Natural Resources.

APPENDIX 4

SAMPLE OF THE FINAL CORRIDOR ASSESSMENT MAP



SCALE : 1:50 000

MERCHANTABLE TIMBER

SAND/GRAVEL DEPOSITS

MOOSE WINTER HABITAT

H HISTORICAL SITES

E EXPERIMENTAL OIL SANDS RECOVERY PROJECT

299 ESTIMATED SURFACE AREA (ACRES)

LIST OF REFERENCES

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ATHABASCA OIL SANDS
MULTIPLE USE CORRIDOR STUDY

SCALE 1 : 250 000

km. 4 2 0 2 4 6 8 km.
mi. 2 0 2 4 mi.
West of the Fourth Meridian

Fig. 6

NATURAL RESOURCE CONSTRAINTS

FISH AND WILDLIFE

- Moose Winter Habitat
- Caribou Habitat

AG	Arctic Grayling
GE	Goldeye
LW	Lake Whitefish
MW	Mountain Whitefish
NP	Northern Pike
SU	Suckers
WE	Walleye
YP	Yellow Perch

MISCELLANEOUS

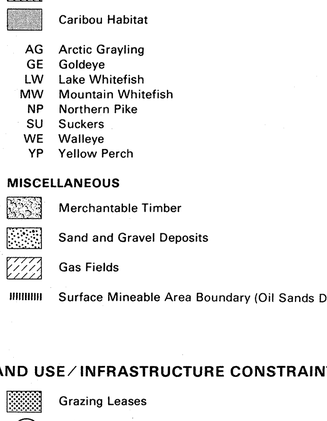
- Merchantable Timber
- Sand and Gravel Deposits
- Gas Fields
- Surface Mineable Area Boundary (Oil Sands Deposits)

LAND USE / INFRASTRUCTURE CONSTRAINTS

- Grazing Leases
- Communication Facilities
- Airstrips
- Highway Campsites
- Generating Stations
- Substations
- Major Transmission Lines
- Major Pipelines
- Commercial Oil Sands Plant
- Experimental Oil Sands Recovery Projects
- Historical Sites

RECOMMENDED CORRIDOR

STUDY AREA BOUNDARY



Alberta
ENERGY AND NATURAL RESOURCES
Resource Evaluation and Planning Division

SURFACE MINEABLE AREA

SCALE 1 : 500 000

- Surface Mineable Area Boundary
- Oil Sands Deposits
- Recommended Corridor

Source: Energy Resources Conservation Board