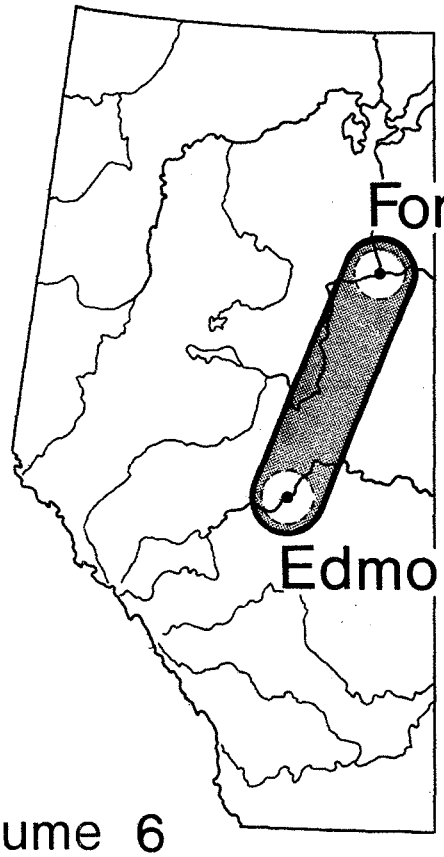
Athabasca Tar Sands Corridor Study



Volume 6 Appendix

Environment and Enginering

powerline – pipeline – highway – railway

prepared for

Alberta
ENVIRONMENT

by

stewart weir stewart
watson & heinrichs

december, 1973

edmonton, alberta

ATHABASCA TAR SANDS

CORRIDOR STUDY

VOLUME 6 - APPENDIX

ENVIRONMENT & ENGINEERING

POWERLINE-PIPELINE-HIGHWAY-RAILWAY

Prepared for:

Alberta
Environment
The Honorable
William Yurko

December, 1973

By:

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Edmonton, Alberta

TABLE OF CONTENTS

page

LIST OF FIGURES

LIST OF TABLES

page

LIST OF TABLES - continued

CHAPTER I

EXISTING FACILITIES

CHAPTER I

EXISTING FACILITIES

In planning for the future we must consider carefully the existing facilities. The map following on page 26 at the end of this chapter shows the location of the existing G.C.O.S. pipelines, the highway link to Fort McMurray and the Northern Alberta Railway. Superimposed on the map is a part of the Alberta Power Transmission Grid showing the Mitsue, Boyle and Bonnyville substations which are the nearest major substations which have been considered as points where power transmission lines might take off and proceed to the Tar Sands development area. Following this map is another map showing the pipelines in the Edmonton area.

POWER TRANSMISSION LINES

There is, at the time of writing, no power transmission line link connecting the Alberta Grid with the Tar Sands area. There are two sources of power serving the Tar Sands area. One is a conglomerate of eight (8) small units which develops 10 megawatts of power. This power source serves Fort McMurray and is connected to the G.C.O.S. plant by means of a 25 KV pole powerline which delivers 5 megawatts of power to G.C.O.S. Great Canadian Oil Sands has two 32.5 megawatt units generating on-site power to meet its own needs.

There is a proposal before the Energy Board for the construction of a 240 KV line from Mitsue Lake Substation of the Alberta Grid System to the G.C.O.S. plant area of the Tar Sands. This line should meet the peak load requirements of three future plants having a total capacity of 300,000 to 400,000 bbls./day. This proposal indicates that one of two things will

happen in the future; either there will be additional power lines leading into the area from outside the Alberta Grid, or, the power needed will be generated in the area and distributed by a local grid system, which will become a part of the Alberta Power Grid System. It should not be assumed that the additional power lines will necessarily come from the generating plants of the southern grid system. Power sources, actual and potential, exist to the West from Peace River Dam, from the proposed dam on the Slave River near Fort Fitzgerald, and possibly from Saskatchewan to the East. Assuming that the pollution problems arising from the use of locally produced coke are solved, it may be more efficient to generate the greater part of the required power in the Tar Sands area itself. In any event the power supply system for the Tar Sands will be integrated with the Alberta Grid. Thus, we foresee the possibility of several power transmission lines entering the Tar Sands area from widely separated sources. No doubt the corridor will have one or more of the future transmission lines.

PIPELINES

Great Canadian Oil Sands has one 16 inch oil pipeline delivering the synthetic oil processed at the G.C.O.S. Plant to Edmonton. The Company through a wholly owned subsidiary Company serves the present needs of the Town of Fort McMurray and the G.C.O.S. Plant with natural gas supplied by the Tweedie gas field north of Lac La Biche.

These two pipelines occupy an adjacent right-of-way from a point two miles South of Wandering River to the extraction plant at Tar Island.

Neither of these lines will be adequate to meet the requirements of the envisioned development of the Tar Sands area.

The following tables give the information which is available at this time regarding the breakdown of costs of construction of these two lines.

EXISTING OIL PIPELINE	(Edmonton to G.C.O.S. Plant at Tar Island)
Length	267 miles
Diameter	16 inches
Present Capacity	68,000 bbls/day
Intermediate Pumping Stations	one at Boyle
Ultimate Capacity	estimated at 100,000 bbls/day with additional pumping stations
Material Costs	not available
Labor Costs	not available
Engineering; Rights-of-Way, etc.	not available
Total Cost of Line	$23,000,000

EXISTING GAS PIPELINE	(Feeding gas from Tweedie gas field to Fort McMurray and the G.C.O.S. Plant)
Length	168 miles (approx.)
Diameter	$10\frac{3}{4}$ inches
Capacity	33,000,000 cu.ft./day
Present Use	20,000,000 cu.ft./day piped in
Projected Future Use	
Material Labor, Engineering and Miscellaneous Costs	not available
Total Cost of Gas Line	$7,000,000

HIGHWAYS

The highway system which is in existence consists of two main parts. The first part is the older section consisting chiefly of portions of Highways 28 and 46, which are two-lane paved rural highways given the highway designation RAU 244 for those sections having 10 foot shoulders and RAU 236 for those sections with 6 foot shoulders. The second part is Highway 63, which is still under construction at the time of writing and at present is being paved. The actual breakdown of the system is given in the two charts which accompany this report. These charts are courtesy of the Department of Highways by way of the Planning Branch.

It should be noted that the free flow of traffic class A service no longer exists on a 25-mile section of Highway 28 between Gibbons and the junction of Highway 46. A brief note on the Levels of Service concept is attached at the end of this section. From Atmore to Wandering River on Highway 63, the designation is RAU 236 with a free flow capacity of from 1700 to 2000 vehicles per day. The variation depends on the percentage of trucks in the total volume of traffic. The percentages are given as 10, 15 and 20 in the column headings under Service Volumes A, B and C.

The second portion of the Highway 63 begins at Wandering River and is being completed to a designation RAU 225 which means that it will be paved to a total width of 25 feet. There are no shoulders provided under the present paving program. The free flow traffic potential is limited to 1300 vehicles per day along with a loss in safety which will prove to be unacceptable in the future.

The present traffic volume between Edmonton and Fort McMurray is in the order of 100 vehicles per day with one plant in operation. It may be pointed out that AADT means the total number of vehicles per year divided by 365, or in words; the average annual daily traffic. Since the Service Level A capacity of a RAU 244 highway is 2000 vehicles per day, a highway of this standard, north of Wandering River, may be adequate while the next 10 plants are being built. Trucks are certain to be a very heavy percentage of the traffic on this road during the 20-year construction period which lies ahead.

(Ref. Road Research OECD 1972 TI7 library)

LEVELS OF SERVICE CONCEPT

As the traffic flow or volume on a road increases, the driving conditions deteriorate and the average speed of the traffic decreases until a saturation point is reached and the flow reaches a maximum which the road is capable of carrying; this traffic capacity is expressed in vehicles per hour. Roads were intended to be designed for some practical capacity somewhat lower than some theoretical value. This idea of practical capacity has been given a new name or series of names which do not really alter the basic ideas. A group of desirable operating conditions is given the name of LEVEL OF SERVICE. There are six of these levels of service.

LEVEL OF SERVICE "A" describes a free flow condition with low volumes and high speeds. Traffic density is low with speeds largely controlled by driver desires and rather high speed limits along with the physical conditions which are a function of the topography. There is little or no restriction on manoeuverability due to the presence of other vehicles and drivers can set their speeds and maintain them with little or no delay.

LEVEL OF SERVICE "B" is in the zone of stable flow, with speeds being restricted by traffic conditions. Drivers still have reasonable choice as to speed manoeuverability (lane of operation). Reductions in speed are reasonable with a low probability of traffic jams etc. The lower level of this service (lowest speed, highest volume) has been associated with the design of rural highways.

LEVEL OF SERVICE "C" is still in the zone of stable flow but speed and manoeuverability are restricted and controlled by the higher volume. A relatively satisfactory speed may be maintained and this level of service may be used in the design of urban situations.

The other levels get progressively worse from the drivers point of view.

TABLE I

HIGHWAY SURFACE VOLUME
EDMONTON - FORT McMURRAY

Section Description			Design	1972	Service Volume								
					A			B			C		
Hwy	From	To	Designation	AADT	10	15	20	10	15	20	10	15	20
28	Edmonton	Namao	RED440	7750	8500	8100		12100	11600		14000	13400	
28	Namao	Gibbons	RAU232	2400	1800	1700	1600	4300	4000	3800			
15	Edmonton	Highway 37	RED440	4500	8500	8100		12100	11600		14000	13400	
37	Highway 15	Gibbons	RAU236	1620	2000	1800	1700	4800	4400	4100			
28	Gibbons	Redwater	RAU236	2670	2000	1800	1700	4800	4400	4100			
28	Redwater	Highway 46	RAU244	1465	2200	2000	1900	5300	4800	4500			
46	Highway 28	Boyle	RAU236	695	2000	1800	1700	4800	4400	4100			
46	Boyle	Highway 63	RAU236	450	2000	1800	1700	4800	4400	4100			
28	Highway 46	Highway 36	RAU244	1100	2200	2000	1900	5300	4800	4500			
36	Highway 28	Lac La Biche	Gravel	200	500	Max.							
46	Lac La Biche	Highway 46	RAU236	470	2000	1800	1700	4800	4400	4100			
63	Highway 46	N. WanderingR.	RAU236	120	2000	1800	1700	4800	4400	4100			
63	N.Wandering R.	N. Horse R.	Gravel	100	500	Max.							
63	N. Horse R.		RAU225	100	1300	1300	1200	3300	3100	2900			
63		Hangingstone	Gravel	100	500	Max.							
63	S.Hangingstone	Airport	RAU225	100	1300	1300	1200	3300	3100	2900			
63	Airport	Fort McMurray	RAU225	220	1300	1300	1200	3300	3100	2900			

TABLE 2

DESIGN STANDARDS FOR RURAL HIGHWAYS

DEPARTMENT OF HIGHWAYS AND TRANSPORT

PROVINCE OF ALBERTA

PRIMARY SYSTEM - FREEWAY — R F D
PRIMARY SYSTEM - EXPRESSWAY — R E D
PRIMARY SYSTEM - ARTERIAL — R A U
SECONDARY SYSTEM - COLLECTOR — R C U
LOCAL ROAD SYSTEM - LOCAL — R L U

ROAD TYPE	SIX LANE DIVIDED		FOUR LANE DIVIDED		FOUR LANE DIVIDED		TWO LANE — TWO WAY											
DESIGN DESIGNATION	RFD-80-655		RFD-80-440		RED-80-440		RAU-80-244		RAU-70-236		RAU-70-232 RCU-70-232×		RAU-70-228 RCU-60-228★		RCU-60-226 RLU-60-226		RLU-50-222	
20 YEAR DESIGN AVERAGE ANNUAL DAILY TRAFFIC	OVER 15,000		OVER 8,000		OVER 6,000		2,500-4,000		1,000-2,500		750-1,500		UNDER 750		UNDER 400		UNDER 150	
TOPOGRAPHY	NORMAL	OTHER	NORMAL	OTHER	NORMAL	OTHER	NORMAL	OTHER	NORMAL	OTHER	NORMAL	OTHER	NORMAL	OTHER	NORMAL	OTHER	NORMAL	OTHER
LEVEL OF SERVICE	A	B	A	B	A	B	A	B	A	C								
DESIGN SPEED — M.P.H.	80	60	80	60	80	60	80	60	70	50	70	50	70 60 ★	50 50 ★	60	40	60	40
OPERATION SPEED — M.P.H.	≥ 60	≥ 55	≥ 60	≥ 55	≥ 60	≥ 55	≥ 60	≥ 50	≥ 60	≥ 40	≥ 50	≥ 40	≥ 50	≥ 40				
DESIGN CAPACITY — VEHICLES PER HOUR	800 PER LANE	500 PER LANE	700 PER LANE	500 PER LANE	600 PER LANE	400 PER LANE	400	800	400	1050								
MAXIMUM CURVATURE	2°30'	4°30'	2°30'	4°30'	2°30'	4°30'	2°30'	4°30'	3°30'	7°30'	3°30'	7°30'	3°30' 5°00' ★	7°30' 7°30' ★	5°00'	12°00'	5°00'	12°00'
MINIMUM STOPPING SIGHT DISTANCE — FT.	750	475	750	475	750	475	750	475	600	350	600	350	600 475 ★	350 350 ★	475	275	475	275
GRADIENT — DESIRABLE MAXIMUM	2.0 %	5.0 %	2.0 %	5.0 %	2.0 %	5.0 %	2.0 %	5.0 %	2.5 %	5.0 %	3.0 % 3.5% ×	6.0 %	3.5 % 4.0% *	7.0 %	4.0 %	7.0 %	5.0 %	8.0 %
LANE WIDTH — FT.	12-13-12		12		12		12		12		12		12		12		11	
OUTSIDE SHOULDER WIDTH — FT.	10		10		10		10	10	6	4	4	2	2	1	1	0	0	
INSIDE SHOULDER WIDTH — FT.	8		6		6													
FINISHED SURFACE WIDTH — FT.	2 @ 55		2 @ 40		2 @ 40		44	44	36	32	32	28	28	26	26	24	22	
[a] BASIC SUBGRADE WIDTH — FT.	2 @ 69	2 @ 67	2 @ 52	2 @ 51	2 @ 52	2 @ 51	56	52	42	38	38 36 ×	34	34 32 *	32	28	26	24	
[b] MEDIAN WIDTH — DESIRABLE — FT.	102	76	102	76	76	42												
MEDIAN WIDTH — MINIMUM — FT.	76	26	42	26	26	20												
NORMAL SIDE SLOPE RATIO	6:1	4:1	6:1	4:1	6:1	4:1	6:1	4:1	4:1	3:1	4:1	3:1	4:1	3:1	4:1(RCU) 3:1(RLU)	2:1	2½:1	2:1
MAX. SIDE SLOPE RATIO ON FILLS OVER 14 FT.	3:1		3:1		3:1		3:1		3:1		3:1 (3:1 OVER 7')×	2½:1	3:1 (3:1 OVER 7')*	2:1	2½:1 OVER 7'	1½:1 OVER 7'	2:1 OVER 7'	1½:1 OVER 7'
DITCH WIDTH — FT.	14 ROUNDED	6	14 ROUNDED	6	14 ROUNDED	6	14 ROUNDED	4	12	3	12	"V"	12	"V"	8	"V"	8	"V"
BACK SLOPE RATIO — NORMAL	5:1	3:1	5:1	3:1	5:1	3:1	5:1	3:1	3:1	2½:1	3:1	2:1	3:1	2:1	2:1	2:1	2:1	2:1
BACK SLOPE RATIO — MAXIMUM	3:1	¼:1	3:1	¼:1	3:1	¼:1	3:1	¼:1	3:1	¼:1	2½:1	¼:1	2½:1	¼:1	2:1	¼:1	2:1	¼:1
[c] BASIC RIGHT-OF-WAY WIDTH — FT.	350 (400)		300 (400)		300 (400)		200 (300)		200 (300)		150 (200) 100 ×	150 (200) 150 ×	150 (200) 100 *	150 (200) 132 *	100		66 OR 99 IN NEW TOWNSHIPS	

NOTES :

× — DENOTES DEVIATION FROM RAU - 70 - 232 STANDARD.

* — DENOTES DEVIATION FROM RAU - 70 - 228 STANDARD.

(a) — SUBGRADE WIDTH FOR ANY SPECIFIC SECTION OF ROAD WILL DEPEND UPON SURFACE WIDTH, DEPTH OF SURFACING AND BASE, ROUNDING AND SLOPES TO BE ACHIEVED, REFER TO SHEETS CB3 - 61.1 TO 61.6 FOR DETAILS.

(b) — MEDIAN WIDTH IS THE DISTANCE MEASURED BETWEEN INNER EDGE OF TRAVEL LANES.

(c) — BRACKETED VALUES FOR RIGHT-OF-WAY WIDTH APPLY THROUGH MARGINAL OR UNDEVELOPED LAND.

RAILWAYS

The Eastern Branch of the Northern Alberta Railway System extends from the marshalling yards on the north-western outskirts of Edmonton to Waterways which is now a part of the Town of Fort McMurray.

The total length of the branch including the mileage from the Dunvegan yards to Carbondale, where Mile 0 for this part of the N.A.R. System begins is 299.8 miles of which the first 120 miles pass through mixed farming and grain growing areas. The settled areas cease abruptly about 15 miles north of Lac La Biche. There are a few people scattered along the railroad. Only 3 settlements of any appreciable size exist along the railroad from the north end of Lac La Biche to Fort McMurray. They are Conklin, Chard and Anzac. There is a sawmill at Imperial Mills. However, Imperial Mills has a gravelled road linking it with Lac La Biche and the permanent residents at Imperial Mills are few in number.

The initial construction of the railroad was done about 60 years ago. The work was done as cheaply as possible with the lightest of steel rails and a minimum of grading and ballasting. The result of this type of construction was an unstable road bed and an expected time of arrival which was uncertain. The upgrading of the road bed was started in the early 1950's and has continued until the present. This railroad performed a very valuable service to the Western Arctic before the Great Slave Railway was completed in 1965.

The Northern Alberta Railway System is jointly owned by the Canadian National Railway Company, a Crown Corporation and the Canadian Pacific

Railway Company, which is of course a stock company whose shares are privately owned.

The System is made up of 4 separate small railroads organized by entrepreneurs in the early part of this century. They were:

(a) The Edmonton Dunvegan and British Columbia Railway running from Edmonton to Dawson Creek.

(b) The Central Alberta Railway from McLennan to Hines Creek.

(c) The Pembina Valley Railway going from Busby to Barrhead.

(d) The Alberta Great Waterways Railway which was the line from Edmonton to Waterways.

The above group is now known as the Northern Alberta Railway Co. The branch we are concerned with is of course that branch which started out as the Alberta Great Waterways Railway. The information which follows is presented in order to show the part which this branch of the N.A.R. has played in the past, and to show that it is in a position to adequately play its part in the future development of the Athabasca Tar Sands.

NORTHERN ALBERTA RAILWAYS

Total Length:	300 miles	
Steel:	155 mi.	100 lb. steel
	40 mi.	85 lb. steel
	105 mi.	60 lb. steel (original)

It is the intention to upgrade the railroad by replacing the 60 lb. steel with 100 lb. steel in the immediate future. This upgrading will increase by more than 50% the capacity of the system.

The following table shows the maximum tonnage hauled and the steady decrease in tonnage hauled since 1965, which was the year the Great Slave railway went into operation.

Annual gross tonnage - Lac La Biche to Waterways:

1958	94×10^6	GTM *
1965	80×10^6	"
1968	42×10^6	"
1969	46×10^6	"
1970	41×10^6	"
1971	39×10^6	"
1972	31×10^6	"

* GTM = Gross ton mile

Gross Ton = Lightweight + pay load of car

The average lightweight of a car is approximately 1/3 of the gross weight of the car, hence the pay tonnage of a train is 2/3 of the gross weight of the train. If we use the 1972 figures from the above table we can compute the average pay load per day over each day of the year. The calculations are based on 173 miles which is the distance from Lac La Biche to Fort McMurray (Waterways Station).

The capacity of a railroad is limited by the weight of the steel rail expressed in lbs. per yard. The heavier the steel the heavier the locomotive and the heavier the locomotive the more it can pull on any given grade.

The axle load permitted on 60 lb. steel is 44,000 lbs. This means that the heaviest locomotive or hauling unit will have 1250 horsepower. Such a unit can pull 1300 gross tons. Trains generally use 3 of these units and therefore the trains will weigh in the order of 4000 gross tons.

The axle load permitted on 100 lb. steel is 55,000 lb. and the horsepower of the hauling unit for this axle load is 1750. This single unit can pull 2200 gross tons, hence the train may be 6600 gross tons. By changing the steel from 60 lb. the capacity of the railway is increased by a theoretical 65%. 6600 Gross tons is very close to 4000 net tons. The railway hauled about 200,000 tons of material for the construction of G.C.O.S. Assuming that the future plants require the same approximate weight of construction material, it is readily seen that only 50 trains would haul all the material for each plant constructed. If we assume plants twice the size of the G.C.O.S. plant,then 100 trains would be required. The present service - 2 trains each way per week.

PRESENT CAPACITY is estimated at 15,000 gross tons per day on 60 lb. steel each way, which is 4 trains fully loaded each way making a grand total of 30,000 gross tons per day.

The capacity with 100 lb. steel, which anticipated with 4 trains each way fully loaded:

8 x 6600 = 52,800 gross tons/day

Say 25,000 tons, one way per day

on this basis and speaking theoretically one large plant would require about 20 train loads. From the foregoing it is concluded that the existing railroad is adequate to supply all the service which it may be asked to give in the foreseeable future.

NORTHERN TRANSPORTATION CO. LTD.

The record of existing facilities would be incomplete if mention of the activities of Northern Transportation Co. were to be omitted.

1956 was the high point of shipping on the Athabasca River out of that which was then called Waterways and is now part of Fort McMurray. In that year Northern Transportation shipped 138,364 tons of freight. Practically all of this arrived in Waterways by way of the Northern Alberta Railways. In 1973 Northern Transportation will ship 24,000 tons of which 20,000 tons will be handled by the railway and 4,000 tons by truck. The bulk of the 1956 tonnage was delivered along the McKenzie River System.

Upon completion of the McKenzie Highway and the Great Slave Railway to Hay River in the Northwest Territories, the McKenzie River bound traffic through Fort McMurray promptly become negligible. However, Northern Transportation did not suffer for it was promptly able to transfer the tugs and barges to a new home port in Hay River, N.W.T. where the major dock facilities are now located. It is of more than passing interest that in 1972 Northern Transportation Co. handled 247,000 tons of freight in the McKenzie System out of Hay River. This freight was delivered to Hay River by way of the Northern Alberta Railways Western Subdivisions, the Great Slave Railway from the junction at Roma, Alberta and by truck along the McKenzie Highway.

EDMONTON TERMINAL FACILITIES

INTERPROVINCIAL PIPELINE COPMANY

Interprovincial Pipe Line Company was incorporated by a special act of the Parliament of Canada in 1949. Lakehead Pipe Line Company Inc., a wholly owned subsidiary, was incorporated in the United States in the same year.

In 1950, the Company constructed a large diameter pipeline from Edmonton to Superior. This line, with an extension to Redwater, was 1,128 miles long and was in operation by December, 1950.

Additional construction of loop lines, extensions of the main line, station tankage or other facilities has taken place each year since 1950.

The system consists of three parallel lines from Edmonton to Superior; two lines from Superior to Sarnia, Ontario -- one via the Straits of Mackinac and one via Chicago; and one line with 111 miles of loop from Sarnia to Port Credit, Ontario with a branch line with 64 miles of loop to Buffalo, New York.

The Company operates as a common carrier and is engaged in the transportation of crude oil and other liquid hydrocarbons at established tariffs.

The Interprovincial system performs the vital function of supplying the needs of all Canadian refineries between Edmonton and the Ottawa Valley. Also it makes available substantial volumes of oil to important U.S. refineries in Minnesota, Wisconsin, Michigan, Ohio and New York. This responsibility is a highly technical one involving close control, the highest degree of operating efficiency, dependability and resourcefulness in coping with the problems of a large system.

The problem is vast. Simply stated, it involves the receipt of 25 different types of crude and their delivery over a distance of 2,000 miles to meet the special needs of some 26 large and demanding customers which are the refineries responsible for the supply of essential petroleum energy in the areas which they serve.

The pipeline system holds 10 million barrels and, at any time, there may be in it as many as 15 different grades of oil. The oil moves at a walking pace, taking slightly less than a month in moving from Edmonton to Toronto. No refinery has more than three to five days of crude oil supplies. This means that the system must be scheduled in such a way as to ensure that the various refineries' essential requirements are met at the time that the need occurs.

TRANS MOUNTAIN OIL PIPELINE COMPANY

The Company was incorporated by a Special Act of the Parliament of Canada, assented to March 21, 1951, with authority to construct and operate interprovincial and international pipe lines for the transportation of oil. The head office of the Company is at 400 East Broadway, Vancouver, British Columbia, V5T 1X2.

The Company owns and operates a pipeline system for the transportation of crude oil from a point near Edmonton, Alberta, to its tank farm and marine terminal in Burnaby, British Columbia, together with a spur line from Sumas, British Columbia, to the International Boundary. At the International Boundary the Company's pipeline joins that of its wholly-owned subsidiary, Trans Mountain Oil Pipeline Corporation, which owns and operates the system in the State of Washington.

Owning no wells itself, no refineries of its own, nor the oil it transports, Trans Mountain is solely a carrier, providing shippers of crude oil with economical trunk line transportation from the areas of production to refining centres and to marine facilities for export via tankers to world markets. The system is also a strategic defence facility which guarantees self-sufficiency in petroleum products to British Columbia and the Puget Sound Area and constitutes an additional energy supply line to the whole Pacific Coast.

When the first batch of crude oil was pumped from Edmonton at the mainline rate of 55,000 barrels daily, there were three stations, Edmonton, Edson and Kamloops (though Edson was not required until 1955), consisting of eight pumping units, amounting to 13,000 horsepower. Today the mainline rate out of Kamloops has peaked to 415,000 barrels per day. There are nineteen stations on the mainline with a total of 52 pumping units which can develop over 104,000 horsepower throughout the whole system and some 36,000 horsepower is being added in the current expansion program.

Nine refineries are now connected to Trans Mountain. Five are in British Columbia operated by Imperial, Shell, Standard of B.C., and two by Gulf of Canada. In the State of Washington four are operated by Arco, Mobil, Shell and Texaco. In 1953 there were only two refineries, Imperial and Shell, in the Vancouver area.

TABLE 3

EDMONTON TERMINAL FACILITIES

Item	Interprovincial Pipelines	Trans Mountain Oil Pipeline
Location	SE¼ Sec 5-53-23-4 NW¼ Sec 32-52-23-4 Industrial Area East of Edmonton	SW¼ Sec 5-53-23-4 Industrial area east of Edmonton
Site Area	320 acres	160 acres
Total Tankage (1973)	3,911,000 barrels	1,900,000 barrels
No. Tanks	27	15
Type of Tankage	Floating Roof	Floating Roof
Installed H.P. (1973)	26,500 H.P.	10,450 H.P.
Oil received average daily 1972	900,000 b/d	311,119 b/d
Pumping Capacity ex-Edmonton	Effective Maximum 1,381,000 b/d	Effective Maximum 340,000 b/d
Number of Incoming (supply) Pipelines	18	15
Number of Ougoing Pipelines	1 - 20" 1 - 24" 1 - 34"	1 - 24" ∅
Other Facilities at Site	1. Pipeline Maintenance Centre 2. District Administration Office	1. Pipeline Maintenance Centre 2. District Administration Office
Connected Public Utilities	County Water System Northwestern Utilities (gas) Calgary Power (electricity) AGT CP/CN	County Water System Northwestern Utilities (gas) Calgary Power (electricity)

	Interprovincial Pipelines	Trans Mountain Oil Pipeline
Fire Service	County of Strathcona	County of Strathcona
Access to Site	Provincial Highway	1. Provincial Highway 2. County Road
Refinery Connections Edmonton Area	Imperial Oil Gulf Oil	No deliveries made to Edmonton refineries.
Average Number of Employees Daily	30	20
Area Serviced	Prairie Provinces Eastern Canada & U.S.A.	Puget Sound Area (USA) Vancouver Refinery Area
Company	Federally incorporated public company operating as a common carrier under jurisdiction of National Energy Board Act.	Federally incorporated public company operating as a common carrier under jurisdiction of National Energy Board Act.
1973 Assessment	$2,129,280.00	$1,157,810.00
1973 Levy	$ 144,791.04	$ 77,371.08
Maximum expanded capacity under present day technology on existing land holdings	Approximately 3,000,000 b/d	600,000 b/d
Cost of new facilities of similar nature - 1973 prices(rough estimate)	$45,000,000.00	$25,000,000.00
Cost of Tankage (approximate)	$3.00/barrel	$3.00/barrel
Cost of Pumps (approximate)	$200.00/H.P.	$200.00/H.P.

TABLE 4.

Soil Capability for Agriculture - Maps of: Edmonton, Sheet 83H; Tawatinaw, Sheet 83I; Vermilion, Sheet 73E - by Soil Research Branch, Agriculture Canada.

Analysis of mileages from the Canada Land Inventory Maps for the existing highway, railway and pipeline for the Southern Area (ARDA) (Edmonton Area to Northern section of Township 69).

	Highway		Railway		Pipeline	
	Miles	%	Miles	%	Miles	%
Class 1. Soils have no significant limitations in the use for crops.	14	10.6	14	10.8	8.5	7.6
Class 2. Soils have moderate limitations that restrict the range of crops or require moderate conservation practices.	15	11.0	9	6.9	17	15.2
Class 3. Soils have moderately severe limitations that restrict the range of crops or require special conservation practices.	36	27.1	20	15.4	22	19.7
Class 4. Soils have severe limitations that restrict the range of crops or require special conservation practices or both.	48	36.1	60	46.2	38	34.2
Class 5. Soils have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible.	3	2.3	10	7.7	3	2.7
Class 6. Soils are capable of only of producing perennial forage crops and improvement practices are not feasible.	4	3.1	5	3.8	7	6.3
Class 7. Soils have no capability for arable culture or permanent pasture.	--	--	--	--	--	--
O. Organic Soils	13	9.8	12	9.2	16	14.3
Total	133	100.0	130	100.0	111.5	100.0

TABLE 5.

