Forintek Canada Corp.
Western Region
2665 East Mall
Vancouver, British Columbia V6T 1W5

Community Sawmill Opportunities Study

Prepared for

Government of Northwest Territories
Industry, Tourism and Investment
Environment and Natural Resources
700 5102 – 50th Avenue
Yellowknife, NT
X1A 3S8

NWT Service Contract 405038

March 2007

Dalibor Houdek
Forintek Project Leader

Roland Baumeister
Department Manager

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Executive Summary

In February 2007, the NWT government in keeping with its mandate to promote a sustainable forest industry entered into a contract with Forintek Canada Corp. to conduct a "Community Sawmill Opportunities Study" designed specifically to establish the foundation for future growth and sustainability. The objective of the study was to examine the economics of community sawmill operations in the NWT to determine the necessary conditions for profitable operations.

In developing the recommendations for the enhancement of the industry, the contractor has reviewed a number of key areas including the state of the current industry, market opportunities, and the need for training, technical support, and capital investment. For the NWT mills that were visited and profiled, some mill-specific observations and recommendations have been provided.

Four specific opportunities have been analyzed:

- The implementation of best practices
- Value-added / secondary wood product manufacturing
- Log home building
- Wood pellet manufacturing

If the creation of sustainable employment and community well-being are important priorities, some may wish to evaluate the opportunity to produce secondary wood products and/or log homes while others will be better positioned to produce lumber and timber products. The production of secondary wood products and/or log homes will displace some of the materials currently being imported. While producing pellets might allow the communities to become more self-sufficient in energy needs, it is not considered to be meeting the additional objectives of the communities in other areas such as employment.

It is evident that local communities are eager to provide sustainable employment to their members, either by restarting their existing sawmill operations or venturing into other business opportunities (e.g.: log homes or wood pellets). However, the communities must first and foremost capture the local markets by gaining the confidence of the NWT customer base. This can only be accomplished by providing the volumes of product that the customers demand in a timely manner and with the desired quality. Although the NWT sawmills are currently not able to provide products such as wood paneling, they can certainly accommodate the immediate demand for rough lumber and cants. While it may be advantageous in the short term to consider opportunities for the supply of green lumber and cants to such projects as the proposed Mackenzie Valley Gas Pipeline (MVGP), it would be unwise to base future sustainability of any community or sawmill operation on such a "project-oriented" demand.

Some of the key recommendations of the report have addressed the need for investments in:

- shelter for both machinery and workers to create an opportunity for extending the operating season
- specific training and technical assistance
- mechanisms to track key costs and operating ratios
- proper air-drying techniques, and investments in small kilns and planers that will allow operators to better serve and capture a portion of the local housing construction market
- equipment to produce secondary wood products and/or log homes

Regardless of the business venture launched, support from the NWT and/or Federal Governments will most likely be necessary. As well, the establishment of new policies could be considered by the NWT Government to further assist the communities in their efforts to become more self-sustaining.

It is not unrealistic to expect that local self-sufficiency, based on a solid foundation of appropriate technologies and best practices could ultimately lead to the enhancement of the NWT sawmilling industry in the broader context.

Team

A study of this scope required a broad range of skill sets with in-depth knowledge of wood resource characteristics; sawmill, drying and value-added operations; waste utilization and market demand. The following individuals participated in this project.

Dalibor Houdek — FORINTEK PROJECT MANAGER

Currently the Group Leader of Forintek's Alberta operations in Edmonton, Dalibor offers an in-depth knowledge of wood processing, and the optimized utilization of wood resources. He holds a Ph.D. in the Technology of Wood Processing, and an engineering degree in Wooden Buildings and Products for the Building Industry. As an entrepreneur, he operated a small log home building company; and as a Forintek Industry Advisor, he has provided technical counseling to both small and large value-added wood product manufacturers throughout Alberta and BC. He also served as the Vice-President of the International Log Builders' Association.

Howard Gribble — PROJECT LEADER

Howard's extensive career throughout the forest industry has encompassed most forest product sectors including wooden pallets & containers, furniture, lumber, plywood, waferboard & OSB, pulp & paper, and a variety of converted wood products. Howard's management experience has included responsibility for most of Forintek's applied research departments in Ottawa, Quebec, and Vancouver, as well as three years as Director of the Furniture Division of Industry Canada. Currently, Howard is under contract with Forintek.

Chris Gaston — MARKET ECONOMIST

As National Group Leader of Forintek's Markets and Economics Group, Chris is recognized internationally for his markets and economics research in Canada, the United States, Japan, China and Europe. He is a past Chairman of the "Team of Specialists for Forest Products Markets and Marketing" for the United Nations Economic Commission for Europe in Geneva, Switzerland. Having served also on the Technical Advisory Committee of the Saskatchewan Forest Centre, Chris is receptive to the desire of regional governments to develop its forest industry and can quickly identify motivating factors and relevant challenges. Chris is an Adjunct Professor at the University of British Columbia.

James Poon — MARKET RESEARCHER

As Market Researcher in the Markets & Economics Group, James' responsibilities include maintaining the Group's Global Trade Flow Databases of both wood and pulp & paper products. James is also responsible for performing market intelligence studies on various wood products. As a graduate of the Wood Products Processing Program offered by CAWP at the University of British Columbia, James' Co-op experience includes working in the fields of industrial engineering and quality control.

Denis Gagné — SAWMILL SPECIALIST

With extensive manufacturing experience in sawmills across Canada, Denis understands well the shop floor challenges of wood processing. Building upon his formal training, which resulted in Certificates as a Head Filer, and Millwright, he has worked for both small and large manufacturers in Quebec, Ontario

and Argentina. His industrial experience included plant maintenance, machinery installation, mill start-ups and operational management. He has also served as an Industry Advisor for Forintek in Alberta for 16 years, providing sawmills with technical support in mill design and upgrades, saw filing, and preventative maintenance.

Fraser McDonald DRYING SPECIALIST

Although relatively new in his role as Industry Advisor at Forintek's Alberta office, Fraser brings essential skills to the Team in response to the kiln drying options for the industry. With eleven years of dry kiln operational experience for producers in BC, as operator and supervisor, Fraser is familiar with the technical and organizational implications of running such facilities.

Acknowledgements

The Forintek project team gratefully acknowledges the support of Mr. Tom Lakusta, Manager, Forest Resources, GNWT Dept of Environment and Natural Resources (ENR), and Mr. Kevin Todd, Natural Resource Economist, GNWT Dept of Industry, Tourism and Investment (ITI) in the execution of this Study. Their assistance in arranging for local community meetings and for the provision of background materials facilitated an efficient response to the needs of both the government and the local communities involved.

Our thanks also goes out to all those persons interviewed at Jean Marie River First Nation, H&D Contracting, K'asho Got'ine Dene Community Council, Deninu Kue First Nation, Patterson Sawmill Ltd., and Geoff Stock of Freund Building Supplies and the NWT Forest Industries Association. All of the in-sight and candid remarks of these individuals helped in the framing of a report that hopefully will assist them in the advancement of their industry and communities.

The Study was jointly funded by ITI, ENR and Indian and Northern Affairs Canada (INAC) through the Strategic Investments in Northern Economic Development (SINED) program.

Table of Contents

List of Appendices

List of Tables

List of Figures

1 Introduction

Over the past 35 years there have been many efforts by the Governments of the Northwest Territories (GNWT) and Canada to identify opportunities for the enhancement of the forest industry in the Territories. Both primary and secondary manufacturing alternatives have been considered, as well as the local (domestic) and export market potential for NWT forest products. Thus far, there has been very little evidence of any advancement in the industry as a result of these initiatives. Despite this apparent lack of advancement in local manufacturing capacity, there does remain a desire within the NWT government and local communities for self sufficiency in terms of both wood products and community employment.

With a land area of almost 1.2 million km^2 (128 million hectares), the Northwest Territories (NWT) is the third largest region in Canada (behind only Nunavut and Quebec). The GDP per capita of NWT is the highest in Canada. In fact, the NWT would be first overall in the world if it was to be considered to be its own country. According to the 2006 census, over 42,000 residents (50% Aboriginal and 50% non-Aboriginal) populate the NWT. These residents are housed in 13,000 dwellings which are half owned and half rented.

It is not unrealistic to expect that local self-sufficiency, based on a solid foundation of appropriate technologies and best practices, could ultimately lead to the enhancement of the industry in the broader context. With its vast forest resources, the NWT has the potential to become self sufficient, both in the demand of wood products and employment in the communities. As well, existing and potential wood product consumers, such as the Housing Corporation and MVGP project, are easily identified. In addition, the upgrading of the transportation infrastructure further improves the chances of exports of NWT wood products in the long term.

With this in mind, in February 2007, the NWT government in keeping with its mandate to promote a sustainable forest industry contracted Forintek Canada Corp. to conduct a "Community Sawmill Opportunities Study" designed specifically to establish the foundation for future growth and sustainability.

This document is the report of Forintek's findings and recommendations.

1.1 Forest Resource

With a land area of 128 million hectares, close to 33 million hectares are forests and wood lands. These forests are composed of softwood (53%) and mixed-wood (47%). In terms of volume, it is estimated that the NWT has a total of 840,000,000m^3 of wood. The following table illustrates the volume of species breakdown:

Table* 1 *Volume of Species Breakdown in NWT (m3)

	Species	Volume	Total Volume
Softwood	Spruce	701,000,000	740,000,000
	Pine	39,000,000	
	Larch	1,000,000	
Hardwood	Aspen / Poplar	99,000,000	100,000,000
	Birch	1,000,000	
Total			840,000,000

Source: http://nfi.cfs.nrcan.gc.ca/canfi/data/merchantable-large_e.html

With almost 740,000,000m^3 of standing coniferous forests (higher than the combined resources of Nova Scotia, New Brunswick and Prince Edward Island), the NWT holds the fifth largest coniferous resource in Canada. The following table illustrates the wood volume by province:

Table* 2 *Wood volume by province and territory (millions of m3)

Province / Territory	Coniferous	Broad-leaved
Newfoundland and Labrador	526	37
Nova Scotia	265	119
Prince Edward Island	15	16
New Brunswick	354	181
Québec	3,213	1,432
Ontario	4,197	2,468
Manitoba	459	275
Saskatchewan	674	536
Alberta	1,597	938
British Columbia	9,990	640
Yukon	491	62
Northwest Territories	776	105
Nunavut	14	2
Total	**22,571**	**6,812**

Source: http://nfi.cfs.nrcan.gc.ca/canfi/facts/table3_e.html

Even though the NWT has a vast amount of forest, the economically harvestable resource is a small fraction of the total NWT resource. In 2004, close to 26,000 m^3 of industrial round-wood were harvested from 51 hectares of NWT forests, of which 29 hectares were reforested. That volume harvested represents less than 0.0035% of all standing resources in the NWT.

1.2 Existing Wood Processing Infrastructure

There appears to be six wood processing plants in the NWT, with three of them being community sawmills located in Jean Marie River, Fort Good Hope and Fort Resolution. The remaining non-community operations can be found in Fort Smith (two companies) and in Hay River. While the majority are producing rough green lumber or timber, one producer is manufacturing air-dried, planed graded lumber.

1.3 Existing Markets for Wood Products

In 1999, shipments of lumber and wood products totaled $1.4 million, compared to $0.7 million in 2002. During the same period, imports of wood products increased from $15.6 million to $26.8 million.

The most notable and biggest customer is the NWT Housing Corporation. However, it has been well documented that NWT customers prefer doing business with non-Northern suppliers. Past experiences tell them that suppliers located north of High Level often have problems, whether they are with quality concerns or mill operations. Therefore, most of the lumber and wood products are purchased from plants in Alberta. In addition, various building supply companies in the NWT also purchase their products from distributors in Alberta.

In addition, numerous diamond and base metal mines in NWT are reportedly in constant need of lumber, timber and panels. These wood products are used for the construction and repairs of tunnels and other applications. Though the annual demand for each mine is limited, as a whole, the mines consume a considerable amount of material.

1.4 Housing Programs

In May 2006, a NWT Affordable Housing Plan was announced through a partnership between the NWT Housing Corporation and the NWT Department of Municipal and Community Affairs (MACA). This plan which is cost shared with the federal government allows for the construction of over 500 new affordable and energy efficient housing units across the NWT over a three year period.

As well, a program called Housing Choices was launched by the NWT Housing Corporation in February 2007. This program will provide a sufficient supply of affordable and suitable housing stock to meet the housing needs of NWT residents. This initiative consists of four housing programs: STEP (Solutions to Educate People), HELP (Homeowner Entry Level Program), PATH (Providing Assistance for Territorial Homeownership), and CARE (Contributing Assistance for Repairs and Enhancement). These housing programs and initiatives could represent an opportunity for NWT wood product manufacturers.

1.5 Mackenzie Valley Gas Pipeline (MVGP) Project

The Mackenzie Valley Gas Pipeline project is yet another developing market opportunity for local sawmills. The proposed pipeline, which is 1,220 km in length, will transport an average of 1.2 billion ft^3 of natural gas per day to southern markets. This $16 billion project is forecast to bring between 6,000 and 11,000 person years of work to the NWT, and five times that in total to Canada. It represents the largest single capital project in northern Canadian history.

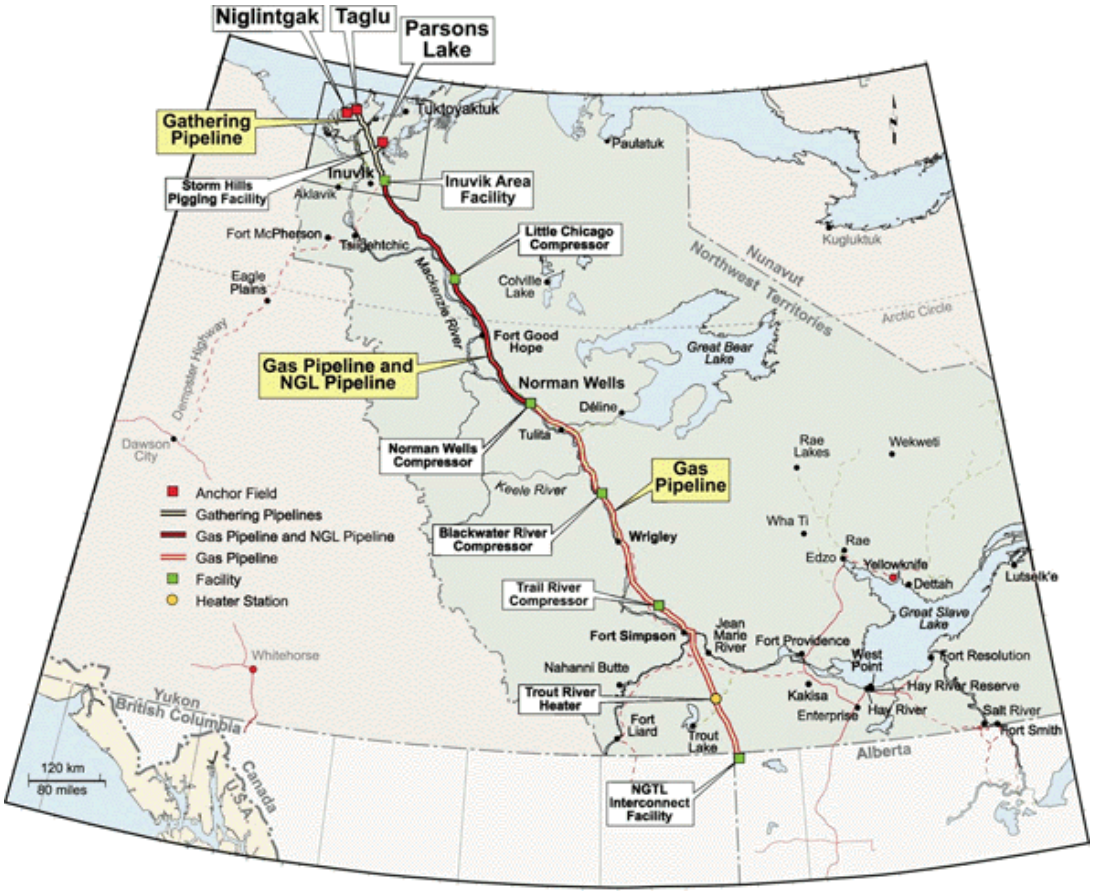


Figure 1. Proposed Mackenzie Valley Gas Pipeline
Source: www.mackenziegasproject.com

The volume of wood products required in this project have been estimated to be the equivalent of approximately 15 million board feet of dimension lumber, skids, dunnage, and lagging. With a unified and planned approach, much of this could be satisfied by local sawmills with rough green lumber and timbers. In addition, trees that are cleared to make way for the pipeline may be made available to the sawmills as an inexpensive raw material source.

1.6 Mining Projects

The diamond mining industry has been the driving force behind the strong economic growth that the NWT has experienced over the last decade. The mining industry is expected to continue to grow over the next decade. However future development is not just associated with diamonds. Record commodity prices may result in new mines producing commodities such as gold, silver, lead, zinc and copper. In fact there are at least six new mining projects that could enter into production over the next five years.

These projects have the potential to have a significant impact on the economy and boost wood product demand. Based on preliminary projections, the anticipated total capital costs for the six projects will exceed $2 billion and once they are operating will create more than 1,900 direct jobs.

2 Objective

The objective of the study, as outlined within the NWT Government's Request for Proposals (RFP) was to examine the economics of community sawmill operations in the NWT to determine the necessary conditions for profitable operations.

3 Methodology

To develop the necessary information required to effectively address the study objective, the following steps were taken:

- two successful mills outside of the Territories were visited and profiled to enable relevant benchmarking with typical NWT mills,
- an investigation and analysis of current and future market opportunities was conducted through interviews with potential consumers of local NWT wood products,
- a recommended procedure was developed for the determination and monitoring of the existing cost structure of a typical NWT sawmill,
- an analysis of kiln drying alternatives was considered, and recommended best practices for the air drying of NWT wood products were prepared,
- the opportunities for improved wood waste utilization were reviewed, and recommendations were developed, and
- recommendations for best practices in small mill operations were developed.

