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Prefeasibility Study Of An Oriented Strand Board Plant In The Northwest Territories

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1.0 BACKGROUND AND INTRODUCTION

The Economic Development and Tourism Branch of the Government of the Northwest Territories awarded a contract to Carroll-Hatch (International) Ltd. (CHI) to perform a prefeasibility study on the potential of an oriented strand board (OSB) production facility located within the Northwest Territories. The terms of reference from the request for proposal are included in Appendix 7 of this report. CHI retained Woodland Resource Services Ltd. (Woodland), a firm of forest resource and engineering consultants in Edmonton, Alberta who are knowledgeable of the resources in the Northwest Territories (NWT), to evaluate the potential fibre supply from the Lower Liard and to provide estimates of the Iog cost and Iogging infrastructure requirements. CHI performed a desk study of all of the remainder of this report.

Sections of the study assess the markets available for OSB, the costs of transportation from plant to market and the determination of the mill net return for the most accessible markets. The log supply and necessary logging equipment and capital costs requirements were assessed. A plant location was selected, based primarily upon the economics of transportation of the log supply and product. Capital and manufacturing costs were estimated and the plant economics developed. Pertinent miscellaneous comments are included in the last section of this report, prior to the appendices.

176 Sbm = 1 m³

2.0 CONCLUSIONS

1. The aspen timber resource in the Fort Liard FMU is by itself insufficient to support anOSB mill ofan economically viable capacity. In order to develop a viable mill, the timber resource base would have to include species other than aspen, such as white spruce and perhaps some balsam poplar.

2. The lack of an existing logging industry of adequate capacity and technical ability is a serious deficiency. To **develop** such an industry specifically for an OSB mill adds significantly to wood costs and cannot be justified for the Fort Liard region.

$246/M Fbm.

3. The estimated cost of logs delivered to the proposed mill, $43.40 per m^3, is at least 75 percent greater than the industry average for Canada. When this cost is extended on the basis of recovered volume in the finished product, it becomes unacceptably high.

4. The capital cost of a medium sized, **modern OSB mill in the Fort Liard region is well above industry** average and this factor, combined with high wood costs, operating costs and especially transportation costs for the finished product, indicate the mill **could not compete** in the market place.

5. Transportation costs of the finished panels to markets are an important consideration in locating waferboard and OSB mills and in this repect the necessity for a combined truck and railway haul from Fort Liard indicates the mill cannot compete.

6. **The market** for OSB will continue to expand over the next 10 years and mills are under construction in Alberta and B.C. to supply anticipated demand. There are several regions in which timber is available to construct other mills **if they are needed.** These mills **would have a significant cost advantage** over" any mil I in the NWT so as to bar it from Canadian and U.S. markets.

7. There are no market opportunities for OSB from Fort Liard in Canada or the U.S.A. in the near future because of probable developments in new mills and the cost factors noted previously. Markets in the NWT and Yukon are too small to support a mill.

9. A cursory estimate of the possibility of manufacturing strands at Fort Liard for sale to other mills in Alberta and B.C. indicates the cost would be prohibitive. The conversion of the wood would have to generate a profit on logs worth $43.40 per m^3 compared to $25.00 per m^3 in Alberta. Manufacturing and transportation costs would be too great, even if the other mills wanted the material.

10. The break even point for the proposed mill is $278 per m^3 with full depreciation and $256 per m^3 with partial depreciation. Considering that the estimated mill net return at Fort Liard is only $145 per m^3 and that the Canadian industry average is $200 per m^3, very large and improbable reductions in costs or increases in average selling prices must occur before the mill could be profitable. Therefore, CHI recommends the project not proceed.

3.0 MARKETS, TRANSPORTATION AND MILL NET RETURN

3.1 INTRODUCTION

Waferboard (WB) and Oriented Strand Board (OSB) are relatively recent developments in the panel product industry. Both are offshoots of the particleboard industry which had its beginning just prior to World War Il. As will be seen, the WB/OSB industry is now a serious competitor to the long established coniferous plywood industry which developed in the 19301s as a structural panel. In addition, there are several other panels which may be used in housing and general construction although not all are technically "waterproof" or "exterior grade". These have varying degrees of importance to the OSB industry.

[n this report, as in most other reports and source material, the waferboard and OSB industries are considered together, generally as waferboard. Statistical market data specifically relating to OSB is generally non-existent.

The emergence of numerous panel products made from both coniferous and deciduous timber species which have been cut or processed to veneers, flakes, particles, strands, fibres or reconstituted from by-products of wood-using industries has had a pronounced effect on the world's timber based economy. The various panels resulting from the numerous production systems, all of which apply heat and adhesives to the reconstituted wood material, frequently are interchangeable in end-use.

In order to clarify the rather confusing melange of panels for the non-familiar reader, the major panels which concern the mill under consideration for the Northwest Territories (NWT) are described in Appendix 2.

3.2 MARKETS FOR 0S6 AND CAPACITY

Because 0S6 is such a relatively new panel it is not yet a major factor in the world trade of panels. It is, however, a major factor in North America as will be shown later in this section.

To place the potential output of a mill in the Northwest Territories in perspective it is useful to consider the global production of panels as shown in Table 3.1. The upward trend in plywood and particleboard manufacture is continuing, especially in Europe where it is of major importance.

TABLE 3.1 WORLD PRODUCTION OF WOOD-BASED PANELS

(million m^3)

Product	I 950	1960	1970	I 975	1980	1982
Veneer	n/a	I .20	3.30	3.70	4.50	3.90
Plywood	6.10	I 5.30	33.20	34.30	39.20	36.90
Particleboard	0.02	3.10	19.20	30.70	41.50	38.50
Fibreboard	5.40	9.50	14.20	I 5.70	16. IO	14.90
Total	I I .52	29. IO	69.90	84.40	I 01.30	94.20

Source: FAO Yearbook of Forest Products, 1960, 1980, 1982.

Note: Particleboard generally refers to industrial particleboard with non-waterproof adh&ives but also includes waferboard and OSB.

On a geographical basis North America leads in capacity with about 35 percent of the total, followed by Europe with 32 percent, Japan and the U.S.S.R. with about 10 percent each, other Asian sources with approximately 8 percent, Latin America and others, about 5 percent.

Canada, with a total panel capacity of about 3 million m^3, is a relatively small contributor to the global supply of panels. Uniquely, however, Canada has been the leader in developing waferboard and OSB, although the United States has now far surpassed us in capacity. There are two 0S6 mills in Scotland based on coniferous species. Europe employs several types of non-structural panels in uses for which a fully structural type such as OSB is required in North America. Reference to overseas markets will be made later.

3*3 CANADIAN CAPACITY AND PRODUCTION OF OSB

The Canadian waferboard industry, began in 1962 with a mill in Hudson Bay, Saskatchewan. This mill was purchased and expanded by MacMillan, Bloedel in 1964. [t was largely due to their marketing and technological developments that the acceptance of waferboard has reached its present level in both Canada and the U.S.A. There are now twelve operating mills in Canada with an estimated capacity of [,500,000 m^3, as summarized in Table 2. By year end 1988 total installed capacity will be about 2,200,000 m^3, of which 1,100,000 m^3 or 50% will be OSB from the 15 mills shown on figure 1. Reports suggest one other OSB mill is under serious consideration for Northern Alberta.

TABLE 3.2 CANADA WAFERBOARD AND 0S6 INDUSTRY

(a) @crating Mills -1986	Location	Annual Capacity (m^3)
Atlantic Waferboard Inc.	Chatham, N.B.	141,200
Forex-Leroy	Val d'Or, Quebec	I 55,000
Grant Waferboard	Englehart, Ontario	I 55,000
Great Lakes Forest Products Ltd.	Thunder Bay, Ontario	I 05,900
MacMillan Bloedel Limited	Hudson Bay, Saskatchewan	158,900
	Thunder Bay, Ontario	I I 7,700
Malette Waferboard	St. Georges de Champlain, Quebec	1 14,700*
Normick-Perron Ltee.	La Sarre, Quebec	88, 300'
Pelican Spruce	Edson, Alberta	220 ,000'
Waferboard Corporation	Timmins, Ontario	70,600
Weldwood of Canada	Longlac, Ontario	I 10,300
	Slave Lake, Alberta	I 10,300*
Total, Operating		I ,547,900
(b) Under Construction, 1987/88		
Louisiana-Pacific	Dawson Creek, B.C.	230,000
Normick Perron	Chambord, Quebec	220, 000'
Pelican Spruce	Drayton Valley, Alberta	220 ,000*
Total, Under Construction		670,000
Probable Total Operating Capacity, Year End 1988		2,2 I 7,900

* 0S6 Mill

Source: Various, CHI Files

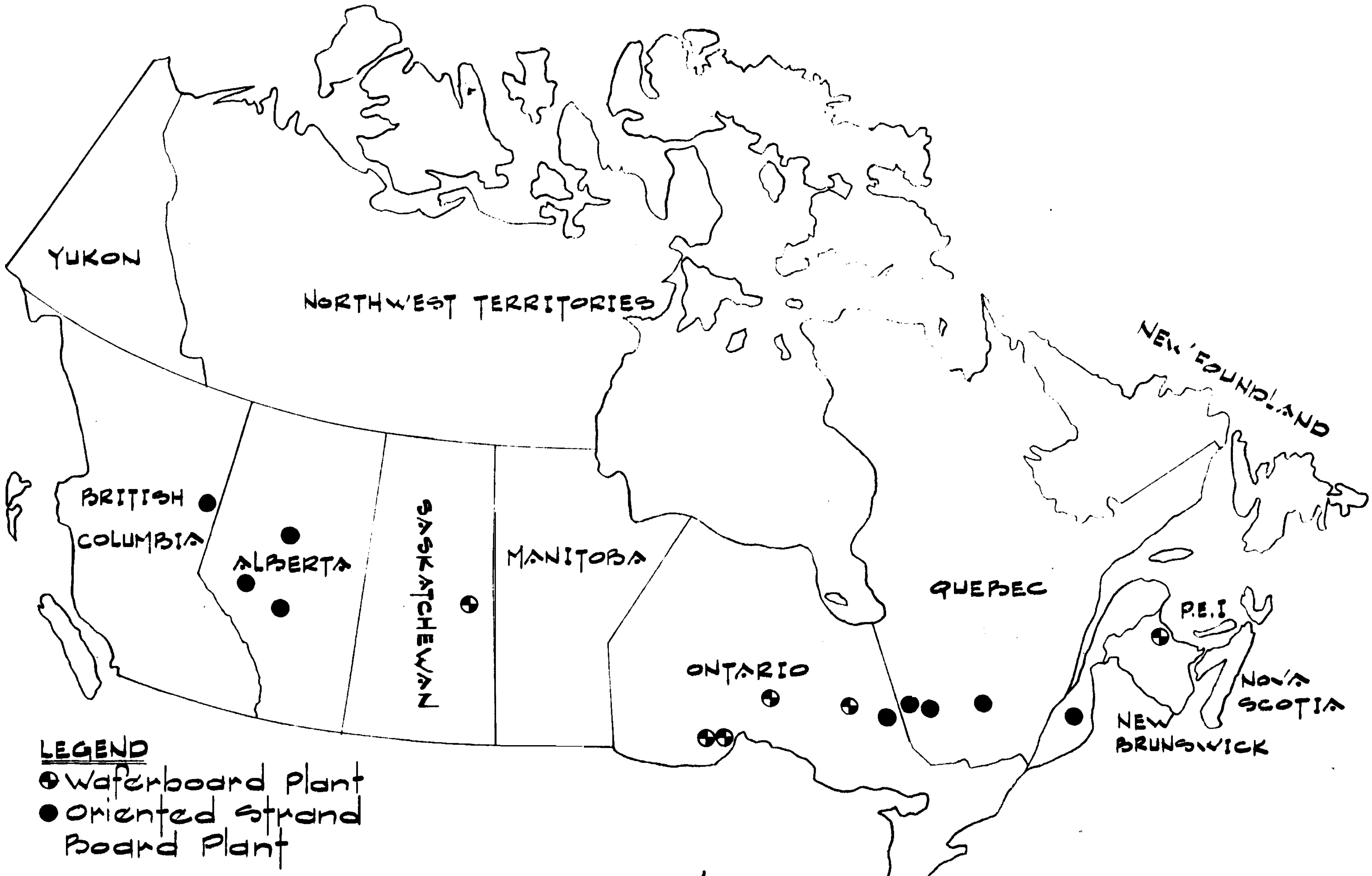

FIG. 1
PROBABLE LOCATION OF WAFERBOARD/O.S.B. MILLS (1988)

The rapid development of this industry, which occurred mainly in Eastern Canada, resulted from the steadily increasing cost of peelable coniferous logs for the plywood industry in the west. The availability of relatively low cost poplar species close to the major population centers in the eastern provinces, which consume significant volumes of sheathing materials in the home construction industry, stimulated waferboard development east of the Great Lakes. However, there are signs that some mills in that region are now experiencing increasingly higher wood costs because of longer hauling distances and trucking costs. The recent upsurge in capacity in Northern Alberta and B.C. relates to the development of markets in the Western United States particularly for "performance rated" panels such as OSB. Abundant reserves of poplar timber and generous financial inducements from various levels of government are significant stimuli.

The construction plywood industry as has been noted, is a major competitor with WB/OSB. Plywood production is concentrated in B. C., especially in the Interior as shown in Table 3-3.