Land Capabilities for Forestry - Maps of: Tawatinaw, Sheet 83I; Vermilion, Sheet 73E - by Soil Research Branch, Agriculture Canada.

Analysis of mileages for the Canada Land Inventory Maps for the existing highway, railway and pipeline for the Southern Area (ARDA) (Township 58 to northern part of Township 69).

	Highway		Railway		Pipeline	
	Miles	%	Miles	%	Miles	%
Class 1. Lands having no important limitations to the growth of commercial forests.	--	--	--	--	--	--
Class 2. Lands having moderate limitations to the growth of commercial forests.	--	--	--	--	--	--
Class 3. Lands having moderate limitations to the growth of commercial forests.	6	7.2	1	.9	5	7.1
Class 4. Lands having moderately severe limitations to the growth of commercial forests.	65	77.8	86	77.5	51	71.8
Class 5. Lands having severe limitations to the growth of commercial forests.	.5	.6	--	--	--	--
Class 6. Lands having severe limitations (slightly less than Class 5) to the growth of commercial forests.	1	1.2	4	3.6	1	1.4
Class 7. Lands having severe limitations which preclude the growth of commercial forests.	11	13.2	20	18.0	14	19.7
Total	83.5	100.0	111	100.0	71	100.0

TABLE 6.

Land Capability for Wildlife - Ungulates - Maps of: Edmonton, Sheet 83H; Tawatinaw, Sheet 83I; Vermilion, Sheet 73E - by Soil Research Branch, Agriculture Canada.

Analysis of mileages from the Canada Land Inventory Maps for the existing highway, railway and pipeline for the Southern Area (ARDA) (Edmonton Area to Northern section of Township 69).

	Highway		Railway		Pipeline	
	Miles	%	Miles	%	Miles	%
Class 1. Lands have no significant limiations to the production of ungulates.	2	1.5	3.5	2.7	2	1.8
Class 2. Lands have very slight limitations to the production of ungulates.	34	25.6	25	19.2	28	25.1
Class 3. Lands have slight limitations to the production of ungulates.	2.5	1.9	6	4.6	--	--
Class 3W. Lands in this special class are Class 3 that are winter ranges on which animals from surrounding areas depend.	.5	.4	--	--	1	.9
Class 4. Lands have moderate limitations to the production of ungulates.	75	56.4	92	70.8	65	58.3
Class 5. Lands have moderately severe limitations to the production of ungulates.	18	13.5	2.5	1.9	11	9.9
Class 6. Lands have severe limitations to the production of ungulates.	1	.7	1	.8	4	3.6
Class 7. Lands have limitations so severe that there is no ungulate production.	--	--	--	--	.5	.4
Total	133	100.0	130	100.0	111.5	100.0

TABLE 7.

Land Capabilities for Wildlife - Waterfowl - Maps of: Edmonton, Sheet 83H; Tawatinaw, Sheet 83I; Vermilion, Sheet 73E - by Soil Research Branch, Agriculture Canada.

Analysis of mileages from the Canada Land Inventory Maps for the existing highway, railway and pipeline for the Southern Area (ARDA) (Edmonton Area to Northern section of Township 69).

	Highway		Railway		Pipeline	
	Miles	%	Miles	%	Miles	%
Class 1. Lands have no significant limitations to the production of waterfowl.	--	--	--	--	--	--
Class 2. Lands have very slight limitations to the production of waterfowl.	--	--	--	--	--	--
Class 3. Lands have slight limitations to the production of waterfowl.	2	1.5	11	8.5	8	7.1
Class 4. Lands have moderate limitations to the production of waterfowl.	21	15.8	23	17.7	13	11.7
Class 5. Lands have moderately severe limitations to the production of waterfowl.	26	19.5	39	30.0	29.5	26.5
Class 6. Lands have severe limitations to the production of waterfowl.	84	63.2	57	43.8	61	54.7
Class 7. Lands have such severe limitations that almost no waterfowl are produced.	--	--	--	--	--	--
Total	133	100.0	130	100.0	111.5	100.0

TABLE 8.

Land Capabilities for Recreation - Maps of: Edmonton, Sheet 83H; Tawatinaw, Sheet 83I - by Soil Research Branch, Agriculture Canada.

Analysis of mileages from the Canada Land Inventory Maps for the existing highway, railway and pipeline for the Southern Area (ARDA) (Edmonton Area to Northern section of Township 69).

	Highway		Railway		Pipeline	
	Miles	%	Miles	%	Miles	%
Class 1. Lands have very high capability for outdoor recreation.	--	--	--	--	--	--
Class 2. Lands have a high capability for outdoor recreation.	--	--	--	--	--	--
Class 3. Lands have a moderately high capability for outdoor recreation.	--	--	4	3.1	--	--
Class 4. Lands have a moderate capability for outdoor recreation.	--	--	6	4.6	1	.9
Class 5. Lands have a moderately low capability for outdoor recreation.	17	12.8	34	26.2	14.5	13.0
Class 6. Lands have a low capability for outdoor recreation.	111	83.5	86	66.1	96	86.1
Class 7. Lands have a very low capability for outdoor recreation.	5	3.7	--	--	--	--
Total	133	100.0	130	100.0	111.5	100.0

TABLE 9 .

Soil Capabilities for Agriculture - Map prepared by Tom Peters and Associates.

Analysis of mileages from the Soil Capability for Agriculture Maps for the existing highway, railway and pipeline for the Northern Area (Northern part of Township 69 to Fort McMurray).

	Highway		Railway		Pipeline	
	Miles	%	Miles	%	Miles	%
Class 1,2,3. Soils have no significant limitations; have moderate limitations; have moderately severe limitations that restrict the range of crops or require special conservation practices or both.	15	10.9	--	--	16	13.3
Class 4. Soils have severe limitations that restrict the range of crops or require special conservation practices or both.	8	5.8	8	4.9	8	6.7
Class 5 & 6. Soils have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible; soils are capable of only producing perennial forage crops and improvement practices are not feasible.	77	55.9	96	58.5	56	46.7
Class 7. Soils have no capability for arable culture or permanent pasture.	2	1.4	8	4.9	4	3.3
O. Organic Soils	35	26.1	52	31.7	36	30.0
Total	138	100.0	164	100.0	120	100.0

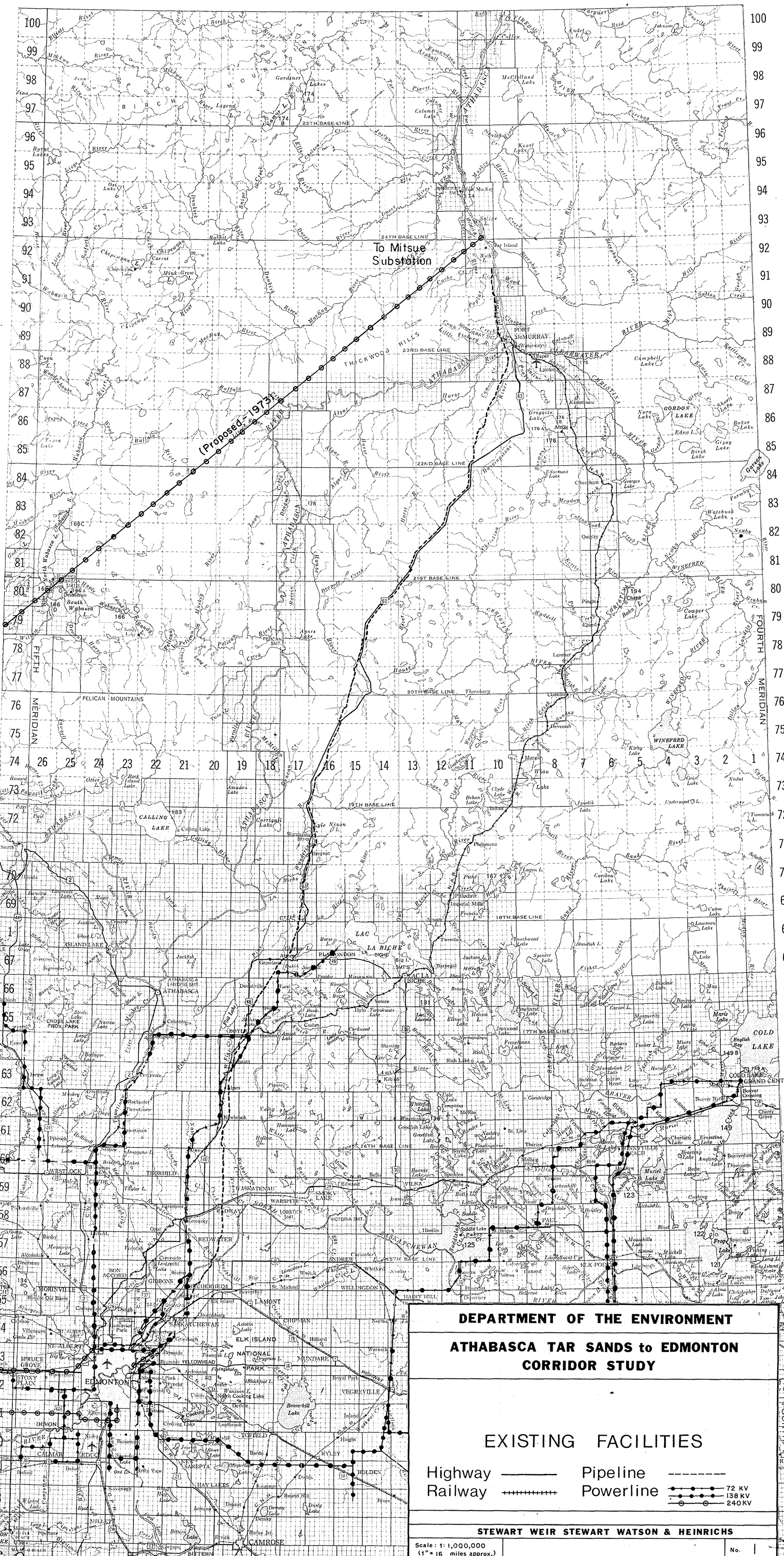
TABLE 10.

Environment Sensitivity - Map prepared by Bolter Parish Trimble Ltd.

Analysis of mileages from Environment Sensitivity Map for the existing highway, railway and pipeline for Edmonton to Fort McMurray Area.

	Highway		Railway		Pipeline	
	Miles	%	Miles	%	Miles	%
Class 1. Moderate sensitivity. High runoff source areas.	--	--	--	--	--	--
Class 2. Moderate sensitivity. Deep valleys.	2	.7	--	--	11	4.8
Class 3. Moderate sensitivity. High drainage density areas.	29	10.7	68	23.1	41	17.7
Class 1 & 2. High sensitivity. Combination of high runoff source areas and deep valleys.	--	--	--	--	--	--
Class 1 & 3. High sensitivity. Combination of high runoff source areas and high drainage density areas.	45	16.6	7	2.4	33	14.3
Class 2 & 3. High sensitivity. Combination of deep valleys and high drainage density areas.	10	3.7	6	2.0	4	1.7
*Total sensitive areas Edmonton to Fort McMurray	86	31.7	81	27.5	89	38.5
Total mileage from Edmonton to Fort McMurray	271		294		231.5	

*NOTE: The total mileage along the existing highway, railway and pipeline in the sensitive areas was divided by the total mileage from Edmonton to Fort McMurray to give the percentage of the existing facility in Environment Sensitive Areas.



DEPARTMENT OF THE ENVIRONMENT

ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY

EXISTING FACILITIES

Highway ——— Pipeline - - - - - -

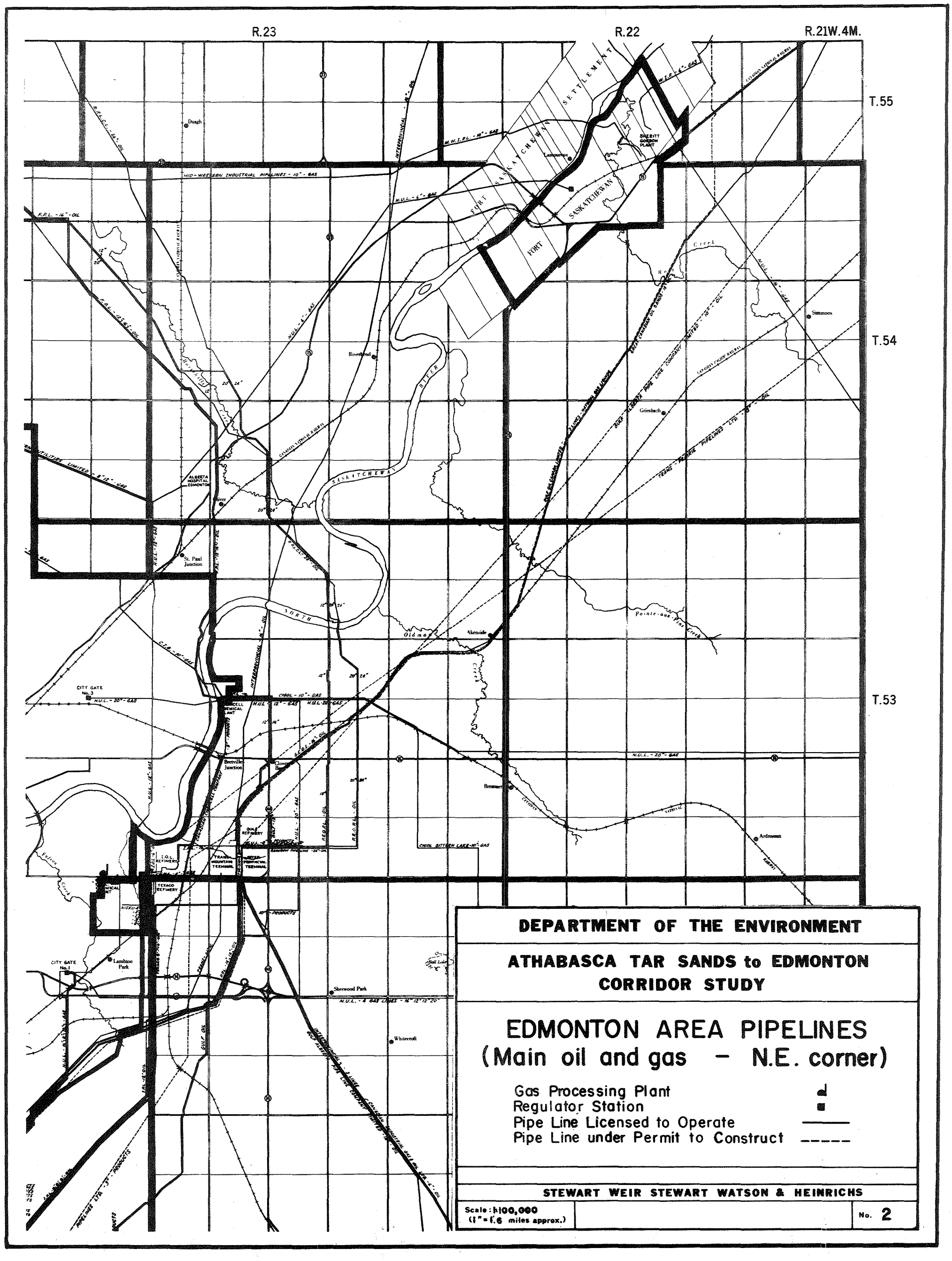
Railway +++++++++++ Powerline 72 KV / 138 KV / 240 KV

STEWART WEIR STEWART WATSON & HEINRICHS

Scale : 1: 1,000,000 (1" = 16 miles approx.)

No. 1

Prepared From Base Map Provided By Survey Branch, Department Of Highways & Transport


R.23
R.22
R.21W.4M.
T.55
T.54
T.53
Duagh
Riverbend
Grosbach
Simmons
Ardrossan
Alcenside
Old ma
Pointe-aux-Pins Creek
St. Paul Junction
Lambton Park
Sherwood Park
Whitecroft
Bretville Junction
Clover Bar
Breiner
SASKATCHEWAN
FORT SASKATCHEWAN
SETTLEMENT
FORT
RIVER
Creek
ALBERTA HOSPITAL EDMONTON
SHERITT GORDON PLANT
CITY GATE No. 3
CITY GATE No. 1
CELL CHEMICAL PLANT
TEXACO REFINERY
GULF REFINERY
I.O.L. REFINERY
TEXAS MOUNTAIN TERMINAL
INTERPROVINCIAL TERMINAL
NORTH
CANADIAN NATIONAL RAILWAYS
CANADIAN PACIFIC RAILWAY
M.W.I.P.L. - 10" - GAS
MID-WESTERN INDUSTRIAL PIPELINES - 10" - GAS
F.P.L. - 16" - OIL
F.P.L. - 12¾" - OIL
N.U.L. - 6" - GAS
N.U.L. - 20" - GAS
N.U.L. - 4 GAS LINES - 16" 12" 12" 20"
CHOL - 10" - GAS
CHOL BITTERN LAKE - 10" - GAS
R.R.O.R.L. - OIL
INTERPROVINCIAL - 4" - OIL
INTERPROVINCIAL - 4" - OIL
INTERPROVINCIAL - 4" - OIL
INTERPROVINCIAL - LINES
GULF OIL
PIPELINES LTD. - 3" - PRODUCTS
PIPELINES LTD. - 8" - OIL
PRODUCTS
GREAT CANADIAN OIL SANDS - 16" - OIL
GREAT LAKES PIPE LINE COMPANY - 10" - OIL
TRANS-PRAIRIE PIPELINES LTD. - 8" - OIL
UTILITIES LIMITED - 8" - 12" - GAS
DEPARTMENT OF THE ENVIRONMENT
ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY
EDMONTON AREA PIPELINES
(Main oil and gas - N.E. corner)
Gas Processing Plant
Regulator Station
Pipe Line Licensed to Operate
Pipe Line under Permit to Construct
STEWART WEIR STEWART WATSON & HEINRICHS
Scale: 1:100,000
(1" = 1.6 miles approx.)
No. 2

CHAPTER 2

LOCATION

OF THE

TRANSPORTATION FACILITIES

CHAPTER 2

LOCATION OF THE TRANSPORTATION FACILITIES

This section of the report deals with the physical parameters which may be used as guidelines by those who are charged with the responsibility for the actual location of each of the facilities being studied.

In the past, the location of power lines, pipelines, highways, railways, water lines, golf courses, strip mines or any cultural features having an impact on the physical or cultural environment, were left by default in the hands of engineers, architects, business men or promoters.

In the future two additional groups of people will play dominating roles in the planning stages of any major development which will have a significant impact on the physical and/or cultural environment.

The first of these groups will be scientists who have made it their life work to become expert in one or more of the fields of natural or social sciences and who are in a position to evaluate the environmental impact of a given activity.

The second group consists of those members of the general public who, whether organized or not, are sufficiently interested, in any given proposal, to take part in a public discussion of the merits and impact of that proposal.

It is not within the terms of reference for this study to discuss the role or roles which these groups will play. It is sufficient to state that from now on each of these groups, and the individuals making up these groups will play a significant role which will steadily grow in importance, for it is believed that when reasonable people are given all of the pertinent information, and the project has been properly

researched, and it is truly in the public interest, these reasonable men and women will approve the project.

The main physical parameters used as guidelines for the actual location of power transmission lines, pipelines, highways and railways are presented here as background information for the laymen who may not be familiar with the procedures or thought processes used by the location engineers.

Under a separate heading are environmental considerations which in the past have often been overlooked or ignored.

The accompanying chart may be both interesting and informative because it shows those parameters which are common to the location of the four facilities being studied. The chart also shows which parameters are unique to a given facility.

It may be observed that, in the past, the physical parameters which have governed the location of the transportation facilities have consciously or unconsciously taken note of environmental factors.

The villains in the act are the careless construction practices which have been followed in the work which produces the finished structures. If construction practices are governed by short term cost-benefits, the end result may well have a negative environmental impact.

FIGURE 3

MATRIX - PHYSICAL LOCATION CONTROL PARAMETERS

Legend:

	positive	negative
Very Important Control -		
Important Control -		
Control -		
Less Important Control -		
Neutral -		

	Power lines	Pipe lines	Highways	Railways
1. Traffic generating centres				
2. Industrial Areas				
3. Resources for development				
4. Forested Areas				
5. Agricultural Areas				
6. Residential Areas				
7. Recreational Areas				
8. Scenic Vistas and View Points				
9. Archaeological, historic sites, cemeteries, etc.				
10. Beauty spots				
11. Permanent physical land use interference				
12. Property Severance				
13. Existing facilities and utilities				
14. Use of existing rights-of-way				
15. Location of existing access roads (area access)				
16. Habitat of wild life				
17. Icing conditions, heavy snowfall, wind				
18. Good River and Stream Crossings				

NOTE: positive means an item which would attract the facility to locate near by or is a positive factor in the location. negative means an item which should be avoided or is a negative factor in the location.	Power lines	Pipe lines	Highways	Railways
19. River Crossing requiring river training				
20. Flat grades (vertical alignment)				
21. Flat curvature and bends (horizontal alignment)				
22. Straight line locations (beginning to end point)				
23. Permafrost				
24. Gravel deposits				
25. Sand Areas				
26. Solid Rock Areas				
27. Stable Side Hills				
28. Slide areas				
29. Muskeg				
30. Deep organic soils other than muskeg				
31. Shallow top soil cover				
32. Well drained soils				
33. Sharp ground slope changes				
34. Valley bottom location				
35. Ridges				
36. Low saddles in rolling topography				
37. Use of topography to hide facility				

POWER TRANSMISSION LINE LOCATION

I. COST FACTORS

1. Location Surveys
2. Rights-of-Way Acquisition
3. Material Costs
4. Construction Costs
5. Operational Costs

The following information has been supplied by Calgary Power Company and edited for this presentation.

II. GENERAL CONSIDERATIONS

The basic consideration is to minimize the conflict between rights-of-way and present and prospective use of land on which the facilities may be located, coincident with realistic economic factors and satisfactory and reliable customer service.

III. PHYSICAL FACTORS AFFECTING LOCATION

A. POSITIVE CONTROLS

1. Straight lines wherever possible.
2. Use existing rights-of-way where possible.
3. Use topography to screen the facility where it may be unsightly to have it exposed.
4. Highway crossings should be in valleys.
5. Lines routed to minimize the number of crossings of highways, railroads, other high power transmission lines.
6. Consideration is given to ready made access roads for construction and maintenance.
7. Choose grasslands in preference to cultivated lands.

B. NEGATIVE CONTROLS

1. Avoid where possible parks, Indian reserves.
2. Avoid prime and scenic timber areas.
3. Avoid tunnel views visible from highways and scenic lookouts.
4. Avoid ridge construction for aesthetic reasons as well as physical considerations, such as icing and wind.
5. Avoid locations spanning main road intersections.
6. Avoid telephone lines, pipelines, airports, railways wherever it is possible.

IV. ENVIRONMENTAL FACTORS

1. Powerlines adversely affect the environment from an aesthetic point of view. Items 2 to 6 above indicate how the aesthetics involved may be improved by following the location guidelines as suggested by these negative controls.
2. From the physical environment point of view, the major impact comes chiefly from:
   a. The crossing of streams during construction where bank stability is disturbed. This impact may be avoided or made negligible using proper techniques.
   b. The clearing of the right-of-way. The impact may be minimized by limiting the clearing of trees from the right-of-way to that which is necessary for the safety of the completed conductor and towers.

PIPELINE LINE LOCATION

I. COST FACTORS

1. Location Surveys
2. Rights-of-Way
3. Material Costs
4. Construction Costs
5. Operational Costs

II. GENERAL CONSIDERATIONS

1. Material costs are such a high percentage of the total cost of a pipeline that straight line locations from control point to control point are required from the economic point of view.
2. Gas pipelines are considered dangerous.
3. Oil pipelines are considered as pollutants.
4. Gas lines ignore grades; oil pipelines are more sensitive to grades than gas lines, but, neither oil lines nor gas lines are sensitive to the grades which govern in highway or railroad design.
5. Pipelines do not normally interfere with land use after the pipe has been installed.
6. Long sweeping curves are objectionable from the construction point of view.
7. Environmental factors must now be considered as an integral part of all phases of pipeline construction.
8. The effects of construction on the environment will have an important effect on the construction time-table. For example, the crossing of streams must be done when the impact on fish habitat will be a minimum, and when there will be no interference with the spawning activities of the fish.

III. PHYSICAL FACTORS AFFECTING THE LOCATION OF PIPELINES

A. POSITIVE CONTROLS

1. Suitable river crossings.
2. Valley bottoms and ridge locations as opposed to side hill locations.
3. Presence and extent of well-drained stable and neutral soils which may be suitable for spring breakup or wet season construction.
4. The location of suitable camp and storage areas.
5. Access roads which will be available during the construction and maintenance period.

B. NEGATIVE CONTROLS

1. Slide areas and potential slide areas and hillside locations in general.
2. Saturated sands, silts, areas of loess.
3. Muskeg and other soils where the water-table is at the surface or at the level of the pipe.
4. Shales carrying a high sulphur content and bedrock or large boulder fields or gravel pits.
5. Springs, wells, watering areas used by others.
6. Areas where wind or water action may expose the pipe and thus destroy its protective coating.
7. Sharp slope changes at crests or valley bottoms.
8. Areas considered unworkable in the wet season or during the spring breakup should be noted for future reference.
9. The location of existing structures such as water lines, sewers, highways, power lines, pipelines and other cultural features which must be crossed.

10. Sites which must be avoided such as cemeteries or individual burial grounds, archaeological and historical sites.

11. Permafrost areas (not a factor in the study area), ground currents or force fields.

12. Sensitive areas such as sand dune areas.

IV. THE ENVIRONMENTAL IMPACT

1. Reference is made to the Farm Resident Questionnaire which is part of Chapter 3 of Volume 6 of this report. The social and cultural impact of pipelines and other modes of transport are shown with significance and clarity in the answers to this questionnaire and will not be repeated. Only the physical environment will be mentioned here.

2. The effects on the environment of clearing the right-of-way and the construction of a pipeline through heavily forested areas: The impact may be beneficial to the overall environment and is not necessarily wholly harmful.

3. The temporary and permanent effects of a pipeline crossing a stream: Not all streams are a suitable habitat for significant fish populations. Not all streams which are a suitable habitat are significantly damaged by pipeline crossings. Each stream must be studied separately and treated accordingly.

4. The impact of a pipeline crossing a muskeg: From the economic point of view, a muskeg is an obstruction having a very limited value. As an ecosystem, it requires study.

   As a fresh water reservoir, it plays an important role in stream flow regulation. It is, therefore, environmentally important.

5. The effect on farm land: The physical effects are well integrated with socio-economic effects. An estimate of the importance of these effects may be estimated from the results of the farm questionnaire to above.
6. The effect on recreational activities of the clearing a pipeline right-of-way through a wilderness area: Its effect is of local importance and its magnitude may be considered negligible for many miles of the pipeline.

HIGHWAY LOCATION

I. COST FACTORS

1. Location Surveys
2. Rights-of-Way
3. Construction Materials in area
4. Construction Costs (including material)
5. Operational Costs

II. GENERAL CONSIDERATIONS

The parameters and definitions of various standards of rural highways and roads are outlined in Table 2 in Chapter I as supplied by the Department of Highways.

1. Capacity Required
   - (a) Trunk road, feeder road, access roads, etc.
   - (b) Population density along the route including future projections.
   - (c) Volume of industrial traffic expected.
   - (d) Resource development.
2. Alignment
   - (a) Requirements dictated by capacity required.
   - (b) Aesthetics.
   - (c) Safety.
   - (d) Sight distance.
   - (e) Maximum speed desire.
3. Grades
   - (a) Volume of industrial traffic
   - (b) Winter conditions.

(c) Aesthetics.

(d) Safety.

(e) Sight distance.

III. PHYSICAL FACTORS AFFECTING THE LOCATION OF HIGHWAYS

A. POSITIVE CONTROLS

1. The location of traffic-generating centers.
2. Gently rolling topography meeting grade requirements.
3. Good river crossings.
4. Low saddles.
5. Side hills which are stable.
6. Presence of gravel deposits.
7. Stable, well-drained soils with shallow organic cover.
8. Recreational areas, viewpoints.
9. Resources requiring development.
10. Location of access roads.

B. NEGATIVE CONTROLS

1. Muskeg areas.
2. Slide areas and steep grades with erodable soils.
3. Deep organic soils other than muskeg.
4. Permafrost, icing conditions, heavy snowfall.
5. River crossings requiring extensive river training.
6. Solid rock areas.
7. Forest areas if alternate exists.
8. Wet land areas being the habitat of nesting birds, beaver, muskrats, etc.
9. Beauty spots which will be harmed or destroyed by construction of the highway.

10. Archaeological and historical sites, cemetaries and native burial grounds or ceremonial centers.
11. Indian Reserves without proper permission from the band affected.

IV. THE ENVIRONMENTAL IMPACT

A highway has an enormous environmental impact. The beneficial effects of highways need no elaboration here. The modern highway is the result of the invention of the motor car. For better or for worse it has transformed the planet. Were it not for the motor car and its track, the highway, the development of the tar sands would be at some point in time far into the future.

Specifically, we are concerned here with the short term and long term effects of the following activities directly connected with the construction of a highway.

1. The right-of-way through a forested area.
2. The taking out of use for other purposes the land occupied by the right-of-way.
3. The temporary and permanent effects of the construction of the necessary bridges and culverts.
4. The effects of development along the highway.
5. The effect on people's way of life.
6. Resource development.
7. Resource depletion.
8. Recreational activities, etc.