The government has recognized the immediate opportunity for the potential supply of wood products to the Mackenzie Valley Gas Pipeline (MVGP), while at the same time proposing a rational investigation into the longer term opportunity for the development of community manufacturing facilities. Furthermore the government has stipulated that the following marketing, technical and economic issues be addressed in the final Study Report:

- MVGP as a potential market in the near term
- Potential to export specialty products to southern markets
- The restrictive cost of timber harvesting
- The lack of contractors and logging equipment
- The inconsistent operation and underutilization of existing sawmills
- Current manufacturing capacity
- Operational challenges including market development costs, product pricing, cost control, economies of scale, the lack of kiln capacity, and high energy costs

4 Visits to NWT Sawmilling Operations

During the week of March 12, 2007, the Forintek project team and officials of the GNWT visited four typical NWT sawmilling operations (Jean Marie River, H&D Contracting, Fort Resolution, and Patterson Sawmill Ltd.), and held a conference call with another remote community (Fort Good Hope) to investigate opportunities for improvements in processing. When operating, these mills collectively account for the majority of the lumber and building logs manufactured in the NWT, and are indicative of the state of the industry. In gathering the information from each mill, an effort was made to collect

sufficient data for an analysis of the existing cost structures of these operations. As well, labour and equipment utilization was discussed, the quality of logs and product was inspected, and maintenance issues were reviewed.

During the mill visits, the project team drew attention to any opportunities for improvements that became apparent. The visits encompassed all aspects of the sawmill operations from the wood yard to the finished product. During the visits, attention was also paid to material handling and drying practices. Where appropriate, technical and economic issues confronting the mill's management were discussed, and new product opportunities were highlighted.

The information gathered at each of these mill visits has been assimilated into five separate Appendices to this report. Each profile incorporates the observations of the Forintek project team, and includes company-specific recommendations.

Some of the general observations made during these interviews include:

- In most cases, the breadth of competencies necessary to build and maintain a sustainable sawmill (e.g.: mechanics, quality control, grading) is lacking within the communities, and there is an expressed concern that training could lead to migration away from home for higher paid jobs.
- None of the operations that were studied provide shelter for their equipment, and in all but one case, there was no evidence of an effort to properly maintain it.
- The communities seemed to lack proper guidance in equipment selection, purchasing and start-up.
- Accepting the fact that logging operations are seasonal in nature due to weather and site conditions, all of these operations could benefit from longer manufacturing periods by adding some form of shelter for equipment and personnel.
- Productivity levels varied dramatically from place to place.
- Although there appears to be a common interest in establishing a wood pellet operation, there is a general lack of knowledge of the governing factors associated with the establishment of such a facility.
- The lack of kiln/air drying planing and grading capacity restricts direct market access to the construction industry for all of the mills studied. All products are sold as rough and green. There may be an opportunity for a NWT remanufacturing facility to produce local materials and export products from NWT fibre.
- The majority of lumber used by NWT Housing Corporation in various housing programs are imported from Alberta.
- Under the current scenario, all wood product demand increases are being addressed by increased imports.
- Possibly due to the scale of operations and/or lack of business background, there has been a lack of initiative to establish performance criteria, and procedures to systematically track costs in the mills.
- There is now an apparent genuine interest in establishing a formatted mechanism whereby sawmillers might track costs and measure/monitor their performance.
- Most of the communities interviewed expressed an interest in producing either building logs, or log home kits. All communities could benefit from qualified guidance in the consideration of this potential manufacturing opportunity.
- Although over 60% of the wood harvested in the NWT is consumed as fuel wood, there is a need to understand its relative economics as a "manufactured" product vis-à-vis other alternative products that could be manufactured from the same fibre.

These general observations are the basis for the "conclusions and recommendations" included under Section 11.0 later in this document.

5 Best Practices in Small Sawmill Operations

As in any manufacturing environment, the introduction of "best practices" into small scale sawmill operations such as those typical to the NWT can only hope to achieve some measure of success if a staged-in approach is adopted. As a starting point, it is essential to identify those critical areas where improvements are essential to the enhancement of the contribution of the manufacturing venture to the long term sustainability of the local community.

In Section 4 above, there were numerous general observations identified with respect to the current status of the NWT sawmilling industry. These observations provide a good indication of the critical areas that should be addressed as a first step to sustainability.

It is therefore proposed that the first phase of the implementation of "best practices" into the industry should include the following priority items:

1. The establishment of a formatted mechanism whereby sawmillers might track costs and measure/monitor their performance.

2. The transfer of "air-drying" best practice knowledge to position sawmillers to access the market for dried construction materials.

3. The facilitation of the evaluation of new and/or cooperative joint ventures in such areas as log home building, wood pellet manufacture, and remanufactured wood products.

4. The establishment of training programs to address the need for a greater breadth of the competencies necessary to build and maintain a sustainable sawmill (e.g.: basic business skills, mechanics, quality control, grading).

5. The provision of access to technical assistance targeted specifically at equipment maintenance, materials handling and improved productivity. This should also include proper guidance in equipment and shelter selection, purchasing and start-up procedures.

The first three of these priority items are addressed within this study report. Item #1 is covered immediately below in this section. Item #2 is handled in section 7.0 under "Kiln Drying Alternatives". Item #3 is split into three separate sections as follows: section 10.0 "The Log Home Building Option", section 8.1 and 9.3.4 "The Wood Pellet Option", and section 9.3.2 "Remanufactured Wood Products".

The last two items are both centered around the need for technical assistance and guidance to ensure that the necessary competencies and infrastructure are in place to support sustainable wood products manufacturing entities within the communities. Forintek can assist the communities and the NWT government in addressing this important need.

5.1 Tracking the Costs, Revenues and Cash Flow

Sawmills are complex businesses often with a complex cost structure. In order to establish that a mill is profitable, or if a mill receives enough compensation for their product in order to cover all of the costs and allow for future expansion is a vital part of the business.

It was apparent from the meetings with the small NWT community mills that there is not a clear understanding of the operations cost structures of these mills. Furthermore, in order to obtain support for any desired rejuvenation or enhancement of these operations there is a need to establish a tracking mechanism of various costs within the sawmills. It is understood that the communities don't have either a substantial infrastructure or the resources to do an elaborate cost analysis. However, in order to establish a profitable mill, understanding the costs that are coming to play is essential.

In this section of the report, the summary of major costs that come to play will be described. The information in this section is not necessarily exhaustive, as would apply to a large Canadian sawmill, but it will provide guidance with respect to what major costs need to be tracked in the mill.

There are two types of operating costs:
- direct costs, and
- overhead costs.

The direct costs are the costs of material and labour required to produce a finished product. In the case of a sawmill, it is the total delivered cost of logs to the sawmill and the total cost of wages associated with the manufacturing of the product (sawmill operators, helpers, equipment operators, and other production personnel).

The overhead costs are the costs of all the other functions and services required to keep the business operational. They include, but are not limited to:

- Infrastructure Depreciation
- Cost of Energy
- Fuel Cost
- Maintenance Cost
- Transportation Cost
- Waste Removal
- Administrative Cost
- Insurance Cost
- WCB Cost
- Inventory Cost

Infrastructure depreciation refers to a loss of value that the purchased machine or sawmill equipment incurs. This applies not only to the sawmill equipment but also to vehicles and heavy machines such as forklifts, buildings and other types of shelter that the sawmill is housed in, as well as the cost of land that was purchased for the business and will be amortized over a period of time as a business expense. The tax laws establish the amortization periods for individual items that then translate into the total depreciation cost. As an example, if a new mill is purchased at a cost of $100,000 and its amortization

period is 10 years, $10,000 per year is its depreciation cost that needs to be recovered through sale of the product. Also if the purchase is financed, the cost of financing will become part of the mill's cost.

Cost of energy refers to the total cost the business will pay for the purchase of electricity provided that the business is connected to the main power grid and purchases electricity for the operation. Collecting this information is only a matter of tracking the monthly bills received from the power company.

Fuel cost refers to the cost of gasoline and/or diesel needed to operate the vehicles and/or to fuel the power generator. It is imperative that the amount of fuel is tracked every time the fuel is used and the current price of the fuel is recorded. This will provide the basis for establishing the total fuel cost.

Maintenance cost reflects the cost of maintaining the mill and other equipment needed for the manufacture of the product. This will include the regular maintenance of the mill and vehicles, including the cost of saw blades, parts, lubricants, repairs of the power generator, purchase of new tires for the vehicles, etc. The manufacturer of each piece of equipment should be able to provide information on what can be expected as an average maintenance cost for their equipment. However, this should only serve as a guide to establish if the costs that are incurred by the mill are in line with what is typical for the particular equipment. If the mill's costs are much higher than what is expected, additional analysis might be needed to identify the reason for the imbalance.

Transportation cost includes all the costs associated with transportation of product to the customer. This information is important for establishing the appropriate rates for material and product delivery.

Waste removal cost is the cost associated with the disposal of waste that is generated by the mill. Depending on the type of waste that is generated, some might be utilized in profit generating end-uses. For example, the slabs from the lumber production could be packaged and sold as firewood. Bark and chips or sawdust could be sold as a hog fuel if there was a facility that could utilize it. The sawmill should look at every product and byproduct as a potential profit generating item as every dollar made by the mill contributes to the financial bottom line. Most sawmills (even the high volume mills) in Canada could not operate with a profit if the byproducts such as chips and hog fuel were not sold to other processes. Breaking even on the removal of the waste is better then paying for disposal with no revenue offsetting the cost.

Administrative cost refers to the cost of administering the business. This might include hiring a part time or full time secretary/administrator whose roles might be looking after the office related tasks, keeping the books and tracking the costs, monitoring production on a daily basis, answering phones etc. These tasks could also be split between the office person and the sawmill supervisor, whose responsibilities might be tracking the production and assisting the administrator to keep track of the costs. Administrative costs will also include the cost of office infrastructure such as computer, phone, fax, office supplies, lighting, heating, etc.

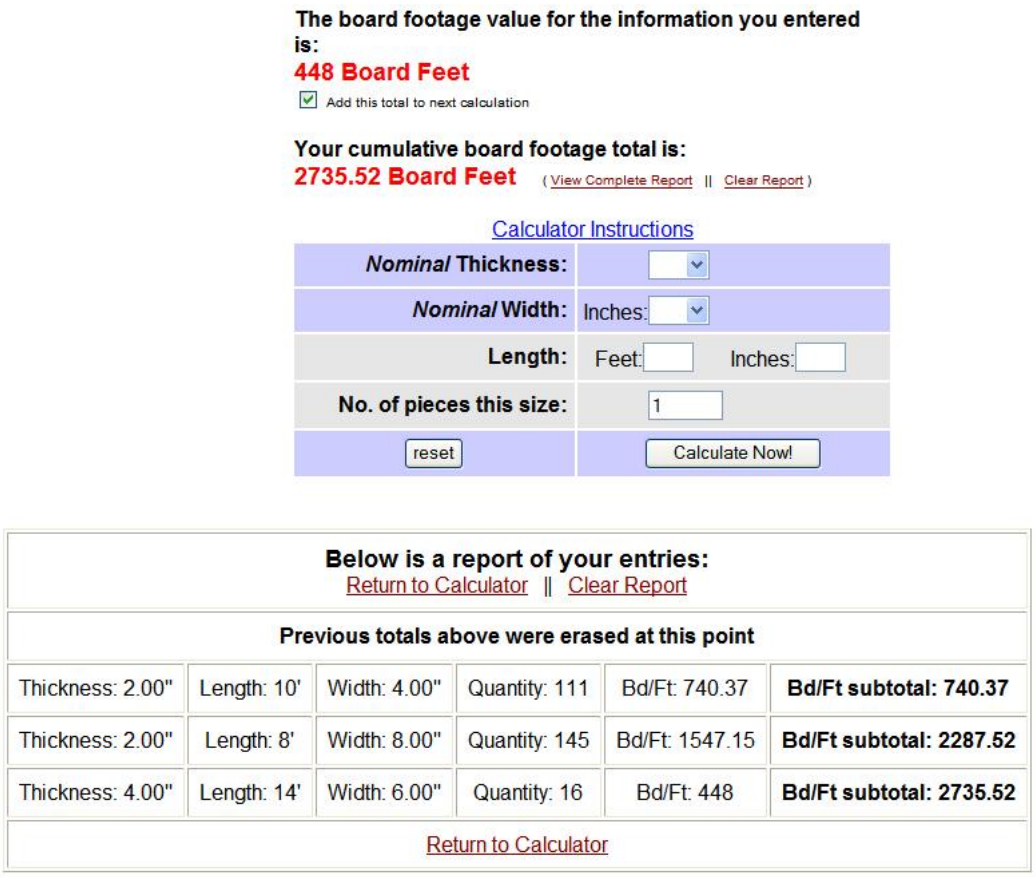
Insurance cost is the cost of liability, fire, and other insurance the business will subscribe to. It is recommended to have business insurance in order to protect the company from potential losses.

WCB cost is the total of WCB premiums that the sawmill pays for their employees.

Operating capital is necessary to successfully operate a business. Small sawmills processing around 700 to 1000 m^3 of logs per year will need $30,000 to $50,000 of operating capital to run their business. This amount might be even higher if the mill must pay for the whole year log supply at once as it might be the

case with some NWT community sawmills. Lack of operating capital will lead to cash flow problems that could eventually cause the business closure. Operating capital is one of the items most often omitted when establishing new business.

Tracking the business revenues is another piece in the puzzle of establishing profitability. Production must be measured and the volume of lumber produced must be recorded. The logs that are entering the process should be tracked to establish the log volume being processed. The produced lumber must be tracked to establish the average lumber recovery factor (LRF) being achieved. The LRF is one of the main indicators of the mill's performance and it represents the number of board feet (FBM) produced from $1m^3$ of logs. The more lumber that can be recovered, the greater the value extracted from the resource. The logs are scaled and tracking is a matter of recording as it enters the mill. The saw operator is in the best position to record the volume of logs entering the process into a simple spreadsheet. Once the day is completed the lumber is piled in a bundle and it can be easily calculated based on its size and length. The sawmill operator and/or the helper needs to record how many pieces of each dimension and length was produced on each particular day. This information can be handed to the administrative assistant and she/he can enter these numbers into a simple, very user-friendly Softwood Lumber Board Footage Calculator that is available at the WoodWeb internet site (www.woodweb.com/Resources/RSCalculators.html). This allows operators to very quickly calculate the board footage of each particular dimension produced that day. The following picture shows the report that can be printed from the site.



The board footage value for the information you entered is:
448 Board Feet
Add this total to next calculation

Your cumulative board footage total is:
2735.52 Board Feet (View Complete Report || Clear Report)

Calculator Instructions

***Nominal* Thickness:**	
***Nominal* Width:**	Inches:
Length:	Feet: Inches:
No. of pieces this size:	1
reset	Calculate Now!

Below is a report of your entries:
Return to Calculator || Clear Report

Previous totals above were erased at this point

Thickness: 2.00"	Length: 10'	Width: 4.00"	Quantity: 111	Bd/Ft: 740.37	**Bd/Ft subtotal: 740.37**
Thickness: 2.00"	Length: 8'	Width: 8.00"	Quantity: 145	Bd/Ft: 1547.15	**Bd/Ft subtotal: 2287.52**
Thickness: 4.00"	Length: 14'	Width: 6.00"	Quantity: 16	Bd/Ft: 448	**Bd/Ft subtotal: 2735.52**

Return to Calculator

Figure 2. Sample of Softwood Lumber Board Footage Calculator Report Available from www.woodweb.com

Each day's production can be recorded in the MS Excel spreadsheet, and a value assigned to it based on local lumber pricing in order to identify how much dollar value was produced on any given day. This is a quick measure of how the mill performed each day. On a weekly or monthly basis this can be compared with all the operation costs incurred and the performance of the operation can be assessed. In responding to the observed need of NWT sawmills, Forintek has developed a sample MS Excel spreadsheet that is attached to this report. This spreadsheet allows some simple tracking of various costs as well as tracking of the revenue generated by the mill. It must be noted however that all the numbers currently placed in the spreadsheet are just arbitrary and have no correlation to any mill's performance. However, the formulas embedded in the spreadsheets will produce the desired results. The numbers inserted are only meant to provide an example of how to track the basic performance characteristics and could be done as easily manually on paper.

6 Review of Successful Small Sawmills

To establish goals for the enhancement of existing manufacturing operations, benchmarking efforts must be aligned with successful establishments in a similar operational environment as much as possible. The opportunity for misleading advice is great in the case of the existing NWT mills. A major sawmill in other parts of the country produces as much lumber in one day as the largest NWT mill produces in a year. A review of appropriate mills outside of the Territories however is feasible, and could result in the transfer of useful information to those communities wishing to move their manufacturing forward to the next level.

In Sections 6.1 and 6.2 of this report, Forintek has profiled two successful small mill operations in Alberta. These mills (identified as mill "A" and mill "B") have been selected by Forintek's Industry Advisors as mills operating at a similar scale as a typical mill in the Northwest Territories. Mill "A" has installed a home-made dryer and a second-hand planer to enable the production of value-added products on a small scale, while mill "B" focuses on the production of rough green lumber in sizes varying from 1"x3" to 12"x12".

These reviews document the products manufactured, technology used, harvesting methods, manning levels, and other operational parameters. Numerous photos have been included to showcase the set-up of the operations. Information gleaned from these two profiles will be used later in this report to support the development of best practices for profitable small mill operations in the NWT.

It soon became apparent during the mill visits in the NWT, that the production "north of 60" is focused on the summer months of the year, without protection from the elements, and without manufacture beyond rough green lumber. Both of the Alberta mills (a little "south of 60") manufacture product year round, under cover, with relatively low capital investment. Mill "B" is selling product similar to that produced by NWT mills, and mill "A" has taken it one step further and has proven that it is possible to produce dried and planed value-added products in relatively small quantities for the marketplace.