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TABLE 3.3 CANADIAN CONSTRUCTION PLYWOOD INDUSTRY

MILL LOCATIONS AND CAPACITY

	Number of Mills	Capacity m^3	Notes
B.C. Coast	8	886,000	2 are small volume specialty mills
B.C. Interior	10	960. 000*	Mainly spruce sheathing
Total B.C.	18	1,846,000	
Alberta	3	232,000	Mainly spruce sheathing
Saskatchewan	1	66,000	
Ontario	2	90,000	Spruce and poplar sheathing
Quebec	1	30,000	Spruce and poplar sheathing
Total	25	, 49000	

* Two mil Is are expanding capacity

Data in CHI files indicates that almost 1,600,000 m^3 of the total capacity is in sheathing grades with which OSB competes. The sanded Douglas fir plywood, primarily produced in the B.C. Coastal mills, serves the specialty, concrete form, and industrial re-manufacturing markets. It is generally produced in thicknesses greater than 12 mm. The competitive aspect with OSB is of minor importance in these uses of Douglas fir plywood.

3.3.1 SHIPMENTS OF CANADIAN WAFERBOARD/OSB

The story of production and shipments of WB/OSB is that of a rapidly expanding industry in Canada and the U. S. A., with a corresponding decrease in plywood output. It is estimated that in 1986 WB/OSB represented 30 percent of the combined consumption of 2,500,000 m^3 of plywood and WB/OSB in Canada.

TABLE 3.4 CANADIAN WAFERBOARD

PRODUCTION AND SHIPMENTS

(m^3)

	Production	Shipments			
		Domestic	Exports	Total	Value thousand $
1970	57,370	54,721		54,721	n/a
1971	97,087	88,261	4,413	92,674	n/a
1972	110,327	97,087	8,826	05,913	n/a
1973	141,218	123,566	15,004	38,570	n/a
1974	216,240	154,457	44,131	98,588	n/a
1975	273,610	141,218	127,979	269,197	n/a
1976	314,299	145,631	138,570	284,201	37,754
1977	361,029	191,697	191,527	383,224	53,865
1978	450,817	227,714	228,889	456,603	72,732
1979	569,285	258,605	269,868	528,473	88,694
1980	545,331	275,361	301,169	576,530	79,909
1981	696,331	368,176	298,023	666,199	103,248
1982	492,447	294,580	241,419	535,919	76,780
1983	863,442	474,308	376,784	851,092	128,760
1984	1,190,254	558,473	623,852	1,182,325	184,837
1985	1,336,566	590,322	740,742	1,331,064	241,435
1986(1)	1,400,000	750,000	650,000	1,400,000	276,000

(1) Based on data to 30 September, 1986

Note: Prior to 1976 Waferboard was not reported as such by Statistics Canada 0S8 is not identified in data reported but is included in Waferboard.

Source: Statistics Canada, CHI files, interviews.

The significant features of the table are:

(i) The volume of shipments (demand) which has risen by 240 percent from 1980 to date.

(ii) The level of WB exports, including OSB in the past 3-4 years, averaging about 50 percent of total shipments for several years - rising to 55 percent in 1985. The estimated reduced level of exports in 1986 may be attributed both to the replacement of plywood in domestic markets due to the recent strike in B.C. and an actual reduction in export potential due to the significant increase in WB/OSB capacity in the United States. It is estimated that 95 percent or more of all exports are to the U.S.A. There are no exports from the U.S.A. to Canada.

(iii) The high operating capacity ratio which has generally been about 90 percent in the mills, with the exception of Atlantic Waferboard which was re-organi zed in 1986 after two years of idleness.

Various estimates of the trends in WB/OSB and plywood demand in Canada have been made by industry representatives and market researchers. The consensus appears to be that the demand for WB/OSB will increase by about 300 percent to the end of the century to about 3. I million m^3 with a commensurate increase in capacity. By 1988 demand ,is estimated to be 2 million m^3 which is 90 percent of the probable installed capacity at that time.

A small percentage of the Canadian market for structural panels is supplied by imported coniferous plywood from the U.S.A. The average volume imported up to 1985 has been about 15,000 m^3 per year, much of which is in grades and lengths not available in Canada. In 1986 the volume is estimated at 41,000 m^3 due to the shortage brought about by the forest industry strike in B.C. It is probably dropping back to the 15,000-20,000 m^3 range now.

There is no importation of waferboard into Canada.

Meanwhile, coniferous plywood demand will probably decrease by 35 percent over the next 15 years as WB/OSB continues to erode the plywood sheathing market. While somewhat, in CHI's judgement, optimistic, the general level of increase in demand for WB/OSB appears reasonable when wood cost differentials, local demand and proximity of resources to the major markets, product improvements and transportation costs are considered.

The demand values include exports to the U.S.A. which are forecast to level out at about 0.95 million m^3 in the early 1990's - only about 10 percent of the U.S. demand at that time. This suggests the supply available in Canada will average about 1.67 million m^3 in the early 1990's.

3.3.2 REGIONAL MARKETS IN CANADA

Quebec and Ontario are the major market areas for structural panels in Canada, accounting for 50 percent of the plywood and 72 percent of the WB/OSB consumed domestically in 1985. Probably they consumed almost 75% of all waferboard in 1986. However, the increasing consumption in Western Canada is significant as indicated in Table 5, which is a broad estimate of the pattern and volumes of consumption. The overall annual rate of increase in consumption in Western Canada, including Yukon and NWT, has been about IO percent from 1983- 1985. The 1986 I.W.A. strike in B.C. has probably artificially increased the demand for 1986 compared to 1985 but it may be reasonable to allow an annual rate of 10 percent to year end 1989 from 1985. On that basis the total Western demand for

WB/OSB will then total approximately 189,000 m^3. The appearance of OSBin the home building trade in B.C. and the development of mills in B.C. and Alberta suggests that the increase will proceed at least at this rate - approaching total Western, Yukon and NWT consumption of 229,000 m^3 in early 1990.

excess supply for western Canadian markets

[n 1990 the operating capacity of Western WB/OSB mills will be about 939,000 m^3 which, at an optimistic export ratio of 60 percent, will leave 376,000 for domestic shipments, including Western Canada. Improvements in plant capacities will likely increase this output. At the same time the B.C., Alberta and Saskatchewan plywood industry will still be producing over I million m^3 of sheathing, of which 50 percent will go to Eastern Canada and only about 20 percent, at best, will be exported. At least two of the plywood mills in the B.C. Interior are increasing their capacity by about 30 percent by replacement of old equipment with new state-of-the-art technology. This indicates a conviction that plywood will maintain a strong position in the market for structural panels. Under this scenario price competition will be keen.

TABLE 3-5 - ESTIMATED CANADIAN MARKETS FOR CONSTRUCTION PLYWOOD AND WAFERBOARD

(thousands of m^3)

	British Columbia			Alberta			Saskatchewan			Manitoba			Western Total		
	PLY	WB	Total	PLY	WB	Total	PLY	WB	Total	PLY	WB	Total	PLY	WB	Total
1979	410.0	3.0	413.0	399.2	16.0	415.0	20.2	22.0	142.0	108.8	18.0	127.0	1,038.2	59.0	1,097.0
1980	474.8	4.0	479.0	397.7	18.0	416.0	89.7	23.0	113.0	75.6	20.0	96.0	1,037.8	65.0	1,103.0
1981	413.9	6.0	420.0	380.8	39.0	420.0	98.6	36.0	135.0	88.5	25.0	114.0	981.8	06.0	1,088.0
1982	298.0	6.0	304.0	282.8	31.0	314.0	74.6	20.0	95.0	70.5	15.0	85.0	725.9	72.0	798.0
1983	365.8	7.0	373.0	274.9	40.0	315.0	99.5	26.0	125.0	85.3	18.0	103.0	825.5	91.0	915.0
1984	293.5	1.0	294.0	220.0	57.0	277.0	64.7	37.0	102.0	92.2	26.0	118.0	675.4	130.0	805.0
1985	288.7	11.0	300.0	248.6	65.0	314.0	68.3	39.0	107.0	98.2	27.0	125.0	703.8	142.0	846.0
1986*	295.4	20.0	315.0	225.2	80.0	305.0	64.8	40.0	105.0	99.8	30.0	130.0	685.2	170.0	855.0

	Ontario			Quebec			Atlantic			Eastern Total			Canada Total		
	PLY	WB	Total	PLY	WB	Total	PLY	WB	Total	PLY	WB	Total	PLY	WB	Total
1979	468.3	129.0	597.0	385.2	55.0	440.0	123.1	16.0	139.0	976.6	200.0	1,177.0	2,014.8	259.0	2,274.0
1980	434.8	133.0	567.8	353.3	60.0	413.0	110.4	17.0	127.0	898.5	210.0	1,188.0	1,936.3	275.0	2,211.0
1981	371.5	175.0	547.0	288.9	67.0	356.0	95.7	20.0	116.0	756.1	262.0	1,018.0	1,737.9	368.0	2,106.0
1982	292.0	147.0	439.0	264.6	64.0	329.0	70.0	12.0	82.0	626.6	223.0	850.0	1,352.5	295.0	1,648.0
1983	375.5	254.0	630.0	338.7	16.0	455.0	102.3	13.0	115.0	816.5	383.0	1,200.0	1,642.0	474.0	2,116.0
1984	390.5	311.0	702.0	326.9	98.0	425.0	93.9	19.0	113.0	811.3	428.0	1,240.0	1,486.7	558.0	2,045.0
1985	473.4	320.0	793.0	352.4	108.6	457.0	91.3	20.0	111.0	917.1	449.0	1,366.0	1,620.9	590.0	2,211.0
1986*	526.3	400.0	926.0	383.2	152.0	535.0	101.5	28.0	130.0	1,011.0	580.0	1,591.0	1,696.2	750.0	2,446.0

Source: Statistics Canada 36-001

Al data for plywood is as reported by Statistics Canada

Waferboard data is as reported for Ontario and Quebec only. All other provinces estimated by CHI.

* Estimated by CHI based on data to 30 September, 1986

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3.3.3 MARKETS FOR WB/OSB FROM MILLS WEST OF WINNIPEG

Table 6 following summarizes CHI's estimate of WB/OSB demand and supply in western Canada. Because one or two mills tend to be built simultaneously and the break-in period may be protracted the annual volumes may not be attained exactly as shown at year's end. Nevertheless, CHI believes the table fairly summarizes Western Canadian developments.

TABLE 3-6 - PROBABLE DEMAND/SUPPLY BALANCE(1)
FOR
WB/OSB IN WESTERN CANADA
(m^3)

A = B + C
E = C − D

	D Demand	Supply: A Total		Supply: B Export		C Domestic	E Surplus
1986	156,000	489,200	=	293,500	+	I 95,700	39,700
1987	172,000	489,200		293,500		I 95,700	23,700
1988	189,000	939,200		563,520		375,680	I 86,680
1989	208,000	939,200		563,520		375,680	167,680
1990	229,000	939,200		563,520		375,680	146,680

(1) Based on mills west of Winnipeg

The western mills are estimated to have a larger ratio (60 percent) of exports than the Eastern mills (40-45 percent). However, as the U.S. supply increases Canada will suffer a reduction in exports - sometime after 1990. The surplus shown represents the volumes available for possible additional shipments in the West, to portions of eastern Canada or exports, if demanded. The theoretical surplus is equivalent to one medium sized mill.

If the demand exceeds the indicated volumes due to very strong markets, other mills will be built in the West. Large volumes of poplar timber are available in North-Central and North-East B. C., and this could lead to mills being built in these regions. Delivered costs of OSB would be significantly less than from the NWT.

3.3.4 NORTHWEST TERRITORIES MARKETS FOR WB/OSB

Shipment data for WB/OSB to the Yukon and Northwest Territories are not shown in Statistics Canada reports so any estimate without a specific survey is subject to error. CHI has used a Canadian Forestry Services Report (1) as a basis of estimate.

TABLE 3.7 **PLYWOOO CONSUMPTION IN Tf-E NORTHWEST TERRITORIES 1980-81**

	Thickness (in.)							
Quantity	1/8a	1/4	5/16	3/8	1/2	518	3/4	Total
Number of sheets	1,906	40,031	13,656	50,969	46,875	31,063	43,031	227,531
M Sq. Ft.	61	1,281	437	1,63 I	I ,500	994	I ,377	7,281
% of total	0.8	17.6	6.0	22.4	20.6	13.7	18.9	100.0

	Finish						
Quantity	Paneling[a]	Good 2 sides	Good I side	Tongue & groove[b]	Formply[c]	Standard sheathing	Total
M sq. ft.	61	6	3,055	752	544	2,863	7,28 I
%of total	0.8	0. I	42.0	10.3	7.5	39.3	I 00.0

a Paneling, usually l/8-in. thickness or more.
b Select and better **(plywood grades).**
c Select oneside (plywood grades).

(1) **"The Forest Industry in the Economy of the Northwest Territories, 1980 -81.'**' R.A. Bohning, Information Report NOR-X-277 Northern Forestry Centre, 1986.

This indicates 7.3 million sq. ft. (surface measure) was used in all grades and thicknesses in 1981. From the data CHI estimates that the total volume consumed is equivalent to8,211 m^3. Of this, certain grades and thicknesses e.g. 1/8” **panelling, and l/4" Good I** Side are not replaceable by WB/OSB. Using the total percentage of sheathing (39.3) and tongue and groove (10.3), CHI concludes 50 percent of the shipments, that is 41,000 m^3 could have been replaced by WB/OSB although, realistically, probably only 50% (2000 m^3) of that may have occurred over the past five years. A reasonable estimate of WB/OSB currently being consumed from Northern Alberta Mills is perhaps 3,000-3,500 m^3 in the NWT.