RAILWAY LOCATION

Assuming that there is economic or other justification for the construction of a railroad, we may consider its location as follows:

I. COST FACTORS

1. Location Surveys
2. Acquisition of Right-of-Way
3. Material Costs - rails, ties, etc.
4. Construction Costs, Labor
5. Operational Costs

II. GENERAL CONSIDERATIONS

The capacity required will largely determine the specifications for alignment and ruling grades which the location engineer will make every reasonable effort to meet. In the study area under discussion, grades would probably take precedence over alignment for there will be a maximum grade which cannot be exceeded under any physical circumstance without bringing into doubt the feasibility of the route selected. When it is considered that the load hauled by a single locomotive up a 0.3% grade will only be one-half that which can be hauled by the same locomotive on a level track, we can readily see that railways are very sensitive to grades. Highways are sensitive to grades for similar reasons, but, by the nature of the difference between a train weighing several thousand tons travelling on a thin ribbon of track and a vehicle traveling on rubber-tired wheels with a very flexible steering system and weighing from one to about forty tons, the degree of sensitivity is far less for highways than it is for railroads.

III. PHYSICAL FACTORS AFFECTING THE LOCATION OF RAILWAYS

A. POSITIVE CONTROLS

1. Ideal level ground from beginning to end, and as a straight line location.
2. Good river crossings.
3. Low saddles.
4. Valley locations on stable well-drained soil.
5. Gravel deposits for ballast.
6. Urban areas which must be served by the railroads.
7. Resources to be developed.
8. Recreation areas.

B. NEGATIVE CONTROLS

1. Muskeg areas.
2. Slide areas and steep grades with erodable soils.
3. Deep organic soils other than muskeg.
4. Permafrost, icing conditions, heavy snowfall.
5. River crossings requiring extensive river training.
6. Solid rock areas.
7. Forest areas if alternate exists.
8. Wet land areas being the habitat of nesting birds, beaver, muskrats, etc.
9. Beauty spots which will be harmed or destroyed by the construction of the railway.
10. Archaeological and historical sites, cemetaries and native burial grounds or ceremonial centers.
11. Indian Reserves without proper permission from the band affected.

IV. THE ENVIRONMENTAL IMPACT

1. Aesthetic values: Since railroad grades follow the natural contours where it is practical to do so, the railway blends into the landscape and causes surprisingly little disturbance to natural aesthetic values.
2. Socio-economic values: The impact of the motor car and the highway on these values is so enormous that the role of the railroad becomes obscured. The economic importance is only noticeable when the facility fails to operate. The social impact is only noticed, again, when the facility fails.
3. The physical impact on the environment: The impact is similar to that of the highway but the magnitude is less. We will consider:
    (a) Rights-of-way through forested areas.
    (b) Taking out of land from agriculture.
    (c) The effects of drainage structures.
    (d) Resource depletion.

CHAPTER 3

PIPELINE AND POWERLINE IMPACT RURAL AGRICULTURAL AREA

CHAPTER 3

PIPELINE AND POWERLINE IMPACT RURAL AGRICULTURAL AREA

The impact of Pipelines and Powerlines upon the social and physical environment of the agricultural community was assessed using information received from the farm residents. This information was gathered from a questionnaire, public meetings and personal interviews.

Six hundred (600) questionnaires were sent out to the farm residents dispersed throughout the study area. Analysis was carried out using one hundred (100) completed questionnaires, thus our results were applicable, also represent percentages. A total of 122 questionnaires were returned to study headquarters, some of these only partially answered and several after our analysis had been completed. The additional returns did not affect our analysis.

Following our conclusions is a statistical summary of each of the questions. The statistical summary is followed by the questionnaire with the details of all one hundred (100) returns. The number in the brackets indicates the percentage of the returns which did not answer that particular question. A star (*) beside the particular answer indicates the rated answer of the total imput to that question and was used in our statistical summary.

The conclusions reached from a study of the questionnaire were discussed at five public meetings and changed slightly to clarify the meaning. They were also discussed on an individual basis with many farm residents. (Documentation of the public meetings forms a separate volume.)

CONCLUSIONS

The above average response to the questionnaire by the farm residents indicates serious interest and concern in the study of a multi-use transportation corridor. Some general observations from the questionnaires are as follows:

- Strong preference for a multi-purpose single corridor is indicated.
- Corridor location preference is along existing pipelines, railways and/or highways.
- Consideration of the attraction of urban and other uses such as hiking trails, youth hostels, skidoo trails is not favored in agricultural areas but was recommended for non-agricultural areas.
- Soil conservation and total property restoration are of a major concern.
- Development of a service road along the corridor and/or fencing of the corridor area favored only where it benefits the farm operation.
- Compensation for total property damage and injurious effect (being subjective) is a concern requiring further study in detail.

The establishment of pipelines and powerlines in a multi-purpose single corridor would cause some disruption to the physical and social environment of the farm community during construction but once operating the impact is relatively small. With ample notice, fair compensation and proper construction practices, very little opposition would be expected from the farming community. The multi-purpose single corridor is recommended rather than many single rights-of-way in the agricultural farm community.

STATISTICAL SUMMARY TO FARM RESIDENT QUESTIONNAIRE

A. FARM AND FARMING OPERATIONS

- majority of the farms have mixed farming operations
- majority have 320 acres or more
- majority have good productive land
- most don't have pipelines crossing property (only 35% have)
- 55% don't have powerlines crossing property (41% do)
- majority have buildings 100 yards or more from highway
- majority don't want transportation corridor within 300 feet of buildings
- tree growth mainly poplar and spruce (wind breaks)
- cutting trees great concern for farming operation and living area
- 37% with gas for own use
- 92% with electricity for own use
- 71% with running water for own use
- 69% with sewage for own use
- 93% with telephone for own use
- 34% with gas crossing land
- 54% with electricity crossing land
- 13% with running water crossing land
- 11% with sewage crossing land
- 43% with telephone crossing land
- others - buried telephone cable, propane

B. PIPELINES AND PIPELINE CONSTRUCTION

- pipeline construction phases in regard to magnitude of impact on farm operations and relative importance to the farmers:

a)	Surveying and location	Medium magnitude and	important
b)	Construction of gates & fences	Large magnitude and	very important
c)	Clearing & disposal of tree cover	Medium magnitude and	very important
d)	Top soil conservation, stripping & stock-piling	Large magnitude and	very important
e)	Grading right-of-way, levelling so that construction machinery can proceed without hindrance	Large magnitude and	very important

B. PIPELINES AND PIPELINE CONSTRUCTION (continued)

f) Hauling pipe	Medium magnitude	and	important
g) Ditching	Large magnitude	and	very important
h) (1) Roads & Highway crossings			
(i) bored (tunnelled)	Small magnitude	and	not very important
(ii) open cut	Medium magnitude	and	important
(2) River & stream crossings	Small magnitude	and	not very important
i) Foreign Utility Crossings (power lines, oil & gas pipelines, communication cables, railways, sewage lines, water lines)	Large magnitude	and	very important
j) Placing pipe-bending, welding, x-raying, joint coating & wrapping, lower pipe in, backfilling & compaction	Medium magnitude	and	Important
k) Pressure testing	Medium magnitude	and	important
l) Surface restoration and clean-up	Large magnitude	and	very important
m) Installations of scraper traps, trap sumps, valves and other above-ground appurtenances (installations)	Large magnitude	and	very important

SUMMARY OF ABOVE IN ORDER OF IMPORTANCE (6 most important phases):

(1) top soil conservation, stripping and stockpiling
(2) surface restoration and clean-up
(3) installation of scraper traps, trap sumps, valves and other above ground appurtenances
(4) construction of gates and fences
(5) surveying and location
(6) clearing and disposal of tree cover

B. PIPELINES AND PIPELINE CONSTRUCTION (continued)

- least disruptive to most disruptive seasons are winter, fall, spring, summer
- top soil stripping and replacement, proper tamping and levelling are very important
- it takes longer than one (1) year for land to regain its former productive capabilities
- 54% of those with pipeline construction on land had adverse effects
- only 35% of those with adverse effects were without satisfactory compensation
- 42% of the farmers with adverse effects indicated they had to rectify construction damage on their own
- pipeline and pipeline construction will benefit 24% and not affect 49%
- 37% want permanent corridor road. 20% say no, 26% possibly.
- 33% want permanent fence. 39% say no, 26% possibly.
- majority want pipeline left in ground rather than disturb land again if no longer required
- 3' and 4' cover over pipeline concensus of opinion
- gas connection would be an asset
- oil and gas pipelines concern for safety to 25%, not 30%

C. POWER TRANSMISSION LINES AND POWER TRANSMISSION LINE CONSTRUCTION

- Power Line Construction Phases in regard to magnitude of impact on farm operations and relative importance to the farmers:

a) Surveying & location	Medium magnitude and very important
b) Construction of gates & fences	Large magnitude and very important
c) Clearing and disposal of tree cover	Large magnitude and very important
d) Hauling of poles and materials	Small magnitude and important
e) Setting structures (poles)	Medium magnitude and very important
f) Stringing conductor (wire)	Medium magnitude and important
g) Testing of transmission line	Small magnitude and not very important
h) Surface restoration	Large magnitude and very important

- Majority want above-ground distribution power lines
- Transmission lines should be located (in order of preference)

  Firstly: along edge of highway and road allowance

  Secondly: along section and $\frac{1}{4}$ section lines

  Thirdly: several hundred feet off highway or road allowance in field
- 16% had adverse experience with powerline construction
- 23% didn't receive satisfactory compensation
- 10% said it cost them to rectify situation
- Poles and structures located in field have little effect on cattle; great effect for crops; little effect for safety
- Powerline connection not an asset to 20%
- Powerline connection already installed for 86%

D. GENERAL

- A roadway is not unsightly
- A railway is not unsightly
- A pipeline is not unsightly
- Transmission lines are not unsightly
- 47% want more regulations imposed on transportation facilities
- 70% want one corridor
- Effect of multiple-use corridor or single corridor on community financially is good, 67%; socially, not very good, 38%; regarding vandalism, not very good, 42%; health and welfare of residents, not very good, 35%.
- The majority of farmers don't want employment by companies doing construction at any time.
- Construction would possibly effect hiring farm labourers
- Summary of corridor preference (in order of preference)

  1. Widen existing pipeline right-of-way to include pipelines and powerlines
  2. Widen existing highway right-of-way to include pipelines and powerlines
  3. Widen existing railway right-of-way to include road, pipelines and powerlines

D. GENERAL- (continued)

4. New facilities in a completely new single corridor
5. New facilities in several rights-of-way

E. ENVIRONMENTAL (PHYSICAL AND SOCIAL)

Environmental importance of the following:

Creeks	Very important
Rivers	Very important
Sloughs	Not very important
Lakes	Very important
Muskeg	Not important
Forest	Very important
Vegetation	Very important
Parkland	Very important
Grassland	Very important
Agricultural land	Very important
Hiking trails	Not important
Nature trails	Not important
Wildlife	Very important
Wildfowl	Very important
Fish	Very important
Recreation	Important
Social	Very important
Country life	Very important
Your town or village	Very important
Isolation	Not important

- 80% want multiple-use corridor according to environmental impact
- No new transportation facilities would benefit farmers during construction operation
- 22% say it would have a bad effect
- in urban areas the farm residents want tent and trailer sites, picnic shelters and parks, motels and hotels, gas service stations, restaurants, grocery stores, telephones, nature trails, horse trails, boating, canoeing, fishing, swimming pools, golf courses, tennis courts, baseball and football fields, curling rinks, skating and hockey rinks.

E. ENVIRONMENTAL (PHYSICAL AND SOCIAL) -(continued)

- They don't want youth hostels, novelty and souvenir shops, hiking trails, ski-doo trails in urban areas.
- In agricultural farm land of the above-mentioned recreation facilities, the farm residents don't want tent and trailer sites, motels, hotels, youth hostels, restaurants, grocery stores, novelty and sourvenir shops, hiking trails, horse trails, ski-doo trails, swimming pools, tennis courts, curling rinks.
- In non-arable virgin forest areas they want tent and trailer sites, picnic shelters and parks, telephones, hiking trails, nature trails, horse trails, ski-doo trails, boating, canoeing and fishing.
- The rating of deterioration by construction roads, pipelines, power lines of the following:

muskeg	low
vegetation	medium
river or stream channels	medium
banks	high
river or stream flow	medium
soils	high
trees	high
fish life	medium
wildlife	medium
wild fowl	medium
lakes	medium

- 32% have seen instances of adverse effects by construction on creeks, streams, rivers, lakes and wildlife habitat.

ATHABASCA TAR SANDS TRANSPORTATION CORRIDOR STUDY
FARM RESIDENTS QUESTIONNAIRE

Stewart, Weir, Stewart, Watson and Heinrichs are engaged in a Transportation Corridor Study, Athabasca Tar Sands to Edmonton, Alberta, Canada, for the Department of the Environment of the Government of Alberta. The main object is to determine the most suitable route for a transportation corridor or corridors in regard to pipelines, powerlines, highways and railways with emphasis on oil and gas pipelines and power lines. The Study is to take into account the environmental, social, economic, legal and engineering aspects of selecting the corridor or corridors.

The corridor would be some 250 miles long and pass through firstly, the Edmonton Industrial urban area, secondly agricultural farm land, thirdly virgin forest area and fourthly the Athabasca Tar Sands Area. During the next 15 years all predictions indicate a major increase in activity in the Tar Sands with a corresponding requirement for the transport of people, material and energy between Fort McMurray and Edmonton.

This is an extensive questionnaire and will take you some time to complete in the necessary detail. A good return on this questionnaire will reflect the thinking of the farmers in this area in regard to pipelines, powerlines, etc. These results will be taken into account in our recommendations to the government. We request therefore that you take time and effort to answer this questionnaire.

Please answer as soon as possible and return the questionnaire in the enclosed stamped and addressed envelope.

Please check the box ☑ off to the right for your answers to the following questions.

A) Farm and Farming Operations

So that we can properly analyze the questionnaire, please fill in the following general information about your operations.

1) Location - (if you wish to remain anonymous, please do not fill in)

Section____Township____Range____West of the 4th Meridian

2) Type of agricultural (farming) operation (example - grain farming, livestock farming, hay and forage, mixed farming, other)

Answer: Mixed farming - 67*, Grain - 16, Livestock - 5
Hay & Forage - 3, Other(dairy, beekeeping, etc.) - 9

3) Size of farming operation

Less than 160 acres ☐6 160-320 acres ☐36 more than 320 acres ☐56* (2)

4) Do you classify your property as being within a good, fair or poor productive area for your operation?

Good ☐ 66* Fair ☐ 27 Poor ☐ 2 (5)

5a) Have you pipelines crossing your property?

Yes ☐ 35 No ☐ 62 Number ☐ (3)

b) Have you powerlines crossing your property?

Yes ☐ 41 No ☐ 55* Number ☐ (4)

6a) How far off the road allowance or highway do your farm buildings begin?

Answer: 0-50 yds. - 29 51-100 yds. - 21 101 yds. over - 38* (12)

b) Would you want a transportation corridor within 300 feet of your buildings?

Yes ☐ 14 No ☐ 81* (5)

c) What type of tree growth do you have on your farm near the highway or road allowance?

Answer: Poplar - 40, Spruce - 24, Natural growth - 14, Windbreak - 8, Other - 26

d) i) Would the cutting of the trees for a right-of-way cause any concern for your farming operation?

Great concern ☐ 45* Little concern ☐ 31 No concern ☐ 22 (2)

ii) Would the cutting of the trees for a right-of-way cause any concern for your living area?

Great concern ☐ 61* Little concern ☐ 18 No concern ☐ 17 (4)

7a) What utilities do you have on your farm?

i) For your own use

Gas	Yes ☐ 37	No ☐ 42*		(21)
Electricity	Yes ☐ 92*	No ☐ 5		(3)
Running Water	Yes ☐ 71*	No ☐ 20		(9)
Sewage	Yes ☐ 69*	No ☐ 20		(11)
Telephone	Yes ☐ 93*	No ☐ 5		(2)

ii) Crossing your property

Gas	Yes ☐ 34	No ☐ 49*		(17)
Electricity	Yes ☐ 54*	No ☐ 35		(11)
Running Water	Yes ☐ 13	No ☐ 62*		(25)
Sewage	Yes ☐ 11	No ☐ 62*		(27)
Telephone	Yes ☐ 43*	No ☐ 40		(17)

b) Others - please describe

Answer: Buried telephone cable, propane for heating.

B) Pipeline and Pipeline Construction

1. There are a number of steps involved in the construction of a pipeline. Some of these will have an impact or effect upon your agricultural operation and the environment. The magnitude (extent, size, degree) to which each construction phase effects (disrupts, assists) your farming operation will vary. The importance (significance, value) of each phase of the construction to your farming operation and the environment will also vary. Assuming that all work is done in a workmanlike manner, please check the appropriate column (✓) for impact and importance and also any comments you may have on the particular construction phase. Reference to the four examples below will help in filling out this question.

Example I

The magnitude of the impact or effect of the construction of gates and fences on your actual farming operation may be small but you may consider this very important in regard to the safety of your livestock or it may not be important if you have no livestock.

Example II

The magnitude of the impact of placing the pipe on your actual farming operation may be small but it may be very important to you to know that it has been done properly and that the pipeline has been inspected for safety.

Example III

The magnitude of the impact of surface restoration and clean-up on your farming operation may be large, but once completed in a satisfactory manner may not be very important.

Example IV

The magnitude of the impact of above-ground installations on your farming operations may be large and also important because of the continuous concern for them.

CONSTRUCTION PHASES	MAGNITUDE OF IMPACT ON YOUR FARM OPERATION			RELATIVE IMPORTANCE TO YOU?			COMMENTS
	Large	Med.	Small	Very Important	Important	Not Very Important	
a) Surveying & Location	19 (9)	38 *	34	28 (12)	31 *	29	Not near buildings along edge of fields stakes, damage machines, livestock.
b) Construction of gates & fences	47 (14) *	24	15	52 (12) *	24	12	Fences for cattle & horses. Oilfield gates left open(used as dump).
c) Clearing & disposal of tree cover	39 15	22 *	24	52 (9) *	20	19	Power Co. sprayed & left trees, shd. replace trees, leave as many as possible.
d) Top soil conservation,stripping & stockpiling	65 (15) *	16	4	65 (10) *	20	5	Disrupts crops,livestock, little topsoil,do it right to begin with.
e) Grading right-of-way,levelling so that construction machinery can proceed without hindrance	45 (14) *	27	14	51 (13) *	22	14	Don't want right-of-way, compacts soil,detriment to livestock,pasture, hay, etc.
f) Hauling and stringing all pipe & materials	31 (18)	31 *	20	33 (12)	30 *	25	Compacts soil, livestock concern,in summer only.
g) Ditching	53 (13)*	21	13	50 (11)*	22	17	
h)1)Roads & Highway Crossings i)bored (tunnelled)	22 (19)	20	39 *	24 (16)	20	40 *	
ii)open cut	30 (25)	23 *	22	33 (19)	24 *	24	
2)River & Stream Crossings	14 (27)	9	50 *	18 (23)	11	48 *	
i) Foreign Utility Crossings(power lines,oil & gas pipelines,communication cables, railways,sewage lines,waterlines)	47 (21) *	16	16	41 (22) *	22	15	

CONSTRUCTION PHASES	MAGNITUDE OF IMPACT ON YOUR FARM OPERATION			RELATIVE IMPORTANCE TO YOU?			COMMENTS
	Large	Med.	Small	Very Important	Important	Not Very Important	
j) Placing pipe (bending, welding, x-raying, joint coating & wrapping, lower pipe in, back-filling & compaction)	36 (18)	27 *	19	39 (12)	26 *	23	Destroy good land, not in summer safety.
k) Pressure testing pipeline	23 (23)	18 *	36	30 (16)	22 *	32	Livestock affects all operations safety
l) Surface restoration & clean-up	71 (17) *	9	3	79 (9) *	10	2	Cables left from wells, best topsoil
m) Installation of scraper traps, trap sumps, valves and other above-ground appurtenances(installations)	58 (16) *	16	10	60 (23) *	7	10	Nuisance, inconvenience, livestock, loss of income to farmer-expensive, keep off private land.

GENERAL COMMENTS:

- all questions depend on location and time of year.
- loss of trees; cripple small farms.
- most damage with compensation rectified over short period of time.

2. Of all the above items in "1", please list the four (4) most important ones.

1) a-11, b-8, c-9, d-24, e-3, g-1, h_2-1, i-6, j-3, k-2, l-14.

2) a-5, b-5, c-3, d-27, e-5, g-3, h_2-1, i-6, j-1, k-3, l-10, m-9.

3) a-2, b-8, c-2, d-7, e-5, f-2, g-4, h-3, h_2-3, i-6, j-5, k-3, l-17, m-4.

4) a-4, b-4, c-5, d-4, e-1, g-3, h-1, h_2-2, i-3, j-6, l-18, m-18.

Summary of Question 2 (In order of importance)

1. Top soil conservation, stripping and stockpiling.
2. Surface restoration and clean-up.
3. Installation of scraper traps, trap sumps, valves and other above ground appurtenances (installations).
4. Construction of gates and fences.
5. Surveying and location.
6. Clearing and disposal of tree cover.

B) Pipelines and Pipeline Construction - (continued)

3. Please indicate, in order, the seasons (winter, spring, summer, fall) when pipeline construction is least disruptive to agricultural operations.

Season least disruptive:	1. W-79, Sp-3, S-0, F-14	(4)
Summary:		
W	2. W-8, Sp-15, S-15, F-40	(22)
F		
Sp	3. W-2, Sp-37, S-24, F-14	(23)
S		
Season most disruptive	4. W-2, Sp-28, S-50, F-16	(4)

Other remarks:

Spring is bad (ground is soft, muddy), crop planting, cave-ins.
Winter - restoration difficult - nothing doing on land in winter.
Fall - harvest.
Summer - best if dry, depends on whether land is cultivated or pasture, OK on edge of property, compensation inadequate, only benefit to corporation - disrupts life and land.

4. a) Do you consider top soil stripping and replacement before and after pipeline construction

Not Important	☐ 2	
Important	☐ 11	
Very Important	☐ 87*	(10)

b) Do you consider proper tamping and grade levelling after construction

Not Important	☐ 0	
Important	☐ 18	
Very Important	☐ 80*	(2)

c) Please give your reasons.

Answer: Topsoil very important. Soft ditches cause machine breakages, machines stuck. The need to cross line, level off ridges (GCOS). Prevent erosion. Clay hard to work with, limited topsoil. Cave-ins of ditches. No regrowth where not properly done. Inconvenience. Devalue property, must live with results. Land must be passable and productive. Should leave as it is. Better road appearance - reseed, keeping clean of weeds, tamping soil to prevent settling. Danger to cattle (2 killed in ditches). No inspection. Leave site messy.

5. With proper restoration immediately after pipeline construction, how long until your land regains its former productive capabilities?

1 - 6 months	☐ 3	
6 months - 1 year	☐ 28	
Longer	☐ 64*	
Never	☐ 1	(4)

6a) Has your farming operation been subject to favorable or adverse experiences in regard to pipeline construction?

favorable ☐ 25 adverse ☐ 29* (46)

b) How long a period over which this has happened?

Answer: From three weeks to three years as far back as fifteen years to only one year.
Sometimes caused recurring problem.

c) Did you receive satisfactory compensation from the company doing the construction?

Yes ☐ 31* No ☐ 17 (52)

d) Did it cost you anything to rectify if adverse?

Yes ☐ 17 No ☐ 23* (60)

Explain: Can't use gas R/W. Contractors most co-operative. Cereal crop disrupted for one year. Poorly filled ditches, clay on topsoil. Can't build subdivision. Had to clean up after spraying; destroyed swaths, needed additional restoration, problems with regard to battery sites. Had to level and remove stones, repair cave-ins, fencing, enter land without permission, compensation too low, legal advice necessitated.

7. Do you feel that pipelines and pipeline construction will have a social benefit or detriment to your farm or community or no effect?

Benefit ☐ 24 Detriment ☐ 22 No effect ☐ 49* (5)

8a) If a pipeline corridor comes into effect and if the corridor is disturbed approximately every 3 years for the addition of more pipelines or powerlines, should the corridor have a permanent service road?

Yes ☐ 37 No ☐ 20 Possibly ☐ 41* (2)

b) Should the corridor have a permanent fence?

Yes ☐ 33 No ☐ 39* Possibly ☐ 26 (2)

9. Should the pipeline be no longer required, would you prefer to have it left in place rather than again disturb the land for removal?

Yes ☐ 78* No ☐ 13 (9)

10. What minimum depth of cover over the pipe do you consider sufficient to minimize interference with your farming operations?

24" ☐8 30" ☐12 36" ☐32* 42" ☐8 48" ☐33* Other ☐2 How much 5-6', 10' (5)

11. If you were allowed a connection for gas supply to your farm, would you consider a natural gas pipeline an asset crossing your land?

Yes ☐ 73* No ☐ 25 (2)

12. Do you feel that the construction and operation of oil and/or gas pipelines would cause any concern for safety on your farm?

Yes ☐ 25 No ☐ 30 Possibly ☐ 44* (11)

Remarks, if any: Contract mistakes, concern of gas explosions, oil leaks, need 2 years compensation for crops, gas supply would make up for inconvenience, farms cut up by roads, transfer easement back to farmer when finished with lines, concern for cattle, kids, machinery need inspection, high pressure lines with less than 2' cover, weed problem, danger of explosions and fires from leaks in lines.

C. Power Transmission Lines and Power Transmission Line Construction
(Lines other than farm service lines)

1. There are a number of steps involved in the construction of power transmission lines. Some of these may have an impact or effect upon your agricultural operation and the environment. The magnitude (extent, size, degree) to which the construction of a power line affects(assists, disrupts) your farming operation will vary. The importance(significance, value) of each phase of the construction to your farming operation and the environment will also vary. Assuming all work is done in a workmanlike manner, please check (✓) the appropriate columns below for impact and importance and any comments you may have regarding the construction phases. Reference to the example below will help in filling out this question.

Example

The magnitude to which the surveying and location effects your actual farming operation may be small but this particular phase may be important in your own judgment because of various reasons such as - you may wish to know exactly where the poles are to be located, trespassing or for some other reason.

CONSTRUCTION PHASE	MAGNITUDE OF IMPACT ON YOUR FARM OPERATION			RELATIVE IMPORTANCE TO YOU?			COMMENTS
	Large	Med	Small	Very Important	Important	Not Very Important	
a) Surveying & location	34 (14)	22 *	30	46 (9) *	23	22	Need location to re-evaluate. Stakes interfere with machinery, livestock, etc.
b) Construction of gates & fences	45 (17) *	19	19	50 (11) *	25	14	Have enough fences only to protect cattle.
c) Clearing & disposal of tree cover	41 (15) *	24	20	51 (11) *	20	18	Need shelterbelts land broken, depends on time.
d) Hauling of poles & Materials	21 (12)	28	39 *	26 (11)	32 *	31	Hard to work around ruts in field, only in winter.
e) Setting structures (poles)	38 (15)	26 *	21	46 (9)*	28	17	Debris and wastage clay exposed.
f) Stringing conductor (wire)	18 (18)	30 *	34	20 (15)	36 *	29	Tramping land, underground not important.
g) Testing of transmission line	9 (15)	26	50 *	15 (17)	22	46 *	Scattered debris.
h) Surface restoration & clean-up	64 (5) *	16	18	61 (21) *	13	5	Clean up mess, restoration never complete.

2. At considerable increased cost (10 times the average), distribution power lines (lower voltage) can be placed below ground. Which would you prefer realizing such costs will be passed on to consumers?

Above ground ☐ 58*

Below ground ☐ 25 (17)

3. At increased cost (15-25%) transmission lines can be placed away from the road and highway rights-of-way. Some people consider trasmission lines along highways and road allowances unsightly.

Would you rather have the transmission line:

(a) several hundred feet off the highway or road allowance within your farm 1-7, 2-15, 3-59 (19)

(b) along the edge of the highway or road allowance 1-62, 2-19, 3-11 (8)

(c) along section or $\frac{1}{4}$ section lines 1-29, 2-50, 3-8 (13)

(Rate in order of preference from 1 to 3)

4a) Has your farming operation been subject to favorable or adverse experiences in regard to power transmission line construction (other than services to your farm)?

Favorable ☐ 47* Adverse ☐ 16 (37)

b) Did you receive satisfactory compensation from the company doing the construction?

Yes ☐ 23 No ☐ 23* (59)

c) Did it cost you anything to rectify if adverse?

Yes ☐ 10 No ☐ 34* (56)

d) Comments, if any: Run into poles, hook guy wires, smash machinery, unmarked wire in ground, power poles on R/W no problem, disturb trees that protect feed lot, hazard to cattle, eyesore, shelterbelt destroyed, poles where no easement exists, poles where no compensation, should obtain right-of-entry, unsatisfactory settlement, inconvenience, hwy. 46 through land, cables left, loss of grain, special rates for power not given, no regards to farmers for trespassing.

5. Power poles or structures located in your field may effect your farming operation. Would you please indicate to what extent these may effect your operation.

		Great Effect	Little Effect	No Effect	
a)	For cattle	☐ 19	☐ 38*	☐ 30	(13)
b)	For crops	☐ 63*	☐ 26	☐ 4	(7)
c)	For safety	☐ 37	☐ 41*	☐ 12	(10)

6. If you were allowed a connection to the powerlines, would you consider it:

An asset	Yes	☐ 34*	No	☐ 20	(46)
Already have this	Yes	☐ 86*	No	☐ 8	(6)

D. General

1. Do you consider the following to be unsightly:

		Yes	No	Possibly	
a)	a roadway	☐ 6	☐ 61*	☐ 22	(11)
b)	a railroad	☐ 24	☐ 42*	☐ 24	(10)
c)	a pipeline	☐ 9	☐ 63*	☐ 19	(9)
d)	transmission lines	☐ 27	☐ 43*	☐ 24	(6)

2a) Do you feel that more regulations should be imposed on transportation facilities even if it means a greater cost to the companies and eventually the consumer?

Yes ☐ 47* No ☐ 43 (10)

b) How much greater cost (if any)?

Answer: 2%–2, 5%–1, 10%–6, 15%–4, 20%–2, 25%–4

3. Considering your community, and your farmland, would it be desirable or would your preference be to have all the various modes of transportation (railway, highway, pipelines, transmission line) located in a single wide right-of-way or dispersed throughout various locations in your region?

One corridor ☐ 70*

Many corridors ☐ 22 (8)

4. How do you feel about the necessary number of people required from outside the community to develop either a multiple use right-of-way or many single rights-of-way?