6.1 Visit to Alberta Benchmark Sawmill "A" - February, 2007

6.1.1 Introduction

Although benchmark sawmill "A" is small in terms of annual production, it is successful in its own right, and serves as a useful model for smaller, forward looking operations. The factual and pictorial information contained in this report is structured in a fashion that should assist the reader in making direct comparisons to their own plants, and in identifying opportunities for improvements. Where capital expenditures might be required, some possible sources of supply are included to facilitate consideration by the reader.

6.1.2 Raw Material Supply

Lodgepole pine is the primary species processed at Sawmill "A", along with a small quantity of birch which is used for flooring products.

Total log consumption is 700 m^3 per year. To prevent log deterioration and checking only a small inventory is maintained.

Figure 3. Log Storage at Sawmill "A"

6.1.3 Logging & Transportation

Contractors are hired to cut and transport the tree-length logs to the mill site. The trees are delimbed in the forest, and transported to the mill in lengths that vary from 20' to 55'. The average diameter at the bottom is 15", and the top is 3".

The tree-length logs are cut into shorter 8' to 16' log lengths in the yard.

The logs are <u>not</u> debarked before processing, and particular attention is given to the handling of the logs between the yard and the sawmill deck to prevent against contamination by dirt or rocks.

6.1.4 Primary Breakdown

A Wood-Mizer LT 40 Super-Hydraulic (Stationary) is used for cutting the logs into flitches.

LT 40 Super-Hydraulic specifications:

Log diameter capacity: 36”
Log length capacity: 21’standard and up to 45’with bed extension)
Production rate: up to 400 fbm/hr.
Operating costs: $40.00 per Mfbm
Price for new LT 40: $34,000

Web site for more information:
www.woodmizer.ca

Figure 4. Detail of Wood-Mizer LT 40

6.1.5 Lumber Recovery

The lumber recovery factor for this type of operation ranges from 165 to 180 fbm per m^3 of logs.

6.1.6 Edging Equipment

There are many different brands and models that could be purchased either new or used for this application. See the web site addresses on the last page of this section for possible suppliers. In sawmill “A”, a Gabbiani board edger has proven to be very appropriate for the application.

Edger specifications:

Maximum board thickness: 4”

Maximum board width: 12”

Used purchase price (est.): $3,000

Figure 5. Gabbiani Board Edger at Sawmill “A”

6.1.7 Drying Facility

The dryer is an in-house build system that uses a combination of two heat sources.

1. Solar panels located on the south side of the building are used to heat water.
2 A hot water boiler is also used to supplement the solar panels.

Figure 6. In-house Build Solar Kiln With Drying Capacity of 10,000 per charge

6.1.8 Planer / Moulder

A Weinig Profimat 22 is used as either a planer or a molder to produce a wide range of value-added products, including planed lumber, flooring, moldings, siding and paneling.

A Profimat, or similar molder is capable of providing the flexibility needed for small operators who may, because of space or capital budget restrictions, want to be able to manufacture a variety of products on the same piece of equipment.

Used purchase price (est.): $15,000
(10 to 15 years old)

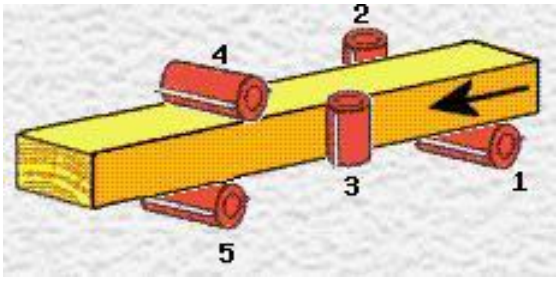


Figure 7. Weinig Profimat 22 Moulder Installed at Sawmill "A"

6.1.9 Trimming

Sawmill "A" has installed a radial-arm saw to trim all the boards required for their complete range of products.

Industrial radial-arm saws such as the one shown in the photograph are easy to find on the used equipment market.

See Web site listings on the last page of this section for more information**.**

Figure 8. Industrial Radial Arm Saw

6.1.10 Machining

Sawmill "A" has proven that innovation does not just apply to the heavyweights in the industry. By modifying an industrial shaper they have been able to cost-effectively manufacture the end tenons for their flooring and paneling products. A tongue & groove joint is required in all of these products.

Again, capital equipment costs can be kept under control through the use of the internet to locate sources of used machinery.

See Web site listings on the last page of this section for more information**.**

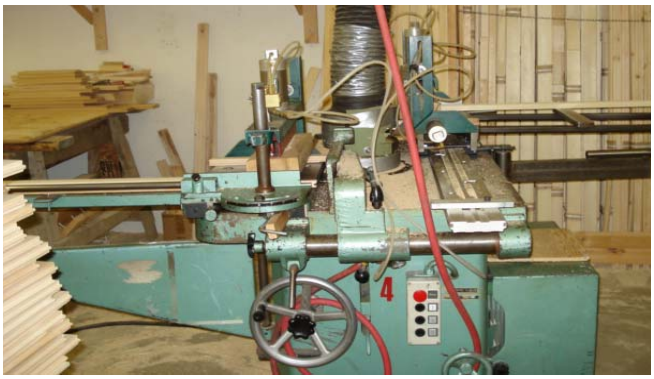


Figure 9. Modified Industrial Shaper Used as End-Tenoner

6.1.11 Products

Products are trimmed to different lengths according to customer demands. Most of the product range is sold directly to local customers.

Paneling represents 25% of production and it is manufactured in lengths between 6 feet and 10 feet.

Siding products account for 30% of production. Siding is manufactured in lengths from 4 feet to 16 feet.

Sawmill "A" also produces some moldings.

Figure 10. Examples of Paneling and Siding Produced at Sawmill "A"

Flooring products amount to 25% of production. It is produced in lengths from 6 feet to 16 feet.

Figure 11. Example of Solid Wood Flooring

6.1.12 Packaging

A small strapping machine is used to strap bundles of products with a non-metallic strapping tape.

Web site for more information: www.dynaric.com

Figure 12. Strapping Machine (L) Used for Strapping Products Into Bundles (R)

6.1.13 Waste Utilization

The sawdust and shaving residues from sawmill "A" are used for animal bedding at the owner's farm. The wastes from the manufacturing process, (e.g.: trimmings, slabs, log defects, etc.) are burned in the furnace of a hot water boiler to heat the main building and to operate the kiln.

Figure 13. Wood Waste (R) and Wood Burning Furnace (L)

There are many wood burning furnace models available with a wide range of capacities.

Useful information can be obtained by visiting www.greenwoodfurnace.com or the Government of Canada website www.canren.gc.ca/prod_serv/index.asp?caId=1038&pgId=56.

Figure 14. Firewood for Sale

6.1.14 Operating Parameters

Sawmill "A" operates twelve months per year.

Logging	Contracted out
Transportation	Contracted out
Logging & Transportation cost	$25 per m^3
Labour	4 persons
Average wage	$15 per hour
Work week	40 hours
Wood-Mizer operation cost	$40.00 per Mfbm (including maintenance)
Other maintenance costs	$2 per Mfbm (estimate)

Annual sales	$300,000
Investment	$500,000
Average product price	$2,500 per Mfbm (approximate equivalent)

6.1.15 Web Sites to Visit

As mentioned earlier in this report the internet offers many opportunities for planning capital equipment expenditures, and for the purchase of both new and used equipment. The following web sites are just a sampling of the possible sources of information available.

www.machpro.com
www.revuebst.com
www.tremzaction.com
www.dynaric.com

For informative articles:
www.fdmonline.com
www.forintek.ca
www.valuetowood.ca
www.solutionsforwood.ca

6.2 Visit to Alberta Benchmark Sawmill "B" - February, 2007

6.2.1 Introduction

Benchmark sawmill "B" is larger in terms of annual production than sawmill "A", but can still serve as a useful model for sawmills in the Northwest Territories. Whereas sawmill "A" manufactures a range of value-added wood products, sawmill "B" has focused on rough lumber as its source of livelihood. Once again the factual and pictorial information contained in this report is structured in a fashion that should assist the reader in making direct comparisons to their own mill, and in identifying opportunities for improvements. Where capital expenditures might be required, some possible sources of information are included to facilitate consideration by the reader.

6.2.2 Raw Material Supply

Lodgepole Pine is the primary species processed at Sawmill "B".

Total log consumption is 13,755 m^3 per year.

Figure 15. Delivery of Logs to Log Yard at Sawmill "B"

6.2.3 Logging & Transportation

Contractors are hired to cut and transport the tree-length logs to the mill site.
The average diameter at the butt end averages 20", and at the top it is 3".

6.2.4 Log Preparation

In the log yard, a Cat 330 is used to unload the logs from the logging tucks. A Hood 2400 portable slasher is used to buck logs into 16' lengths.

Figure 16. Cat 330 for Unloading Logs from the Truck (L) and Portable Slasher (R).

6.2.5 Primary Breakdown

The initial breakdown of the log is done on a Helle Carriage equipped with an edger with three movable saws.

Figure 17. Helle Carriage Installed in Sawmill "B"

Figure 18. Detail View of Sawyer's Console (L) and Edger With Three Movable Saws (R).

6.2.6 Lumber Recovery

The lumber recovery factor for this type of operation ranges from 165 to 180 fbm per m^3 of logs.

6.2.7 Gang Edger

To break down the bigger cants, sawmill "B" uses a 6' Cornell Gang Edger equipped with 14 saws.

Figure 19. Cornell Gang Edger installed at Sawmill "B"

6.2.8 Trimming

A trimmer with a saw at each end is used to cut products into lengths from 6 feet, up to16 feet.

Figure 20. Double-end Trimmer Installed in The Sawmill "B"

6.2.9 Sorting & Piling

A “live chain” is used to move lumber from the sawmill to the sorting area, which is located outside of the main building. The products are sorted and piled by hand onto buggies for transport to the storage area.

***Figure 21. “Live Chain” (L) and Detail View of The Sorted Lumber Pile in The Buggy* (R).**

6.2.10 Lumber Handling

A Deere 544H front-end loader is used by sawmill “B” to move finished product, as well as for a variety of other tasks around the mill.

Figure 22. Deere 544H Front-end Loader Handling Finished Product

6.2.11 Products

Sawmill “B” produces only rough lumber in sizes that vary from 1”x 3” to 12” x 12”.

6.2.12 Waste Utilization

A Burks Kodiak hog is used to turn debris into mulch for use as farm bedding.

Figure 23. Burks Kodiak Hog

6.2.13 Operating Parameters

Sawmill "B" operates twelve months per year.

Logging	Contracted out
Transportation	Contracted out
Logging & Transportation cost	\$45 per m^3
Labour	5 persons
Average wage	\$15 per hour
Work week	40 hours
Maintenance costs	\$5 per Mfbm (estimate)
Annual sales	\$1,700,000
Investment	\$1,500,000
Target profit margin	8 % per year
Price of rough green lumber	\$400 to \$600 per Mfbm

6.2.14 Web Sites to Visit

As mentioned earlier in this report the internet offers many opportunities for planning capital equipment expenditures, and for the purchase of both new and used equipment. The following web sites are just a sampling of the possible sources of information available.

www.machpro.com
www.revuebst.com
www.tremzaction.com
www.dynaric.com

For informative articles:

www.fdmonline.com
www.forintek.ca
www.valuetowood.ca
www.solutionsforwood.ca

7 Kiln Drying Alternatives

A dimension lumber mill requires a planer, a grader, and a capacity to demonstrate that moisture content levels consistently meet the requirements of the National Lumber Grades Authority (NLGA) grading rules. The moisture content standards may be satisfied either by air drying or kiln drying the lumber. At the present time, no kiln drying facilities exist in the NWT. Although a central kiln drying service might be a longer term goal for the industry, its acquisition would not be recommended at this time due to the low and inconsistent production levels, high energy costs, and the labour intensiveness of such an operation.

However, the following analysis of alternative drying strategies should assist those mills wishing to improve their present air drying practices, while considering their kiln drying options over the longer term.

7.1 Lumber Drying

The primary objective of drying wood is to attain a final moisture content (M.C.) while maintaining as much of the original product quality as possible. Just as the primary breakdown of hardwoods differs from that of softwoods, drying practices also differ. The differences in drying largely relate to the difference in the end use between softwoods and hardwoods. While softwoods are primarily used in construction applications, many applications for hardwood lumber are visual, and as such drying is critical to preserve the natural grain characteristics and colour.

7.2 Air Drying

While there are advantages of air drying (e.g.: energy savings), there are steps that need to be taken to ensure that the air drying process is done properly. The main limitations of air drying are typically associated with weather and the overall uncontrollable nature of the drying process. Additional limitations include: increased yard maintenance, increased handling, and increased costs associated with lumber protection (from wind, sun, rain, and snow). For lumber that does not need to be at a low moisture content, air drying is generally sufficient to meet the requirements of the application. This would include such end uses as outdoor furniture and other outdoor projects, barns, pole sheds, and garages that will not be heated. Air drying may also reduce the moisture content far enough to enable the pressure treatment of the lumber.

7.2.1 Stickering

- Green lumber should be stickered within 24 hrs of sawing if possible to lessen the effects of staining and biological attack.
- On 1” thick lumber the sticks should be placed 18” apart to reduce the chances of wrap. With softwood, the stickers are typically spaced 2’ or 4’ feet apart on 2” thick and larger material.
- Recommended sticker size – ¾” x 1 ¼”. Thicker and wider stickers may cause sticker stain for hardwood. For softwood, the stickers can be wider and thicker 7/8”x 2”.
- Using stickers with M.C. greater than 10% may cause sticker stain.
- Vertical sticker alignment is important to ensure proper air flow.
- Bolster should be vertically aligned with stickers to provide good support for loads and pile covers. (See sketch below)

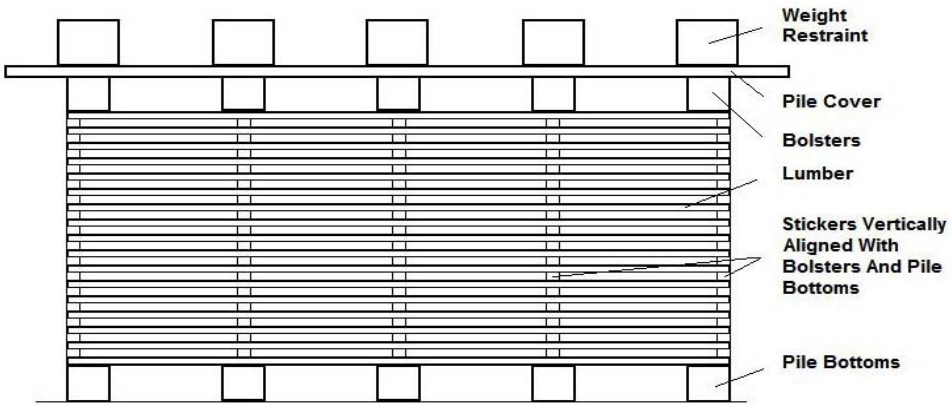


Figure 24. Proper Sticker Alignment with Bolsters and Pile Bottoms

Figure 25. Example of Poor Stickering (L) and Poor Stacking (R).

7.2.2 Yard Layout

- Good air circulation is needed to prevent mould and stain. However too much air can result in drying stresses, and wind breaks may be necessary.
- Loads should be at least 18" off the ground, and good drainage is needed to prevent the pooling of water around the loads.
- Loads should be orientated so that the prevailing winds can flow through the lumber (from the side of bundles, see diagram below).
- Space between rows should be 2' to 3' (see diagram below)
- Space between piles in a row is usually 2' (see diagram below)

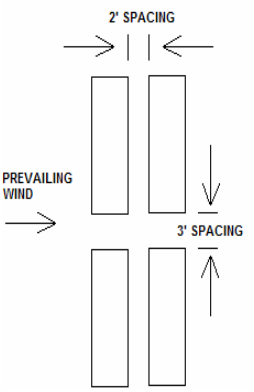


Figure 26. Proper Yard Layout for Most Efficient Air Drying

7.2.3 Lumber Pile Protection

- Lumber should be protected from the direct exposure of sunlight, rain and snow, which may cause unnecessary drying defects.
- Lumber should be protected by waterproof pile covers slightly sloped to promote water run off.
- Pile roof covers should extend beyond the ends and sides of the loads by 1 foot. Roof ties may be needed to hold the roof on the piles in case of a strong wind.
- Sun shields and end coating can help to reduce unnecessary drying losses caused by exposure to direct sunlight.
- Slabs may also be used as pile covers.

7.2.4 Box Piling and Random Width

- To ensure good air flow, short boards can be staggered in the centre and full length boards can be placed on the outside edges.
- Random width boards may need to be piled with spaces between them in every row. It is necessary to ensure that the boards do not extend beyond the desired width of the package.