3.3.5 YUKON MARKET FOR WB/OSB

Data on the Yukon Market is extremely sketchy indicating that a more specific market summary is required. The shipments to the Yukon are included in the **"all** other” category of Statistics Canada reports. Based on the population of the Yukon, 23,400 in 1986, compared to 50,300 in the NWT[1] it might be surmised the consumption of WB/OSB is in proportion, ie. about 50 percent of the 3,500 m^3, above, or I ,750 m^3. However, non-recurring industrial uses might increase this by about 500 m^3.

In summary the current annual use of WB/OSB in the two territories **would appear to be 6,000 m^3 which is much too small a market on which to plan a mill.**

(1) Telephone inquiry to Statistics Canada, Vancouver.

3.4 UNITED STATES CAPACITY AND PRODUCTION OF WB/OSB

TheUnited States has been the world leader in production and useof construction plywood for many decades. In common with ail other factors the cost of production and especially the cost of peeler logs increased in the Pacific Northwest permitting plywood from other sources and other panels to enter the market.

The rapid development of the Southern Pine plywood industry, based on the rapidly growing pine species, permitted the maintenance of plywood as the major panel for building and construction. However during the past 10 years WB/OSB made its appearance, after its encouraging technical and market development in Canada. The early eastern Canadian mills quickly developed export markets in the U. S. Northeast and South Central regions. As market penetration by Canada continued mills came on stream in those and other U.S. regions to take advantage of:

relatively abundant low valued wood species
- lower financing and production costs
- locations near major market areas

shorter and more economic transportation systems

The United States capacity for plywood and WB/OSB has developed from a total capacity in 1970 of approximately 18,500,000 m^3, of which one waferboard mill produced 100,000 m^3, to a current capacity of about 25,600,000 m^3 of which twenty three WB/OSB mills represent 3,300,000 m^3. The plywood component is declining from a [00 percent market share in the early 19701s to an estimated 40 percent by the year 2000.

The United States WB/OSB industry is comprised of the mills listed below and shown also in Figure 2.

TABLE 3.8 UNITED STATES WAFERBOARD AND 0S8 INDUSTRY

			Annual Capacity (m^3)
(a)	Operating Mills -1986	City	
	Blandin Wood Products	Grand Rapids, Minn.	243,000
	Georgia Pocif ic	Woodland, Maine	138,000
		Grenada, Miss.	217, 000*
		Dudley, N.C.	106, 000*
		Skippers, Va.	21 7,000*
	Huber Corp.	Easton, Maine	I I 3.000
	Louisiana-Pacific	Kremmling, Co.	79,000
		Montrose, Co.	79,000
		Athol, Idaho	79,000
		Urania, La.	106,000*
		Houlton, Mass.	141 ,000
		New Limerick, Maine	79,000
		Two Harbaurs, Minn.	74,000*
		Corrigan, Texas	124, 000*
		Dungannon, Va.	79,000*
		Hayward, W is.	287,000
	Northwood Panel board	Solway, Minn.	228,000
	Oregon Strandboard**	Brownsville, Or.	21,000
	Potlatch Corp.	Bemidji, Minn.	I 68,000*
		Cook, Minn.	I 68,000*
	Ternple-Eastex	Claremont, N.H.	71, 000*
	Weyerhaeuser	Grayling, Mich.	296, 000*
		Elkin, N.C.	243, 000*
	Total, Operating		3,356,000
(b)	Under Construction, 1986		
	Arrowood Technologies	Roxboro, N.C.	1 I 5,000*
	Lousiana Pacific	New Waverley, Tx.	88,000
	Total, Under Construction, 1986		203,000
	Probable Total Operating Capacity, Year End 1986		3,559,000
(c)	Under Construction, 1987		
	Georgia-Pacific	Glade Springs, Va.	I 77 ,000*
	International Paper	Nacogdoches, Tx.	I 68,000
	Louisiana-Pacific	Sagola, Mich.	230, 000*
	Langboard Inc.	Valdosta, Ga.	88,000*
	U.S. Waferboard	McCleary, Wa.	I 00,000
	Total, Under Construction, 1987		763,000
	Probable Total Operating Capacity, Year End 1987		4,322,000

*Mil Has Capacity For OSB. ** Mill specializes in comply only.
Source: Various, Cl-n Files

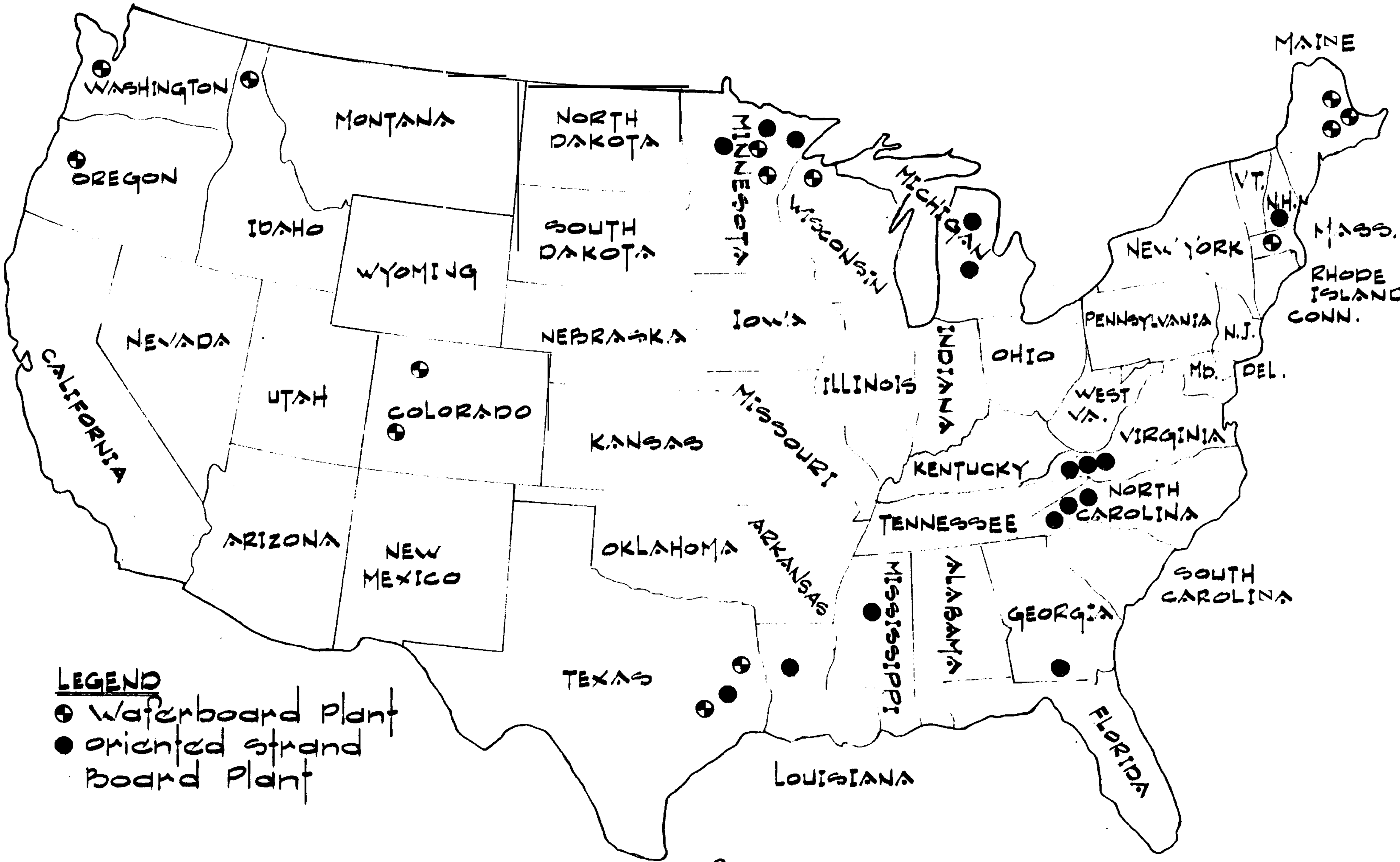

FIG. 2

PROBABLE LOCATION OF WAFERBOARD/O.S.B. MILLS (1988)

Reference to the table and Figure 2 illustrates clearly the geographic "barriers" which appear between major U.S. market areas and Western Canadian mills. Most of these U.S. mills have very favorable wood, labor and transportation costs which cause a chanelling of Canadian exports to certain markets based on favaurable freight charges.

As in Canada the major panel which competes with WB/OSB is coniferous sheathing or "rough" plywood. Plywood production is centered in the West and Southern regions and, of the total, sheathing capacity is forecast to decline from an average of I 7 million m^3 in 198 I to 13 million in 1996. The Western U.S. sheathing mills will experience the most severe decline from 8.2 to 5.0 million m^3. "

The Southern industry, being more modern than the West generally, and specializing in a high volume of sheathing (because of lower log quality) will decline more slowly than the Western. In both regions WB/OSB is expected to displace plywood in the market place at an increasing rate.

3.4.1 UNITED STATES PROJECTED DEMAND FOR WB/OSB

Waferboard/OSB capcity in the U.S.A is currently estimated at 5.3 million m^3 as against a shipment of 4.0 million m^3. Projected increases up to the year 2000 indicate capacity will approach 12.0 million m^3 with a demand amounting to about 13.2 million m^3. In this period imports from Canadian mills will probably increase to approximately 950,000 m^3 by 1990 and then level off as more U.S. capacity comes on stream. Forecast demand is shown in Table 3-9.

TABLE 3-9 - UNITED STATES
ESTIMATED AVERAGE ANNUAL DEMAND FOR STRUCTURAL PANELS
BY 5 YEAR PERIODS

	PLYWOOD	NON-VENEERED(1)	
	(million m³)	(million m³)	Annual rate of increase
1986-1990	17,390	5,330	-
I 990-1995	14,300	9,660	15
1996-2000	12.360	13,240	8

(1) Mostly WB/OSB and some comply.

Source: B. Fuller, Resource Information Systems, Bedford, Mass. Article in **Forest industries Magazine, Jan. 1987**

The higher rate of increase reflects the present early rapid replacement of plywood by WB/OSB. As replacement proceeds the rate drops to a level more in keeping with annual structural panel market trends.

The trend is clearly to an increased rate of replacement of plywood, mainly in the sheathing sector, with waferboard. CHI believes, on the basis of previous projects and reviews, that it is within the capacity of the U.S. timber supply to support the projected increase in WB/OSB output. Several studies have shown that low quality and, hence, generally low cost timber, both coniferous and deciduous, is available in all of the major market areas. Therefore, it is probable that Canadian exports will represent a smaller proportion of U.S. supply, as previously indicated in the Canadian market section. Only those Canadian mills in close proximity to markets or with very favorable cost wil I maintain the greatest share of the U.S. market.

3.4.2 UNITED STATES REGIONAL MARKETS FOR WB/OSB

Of significant importance to the economics of an 0S6 mill in the NWT is the concentration of the markets on an accessible geographical basis. Current total U.S. demand is about 4.9 million m³ of which only, 600,000 m³ is in the Western States ‘l). Forecasts indicate western demand will increase to about I million m³ in I 990 to I.3 million in I 995, at which time the total U.S. demand probably will approach I I.5 million m³.

From the NWT the only U.S. market with a reasonable potential, due to the high cost of transportation, is in the Western and Intermountain regions which appear to be developing as a major market for the panels at the present time. This market is open to certain Western Canadian mills and the most westerly of those of the U.S. Mid-west and South. Presumably, the two Canadian mills under construction in Dawson Creek and Drayton Valley, will target this western region for a major partion of their output as do the existing mills in the Western United States. This possibility and the likelihood of new mills in the Western States suggest that a sizeable percentage of the approximately 780,000 m³ of capacity available in Western North America could be directed to the Western market. New western Canadian mills, will require highly favorable production and shipping costs to compete in the Western U.S.A. A new NWT mill would require exceeding y favorable costs.

3.4.3 ALASKA - MARKETS FOR WB/OSB

The American Plywood Association (1) indicates that approximately 36,000 m³ of coniferous plywood in sheathing grades was shipped to Alaska in 1985. WB/OSB is not reported. However, by deduction from the relative volumes of WB/OSB and sheathing plywood consumed in the Western U.S.A it appears that about 3,600 m³ of WB/OSB may have been shipped to Alaska. The total shipment of the two types of panels would be about 39,600 m³. It should be noted that a 240 Ton per day WB mil I was studied” for Alaska in 1979 and was not found to be viable because of high production costs, the small intro-state market and poor prospects for exports to Asia.

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(1) "Regional Production and Distribution Patterns of the Structural Panel Industry”, American Plywood Association, Tacoma, Wash. May 1986.

3.4.4 GENERAL MARKET FACTORS IN NORTH AMERICA

An exact relationship between the volume of plywood and WB/OSB consumed in North American housing has not been established. The square fwtage built into the structures varies with the type of house e.g. single family, row housing, low rise apartments etc. Nevertheless, housing starts serve as indicators and when the annual rate of new housing starts is high demand is generally strong. Related to this are, naturally, interest and mortgage rates. If the present trend t. lower rates continues the trends in demand/consumption in both Canada and the U.S.A. tabled in this report should easily be attainable.