4. (continued)

a) With regard to sudden increases and decreases in town and village population during construction:

	Good	Not Very Good	Bad	
i) financially	☐ 67*	☐ 21	☐ 1	(11)
ii) socially	☐ 32	☐ 38*	☐ 18	(12)

b) With regard to law enforcement:

i) Vandalism	☐ 13	☐ 42*	☐ 21	(24)
ii) Health & welfare of residents	☐ 28	☐ 35*	☐ 12	(25)

5. Would you want to be employed by the companies during their construction:

	Yes	No	Possibly	
Full Time	☐ 4	☐ 52*	☐ 30	(14)
Off Season	☐ 29	☐ 32*	☐ 28	(11)
During Farming	☐ 3	☐ 59*	☐ 20	(18)

6. Would the construction have an effect on hiring farm laborers?

Yes ☐ 26 No ☐ 28 Possibly ☐ 46* (0)

7. Allowing the fact that additional pipelines and transmission lines will be built, would you rate in order of preference (1 to 5) the following suggested alternatives:

Summary:

a) the widening of any existing pipeline right-of-way to include additional pipelines and power lines,

1 1-40, 2-16, 3-18, 4-12, 5-1 (13)

b) the widening of any existing highway right-of-way to include pipelines and power lines,

2 1-14, 2-27, 3-24, 4-12, 5-2 (19)

c) the widening of any existing railway right-of-way to include road, pipelines and power lines,

3 1-10, 2-22, 3-28, 4-9, 5-7 (24)

d) new facilities in a completely new single corridor

4 1-16, 2-12, 3-6, 4-40, 5-3 (23)

e) new facilities in several rights-of-way

5 1-8, 2-3, 3-5, 4-4, 5-60 (20)

E. Environmental (Physical & Social)

1. Indicate which of the following you consider to be an important part of your local environment.

		Very Important	Important	Not Very Important	Not Important	
1)	Creeks	☐ 62*	☐ 15	☐ 6	☐ 10	(7)
2)	River	☐ 47*	☐ 15	☐ 8	☐ 12	(18)
3)	Sloughs	☐ 9	☐ 24	☐ 30*	☐ 26	(11)
4)	Lakes	☐ 46*	☐ 22	☐ 12	☐ 13	(7)
5)	Muskeg	☐ 7	☐ 12	☐ 25	☐ 47*	(15)
6)	Forest	☐ 46*	☐ 18	☐ 17	☐ 9	(10)
7)	Vegetation	☐ 39*	☐ 34	☐ 4	☐ 9	(14)
8)	Parkland	☐ 34*	☐ 30	☐ 8	☐ 14	(14)
9)	Grassland	☐ 45*	☐ 31	☐ 7	☐ 7	(10)
10)	Agricultural Land	☐ 78*	☐ 15	☐ 2	☐ 1	(4)
11)	Hiking Trails	☐ 11	☐ 16	☐ 26	☐ 32*	(15)
12)	Nature Trails	☐ 15	☐ 20	☐ 21	☐ 27*	(17)
13)	Wildlife (animals)	☐ 46*	☐ 23	☐ 7	☐ 11	(13)
14)	Wild Fowl (birds)	☐ 43*	☐ 26	☐ 9	☐ 10	(12)
15)	Fish	☐ 39*	☐ 20	☐ 9	☐ 15	(17)
16)	Recreation	☐ 29	☐ 34*	☐ 12	☐ 9	(16)
17)	Social	☐ 30*	☐ 30	☐ 17	☐ 9	(14)
18)	Country Life	☐ 48*	☐ 25	☐ 10	☐ 4	(13)
19)	Your Town or Village	☐ 37*	☐ 29	☐ 11	☐ 6	(17)
20)	Isolation	☐ 17	☐ 17	☐ 18	☐ 30*	(18)

2. Which do you consider would have the most favorable effect in your region in regard to environmental impact:

Separate corridors or routes for each highway, pipeline, utility line, etc. or a single corridor containing the right-of-way for all highways, pipelines, utility lines, etc. (Multiple Use Corridor)?

Separate Corridors	☐ 12	
Multiple-use Corridor	☐ 80*	(8)

3. Do you consider that the development of new transportation facilities, roads, pipelines, utility lines, etc. near or through your property would benefit you?

	Yes	No	
During construction	☐ 21	☐ 70*	(9)
During operation	☐ 16	☐ 64*	(20)
Not at all	☐ 23	☐ 52*	(25)
Have a bad effect	☐ 22	☐ 53*	(25)

4. Which of the following recreational facilities would you be in favor of in the Urban Area (around existing towns or villages, i.e. - municipal parks and recreation areas) within or near a transportation (pipeline-power line) corridor?

		Yes	No	
a)	Tent & trailer sites	☐ 54*	☐ 30	(16)
b)	Picnic shelters & parks	☐ 64*	☐ 21	(15)
c)	Motels/hotels	☐ 43*	☐ 38	(19)
d)	Youth hostels	☐ 21	☐ 60*	(19)
e)	Gas service stations	☐ 61*	☐ 22	(17)
f)	Restaurants	☐ 58*	☐ 24	(18)
g)	Grocery stores	☐ 47*	☐ 27	(26)
h)	Novelty and souvenir shops	☐ 35	☐ 41*	(24)
i)	Telephones	☐ 66*	☐ 17	(17)
j)	Hiking trails	☐ 41	☐ 41*	(18)
k)	Nature trails	☐ 44*	☐ 39	(17)
l)	Horse trails	☐ 43*	☐ 41	(16)
m)	Ski-doo trails	☐ 40	☐ 46*	(14)
n)	Boating	☐ 59*	☐ 22	(19)
o)	Canoeing	☐ 58*	☐ 22	(20)
p)	Fishing	☐ 64*	☐ 19	(17)
q)	Swimming pools	☐ 56*	☐ 29	(15)
r)	Golf courses	☐ 53*	☐ 30	(17)
s)	Tennis courts	☐ 48*	☐ 40	(12)
t)	Baseball and football fields	☐ 57*	☐ 27	(16)
u)	Curling rinks	☐ 51*	☐ 36	(19)
v)	Skating & hockey rinks	☐ 59*	☐ 24	(17)

5. Which of the following recreational facilities would you be in favor of in Agricultural Farm Land Areas within or near a transportation (pipeline-power line) corridor?

		Yes	No	
a)	Tent & trailer sites	☐ 41	☐ 41*	(18)
b)	Picnic shelters and parks	☐ 49*	☐ 32	(19)
c)	Motels/hotels	☐ 29	☐ 52*	(19)
d)	Youth hostels	☐ 17	☐ 61*	(22)
e)	Gas service stations	☐ 44*	☐ 35	(21)
f)	Restaurants	☐ 39	☐ 40*	(21)
g)	Grocery stores	☐ 39	☐ 41*	(20)
h)	Novelty and souvenir shops	☐ 19	☐ 58*	(23)
i)	Telephones	☐ 59*	☐ 25	(16)
j)	Hiking trails	☐ 38	☐ 42*	(20)
k)	Nature trails	☐ 42*	☐ 40	(18)
l)	Horse trails	☐ 39	☐ 43*	(18)
m)	Ski-doo trails	☐ 36	☐ 47	(17)
n)	Boating	☐ 48*	☐ 32	(20)
o)	Canoeing	☐ 49*	☐ 32	(19)
p)	Fishing	☐ 53*	☐ 29	(18)
q)	Swimming pools	☐ 40	☐ 41*	(19)
r)	Golf courses	☐ 42*	☐ 38	(20)
s)	Tennis courts	☐ 32	☐ 46*	(22)
t)	Baseball and football fields	☐ 43*	☐ 37	(20)
u)	Curling rinks	☐ 37	☐ 43*	(20)
v)	Skating and hockey rinks	☐ 42*	☐ 39	(19)

6. Which of the following recreation facilities would you be in favor of in the Non-Arable Virgin Forest Areas (away from most modes of transportation and convenience) within or near a transportation (pipeline-powerline) corridor?

		Yes	No	
a)	Tent & trailer sites	☐ 62*	☐ 21	(17)
b)	Picnic shelters and parks	☐ 73*	☐ 14	(13)
c)	Youth hostels	☐ 39	☐ 43*	(18)
d)	Telephones	☐ 66*	☐ 20	(14)
e)	Hiking trails	☐ 67*	☐ 21	(12)
f)	Nature trails	☐ 66*	☐ 20	(14)
g)	Horse trails	☐ 65*	☐ 21	(14)
h)	Ski-doo trails	☐ 58*	☐ 27	(15)
i)	Boating	☐ 67*	☐ 17	(16)
j)	Canoeing	☐ 68*	☐ 16	(16)
k)	Fishing	☐ 70*	☐ 14	(16)

7. Which of the following units would be most susceptible to a high, medium or low deterioration by the construction of any corridor for roads, pipelines, power lines, etc.?

	High	Medium	Low	
a) Muskeg Areas	☐ 11	☐ 19	☐ 50*	(20)
b) Vegetation Areas	☐ 24	☐ 39*	☐ 19	(18)
c) River or stream channels	☐ 31	☐ 23*	☐ 27	(19)
d) River or stream banks	☐ 35*	☐ 24	☐ 21	(20)
e) River or stream flow	☐ 27	☐ 22*	☐ 32	(19)
f) Soils	☐ 37*	☐ 31	☐ 15	(17)
g) Trees	☐ 42*	☐ 23	☐ 16	(19)
h) Fish life	☐ 25	☐ 27*	☐ 31	(17)
i) Wild animal life	☐ 25	☐ 42*	☐ 17	(16)
j) Wild fowl (birds) life	☐ 22	☐ 40*	☐ 20	(18)
k) Lakes	☐ 23	☐ 31*	☐ 29	(17)

8. Have you observed instances in road, pipeline, or utility construction which in your opinion have adversely affected creeks, streams, rivers, lakes and wildlife habitat?

Yes ☐ 32 No ☐ 58* (10)

If yes, please list details:

How: Skeleton Lake is overdeveloped. Lakes polluted with flood run-off, oil, erosion in creeks, breaks in lines mess sloughs, destroy wildlife, fish and bird habitat, disrupt drainage, drain lakes, culvert two feet higher than water bed. Loss of trees, noise.

When: Anywhere from the present to 25 years ago. Don't stop progress but treat everyone fairly. Highway 28 floods one land since 1972, some people have heard on news or read in papers 12 years for trees to return after destroyed.

Where: Forest area (wildlife affected), neighbouring farms, oil fields. Highways, lakes (Whitewood), rivers, creeks (Flat, North Saskatchewan), Highway 36, 63, 28. Redwater, Hinton, Swan Hills, Smoky Lake, Pembina, Strathcona by power line, pipeline, sewer line construction, adverse effect upon ecology. Road increased water level and cut ten (10)acres from farmland.

CHAPTER 4

THE ENVIRONMENTAL IMPACT ANALYSIS

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THE ENVIRONMENTAL IMPACT ANALYSIS

This part of the study makes a serious attempt to analyse the environmental impact of each of the four major ground transportation modes being studied. These are:

Power Transmission Lines

Pipelines, which may be gas, oil or any other commodity which may be transported using pipelines.

Highways

Railways

The impact analysis is done using a comparison matrix as an aid. The matrix used has been designed for the purpose of comparing the effects on the environment resulting from the construction, maintenance and operation of each facility isolated in its own right-of-way. The effect of combining the facilities in common or adjacent rights-of-way are then compared using weighted values taken from the matrices of the individual facilities.

The working out of the comparison matrix may not produce quantitative answers which would be useful in some type of land use formula, but, this exercise, performed by a group of individuals who are expert in a given field, forces each one to think objectively from premises which are not normally their own. One is reminded of the old Hindu fable about the six blind men who went to see the elephant. The punch lines seem appropriate:

"And so these men of Hindustan
Disputed loud and long
Each in his own opinion
Exceeding stiff and strong,
Though each was partly in the right
And all were in the wrong."

For the benefit of those who may not be familiar with the various steps in the construction of the facilities studied, a brief breakdown of the various activities for each are presented. The operation and maintenance of each mode of transportation has its own unique problems and some of the major items are listed under the appropriate heading.

POWERLINE ACTIVITIES

CONSTRUCTION PHASE

a. Surveys and location

b. Acquisition of rights-of-way

c. Construction of fences and gates

d. Clearing and disposing of tree cover

e. Grading and levelling for construction

f. Erosion control

g. Bridges and culverts for maintenance road

h. Hauling tower material and erection

i. Hauling and stringing of conductors

j. Interference with other facilities

k. Major river crossings

l. Underground conductors

m. Sub-station construction

n. Restoration and landscaping

MAINTENANCE AND OPERATION PHASE

a. Towers and conductors in place

b. The substations

c. Noise pollution

d. Interruption of service by breakage

e. Right-of-way maintenance

f. Revisions (increase in capacity)

PIPELINE ACTIVITIES

CONSTRUCTION PHASE

a. Surveys and location

b. Acquisition of rights-of-way

c. Construction of fences and gates

d. Clearing and disposal of tree cover

e. Stripping and stockpiling topsoil

f. Grading and levelling

g. Erosion control

h. Bridges and culverts for construction road

i. Hauling and stringing pipe, etc.

j. Ditching

k. Highway crossings (bored)

l. Highway crossings (open cut)

m. River and stream crossings

n. Crossing other utilities and facilities

o. Pest control

p. Placing pipe

    i. bending, welding, x-raying

    ii. coating and wrapping pipe

    iii. testing pipe

    iv. lowering pipe, backfilling, compaction

q. Restoration and landscaping

r. Major pump station and tank farms

i. location

ii. clearing and disposal of trees

iii. stripping and stockpiling topsoil

iv. building, tank and machine foundations

v. tank erection (welding, x-raying, testing)

vi. erection of buildings

vii. pump and equipment installation

viii. painting, cleanup

ix. restoration of topsoil and landscaping

MAINTENANCE & OPERATION PHASE

a. The pipe in place underground

b. The above ground facilities

c. Noise pollution

d. Air pollution

e. Spills and/or leaks

f. Rights-of-way maintenance

g. Operation staff

h. Local maintenance supply

i. Local payroll

j. Revisions (increase in capacity)

HIGHWAY ACTIVITIES

CONSTRUCTION PHASE

a. Surveys and location

b. Acquisition of rights-of-way

c. Construction of fences and gates

d. Clearing, grubbing and disposal of tree cover

e. Stripping and storing of topsoil

f. Drainage control

    i. additional ditching

    ii. stream diversions

    iii. channel improvement culverts

    iv. temporary culverts and bridges

    v. regular highway ditching

g. Detours

h. Excavation and embankment

    i. grades

    ii. alignment

    iii. side slopes and back slopes

    iv. erosion control

    v. compaction of subgrade and embankments

    vi. chemical stabilization of unstable soils

    vii. soil testing

    viii. actual earth moving from cut to fill

    ix. landscaping

i. Road surfacing

    i. gravel pit development

    ii. crushing and stockpiling

    iii. hauling and placing gravel

    iv. mixing plant for asphalt paving

    v. Hauling and placing pavement

j. Construction camp

    i. the camp facility itself

    ii. camp supply

    iii. supply of materials and local labour

    iv. the temporary population effects

k. Major river crossings

    i. approaches (see item (h) above)

    ii. bridge foundations,piers and abutments

    iii. cofferdams, dikes, falsework

    iv. construction camp (see item (j) above)

l. Road signs

MAINTENANCE AND OPERATION PHASE

a. The road itself, in place

b. The road in use

c. Maintenance yards

d. Material stockpiles for repairs

e. Maintenance grading (gravel roads)

f. Paving patching

g. Snow removal and sanding

h. Drainage facility maintenance

i. Traffic control and safety

j. Future expansion and revisions

RAILWAY ACTIVITIES

CONSTRUCTION PHASE

a. Surveys and location

b. Acquisition of right-of-way

c. Construction of fences and cattle guards

d. Right-of-way clearing and grubbing, disposal

e. Stripping and storing of topsoil

f. Drainage control

    i. regular ditching

    ii. stream diversions

    iii. channel improvement, culverts

    iv. additional off right-of-way ditching

g. Excavation and embankment

    i. grades

    ii. alignment

    iii. side slopes and back slopes

    iv. erosion control

    v. compaction of embankment

    vi. soil testing

    vii. earth moving from out to fill

    viii. landscaping

h. Track laying

    i. supply of ties and steel

    ii. laying ties

    iii. laying steel

    iv. ballasting

i. The construction camp

  i. the camp facility itself

  ii. camp supply

  iii. local material and labour

  iv. the temporary population effects

j. Major river crossings

  i. approaches (see item (g) above)

  ii. bridge foundations, piers and abutments

  iii. cofferdams, dikes, falsework

  iv. construction camp (see item (i) above)

MAINTENANCE AND OPERATIONS PHASE

a. The railway itself, in place

b. The railway in operation

c. Maintenance stock piles

d. Repair and maintenance depots

e. Track and roadbed maintenance

f. Traffic control and safety

g. Future expansion

THE ENVIRONMENTAL IMPACT COMPARISON MATRIX FOR POWER LINES, PIPELINES, HIGHWAYS, RAILWAYS

EXPLANATION OF TERMS

In assessing the impact of the various activities which are listed below, it is difficult to avoid duplication. For example; the stripping of the right-of-way for the construction of a highway does about all the damage that can be done to that particular strip of ground, therefore it is not necessary to repeat the assessment when considering the next step which is the actual construction of the highway. Like the moss-cover on perma-frost, it is the top few inches which are sensitive and important.

Nevertheless, there are chain effects which properly require assessment again and again as different aspects of the environment are considered. For example, the construction of a road allows erosion to take place. Erosion is a natural activity which is increased by road construction. Erosion causes sedimentation and deposition. Sedimentation affects stream beds which in turn affects fish and therefore, fishing. Therefore, road construction affects each of the aspects of the environment, not only for the single condition of erosion but also for the domino effects whch follow.

We must include in our thinking not only the land area occupied by the facility and its right-of-way, but also the areas and the people which are adjacent. In this study we will consider both the Tar Sands area to one end and the sources of material supply and the market for the products at the other.

In this matrix the factors or items included in each mode of transport have been broken into 14 corresponding columns or divisions. The matrix is a check list and more of an aid to those filling it out than those reading it afterwards.

A. CONSTRUCTION ACTIVITIES

1. Survey and Location

This heading covers only the actual field work which precedes the construction of the facility being considered. It consists of such things as the cutting of line; the staking out of rights-of-way; the running of preliminary lines; the staking out of baselines and/or centerlines for construction purposes; the gathering of all the necessary data which goes with the layout and control surveys which are an integral part of all major works.

It does not include an evaluation of the location or route chosen; i.e., the consideration of alternate route - their benefit or harm are not to be considered when filling out the matrix.

2. Rights-of-Way Acquisition

This heading considers only the acquisition of the rights-of-way by purchase or expropriation. e.g., the effect of the loss the right-of-way has to the landowner - the benefit received by the landowner in money. It further is intended also to cover the effects of the continued existence; i.e., the use of the right-of-way by the landowner.

3. Clearing and Right-of-Way Preparation

a. Powerlines

Powerline companies are now clearing only the trees which are tall enough to endanger the conductors should the trees fall down for any reason. The width of the cleared right-of-way in forested areas is determined by the tree heights with an allowance made for future growth. Construction roads on the right-of-way are kept to a minimum,

and ground cover, except for the trees, is left as undisturbed as possible. Methods of stringing conductors across streams are used so that bank disturbance is kept to the absolute minimum possible. Helicopters are being used for the transport of towers to inaccessible areas avoiding the construction of roads in sensitive areas.

b. Pipelines

The width of right-of-way clearing for pipelines has been reduced to the practical minimum. Ground cover is disturbed as little as possible but on side hills grading may be extensive. The restoration and landscaping activities does much to repair this damage. Pipeline construction bridges and culverts across streams are no longer left in place to interfere with the fish habitat. Exceptions to this are made when they serve the public as access to otherwise inaccessible areas.

c. Highways

Highway rights-of-way are generally stripped of all vegetation and organic soil. The top soil is now being stockpiled and later replaced. Organic soils cannot be used in road construction and in general must be removed. For all practical purposes the habitat for all living things is totally destroyed within the right-of-way during the construction phase of building a highway. It is partially restored and in some respects improved by the restoration and landscaping methods used later. It is recognized that fill sections are not as completely devastated as excavation sections.

d. Railways

Railway right-of-way clearing and preparation has similar effects as highway clearing. Since the right-of-way is generally 99 feet instead of the 200 to 400 foot rights-of-way of the highway, the magnitude of the impact is not as large.

4. Construction of the Facility

This heading covers the on-site activities necessary for the construction of the facility being considered.

a. Powerlines

The construction activities include grading and levelling of tower sites and the access road along the right-of-way; erosion control and culverts for the construction access road; positioning and erection of towers; the stringing of the conductors and the building and fencing of substations.

b. Pipelines

The construction activities include grading and levelling for the haul road and for the construction of the pipeline; the stringing of the pipe; the ditching; the welding; wrapping; testing; lowering the pipe; backfilling; highway crossings bored and open cut; crossing other facilities; river andstream crossings of the pipe; river and stream crossings of the haul road.

c. Highways

The construction activities include the construction fences and gates along each boundary of the right-of-way through settled areas. We consider all earthmoving activities including the building of the grade; the side and back sloping; compaction stabilization; the

excavation of borrow pits; the hauling and placing of gravel; the hauling and placing of the stablized bases and the finished paved surfaces. It is difficult to separate the off-site and on-site activities when dealing with the highway surface. We have chosen to consider that the supply of gravel and asphalic concretes is a construction support activity in the same sense that the supply of pipe is a construction support activity in the case of the pipeline construction.

d. Railways

The building of the grade is essentially the same for the railway as it is for the highway. The activities considered are: the construction of fences and gates; all earthmoving activities including the building of the grade, the side and back sloping of the ditches, compaction, stabilization, the excavation of borrow pits.

The placing of ties and steel and the subsequent ballasting with gravel are all carried out in a single sequential operation by a specialized train of equipment which builds its own track as it proceeds down the finished earthwork grade previously built.

5. Construction Support

This item is to consider the off-site activities which are an essential part of the facility being considered. For all of the transportation modes being considered, the following are common activities:

Access roads from existing highways to the on-site construction roads.

The construction camps which will include the effect of the transient labour population, the increased payroll, the effect on the local economy and social structure of these camps, the storage facilities, temporary and permanent, and the hauling of materials of construction using the existing transportation facilities.

6. Restoration and Landscaping

This heading covers the workmanlike restoration of the original undisturbed environment insofar as it is considered beneficial and possible. The work involved varies with the amount of disturbance created by the construction of the facility concerned. Aesthetics is assumed to be considered in all procedures.

a. Powerlines

The powerline creates the least disturbance. In settled areas the land may be used for agricultural purposes as before, except for the very small area occupied by the towers and substations. In forested areas and in crown land in general, the ground cover disturbance is kept to a minimum and consists chiefly of the grading required for the access road and the destruction of the trees. Restoration and landscaping will consist chiefly of erosion control and the reseeding of areas where the grass cover has been removed or destroyed.

b. Pipelines

The construction of the pipeline involves the construction of an access road and also grading for side hill work as well as the ditch itself and the excavation material from the ditch. Therefore, the landscaping and restoration involves more intensive treatment than that given to the powerline right-of-way. The side hill cuts are

partially restored by backfilling and back sloping. The successful seeding of these slopes will satisfactorily protect the disturbed surface from further damage.

c. Highways

The highway construction procedures frequently require the stripping and removal of all vegetation and all top soil from practically the entire right-of-way. Restoration and landscaping under these circumstances is a long and costly business. Where the soil is naturally unstable (sands and silts) the results are frequently far from satisfactory. The construction of large, deep borrow pits, adjacent to but not on the right-of-way, must not be forgotten when considering the effects of the highway activities on the environment.

d. Railways

The railway construction practices are similar to those of the highway. The effects differ in degree only and the restoration and landscaping procedures in the past have lagged far behind the construction phase. But, stricter regulations are now in effect to bring these procedures to the comparable standard of highways. They are no longer able to burn the grass and brush on the right-of-way as was done in the past.

7. Stream Crossing

This heading covers the construction of culverts and bridges as part of the highway and railway facilities and the bank and streambed disturbance in the case of pipelines and the disturbance to the banks where the stringing of powerlines require this activity.

The temporary culverts required for construction of both pipelines and powerlines should be included.

8. Drainage Control

This item is intended to cover all ditching activities which effect the drainage pattern of the original environment. It is to include ditching for erosion control such as the herringbone patterns used in pipeline construction as well as drainage ditches dug for the purpose of stabilizing the subgrade where a highway or railway passes through a muskeg or wetland. It includes, of course, the normal highway and railway ditches which are necessary for the control of run-off water which would otherwise endanger the facility.

B. THE FACILITIES

1. On-Site Facilities

The following are not activities in the usual sense of the word. They are intended to indicate the new creation produced by the preceding construction activities.

a. Powerlines

A powerline conductor hanging passively from its supports has an impact on certain characteristics of the environment. It is a hazard to birds; it affects the scenery. It affects land use and it affects property values.

b. Pipelines

The pipeline pipe is the actual pipe as it lies buried in the ground; a long ribbon of pipe.

c. Highways

The highway is the long ribbon of roadway with its ditches and cleared right-of-way just sitting there.

d. Railways

The railway is the parallel ribbons of steel winding through the countryside along with its embankment and right-of-way.

2. Off-Site Support Facilities

There are the off-site support structures which are required for the proper utilization and maintenance of the facilities being considered.

a. Powerlines

This heading will include the towers and the substations.

b. Pipelines

Included are the above ground facilities such as the storage tanks, culverts and the pumping stations.

c. Highways

Highways include maintenance yards and material storage yards and the shops for the repair of both construction and maintenance equipment. We must also include the supporting service stations and accommodations for travellers.

d. Railways

Include the shops and yards, the accommodation for maintenance and operating personnel, the passing tracks and safety device such as signal systems. To a more limited extent there will be accommodation for travellers; the effect on the environment generally obscured by their location in urban centers, notable exceptions being park accommodations owned by the transportation companies. These accommodations are not important in the present study.

C. THE OPERATION

1. Facility Failure

a. Powerlines

Power failure is the failure of the conductor to transmit energy. It may be caused by a power source failure or a break in the conductor. The effects include fire due to short circuit at substations, etc.

b. Pipelines

A pipeline failure will be a break with resulting leakage of both safe and dangerous material in the vicinity of the failure. The failure may take place in an open field where the results would be without real significance or they could be in a streambed or adjacent to it where the results would be serious. If the product is dangerous, the impact is great wherever the failure occurs. It also includes pump or supply failure.

c. Highways

A highway failure is the failure of the highway to carry traffic. It will be a slide or bridge failure generally caused by floods but may be a structural failure due to overloading or accident. It could be the result of a collision. In any event, the effects would be of a temporary nature.

d. Railways

A railway failure is like the highway failure. It is the failure to carry traffic. It may be caused by floods, etc. as for highways, but, since the railway depends on direct human control of its continued operation, then the human factors such as strikes may be considered.

2. Future Expansion

a. Powerlines

This item provides for an evaluation of such things as increasing the capacity of powerlines, larger towers, steel towers instead of wooden poles; normally expansion would require an additional line.

b. Pipelines

Additional pipelines possibly requiring relative isolation from existing facilities for safety reasons may be required. This may include the increase in the number and capacity of pumping stations, etc.

c. Highways

In the consideration of highways, it may include upgrading the highway by adding traffic lanes or the widening of shoulders, etc.

d. Railways

The double tracking of railways would also be considered here along with the increase in labor required for maintenance, etc.

3. Maintenance

Under maintenance we will consider the labor force required, the effects of right-of-way housekeeping activities such as grass cutting, weed, brush and other pest or nuisance control; problems arising from low rental housing to company employees etc.; local maintenance payroll; public relations, etc. It will include repairs to any break in the operation of the facility and it will include preventive maintenance.

4. Operation

This heading means the facility in operation, and the effects of the operation.

a. Powerlines - energy flowing in a conductor

In the case of powerline operation we have noise effects, hazard to birds and unwary or unfortunate humans, changes in the field of force, etc.

b. Pipelines - products flowing through a pipeline

We have noise, odors, and the ever existent hazard to health and safety from gas lines and other highly flammable product lines.

c. Highways - vehicles travelling on a highway

From highways we have, besides the ever present accident tolls, dust pollution and noise pollution. The highway is both a barrier and corridor to other forms of life beside the human one. It would be difficult to exaggerate or over-emphasize the cultural and social effects of the operation of the highway and its auxiliary services. Not all of them are good.

d. Railways - trains travelling on a track

The train running on the track and all of the implications which go with this fact. The personal services which the railway performs has lessened, but the effect on the economic environment is still very significant and of great importance.

FIGURE 4

ENVIRONMENTAL IMPACT COMPARISON MATRIX FOR POWERLINE PIPELINE HIGHWAY RAILWAY

TO USE THE MATRIX

1. Check each action in the top horizontal list which applies to the mode of transport being assessed. Each action checked, is checked against each environmental item shown in the vertical column to the left. If there is a significant impact, whether long term or short term, place a diagonal slash from the upper right to the lower left corner of each block which represents a significant interaction. If the impact is considered beneficial use + and if harmful use a − in front of each number.

2. Having placed all of the diagonal slashes, then evaluate the magnitude of their effect by using a code system from 1 to 5, where 5 is assigned to an action causing a maximum effect. These numbers indicate relative magnitudes and are placed in the upper left hand corner of the slashed box.

3. In the lower right hand corner of the box, place a number from 1 to 5 to indicate what you consider to be the relative importance of the impact; again 5 is the greatest.

The matrix was filled out by a biologist, construction engineer, geographer, location engineer, soils scientist and a chemical engineer. The individual evaluations of the six participants were fed into a computer, averaged, rounded out to the nearest whole number and the chart completed.

The evaluations are subjective. To be more accurate it would require (1) more basic research and data, (2) more disciplines to be envolved and (3) much more time than was available. The evaluations in regard to importance would still be subjective. The evaluations can be used to point out areas of concern and to make comparisons in certain very particular instances but cannot be used in the ordinary engineering mode.