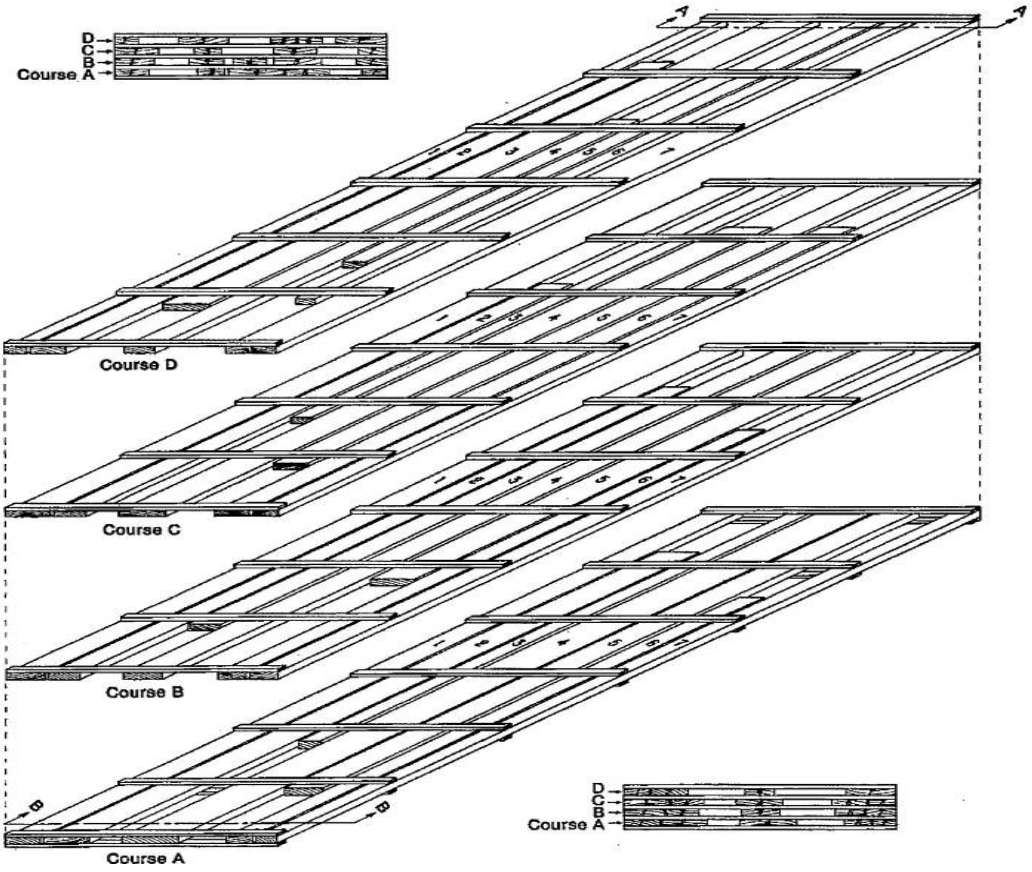


Figure 27. Example of Random Length and Width Lumber Piling
*Source: **http://ohioline.osu.edu***

7.2.5 Determining the End of Air Drying

Air drying can be used to remove free water from lumber. However, after the M.C. of the lumber has dropped to below the fibre saturation point (between 25 and 30 percent), it is recommended that it is placed in a dry kiln for controlled drying to its final M.C. A hand held moisture meter can be used to check the lumber to determine its M.C.

The lumber will dry at a rate determined by the Equilibrium Moisture Content of the surrounding air and the ambient temperature. For this reason, the predetermined and monitored drying schedules employed in a dry kiln offer much better control over end product quality than does air drying (where drying rate is dependent upon mother nature).

7.3 Considerations When Buying and/or Building a Dry Kiln

7.3.1 Energy Requirements

The energy requirements of drying lumber will depend on the amount of water to be extracted from a given amount of lumber, the efficiency of the system, and the amount of time taken to dry the lumber. Energy will be required to meet both heat and electrical demands.

7.3.2 Insulation

Insulated panels with an insulation value of R-20 are typically used in larger industrial kilns. A similar insulation value should be specified. Large industrial kilns use heavy gauge 0.040 inch aluminum or stainless steel panels. Aluminum or wood/aluminum panels should be specified to minimize costs while preserving life cycle performance. A foil faced poly-isocyanurate insulation that is resistant to migrating water vapor should be used to provide a long performance life.

7.3.3 Venting

Venting can be accomplished using the natural draft developed by the circulation fans or by forced draft using an exhaust fan. Either method is effective.

The natural draft method relies on vents placed on the opposite sides of the fans. This allows for the partial pressure developed by the fans to pull in cool dry air and expel warm moist air. An exhaust fan will be necessary if forced draft venting is desired. The natural draft method will be less expensive, easier to control and provide adequate control of humidity.

7.3.4 Equalizing and Conditioning Spray

The amount of moisture needed to add to the lumber for conditioning (stress relief) is approximately 20 pounds per Mfbm. This can either be supplied by low-pressure steam or high pressure atomized water.

7.3.5 Controller

A control system, as a minimal requirement, should be able to monitor, control, and record the drying conditions that the lumber is subjected to. These conditions should include the temperature and humidity in the kiln as well as the fan direction.

Honeywell, Omron, and Johnson Controls all make electronic temperature controllers of varying degrees of sophistication starting in the $200 range. The controllers should be capable of operating in the range of 32^{o} to 212^{o} Fahrenheit. Honeywell and Partlow also manufacture two pen (one each for the dry bulb and wet bulb) circular chart recorders.

7.3.6 Regulatory Concerns

Regulatory restrictions should be addressed prior to proceeding with the project. These restrictions may affect the building or the operation of the kiln facility.

The proper permits should be secured to ensure that local and territorial building, electrical, gas, boiler, plumbing and environmental codes are met. The equipment should be CSA approved to facilitate inspection.

Municipal and District bylaws as well as Territorial and Federal regulations should be confirmed and adhered to. Emission requirements should be confirmed with the appropriate government agencies. Insurance requirements should also be confirmed. A fire protection system may need to be installed.

7.3.7 Miscellaneous

The atmosphere inside the kiln chamber can be quite corrosive. Aluminum or stainless steel is the preferred material for interior sheathing. Wood coated with bituminous or aluminum paint may be a less expensive option with higher maintenance costs. A good vapor barrier is necessary between the interior sheathing and the insulation to prevent the migration of water vapor into the insulation.

Some insurance companies may require the installation of a sprinkler system inside the kiln. As insurance may be necessary to secure a loan, the installation cost of a fire protection system may have to be considered.

A building for the storage and handling of the dry lumber may need to be constructed to protect the lumber from the elements. Likewise, a building will be required to house the energy system, the controller, and provide a working space for the operator.

7.3.8 Kiln Investment Alternatives

There are number of options when it comes to the purchasing of a lumber dry kiln. Different manufacturers offer different options and also the prices may vary substantially. The following table contains basic information about selected types of kilns with small, medium and large drying capacity.

Table* 3 *Summary of Capital Outlay and Basic Characteristics of Selected Kilns

	Small Kiln Capacity		Medium Kiln Capacity	Large Kiln Capacity
Type	Porta Kiln XL (no boiler)	Silmico	Side load with boiler for heating and conditioning	Track load; no boiler, direct fire.
Capacity (fbm)	10,000	10,000 11,000-19,000	50,000	150,000
Specifications	-Track load (on entry only) -Approx. Cost: $104,000	-Track load (entry only) $130,000 for 11,000 fbm $161,000 for 19,000 fbm $9,000 (extra) for hot water duct heater	-Side load -Approx. Cost: $600,000-$700,000	-Track load (entry and exit) -Approx. Cost: $ 1 million
Advantages	- Represents the cheapest alternative in terms of investment. - Requires less yard space. - Depending on volume sawn, lower energy costs (however, if the volume sawn is more than expected, more kiln charges will be needed)		- Increase in drying volume. - Due to the side load specification, less yard space will be required.	- Large volume (less time required on stickers) - Quicker turn around with track kiln.
Disadvantages	- Less volume. - Depending on volume sawn, the potential for degrade (i.e., stain in hardwood) may be higher due to time delay to enter the kiln.		- Side load kilns are more time consuming than track kilns due to loading and unloading times. This should not be a huge factor.	-Requires more yard space. - Higher initial investment cost. - Higher energy costs.

8 Residue Utilization

The work plan associated with this study included an evaluation and quantification of the existing waste levels at the sawmills visited. This was to lead to recommendations for the reduction and/or utilization of these residues for the manufacture of energy and/or wood by-products.

As none of the mills visited were in production at the time, it was not possible to collect any actual data for analysis purposes. Consequently, it is only possible at this juncture to comment on what types of opportunities for the utilization of wood residues can be pursued when the appropriate raw material volumes and markets exist.

Wood residues, depending upon size, can be used in various applications. In areas where there are pulp mills or engineered panel manufacturers, there is a demand for such residues. Shy of that, the only real application is for fuel. In the short term for the NWT, this could supplement material for wood burning stoves/fireplaces. Sawdust and shavings could also be burned as hog fuel which heats the drying kilns and other buildings. In the longer term, this could include a number of bio-product solutions including wood pellets, which are discussed in some detail in the remainder of this section.

8.1 The Wood Pellet Option

In direct response to a common interest on the part of many of those interviewed, a brief overview of the opportunity for the manufacture of wood pellets is provided below.

8.1.1 Wood Pellet Market

Wood pellets are primarily used in Europe and North America. Led by Sweden and Denmark due to government policies, Europe consumed over 2.7 million tonnes of wood pellets in 2004, while North America consumed over 934,000 tonnes. The large European demand is driven by the industries, whereas the residential (heating) market is the driver for the North American market.

With the increased sales of pellet burning appliances, furnaces and inserts, the demand for wood pellets in North America is forecasted to rise. While still small in overall volume, in 2005 alone there was a 76% growth in pellet-burning fireplaces. It is estimated that one pellet-burning stove requires 2.5 tonnes of pellets to heat a single home for one season. (Karwandy, 2007)

In 2006, approximately 625 tonnes of wood pellets was imported from the provinces and sold in the NWT. Several apartment buildings in the NWT as well as the North Slave Correctional Centre are already using pellets in the hope of reducing heating cost. Since these imported wood pellets are being sold in bulk by the pallet at $5.50 / 40lb bag, they are cheaper than most other fuel sources. (Note, it is very likely that locally produced pellets would be sold at a significantly higher price.) The following diagram illustrates the cost in cents in order to provide 1 kWh of heat with various heating fuels.

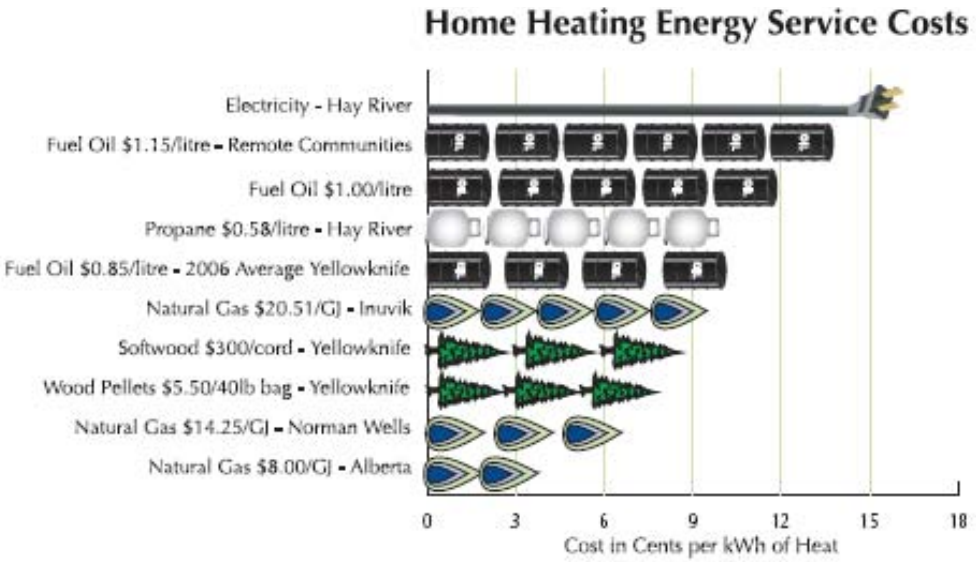


Figure 28. Home Heating Energy Service Costs.
Source: GNWT - Energy for the Future, 2007

As is clearly illustrated, wood pellets (from the south) cost less than other traditional fuels such as firewood, natural gas and electricity. In addition to the lower fuel cost, wood pellet stoves are also found to be more efficient than regular wood stoves and have comparable or lower particulate emissions. For these reasons, sales of wood pellets are expected to grow in future years.

8.1.2 Wood Pellet Prices

As mentioned, a 40lb bag of imported wood pellets is reportedly being sold for $5.50 if purchased in bulk (GNWT - Energy for the Future, 2007). This is equivalent to approximately $300 per tonne. Assuming this price is the same across the NWT, this roughly translates to $190,000 worth of pellets (625 tonnes) were purchased in 2006. Due to economy of scale and other factors, it can be expected that pellets produced within the NWT will be more expensive than imported wood pellets.

On a bigger scope, pellets in North America are being sold at an average price of $232 to $258 per tonne (US$180 to US$200 per ton) in 2007. According to Karwandy, 2007, "These data seem to indicate that the minimum price paid for wood pellets, in today's markets, is $175 per tonne delivered to the end user. However, prices over $200 per tonne are very common. Based on a price of $175 per tonne, a production cost of $75 per tonne and a distribution cost of $66 per tonne a Canadian producer would realize a gross operating margin of $34 per tonne. This value only illustrates the fundamental structure of the pellet market and does not reflect profitability."

8.1.3 Wood Pellet Production

As simple as a pellet sounds, the production process involves several complex stages. The first step of the production includes drying the raw material, which arrives in a variety of partially processed states (chips, shavings, sawdust, stripped bark, etc), to a moisture content of 12%. The raw material is then hogged to a small, uniform particle size. Without any additives, the dry wood dust is pressed into pellet form by the use of conventional equipment. Machinery used to grind and press the pellets is powered by large electric motors, which can only be installed at locations next to a main power grid capable of supporting such consumption. Upon leaving the press, the pellets are cooled immediately, allowing the lignin to be stabilized, and enabling the pellet form to be retained. These pellets are then bagged, or stored in a silo for distribution to the customers.

Thus far, no facility harvests trees solely for the production of pellets as it is deemed uneconomical. However, as pelletizing facilities continue to grow in scale, whole tree processing will become more feasible in the distant future (Karwandy, 2007).

Although the wood pelleting process is considered to be highly scalable, from one tonne per hour to 20 tonnes per hour, plants that produce less than three or four tonnes per hour are at a disadvantage due to the economies of scale (Mani et al., 2006). The following table illustrates the raw material required for a plant to produce at a certain rate.

Table 4 Wood Pellet Production Capacity

Production Rate (tonne / hr)	Production Capacity[1] (tonne / yr)	Quantity of Residuals Required	
		Dry (29% m.c.)[2] (green tonne / yr)	Wet (45% m.c.)[3] (green tonne / yr)
4	29,760	40,176	72,317
6	44,640	60,264	108,475
8	59,520	80,352	144,634
10	74,400	100,440	180,792
20	148,800	200,880	361,584

[1] 7440 hours: 24 hours/day, 310 days/year (85% utilization)
[2] conversion rate of 1.35 green tonne per tonne of pellets (8% moisture content) - Urbanowski, 2005
[3] conversion rate of 1.8 green tonne per tonne of pellets (8% moisture content) - "Wood Pelletization Sourcebook, 1995"
Source: Karwandy, 2007

8.1.4 Wood Pellet Facility Cost

The rule of thumb for building a pelleting facility states that $1,000,000 is required for every 10,000 tonnes of production capacity. This cost includes peripheral equipment, storage, conveyor, and separator systems. Most of the equipment associated with the actual pelleting process, excluding the dryer, represents only a small portion of the investment (Karwandy, 2007). As an example, a facility with a production capacity of 45,000 tonne per year (6 tonne per hour) would cost an estimated $4.5 million.

8.1.5 Wood Pellet Production Cost

According to Urbanowski, 2005, “Some of the crucial factors include raw material availability and cost, dryer costs and assessment of technology or fuel options and cost of getting pellet to the market. Understanding the profitability of a pelleting facility requires a different sort of analysis that accounts for changes in outside conditions like interest rates, exchange rates, feedstock and pellet prices, etc.”

By having a better understanding of the financial feasibility, these cost estimates help to identify the operations that are critical to the success of a pelleting operation. The following table illustrates the estimated cost of production by operation for a facility located in Saskatchewan:

Table 5. Production Cost Estimates for a 6 tonne/hr - 45,000 tonne/yr Facility (Cdn$ / tonne)

	Operating Cost	Capital Cost	Total Cost
Raw material	$22.69	$0.40	$23.08
Drying Operation (45% MC)	$9.17	$2.88	$12.05
Hammer Mill	$0.82	$0.29	$1.11
Pellet Mill (6 tonne/hr)	$2.20	$1.67	$3.87
Pellet cooler	$0.25	$0.15	$0.40
Screening	$0.06	$0.13	$0.19
Packing	$1.60	$0.66	$2.26
Pellet Storage	$0.01	$0.08	$0.09
Miscellaneous Equipment	$0.39	$0.49	$0.88
Personnel Cost (7500 hour/yr)	$14.91	$0.00	$14.91
Land use & Building	$0.06	$0.25	$0.31
Total	**$52.15**	**$7.00**	**$59.15**
Total less Raw Material	$29.46	$6.60	$36.06

Source: Karwandy, 2007

As illustrated, production costs are largely dependent on three items: raw material, personnel cost and drying operation. Raw material, representing about 40% of the production cost, includes a payment of $10 per tonne for the raw material plus the cost of transporting the raw material an average of 7.5 km. Personnel costs represent 25% of production costs and include five workers (two production staff and three baggers) per shift, as well as marketing and administrative staff. Operating the dryer represents 20% of the production cost and assumes a fuel source of wood shavings (10% moisture content) delivered for $40 per tonne. (Karwandy, 2007)

9 An Analysis of Market Opportunities

The study team investigated the main product/market opportunities available to communities from their existing (and to some degree, potential) resources. This included the identification of existing and potential customers (Section 9.1), SWOT analyses of existing log/lumber/residue production (Section 9.2), and discussions on alternative potential market options (Section 9.3).

As it currently stands, most community sawmills are offering their wood products in green lumber or cant form, without further remanufacturing (e.g. kiln drying and planing). In addition, there are sales of firewood.

9.1 Existing and Potential NWT Customers

9.1.1 Housing Construction Lumber

As it currently stands, the houses that the NWT Housing Corporation provides via various housing programs represent 30 – 40% of the NWT housing starts. These homes are built either using the “supply-

ship-erect (SSE)" method or the "labour only" method. For the SSE method, the tenderers are responsible for all operations, from the purchasing and delivering of building material to the construction of the home. For the "labour only" method, the NWT Housing Corporation supplies the building materials while the tenderers provide the labour. Regardless of the method, all of these homes are 100% stick built. In 2006, a total of 53 units were bid and constructed by 4 "labour only" tenders. These 4 tenders used a total of 609,620 fbm of lumber, worth $404,570, to construct the 53 homes, which had a total area of 57,243 square feet. On average, the lumber costs $660/Mfbm delivered to the building site. More than 90% of the dried, planed lumber used in the construction of these homes was imported from the south.