The other uses for WB/OSB in farm construction, crating, "do-it-yourself" etc. are increasing and therefore will support the probable growth of the market.

3.5 ASIA - MARKETS FOR 0S6

The British Columbia plywood industry has conducted a major campaign to introduce coniferous plywood into Asia, especially Japan, and lately China. The results have been indifferent since only about 20,000 m^3 have been shipped annually over the past few years. The American Plywood Association is conducting a similar promotional exercise.

There is an ingrained Japanese opposition to coniferous plywood from both the cost and technical aspects. Codes and standards are very rigid, requiring exhaustive discussion and testing. The concept of a timber - framed house is new and is only slowly catching on. WB/OSB will face the same hurdles as plywood for major market acceptance although token shipments have been made.

In export data and international customs nomenclature, waferboard and 0S6 are included with non-structural particleboard. Total Canadian shipments of both types to the Orient were only 4,016 m^3 in 1985 and probably 5,000 m^3 for 1986. South Korea accounts for about 60 percent. Japan does not appear to have imported any. Much of the intermittent shipment of waferboard consists of small packages.

Faced with technical problems, a tariff of 10 percent, rail costs to Vancouver of about $6 1.00/m3, terminal charges and ocean freight of about $40.00 per m^3 the chance of large scale shipments to the Orient are virtually non-existent in the foreseeable future from the NWT.

3.6 OTHER MARKETS

Waferboard is being exported in small quantities, to markets other than the United States and the Orient. The U.K. and other European countries import,ed 6,610 m^3 of all types of particleboard and waferboard in 1985 of which the U.K. took 3,996 m^3. Various other countries imported relaively small volumes to bring the total Canadian exports of particleboard to 1,019,113 m^3 of which the U.S.A. imported 1,008,000 m^3, including 741,000 m^3 of waferboard.

The clear inference is that, except for the U.S. market, WB/OSB is far from being a major exportable item in substantial volumes and unlikely to be so for some time considering present and future production of several competitive panels, including 0S6, in foreign markets.

3.7 TRANSPORTATION COSTS

The cost of transportation of finished OSB or waferboard is a major factor in a mill’s economic viability. The product weighs between 35 -45 Ibs. per cubic foot. CHI has used an average of 42 Ibs. in this study as the most probable density, which means a cubic metre weighs 1,483 tbs. It is approximately 45 percent heavier than spruce plywood of equivalent thickness and 17 percent heavier than Douglas fir plywood. This weight is a major factor in determining that a mill site be chosen in close proximity to the probable market as illustrated in the maps of mill locations. If not close to the major markets, a mill must therefore obtain favorable transportation costs.

CHI has obtained estimates of freight costs to the major markets of interest from several sources. Inquiries to trucking companies operating in the NWT and Northern Alberta indicate substantial problems exist. The Lower Liard region does not appear to be well served with trucks at this time although, if a mill existed at Fort Liard contracts might be negotiated. Approximately 7 "B-trains" would be needed daily to move the [34,000 m^3 annual output. These consist of a semi-trailer and full trailer, with a total load capacity of about 75,000 Ibs. Units of this size would tend to reduce the unit cost to reasonably economic levels although rail shipments would probably be the most economic means. Because no railroad services the Lower Liard area al I shipments must be trucked out at least to Fort Nelson for loading on B.C. Rail there. This will add to costs since about 3 truck loads must be on hand at Fort Nelson for each rail car. Temporary storage and a loading crew with a forklift must be provided at Fort Nelson and the scheduling must be such that each loaded rail car contains a shipment for a specific customer. Switching cars for partial unloading at two or three destinations is costly and unpopular with recipients.

The ideal, of course, is to utilize trucks from the mill to customers unloading dock but the rates quoted at this time make this uneconomical.

Truck Transportation Rates

These rates are as estimated by the few companies who operate in the NWT and/or Northern B.C. and Alberta. The rates are based on their present operations which generally do not include a daily movement of several full loads of a single product from a mill such as proposed at Fort Liard. If this mill were constructed the necessary negotiations would, in all probability, lead to rates more competitive with the railroads.

The truck haul from Fort Liard to Fort Nelson and beyond to a specific destination was, in all cases, described as expensive because of infrequent service now and the necessity of a long, non-revenue producing back haul. Two Northern companies would not quote on this routing.

Only one company, Arrow Transfer, Vancouver made an estimate of rates from Fort Liard to Vancouver based on a 40,000 lb. load at $4.50 per loaded mile. On this basis a truck haul to Vancouver (about 1200 miles) would cost $5,460 or $200 per m^3 which is well above the combination truck/rail cost of $61.35. While this might be negotiated downward it is unlikely ever to be competitive with the rail/truck rates.

TA6LE 3.10 - ESTIMATED TRUCKING RATES
WESTERN CANADA FROM FORT LIARD

TO	BASIS AND RATES
Fort Nelson	40,000 Ibs. $4.50 per loaded mile 20,000 ~&. $210.00 per load 20,000 . $1.20 per 100 Ibs.
Hay River	70,000 lbs. $1,200 per load (approx.)
Edmonton	20,000 lbs. $8.94 per 100 tbs. 40,000 lbs. $7.95 per 100 Ibs.
Vancouver	40,000 Ibs. $4.50 per loaded mile

Truck lines which operate into the United States would not quote on shipments from Fort Liard since most pick up loads from local carriers from Hay River which are transferred at Edmonton. Indications are that shipments to Salt Lake City, for example would cost at least the same as to Vancouver. On this basis truck shipments to the U.S.A. from Fort Liard are considered beyond the economic range of the mill.

Rail Transportation

The nearest railroad, as noted, is the B.C. Rail system at Fort Nelson. The CNR at Hay River could be used but excessive truck hauling from Fort Liard, about 340 miles distant and loading requirements at trackside similar to those described for Fort Nelson indicate this is not a good solution to the problem. Nevertheless, rates have been obtained from the three railroads which might be involved in shipments i.e. B. C. R., CNR, Burlington - Northern.

To gain the advantages of lowest cost rates by railroad, loads which exceed a guaranteed minimum weight are required. As noted in the listed rates these minimums are 130,000 Ibs. and 140,000 Ibs. and upward. The maximum load on a rail car is probably 160,000- 165,000 Ibs.

TABLE 3-1 I - CANADIAN RAILROAD FREIGHT RATES

C$ per 100 Ibs.

	CNR			BCR	
(a)	Basis(1)	130,000 Ibs.		Basis(3)	140,000 Ibs.
	From:	Hay River		From:	Fort Nelson
	To Edmonton		2.94	To Edmonton	I st 80,000 Ibs. @ $2.09 per 100 lbs. Balance @ $1.58
	Calgary		2.94	Calgary	I st 80,000 Ibs. @ 2.64 per 100 tbs. Balance @ [.97
	Regina		3.58	Regina	I st 80,000 Ibs. @ 3.02 per 100 Ibs. Balance @ 2.00
	Vancouver		3.95	Vancouver	140,000 Ibs. min. @ 2.16 per 100 Ibs.
	Winnipeg		4.00	Winnipeg	Ist 80,000 lbs. @ 4.24 per 100 Ibs. Balance @ 3.18
	Toronto		5.82		
	Prince Rupert		4.47		
(b)	Basis(2)	120,000 Ibs.			
	From:	Prince Rupert			
	(Rail car barge)				
	To Anchorage		3.01		
	Fairbanks		4.78		

(1) Based on a minimum car load. weight of 130,000 Ibs.

(2) Based on a minimum car load weight of 120,000 Ibs.

(3) Based on a minimum car load weight of 140,000 tbs.

TABLE 3-12 - BURLINGTON NORTt-ERN RAILROAD FREIGHT RATES

U.S. $ per 100 Ibs.

Basis:	Minimum weight 85,000 Ibs. and the balance above this at the lower rate quoted.	
From:	Vancouver, B.C.	
To:	San Francisco	85,000 Ibs. @ $3.09 per [00 Ibs. Balance @ 2.89 per 100 Ibs.
	Los Angeles	85,000 tbs. @ $3.35 per 100 Ibs. Balance @ $3.15 per 100 Ibs.
	Phoenix	85,000 @ $4.01 per 100 lbs. Balance @ $3.81 per 100 tbs.
	Denver	130,000 Ibs. minimum @ $3.29 per 100 Ibs.
	Salt Lake City	120,000 Ibs. minimum @ $3.43 per 100 lbs.

As an example of cost calculation the rail freight cost from Fort Nelson to Calgary is as follows, using BCR rates:

Example: 145,000 lb. carload, Fort Nelson to Calgary

80,000 lbs. @	$\frac{2.64}{100}$	=	$2,112.00
65,000 lbs. @	$\frac{1.97}{100}$	=	1,280.00
			3,392.00

One cubic metre of 42 lbs. OSB weighs 1,483 Lbs.
so 145,000 lb. car contains 97.8 m^3.

Freight cost = $\frac{\$3,392}{97.8}$ = $34.69 per m^3

Based on the rates quoted, CHI estimates transportation costs to potential markets as follows:

TABLE 3-13 - EXAMPLES OF TRANSPORTATION COSTS

	Via	$/$m^3$
1. Fort Liard - Vancouver		
(a) Fort Liard - Fort Nelson	Truck	26.97
Fort Nelson - Loading		2.36
Fort Nelson - Vancouver	B.C. Rail	32.03
Total		61.36
(b) Fort Liard - Vancouver	Truck (40,000 lbs)	200.00
2. Fort Liard - Edmonton		
(a) Fort Liard - Fort Nelson	Truck	26.97
Fort Nelson - Re-loading		2.36
Fort Nelson - Edmonton	BC/CP Rail	27.75
Total		57.08
(b) Fort Liard - Calgary	(truck 40,000 lbs.)	146.67
3. Fort Liard - San Francisco		
(a) Fort Liard - Fort Nelson	Truck	26.97
Fort Nelson - Re-loading		2.36
Fort Nelson - Vancouver	BC Rail	32.03
Vancouver - San Francisco	BNR	54.90*
Total		116.76

*BNR converts to Canadian funds @ $ 1.23/U.S.$

3.8 PRICES AND MILL NET RETURN

The market prices for waferboard and OSB reflect the supply and demand in the major market areas such as Toronto, Montreal and several cities in the U.S.A. Waferboard and OSB, as already noted, are extensively marketed in the U. S.,A. and competitive pricing is a key factor in a companyls operation.

The characteristics of the panel market include volatile pricing often accompanied by heavy discounting at the wholesale level. The reported price lists and officially published company price lists are frequently out of date when received.

The key factor in the economics of the producing mill is the "mill net return". This is the residual price accruing to the mill after delivery to th-s freight charges, duties, customs brokerage, and discounts. On this basis certain markets will be closed to even the most efficient mills because the mill net return is less than the cost of production due to factors such as high transportation costs, tariffs and the fluctuations in market prices.

Based on the preliminary review of freight charges CHI did not consider markets beyond the Toronto region or east of the United States lntermountain region as being within the probable marketing area from the NWT The decision was made to concentrate on the Western third of the U.S.A. and the Canadian West.

3.8. I CANADIAN MILL NET RETURN

As an indication of the mill net return achieved by Canadian WB/OSB mills, the following values have been derived from Statistics Canada reports. It should be noted there are no routinely reported delivered prices for Canadian WB/OSB, so that the table should be considered as a close approximation of the national average.

TABLE 3-14 - ESTIMATED MILL NET RETURN VALUE

FOR CANADIAN WAFERBOARD/OSB MILLS

C$ per m^3

	1980	1981	1982	1983	1984	1985	1986
March	131	162	117	150	148	176	200
June	115	176	117	153	149	177	193
September	48	154	147	165	161	192	210
December	60	133	150	129	178	193	nla
Annual Avge.	138.5	156.3	132.8	149.3	159.0	184.5	201.0
% Variance Above	+ 15.5	+ 12.6	+ 13.0	+ 10.5	+ 19.0	+8.5	+4.5
% Variance Below	-17.0	-14.9	- 11.9	-13.6	-6.3	-4.6	-4.0

Source: Statistics Canada, Report 36-003.

Table 3-14 is calculated on the net value of all sales and therefore includes credits from U.S. dollars on export shipments. The fluctuations in average prices are evident although the general trend is towards an increase of about 45 percent from 1980 to 1986. Inquiries by CHI indicate there is no clear cut pattern of a price differential between waferboard and OSB. Some sales are made with no price difference while some are made with a premium of 10- 15 percent for OSB graded as a performance-rated panel, especially when produced in the 5/8" -3/4" thickness and tongued and grooved, a panel used primarily for combined sub-f laoring and underpayment.

Current Canadian wholesale prices in selected major markets have been obtained from price lists and telephone inquiries. Subject to probable, not identifiable, major discounts to large volume purchasers, CHI estimates the current average delivered wholesale price for WB and OSB in major markets in Canada is as follows:

	C $/m³
Vancouver	234
Calgary, Edmonton	227
Regina	235
Winnipeg	242
Toronto	200

The normal distribution channel for these panels is from the producing mill to a wholesaler/distributor (who may be a branch of a major producer), to the retailer or large volume industrial consumer. [n many cases the shipment is made directly from mill to the end-user although the latter pays the wholesaler. Major distributes also have warehouses in strategic locations in which they hold their inventory. Several eastern Canadian mills use a re-load system whereby a car load or truck load is shipped from the mill to a terminal at Windsor or Niagara Falls, Ontario for re-loading on U.S. carriers there. This provides flexibility and reduced costs of transportation. The distribution system for the proposed mill should be studied in more detail if a decision to proceed is taken.