EXISTING CHARACTERISTICS AND CONDITIONS OF THE ENVIRONMENT

PROPOSED ACTIONS

POWERLINE — A. CONSTRUCTION ACTIVITY: 1. Survey and location - layout and field data; 2. Rights of Way Acquisition; 3. Clearing and right of way Preparation; 4. Construction of Facility - on site activities; 5. Construction Support - off site activities; 6. Restoration and Landscaping; 7. Stream Crossing - conductor over stream; 8. Drainage Control - drainage ditches, herring bone ditches; B. FACILITY: 9. Facility - conductor, (above ground); 10. Facility Support - towers, substations, etc., (on ground); 11. Facility failure - breaks; C. OPERATION: 12. Future Expansion; 13. Maintenance; 14. Operation - energy flowing in conductor

PIPELINE — A. CONSTRUCTION ACTIVITY: 15. Survey and location - layout and field data; 16. Rights of Way Acquisition; 17. Clearing and right of way Preparation; 18. Construction of Facility - on site activities; 19. Construction Support - off site activities; 20. Restoration and Landscaping; 21. Stream Crossing - pipeline under stream; 22. Drainage Control - drainage ditches, herring bone ditches; B. FACILITY: 23. Facility - pipeline, (below ground); 24. Facility Support - valves, pumps, storage tanks, (above ground); 25. Facility failure - breaks; C. OPERATION: 26. Future Expansion; 27. Maintenance; 28. Operation - products flowing through pipeline

HIGHWAY — A. CONSTRUCTION ACTIVITY: 29. Survey and location - layout and field data; 30. Rights of Way Acquisition; 31. Clearing and right of way Preparation; 32. Construction of Facility - on site activities; 33. Construction Support - off site activities; 34. Restoration and Landscaping; 35. Stream Crossing - bridges and culverts; 36. Drainage Control - Highway ditches and drainage ditches; B. FACILITY: 37. Facility - Highway structure (on right-of-way); 38. Facility Support - maintenance yards, service stations (off right-of-way); C. OPERATION: 39. Facility failure - breaks; 40. Future Expansion; 41. Maintenance; 42. Operation - vehicles travelling on highway

RAILWAY — A. CONSTRUCTION ACTIVITY: 43. Survey and location - layout and field data; 44. Rights of Way Acquisition; 45. Clearing and right of way Preparation; 46. Construction of Facility - on site activities; 47. Construction Support - off site activities; 48. Restoration and Landscaping; 49. Stream Crossing - bridges and culverts; 50. Drainage Control - railroad ditches and drainage ditches; B. FACILITY: 51. Facility - railroad structure (on right-of-way); 52. Facility Support - stations, section houses (off right-of-way); C. OPERATION: 53. Facility failure - breaks; 54. Future Expansion; 55. Maintenance; 56. Operation - trains travelling on track

PHYSICAL AND CHEMICAL CHARACTERISTICS	EARTH	a. Construction material	1.		
		b. Soils	2.		
		c. Land form	3.		
		d. Force fields and background radiation	4.		
		e. Unique physical features	5.		
		f. Surficial deposits (organic)	6.		
		g. Bedrock geology	7.		
	WATER	a. Lakes	8.		
		b. Streams	9.		
		c. Underground	10.		
		d. Water pollution	11.		
		e. Recharge	12.		
	ATMOSPHERE	a. Climate (Micro - Macro)	13.		
		b. Odour	14.		
		c. Dust and particulates	15.		
		e. Noise	16.		
	PROCESSES	a. Floods	17.		
		b. Erosion	18.		
		c. Deposition (sedimentation, precipitation)	19.		
		d. Sorption (ion exchange, complexing)	20.		
		e. Stability (slides, slumps)	21.		
		f. Forest fires	22.		
BIOLOGICAL CONDITIONS	FLORA	a. Trees	23.		
		b. Shrubs	24.		
		c. Grass	25.		
		d. Crops	26.		
		e. Microflora	27.		
		f. Aquatic plants	28.		
		g. Endangered species	29.		
		h. Windbreak	30.		
	FAUNA	a. Birds	31.		
		b. Land animals including reptiles	32.		
		c. Fish and shellfish and Benthic organisms	33.		
		d. Insects	34.		
		e. Microfauna	35.		
		f. Endangered species	36.		
		g. Habitat	37.		
CULTURAL FACTORS	LAND USE	a. Wilderness and open spaces	38.		
		b. Wetlands	39.		
		c. Forestry	40.		
		d. Grazing	41.		
		e. Agriculture	42.		
		f. Residental	43.		
		g. Commerial	44.		
		h. Industrial	45.		
		i. Mining and quarrying	46.		
	RECREATION	a. Hunting	47.		
		b. Fishing	48.		
		c. Boating and swimming	49.		
		d. Camping, hiking, and picnicking	50.		
		e. Resorts	51.		
	AESTHETICS AND HUMAN INTEREST	a. Scenic views and vistas	52.		
		b. Wilderness qualities	53.		
		c. Open space qualities	54.		
		d. Landscape design	55.		
		e. Unique physical features	56.		
		f. Parks and reserves	57.		
		g. Rare and unique species or ecosystems	58.		
		h. Historical or archaeological sites, objects, and monuments	59.		
	CULTURAL STATUS	a. Cultural patterns (life style)	60.		
		b. Health and safety	61.		
		c. Employment	62.		
		d. Population density	63.		
	MAN-MADE FACILITIES AND ACTIVITIES	a. Structures	64.		
		b. Transportation network (movement, access)	65.		
		c. Utility network	66.		
		d. Waste disposal	67.		
		e. Barriers	68.		
		f. Corridors	69.		
	ECONOMICS	a. Economic activity	70.		
		b. Local tax base	71.		
		c. Property values	72.		
		d. Social services cost	73.		
		e. Future development	74.		
		f. Resource depletion	75.		
		Total Magnitude	76.	-4 -2	-49 -27 -36 -9 -13 -40 -20 -24 -14 -21 -2 -2
		Total Importance	77.	-5 -0	-49 -33 -37 -15 -17 -54 -19 -24 -13 -21 -2 -1

TOTALS

- The individual evaluations of the six participants who filled out the matrix were fed into a computer, averaged, rounded out to the nearest full number and the chart completed.
- For each mode of transport the individual total is the numerical addition of the average of the six evaluations before they were rounded out. Thus the totals shown may not be exactly equal to the addition of the matrix evaluations as taken from the chart.
- Totals for the various combinations of utilities are not a numerical addition. The individual total value for each of the various modes of transport was assigned a rating factor depending upon the particular combination. This rating factor was fed into the computer and applied before obtaining a total. The rating factor was a combined decision of the six participants.
- The totals can only be used to point out areas of concern and to make comparisons in certain very particular instances. The absolute numerical value is without significance and should not be used in the ordinary engineering mode.

57.	Total Magnitude - Pipeline	3	3	2	2
58.	Total Importance - Pipeline	10	14	4	5
59.	Total Magnitude - Powerline	0	0	0	0
60.	Total Importance - Powerline	0	0	4	4
61.	Total Magnitude - Highway	1	1	0	0
62.	Total Importance - Highway	13	16	12	14
63.	Total Magnitude - Railway	11	16	8	14
64.	Total Importance - Railway	10	13	3	6
65.	Total Magnitude - Powerline Pipeline	5	5	8	8
66.	Total Importance - Powerline Pipeline	12	16	18	20
67.	Total Magnitude - Powerline Highway	7	9	9	8
68.	Total Importance - Powerline Highway	14	16	18	21
69.	Total Magnitude - Powerline Railway	8	11	11	13
70.	Total Importance - Powerline Railway	16	28	31	20
71.	Total Magnitude - Pipeline Highway	11	11	11	11
72.	Total Importance - Pipeline Highway	23	29	32	29
73.	Total Magnitude - Pipeline Railway	13	13	14	14
74.	Total Importance - Pipeline Railway	32	16	18	10
75.	Total Magnitude - Highway Railway	10	10	16	16
76.	Total Importance - Highway Railway	32	36	36	32
77.	Total Magnitude - Powerline Pipeline Highway	5	5	6	6
78.	Total Importance - Powerline Pipeline Highway	16	18	20	21
79.	Total Magnitude - Powerline Highway Railway	8	9	10	10
80.	Total Importance - Powerline Highway Railway	32	29	32	32
81.	Total Magnitude - Pipeline Highway Railway	14	14	10	10
82.	Total Importance - Pipeline Highway Railway	16	18	32	36
83.	Total Magnitude - Pipeline Railway	10	10	16	16
84.	Total Importance - Pipeline Railway	20	23	29	32
85.	Total Magnitude - Pipeline Powerline Highway Railway	16	13	14	14
86.	Total Importance - Pipeline Powerline Highway Railway	20	32	29	32
		-404	-464	-261	-289
		-488	-522	-346	-376
		-503	-556	-611	-647
		-470	-502	-622	-670
		-479	-525	-789	-847
		-757	-813	-921	-984
		-924	-996	-607	-650
		-1079	-1159		

DISCUSSION FOR THE COMPLETED MATRIX

It is realized that this matrix is only one of many which could be devised for the same purpose.

There are major benefits which come from the use of this form of matrix. Since by definition a matrix is an orderly array, the use of a matrix produces an orderly approach to the problem and the matrix is in itself a check list. With a number of people involved in the formation of the matrix, and in the completion of the matrix, there is a reasonable assurance that all of the important factors will be considered.

In any such matrix there are weaknesses. Activities which have a relatively trivial effect may be included. Environmental characteristics which are affected very slightly or not at all are included. The result is a large matrix with many thousands of decisions required of which possibly half may be neutral or nearly so. The completion of this matrix is time consuming and tedious. There is a strong temptation to play a numbers game with the results.

Another weakness is the lack of researched data available. This lack of data means that true objectivity could not be realized in evaluating the magnitude of the impact of a given activity on the 75 environmental characteristics and conditions which might or might not be affected by this activity.

The final weakness to be mentioned is the subjectivity inherent in any evaluation of the absolute and relative importance of the impact of a given activity on an environmental characteristic or condition. This subjectivity tends to be increased by the obvious threat to our future as we consider air

and water pollution which has been well publicized. We also fear the lower standard of living which may result from the depletion of our non-renewable natural resources. The foregoing not only helps to account for our subjectivity, but it also accounts in part for the variations in the subjectivity of individuals.

There are questions which may be asked which no matrix can answer: Who decides which environmental factors are vital to our continued successful survival? Can we avoid basing our activities or our lack of activities on the opinions, biases or prejudices of the people who are most articulate and are able to make the most noise whether they know anything or not about the topic under discussion. Should immediate social benefits be included in a matrix whose major purpose would seem to be the evaluation of the harmful impact of activities on what is essentially the physical environment? Is it right to offset the bad by including that which is good? Is not this way of thinking the reflection of our past behaviour towards things environmental? Would another group of "experts" arrive at the same conclusions which are presented here?

Six people of varied formal education, interests and experience have pooled their opinions by completing this matrix. The results show that they have reached common conclusions. It is reasonable to assume that these conclusions are either very close to the truth or they are worth further investigations, discussion, or possibly formal research. These common conclusions are those which have been included under the heading of Areas of Sensitivity. Well informed people may rightly claim that these

conclusions are obvious and that it doesn't require a matrix to prove them. The weakness in such an assertion lies in the fact that everyone is not well informed and also that even well informed people require objective confirmation of their opinions. Those who filled out the matrix are better informed than they were before they did the exercise. This is possibly the greatest single benefit which has come from the effort to complete the matrix and summarize the results.

It is worth noting that the results from the matrix confirm the consensus of opinion from the communities through which the corridor must pass. It naturally reflects the consensus of opinion held by the compilers of the matrix. This opinion is that a common corridor is the ideal solution. No doubt the actual solution will be a compromise between the ideal and the possible.

CONCLUSIONS

The matrix agrees with the intuitive conclusion that the construction and operation of a powerline has the least impact on the environment and that the highway has the greatest impact.

The list below places the impact of the four facilities in order from the least to the greatest in magnitude and importance.

(a) The powerline

(b) The pipeline

(c) The railway

(d) The highway

An analysis of all possible combinations of corridors indicate that the following conclusions are true:

1. A common corridor containing all of the facilities has the least impact on the environment.
2. That separate corridors for each facility has the greatest impact.
3. The order of preference using the corridor concept for two utilities would be:

   (a) Powerline and railway

   (b) Pipeline and railway

   (c) Powerline and pipeline

   (d) Powerline and highway

   (e) Pipeline and highway

   (f) Highway and railway

Indications are that the highway and railway combination has twice the impact that the powerline and railway has, and that there is only a minor difference between the powerline-railway combination and that of the pipeline-railway arrangement.

4. A further study of the corridor concept where three facilities are placed in a common corridor while the fourth is placed in a right-of-way by itself shows that the most favorable arrangements are in order of preference:

   (a) i. Powerline, pipeline and railway.

   ii. Highway.

   (b) i. Powerline, pipeline, highway.

   ii. Railway.

   (c) i. Pipeline, highway and railway.

   ii. Powerline.

   (d) i. Powerline, highway, railway.

   ii. Pipeline.

There appears to be little difference between (a) and (b) and that in the overall view there is not a great difference in the four possible arrangements.

AREAS OF SENSITIVITY

A study of the vertical columns indicate those activities which have the greatest impact both in magnitude and importance. Some activities have a very minor impact when compared with other activities. Those which have the most significant harmful impact are listed below in the order of their importance:

(a) Pipeline failure.

(b) Highway right-of-way clearing and preparation.

(c) Railway right-of-way clearing and preparation.

(d) Highway drainage control, highway ditches and drainage ditches.

(e) Railway drainage control.

(f) Highway stream crossings.

(g) Pipeline right-of-way clearing and site preparation.

(h) Powerline clearing and site preparation.

(i) Highway on-site construction.

(j) Highway construction support, off-site activities.

(k) Railway construction support.

Detailed specifications would be required for the control of operations of the activities listed in order of magnitude and importance so as to minimize the impact of these activities on the environment. The above statement does not infer that carelessness with those activities not specifically noted would be tolerated.

In general the activities which taken together have the greatest impact are in order of importance and might apply to the overall corridor concept.

(a) Right-of-way clearing.

(b) Drainage control.

(c) Stream crossings.

(d) Construction support.

(e) On-site construction.

(f) Facility failure.

(g) The facility support.

(h) The facility in existence.

The order of impact of the individual modes of transport are shown in Table II on the following page.

TABLE II

Listing of the Environmental Impact (from highest to lowest) of the various activities in the construction and operation of the various modes of transport.

	Powerlines	Pipelines	Highways	Railways
1.	Clearing & Right-of-Way Preparation	Facility Failure	Clearing & Right-of-Way Preparation	Clearing & Right-of-Way Preparation
2.	Drainage Control	Clearing Right-of-Way Preparation	Drainage Control	Drainage Control
3.	Construction Support	Drainage Control	Stream Crossing	Construction of Facility
4.	Construction of Facility	Stream Crossing	Construction of Facility	Construction Support
5.	Facility Support	Construction Support	Construction Support	Stream Crossing
6.	Future Expansion	Construction of Facility	Facility	Facility Support
7.	Facility	Facility Support	Facility Support	Facility
8.	Stream Crossing	Facility	Operation	Restoration & Landscaping
9.	Facility Failure	Future Expansion	Restoration & Landscaping	Facility Failure
10.	Restoration & Landscaping	Restoration & Landscaping	Future Expansion	Future Expansion
11.	Survey & Location	Maintenance	Facility Failure	Operation
12.	Maintenance	Survey & Location	Maintenance	Survey & Location
13.	Operation	Operation	Survey & Location	Maintenance
14.	Rights-of-Way Acquisition	Rights-of-Way Ascquisition	Rights-of-Way Acquisition	Rights-of-Way Acquisition

NOTE: This is a general assessment of the order of impact in regard to each mode. Variations can easily occur in particular instances and the impact of similar activities in each mode is not the same.

CHAPTER 5

CORRIDOR CROSS SECTIONS

CHAPTER 5

CORRIDOR CROSS SECTIONS:

The multiple use single corridor concept introduces a large number of possible arrangements of the various facilities which may be placed in a single corricor.

Some of the factors which will have a major influence on the arrangements are as follows:

1. The effect of major catastrophes such as war, vandalism or other subversive activities, land slides, floods, earthquakes, wind, sleet and ice storms, etc.
2. The relative location of dangerous substance carriers such as high pressure gas lines, lines carrying poisonous fluids, acids or other harmful products.
3. The environmental effects of a wide corridor or a narrow corridor; the possible need for buffer zones and their width. The effect on wild life in general.
4. The social and economic effects.
5. Engineering problems - access, operational, maintenance and design requirements and limitations.
6. Legal difficulties (financing, insurance, administration).
7. Land acquisitions and ownership.
8. The introduction of new modes of transport and future expansion of each of the utilities.
9. The effect of soil studies, forest and other vegetation studies.
10. Existing and future land use problems.

There are undoubtedly other considerations but those given are enough to indicate very clearly the complexity of the problem and the need for extensive study and discussion.

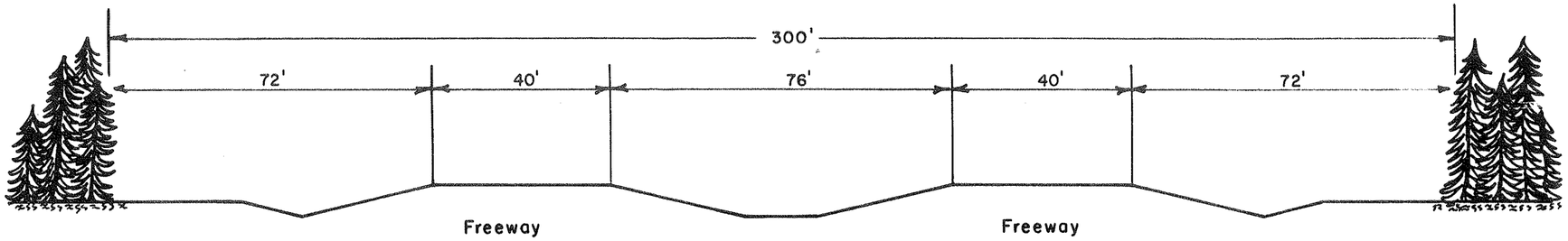
The typical or possible cross-sections which are presented on the following pages are not all of the arrangements which are possible. There are enough of them to stimulate the thinking processes of those who are interested in the problem and also should be of value to those who will make the final decisions as to the final form which the multiple use corridor will take if this type of corridor is adopted. Whatever combination is selected the potential advantages and disadvantages can be summarized as follows:

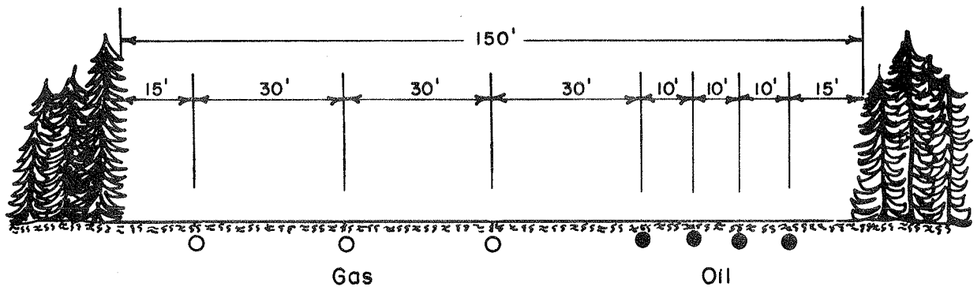
Potential Advantages

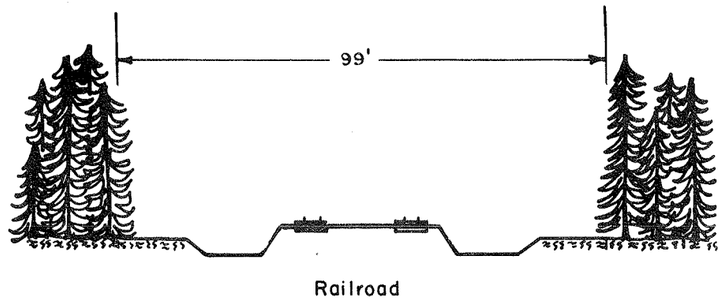
1. Conservation of land and space.
2. Environmental impact restricted to a limited area.
3. Can be used as a positive force in shaping the land use pattern.
4. Administrative and management efficiencies assuming a single authority owning or administering the corridor.
5. Economics of a single land acquisition program.

Potential Disadvantages:

1. Initial resolution of conflicting interests.
2. Potentially higher intensity of environment impact within a restricted area.
3. Complications in engineering design within the corridor.
4. Vulnerability to major catastrophes.







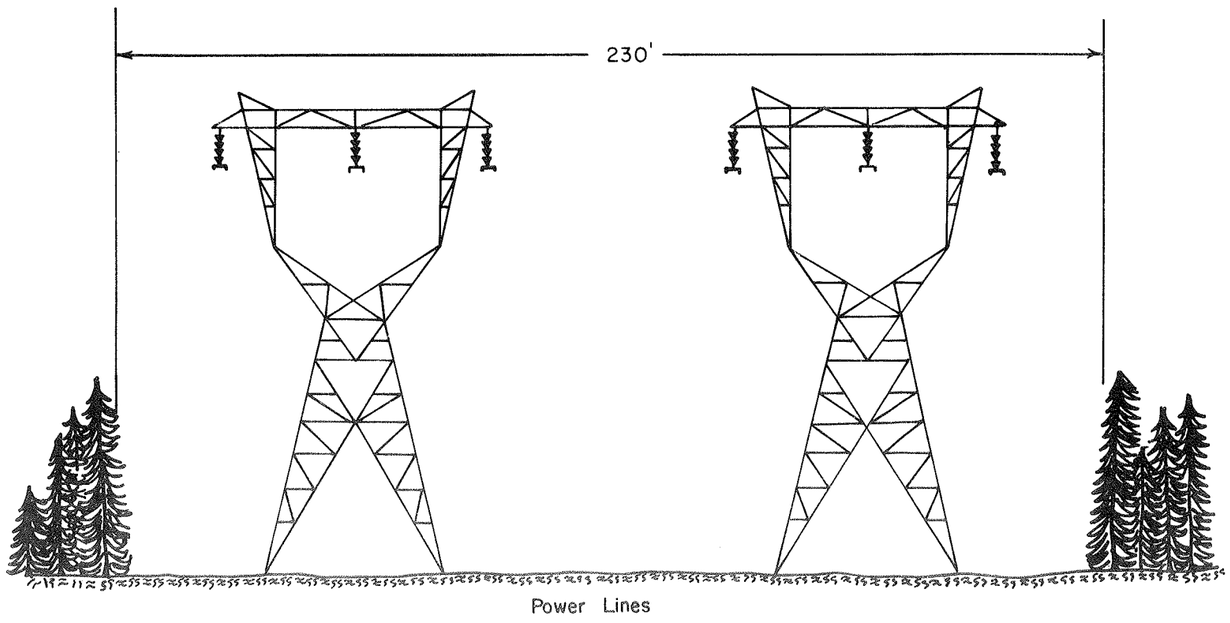
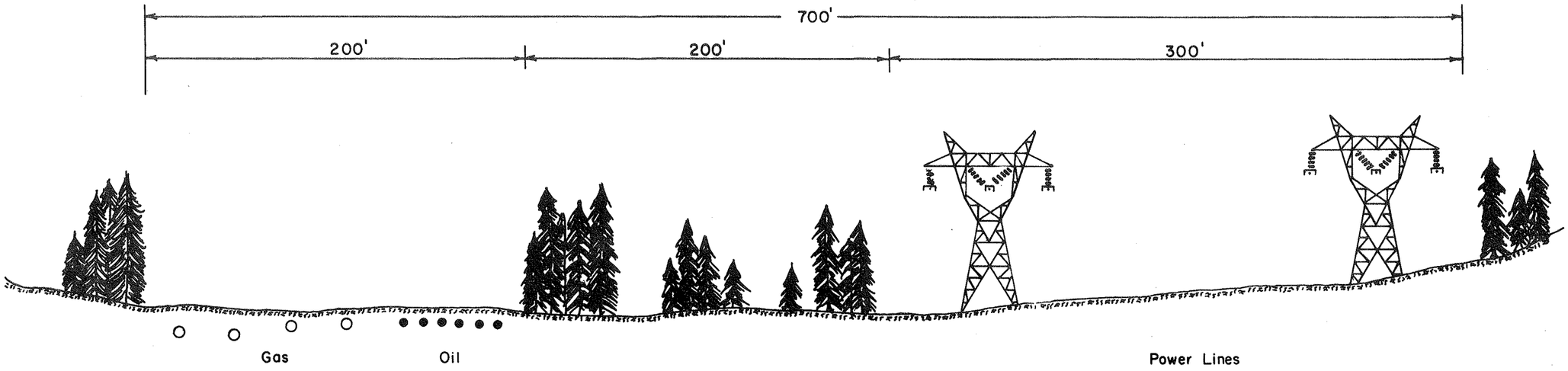
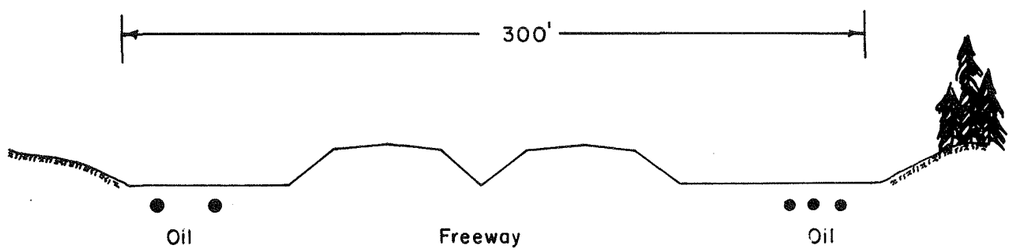


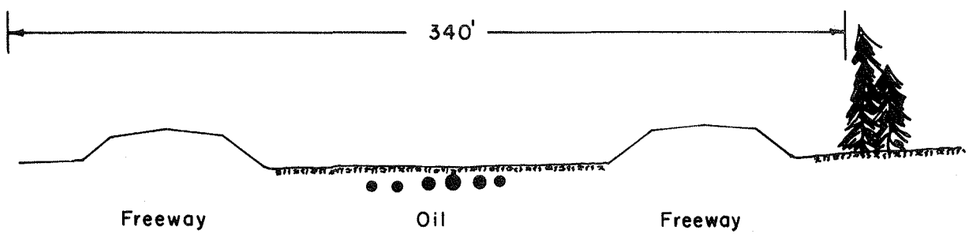
FIGURE 5;

ONE FACILITY IN A CORRIDOR

DEPARTMENT OF THE ENVIROMENT
ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY
CORRIDOR ALTERNATIVES TYPICAL CROSS-SECTIONS
STEWART WEIR STEWART WATSON HEINRICHS







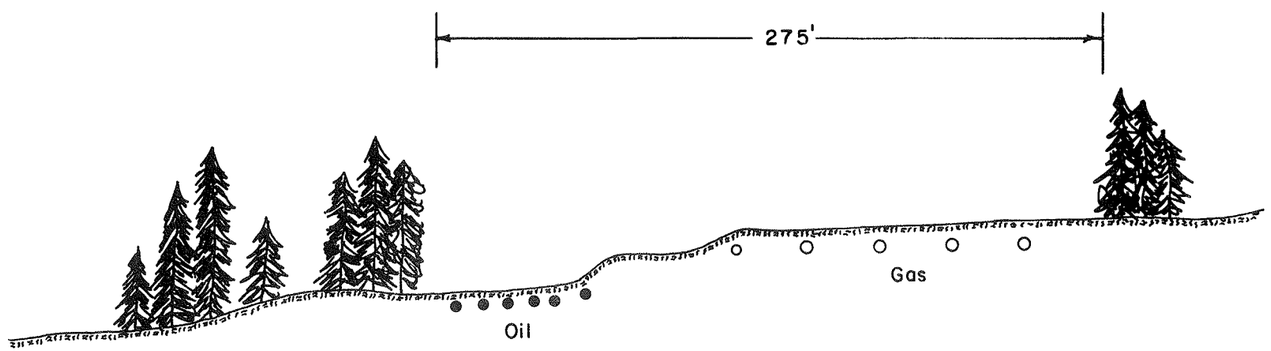
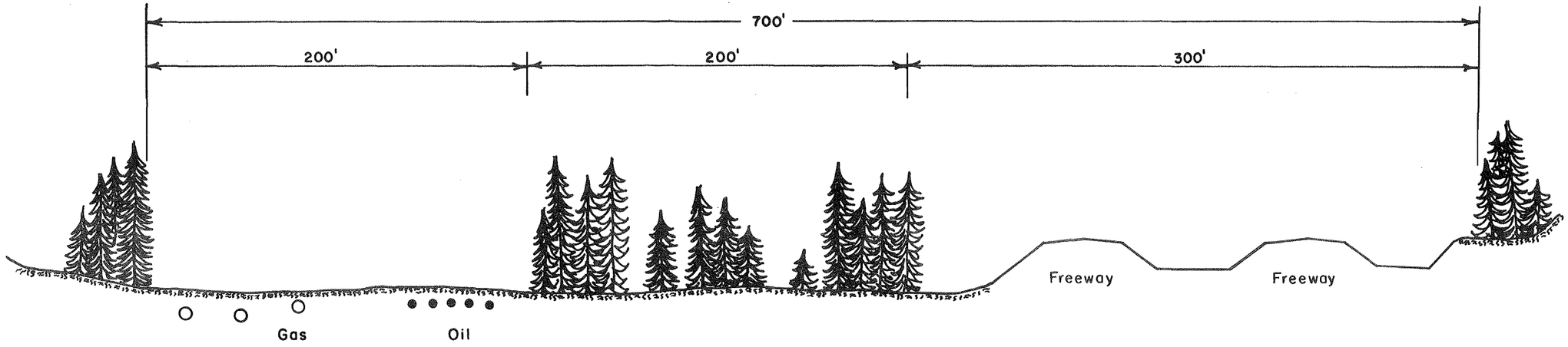
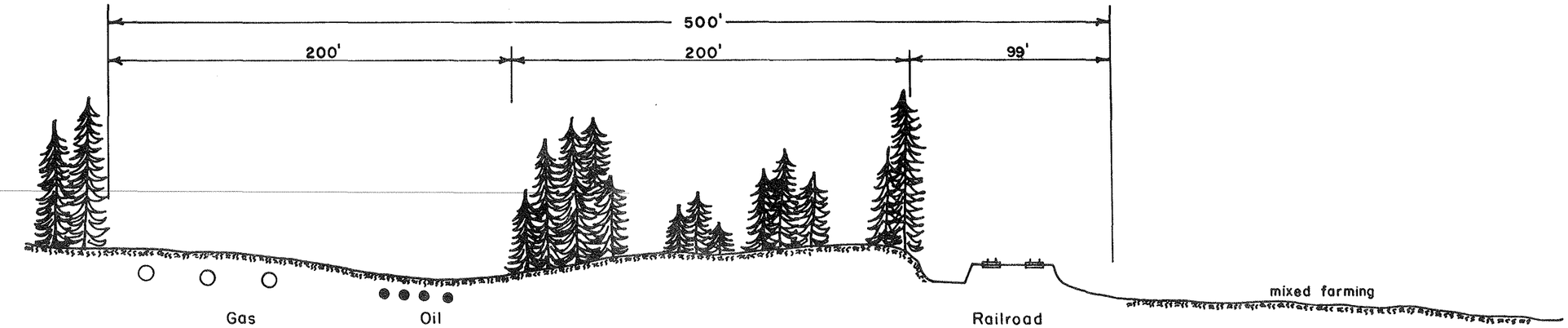