Building supply companies such as Igloo Building Supplies import kiln dried (KD) lumber from the south, and in turn sell to local NWT customers. It has been widely noted that products sourced from the NWT are often problematic; therefore the NWT customers prefer lumber from non-Northern producers. In addition, these customers, including NWT Housing Corporation and the contractors, prefer supplies of southern KD lumber because they are more dependable and are of higher quality. This demand further encourages the NWT building suppliers to carry KD lumber from the south as opposed to northern air-dried lumber. The NWT Housing Corporation does accept air-dried lumber, however past quality and production concerns have limited their purchase of such product. Igloo also stated that they would purchase from Northern producers providing that the mills are able to supply a high quality product at a desired volume. However customers' expectations need to be met.

Aside from the NWT Housing Corporation, Igloo also serves various NWT customers, with stores located in Hay River and Yellowknife. Igloo mentioned that they import their products from the south via their own lumberyard and pre-fab plant, both located in Edmonton. At present, lumber at C&F in Hay River delivered from Edmonton averages $470/Mfbm while lumber delivered from High Level averages $400/Mfbm. In addition to lumber, Igloo also imports prefabricated housing from their plant in Edmonton. The plant has an annual production of about 200 homes, ranging in size from 1,500 to 2,000 square feet. The plant also produces trusses and floor systems.

Even though the NWT Housing Corporation prefers building products from the south, they do support northern businesses. When deciding the winning bid for the project, the NWT Housing Corporation allows northern bids to be at a premium of 15-25% higher than bids from the south. However, more often than not, the bids have gone to the south simply because northern businesses cannot provide adequate materials, in terms of volume and required specifications.

According to Freund Building Supplies, northern graded lumber sells for $500/Mfbm in Fort Smith while the comparable lumber produced in the south sells for $300 to $380/Mfbm in the south. Northern lumber is pricier mainly due to small volume production. It is also noted that No. 2 graded lumber is what most customers demand and that the aforementioned prices are the same across all dimensions. The challenges that northern producers face include; the lack of constant customers, the low overall demand for product, the fierce competition from the south, and NWT customers' preference of southern KD lumber. These and many other factors are making it difficult in justifying new machinery investment and upgrades at NWT mills.

Yellowknife, being the biggest construction market in the NWT, requires a KD product in all the typical lengths and dimensions. However, housing starts in 2006 were 80 units, down from the recent peak of 350 units in 2003. The drop in housing starts may be attributed to the increase in NWT residents migrating to other provinces, while still working in the NWT. As the mines offer free transportation from Alberta to NWT, the workers have less incentive to stay in the NWT year round.

While competing with imported KD lumber is not impossible, it will be a daunting task for the communities. In order to capture the NWT market, northern sawmills must provide a competitively priced, high quality product at a desired volume to the customers. With the announcements of new housing programs and initiatives, it can be expected that NWT Housing Corporation's demand for wood products will rise in the coming years.

9.1.2 Communities

Local communities also represent markets for such products as firewood, log homes, bio-energy products, and secondary wood products such as flooring, cabinetry, and furniture.

9.1.2.1 Firewood

The firewood market in Yellowknife is particularly attractive. As advertised in the local paper, the delivered selling price of firewood is $275-300/cord. Compared to northern dimensional lumber which is sold for $500/Mfbm, and lumber from the south which costs $300 to 380/Mfbm, firewood is rather profitable, considering it involves very little manufacturing steps.

9.1.2.2 Log Homes

Although relatively small in volume as compared to its potential, log homes have been adopted by some communities as a way of bettering their log utilization and reducing their dependence on imported lumber/housing. In 1985, the NWT Housing Corporation elected to remove log homes from their housing programs. However, they would be willing to provide financial support to those communities or individuals who could demonstrate knowledge and expertise in log construction, as well as a commitment to complete the homes.

9.1.2.3 Pellets

While there is no existing pellet production in the NWT, the potential has been raised as a partial substitute for electricity and gas (homes and industrial demands) and firewood. Several apartment buildings have already installed pellet boilers in the hope of reducing their heating costs. As well, the North Slave Correctional Centre in Yellowknife is purchasing heat from two large, commercially-owned wood pellet boilers, resulting in energy savings. In 2006, over 625 tonnes of wood pellets were imported and sold in the NWT.

9.1.2.4 Community Projects

Though small in volume, it was noted that the communities often use green rough timber in various community construction projects. These community project applications include rough outdoor construction, fencing, seating areas, and a boardwalk to attract tourism.

9.1.3 Diamond Mines & Base Metal Mines

The mines are another consumer of wood products in the NWT. According to the communities, the mines are in constant need of lumber / timber for construction and repair purposes. Igloo Building Supplies have been selling rough green lumber to these local mines. This rough green material is reportedly being purchased at a discount of 15-20% (compared to kiln dried prices). The mines do not

typically require treated wood products. Igloo has considered purchasing from northern suppliers, but has encountered both quality and quantity issues.

A total of four mines were contacted, with three of them providing vital information via a questionnaire. These mines are located in remote areas and are only accessible by winter roads. With this constraint, the mines place their orders around October / November and the products are delivered in February (once the winter roads are established). The following section illustrates the various types of wood products consumed by the mines in 2006:

Mine A:

	Material Description	Consumption (pieces)	Dollars Spend
Stock Materials	LUMBER,2"X4"X16'	1,776	$61,000
	LUMBER,2"X6"X16'	413	
	BLOCKING,HARDWOOD 12"X12"X12'	0	
	BLOCKING,HARDWOOD 12"X12"X8'	2	
	BLOCKING,HARDWOOD 8"X8'X12'	9	
	BLOCKING,HARDWOOD 8"X8”X8'	0	
	BLOCKING,ROUGHCUT 12"X12"X12'	18	
	BLOCKING,ROUGHCUT 12"X12"X8"	4	
	BLOCKING,ROUGHCUT 8"X8”X12'	72	
	BLOCKING,ROUGHCUT 8"X8”X8'	26	
	PLYWOOD,1/2"X4'X8' G1S	401	
	PLYWOOD,3/4"X4'X8' G1S	204	
	PLYWOOD,3/4"X4'X8' STD SPRUCE	446	
	PLYWOOD,3/8"X4'X8' STD SPRUCE	196	
Projects Materials	Timbers, Rough 12" x 12" x 16'	248	$71,500
	Timbers, Rough 8" x 8" x 10'	186	
	Planks, Rough 3" x 10" x 10'	945	

As illustrated in the above table, Mine A consumed over 25,550 board feet of lumber, 97,000 board feet of rough timber and 19,000 square feet of plywood. These wood products were purchased from northern businesses (in Yellowknife) such as Home Building Supplies and Energy Wall & Building Products.

Mine B:

Material Description	Consumption (pieces)
2”X4”X8’	4,250
2”X4”X12’	4,250
2”X6”X12’	2,000
2”X8”X12’	600
2”X10”X12’	200
2”X2”X16’	600
6”X6”X12’	400

Mine B claimed that 2006 was their busiest period (in terms of construction activities) throughout the life of the mine. Over 112,000 fbm of lumber / timber products were purchased from a building materials supplier in Yellowknife and Hay River. It was indicated that the majority of the wood products were used

in the expansion of their accommodation complex. Therefore, it is anticipated that they will not require this amount of lumber on-going in future years.

Mine C:

Mine C indicated that they have an annual budget of $50,000 for the purchasing of wood products, which includes fabricating materials for core boxes (plywood), general working lumber (2x4, 2x6) and rough cut planking (1x6) for boardwalks. They also stated that they use rough cuts of 6x6, 8x8 and 12x12 (all 8, 10 and 12 feet long) for their underground programs. Most of these wood products must be treated with preservatives.

Even though they have a large supply of mine timbers on site, due to aging (25 years), these timbers are slowly loosing their strength and are close to being deemed unusable. This mine has considered purchasing from northern suppliers but has found their prices to be excessive. Unlike other mines, Mine C purchases products from Alberta or Northern British Columbia rather than from NWT distributors. In addition, this mine currently operates from an airstrip and has just recently received a winter road permit.

9.1.4 Mackenzie Valley Gas Pipeline (MVGP) Project

Aside from creating numerous job opportunities within the NWT, this $16 billion project has the potential to provide an opportunity for the NWT forest industry to develop. Imperial Oil estimated that the 1,220km long pipeline will require a volume of 35,510m^3 to 43,667m^3 of wood products, such as pipe skids, dimension lumber and swamp mats.

Since the project requires a large amount of wood products relative to existing community sawmill capacity, it may require that the volume be divided into contracts of appropriate sizes. The construction of the pipeline is expected to be compressed into several winters and Imperial Oil has stressed that the arrival of the wood products is critical to the process. The wood products will be required just before pipe and construction equipment is shipped from Hay River. Under the current schedule, delivery will most likely occur during the barge season of 2009.

With the current equipment setup, products such as pipe skids and camp skids can be produced by many community sawmills without much, if any, upgrades. Pipe skids are 4” x 6” x 4’ timbers that are used to support individual joints and strings of welded pipe before the pipe strings are lowered into the trench. Camp skids (6” x 6” x 2’) are used as foundation structures supporting camp modules. The pipe skids and camp skids can be purchased from the south for approximately $5.00 and $2.50 respectively, FOB mill.

Even though this pipeline will consume a significant volume of wood products, the communities must realize that this is a “one-shot” opportunity. Upgrades of the machinery must not be performed solely for the purpose of providing enough volume for the pipeline, but also for other future opportunities.

The following table illustrates the various types of wood products required for this project, in terms of volume, species, and other specification.

JRP Intervenor Information Request
for Mackenzie Gas Project

October 13, 2006 — Response to JRP Intervenor IR Round 5

Table JRP GNWT 5.01-1: Mackenzie Gas Project Estimated Wood Product Demand

Product Type	Pipe Skids [1]	Pipe Laydown Yard Dunnage [2]	Swamp Mats [3]	Wood Lagging Blankets [4]	Pipe Barge Dunnage [5]	Equipment Barge Dunnage [6]	Camp Skids [7]	Dimensional Lumber [8]	Plywood [9]
Species	Spruce, Pine or Douglas Fir	Spruce or Pine	Spruce or Pine	Spruce or Pine	Spruce or Pine	Spruce or Pine	Spruce or Pine	Spruce or Pine	Spruce, Pine or Douglas Fir
Quality	Rough cut	Rough cut	Rough cut	Planed utility grade lumber	Rough cut	Rough cut	Rough cut	Planed construction-grade lumber	Unsanded and good one side.
Dimensions	4 x 6 in x 4 ft	2 x 8 in x 8 to 16 ft	4 x 12 in x 12 in x 24 ft	2 x 4 in x 8 ft and 8 ft wide	12 x 12 in x 12 ft	4 x 12 in x 12 ft	6 x 6 in x 2 ft	2 x 4 in x 8 to 16 ft long	1/4 to 3/4 in - 4 ft x 8 ft sheets
Units	No. of skids	Linear Feet	No. of mats	No. of blankets	No. pieces	No. pieces	No. pieces	Linear Feet	No. Sheets
Location									
McGill Station	110,000	56,000	300	4,400	500	3,000	28,000	40,000	1,500
Trout Lake	60,000	56,000	300	2,500	500	3,000	28,000	40,000	1,500
Ochre River	60,000	56,000	300	50	500	3,000	28,000	40,000	1,500
Camsell Bend	60,000	56,000	300	0	500	3,000	28,000	40,000	1,500
Little Smith	110,000	40,000	300		500	3,000	28,000	40,000	1,500
Tulita		30,000					4,000		
Fort Good Hope	150,000	100,000	300	0	500	3,500	40,000	78,000	2,000
Norman Wells	50,000	60,000	300	350	500	3,500	40,000	78,000	2,000
Little Chicago	215,000	140,000	500	0	1,100	6,000	40,000	99,000	2,500
Swimming Point	50,000	40,000	0	0	400	2,000	16,000	39,000	1,500
Campbell Lake	150,000	100,000	400	0	1,000	6,000	40,000	99,000	2,000
Hay River							16,500	11,100	500
Total	**1,015,000**	**734,000**	**3,000**	**7,300**	**6,000**	**38,000**	**336,500**	**604,100**	**18,000**

Note:
1. Pipe skids are used to support individual joints and strings of welded pipe before the pipe strings are lowered into the trench.
2. Pipe laydown yard dunnage is used to support individual pipe joints in pipe laydown yard.
3. Swamp mats are used to support pipeline equipment on low-load-bearing soil and for temporary bridges along the rights-of-way. They are made by bolting together four 12 x 12 in x 24 ft long timbers to form a mat 4 ft x 24 ft.
4. Wood lagging is applied to the circumference of the pipe and is held in place by a tie wire. Wood lagging is used to maintain separation between the concrete bolt-on weights.
5. Pipe barge dunnage is used to support pipe on barge.
6. Equipment barge dunnage is used to support equipment on barge.
7. Camp skids are used to support camp modules as a foundation structure.
8. Dimensional lumber is used for construction around camps.
9. Plywood is used for construction around camps and hoarding-in during pipeline construction.

Figure 29. Wood Products required for the MVGP Project.
Source: Imperial Oil Resources Ventures Limited

9.2 Products Currently Being Produced by the Communities

Local NWT communities are currently producing rough, green lumber and timbers (cants). Lumber that is air-dried and planed can also be found in the Territories. As mentioned, the challenges that northern producers face includes the lack of constant customers, low overall demand and strong competition from large southern producers. These and many other factors are making it difficult in justifying new machinery investment and upgrades at the NWT mills.

The following tables provide an analysis of the strengths, weaknesses, opportunities and threats (SWOT) associated with these product offerings.

Strengths – Current Product Range

Criteria	Rough Green Timber (cants)	Rough Green Lumber	Air-dried & Planed Lumber
Creation of employment	Good	Better	Best
Ease of processing	Communities are familiar with manufacturing in a minimal number of production phases	Same as rough green timber	Air drying does not require any additional investment in equipment
Impact on construction costs	n/a for construction lumber. Avoids imports of green lumber	n/a for construction lumber. Avoids imports of green lumber	Less expensive than KD for housing construction
Impact on sense of community	Communities have expressed pride in their manufacturing capabilities	Better	Best

Weaknesses – Current Product Range

Criteria	Rough Green Timber (cants)	Rough Green Lumber	Air-dried & Planed Lumber
Education & training	Least issue	Moderate issue	Biggest issue
Delivered log costs	High logging costs not an issue compared to imports.	Same	High logging costs make it difficult to compete with imported dimension lumber
Security of timber supply	There is no long term timber supply agreement at present. Even on a small scale basis, the process for securing access to logs is complex.	Same	Same
Market size	Market for timbers can be substantial, but sporadic (e.g.: pipelines, mining tunnels)	Market for rough green lumber is limited to industrial uses	Northern lumber has had difficulty competing with imported KD dimensional lumber for construction
Equipment maintenance	The lack of shelter coupled with harsh weather conditions and the lack of trained maintenance personnel plays a heavy toll on equipment longevity	Same	Same
Housing acceptance criteria	Demand is for dried, planed lumber	Same	n/a
Equipment investment	Most communities require sawmill upgrades	Most communities require sawmill upgrades	Most communities would require sawmill upgrades plus planers
Diamond and base metal mines	Limited market as they require wood products that are treated	Same	Same

Opportunities – Current Product Range

Criteria	Rough Green Timber (cants)	Rough Green Lumber	Air-dried & Planed Lumber
Diamond mines	Limited opportunity as the sawmills are not equipped to provide treated products.	Same	Same
Mackenzie Valley Gas Pipeline	Potential "one-off" market, if mills can meet scheduling and volume requirements. Potential log supply opportunity.	Potential "one-off" market, if mills can meet scheduling and volume requirements. Potential log supply opportunity.	Limited market. Potential log supply opportunity.
Self sufficiency	Continued for industrial products	Continued for industrial products	Potential for housing products
Dept of Transportation	Limited market	Good market	Limited market
Housing construction	Potential with log homes	Potential with log homes	Good potential, subject to economics. This also opens up the largest, housing market – Yellowknife.

Threats – Current Product Range

Criteria	Rough Green Timber (cants)	Rough Green Lumber	Air-dried & planed Lumber
Trained workers	Once trained, workers may leave communities in search of higher paying jobs	Same	Same and even more critical
Job market	Cannot compete with wages offered by the diamond mines	Same	Same
"One shot" market demands	The communities could potentially be left with excess capacity if mills are upgraded just to satisfy the sporadic demands of "one shot" projects such as the MVGP.	Same	Same
Competing with imports	Low	Low	High

9.3 Alternative Market Options

Although air-dried, planed lumber is manufactured by one company, the majority of NWT sawmills are producing lumber and cants which are green and rough. As listed above, the NWT Housing Corporation and Igloo Building Supplies are potential customers for the community mills. At present, these customers are purchasing their wood products from Alberta suppliers. The reasons for this are; purchase of cheaper product (economy of scale), continuity of supply, and consistent quality (already graded). Also, NWT Housing Corporation is demanding dried, planed (and graded) lumber, not rough green cants/lumber. Should the communities improve their manufacturing and air drying techniques, the communities could potentially become the "preferred supplier" to such customers as Housing Corp and Igloo. By doing so, it is believed that the concept of "create local, sell local" could evolve to the advantage of the communities and the NWT as a whole. In addition, new job opportunities would also be created as more workers would be needed to operate the machinery. Finally, this opens the door to further remanufactured products such as millwork and flooring or even furniture.

9.3.1 Kiln Dried / Planed Lumber

The purchase of a small planer (for as little as $3,000) could satisfy the planing needs of a small community sawmill. By purchasing small kilns, the mills could further position themselves, thus capitalizing on local demands for kiln dried lumber. This would help increase the confidence of potential customers such as the NWT Housing Corporation and Igloo Building Supplies. In addition, the production of dried and planed lumber has the additional advantage of offering further remanufacturing opportunities.