CHI has eliminated Toronto from the potential market zone, since the rail freight from Hay River to Toronto is quoted as $5.82 per 100 Ibs. or $86.3 I per m^3, plus a further $40.00 approximately from Fort Liard to Hay River. Shipping from Fort Liard to Fort Nelson to Toronto is even more expensive, since both the BCR and the CNR would be involved.

From the preceding selling prices, less freight costs and sales costs, the average mill net return may be estimated as follows.

TABLE 3-15 - AVERAGE MILL NET RETURN FROM NWT MILL

(Based on Western Canadian Prices)

(Per m^3)

Location:	Reqina	Edmonton	Calqary	Vancouver
Selling Price	235.00	227.00	227.00	234.00
Transportation Cost	67.64	57.08	64.30	61.36
IO% Sales Cost	23.50	22.70	22.70	23.40
Mill Net Return	143.86	I47• 22	I 40.00	149.24
Averoge Mill Net Return:		$145.00		

3.8.2 MILL NET RETURNS FROM WESTERN U.S. MARKETS

Table 3-16 indicates the average prices delivered to wholesalers in the two western regions of the U.S.A. Specific cities are not identified in the source material but CHI considers these as representative of the major cities in the regions. Western Canadian and U.S. mills must approximate these delivered prices to be competitive.

TABLE 3-16 - U.S. WAFERBOARD/OSB MARKET QUARTERLY PRICES(1)

U.S. $ PER M^3 FOR GIVEN THICKNESS

BY REGION

	SOUTHWEST					INTERMOUNTAIN				
	3/8”	7/16“	1/2”	5/8”	3/4”	3/8”	7/16“	1/2”	5/8”	3/4”
1985										
MAR		150	-	-		-	-	-	-	-
JUN		148	153	163		153	153	151	163	172
SEP		167	153	166		157	160	157	166	175
DEC		141	153	166		157	155	157	166	169
1986										
MAR	-	151	-	173		161	170	164	173	172
JUN	168	149	-	163		168	167	165	166	169
SEP	164	157	-	169		169	153	158	166	167
DEC	164	145	155	166		160	145	154	159	164

(1) Prices fob mill to wholesaler - includes freight.
- = No price quotation   5/8” and 3/4” are Tonaue and Grooved
Prices converted to $ per m3 from data given in M Sq. Ft.
Source: Crow’s Weekly Letter, Portland, Oregon

The indicated average of prices is approximately C$2 12.00 per m^3 in December 1986 which must include all transportation costs, U.S. duty of 4 percent and any brokerage fees. When the transportation costs developed in Sections 3 and 5 are subtracted, there is insufficient residual to cover any mill costs. Therefore it must be concluded that the United States market is not open to a mill at Fort Liard.

mill net return < 0

4.0 LOG SUPPLY AND INFRASTRUCTURE

4.1 LOG SUPPLY

One of the most important elements in planning any mill, but especially a large capacity, automated OSB facility is the log supply. Consideration must be given to (a) annual volume available (b) distance from mill site i.e. transportation factor (c) species (d) quality (e) average diameter and length of items (f) delivered cost to the mill yard.

There have been several surveys of the resource in the NWT, especially in the Lower Liard Forest Management Unit, but none were directed towards the WB/OSB type of mill. In order to synthesize the inventory data and obtain an estimate of probable costs CHI retained Woodland Resource Services Ltd. Edmonton, to submit a report, enclosed as Appendix 1.

Woodland's report states there are deficiencies in the inventory data and that a detailed evaluation of quality and extent of the timber supply is required before a final decision on a mill is taken. At CHI'S request Woodland made a cursory examination of data for the Hay River region, as a potential alternative site, but reported the volume and quality available was suspect. This region was, therefore, quickly eliminated.

The AAC in the Lower Liard Forest Management Unit is summarized as follows:

TABLE 4-1 - ESTIMATE OF A.A.C. IN LOWER LIARD FOREST MANAGEMENT UNIT

	GROSS VOL.(m3)	x	DECAY FACTOR	NET VOL m3	CUNITS
Aspen poplar (100 yr. rotation)	260,000		.75	I 95,000	68,835
White spruce (pulpwood)" (120 yr. rotation)	355,'400		.98	348,292	122,947
White spruce (sawlog) (150 yr. rotation)	197,600		.98	193,650	68,358
Total				736,942	260,140

In addition to the aspen poplar there is apparently a measurable volume of black poplar (P. balsamifera) which Woodland has excluded because of adverse effects of high moisture content in waferboard mills. This has been overcome to some degree in one or two mills with considerable difficulty. Reference is made by Woodland that the aspen in mixed stands has a very high degree of decay and is also excluded from the AAC calculation. CH1's experience tends to confirm that these exclusions are reasonable, although on closer examination and laboratory testing someof the uncounted volume might reusable.

Mixed species can beusedin WB/OSB but the input to thewaferizers and through tothe press must be controlled to avoid unscheduled sudden and severe changes in moisture content, strand quality, variations in resin application and average density of thereat before pressing.

From the 1982 survey of the Lower Liard, it is estimated that decay factorsin the stands were as follows.

TABLE 4-2 - ESTIMATES OF DECAY VOLUME - LOWER LIARD [1]

Species	Incidence %	Advanced Decay %	Advanced and Incipient %
Aspen Poplar	55.20	I 5.40	29.60
Balsam Poplar	60.40	7.90	27.90
White Spruce	7.90	0. I I	I .10

In accordance with the terms of reference, CHI first considered a mill based exclusively on the aspen resource.

(1) "Lower Liard River Timber Inventory, {982", Department of Indian and Northern Affairs, Fort Smith, NWT.

The net volume of aspen available from the AAC is 68,835 cunits which, if entirely convertible, would support a mill of a maximum capacity of 75,500 m^3. This assumes an overall loss factor (decay plus mill processing losses) of 40 percent which experience indicates may apply to the aspen.

In the opinion of CHI and knowledgeable industry executives, a mill of this size is uneconomical except under special conditions. The two small capacity mills listed in Table 4-2 are such cases. The Waferboard Corporation and Normick mil Is were both closely integrated with existing operations e.g., plywood at the same site, so that unit costs are greatly reduced because of shared services, log yards, etc.

If a small mill were built at Fort Liard it would have to support all aspects of the operation from sales revenues. By employing a press size of 4’ x 8’ - 12 openings, the capacity would be approximately correct for the aspen timber supply. However, a 50 percent reduction in press capacity (below that of the mill described later), does not mean an equivalent reduction in capital and operating costs. These would, based on other mill experience, be reduced by only about 30 percent, which means unit costs and especially depreciation, remain high.

Considering these factors, CHI recommends that only a larger unit should be analyzed in detail. Therefore the log supply must include spruce pulpwood to ensure an adequate volume.

The mill capacity selected by CHI requires 104,674 oven dry tons (ODT) of wood per year into the press. Considering in-plant losses and the probability of severe decay in the logs, CHI estimates the wood input into the mil I yard must increase by 36 percent over the output of finished panels, i.e. to I 42,357 ODT annually. CHI has found that while decay loss factors are relatively high in forestry data for poplar, the factor is often not sufficiently large when logs are processed. This loss factor of 36 percent is weighted by the inclusion of the spruce, which is less prone to decay than the poplar. The indicated supply of aspen (1 95,000 m^3) would provide only about 79,470 ODT or 56 percent of requirements. The balance 62,887 m^3 would have to come from spruce pulpwood, with perhaps some additional small volumes of other species.

CHI has assumed for this estimate the log mix will be 50/50 aspen and spruce pulpwood which equates to an annual total input volume of 328,500 m^3. This supply can be obtained from the estimated total AAC of 543,292 m^3 including aspen and spruce pulpwood.

While the total volume is sufficient for the proposed mill **the average size of the logs will require a much greater than usual de-barking capacity.** The AAC volume calculations are based on all stems 17.0 cm and up stump diameter to 3. I cm top diameter on a minimum average length of 17.5 m. Clearly there must be larger diameter logs in the stands but data on the diameter classes are not available. In any event if the smallest diameter classes are by-passed or **long logs are cut up in the** woods then the net volume available for the mill might decrease, **unless the** species ratio is significantly changed, or larger areas are logged. These factors would probably change the delivered cost of logs. Based on visual inspection and measurement at WB/OSB mills in Canada, CHI estimates the normal average diameter range is from 4.3 cm to 6.0 cm for logs delivered in 3.8 metre lengths.

4.2 INFRASTRUCTURE

Woodland states that logging infrastructure of a size and quality to support the mill does not exist in the Lower Liard region.

In order to supply the mill an average of 46 truck loads of 40 tons each are required daily for 250 days per year. This number would double during the logging season during freeze-up and practically vanish during break-up. Woodland has based its estimate of logging requirements on hauling tree-length logs but in CHI'S opinion this **could be changed following re-examination of timber inventory and the cutting changes alluded to above. It may be possible to deliver logs in** 8 foot (nominal) lengths with smaller vehicles.

The logging infrastructure which would be required is considerable, requiring probably 20 skidders, 5 loaders, 5 cats and 30-35 trucks for the necessary volume. All of this would require purchase, financing and maintenance by interested loggers who presumably would live in or near Fort Liard or Fort Simpson. Based on the Woodland estimates of personnel required the 328,000 m^3 input would require about 150 people in logging and hauling operations, plus supporting personnel in equipment, truck maintenance, saw servicing, fuel supply etc. Camps would have to be established. Whether all of these items can be established in or near either of the two communities on an on-going, economically sound basis requires serious investigation.

In the absence of more precise data, CHI has used the delivered cost of logs estimated by Woodland for cost calculations in the report, ie. $43.40/$m^3$ or $122.80 per cunit. This is almost 100 percent greater than the average for the WB/OSB industry in Canada.

5.0 SITE SELECTION

5.1 TRANSPORTATION

Transportation of the log supply to the production plant log yard and transportation of the products to market is of major significance to the economics of an oriented strand board plant. The cost of transporting the log supply is very significant due to the need to haul by truck. Therefore, the alternative communities for the plant site closest to the Lower Liard Forest Management Unit are Fort Simpson, Fort Liard and Hay River. The estimated cost to transport logs from the forest in the Lower Liard to Fort Simpson or to Fort Liard is $12.90 per cubic meter. To truck from Fort Simpson to Hay River would cost another $\$12.90/m^3$, assuming no offloading/reloading charges.

The least cost transportation of the board over large distances is usually by rail unless some unique trucking haul-back situation prevails. Contacts with trucking companies in the NWT has confirmed that no such conditions exist. Closest access to B. C. Rail (BCR) is at Fort Nelson and to Canadian National Railway (CNR) is at Hay River.

A very preliminary study of the annual transportation costs for plants sited at each of the above alternative locations is summarized on Table 5-1. An assumption has been made for the purposes of this analysis that 45% of the product is shipped to Vancouver, 45% to Edmonton and 10% is consumed in the Yukon and NWT. The freight of this last portion is deemed to have a relatively minor effect on the overall transportation cost picture.

TABLE 5-1 - ANNUAL TRANSPORTATION COSTS FOR THREE PLANT SITES

	Fort Simpson		Hay River		Fort Liard	
ITEM/PLANT LOCATION	Total ($1000's)	Unit *5 ($/m3)	Total ($1000's)	Unit ($/m3)	Total ($1000's)	Unit ($/m3)
Log Hauling *1	4,747.0	39.01	9,494.0	78.02	4,747.0	39.01
Product Transport*2:						
- To Vancouver						
Truck *3	2,639.5	43.38			1,319.5	21.69
Transfers	I 43.7	2.36		-	I 43.7	2.36
Rail	1 ,948.9	32.03	3,563.6	43.60	1 ,948.9	32.03
Sub-Total	4,732. I	77.77	3,563.9	43.60	3,412. I	56.08
- To Edmonton						
Truck *4	2,499.6	41.08			5,738.4	94.32
Transfers	143.7	2.36				
Rail	2,652.6	43.60	2,652.;	58.58		
Sub-Total	**5,295.9**	**87.04**	**2,652.6**	**58.58**	**5,738.4**	**94.32**
Total Product Transport	10,028.0	82.41	6,216.5	51.09	9,150.5	75.20
Total Transportation	14,775.0	121.42	15,710.5	129. I I	13,897.5	I 14.21

*1 Total Iogsfrom forestto plant.

*2 Assumed Product Market Values:
1 0% sold "locally" - no evaluation made.
45% sold Edmonton area.
45% sold Vancouver area.

*3 Transfer at Ft. Nelson.

*4 Transfer atHay River.

*5 Unit costs all based on product volumes.

The annual transportation costs for a plant situated at Fort Liard are approximately $900,0001ess than at Fort Simpson and $1,800,000 less than at Hay River.

5.2 INFRASTRUCTURE CONSIDERATIONS

The communities of Fort Simpson, Fort Liard and Hay River have populations of about 1,000, 400 and 3,000 respectively. A modern OSB plant of smaller size yet with economies of scale requires a plant management and staff of about 140 people for a four-shift operation. A further seasonal crew of approximately 150 would be required for the Ioggi ng operation. Additional manpower is required for transportation of product and supplies, and maintenance of equipment. It is clear that such a large total work force and all of the support services are not available at any of these communities. Therefore, included in the capital cost is an allowance of $1,150,000 for some staff housing and an activity center for staff employees, training, etc. Allowances have also been made for mill maintenance shops beyond those normal Iy found in a mi I I located adjacent to service i ndustri es. (See Section 6.)