FIGURE 6 ;

TWO FACILITIES IN A CORRIDOR

DEPARTMENT OF THE ENVIROMENT
ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY
CORRIDOR ALTERNATIVES TYPICAL CROSS-SECTIONS
STEWART WEIR STEWART WATSON HEINRICHS





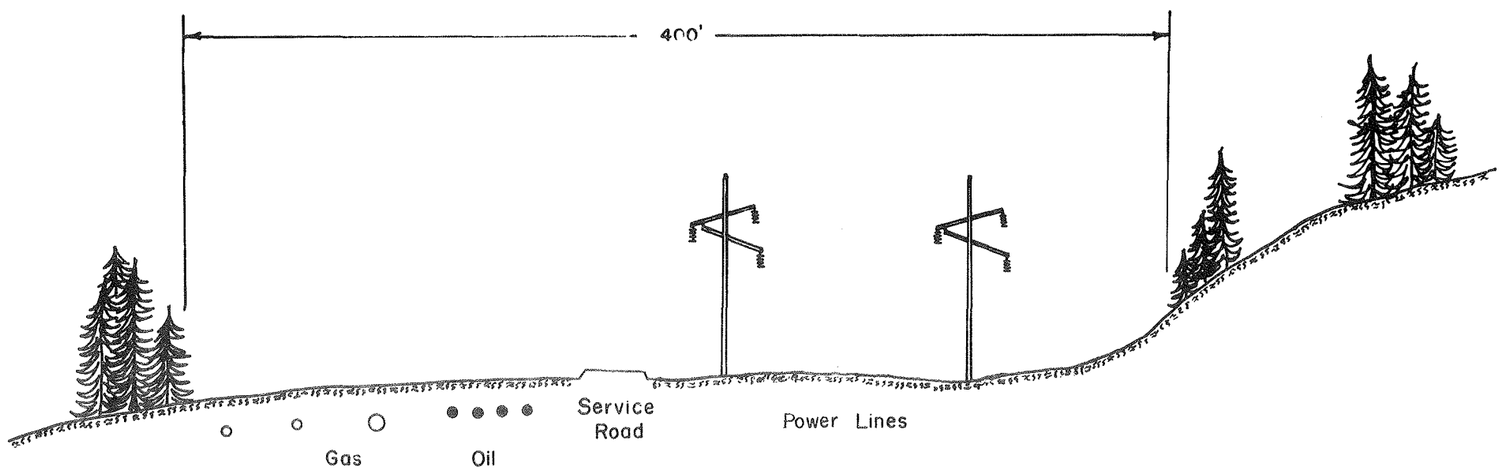
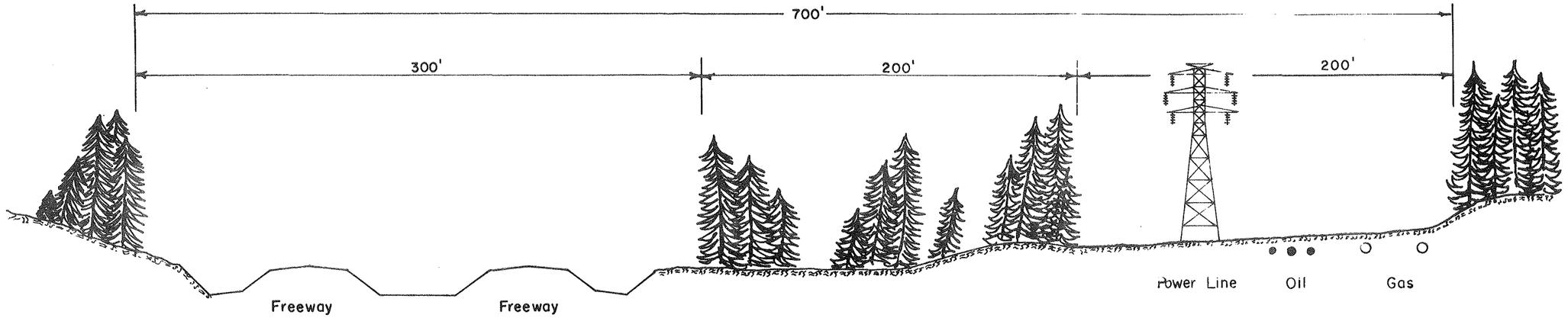
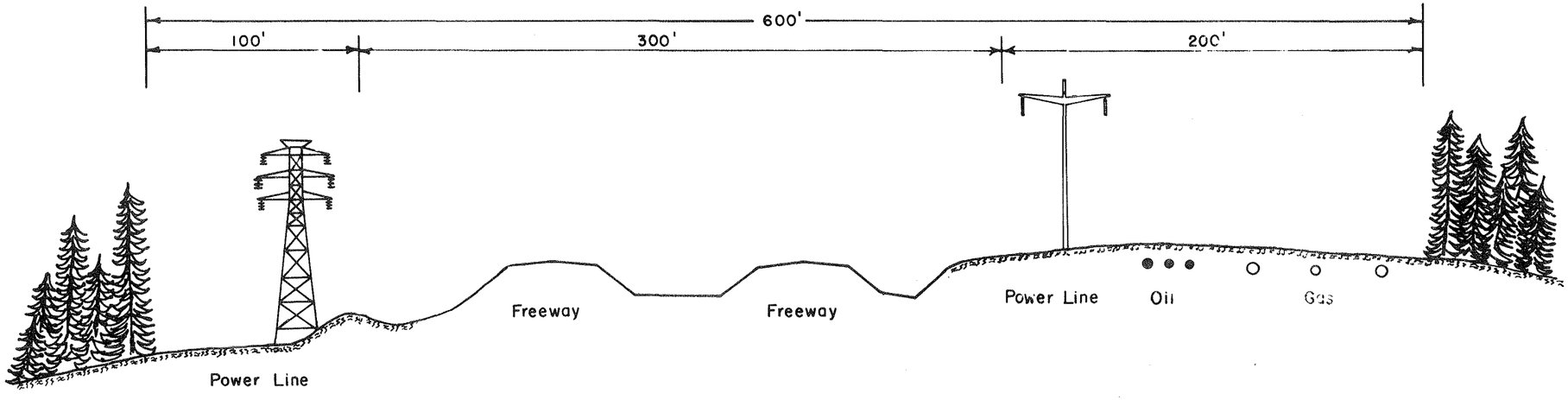


FIGURE 7;

TWO FACILITIES IN A CORRIDOR

DEPARTMENT OF THE ENVIROMENT
ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY
CORRIDOR ALTERNATIVES TYPICAL CROSS SECTIONS
STEWART WEIR STEWART WATSON HEINRICHS





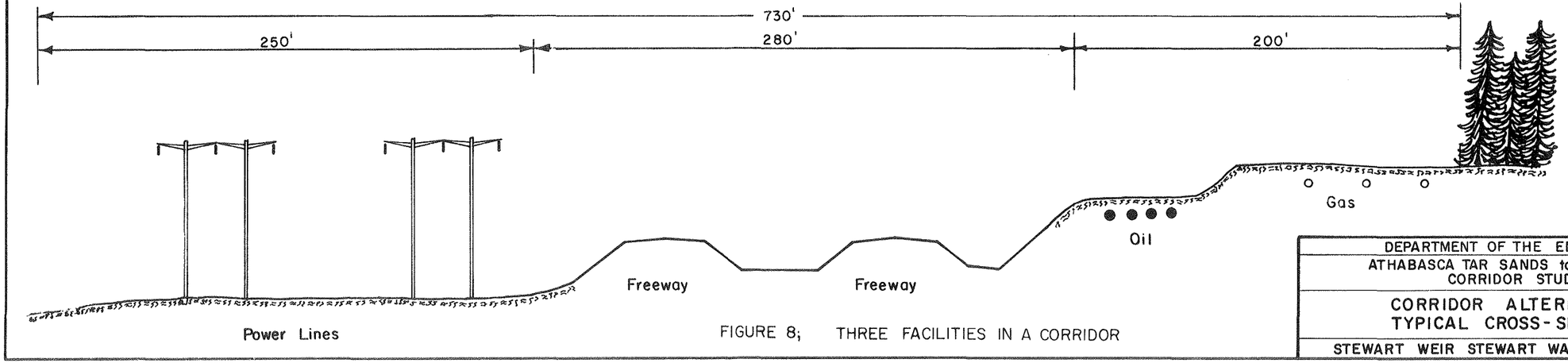


FIGURE 8; THREE FACILITIES IN A CORRIDOR

DEPARTMENT OF THE ENVIROMENT
ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY
CORRIDOR ALTERNATIVES
TYPICAL CROSS-SECTIONS
STEWART WEIR STEWART WATSON HEINRICHS

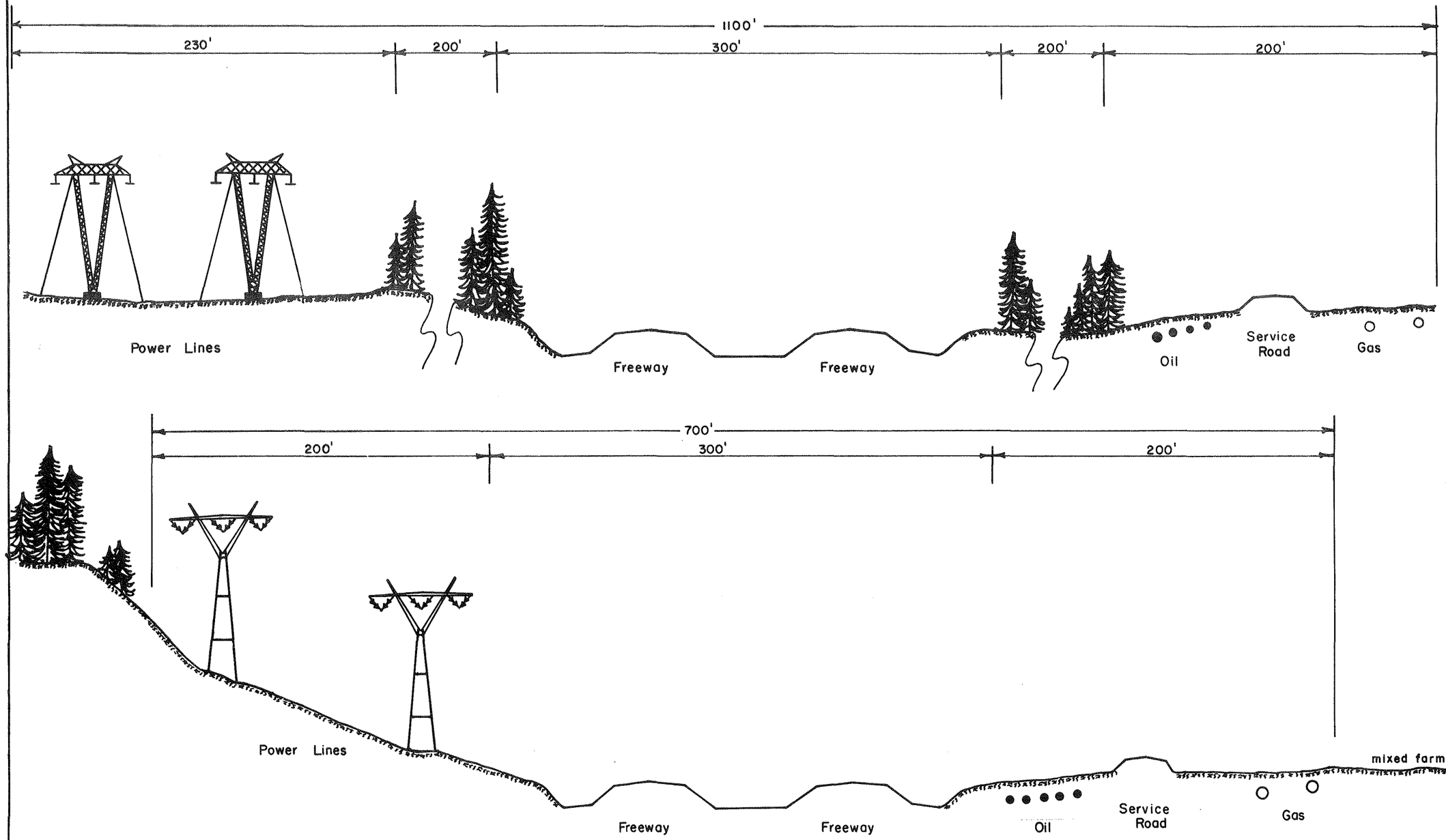
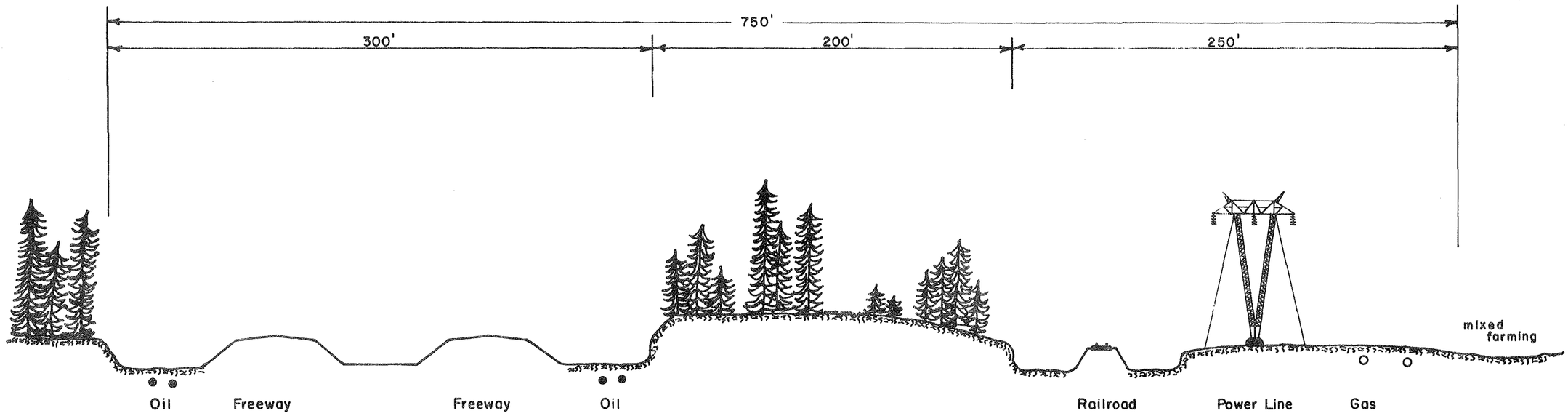


FIGURE 9;

THREE FACILITIES IN A CORRIDOR

DEPARTMENT OF THE ENVIROMENT
ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY
CORRIDOR ALTERNATIVES TYPICAL CROSS-SECTIONS
STEWART WEIR STEWART WATSON HEINRICHS



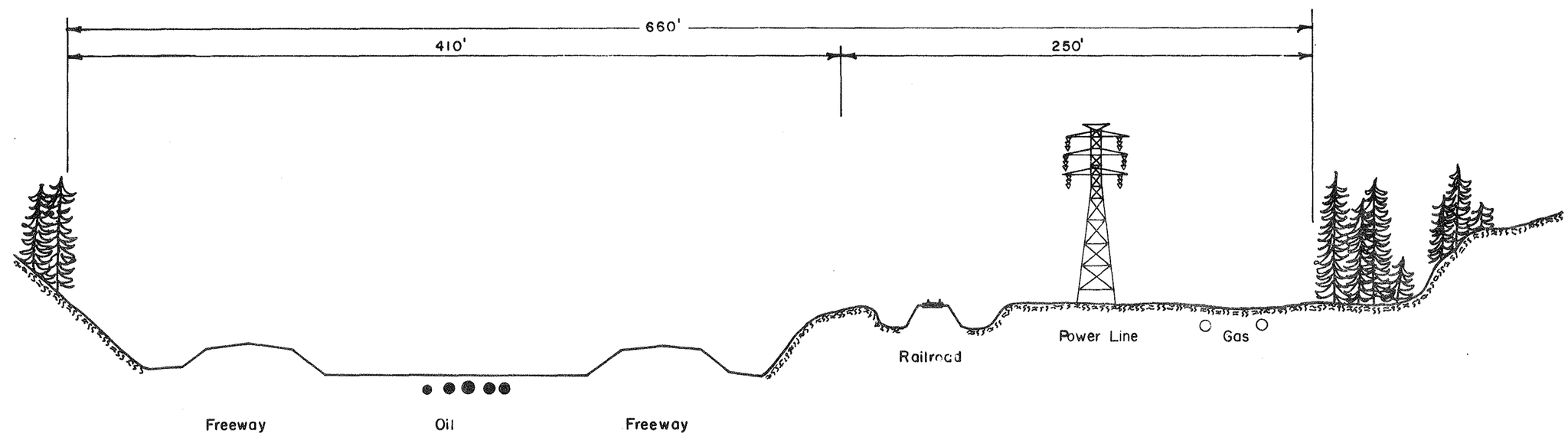


FIGURE 10;

FOUR FACILITIES IN A CORRIDOR

DEPARTMENT OF THE ENVIROMENT
ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY
CORRIDOR ALTERNATIVES
TYPICAL CROSS SECTIONS
STEWART WEIR STEWART WATSON HEINRICHS

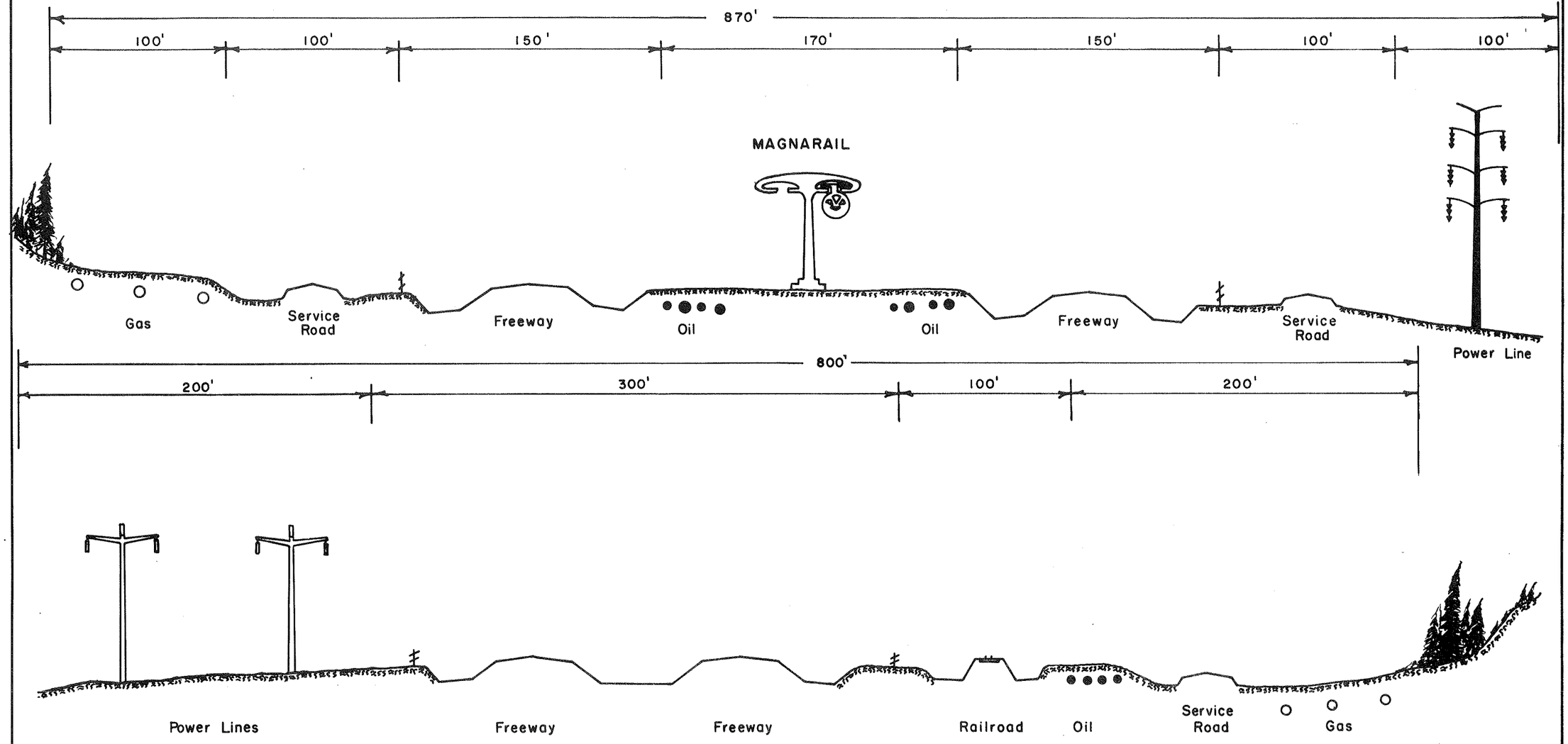


FIGURE 11;

FOUR FACILITIES IN A CORRIDOR

DEPARTMENT OF THE ENVIROMENT
ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY
CORRIDOR ALTERNATIVES TYPICAL CROSS SECTIONS
STEWART WEIR STEWART WATSON HEINRICHS

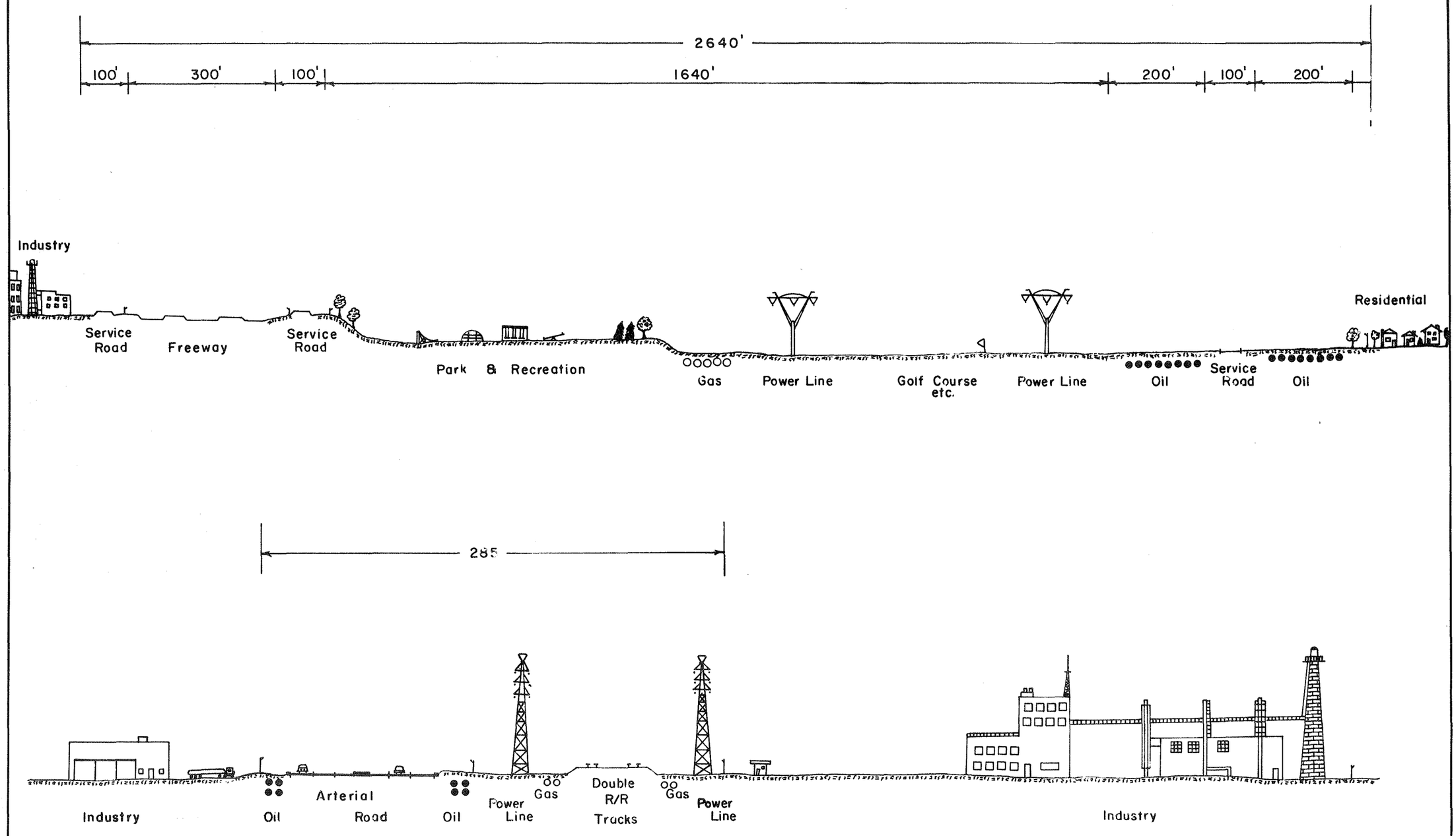


FIGURE 12;

FACILITIES IN A CORRIDOR IN THE INDUSTRIAL AREA

DEPARTMENT OF THE ENVIROMENT
ATHABASCA TAR SANDS to EDMONTON CORRIDOR STUDY
CORRIDOR ALTERNATIVES TYPICAL CROSS-SECTIONS
STEWART WEIR STEWART WATSON HEINRICHS

CHAPTER 6

COST ANALYSIS

CHAPTER 6

COST ANALYSIS

This section of the report deals with the unit costs of construction for the four facilities being studied.

Powerline costs are presented through the courtesy of Calgary Power Ltd. and the Alberta Power Corporation.

Calgary Power estimates show the estimated costs for three different capacity transmission lines for three different locations. Two locations are in the vicinity of Highway 63 and one is along the general route of the NAR. The Albera Power estimate is for a 240 KV line from the Mitsue substation to the tar sands area of the proposed Syncrude development.

Pipeline estimates are those of the Home Oil Corporation and are given for various sizes of pipe and for different levels of service.

Highway and railway costs are more general in nature and are presented chiefly for comparison purposes. They are not intended for use for estimating future costs. Detailed estimates would be misleading. The figures given show the order of costs which might be expected it if were decided to abandon either of these facilities either in whole or in part in order to create a fully common corridor where such might be considered practical.

Approximate unit costs for highway construction are given in Table 21 and 22. These were supplied through the courtesy of the Department of Highways.

TRANSMISSION LINE COSTS

As mentioned previously, there is a possibility of several power transmission lines entering the Tar Sands Area from widely separated sources, with at least one and possibly two lines location in the proposed corridor.

The estimated cost of the proposed Albert Power Ltd. Transmission Line from Mitsue Lake to the Tar Sands is as follows:

Length of Line		170 miles
Voltage		240 K.V.
Capacity		150 to 200 megawatts
Material Costs		$17,000.00
*Construction Costs		$13,000.00
Total Cost/Mile excluding clearing		$30,000.00
Clearing at average cost $250.00/acre		3,750.00
	Total	$33,750.00/mile
For 170 miles	Total	$5,757,500.00

*Includes labor, easements, engineering and miscellaneous costs.

To put the above figures in perspective, the average cost/mile of the 60.7 miles of 240 KV from Barrhead to Mitsue substation completed in November of 1968 was $26,734.00 per mile.