9.3.2 Remanufactured Wood Products

Remanufactured products that the communities could produce span the full range, from simple planing modifications that could produce tongue and groove flooring, all the way to furniture. The advantages of such value added manufacturing include the opportunity for training and developing a skilled work force, greater community employment, smaller resource requirements, and the opportunity to brand and even export First Nations wood products. The production of remanufactured wood products also has a potential fit with log home manufacturing.

The kilns, planers and other equipment might be too expensive for the individual communities. Therefore the installation of a conveniently located central remanufacturing facility to service the drying and planing needs of the surrounding communities could be considered. In addition to meeting the demand from the NWT Housing Corporation, Canadian Mortgage and Housing Corporation and others for KD lumber, the central facility could also be equipped to manufacture flooring, wall paneling, siding, moulding, or even doors / windows and furniture. The latter could necessitate cooperative ownership of additional equipment such as lathes, jointers, finishing equipment, etc. The following tables provide a SWOT analysis of developing such a cooperative remanufacturing capacity.

Strengths – Lumber Remanufacturing

Criteria	Comments
Create employment, training and community stability	These appear to be the common, primary objectives of all communities
Positive attitude towards restarting and/or enhancing local sawmills.	All of the communities appear very eager to restart or enhance their mills. This could prove to be a major contributing factor in their future success.
Self sufficiency	This is especially the case for log homes, but could also be a supply source for Housing Corp. and others.
Government funding	A cooperative initiative based upon a sound business plan targeted at import replacement and community sustainability could attract government financial support.
Lower vulnerability to high log cost	The logical thing to do with high cost logs is to produce high value products

Weaknesses – Lumber Remanufacturing

Criteria	Comments
Negative reputation	Housing Corporation's experience in dealing with NWT suppliers has been mixed and has resulted in concern over the consistency of supply of a quality product. While this is true for dimension lumber, it could impact their purchase criteria for finished products as well.
Training and education	This can be tackled (at a cost) by providing training classes and workshops in the communities, whether it is machine operation or preventive maintenance.
Shortage of appropriate planed lumber supply	Catch-22
Remote area	Parts replacement can be an issue for remote communities, and should be a consideration when selecting equipment.
Security of timber supply	There is no long term timber supply agreement at present. Even on a small scale basis, the process for securing access to logs is complex.

Opportunities – Lumber Remanufacturing

Criteria	Comments
New products	Suitably equipped with a planer, dryer and moulders and other value adding equipment, a cooperative remanufacturing plant could diversify its product offering beyond cants and lumber while employing more workers.
Added product value	Not only would this create more employment for the communities, these new value-added products (that are sold to other provinces) could be priced competitively.
Housing construction	Even if Northern dimension lumber cannot be competitive with imports, Housing Corp. and others could be convinced to purchase domestic interior finish items.
Export potential	First Nations branded products from simple (e.g. carvings) to elaborate (e.g. furniture)

Threats – Lumber Remanufacturing

Criteria	Comments
Trained worker retention	Upon receiving their training, the workers could simply leave town to find a better paid job elsewhere, leaving the community behind.
Disparate communities	For example, agreeing on the location of such a facility.
Vulnerability to council members	Any change from the status quo is not possible without full council approval.
Wages	It is difficult for NWT wood product manufacturers to attract and retain workers due to the wage scales in other competing NWT industries. Most communities are paying their workers $18 - $23 per hour. Meanwhile, students that work for the GNWT get paid $22 per hour plus benefits. In addition, nearby diamond mines are reportedly paying their workers $91,000 annually. In addition, these miners receive bonuses and benefit packages after just two years of employment. However, value added products do offer the potential for higher salaries. This could negate the threat.

9.3.3 Log Homes

Based upon the level of interest expressed by the NWT communities and others during this study, a log home manufacturing operation could represent a realistic goal for the Territories. Regardless of whether this evolves as an independent company or a cooperative effort, the new entity could possibly serve clients throughout the NWT, other regions in Canada and at a later time possibly even international markets. Prior to 1985, it was reported that at least 8 community sawmills were building log homes. Unfortunately, log homes are no longer an option within the various housing programs supported by the NWT Housing Corporation. The biggest reason for this cancellation appears to be the higher material and construction cost. It is believed that the trees in the NWT rarely meet the size specification for log construction and as a result the logs must be imported from the south. However, the NWT Housing Corporation stated that they would be willing to finance a log home, providing that the builders have the expertise and that they show dedication in completing the construction of the home.

Another possible related market opportunity could evolve from established log home builders in British Columbia and Alberta. Specialized crafting work by the First Nation communities in the NWT could be offered under contract to these builders. For example, a log home producer in B.C. hires First Nation workers to do special crafting on logs for decorative purposes (as illustrated below), adding a unique, exotic touch to the product.

Figure 30. Worker Crafting an Architectural Feature for a Log Home

The following tables provide a SWOT analysis of items impacting on the establishment of a log home manufacturing facility in the NWT.

Strengths – Log Home Manufacturing Facility

Criteria	Comments
Application of inherent expertise	Local workers can apply their crafting and sculpting skills to use in a manufacturing environment.
Employment creation, training and community stability	These appear to be the common objectives of all communities.
Enthusiastic attitude towards new business opportunities.	All of the communities are passionate about the possible new opportunities, such as log homes and wood pellets. All parties have requested more information on new business opportunities.
Housing self sufficiency	Can now compete with less expensive imported dimension lumber for platform frame homes.
Lower vulnerability to high log cost	The logical thing to do with high cost logs is to produce high value products
Low equipment requirement	Can be as simple as using hand tools

Weaknesses – Log Home Manufacturing Facility

Criteria	Comments
Lack of education and training.	This can be tackled by providing training classes and workshops to the communities at a cost.
Equipment	E.g. total lack of lathes in NWT.
Transportation	Delivery to the customer could be a potential weakness as the communities are located in remote areas. However, log home manufacturers in other parts of Canada have proven that they can ship their products competitively to international markets.
Security of timber supply	There is no long term timber supply agreements at present. Even on a small scale basis, the process for securing access to logs is complex.

Opportunities – Log Home Manufacturing Facility

Criteria	Comments
Self sufficiency	Reduce reliance on imported graded lumber / manufactured housing
Niche markets	With proper marketing, log homes manufactured "North of 60" could attract some customers as unique and rustic.
First Nations branding	It is well documented that some markets such as Japan are willing to pay high prices for First Nations, hand-made wood furniture and sculptures. The very same concept can be applied to the log homes.
Log home building components	Other log home builders might find the crafting from NWT workers to be very appealing for incorporation into their own product.
Expanded product opportunities	E.g. millwork, flooring, partition walls, cabinetry, doors, windows, etc.

Threats – Log Home Manufacturing Facility

Criteria	Comments
Trained worker retention	Upon receiving their training, the workers could leave town to find a better paid job elsewhere.
Wages	It is difficult for NWT wood product manufacturers to attract and retain workers due to the wage scales in other competing NWT industries. Most communities are paying their workers $18 - $23 per hour. Meanwhile, students that work for the GNWT get paid $22 per hour plus benefits. In addition, nearby diamond mines are reportedly paying their workers $91,000 annually. In addition, these miners receive bonuses and benefit packages after just two years of employment. However, value added products do offer the potential for higher salaries. This could negate the threat.
Log quality	Some regions may not have the resource to meet the log home quality standards.

9.3.4 Pellets

The communities have demonstrated a strong interest in producing wood pellets. There have been requests for more information regarding the setup requirements, production costs and market values for such an operation.

As a rule of thumb, it costs approximately $1,000,000 to set up every 10,000 tonnes of production capacity (Karwandy, 2007). It is also noted that a plant designed to produce less than three or four tonnes per hour is at a disadvantage due to the economies of scale. As a result, it would take close to $3,000,000 to open an economically feasible pellet plant. Perhaps, one centrally located wood pellet plant producing enough products to supply all of the NWT might be justified if enough low cost material is available.

Even with government funding and collaboration from a number of NWT communities, the survival of a pellet plant would be highly dependent on the security of fibre supply and the delivered cost of the raw material. Even though the NWT has a vast amount of forest, the volume of economically harvestable timber is a small fraction of the total NWT resource, especially if harvested for pellet manufacture alone (as opposed to using residual fibre from lumber production). As mentioned previously, the raw material arrives in the form of chips, shavings, sawdust, and stripped bark, which are all low cost inputs. Furthermore, no facilities harvest trees solely for the production of pellets as it is deemed uneconomical (Karwandy, 2007).

The following tables provide a SWOT analysis of items impacting on the establishment of a wood pellet manufacturing facility in the NWT.

Strengths – Wood Pellet Manufacturing

Criteria	Comments
Environmentally friendly	Compared to traditional fossil fuels such as natural gas, heating oil and coal, pellets are considered to be an environmentally friendly alternative.
Strong forecast	As illustrated by the increased purchase of pellet heating appliances, demand for wood pellets is expected to continue to grow in North America.
Enthusiastic attitude towards new business opportunities.	All of the communities are passionate about the possible new opportunities, such as log homes and wood pellets. All parties have requested more information on new business opportunities.

Weaknesses – Wood Pellet Manufacturing

Criteria	Comments
Lack of education/training	Whether it relates to raw material preparation or pellet handling, this can be tackled by providing training classes and workshops in the communities.
Lack of knowledge	As with any new product venture there would be a steep learning curve.
Expensive investment	Due to the size of the required investment, government financial support would likely be required.
Delivered fibre supply	This will be somewhat dependent on the availability of residue fibre from lumber manufacture.
Pellet burning stoves	In order to use the pellets to heat the communities, pellet burning stoves must be purchased. This is also true on a much larger scale for industrial energy needs.
Remote area	Parts replacement can be an issue for remote communities, and should be a consideration when selecting equipment.
Labour supply	Relocation of workers may be necessary.
Energy requirement	Energy requirements are very high for pellet manufacturing. This more or less necessitates that the location of the pellet manufacturing facility is on the hydro grid.
Security of timber supply	There is no long term timber supply agreement at present. Even on a small scale basis, the process for securing access to logs is complex.

Opportunities – Wood Pellet Manufacturing

Criteria	Comments
Market "dominance"	As the only pellet producer north of 60, the potential firm could have preferential access to all the pellet needs of the Yukon, Northwest Territories and Nunavut. As well, product could be sold to nearby provinces such as northern British Columbia and northern Alberta.
Government buildings	The NWT Government could follow the Swedish precedent and implement wood pellet fired heating systems in all government buildings and establishments. This would provide a constant demand for the plant.
Savings	Possible savings from local community heating bills could be used elsewhere, such as upgrading the equipment in community sawmills.

Threats – Wood Pellet Manufacturing

Criteria	Comments
Trained worker retention	Upon receiving their training, the workers could simply leave town to find a better paid job elsewhere, leaving the community behind.
Conflicts and arguments	If the communities are unwilling to work together, any cooperative wood pellet manufacturing ventures might fail.
Competition	Even though the wood pelleting process is highly scalable, this proposed NWT pellet firm could be out of business if a larger-scaled pellet plant south of 60 sells their products cheaper in the prospective markets.
Feedstock	A constant supply of raw material is critical to the success of the pellet plant. Supply scheduling would have to account for harsh winter conditions.
Strong demand forecast	The strong demand forecast could very well attract more openings of pellet plants across North America.
Winter conditions	Even though the machines will be indoors, the extreme weather might freeze some of the hydraulics on the machinery.
Wages	It is difficult for NWT wood product manufacturers to attract and retain workers due to the wage scales in other competing NWT industries. Most communities are paying their workers $18 - $23 per hour. Meanwhile, students that work for the GNWT get paid $22 per hour plus benefits. In addition, nearby diamond mines are reportedly paying their workers $91,000 annually. In addition, these miners receive bonuses and benefit packages after just two years of employment.

This entire SWOT analysis is highly dependent on a detailed cost-benefit analysis.

10 The Log Home Building Option

During the interviews conducted with communities in the Northwest Territories, a question was posed on numerous occasions, on the feasibility of constructing log homes for local markets. Because of the almost universal interest in this product area, this section of the report is devoted to the "Log Home Building Option". The communities and entrepreneurs felt that there would be markets for both permanent housing as well as recreational properties. Among these two areas there is also a potential for commercial structures and portable buildings that could be used for the establishment of mining camps.

In log construction, there are two distinct methods of producing log buildings:

- **Handcrafted method,** which is the traditional method, using predominantly hand-held tools (chainsaws, scribers, axes etc.)

- **Machine profiled method,** utilizing equipment that profiles naturally shaped logs into uniform building components

Both of these methods have advantages and disadvantages that will need to be considered with respect to the community's needs, available skill capacity, capital investment both initial and ongoing, operational requirements, and the community's geographical location related to access to repair services etc.

10.1 Handcrafted Log Construction Systems

Handcrafted log homes are produced using peeled naturally shaped logs that are manually scribed and shaped with predominantly handheld tools. The requirements for building handcrafted log homes are summarized in an industry standard published by the International Log Builder's Association. A copy of the standard can be viewed and printed on the association's website at www.logassociation.org/resources/ilbastandards.pdf. Also, the International Code Council in the USA has recently developed a log building standard that will soon become part of the International Building Code in the USA (www.iccsafe.org/news/nr/2007/0228log.html). This will be the first national standard for log construction in the world and it is inclusive to both handcrafted and machine profiled log homes. It is possible that this standard could be adopted in Canada as well.

Using the traditional (hand crafted) method, each log is scribed and fitted separately with the neighbouring bottom log, and when the fitting is completed, another log can be fitted over it. In reality, this means that if a rectangular log structure with four exterior log walls is built, the crew can only work on two logs (on the opposite walls) at any given time. When those two logs are fitted the crew continues fitting two logs on the remaining two walls.

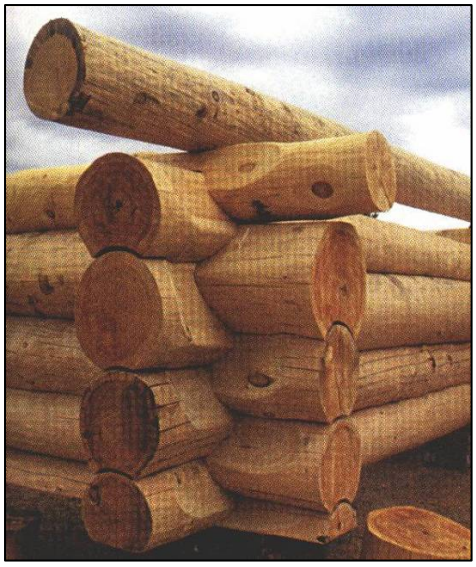


Figure 31. Traditional Method of Constructing Log Structures Fitting One Log at a Time.

The logs used are generally as long as the full length of the wall plus what is required for producing the corner joints. The length of log required for the production of the corner joint will vary depending on the joint's style between 1 and 2.5 times the mean log diameter per joint. Shorter logs are used between the window openings, doors, etc.

This manufacturing method requires lifting equipment (such as a truck crane) to place logs on/off the building, and to move them from one station to the next. The log building site requires enough space to be able to pre-construct the log package and to store and move logs from the storage to the work areas.

Both skill and labour requirements to produce log structures using this method are relatively high. The productivity levels are dependent on the skill level of the log building crew and on average can be assumed to be approximately one fitted log per day per trained builder. However, there are log builders who are able to fit up to two logs per day per worker. Under certain conditions (mainly proximity to the final construction site) log homes don't need to be pre-built off site and can be constructed directly on the permanent foundations.

Using an advanced, so called "**accelerated" building method**, log structures are built using a different philosophy. The log structure is pre-built without precise fitting of one log at a time. Instead, the entire structure is put together using pre-calculated rough notches and logs are held in place by mechanical spacers. When the entire structure is roughly assembled, all the logs are scribed at one time, the logs are marked to record the appropriate location of each log in the building and the entire structure is disassembled and all logs are cut. If the method is well understood and the tasks precisely executed, the entire wall package is ready for final assembly on the permanent site without additional pre-assembly.

Figure 32. Log Shell Under Construction Using "Accelerated" Log Building Method.
Source: www.logbuilding.org

Using this method, logs need to meet the same requirements as with the traditional method. A lifting device is also necessary to place logs on/off the log wall and to move them between work areas. In addition to the space required to pre-construct the log package and to store and move logs from the storage to the work areas, the log building site requires enough space to dismantle the entire structure for cutting. However, all the cutting doesn't have to be necessarily done at once.

The skill requirements to produce log structures using this method are as high as in the traditional method. In addition, a good understanding of this accelerated manufacturing method is necessary. The labour requirements are lower than with the traditional method because of the decreased handling of the logs.

Although productivity levels are dependent on the skill level of the log building crew, the nature of this method affords an opportunity for productivity increases resulting from reduced log handling, and the fact that all logs can be scribed and cut all at once. The time to produce the "unit" shell can thus be reduced by 30-35%. Once the logs are cut, they don't need to be pre-assembled again and they can be transported to their final destination and assembled on the permanent foundations.

The initial capital investment for using this accelerated building method is somewhat higher as the purchase of mechanical spacers to pre-construct the log shell before scribing and cutting is necessary.

Both of the above methods require full length logs for constructing the buildings and each log has a precise location in the building and can't be interchanged with any other log due to its unique shape and size. Generally, the manufacturing of log homes using these methods occurs outside, unless capital is invested into the appropriate infrastructure and manufacturing facility (covered building) to preassemble entire structures under the roof.

This fact could be a certain disadvantage given the geographical location of most communities in the NWT and the apparent lack of available capital in the communities. The weather throughout a significant

portion of the year would limit the time span available for the efficient manufacturing of log shells. As well, retaining a workforce continuously willing to work outside would be a challenge.