5.3 SITE SELECTION

Fort Liard has been selected as the site for the OSB plant in this prefeasibility study, since it incurs the least cost for transportation of the three communities and no apparent infrastructural benefits are in existence at any of the communities.

The Dene population of Fort Liard has a median age of 2 I years. Income is essentially derived from trapping, fishing and hunting although there is a trend towards industrialized employment. This trend probably relates to the development of gas wells and a silver-lead-zinc mine in the surrounding territory.

The Liard Valley Development Corporation is established to improve the local economy and would be an important agency in establishing a logging and plant work force if an OSB mill were constructed. However, there may be an insufficient number of workers available from the total population after the children, elderly and the disinclined are eliminated. Therefore, the Iabour force would need to be supplemented from other areas.

It is apparent that, while centrally located from the aspects of logging and products transportation cost, Fort Liard is not particularly well supplied with local Iabour for an OSB type of mill.

6.0 CAPITAL COST

6.I PREFEASIBILITY CAPITAL COST ESTIMATE

File data and knowledge of the cost of typical new plants currently under construction indicates a basic capital cost of slightly over $47,000,000 for a plant of I 34,000 m^3 annual capacity. Other allowances will be required for a plant 'to be built in the Fort Liard region. These are outlined on Table 5-2 and described below.

TABLE 6-1 - NWT **ORIENTED STRAND BOARD**

PREFEASIBILITY CAPITAL COST ESTIMATE

		$ CDN (I 000's)
A.	OSB **PLANT**	
1.	BASIC CAPITAL COST	47,500
2.	ADDITIONAL ALLOWANCES:	
a)	Increment for power generation	3,000
b)	Hot pond improvements	300
c)	Increased slashing/debarking	I ,000
d)	Foundation	I ,000
e)	Road and yard	300
f)	Staff housing and activity centre	I ,150
g)	Shops, warehouse, fire protection	2, I 00
h)	Remote construction	4,150
	TOTAL PLANT CAPITAL COST	60,500
		$ CDN (I 000's)
B.	LOGGING EQUIPMENT AND CAM%	
1.	Woodland estimate	I 0,130
	TOTAL PROJECT CAPITAL COST*	70,630

* Prefeasibility study level of accuracy estimate is (+) or (-) 22% due to dependency on published "data ond unknown config-uration of plant at this stage of develo-pment.

6.2 COMMENTS ON THE ESTIMATE

A.1 Basic Capital Cost

Includes log handling facilities for logs of 300 to 350 mm average diameter; thermal fluid plant, mill heat and process; drying; classifying; forming; pressing; trimming; minor panel finishing; quality control; power and control; minor maintenance shops; offices; spares; site and services; building; and all construction and installation costs

Mobile equipment at plant assumed lease/purchase.

No land cost.

2. a) Increment for power generation added to cover cost of raising steam, turbogeneration and standby process heat load.

2. b) Hot pond improvements added due to small logs, increased bulk volume, increased snow load, increased thermal requirement and insulation.

2. c) Increased slashing/debarking is required to handle the average smaller log diameter.

2.d Foundations. Permafrost and discontinuous permafrost conditions exist in the NWT. The major piece of equipment in an OSB plant is a hydraulic press which is a large, heavy unit requiring a pit and very stable foundations. The selection of a mill site must consider the soil conditions and the presence of permafrost. Drainage problems etc., must be addressed in great detail. The estimate therefore includes an allowance to cover the potential additional foundation costs. This allowance may not be adequate if permafrost conditions prevail. The scope of this study is not adequate to assess the problem ful Iy, bu,t future. feasibility studies should not omit detailed foundation considerations. This point can not be made too strongly.

2.e Road and Yard. Due to NWT weather conditions preparation of the roads and yards should be improved compared to more moderate climates. As the mill is to operate during spring break-up it will be necessary to ensure that the log handling mobile equipment can operate on properly prepared roads and yard areas.

2.f Staff Housing and Activity Centre. Staffing a remote mill with well-trained and experienced personnel requires amenable housing and the benefits accruing from community and company activities. Therefore this allowance has been included to cover some management housing and a small activity centre. The centre can be used for company meetings and training when appropriate.

2.g Shops, Warehouse and Fire Protection. This allowance is for mechanical, electrical, welding and paint shops suitable to support this remote mill. Major repairs will rely on services available in a larger centre and therefore large equipment will be trucked out for repair. A deep reservoir for fire water and the necessary heated pump house will be required.

B. I Logging Equipment and Camps. Refer to Woodlands estimate in Appendix 1.

7. MANUFACTURING COSTS

7.1 ANNUAL LABOUR COSTS

Crew list and management personnel are itemized on Table 7-1 which also develops the annual labour costs. This table is based upon the following assumptions:

- 4 shifts per week working 5 days each
- I shift per week downtime for maintenance
- 24 hour operation for 335 days per year
- fringe benefits 27% for crew and 30% for staff

  wage rates based upon coastal B.C. union rates to assist in attracting labour to a remote plant in the NWT.

TABLE 7-1 - PERSONNEL - ANNUAL LABOUR COSTS

Personnel	I St Shift	2nd Shift	3rd Shift	4th Shift	Total Crew	Wage	Net Annual Labour cost '
OPERATING:							
Security	I	I	I	I	4	16.25	135,200
Weigh Scale	I				I	16.02	33,322
Cat 980					I	20.75	43,160
Cat 966		I	I	I	4	20.44	170,06 I
Grapple		I	I	I	4	18.61	154,835
C/O Saw		I	I	I	4	19.09	158,829
Debarker		I	I	I	4	19.37	161,158
Log Pond	I	I	I	I	4	18.82	156,582
Slasher	I	I	I	I	4	19.08	158,746
Waferizer	I	I	I	I	4	19.63	163,322
Dryer/Classifier	I	I	I	I	4	20.44	170,06 I
Blender	I	I	I	I	4	19.08	158,746
Forming/Pressing	I	I	I	I	4	20.98	I 74,554
Cut-up Line	I	I	I	I	4	20.44	270,06 I
Stacking	I	I	I	I	4	19.08	158,746
T & G; Specialties	I				I	20.21	42,307
Forklift	2	I	I	I	5	19.63	204,152
Warehouse	!	I	I	I	4	16.90	I 40,608
Shipping	I				!	19.67	40, I 94
Trainee/Spare	2	I	I	I	5	16.38	170,352
Clean-up	5	4	4	4	17	15.72	555,859
First Aid/Misc. * I	2	I	I	I	5	20.17	209,768
Quality Control	I	I	I	I	4	20.98	174,552
Thermal Plant Operator *2	I	I	I	I	4	21.73	180,792
OPERATING TOTALS	32	23	23	23	104	-	3,93 I ,615
		Including 27 ?6 Benefits					4,993, I 5 I

TABLE 7-1 - PERSONNEL - ANNUAL LABOUR COSTS (cent'd)

Personnel	1st Shift	2nd Shift	3rd Shift	4th Shift	Total Crew	Wage	Net Annual Labour Cost
MAINTENANCE:							
Millwright	3	2	1	2	8	20.88	347,443
Electrician/Electronics	2	1	1	1	5	20.88	217,152
Welder	1				1	20.65	42,952
Filer/Grinderman	1				1	21.32	44,346
Oiler	1				1	17.25	35,880
Heavy Duty Mechanic	1				1	21.65	45,032
MAINTENANCE TOTALS	9	3	2	3	17		732,805
		Including 27 % Benefits					930,662
ADMINISTRATION:							
Manager	1				1	75,000	75,000
Production Superintendent	1				1	55,000	55,000
Shift Foremen	1	1	1	1	4	47,000	188,000
Quality Control Supervisor	1				1	45,000	45,000
Plant Engineer	1				1	55,000	55,000
Maintenance Supervisor	1	1	1	1	4	47,000	188,000
Accountant	1				1	40,000	40,000
Clerk	2	-	-	-	2	25,000	50,000
Secretary/Receptionist	1	—	—	—	1	20,000	20,000
ADMINISTRATION TOTALS	10	2	2	2	16	-	716,000
		Including 30 % Benefits					930,800
GRAND TOTALS	50	27	26	27	137		5,380,420
		including Benefits					6,854,613

* The first aid/miscellaneous crew members are expected to perform ongoing tasks in addition to first-aid functions. Such tasks are:

- purchasing assistance such as requisitioning and receiving.
- supervision of the tool room
- control and maintenance of spares inventories
- assistance to the maintenance supervisor in forwarding communications to/from the shift millwright and electrician
- other miscellaneous duties.

*2 Thermal plant operator will be expected to assist the shift forman in monitoring the dryers as well as operating the thermal plant and generators.

7.2 ANNUAL MANUFACTURING COSTS

The manufacturing costs are summarized on Table 7-2 which shows annual total and unit costs related to a production level of 134,000 m^3 per year.

TABLE 7-2 - ANNUAL MANUFACTURING COSTS

ITEM		ANNUAL COST ($ I 000's)	UNIT ' COSTS ($ per m³)
1.	Raw Materials		
	- wood	14,258	106.41
	- Resin	4,543	33.90
	- Wax	983	7.39
	Total Raw Materials	19,784	147.64
2.	Labour	6,855	51. Is
3.	Oper. & Maint. Supplies	927	6.92
4.	**Fuel**	I 94	I .45
s.	Office Overheads	I 00	0.75
.6.	Taxes & Insurance	879	6.56
7.	Interest Costs:		
	Working Capital (less logs)	165	1.23
	- Log Inventory	81 I	6.05
	- 40 % of capital cost	I ,554	1 I .60
	Total Interest Costs	2,530	I 8.88
8.	Total Manufacturing Costs Excluding Depreciation	31,269	233.35
9.	**FULL Depreciation**	6,016	44.89
	Total Manufacturing costs	37,285	278.25
	Depreciation percent of total costs		16. I
I o.	**PARTIAL Depreciation**	3.008	22.45
	Total Manufacturing Costs	34;277	255.80
	Depreciation percent of total costs		8.8

Two **methods of determining depreciation have been included. The first as** shown on line 9 of Table 7-2 has utilized the full capital cost of the project as follows:

- 15 year straight line depreciation for all equipment, buildings, etc., and,
- 5 year straight line depreciation on all mobile equipment and portable logging **camps**

The second method as shown on line 10 of Table 7-2 assumes that half of the capital cost has been provided through government grants. Therefore, the balance, or 50% of the capital cost, has **been depreciated on the same basis as the first method.**

Comments regarding the derivation of the manufacturing costs are related to the line numbers of Table 7-2 follow:

1. Raw Materials
   Wood: based on 328,500 m^3 per year at $43.40 per m^3.
   Resin: based on 2.75% resin by weight at $1.60 per kg. delivered.
   Wax: based on 1.25% wax by weight at 48.36 per litre plus trucking from Edmonton at $196,000 per year.

2. Labour: refer to paragraph 7. I and Table 7-1.

3. Operating and Maintenance Supplies:
   Operating, maintenance and other consumable supplies include: saws, saw teeth, knives, board coating, cutters, lubricants, fuel, misc. small supplies, small tools, spares, outside repairs, building and roads maintenance.

4. Fuel: diesel fuel consumed at the plant is included for operation of the 980 and 966 log loaders, forklifts and for running a stand-by 300 KVA generator for 10% running time (deemed to be high).

5. Office Overheads: telephone, telex, photocopying, stationery, periodicals, association dues, charitable donations, travel, etc.

6. Taxes and Insurance: based upon ½ % of capital cost not including the activity centre and spares.

7. **Interest Costs**

Working Capital: a preliminary rough estimate of the working capital (less log inventory allowances) has been made at $1,500,000, which at I I % interest amounts to $165,000 per year.

Log inventory: the assumption has been made that logging and log hauling occurs for 4½ months of the year and therefore the log inventory at the end of that period is equal to 7½ months production plus a 2 month log reserve. Interest rate used is I l%.

Capital Cost: the assumed financing is 10% equity, 40% loans and 50?6 government grant. Therefore, on the average, one half of the loans (or 20% of the capital) is outstanding while the loans are paid off with an assumed series of equal principal payments. Therefore, the average interst cost is 11% of 20% of total capital cost. Note that for the first depreciation method, ie. full depreciation, a similar 40?6 loan has been assumed.

8. ECONOMICS

8. I POTENTIAL PLANT EARNINGS

Evaluation of the mill net returns in Section3 of this report indicated the levels at typical Canadian OSB plants and those to be expectedat a plant located in Fort Liard for the most accessible markets. The following tables have been developed for three levels of mill net returns set at $160, $180 and $200 per cubic metre defining cases A, B and C respectively.

The $!60 per m^3 level reflects a situation in which a moderate decline occurs perhaps due to temporary oversupply in the market place.

The $180 per m^3 level is slightly below the probable average mill net return ‘" 1986 but could occur if a 10 percent drop in average prices occurs. Such change occurs fairly frequently in the forest products industry.

The $200 per m^3 level is a projection of a probable 1987 level. Current indications are that mortgage rates are dropping which usually stimulates housing starts (a prime OSB market) and therefore the average mill net return may be reasonably expected to be in the $200 to $210 per m^3 level in 1987.