Following are three cost comparison charts which were prepared by Calgary Power Ltd. for three levels of voltages and three routes from Atmore to Fort McMurray. (Tables 12, 13,14)

TABLE 12

COST COMPARISONS FOR TRANSMISSION LINES ATMORE (AREA) TO FORT McMURRAY SHOWING 1973 PRICES

		138 KV Cost/Mile (Average)					
		Route 1		Route 2		Route 3	
		Cost	%	Cost	%	Cost	%
a)	Total Material Costs	13,850	37	13,850	34	13,850	29
	Structure Costs	(7,010)	19	(7,010)	17	(7,010)	15
	Cond. and Access Costs	(6,840)	18	(6,840)	17	(6,840)	14
b)	Total Const. Labor Costs	12,700	34	14,570	35	19,000	40
	Structure Labor	(9,000)	24	(10,500)	26	(13,700)	29
	Cond. and Access Labor	(3,700)	10	(4,070)	10	(5,300)	11
c)	Total R/W Prep. Costs	3,950	11	5,400	13	6,700	14
	Survey Costs	(1,200)	3	(1,500)	4	(1,700)	4
	Clearing & Disp. Costs	(2,750)	7	(3,900)	9	(5,000)	10
d)	Total Other Costs	6,730	18	7,260	18	8,270	17
	(4.9% Total) Engineering Costs	(1,840)	5	(1,840)	4	(1,840)	4
	(7% Labor) Field Supervision Costs	(890)	2	(1,020)	2	(1,630)	3
	(12% Total) Financing and Other Costs	(4,000)	11	(4,400)	11	(5,100)	11
e)	Total Project Cost	37,230	100	41,080	100	47,820	100

Note:				
	(1) Conductor	2-266.8	2-266.8	2-266.8
	(2) Tower Style 25%	Steel(S.S.)	Steel(S.S.)	Steel(S.S.)
	75%	Steel(Guyed)	Steel(Guyed)	Steel(Guyed)
	(3) Lightning Wire	2-5/16 (Gd. 220)	2-5/16 (Gd. 220)	2-5/16 (Gd. 220)
	(4) Line Capacity (Range)	25-35MW	25-35MW	25-35MW

Route 1 - Along easterly limit of Highway 63

Route 2 - Approximately 250' east or west of Highway 63

Route 3 - Approximately 500' west of NAR railway

TABLE 13

COST COMPARISONS FOR TRANSMISSION LINES
ATMORE (AREA) TO FORT McMURRAY
SHOWING 1973 PRICES

		240 KV Cost/Mile(Average)					
		Route 1		Route 2		Route 3	
		Cost	%	Cost	%	Cost	%
a)	Total Material Costs	20,730	41	20,730	37	20,730	32
	Structure Costs	(9,860)	19	(9,860)	18	(9,860)	15
	Cond. and Access Costs	(10,870)	21	(10,870)	19	(10,870)	17
b)	Total Const. Labor Costs	16,600	33	19,240	34	25,300	39
	Structure Labor	(12,500)	25	(14,500)	26	(19,100)	30
	Cond. and Access Labor	(4,100)	8	(4,740)	8	(6,200)	10
c)	Total R/W Prep. Costs	4,100	8	5,800	10	7,300	11
	Survey Costs	1,200	2	(1,500)	3	(1,700)	3
	Clearing & Disp. Costs	(2,900)	6	(4,300)	8	(5,600)	9
d)	Total Other Costs	9,360	18	10,050	2	11,230	17
	(4.9% Total) Engineering Costs	(2,700)	5	(2,700)	5	(2,700)	4
	(7% Labor) Field Supervision Costs	(1,160)	2	(1,350)	2	(1,630)	3
	(12% Total) Financing and Other Costs	(5,500)	11	(6,000)	11	(6,900)	11
e)	Total Project Cost	50,790	100	55,820	100	64,560	100

Note:				
	(1) Conductor	2-477	2-477	2-477
	(2) Tower Style 25%	Steel (S.S.)	Steel (S.S.)	Steel (S.S.
	75%	Alum. (Guyed)	Alum. (Guyed)	Alum. (Guyed)
	(3) Lightning Wire	2-5/16 (Gd. 220)	2-5/16 (Gd. 220)	2-5/16 (Gd. 220)
	(4) Line Capacity (Range)	150-200 MW	150-200 MW	150-200 MW

Route 1 - Along easterly limit of Highway 63

Route 2 - Approximately 250' east or west of Highway 63

Route 3 - Approximately 500' west of NAR railway

TABLE 14

COST COMPARISONS FOR TRANSMISSION LINES
ATMORE (AREA) TO FORT McMURRAY
SHOWING 1973 PRICES

		500 KV Cost/Mile (Average)					
		Route 1		Route 2		Route 3	
		Cost	%	Cost	%	Cost	%
a)	Total Material Costs	41,000	43	41,000	39	41,000	34
	Structure Costs	(14,860)	16	(14,860)	14	(14,860)	12
	Cond. and Access Costs	(26,140)	27	(26,140)	36	(26,140)	22
b)	Total Const. Labor Costs	32,200	34	38,500	36	50,000	41
	Structure Labor	(25,300)	26	(29,400)	28	(38,400)	32
	Cond. and Access Labor	(6,900)	7	(9,100)	9	(11,600)	10
c)	Total R/W Prep. Costs	4,250	4	6,250	6	7,970	7
	Survey Costs	(1,200)	1	(1,500)	1	(1,700)	1
	Clearing & Disp. Costs	(3,050)	3	(4,750)	5	(6,270)	5
d)	Total Other Costs	18,360	19	19,800	19	22,310	18
	(4.9% Total) Engineering Costs	(5,810)	6	(5,810)	6	(5,810)	5
	(7% Labor) Field Supervision Costs	(2,250)	2	(2,690)	3	(3,500)	3
	(12% Total) Financing and Other Costs	(10,300)	11	(11,300)	11	(13,000)	11
e)	Total Project Cost	95,810	100	105,550	100	121,280	100

Note:	(1) Conductor	4-556.5	4-556.8	4-556.5
	(2) Tower Style 25%	Steel (S.S.)	Steel (S.S.)	Steel (S.S)
	75%	Steel (Guyed)	Steel (Guyed)	Steel (Guyed)
	(3) Lightning Wire	2-5/16 (Gd. 220)	2-5/16 (Gd. 220)	2-5/16 (Gd. 220)
	(4) Line Capacity (Range)	600-800 MW	600-800 MW	600-800 MW

Route 1 - Along easterly limit of Highway 63

Route 2 - Approximately 250' east or west of Highway 63

Route 3 - Approximately 500' west of NAR railway

PIPELINE COSTS

Due to heavy demand placed on conventional crude, the Tar Sands of Alberta will be exploited to produce large volumes of synthetic crude in the near future. It is anticipated that ten plants of 125 M B/D capacity each will be built within a ten to twenty year period. In this report we have computed the cost of transportation of synthetic crude from the Fort McMurray area to Edmonton, with the objective to provide an ultimate pipeline capability of 1,250 M B/D.

In order to select the most optimum pipe diameter, we have evaluated the cost of service for four pipe sizes at various throughputs. The following assumptions were used in the present cost of service study:

A. Hydraulic:

1. It was assumed that the oil being transported is of light synthetic variety, having an A.P.I. gravity of 35° and a viscosity of 8 centistokes.
2. Maximum pipeline operating pressure of 1050 p.s.i.g. and a pressure drop between two consecutive pump stations of 1000 p.s.i.
3. Distance between Fort McMurray to Edmonton - 278 miles.

   Fort McMurray Elevation - 1070 feet

   Edmonton Elevation - 2200 feet

B. Financial:

1. Return on the investment at the rate of 10%.
2. 80/20 percent Debt Equity ratio.
3. Debt retired in 20 equal yearly installments.
4. A flat depreciation rate of 5% on all types of equipment.
5. Interest on outstanding debt at 9%.
6. No escalation in operating or other costs has been allowed.
7. An average of five years of cost of service is computed.

C. Pipeline Cost:

1. Four pipe sizes, namely 26", 30", 36" and 48" have been evaluated.
2. A detailed cost of pipeline construction per mile was estimated. A steel price of $400/short ton was used.
3. The pipeline was telescoped and half of its length was designed for 1100 p.s.i.g. and the other half for 800 p.s.i.g.
4. Figure 13 shows the relative cost of installation for various pipe sizes.

D. Pump Station Cost:

1. It was envisaged that all the pump stations will be electric motor driven. The cost of pump station was calculated at the rate of $200/horsepower installed.
2. All pumps have an efficiency of 80%.
3. No standby horsepower was provided.

E. Engineering Data:

Tables 15 to 20 detail the various costs that were used in computing the cost of service.

F. Discussion:

Figure 14 depicts the five year average cost of service for four pipe sizes at various flow rates.

From the Figure 14, the most optimum pipe size depends on the throughput capability desired in a system. If the Tar Sands pipeline is to have capability in excess of 800 M B/D, then 36" pipe would be the most optimum size. If a throughput of 800 M B/D or more is not realistic, then 30" or 26" pipelines are the next optimum sizes in the same order.

It is interesting to note that the throughput capability of 26" and 30" looped lines is approximately the same as that of a 36" line. If a 26" pipeline is installed in year one and throughput requirements increase at the rate of 125 M B/D per year then we would be obliged to loop the 26" with a 30" line in year three. This would keep the pressure drop per mile under 20 p.s.i.

Referring to Figure 14 again, for throughputs in excess of 1,500 M B/S, the most optimum pipe diameter would be 48".

Figure 15 shows the yearly average cost of service of the looped line and also for a 36" and 48" pipeline. Again, a 36" line is the preferred choice if the pipeline system is required to deliver throughputs in excess of 375 M B/D.

TABLE 15

PIPELINE AND ANCILLARY EQUIPMENT COST
(in $1,000's)

	26"	30"	36"	48"
Pipeline	47,435	58,380	74,166	124,807
Tankage at $3/barrel	2,250	3,750	3,750	3,750
Metering	1,000	1,500	1,500	1,500
Supervisory	1,000	1,000	1,500	1,500
Roads	1,000	1,000	1,000	1,000
3 River Crossings	1,200	1,500	1,500	1,500
35 Creek Crossings	800	1,050	1,050	1,050
Transportation Vehicles	100	100	100	100
Maintenance Shop	100	100	100	100
Sub total	56,685	68,380	84,166	134,807
Contingencies 10%	5,668	6,838	8,416	13,480
Interest During Construction 1 Year	5,688	6,838	8,416	13,480
	68,020	82,100	101,000	161,800
Line Fill	3,710	4,970	7,090	12,610

TABLE 16

HORSEPOWER REQUIREMENT AND ITS COST
(Cost in 1,000's)

	Flow M B/D						
26" Pipeline:	250	500	750	1,000	1,250	1,500	1,750
Horsepower per station	5,000	9,500	16,000				
Number of stations	2	6	10				
Total horsepower	10,000	57,000	160,000				
Pump costs at $200/H.P.	2,000	11,400	32,000				
Power cost at $48/H.P/year	480	2,736	7,680				
Repair & maintenance at $3/H.P.	30	171	480				
30" Pipeline:							
Horsepower per station	3,500	10,000	13,500	19,000	24,500		
Number of stations	2	3	6	9	12		
Total horsepower	7,000	30,000	81,000	171,000	294,000		
Pump costs at $200/H.P.	1,400	6,000	16,200	34,200	58,800		
Power cost at $48/H.P./year	336	1,440	3,888	8,204	14,112		
Repair & maintenance at $3/H.P.	21	90	243	513	882		
36" Pipeline:							
Horsepower per station	4,000	8,000	13,000	20,000	22,500	28,000	
Number of stations	1	2	3	4	6	8	
Total horsepower	4,000	16,000	39,000	80,000	135,000	224,000	
Pump costs at $200/H.P.	800	3,200	7,800	16,000	27,000	44,800	
Power cost at $48/H.P./year	192	768	1,872	3,840	6,480	10,750	
Repair & maintenance at $3/H.P.	12	48	117	240	405	672	
48" Pipeline:							
Horsepower per station	2,500	7,500	15,500	14,000	22,500	23,000	33,500
Number of stations	1	1	1	2	2	3	3
Total horsepower	2,500	7,500	15,500	28,000	45,000	69,000	100,500
Pump costs at $200/H.P.	500	1,500	3,100	5,600	9,000	13,800	20,100
Power cost at $48/H.P./year	120	360	744	1,344	2,160	3,312	4,824
Repair & maintenance at $3/H.P.	8	23	47	84	135	207	302

TABLE 17

TOTAL CAPITAL EXPENDITURE SUMMARY
(in $1,000's)

	Flow M B/D						
	250	500	750	1,000	1,250	1,500	1,750
26" Pipeline:							
Pipeline tankage, etc.	68,020	68,020	68,020				
Pump station	2,000	11,400	32,000				
	70,020	79,420	100,020				
30" Pipeline:							
Pipeline tankage, etc.	82,100	82,100	82,100	82,100	82,100		
Pump station	1,400	6,000	16,200	34,200	58,800		
	83,500	88,100	98,300	116,300	140,900		
36" Pipeline:							
Pipeline tankage, etc.	101,000	101,000	101,000	101,000	101,000	101,000	
Pump station	800	3,200	7,800	16,000	27,000	44,800	
	101,800	104,200	108,800	117,000	128,000	145,800	
48" Pipeline:							
Pipeline tankage, etc.	161,800	161,800	161,800	161,800	161,800	161,800	161,800
Pump station	500	1,500	3,100	5,600	9,000	13,800	20,100
	162,300	163,300	164,900	167,400	170,800	175,600	181,900

TABLE 18

GENERAL OPERATING COST SUMMARY
(Common for all Flow Rates and Pipe Size)
(in $1,000's)

Car and truck operating	32
Communication	24
Contract services	60
Aerial inspection	15
Insurance and taxes, capital*	496
Light and water	20
Operating supply	35
Mobile Radio	20
Convention-Training	20
Miscellaneous	40
Pipeline Repair and Maintenance $\frac{1}{4}$% of capital	145
Meters	25
Electrical	25
Storage	30
Other	30
Travel and living	20
General and administration	150
	1,187

*For 750 MB/D 30" case, taxes at $\frac{1}{2}$% of capital costs.

TABLE 19

TOTAL OPERATING COST SUMMARY
(in $1,000's)

	Flow M B/D						
	250	500	750	1,000	1,250	1,500	1,750
26" Pipeline:							
General	1,190	1,190	1,190				
Power	480	2,736	7,680				
Repair and maintenance	30	171	480				
	1,700	4,100	9,350				
30" Pipeline:							
General	1,190	1,190	1,190	1,190	1,190		
Power	336	1,440	3,888	8,204	14,112		
Repair and maintenance	21	90	243	513	882		
	1,550	2,720	5,320	9,910	16,180		
36" Pipeline:							
General	1,190	1,190	1,190	1,190	1,190	1,190	
Power	192	768	1,872	3,840	6,480	10,750	
Repair and maintenance	12	48	117	240	405	670	
	1,390	2,010	3,180	5,270	8,080	12,610	
48" Pipeline:							
General	1,190	1,190	1,190	1,190	1,190	1,190	1,190
Power	120	360	744	1,344	2,160	3,310	4,820
Repair and maintenance	8	23	47	84	135	210	300
	1,320	1,570	1,980	2,620	3,490	4,710	6,310

TABLE 20

HORSEPOWER CALCULATIONS

	Flow M B/D						
	250	500	750	1,000	1,250	1,500	1,750
26" Pipeline:							
Pressure drop/mile	5.3	18	36.5				
Pressure	1,938	5,469	10,612				
Number of stations	2	6	10				
Station horsepower	5,000	9,500	16,000				
30" Pipeline:							
Pressure drop/mile	2.7	8.7	17.5	28.5	40.5		
Pressure	1,215	2,883	5,330	8,388	11,724		
Number of stations	2	3	6	9	12		
Station horsepower	3,500	10,000	13,500	19,000	24,500		
36" Pipeline:							
Pressure drop/mile	1.15	3.75	7.6	12.5	17.4	25.0	
Pressure	784	1,508	2,577	3,940	5,302	7,415	
Number of stations	1	2	3	4	6	8	
Station horsepower	4,000	8,000	13,000	20,000	22,500	28,000	
48" Pipeline:							
Pressure drop/mile	0.1	1.0	1.95	3.25	4.8	6.5	8.6
Pressure	492	743	1,007	1,368	1,799	2,272	2,856
Number of stations	1	1	1	2	2	3	3
Station horsepower	2,500	7,500	15,500	14,000	22,500	23,000	33,500

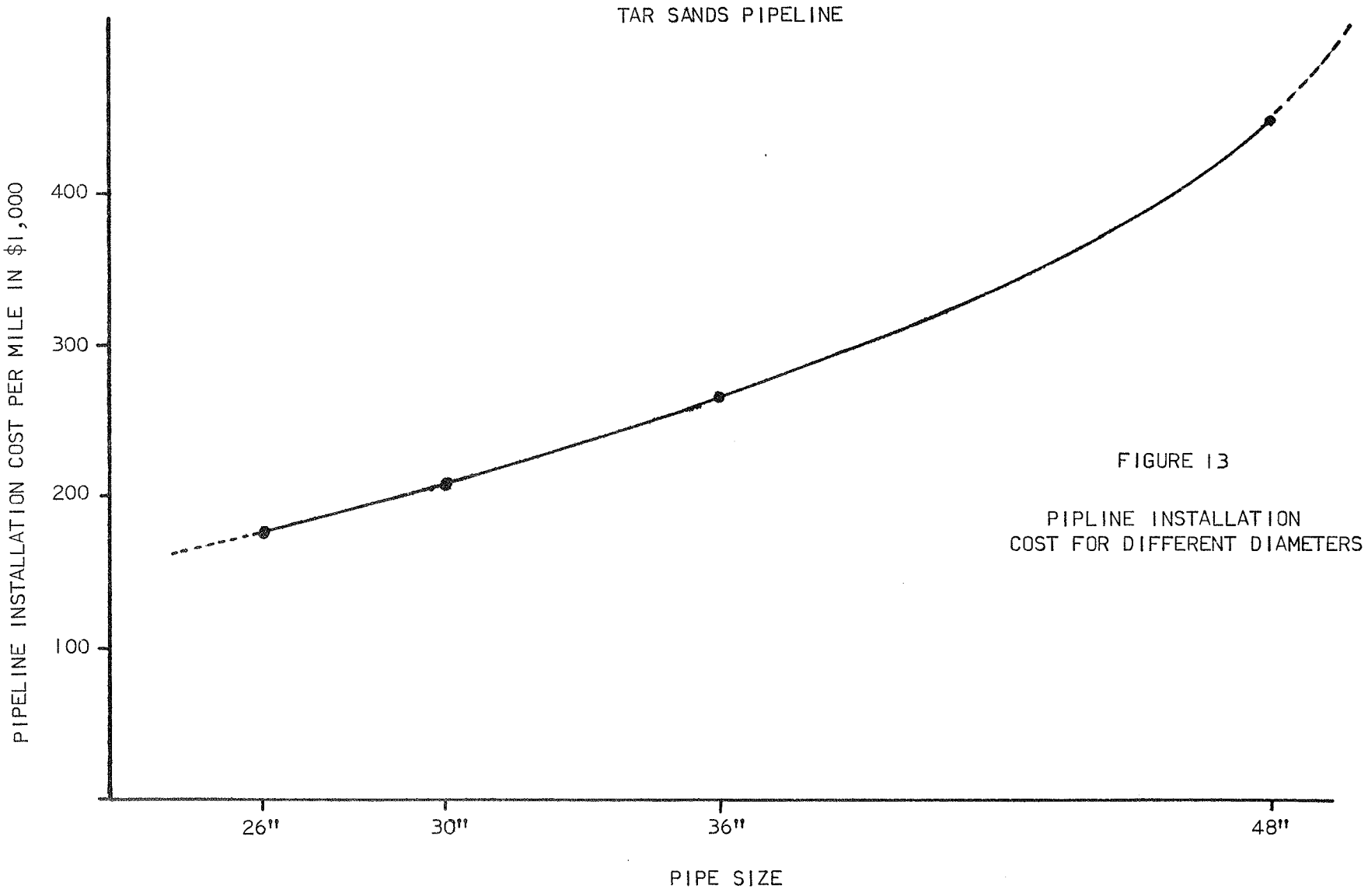


FIGURE 13

PIPLINE INSTALLATION
COST FOR DIFFERENT DIAMETERS

FIGURE 14

TAR SANDS COST OF SERVICE

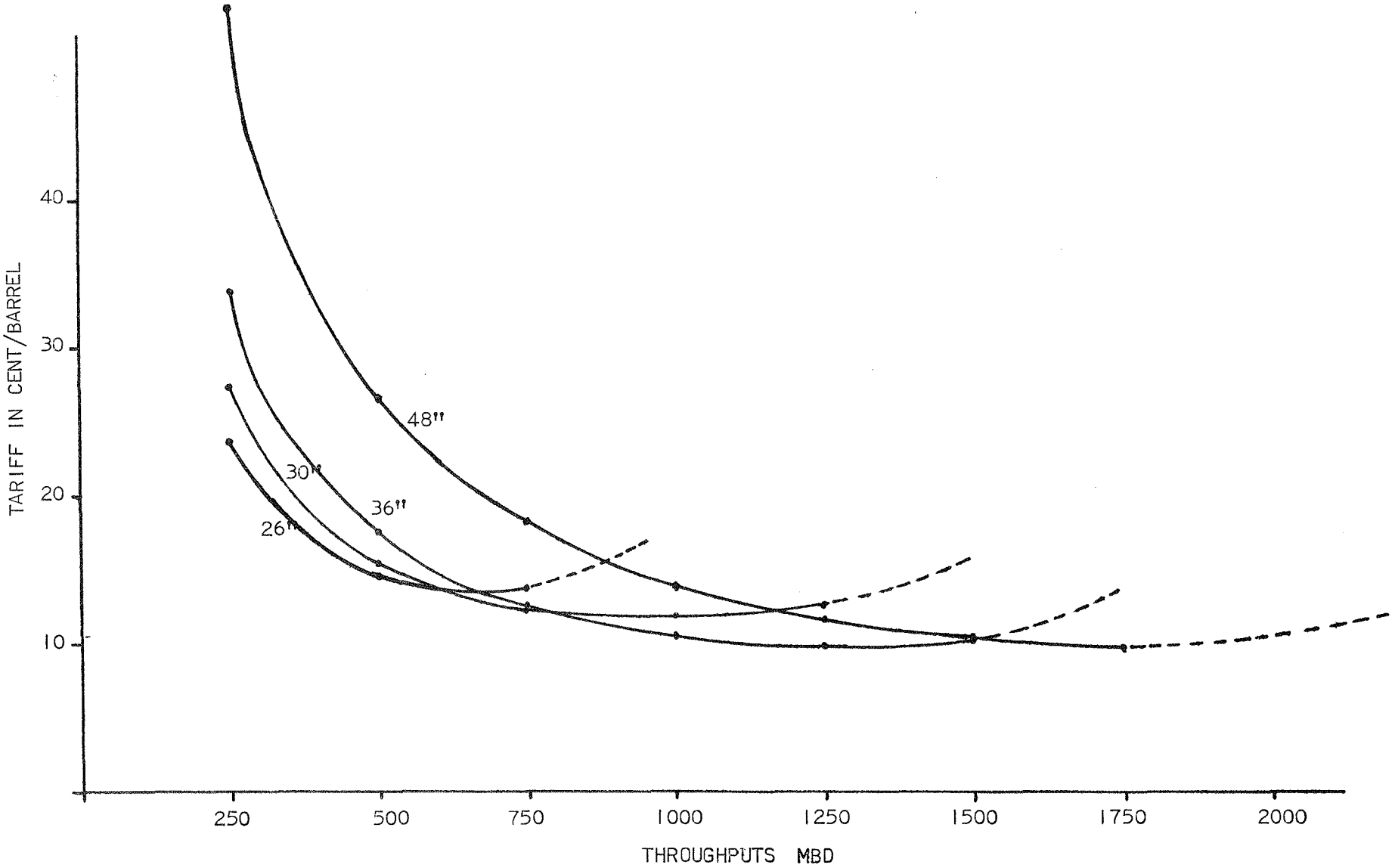
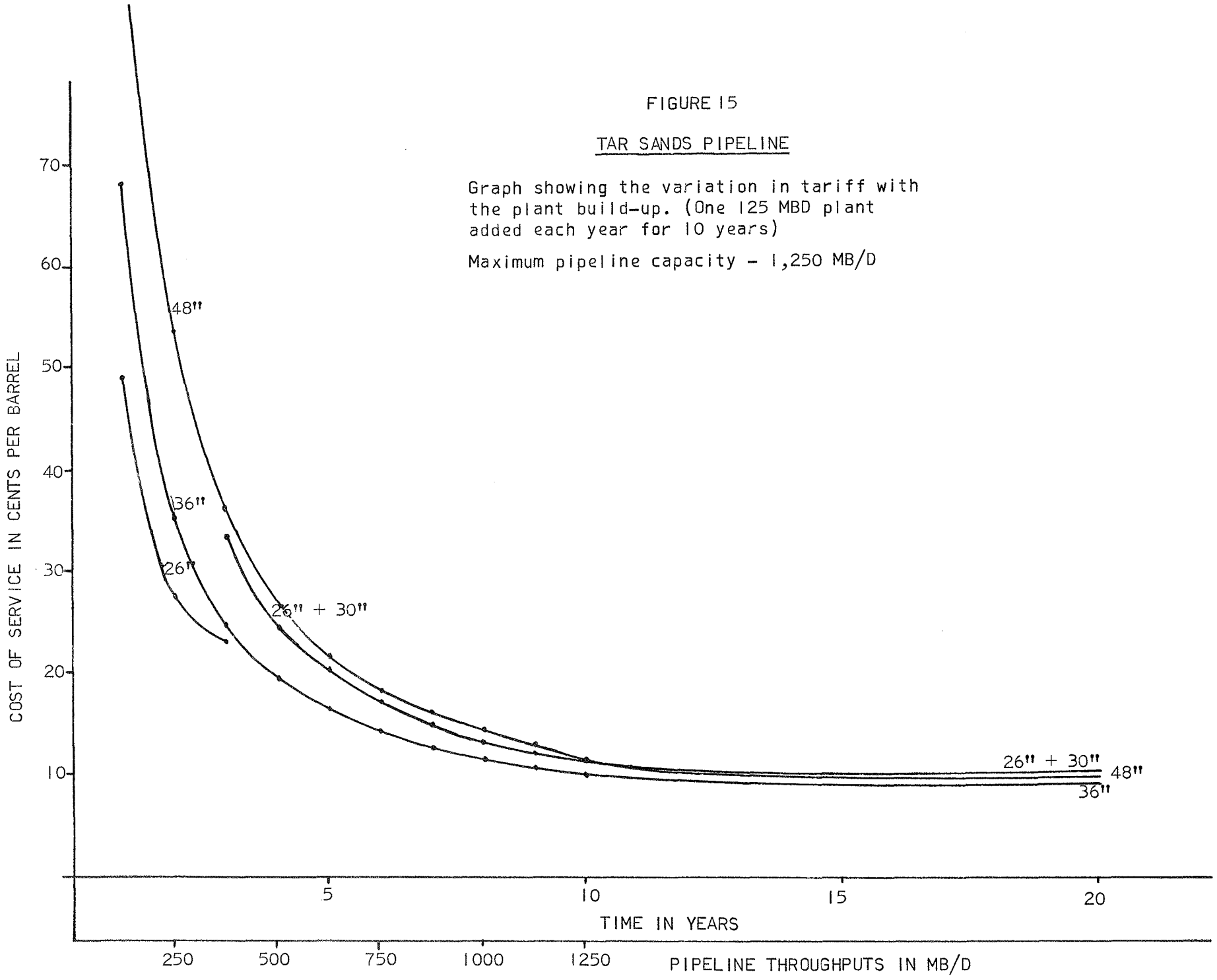


FIGURE 15

TAR SANDS PIPELINE

Graph showing the variation in tariff with the plant build-up. (One 125 MBD plant added each year for 10 years)

Maximum pipeline capacity - 1,250 MB/D



HIGHWAY COSTS

Estimated costs of an *RAU236 Highway, through crown land on a per mile basis.

Cost of Right-of-Way	36 acres at $100/acre	$ 3,600
Clearing & Grubbing(average)	36 acres at $300	11,000
Stripping & Grading	80,000 cu.yds. at $0.50	40,000
Drainage & Culverts		5,000
Fencing	2 miles per mile of road at $1,200	2,400
Replace top soil & seeding		3,000
Full depth pavement soil cement plus 2" pavement		85,000
	Total	$150,000
	Engineering & Supervising	15,000
		$165,000
	Contingency at 10%	17,000
		$182,000

Cost of major bridges - $40.00 per square foot.

Overpasses where required are currently costing from $25.00 to $35.00 per square foot - from $250,000 to $400,000.

Estimated cost of 4-lane divided highway with median strip and with full underdrainage - $400,000 per mile.

* RAU236 Highway is a two 12 foot lane highway with 6 foot paved shoulders.

TABLE 21

1973 SURFACING - APPROXIMATE COST PER SQUARE YARD-INCH - (Contract, Materials, Engineering)

HAUL MILES	1/2" SEAL COAT	1" PLANT MIX	1" No.1 M.C.	1" No.1 W.B.	1" No.2 W.B.	SUB-GRADE PREP.	ASPH. SPRAY COATS	1" SOIL-CEMENT	1" No.2 CEMENT TREAT.
0.00	$3,500.00	$0.38	$0.32	$0.15	$0.13	$0.15	$0.03	$0.27	$0.30
5.00	per	0.40	0.34	0.17	0.15			0.29	0.32
10.00	Mile	0.42	0.36	0.19	0.17			0.31	0.34
15.00	24'	0.44	0.38	0.21	0.19			0.33	0.36
20.00	Wide	0.46	0.40	0.23	0.21			0.35	0.38
25.00		0.48	0.42	0.25	0.23			0.37	0.40
30.00		0.50	0.44	0.27	0.25			0.39	0.42
35.00		0.52	0.46	0.29	0.27			0.41	0.44

SQUARE YARDS PER MILE

12' Top Width 7,040	32' Top Width 18,773
16' Top Width 9,387	36' Top Width 21,120
20' Top Width 11,733	40' Top Width 23,467
24' Top Width 14,080	44' Top Width 25,813
28' Top Width 16,427	48' Top Width 28,160

TABLE 22

HIGHWAYS – APPROXIMATE PRICES FOR ESTIMATING 1973-1974

Contract Items	Est. Unit Price
Overburden Removal (Sand & Gravel Pits)	$ 0.30 per Cu. Yd.
Excavation & Backfill	1.00 per Cu. Yd.
Haul of Unsuitable – B.L.F.	0.44 per Cu. Yd.
– Road Haul	0.20 per Cu. Yd. Mi.
Pit Run Fill	0.50 per Cu. Yd.
Preparing Subgrade – Top Layer	0.10 per Sq. Yd.
– 2nd Layer	0.17 per Sq. Yd.
Des. No. 2 Material	1.80 per Ton (Less $0.20 for Ready Cr.)
Des. No. 2 Material – Crush to S.P.	0.80 per Ton
Des. No. 1 Material	2.10 per Ton (Less $0.30 for Ready Cr.)
Des. No. 1 Material – Crush to S.P.	1.00 per Ton
Soil-Cement Material	2.30 per Ton
Cement Stab. Gravel Base	2.80 per Ton
Mixing Binder (at 2" thick)	0.12 per Sq. Yd.
Plant Mix Material	4.50 per Ton (Less $0.30 for Ready Cr.)
Gravel Surfacing (Haul Rds., etc.)	1.00 per Ton
Spray Coats (Prime, Seal, Tack, Fog)	0.01 per Sq. Yd.
Seal Coat Chips – Crush to S.P.	6.50 per Cu. Yd.
Asphaltic Curb and/or Drainage Curb	1.00 per Lin. Ft.