An alternative to building with full length logs is a **method using short logs called "Piece-On-Piece"**. This method was developed around a log building system that could be categorized as a post and beam, or panelized system using logs. The method was very popular in eastern Canada in the 1800's and early 1900's and in recent years it is experiencing a revival. The advantage of using shorter logs is the fact that they are easier to obtain and easier to handle. This could also be an advantage in the NWT, given the fact that most locally sourced logs tend to have larger taper. With the employment of a crane and other lifting devices the entire sections of walls can be prefabricated and then brought to the construction site for reassembly.

"Piece-on-Piece" log buildings can be prefabricated in smaller sections shorter than 12' (3.6 m), and often as short as 8'. These sections are built using jigs and the manufacturing can be relatively easily mechanized. The production of these smaller segments can be easily set up inside a small shop. Such a facility would be easier to acquire, and less costly to heat in the winter months. The logs in completed sections are connected using throughbolts, and sections can be handled and further finished. The window and door openings can be produced inside the shop and the finished sections can be stored until all components are ready for assembly on a permanent house foundation.

Figure 33. Home Being Built Using "Piece-on-Piece" Building Method
Source: www.logworks.ca

This technology can offer a number of advantages in northern climates. It allows log building crews to operate year round in a relatively small shop that could also be used for the manufacture of other log home components such as stairs, roof assemblies, railings or rustic furniture. The wood waste generated in production can be utilized to heat the shop in the cold climate.

The level of skilled labour required for this technology is not as high as with the previous methods because the production workers can focus entirely on scribing and cutting the lateral grooves, squaring the wall sections, and finishing openings for doors and windows. There needs to be a good understanding of this method to ensure that quality structures are produced. However, the assembly crew (can be the same as the production crew) must be supervised by a qualified builder in order to properly assemble and finish

the homes on the foundations. Failure to do so can result in a poorly performing building envelope which might be difficult or impossible to fix.

Structures built using this technology can reach significant dimensions as the wall sections can be connected by log or timber posts. This allows the construction of larger gathering or industrial/commercial structures with short logs.

Figure 34. Large Indoor Tennis Court Built Using Short Logs

Another alternative that could be considered is building dovetail style chinked structures. Manufacturing of this old proven structure can be relatively well mechanized using various jigs that allow for the production of joinery in an efficient manner.

The requirements for wood are similar as in previously discussed styles, however the wood needs to be milled or hewed into cants before the joining takes place.

This operation could be done at a local mill, or could be complimentary to a sawmill operation. If properly set up, this technology could offer a great potential to NWT communities. As previously discussed, the "Piece on Piece" system technology could be brought into a relatively small indoor shop. In addition to the infrastructure needed for handcrafted log construction specialized notching jigs are also needed. There are also industrial systems available on the market that can produce dovetailed joints in several seconds.

Traditionally, there are spaces left between the logs in the wall, which are later sealed with a specialized chinking system that ensures a long lasting and weather tight building envelope. However, the system can be designed with other types of joints between the logs (such as double T&G) and then the chinking is not required (see picture below).

Figure 35. Cutting of Dovetail Corner Joint Using Jigs (l), Machine Cut Dovetail Joint (R)
*Source: **www.truenorthloghomes.com** (R)*

10.1.1 Material Requirements for Handcrafted Log Homes

Handcrafted log homes are generally built from logs of larger dimensions than in the machine profiled industry. According to the ILBA Log Building Standard, the smallest log diameter (on the top) shall be no less then 8" (200 mm). Minimum log diameters are also prescribed by Canadian National Energy Code (CNEC) to ensure sufficient thermal properties of building envelopes. Permanent log homes built from round logs should have a mean diameter of no less than 12" (300 mm).

A separate forest resource assessment would be required to identify whether or not there is a sufficient resource of logs with 12" (300 mm) mid-span diameter that meet the criteria prescribed by the ILBA standard in terms of its size and quality requirements.

The species noted during the field visits to the NWT communities were spruce and aspen. Both of these species could be used for manufacturing of log homes as long as they have the appropriate dimensions and quality.

In order to establish the log volume needed for log home construction, it can be assumed that approximately 60 m^3 of house logs are needed to construct a log package for a simple 1,200 square foot home with a simple log roof system. This assumption is based on logs of 12" (300 mm) diameter at mid-span.

10.2 Machine Profiled Log Construction Systems

Machine profiled log construction systems utilize logs/timbers profiled by machines into a uniform profile. The profiles vary substantially based on the type of machine and the system's design. Generally, log profiles are smaller in cross-section than those of handcrafted log systems. However, the diameters should not be smaller than those prescribed by the Canadian National Energy Code [minimum diameter of 12" (300 mm)] to provide sufficient thermal insulating properties of the building envelope. In the case of square timbers used for log construction, the National Energy Code specifies a minimum wall thickness of 6" (150 mm). However, given the harsh climate in the NWT, and the general trend towards improving the energy efficiency of Canadian housing, this would likely be insufficient for permanent housing.

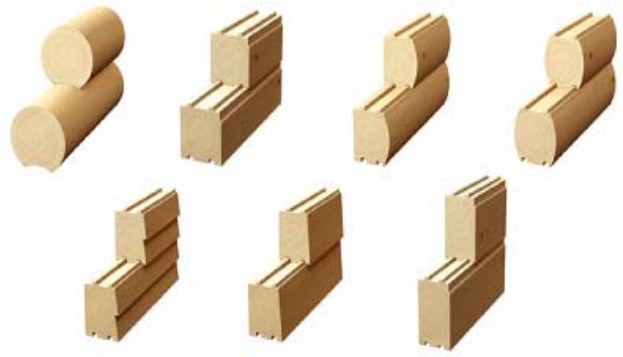


Figure 36. Common Log Profiles Used in Machine Profiled Log Home Industry

The manufacturing of building components occurs on "mill like" machines that are often connected by conveyors to allow for efficient manufacturing. The length of individual components is limited mostly by the machine's design. It rarely exceeds 24' (approximately 7.2 m). The length of individual components thus requires longitudinal jointing of logs/timbers in the wall.

In terms of machinery available for the production of log homes, most companies either custom build their own manufacturing system or customize an off-the-shelf system. These systems offer various levels of sophistication. There are several manufacturers of log home equipment in North America. The level of sophistication, productivity, and capital required to purchase one of these systems vary substantially. The purchase cost ranges from approximately $65,000 to about $1.5 million, not including the construction of a building and other accompanying infrastructure.

Figure 37. High Production Machine Profiled Log Home Manufacturing Facility (L) and Simple Log Lathe Produced by Isaac Ironworks Ltd., Designed For One-man Operation (R).

It is quite obvious that the higher the capital investment, the higher the productivity. However, the more complex and expensive systems also require higher-skilled operators to run the machine centres. An appropriate level of maintenance is also required to keep the machinery operational. The simpler systems are easier to operate and maintain, even though the productivity might be lower. However, they can still provide enough capacity to meet the community's needs. This should be carefully considered given the geographical location and remoteness of communities in the NWT from major supply and service centres.

Figure 38. Portable Machine Profiled Log Home Built On Pressure Treated Skids

For the purpose of this project, equipment manufacturers producing log home building equipment were researched. As indicated earlier, there is a relatively limited number of North American manufacturers offering log building equipment. These are:

Isaac Ironworks, Ltd.
R.R.#1, Site 4, Box 24
Spirit River, AB, T0H 3G0
Ph: 780-351-2278
Fax: 780-351-2251
isaacironworks@characterlink.net
Produces a range of equipment, including a log lathe/notcher in one compact unit. This unit is in a lower price range designed for a one or two men operation.

Pendu Mfg. Inc.
718 North Shirk Road
New Holland, PA 17557, USA
Phone: (800) 233-0471, (717) 354-4348
Fax: (717) 355-2148
www.pendu.com
Produces machinery for the log home and pallet industries. The company produces a range of products. The log home equipment is designed for high production manufacturing.

River Valley Machinery Inc.
PO Box 129
East Livermore, Maine 04228, USA
Ph: 207-897-5300
Fax: 207-897-2888
sspilecki@aol.com
www.auburnmachinery.com
Specializes in log home production equipment. The company focuses predominantly on higher productivity, larger sized equipment.

Based on the information gathered, both Pendu Mfg. Inc. and River Valley Machinery focus on supplying complete high production sophisticated log home building systems. However, Isaac Ironworks, Ltd. from Alberta developed a log lathe that is very compact with sufficient productivity levels of about 80 to 160 linear feet of logs produced per hour of operation. The machine can be operated by one person with the help of a log lifting device. Further investigation of this equipment would be necessary to provide additional details.

NWT communities considering the establishment of a log building operation should look carefully at the combination of a simple machine profiling system and "Piece-on-Piece" wall component prefabrication.

Such a strategy could address the specific objectives of a particular community in terms of employment, economic development, and housing. Furthermore, it would most likely provide the best alternative given the labour shortage in some communities and the climatic conditions in the NWT. However, a detailed analysis and consultation within the particular community would be necessary before a firm recommendation could be put forward.

10.3 Infrastructure Required for a Log Building Operation

To pre-construct log shells, a log building yard would be needed. Ideally this yard should be in an industrial zone, or (at a minimum) far enough away from residential areas so that chainsaw noise and/or sawdust would not pose any problems. The yard should also be serviced with electricity and water. The

ground should be leveled and stabilized for preconstruction. The size of a log building yard will depend on the production levels. However, a small handcrafted yard should be a minimum of 0.75 to 1 acre in size with good access for wood delivery and transportation of log components.

For handcrafted manufacturing, it would be beneficial to have at least one small multifunctional building in the yard, providing tool storage, office space, a washroom, tool maintenance shop, and place to warm up in the cold weather. As the business grows, a small covered shop for piece log work could be build. In the case of a machine profiled operation, the entire machinery should be housed under shelter (lean-to at a minimum). Choosing a manufacturing technology that would allow the production of log buildings in the shop would greatly extend the building season and would improve the efficiency of the entire operation.

The primary single piece of machinery required would be a rough terrain crane or a zoom-boom forklift with certified tongs and slings. While the lifting device does not need to be new, it should be safe and in good working order. Given the size of the operation that might be possible in one of the communities, the zoom-boom forklift might be an ideally suited piece of equipment to handle logs and other materials in the yard.

The following table establishes the basic, required infrastructure for a log building operation.

Table 6. Basic Infrastructure Required For Log Home Manufacturing

	Handcrafted	**Machine Profiled**
Adequate land to carry out construction projects	√	√
Outbuilding(s) in the yard (storage and manufacturing space, office/ administration)	√	√
Washroom facility	√	√
Water Service	√	√
Single Phase Power	√	√
Rough Terrain Crane or Zoom-boom Forklift with Certified Tongs & Slings	√	√
Builder's Level	√	√
Assorted Power and Building Tools (see the list bellow)	√	√
Level III Safety Kit	√	√
Trailer to Transport Log Packages to Permanent site (if not possible to hire)	√	√
Log Mill		√
Three Phase Power or Generator		√
Shed or Building to House the Log Mill		√

An additional assortment of log building carpentry and construction tools will be needed for construction. These might include but are not limited to: chainsaw(s) with accessories, grinders (small and large), curved and straight power planer, larger hand drill with set of bits, straight and curved chisels, single edge carpenter's axe, mallet, sledge, peeling spud and drawknife (for handcrafted), set of levels 2', 4' & builders level, cant hooks & peaveys & log carriers, log scribers (for handcrafted), indelible pencils & timber crayons, chalk lines, 25-30' & 50-100' measuring tape, log calipers, log dogs and holding pins, log

cleats, heavy duty metal toolbox, stepladder 6'-8', come-a-long (2-3 ton), personal protective gear (hardhat with earmuffs and shield, steel toe boots, safety chaps of pants, chainsaw gloves, dust mask).

10.4 Capacity Available in the Community and Additional Training Requirements

In order to ensure that the log structures produced are a quality product, log building training would be necessary. This could be achieved by attending an established log building school, or by organizing a training program in the particular community. At the beginning, basic log building skills need to be obtained, and as the operation starts manufacturing the product, additional training would be necessary. Most of the basic training would be independent of what log building manufacturing method is chosen as the key in that stage is to establish basic principles of properly constructed log buildings.

The scope and the level of training would also be dependent on whether the community/company produces just the log work (the log package) or completed homes; and whether the product is being manufactured to satisfy local community needs, or as suggested earlier is responding to a demand from mining camps.

Training in the following areas would be required if only log packages are considered:

Hand tool and construction safety
Crane operation/safety
Basic and advanced log building

Should completed units be produced, additional training would be needed as follows:

General contracting
Finishing log structures (installing windows, doors, interior framing, drywalling, etc.)
Electrical wiring for log structures
Plumbing for log structures

If the log work is produced on a log lathe or in a mill-like environment, the log mill operation and maintenance training would be necessary to properly operate and maintain the equipment.

A number of basic and advanced log building courses are offered in Canada. Most of these courses are offered at log building schools. However, it might be possible to arrange for an instructor to provide training directly in the community.

Also, in British Columbia, log building has been recognized as a trade by the Industry Training Authority (www.itabc.ca), and an apprenticeship log building program has been established at the Thompson Rivers University (www.tru.ca/index.html). However, the program is currently on hold.

Some of the private educational facilities and/or companies offering basic and advanced log building courses are listed below:

Del Radomske's Okanagan School of Log Building International
Del Radomske
1231 Philpott Rd., Kelowna, BC V1P 1J7
phone: 250-765-5166 fax: 250-765-5167
e-mail: info@okanaganschooloflogbuilding.com

website: www.okanaganschooloflogbuilding.com
Industry training, handcrafted log homes.

Island School of Building Arts
James Mitchell
3199 Coast Road, Gabriola Island, BC V0R 1X7
phone: 250-247-8922 fax: 250-247-8978
e-mail: info@logandtimberschool.com
website: www.logandtimberschool.com
Training in log building and timberframe construction for pre-industry employment.

Pat Wolfe Log Building School
Pat Wolfe
RR #2, Lanark, ON K0G 1K0
phone: 613-256-0631 fax: 613-256-8413
e-mail: pwolfe@istar.ca
website: www.logbuildingschool.net
Handcrafted log building school.

Custom Log Homes Ltd.
Howard Williamson
3030 - 40th St. S.E., Salmon Arm BC V1E 1X7 Canada
phone: 250-832-3690 fax: 250-832-8313
e-mail: cuslog@airspeedwireles.ca
website: www.customloghomesltd.com
Log home company offering basic log building training.

11 Conclusions and Recommendations

The nature of the NWT wood products industry and the environment within which it is currently operating offers an opportunity to present a number of general conclusions and recommendations for the independent and/or combined consideration of all stakeholders (e.g.: the manufacturers, local communities and governments). These observations and suggestions are based upon a combination of information gathered during the March 2007 visits with the NWT industry and communities, published historical data, and on Forintek's broader knowledge of the Canadian industry and global wood products markets.

During the mill visits, it was observed that NWT's community sawmills produce limited types of wood products. Aside from firewood, these operations are selling their products as green lumber or cants. Most of the rough green products manufactured in the NWT are shipped to Alberta where further remanufacturing takes place. However, a small amount of locally made wood products are sold in the communities for use in non-housing construction and industrial applications such as walkways, playgrounds and other landscaping projects.

Customers such as the NWT Housing Corporation and Igloo Building Supplies tend not to purchase from the local sawmills. Their preference is for kiln dried, planed, graded (dimension) lumber imported from the south. There is only one NWT manufacturer supplying air-dried, planed and graded lumber, which is only available in small quantities. While competing with imported KD lumber is not impossible, it will be somewhat challenging for the communities. Due to economies of scale and other factors, northern KD, planed, graded lumber will have trouble competing economically. For the NWT customers to purchase these pricier products, northern sawmills must provide lumber that is somewhat comparable to the products from the south. The products that northern sawmills produce must be competitively priced, possess a high quality and must be available to the customers at a desired (large) volume.

The diamond and base metal mines are in constant need of wood products (e.g. timber and plywood) for a number of end-uses including construction and repair of tunnels. Similar to the NWT Housing Corporation, the mines do not purchase from the community sawmills, but rather from NWT distributors such as Igloo. Reasons for this include price and continuity of supply.

It is evident that local communities are eager to provide sustainable employment to their members, either by restarting their existing sawmill operations or venturing into other business opportunities (e.g.: log homes or wood pellets). However, the communities must first and foremost capture the local markets by gaining the confidence of the NWT customer base. This can only be accomplished by providing the volumes of product that the customers demand in a timely manner and with the desired quality. Satisfied customers are most likely to return with more requests for products in the future. Although the NWT sawmills are currently not able to provide products such as wood paneling, they can certainly accommodate the immediate demand for rough lumber and cants.

If the creation of sustainable employment and community well-being are top priorities, it is believed that some communities will gain most benefit by producing secondary wood products and/or log homes while others will be better positioned to produce lumber and timber products. Compared to wood pellet production, each of these options will require less capital investment while generating more employment opportunities. In keeping with the desire to be more self-sufficient in terms of wood product needs, the production of secondary wood products (and/or log homes), will displace some of the materials currently being imported.

While switching from traditional heating methods such as fuel oil and firewood to wood pellets will create savings, producing pellets within the communities would not be feasible due to various economic factors. In 2006, the NWT consumed only 625 tonnes of wood pellets valued at approximately $190,000. While the demand for wood pellets might grow in the future, operating a pellet plant (with an estimated startup cost of $3 million) to provide solely for NWT pellet users appears unfeasible. In particular, no facility harvests trees solely for the production of pellets as it is deemed uneconomical. To have a viable project would require the proponent to explore the export option and identify customers from other provinces. In addition, more pellet plants will be opened across North America in the future, thus creating greater competition. Although, producing pellets might allow the communities to become more self-sufficient in energy needs, it may not meet the additional objectives of the communities in other areas such as employment.

Regardless of the business venture launched, support from the NWT and/or Federal Governments may be necessary. This support could have many forms, including but not limited to:

- increased timber resource allocation to various communities,
- simplified longer term access to raw material to foster investment in the sector,
- financial assistance to establish new community businesses, or tax relief.