The potential plant earnings have been developed on Tables 8-1 and 8-2 for conditions of full and partial depreciation to reflect the full capitalization or government grant situation.

TABLE 8-1 POTENTIAL PLANT EARNINGS WITH FULL DEPRECIATION

Item	Units	Case A	Case B	Case C
Production	m^3 per yr.	I 34,000	I 34,000	I 34,000
Mill Net Return	$ per m^3	160	180	200
Net Sales Revenue	$(I 000’s)	2’1 ,440	24,120	26,800
Manufacturing Costs	$(I 000’s)	37,285	3 7 , 2 8 5	37,285
Gross Profits (Losses)	$(1000’s) “	15,845)	(13, 165)	(10,485)
Taxes	$(I 000%)	-	-	-
Net Profits (Losses)	$(1000’s)	I5,845)	(13, I65)	(I0,485)

TABLE 8-2 POTENTIAL PLANT EARNINGS WITH PARTIAL DEPRECIATION

Item	Units	Case A	Case B	Case C
Production	m^3 per yr.	134,000	134,000	134,000
Mill Net Return	$ per m^3	160	180	200
Net Sales Revenue	$(1000's)	21,440	24,120	26,800
Manufacturing Costs	$(1000's)	34,277	34,277	34,277
Gross Profits (Losses)	$(1000's)	(12,837)	(10,157)	(7,477)
Taxes	$(1,000's)	-	-	-
Net Profits (Losses)	$(1000's)	(12,837)	(10,157)	(7,477)

It is clear from Tables 8-1 and 8-2 that the mill is in a loss position for all selected mill net return levels. The break even point occurs when the mill net return is equal to the unit manufacturing costs. The unit manufacturing costs for full and partial depreciation conditions from Table 7-2 are $278 and $256 per m^3 respectively. These costs are 39 and 28 percent greater than the $200 per m^3 mill net return to be expected in 1987 at a typical Canadian 0S6 plant and 9[.7 and 76.5 per cent greater than the average mill net return calculated in Section 3 for the NWT plant at $145 per m^3.

8.2 POTENTIAL FOR ECONOMIC IMPROVEMENT BY REDUCING COSTS

Table 8-3 develops-the percentages of each unit manufacturing cost element of the total and their rank of importance.

TABLE 8-3 UNIT COST PERCENTAGES

ITEM		UNIT COSTS ($/m3)	PERCENT COSTS FULL DEP'N	PERCENT COSTS PARTIAL DEP'N	RANK FOR PARTIAL DEP'N
1.	Raw Materials:				
	- wood	106.41	38.2	41.6	I
	- Resin	33.90	12.2	I 3.3	3
	- Wax	7.39	2.7	2.9	6
	Total Raw Materials	147.64	53. I	57.8	-
2.	Labour	51.15	18.4	20.0	2
3.	Oper. & Maint. Supplies	6.92	2.5	2.7	7
4.	Fuel	1.45	0.5	0.6	10
5.	Office Overheads	0.75	0.3	0.3	12
6.	Taxes & Insurance	6.56	2.4	2.6	8
7.	Interest Costs:				
	Working Capital (less logs)	1.23	0.4	0.5	II
	- Log Inventory	6.05	2.2	2.4	9
	- 40 % of capital cost	I I .60	4.2	4.5	5
	Total Interest Costs	18.88	6.8	7.4	
8.	Total Manufacturing Costs Excluding Depreciation	233.35	83.9	91.2	
9.	FULL Depreciation	44.89	[6. I	-	-
	Total Manufacturing costs	278.25	I 00.0	-	-
I o.	PARTIAL Depreciation	22.45		8.8	‘ 4
	Total Manufacturing Costs	255.80		I 00.0	

Comments on potential to improve the unit costs follow:

TABLE 8-4 POTENTIAL MANUFACTURING COST IMPROVEMENTS

RANK	%	ITEM	COMMENT
1	41.8	Wood	Contact with Woodland indicates that the estimate of log cost is realistic, based upon available data.
2	19.6	Labour	Crew size **and wage rates realistic** for trained reliable personnel. No relocation allowances. Crew and staff training at start-up not included. On-going crew training included.
3	13.3	Resin	Based on quotations received by telephone.
4	8.8	Depreciation	Partial depreciation taken as shown.
5	4.6	Loan Interest	This figure would be higher in early years and therefore significance to cash flow is understated.
TOT.	88. I		

Consideration of the five elements which amount to 88% of total manufacturing costs indicate little potential for improvement.

8.3 ECONOMIES OF SCALE

After CHI had commenced work on the study and explored the annual production volume based upon the annual volume of poplar available to the mill, it was realized that the plant would not be economic due to its small, size. This preliminary conclusion is confirmed by the development of a rough capital cost estimate and approximations of the manufacturing costs. The capital cost is estimated to be about $6 I million for the plant and logging equipment developed on the same basis as the larger mil I capital cost estimate. The production of the smaller plant based on 195,000 m^3 per year log input of aspen only would be about 75,500 m^3 of board. The manufacturing cost development is shown on Table 8-3.

TABLE 8-5 MANUFACTURING COSTS (SMALLER MILL)

ITEM		ANNUAL COST ($ I 000's)	UNIT COSTS ($ per m3)
1.	Raw Materials		
	- wood	8,028	106.33
	- Resin	2,558	33.88
	- Wax	553	7.32
	Total Raw Materials	I I ,140	147.53
2.	Labour	6,453	85.47
3.	Oper. & Maint. Supplies	855	I I .32
4.	Fuel	I 13	I .49
5.	Office Overheads	95	I .26
6.	Taxes & Insurance	806	10.68
7.	Interest Costs:		
	- Working Capital (less logs)	92	I .22
	- Log Inventory	495	6.56
	- 40 % of capital cost	I ,339	I 7.74
	Total Interest Costs	I ,926	25.52
8.	Total Manufacturing Costs Excluding Depreciation	21,388	283.27
9.	FILL Depreciation	4,760	63.05
	Total Manufacturing costs	26,148	346.32
	Depreciation percent of total costs		18.2 %
I o.	PARTIAL Depreciation	2,380	31.53
	Total Manufacturing Costs	23,768	314.80
	Depreciation percent of total costs		I o. o%

The total manufacturing costs are $346 and $315 per m^3 with full and partial depreciation. These costs are greatly in excess of the $145 per m^3 anticipated average mill net return at the NWT plant, and exceed the total manufacturing costs of the larger plant as follows

TABLE 8-6 - COMPARISON OF MANUFACTURING COSTS FOR TWO LEVELS OF PRODUCTION

Item	Units	Larger Plant	Smaller Plant	Percent Cf. Laraer Plan{	Percent Cf. Average Plant
Production	m^3 peryr	I 34,000	75,500	56.3	
Mfg. Costs with Full Depreciation	$ per m^3	278	346	124	238
Mfg. Costs with Part. Dep'n.	$ per m^3	256	315	123	217

8.4 NWT AS A RAW MATERIAL SOURCE

The potential of the NWT as a source of raw material for a processing facility located in Alberta or British Columbia is not good due to the high cost of logging and of transportation. The cost of poplar logs in Alberta is approximately $25 per m^3 delivered at the sawmill, compared to Woodland's cost for the NWT estimated at $43.40 at Fort Simpson. This log cost is about 174% of the Alberta cost, exclusive of any processing or transport-to-plant costs.

Considerations of transporting processed wafers is impractical due to the increased costs associated with: log yard handling; debarking/slashing; waferizing; drying; classifying; wafer storage; wafer transport; and disposal of residues such as bark, trim ends, sawdust and fines. The costs of the capital required to build a waferizing facilify in the NWT "and wafer receiving and storage facilities at the user's plant will also have to be offset. The distances to transport to existing plants at Slave Lake, Edson, Drayton Valley and Dawson Creek are great, making the cost of further hauling prohibitive.

9.0 COMMENTS

In Cl-n's opinion there are comments which should be made in order to assist the NWT Development Groups in evaluating the conclusions reached in this report. Not all of the following comments arise directly from the study but CHI feels they should be made.

1. Forest Inventory

The forest inventory must be determined more exactly to define the important factors of distribution of species by diameter classes, decay factors, possible utilization of balsam poplar.

2. Species Assessment

In planning a re-constituted panel mill such as an OSB plant it is vital that a preliminary assessment of waferizing drying, blending, pressing and panel characteristics of the various species be completed by appropriate laboratories.

3. Soil Conditions

Probable unexpected soil conditions, extremes of weather and the remote site will add to the total capital cost of the mill over the cost of an identical mill in a more southerly location.

4. Staff Remuneration

Extra financial inducements will be required to attract competent managers and key personnel to locate in the Fort Liard area.

5 Technical Competence

A high degree of technical competence and a supporting program to develop this in untrained employees will be required on a continuing basis. The job requirements permit both men and women to be eligible.

6. Seasonality Consideration

The seasonal aspect of logging operations may cause problems in developing a permanent crew especially if operators must make their own investment in trucks, etc.

7. Funding

It is understood that the Federal Native Economic Development Program could fund 50 percent of the capital cost of projects owned and operated by Native groups, who would require to have about 10 percent equity participation.

8. Residues

0S6 mills do not generate large volumes of residue and in this case the material developed will be fully utilized in the thermal and electrical generation plant which makes the mill self sufficient in energy. Dry trim will be used to improve quality of boiler fuel. Generation of electric power for sale outside the mill is not considered economically viable.

9* Natural Gas

At some future date the purchase of natural gas from the gas wells in the general area of Fort Liard might be considered for fuel. Proximity of the plant to a gas pipline should be considered.

I o. Local/Native Employment

Of the total plant operating crew of 137 persons, it is estimated that 20 - 25 would have to be brought in initially from outside the Fort Liard area. The balance, about 115, could be engaged from the local population. As the crew gains experience, some of the local trainees would have' the opportunity to move up to the more skilled jobs.

I 2. Investment in Job Creation

The total jobs created on an annual, ongoing basis would be 137 in the mill plus 70 in logging, for a total of 207. Therefore, the capital invested per job created is $341,000.00.

13. Disadvantaqes of Northern Resource Compared to Southern

It is recognized that although the aspen timber resource which exists in the Northwest Territories contains several positive features, there are certain disadvantages to its utilization:

(1) generally smaller size distribution;

(2) an average lower quality;

(3) highly seasonal logging activity;

(4) distance tohaullogs tomilland endproducts to customer is extreme;

(5) practically no logging infrastructure in place;

(6) net result of the above is that unit cost is well above the average of the 0S6 industry.

APPENDIX I - ESTIMATE OF ANNUAL ALLOWABLE CUT AVAILABLE IN N.W.T. IN SIRPORT OF 0S6 PRODUCTION

WOODLAND RESOURCE SERVICES LTD.

WOODLAND RESOURCE SERVICES LTD.
FOREST RESOURCE AND ENGINEERING CONSULTANTS
10735-ISOTH STREET, EDMONTON, ALBERTA, CANADA T5S IGS TELEPHONE (403)483-4666

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JAN 26 1987
CARROLL HATCH
(INTERNATIONAL) LTD.

PLEASE QUOTE OUR FILE NO.

Janu.a ry 19, 1987 T39.3 .41 E .

Carrel 1 -Hatch (International) Ltd.
148 East 2nd Street
North Vancouver, B.C.
V7L 1C3

Att n: **Mr. Archie Sudbury**

RE: NWT - OSB PREFEASIBILITY STUDY
WOODLAND RESOURCE SERVICES LTD. INVOLVEMENT

Dear Archie:

As per your recent request, please find attached our cursory assessment of the timber supply in the Northwest Territories and estimates of available annual allowable cut. Unfortunately, information relative to the timber supply is insufficient for the determination of accurate forecasts and any detailed assessment of the potential for O.S.B. production must be preceeded by a detailed evaluation of the raw material base, specific to such production.

Included as part of our review are forecasts of both crew and equipment needs relative to the annual allowable cut supported by available data, and the cut deemed necessary to support O.S.B. production.

I trust this information will be of assistance to you in the completion of your study.

.Yours truly,

WOODLAND RESOURCE SERVICES LTD.

B.P. (Brian) Adams, R.P.F.
Senior Forestry Consultant

BPA:ap
attach.

ESTIMATE OF ANNUAL ALLOWABLE CUT AVAILABLE IN N. W.T. IN SUPPORT OF O.S.B. PRODUCTION

INTRODUCTION

Woodland Resource Services Ltd. has been requested to review available timber inventory data relative to the timber resource in the Northwest Territories to determine if sufficient volumes of appropriate species of timber are available to sustain a minimum annual harvest of 80,000 cunits (230,000 m^3).

In addition, an estimate” of crew and equipment requirements necessary to handle this volume together with an estimate of capital costs, has also been prepared.

Unfortunately, assessement of the timber supply in the Territories is incomplete,hence it is difficult to derive reliable estimates of volume for both the hardwood and softwood component.

The timber resource available is generally confined to the Cameron Hills/Slave River region near the Alberta/NWT border and the Liard River Valley, specifically south and west of Fort Simpson.

The Liard Forest Management Unit contains the largest, most productive single tract of uncommitted timber in the Northwest Territories. Volume estimates for both coniferous and deciduous species found in this area were prepared by the Department of Indian and Northern Affairs; Fort Smith, N.W.T. in 1982.

On the basis of the review of this document, a review of aspen utilization and research in northern and west central Alberta and other documents pertinent to this study, Woodland Resource Services has prepared the following to supplement information being developed and assembled by Carroll-Hatch (International) Ltd.