TABLE 22 (CONTINUED)

Contract Items (continued)		Est. Unit Price
Asphaltic Flume		$ 4.00 per Lin. Ft.
Outlet Drain Pipes		5.00 per Lin. Ft.
Solid Concrete Median (on structure)		10.00 per Lin. Ft.
Concrete Curb (for Raised Medians)		3.00 per Lin. Ft.
Median Fill		3.00 per Ton
Median Surfacing		6.00 per Ton
Reinforcing Steel (Installation)		0.10 per Lb.
Haul: C.Y.M.	– Basic Load Factor	0.44 per Cu. Yd.
	– Road Haul	0.11 per C.Y.M.
T.M.	– Basic Load Factor	0.32 per Ton
	– Road Haul	0.08 per T.M.
Materials		
Asphalt (Min. at Cal., Edmt'n.,Lloyd.)	RC	0.20 per Gal plus haul cost
	MC	0.19 per Gal plus haul cost
	AC	0.18 per Gal plus haul cost
Portland Cement (Min. at Exchaw,Edmt'n.)		30.00 per Ton plus haul cost
Gravel and Sand		0.10 per Cu. Yd. (Royalty)
Down Drain Pipe		3.00 per Lin. Ft.
Reinforcing Steel		0.10 per Lb.
Engineering – Approximate		7–10% of Contract

RAILWAY COSTS

The following costs are estimates only and are based on past and present costs. They are not intended for use as estimates of future costs which are escalating rapidly.

	Per Mile Costs
Rights-of-way 12 acres at $300.00/acre	$ 3,600
Clearing 12 acres at $700.00/acre	8,400
Grading 35,000 cu.yds. at $1.00/cu. yd.	35,000
Bridges & drainage structures	55,000
Laying of 100 lb. steel (used)	55,000
New ties 3000 at $8.00	24,000
Ballast 5000 cu.yds at $5.00/cu.yd.	25,000
Labor	10,000
Engineering Surveys Supervision	4,000
Total	$220,000

A glance at the map shows that the Northern Alberta Railway and Highway 63 follow roughly parallel routes some 30 to 40 miles apart from the Lac La Biche area to Anzac, where they begin to converge on Fort McMurray.

The point, where the four facilities being studied are all together, is at the town of Boyle. If it were considered advisable to reroute the railroad to bring it into a common corridor with the other facilities, then the probable length of new railroad required would be in the order of 180 miles. This distance is based on the assumption that the revision to the railroad would go from Boyle to Anzac with the railroad being in the common corridor to a point some six to seven miles west of Gregoire Lake.

If we use the above estimated costs per mile, this revision would cost 180 x $220,000.00 = $39,600,000.00, say $40,000,000.00.

CHAPTER 7

INTER-PARTY RESPONSIBILITIES IN UTILITY CORRIDOR

Prepared for:

Alberta Environment
The Honourable
William Yurko

December, 1973

By:

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CHAPTER 7

INTER-PARTY RESPONSIBILITIES IN UTILITY CORRIDOR

NOTES

INTRODUCTION

In the context of establishing a corridor, the "intermediate" problem has to do with the interaction of corridor occupants vis-a-vis each other; the interaction of corridor occupants vis-a-vis financial institutions; the interaction of corridor occupants vis-a-vis insurance companies; and the interaction of the Corridor Condominium Corporation, et al, vis-a-vis the public at large.

To this end, it was deemed expedient as the legal advisors to the corridor study group to do a brief survey of financial and insurance institutions which would likely be involved in any corridor project. Attached hereto and marked Schedule "A" is a typical questionnaire sent to the financial institutions. Attached hereto and marked Schedule "B" is a typical questionnaire sent to the insurance companies.

NOTES

The results of the foregoing questionnaire have been analysed herein, and throughout display what might be termed a cavalier attitude to the condominium concept of corridor occupancy both vis-a-vis financing and insurable liabilities.

From an informal canvas of two major pipelining companies involved, voluntarily, with the corridor study group, the results could have been predicted. It appears in fact that as between the pipelining companies and their financiers, the major criteria in obtaining monies or pipeline financing is "throughput". Consequentially, the form of land occupancy, be it within or without a corridor, is of little significance except to the solicitors who are ultimately left with the duty of obtaining from the pipelining company some form of security upon which the financial institution could rely upon, if in fact the pipelining corporation went bankrupt.

Needless to say, bankruptcies are uncommon in the area of pipelining, and the practice, though certainly unintended, is that less than adequate security has in fact been approved from time to time by financial institutions, presumably because the desirability of making large loans for pipelining purposes supercedes the legal technicalities necessary to obtain complete security as against the pipeline itself.

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CORRIDOR OCCUPANTS VIS-A-VIS CORRIDOR OCCUPANTS

A. THE CONDOMINIUM CONCEPT APPLIED

It has been suggested in Part I of the Report of the Legal Discipline of the Corridor Study Group that an alternative to the "ordinary" framework of corridor occupancy is the Condominium Concept. The Condominium Concept brings to the corridor certain alterations of basic legal premises which are, in the opinion of the authors herein, unique.

The Condominium Concept, as applied to a utility corridor, would give each occupant of the corridor a condominium title as opposed to an easement or other interest. All other property in the corridor including surface would ordinarily be owned by the condominium corporation, which would, in addition to having title to the aforesaid common property, operate as the authority and administrator of the utility corridor.

Like any corporation it would be personified by a Board of Directors elected and appointed by the corridor condominium title holders and (the Department of the Environment)*.

In the condominium structure the condominium title holder will have a responsibility to his fellow

* The Department's participation would be achieved through new legislation.

NOTES

condominium title holders, as well as to the condominium corporation at large. Reciprocally, he will thereby be the beneficiary of the responsibilities which befall the other individual condominium title holders and the condominium corporation. Primarily, the addition of the condominium corporation adds a party to whom responsibility is required. This may seem to be an unnecessary complexity. However, the authors believe this complexity to be justifiable in order that the control, administration and operation of the utility corridor be lodged in one legally personified body, the condominium corporation.

NOTES

B. INTER-CORRIDOR LIABILITY

As between occupants of the corridor it is suggested, that the basic common law position should be maintained. Occupants would then be liable to other occupants for their negligence, breaches of contract, and breaches of their duties as occupants of land. Although these "common-law" remedies are often difficult to apply, we are loath to suggest that rules created through centuries of human experience should be cast aside.

The following material is not and does not purport to be a detailed analysis of the common law of torts* These principles are well known to those versed in the field of law. This brief explanation then is designed to provide some insight for those not so trained so that the necessary policy decisions can be made more astutely.

(1) Negligence

If the general Law of Negligence applied, it would follow then that occupants would be liable for damages caused through negligence. In the terminology of the now famous case of Donahue (McAllister) v. Stevenson: House of Lords (1932) A.C. 562, the

* The body of law dealing with duty, breach thereof and remedies for breach.

NOTES

corridor occupant "must take reasonable care to avoid acts or omissions which (he) could reasonabley foresee would be likely to injure (his) neighbour".

Thus if an "accident" occurred which contained these ingredients:-

> "(a) A legal duty on the part of "A" towards "B" to exercise care ....
>
> (b) Breach of that duty,
>
> (c) Consequential damage to 'B'".
> (Winfield on Tort, 8th Edition, p.42)

"A" would, in law, be responsible to "B" for his damages.

Without detailing the millenium of cases which have refined and applied these principles it seems clear that the common law of negligence provides adequate safeguards for various industrial accidents that could occur and be magnified by the proximity of different utilities.

(2) Occupiers Liability

At common law the occupant of land owes a duty to persons entering upon his land to insure

NOTES

that the condition of the premises is not dangerous. The duties of the occupier however, are cast in a descending scale for different types of persons entering upon the land.

For those persons invited upon the land for business which concerns the occupier it is settled law ...

> "that he (the invited) using reasonable care on his part for his own saftey, is entitled to expect that the occupier shall on his part use reasonable care to prevent damage from unusual danger which he knows or ought to know and that there was evidence of neglect".
>
> (Winfield on Tort) 8th Ed.p.171.

For those persons who enter land with implied permission, for their own purposes and not for the occupants business purposes;

> "The occupant must warn a licensee of any concealed danger (or trap) of which the occupier knows".

For those persons who entered as trespassers the Law is in a confused state but the traditional rule was enunciated in Robert Addie & Sons (Collieries) Ltd. vs. Dumbreck (1929) A.C. 358 to be:-

> "towards a trespasser the occupier owes no duty to take reasonable care for his protection or even protect him from concealed danger. The trespasser comes onto the premises at his own risk. An occupier is in such a case liable only where injury is due

NOTES

> to some willful act involving something more than the absence of reasonable care. There must be some act done with the deliberate intention of doing harm to the trespasser, or at least some act done with reckless disregard of the presence of the trespasser".

However this area of law would be of little consequence to corridor occupants, since they would all have rights vis-a-vis the "common property", and could trespass only upon another condominium owners property. In the latter case the consequences of the trespass could be determined by an administrative body rather than the courts*.

(3) Rylands v. Fletcher

As a corollary to these two doctrines the "rule in Rylands v. Fletcher" (1868) 3 H.L. 330, could provide additional protection. In this case, water had escaped from the A's land and caused damages to B's mine shafts. No negligence was involved. Blackburn, J. delivered the classical exposition of the doctrine.

"... the person who for his own purposes

* See page 140 ante.

> brings on his lands and collects and keeps there anything likely to do mischief if it escapes, must keep it at his peril, and, if he does not do so, is primia facie answerable for all the damage which is the natural consequence of its escape".
>
> (1866) L.R. 1 Ex. 265, 279-280).

Viscount Simon refined this rule by stating that it was conditioned by two elements.

(a) "the condition of the 'escape' from land of something likely to do mischief if it escapes".

(b) "the use of the land must be 'a non-natural' use".
(Midwood & Co. Ltd. v. Manchester Corp. (1905) 2 K.B. 597.

Since this doctrine has been applied to escaping gas, oil, noxious fumes, electricity, and explosions it seems clear that it could provide protection in the corridor context.

See: Butcheller v. Tunbridge Wells (1901) 84 L.T. 765.
Smith v. G.W. Ry (1926) 135 L.T. 112.
Miles v. Forest Rock (1918) 34 T.L.R. 500.
Rainham Chemicals v. Belvedere (1921) 2 A.C. 465.
West v. Bristol Tramways (1908) 2 K.B. 14.

These three doctrines coupled with the law of contracts then provides a multiplicity of remedies which could be invaluable when applied to a transporation corridor. It is suggested that it would

be imprudent to attempt to crystallize these rights in statutes -- as the enuciation of some rights could have the effect of negating others.

This dissertation on occupiers liability must be kept in context. It concerns and deals with the duties of occupants (condominium owners) vis-a-vis each other and vis-a-vis third parties ONLY. The authors have not attempted to explore the area of third party duties owed to occupants, which is an area of law beyond the scope of this report.

C. INTER-CORRIDOR LIABILITY - OCCUPANTS/ CONDOMINIUM CORPORATION

The Condominium Corporation is, by statute, a legally constituted body. It would have the same rights and privileges, against condominium owners as would any "neighbour". It's liabilities, on the other hand, would be, minimal vis-a-vis these owners.

Conversely each occupant/owner would have an additional duty to the condominium corporation necessitated by it's very existance. However, since each condominium owner has, incidental to his condominium title a fractional interest in the "common area" owned by the Condominium Corporation he would

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of necessity have a practical interest in refraining, from injuring or damaging his own interest.

The condominium owner is entitled by law to use the common areas of a condominium, in accordance with the By-Laws or Rules of the Condominium. He would, therefore, never be a trespasser, yet would have to observe these additional statutorily authorized By-Laws, at the risk of suffering legal consequences.

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(1) The Need For an Administrative Tribunal

The obvious question at this juncture is -- who is to decide the rights and liabilities of the corridor occupants when disputes arise?

Recourse to the traditional Court structure produces several complaints:

(a) the process is slow;

(b) the process is costly;

(c) the Courts would lack expertise in the utilities field.

It is suggested then that it may be useful to create an independant tribunal which would have the administrative duty of settling disputes and making awards for and against the occupants. Appeals from this Board would lie to the Appellate Division of the Supreme Court of Alberta against errors in law and questions as to jurisdiction. No appeal would lie where the occupant disputed the manner in which the Board exercised its jurisdiction.*

* An appeal would lie if the Board acting judicially did not observe the rules of natural justice.

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D. THE SURVEY

As previously mentioned, to obtain opinions of possible participants in the corridor project, surveys were drafted and submitted to various financial institutions and insurance companies. Our major concern was to insure that the occupants "interest in land" was sufficient to satisfy the requirements of both financiers and insurance companies.

One survey was submitted to the following insurance companies;

(1) Confederation Life Insurance Co.
(2) Montreal Life Insurance Co.
(3) Canadian Premier Life Insurance.
(4) Lloyds Underwriters Non-Marine Association.

The other survey was submitted to the following financial institutions;

(1) The Bank of Commerce.
(2) The Bank of Montreal.
(3) The Bank of Nova Scotia.
(4) The Toronto Dominion Bank.
(5) Wood - Gundy.

75%*of the Insurance Companies responded while 100% of the Financiers submitted their answers.

* 100% response obtained after this report completed.

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(1) Qualifications of the Survey

(i) Although at first glance, the nominal numbers of enquiries suggests that the responses may not be representative; it is suggested that since few institutions have the size to participate in a project of this magnitude, the field has been reasonably canvassed.

(ii) One of the inherant irretractable problems in drafting this survey was that the financial and insurance institutions could not provide concrete answers without having detailed information as to the participants, their corporate structure, their financial status, the governing corridor legislation, the actual distances between utilities and other diverse factors. In turn this information could not be produced until the corridor project was in its final stages of development. Therefore many responses are qualified responses and thus difficult to interpret.

(iii) The differences in terminology in the practise of law, the financial sector, and the insurance sector, also created problems. Conclusions reached from this survey are subject then to question.

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Was the response an answer to the question we intended to ask?

(2) Advantages

(i) It should be noted that the comments and reservations expressed in the responses indicates that the questionnaire was answered thoughtfully. Therefore the problem in assessing what percentile of responses were made "in gest" or without consideration would not appear to be a problem for the interpreter.

(ii) All respondents were persons of above average intelligence in responsible positions with an expertise in the field of enquiry, therefore, it can be presumed that the questionnaire was basically understood and considerable expertise is inherant in the answers.

NOTES

E. RELATIONSHIP - CONDOMINIUM OWNERS VIS-A-VIS FINANCIAL INSTITUTIONS

ANALYSIS

(1) Responses from Financial Institutions

(a) Introduction

All those who responded had been involved in the financing of pipelines and power lines. Only two of those surveyed had financed Microwave construction. Further, the respondents showed that all institutions were very interested in having the opportunity to finance this project.

It seems clear from the survey then, that all were experienced and enthusiastic.

(b) Interest in Land

Survey Questions

1. Should the utility's interest in land consist solely of a tenancy for 100 years, would this cause the application to be refused?

2. Should the utility's interest in land consist solely of a tenancy for 50 years, would this cause the application to be refused?

3. Should the utility's interest in land consist solely of a tenancy from year to year, would this cause the application to be refused?

All the responses showed that a tenancy for a 100 years or a tenancy for 50 years would not cause the application for financing to be refused.

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The responses as to whether a tenancy from year to year would be sufficient were mixed and difficult to interpret. 25% were unable to answer the question without the detailed knowledge inherant in a specific application. 25% suggested the application would probably be refused. 25% suggested that this negative factor could be offset by positive factors in other areas to be assessed. 25% stated that as a minimum requirement the interest in land should last for a period at least equal to the senior debt.

It is suggested that the variance in responses and the qualifications included mean that a year to year tenancy would be undesirable or insufficient.

(c) Easements

Survey Questions

Should the utility's interest in land consist solely of:

(a) an easement in a distinct parcel of land containing the utility,

would this cause the application to be refused?

75% of those surveyed were of the opinion that an easement would provide a sufficient interest in land if all other factors were satisfactory. One party stated that the easement would have to exist

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for at least as long as the senior debt.

All the participants expressed the opinion that if an easement was coupled with a right of way -- or -- an easement was coupled with a common interest in the property of the corridor that that would be sufficient. (Presumably those parties which expressed a desire for the easement to last the life of the senior debt would add that qualification here also).

Survey Questions:

Should the utility's interest in land consist of:

a) an easement in a distinct parcel of land containing the utility, and

b) a common interest in the common property of the corridor, and

c) a) and b) being subject to an over-riding common interest in all corridor property being held by the Government of Alberta,

would this cause the application to be refused?

With the exception of one participant who did not understand this question -- the responses were that these interests would be satisfactory.

(d) Condominium Interests

Survey Question:

Should the utility's interest in land consist solely of a "condominium property interest", would this cause the application to be refused?

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The responses to this question were varied and thus difficult to analyze. 50% stated that the "condominium interest" in land would be acceptable where as 25% stated that if the applicant had a "condominium type" interest his request for finances could hinge on the viability of the other participants in the corridor.

(e) Transferability

Survey Questions:

1. How much importance is placed on the fact that the borrower can transfer his interest in land to the lender?

   a) it is not important

   b) it is important

   c) it is very important

2. Assuming in all other respects the applicant has satisfied your requirements: Should the utility's interest in land consist solely of a tenancy for 100 years, would this cause the application to be refused:

   a) if that interest was transferable?

   b) if that interest was not transferable?

3. Should the utility's interest in land consist solely of a tenancy for 50 years, would this cause the application to be refused:

   a) if that interest was transferable?

   b) if that interest was not transferable?

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All companies responding indicated that the right of a corridor occupant to assign his interest to a third party was important. However, companies were equivocal in determining whether a non-transferable interest would result in a refusal to finance.

In the case of non-transferability, the term of the interest was deemed unimportant. Provided that the interest was transferable it was clear that whatever the interest, it ought to be at least equal in duration to the "senior debt".

CONCLUSIONS

(1) The condominium concept provides a form of interest, which, being unlimited in term, and transferable, meets the basic requirements of financial institutions.

   (a) Condominium title provides each owner occupant with a registered legal title, against which financial institutions could themselves register documents of security.

   (b) The condominium title, in the event of default, can be foreclosed.

   (c) Condominium title can be transferred either voluntarily or by operation of law.

(2) Additionally, the authors feel that the condominium concept would promote multiple and independant participation of several separate financial institutions, thereby reducing the necessity of a "super" financial capacity of a single company or corporate group.

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F. RELATIONSHIP - CONDOMINIUM OWNERS VIS-A-VIS INSURANCE INSTITUTIONS

(a) Introduction

The survey here was small. It was deemed that the number of Canadian companies large enough to insure a project of this magnitude without collaboration was limited. However, the response appears to be of some significance. (Also see conclusions).

(b) Analysis

The insurance companies appear totally unconcerned as to whether the utilities interest is a tenancy, easement, or "condominium interest". Furthur, they do not appear concerned as to the duration of these various types of interests in land.

They consider the proximity of utilities to be of great importance as the risk and corresponding premiums would increase as the distance was reduced.

However, the existing statutory requirements for the minimum distances between utilities would appear to conform to Insurance Company policy. Therefore legislative change here would appear unnecessary, unless it were otherwise advisable to reduce distance requirements between utilities.

Finally, one company expressed concern with the

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entire concept. In their opinion the proximity of all utilities within a single corridor could produce a situation conducive to catastrophe. That is, a pipeline explosion could destroy or damage all the utilities in the corridor -- as well as injure third parties.

CONCLUSIONS

(1) The condominium concept causes no problems in respect of insurability.

(2) The corridor concept, that is, the location of several utilities in close proximity to each other, does cause some definite problems in respect of insurability.

(3) The problem of insurability would undoubtedly be reflected in increased premiums.

(4) The condominium concept, does impose an additional necessity, on the condominium corporation, in that, it will have to obtain "a blanket policy" to protect itself. An overlap of insurance results, which overlap is provided for in present condominium legislation.

(5) The condominium concept will permit, as with financing, multiple participation by insurers; the risk will therefore be potentially distributed.

(6) The condominium concept also gives rise to the possibility of individual "no-fault" insurance.

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CONCLUSIONS

1. The authors in preparation of this interim report and the preparation and distribution of the original survey have considered other formulas for utility integration between the two "designated" termini. These are listed below in order ranging from minimal corridor control to maximum corridor control.

(a) Government Zoning

The Government zones a strip of land between the termini as corridor land and merely requires that all utilities place their inter-termini facilities within the zoning area.

(b) Government or Private Ownership of "Corridor"

The Government and Crown Corporation or a private corporation or syndicate leases, eases or purchases outright the designated corridor area and in turn leases, eases or licenses use of segments of the corridor to participants.

(c) Condominium Concept

Government, Crown Corporation, private corporation or syndicate, purchases the designated corridor in fee simple. The owner, then sub-divides the

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corridor as required and causes a registered condominium plan of sub-division to be registered. The owner then sells individual condominium titles to participant utilities.

In doing the research and attempting to mentally work through each type of possible participation the authors chose, as the most viable, the condominium concept. It yeilds up, in the opinion of the authors, the maximum control of the corridor with the utmost of legal autonomy for the individual "occupier/ participant".

SCHEDULE "A"

SURVEY - FINANCIAL INSTITUTIONS

Re: The Alberta Transportation Corridor

Preamble

As this questionnaire is not intended to be a "behavior study" but rather a general survey for preliminary purposes, we have provided space for additional comments or qualifying statements.

Purposes of the Survey

This survey was created in an attempt to obtain various views on two problems:

a) What interest or estate in land is sufficient to provide sufficient security for the lender;

b) Will the construction of a utility within close proximity to other utilities present any peculiar problems in obtaining finances?

General Information

Since this will be the first corridor in Alberta, the inter-relationship between the Government sector and private participants is undecided. One possibility is that the various interests in land be analogous to that of condominium property holders. That is, the Government would have a continuous common interest in the entire corridor; the various utilities would have:

a) a common interest in the common property within the corridor;

b) an interest in the specific area containing their utility.

Briefly, the rationale for utilizing this type of structure rather than accepted forms is this:

The Provincial Government would have an interest in the whole corridor and thus could insure that it is developed in accordance with "public policy". At the same time, the various private utilities would have a separate distinct interest in land.

It is to be emphasized that this proposal is only one of several and is not Government policy. Our hope at this time is to obtain your initial (general) reactions to such a scheme.

QUESTIONNAIRE

A. (1) Has your institution previously financed the construction of any of the following utilities?

- pipelines yes _____ no _____
- microwave lines yes _____ no _____
- power lines yes _____ no _____

Comments _____

_____

(2) Assuming a corporation wished to construct a utility from Fort McMurray, Alberta to Edmonton, Alberta, would your institution be interested in considering the* application if it involved construction of:

- a pipeline yes _____ no _____
- a microwave line yes _____ no _____
- a power line yes _____ no _____

Comments _____

_____

_____

* "Application" herein and hereafter means "an application for financing".

B. ASSUME: THAT IN ALL OTHER RESPECTS THE APPLICANT HAS SATISFIED YOUR REQUIREMENTS:

1. Should the utility's interest in land consist solely of a tenancy for 100 years, would this cause the application to be refused?

yes _____ no _____

Comments: _____

_____

_____

_____

2. Should the utility's interest in land consist solely of a tenancy for 50 years, would this cause the application to be refused?

yes _____ no _____

Comments: _____

_____

_____

_____

3. Should the utility's interest in land consist solely of a tenancy from year to year, would this cause the application to be refused?

yes _____ no _____

Comments: _____

_____

_____

_____

4. Should the utility's interest in land consist solely of:

a) an easement in a distinct parcel of land containing the utility,

would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

5. Should the utility's interest in land consist solely of:

a) an easement in a distinct parcel of land containing the utility and

b) a right-of-way over adjacent utilities within the corridor,

would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

6. Should the utility's interest in land consist solely of:

a) an easement in a distinct parcel of land containing the utility and

b) a common interest in the common property of the corridor,

would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

7. Should the utility's interest in land consist of:

a) an easement in a distinct parcel of land containing the utility, and

b) a common interest in the common property of the corridor, and

c) a) and b) being subject to an over-riding common interest in all corridor property being held by the Government of Alberta,

would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

8. Should the utility's interest in land consist solely of a "condominium property interest", would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

C. HOW MUCH IMPORTANCE IS PLACED ON THE FACT THAT THE BORROWER CAN TRANSFER HIS INTEREST IN LAND TO THE LENDER?

1. a) it is not important _____

b) it is important _____

c) it is very important _____

Comments: _____

_____

ASSUMING IN ALL OTHER RESPECTS THE APPLICANT HAS SATISFIED YOUR REQUIREMENTS:

1. Should the utility's interest in land consist solely of a tenancy for 100 years, would this cause the application to be refused:

a) if that interest was transferable?

yes _____ no _____

b) if that interest was not transferable?

yes _____ no _____

Comments: _____

2. Should the utility's interest in land consist solely of a tenancy for 50 years, would this cause the application to be refused:

a) if that interest was transferable?

yes _____ no _____

b) if that interest was not transferable?

yes _____ no _____

Comments: _____

SCHEDULE "B"

SURVEY - INSURANCE COMPANIES

Re: The Alberta Transportation Corridor

Preamble

As this questionnaire is not intended to be a "behaviour study" but rather a general survey for preliminary purposes, we have provided space for additional comments or qualifying statements.

Purposes of the Survey

This survey was created in an attempt to obtain various views of insurance companies on the insurance problems which could occur in insuring utilities within a transportation corridor.

a) What interest or estate in land is sufficient to provide an "insurable interest"?

b) Will the construction of utilities within close proximity to other utilities present any peculiar problems in obtaining adequate insurance?

General Information

Since this will be the first corridor in Alberta, the inter-relationship between the Government sector and private participants is undecided. One possibility is that the various interests in land be analogous to that of condominium property holders. That is, the Government would have a continuous common interest in the entire corridor; the various utilities would have:

a) a common interest in the common property within the corridor;

b) an interest in the specific area containing their utility.

Briefly, the rationale for utilizing this type of structure rather than accepted forms is this:

The Provincial Government would have an interest in the whole corridor and thus could insure that it is developed in accordance with "public policy". At the same time, the various private utilities would have a separate distinct interest in land.

It is to be emphasized that this proposal is only one of several and is not Government policy. Our hope at this time is to obtain your initial (general) reactions to such a scheme.

QUESTIONNAIRE

A. (1) Has your company previously insured any of the following utilities?

- pipelines yes _____ no _____
- microwave lines yes _____ no _____
- power lines yes _____ no _____

Comments: _____

_____

(2) Assuming a corporation wished to construct a utility from Fort McMurray, Alberta to Edmonton, Alberta, would your institution be interested in considering the *application if it involved construction of:

- a pipeline yes _____ no _____
- a microwave line yes _____ no _____
- a power line yes _____ no _____

Comments: _____

_____

* "Application" herein and hereafter means "an application for insurance".

(3) Assuming a corporation wished to construct a utility from Fort McMurray, Alberta to Edmonton, Alberta, would your institution be interested in considering the application if the utility was to be situated within a transportation corridor? yes _____ no _____

Comments: _____

_____

_____

_____

B. ASSUME: THAT IN ALL OTHER RESPECTS THE APPLICANT HAS SATISFIED YOUR REQUIREMENTS:

1. Should the utility's interest in land consist solely of a tenancy for 100 years, would this cause the application to be refused?

yes _____ no _____

Comments: _____

_____

_____

_____

2. Should the utility's interest in land consist solely of a tenancy for 50 years, would this cause the application to be refused?

yes _____ no _____

Comments: _____

_____

_____

_____

3. Should the utility's interest in land consist solely of a tenancy from year to year, would this cause the application to be refused?

yes _____ no _____

Comments: _____

_____

_____

_____

4. Should the utility's interest in land consist solely of:

a) an easement in a distinct parcel of land containing the utility,

would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

5. Should the utility's interest in land consist solely of:

a) an easement in a distinct parcel of land containing the utility and

b) a right-of-way over adjacent utilities within the corridor,

would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

6. Should the utility's interest in land consist solely of:

a) an easement in a distinct parcel of land containing the utility and

b) a common interest in the common property of the corridor,

would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

7. Should the utility's interest in land consist of:

a) an easement in a distinct parcel of land containing the utility, and

b) a common interest in the common property of the corridor, and

c) a) and b) being subject to an over-riding common interest in all corridor property being held by the Government of Alberta,

would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

8. Should the utility's interest in land consist solely of a "condominium property interest", would this cause the application to be refused? yes _____ no _____

Comments: _____

_____

_____

_____

C. ASSUME: THAT IN ALL OTHER RESPECTS THE APPLICANT HAS SATISFIED YOUR REQUIREMENTS:

(1) How much importance does your company place on the proximity of the applicant's utility to other utilities?

a) it is not important _____

b) it is important _____

c) it is very important _____

Comments: _____

_____

_____

_____

(2) IF question C (1) was answered as "important" or "very important", please answer the following:

a) to be in accordance with your company's policy, what is the minimum distance between a pipeline and a power line? Distance _____

Comments: _____

_____

_____

_____

b) to be in accordance with your company's policy, what is the minimum distance between a pipeline and microwave towers? Distance _____

Comments: _____

_____

_____

_____

c) to be in accordance with your company's policy, what is the minimum distance between a pipeline and second pipeline? Distance _____

Comments: _____

_____

_____

_____

d) to be in accordance with your company's policy, what is the minimum distance between a microwave tower and a powerline? Distance _____

Comments: _____

_____

_____

_____

e) if there are other structures which impose additional risks vis-a-vis a utility (houses, water lines, sewers, buildings, etc.) please list below:

	applicant utility	existing utility	minimum distance
(1)			
(2)			
(3)			
(4)			
(5)			
(6)			
(7)			
(8)			

General Comments: _____