It must be emphasized that the information supplied is based strictly on the review of available information combined with our experience with aspen and familiarity with the forest , industry of the Northwest Territories, and is not supported by any on-site investigation by Woodland Resource Services Ltd.

In light of the above, it is imperative that any indepth feasibility study of the potential for O.S.B. production in the Territories be preceeded by a detailed evaluation of the quality and extent of the raw material supply.

AVAILABLE TIMBER SUPPLY

LIARD F.M. U.

The following estimates of annual allowable cut (A.A.C.) are based on the utilization of pure stands of asp-en and white spruce/white spruce mixedwood stands. Admixtures of aspen particularly, have not been included in A.A.C. estimates as experience in Alberta indicates wood quality of the aspen to be considerably lower than in pure stands. It should be noted that poplar has been excluded from hardwood estimates due to its excessively high moisture content.

a) ESTIMATE OF A.A.C.

	GROSS VOL.(m³) x	DECAY FACTOR =	NET VOL(m³)
Aspen poplar (100 yr. rotation)	260,000	,75	195,000
White spruce (sawlog) (150 yr. rotation)	197,600	.98	193,650
White spruce (pulpwood) (120 yr. rotation)	355,400	.98	348,292
TOTAL A.A. C.			736,942m³

NOTE: The following utilization standards has been applied to obtain the estimates, of A.A.C.

- Aspen and white spruce pulpwood utilization standard
  - top d.i.b. (cm) 8.0
  - stump ht. (m) 0.3
  - min. stump d.i.b. (cm) 17.0
- White spruce - sawlog utilization standard
  - top d.i.b. (cm) 15.0
  - stump ht. (m) 0.3
  - min. stump d.i.b. (cm) 27.4

b) STAND DESCRIPTION

The timber available in the Liard F.M.U. is comprised of aspen and white spruce, both pure and in combination with balsam poplar and minor quantities of white birch. Available information concerning the quality and quantity of the timber indicates that timber is generally quite small. The best timber available in this area is located on the alluvial flats of the Liard River. This timber (white spruce) is deemed to be some of the best quality wood available in the Territories.

Lack of sufficiently detailed inventory nformation for this region precludes the preparation of any reliable estimate of tree size and tree size distribution. Furthermore, volumes have not been adjusted to reflect accessibility of "available" timber nor local timber requirements, i.e. fuelwood. Historically, 1500 cords of fuel wood (3,600 m^3) are harvested from the area each year for local consumption. Therefore, estimates of available volumes are in all liklihood somewhat high.

Merchantable stands of both hardwoods and softwoods are defined as those stands of 17.5 metres minimum average height to the utilization standards presented earlier in this report. Stands not meeting these criteria are deemed to be unmerchantable.

OTHER SOURCES OF SUPPLY

A cursory review of the timber in the Cameron Hills/Slave River indicates that the limited softwood volume is fully committed to the support of area sawmills. The available aspen volume is insufficient to supply the total need of an O.S.B. plant. Furthermore, as it consists almost entirely in mix with white spruce, its quality is suspect. The fact that this timber component is concentrated on the unstable upper slopes of the Cameron Hills further detracts from its suitability as a source of supply.

LOGGING

a) ESTIMATED COST OF LOGS DELIVERED

		$/m³
0	Logging cost (loaded) - falling, skidding, limbing, bucking, loading	= 12.00
0	Access Development	6.50
•	Road Maintenance	7.00
•	Haul Cost	12.90
•	Camp/Commuting cost	2.50
0	Overhead	2.50

TOTAL ESTIMATED COST OF LOGS DELIVERED $43.4o

The estimate of cost of logs delivered has been determined utilizing the cost model developed for the report "Utilization of Hardwoods in Northern Alberta" prepared for the Northern Alberta Development Council, 1984, adjusted to reflect the situation in the Territories. A maximum haul distance of,250 kms has been assumed for purposes of cost estimation.

b) EQUIPMENT REQUIREMENTS

- AAC 195,000 m^3 (single shift)

		CAPITAL COST	
15 skidders	@	$115,000	$ 1,725,000
3 loaders	@	$155,000	465,000
3 cats	@	$210,000	630,000
25 trucks	@	$100,000	2,500,000
2 - 3 logging camps	@	$140,000	280 - 420,000

AAC 230,000 m^3 (single shift)

17 skiders	@	$115,000	1,955,000
4 loaders	@	$155,000	620,000
4 cats	@	$210,000	840,000
30 trucks	@	$100,000	3,000,000
2 - 3 logging camps	@	$140,000	280 - 420,000

C) MANPOWER REQUIREMENTS

- AAC 195,000 m^3 (single shift)

15 skidder operators
10 bucker/limbers
16 failers
3 loader operators
3 cat operators
25 truck operators
1 forester
1 manager
1 accountant/clerk
1 office clerk
6 kitchen staff
4 logging supervisors/technicians
86 people

0 AAC 230,000 m^3 (80 ,000 cunits) (single shift)

17 skidder operators
12 bucker/limbers
19 failers
4 loader operators
4 cat operators
30 truck operators
6 kitchen staff
1 office clerk
1 accountant/clerk
1 forester
5 logging supervisors/technicians
1 manager
100 people

Equipment and manpower requirements could be reduced through the utilization of feller bunchers in the harvesting operation with a corresponding increase in , capital cost.

d) CAPITAL EQUIPMENT COSTS

	1986 REPLACEMENT COST	APPROX . USED COST
Rubber Tired Skidder	$ 115,000	$ 69,000
Wheeled Loader	155,000	93,000
Dozer Cat	210,000	126,000
Feller/buncher	260,000	156,000
Log Truck	100,000	60,000
Self-contained 45-man camp	140,000	70,000

APPENDIX 2 - DESCRIPTION OF TYPES OF PANELS

APPENDIX 2

DESCRIPTION OF TYPES OF PANELS

Panels may be separated into two broad classes:

Structural Class: This is the class into which OSB falls and refers to panels where strength and performance under severe conditions, such as long-term exposure to weather, are the over-riding characteristics. Apearance is not a paramount consideration. Generally, a fully waterproof or "exterior" quality adhesive such as phenol-formaldehyde is required. In Canada, panels considered as structural are generally "softwood" or Construction Plywood, which includes the coniferous plywoods: Douglas-fir, Canadian Softwood Plywood (CSP) and poplar plywood, together with waferboard and oriented strand board. The terms "construction", "exterior" and "structural" are used interchangeably in the industry to refer to panels suitable for use under the conditions noted above. For the most part structural panels require roundwood or solid wood as the basic material.

Non-Structural Class: Panelsin this class are usually manufactured for applicat ons where long-term exposure to weather and humidity is not expected and strength properties are not critical. Appearance and surface quality are often of major importance, either in the basic panel or in the final stage after further finishing has been applied. The panels are usually produced witha "non-waterproof ''adhesive such as urea-formaldehyde. Typical applications include cabinet and furniture manufacture, substrates for prefinishing, wall panel ling and miscellaneous millwork. The class includes particleboard, medium-density fibreboard (MDF), hardboard, softboard (insulating boards, acoustic tiles, etc.) and hardwood plywood.

Notwithstanding the previous classification, there is considerable overlap in the actual use of all panels. Frequently, a structural panel, for example, construction plywood, is used in a non-structural application such as a furniture component, shelving, etc. based on price and availability. Waferboard may be used to some extent as an interior, decorative wall panel. Particleboard (interior quality adhesive) is used as a sub-flooring in house construction; where it competes with CSP, WB and OSB, hardboard is employed as exterior siding; and rigid insulating board is used as a wal I sheathing, under an outside cladding.

The following technical definition of each panel in the structural class is important in the consideration of a new industry such as proposed.

Oriented Strand Board (OSB)

Oriented strand board (OSB) refers to a type of panel which is composed of long narrow "strands" about 0.7 mm x 19 mm x 75 mm in dimension. These strands can be aligned, more or less in parallel, on the face of a panel with a cross alignment in the core. Panels may be made with 3 or 5 ply construction. Strength and stiffness properties are increased in the "long" direction to a level close to that of coniferous plywood and superior to that of waferboard.

Waferboard (WB)

Waferboard is a sheet material made from "wafers" which resemble small rectangular pieces of veneer about 35 to 75 mm along the grain, with an average of 0.5 mm to 1.0 mm in thickness and widths up to about 30 mm.

In Canada, both strands and wafers are cut from roundwood bolts, generally of poplar species, by strand waferizing machines in which the knives are mounted on a large revolving disc. Thickness of strands or wafers must be maintained in strict limits. The cutting action is similar to that of a veneer slicer. Dried strands and wafers are blended with a phenol-formaldehyde resin and formed into a mat which is hot-pressed to a density of about 670 kg per m^3, and mainly sold in 1220' x 2440 mm panel sizes.

The finished panels are usable in exterior applications due to the waterproof glue employed. Major uses are for roof and wall sheathings and general utility purposes, in direct competition with construction plywood.

CSA Standard 0188.2 M 78 applies to waferboard and OSB produced in Canada which has led the world in practical development of the original technology, originally conceived in the U.S.A.

Softwood or Construction Plywood

The term "Construction Plywood" is employed by Statistics Canada to include both coniferous plywood and poplar plywood:

i) Douglas-fir plywood (DFP) is a plywood in which all the veneers "are of coniferous species, with the face veneer being specifically of Douglas-fir. The adhesive employed is normally phenol-formaldehyde resin.

ii) Canadian softwood plywood (CSP) permits combinations of coniferous and poplar veneers. The face and back must be of coniferous species, other than Douglas-fir. These face veneers are generally spruce, balsam or hemlock, with spruce predominating. Two poplar species, P. balsamifera and P. tremuloides, are permitted to be used with coniferous species under the CSA standard. Adhesive requirements far CSP are the same as for Douglas-fir.

iii) Poplar plywood may be produced with all veneers of poplar species only or with only the face and back veneers of poplar. Inner plies may be of birch or any combination of several coniferous species, spruce being the most commonly used. Poplar plywood may made with either exterior or non-exterior adhesives. When used in structural applications it must conform to the same adhesive requirement as the coniferous plywoods.

Construction plywood may be further sub-divided into two broad grade groups - sanded or sheathing. Sanded plywood is made with a face of the highest quality, smooth cut veneer, which is sanded to prescribed tolerances, permitting high quality final surface treatments, e.g., painting, overlaying. Sheathing plywood has a generally knotty, rough veneer face, with certain open defects and is, for the most part, not sanded. There are, however, select sheathing grades which are given a degree of sanding, to tolerances broader than those specified for sanded grades. Thicknesses of these panels range from 6.35 mm to 25.4 mm while panel dimensions are normally 1220 mm x 2440 mm. Some mills can produce panels 3048 mm in length.

The sheathing grades of plywoods are the major target markets for both waferboard and OSB and, as will be seen, are losing ground to the newer panels.

Comply

A veneer can be applied to the face and back of a strand board core to produce a multi-ply structural panel called "Comply". The same type of panel can be made also with a particleboard type (non-aligned particles) of core, with phenol-farmaldehyde adhesive. There is no production of Comply in Canada and very little in the U.S.A. because of the cost of production.

Generally, waferboard, OSB and Comply are each made and sold in panel sizes similar to plywood, although the production technology permits the production of very large panels up to 244 cm x 488 cm which are subsequently cut to the standard sizes.

The other panels which have some effect on OSB, WE and plywood markets are the particleboard and fibreboards which are most often, especially in North America, produced from mill residues such as shavings or chips.

Particleboard

Particleboard is a panel generally made for non-structural uses and which is usually, although not always, bonded with a non-exterior adhesive, urea-formaldehyde.

In Canada, particleboard is manufactured from wood material in the form of particles produced by mechanical means such as chipping, flaking, hammermilling, etc. as distinct from fibres which are made by refining by steam and high pressure. The raw material is a by-product of other processes, e.g., shavings which are subsequently broken down into a random mixture of various shapes and sizes.

Most particleboard is made in a thickness range of 12.7 mm - 25.4 mm with a density range of 640 kg -720 kg per m^3. Some is made at 300 kg per m^3 for door cores.

Fibreboard

Fibreboard panels are made by either pressure refining or grinding residues and then applying heat and pressure. The pressing may be either by a "wet" process in which the fibres are carried in an aqueous suspension and pressed in the wet condition; or "dry" process inwhich the fibresare dried before pressing. "

Three types of fibreboards are recognized, generally classified by density range:

i) **Hardboard:**

Hardboard is fibreboard, generally from 6.25mm up to I 1. I mm thick, produced to a density greater than 496 kg per m^3, up to 990 per m^3, in a wet process. A minimal amount of phenolic resin is added before pressing. Generally it is used in furniture manufacture or in applications where surface quality is important, e.g., prefinished paneling.

ii) So ftboard:

Softboard is a fibreboard made in a wet process and pressed to densities less than 496 kg per m^3. [t is also called "rigid insulating board". This is sometimes impregnated with asphalt for wall sheathing uses. Ceiling (or acoustic) tiles are the major products of the softboard group.

iii) Medium-Density Fibreboard (MDF):

MDF is made by the dry process with the addition of about 10% of urea-formaldehyde resin and compressed to a density range of 720-880 kg per m^3. Most MDF panels are in the 15.8mm to 19mm thickness range. This may be used either as a core panel or as a substrate for direct printing and finishing. Some is made for exterior cladding. The new mill at Blueridge, Alberta will produce MDF.