As well, the establishment of new policies could be considered by the NWT Government to further assist the communities in their efforts to become more self-sustaining. For instance, offering a tax credit on wood products manufactured in the NWT might encourage local customers to consider local producers as preferred suppliers of wood products. In addition, providing support and funding for industry specific training and technical assistance will enable local sawmills to operate more efficiently and improve profitability.

<u>Short Term Recommendations</u>

1. In the short term, it is recommended that NWT sawmill operators make a concentrated effort to preserve their machinery and other assets from deterioration due to exposure to the elements. Providing shelter for both machinery and workers creates the opportunity for extending the operating season, thus improving the potential for developing a profitable business.

Figure 39. A Readily Constructed Shelter for Equipment and Personnel Can Extend Manufacturing Periods Despite Inclement Weather.

2. Local communities and sawmillers would also benefit greatly from specific training and technical assistance. It is recommended that such initiatives include sawmill operation and maintenance, product quality and consistency, and business management. Forintek could assist in some of these areas.

3. Any successful business is constantly aware of their operating costs, pricing structures and revenues. The essential component in maintaining such awareness is the establishment of mechanisms to track key costs and operating ratios. It is highly recommended that NWT mills take steps to put these mechanisms in place.

4. The next logical short term step is to implement proper air-drying techniques, and to invest in small planers that will allow operators to better serve and capture a portion of the local housing construction market.

4. It also recommended that communities continue to speak with the mines and the Mackenzie Valley Gas Pipeline project proponents regarding their wood product needs. This is a natural complement to the production of (and community demand for) green lumber and cants.

5. Even though there is no significant difference between lumber that is air-dried or kiln-dried, builders in the NWT have limited their purchases of air-dried products due to quality concerns. If the housing construction market continues to insist that planed lumber must be kiln-dried, sawmillers may have to purchase small sized kilns to compete in this market. As well, to supply the construction market, mills will need to have their lumber graded.

Medium to Longer Term Recommendations

1. In addition to meeting the demand from the house construction and the industrial markets, mills that have been equipped with kilns and planers will be capable of manufacturing quality secondary wood products such as tongue-and-groove paneling, siding and flooring. Once the customers' confidence has been captured, it is recommended that sawmills consider expanding their product line. In the larger communities where the need for employment is greater, other machinery such as moulders, jointers and finishing equipment could be purchased by the mills at a later date, thus enabling them to manufacture such products as doors, windows, and furniture. Moreover, the community workers could incorporate their crafting and sculpting skills into products such as artistic furniture, or custom doors. This often adds significant value to locally sourced material. By expanding their product line, more sustainable employment will be created. It should also be noted that markets such as Japan are willing to pay higher prices for First Nations' hand-made wood furniture and sculptures.

2. Another medium term product opportunity is log homes. In addition to reducing community dependency on imported housing or construction materials, it offers a natural complement to the millwork products as discussed above. Log homes manufactured in the NWT could incorporate locally produced wall paneling, moulding, doors, windows and flooring into their construction, and could be furnished with locally produced furniture. Similar to the wooden furniture, in selected export markets "northern-made" log homes can be priced at a premium, particularly should they have First Nations branding accompanied by proper market advertising. Log construction does not require extensive capital investments into equipment. Another possible related market opportunity could evolve from partnerships with established log home builders in British Columbia or Alberta. Specialized crafting work could be contracted out to First Nation communities in the NWT, where the workers would provide special crafted log home components such as "totem-like" carved posts and carved door blanks. In the beginning, the community might find an entry into the industry by supplying house logs that meet the log builders' specifications.

3. Finally, NWT sawmillers appear to have a strong common interest in venturing into pellet production. Even though this environmentally friendly fuel has a strong demand forecast, operating a pellet production plant presents several challenges. For instance, pellet production is very capital intensive, and it is has been clearly noted that at least $3,000,000 is required to open a feasible pellet plant. Furthermore, the location of this plant is deemed critical, both in terms of the proximity to the power grid and the delivery of a low cost residual fibre supply. While venturing into pellet production appears to be attractive, further research (cost-benefit analysis, fibre supply, logistics, etc.) is highly recommended before proceeding into this business.

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Appendix A

Visit to Jean Marie River First Nation, NWT
March 12, 2007

Visit to Jean Marie River First Nation, NWT
March 12, 2007

Attendance

- Jean Marie River First Nation – Chief Stanley Sanguez, Isadore Siman (Band Council), Arnold Gargan (Economic Development Officer), Ernest Hardisty (Band Member)
- NWT Government – Tom Lakusta, Kevin Todd
- Forintek Canada Corp Project Team – Dalibor Houdek, Denis Gagne, Chris Gaston, James Poon, Howard Gribble

Equipment

Figure A 1 Kara 2000 Sawmill At Jean Marie River

Kara 2000 Mill (see above photos)
- $85,000 - $90,000

2 saws + sharpening tool

Diesel Generator
- $15,000 – brand new
- Produces enough power to run the entire mill.
- Could also contribute power to the community if the mill were located closer to town.

2 forklifts (purchased second hand)
- Model = 950 Caterpillar
- One has a grapple and the other has a boom
- One is currently out of order (estimated repair bill: $15,000)

No board edger.

Additional Processing Equipment

Figure A 2 Old Log Lathe Used To Produce Log Packages at Jean Marie River

Although in disrepair, the community still has a Coutts saw and carriage, a log lathe, and a planer (1960s vintage). The mill reportedly produced 24,000 fbm/day with the Coutts equipment.

State of Repair

The Kara 2000 equipment will be started up again this summer. It is in reasonably good repair (primarily because of its age). Outside operation of this unit is restricted by the cold temperatures. It freezes up at -15^{0}Celsius.

Although the Coutts saw is the machine preferred by the community, it is in disrepair. Replacing or repairing this unit is not recommended for the following reasons:

- It will be difficult to find a unit in good running condition.
- No more parts are available for this mill, and the cost of machining some of the parts would be too expensive.
- Due to the age of the technologies there is a better way to produce the same amount of lumber at lower cost using less energy and manpower.

Raw Material Supply

- 1,000 m^3 of white spruce logs are processed annually
- Currently, there is 1,600 m^3 in the log yard
- Access to aspen and poplar is limited
- Unsure of logging allocation (according to estimates, as much as 20,000 m^3 annually could be available in the area)

Logging & Transportation

The community does not have the equipment to do their own logging, and requested assistance in the determination of log costs for both purchases and sales. Selective logging is practiced in the region.

Figure A 3 Log Storage at Jean Marie River

Lumber Recovery: 185 to 190 fbm per m^3 should be the norm for this sawmill.

Production: Green dimension lumber (mix of 2x2, 2x4, 4x10, etc)

Average volume: 2,500 fbm per day

Best volume: 10,000 fbm per day

Figure A 4 Lumber Storage At Jean Marie River

Waste Utilization

- butt-ends and slabs could be sold as firewood
- sawdust could be used as landfill
- opportunities for wood pellets and biofuels are being considered

Labour

In the past, there were 4-5 workers employed at the sawmill; 1 sawyer, 1 loader operator, 1 sorter, 1 worker bucking logs to length.

Workers were paid $16/hr on average.

Notes and Observations

General

- The community has a population of 74, and the Council hopes that the sawmill will soon provide jobs for 5 people.
- The community is working towards self-sufficiency, and is seeking guidance and roadmaps to success.
- In this regard, the constraints to advancement have already been identified as: lack of financing, labour, direction, and equipment (the community feels that there is a need for a skidder, a loader and a logging truck).

Mill Site

- Mill location: the poor quality of the soil is a big factor for spring operation, and is not suitable for sawmill foundations.
- The site is too narrow for mobile equipment.
- The community is not happy with the current mill location, and is considering relocation closer to the resource.

Operations

- The Kara 2000 sawmill is a good system which has been used in many countries around the world. It can be operated with less people, and is a good fit for Jean Marie River.
- Log optimization is at the discretion of the sawyer, and is based on experience.
- Inventory space for tree-length and rough lumber is unorganized.
- There is an apparent need for assistance in the pricing of products for sale.

Market Interests

- The community is interested in making wood pellets, and requested information on how to set up a production facility.
- Interest was also expressed in biomass (i.e. hog fuel as opposed to pellets), for heating homes and possibly a kiln dryer.

- The community would like to better understand the opportunity for kiln dried lumber.
- The community has previously experimented with the production of log building kits, and they have expressed an interest in re-entering this market.
- Due to the state of their equipment, the mill has been turning down calls for product from neighbouring communities.
- The Mackenzie Valley Gas Pipeline is seen to be a market opportunity for the community once the project has started.

Community Expectations

The community has the following expectations of what knowledge should be transferred in the Community Sawmill Opportunities Study:

- How to calculate the selling price for lumber (would like to have a "recipe" for determining log processing costs, and product sales prices).
- How to operate their sawmill on a small scale, but for a profit (would like to have a break-even chart to guide the operations).
- How much to compensate workers.

Recommendations Specific to Jean Marie River Sawmill

Mill site

1. The sawmill should be relocated to a new site, to provide a solid foundation for equipment and shelters.

2. The yard lay-out should be planned and implemented before the next start-up of the sawmill operation.

Operations

3. To prevent further deterioration, the sawmill equipment should be cleared of snow and covered with tarps immediately.

4. Once the JMR sawmill reaches full productivity, additional output volumes from the same number of workers could be realized through the addition of a board edger (estimated cost $15,000).

5. The Kara 2000 and the new edger (if acquired) should be located inside a building, or at least protected under a separate structure (see photo included in the General Conclusions and Recommendations of this report).

6. To ensure proper functioning, all the production machinery needs to be installed on a concrete footing or floor.

7. High speed teeth are recommended for sawblades to cope with the foreign debris from the ground (carbide teeth would not be appropriate in the Jean Marie River operation).

8. Considering the product volume to be manufactured it is recommended that JMR doesn't acquire their own skidder, loader and logging truck. Its cost would be difficult to justify, and amortize, by an operation of this size. Also, keeping the equipment in good working condition would be a challenge given the lack of manpower in the community and the remoteness of JMR from a major centre. The community should rather consider contracting its logging to an established logging contractor. This will ensure that the logging costs stay under control and the equipment cost and operation will not be a burden for the community.

Market Focus

9. JMR should initially focus on the production of dimension lumber for the community, and for the needs of the surrounding communities. It is recognized that the potential also exists for the Mackenzie Gas Valley Pipeline (once started) to generate a short term, but relatively substantial demand for wood products. If JMR wants to supply some of this material it needs to establish in advance, a smoothly operating mill capable of responding to such a market demand.

10. An additional opportunity could also be developing in the mining industry. The community indicated that the Prairie Creek Mine could be opening and needing timbers. Again, JMR will have to have the mill consistently operational in order to respond to this market.

Appendix B

Visit to H&D Contracting, Fort Smith, NWT
March 13, 2007

Visit to H&D Contracting, Fort Smith, NWT
March 13, 2007

Attendance

- H&D Contracting – Norm Dievert
- NWT Government – Kevin Todd, Paul Weidrick
- Forintek Canada Corp Project Team – Dalibor Houdek, Denis Gagne, Chris Gaston, James Poon, Howard Gribble

Equipment

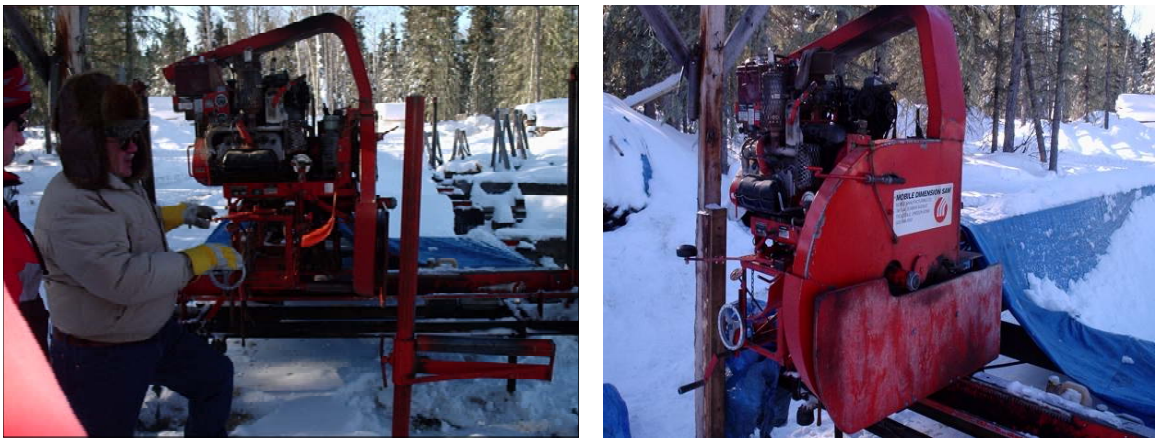

Figure B 1 Mobile Dimension Sawmill Operated By H&D Contracting

State of Repair

Although the sawmill is now 15 years old, it has been well cared for, and is protected from the elements.

Raw material supply:

- 500m^3 of logs are processed annually at a rate of 15 logs per day
- White Spruce and some Jack Pine
- The end product shows some evidence of spruce budworm attack

Figure B 2 Spruce Budworm Damage

Logging & Transportation

- Selective logging is carried out from November through March using a John Deere skidder, and a modified Massey Ferguson farm tractor for lifting

Figure B 3 John Deere Skidder

Lumber Recovery

- The mill is being operated with maximized lumber recovery as a goal.

Production

- Partially air dried and green 2" dimension lumber (50,000 fbm/year)
- 1000 fbm/day with one operator (and 1700 to 2000 fbm/day for a two man crew)
- Off-cuts and slabs are sold as firewood

Figure B **4** *Lumber Storage*

Waste Utilization

- The slabs from the side of the logs are initially used to protect the lumber from the sun and rain water
- Sawdust and residues are spread on logging trails

Labour

- H&D Contracting is basically a one-man operation, with some part time assistance.

Notes and Observations

- The company has secured a market for 100% of their production. The air dried product is sent to a planer operation in Fort Smith for further processing. This relationship is unique to most small operators in the NWT.
- The relocation of the sawmill closer to Fort Smith could result in the hiring of an additional person and increased production.
- The relocation could also result in improved profit margins by reducing the travel costs to the mill site every day.
- Some improvement could be made in the drying area.

Recommendations Specific to H&D Contracting

1. Best practices for air drying have been described earlier in this report. In the case of H&D Contracting more uniform drying quality could be achieved by:
    - Relocating the piles to maximize air flow
    - Paying greater attention to sticker placement.
2. In order to increase production, a second person would be needed. A separate board edger could further increase the lumber output.

Appendix C

K'asho Got'ine Dene Community Council,
Fort Good Hope, NWT
Conference Call - March 13, 2007

K'asho Got'ine Dene Community Council, Fort Good Hope, NWT
Conference Call - March 13, 2007

Attendance

- K'asho Got'ine Dene Community Council – Vivian Manuals, EDO
- NWT Government – Kevin Todd
- Forintek Canada Corp Project Team – Dalibor Houdek, Denis Gagne, Chris Gaston, James Poon, Howard Gribble

Equipment

The Community owns and operates a Wood-mizer saw and edger. These units are described in the following excerpts from the manufacturer's promotional literature:

LT40 SUPER HYDRAULIC - SPECIFICATIONS	
Dimensions (with trailer package)	
Length	26'2" (8m)
Width	6'6" (2m)
Height (Maximum head position)	11' (3.3m)
Weight (With heaviest power options)	4210 lbs (1909kg)
Maximum Cutting Capacities	
Log Capacity *	36" (91cm) dia., length 21' (6.4m) and up to 45' (13m) w/bx
Production Rates **	up to 550 bd.ft./hr.
Power Selections	
Standard	25HP (18.6kW)3-Phase Electric
Optional	51HP (38kW) Diesel

TWIN BLADE EDGER SPECIFICATIONS	
Width of Passage	24.75" (62.9cm)
Maximum Board Thickness	2" (5cm)
Blade Size	0.16" x 14" dia. (35.6 cm) - 18 teeth
Maximum Machine Length	20' 5" (6.3 m)
Maximum Machine Width	76" (1.9 m)
Maximum Machine Height	47" without rollers
Feed Speed	55-70 FPM
No. of Driven Bottom Rollers	4
No. of Hold Down Rollers	2
Saw Diameter	14"
Outfeed Table	10' (3.05 m)
Infeed Table	6' 5" (1.96 m)
Return Rollers (Optional)	2
Machine Weight	2260 lbs. (1025 kg)

Approximate New Equipment Costs

- Sawmill $35,000
- Edger $14,000

State of Repair

- The community's equipment was recently purchased (less than 10 years old), and it has reportedly been installed with partial protection from the elements under a roof without walls.

Raw Material Supply

- 500 m^3 @ approximately 0.3 m^3 per log from an island on the Mackenzie River

Logging & Transportation

- Recently, logs were brought in at a price of $50 / log, including felling, skidding and deliver to the mill
- The community does not have its own logging equipment
- Since the delivered cost is very high, the community insists that logs meet specific measurement criteria. However, details were not provided.

Lumber Recovery

- The lumber recovery factor is not known, however 2 to 6 pieces are extracted from each log, depending on log size.

Production

- The sawmill cuts rough green lumber for use in local community projects.
- On average, ten to twenty logs per day are processed into dimension lumber (1"x4" up to 2"x12") and timbers (4"x4" up to 8"x8").

Waste Utilization

- Currently, the sawmill gives away any scrap materials for use as firewood in the community.

Labour

- The mill employs 1 manager + 1 worker.
- Wage rates are:
    - Manager @ $23/hr
    - Worker @ $18/hr
    - Students @ $15/hr (note: students working for GNWT get paid $22/hr + benefits)

Notes and Observations

General

- This interview was carried out through a conference call, and with no site inspection of the installed equipment.
- The community has a population of over 700, and the Council hopes that the sawmill will continue to provide jobs for 2 people.
- Cost of living in the community is high (e.g.: gas is at $1.42 / litre)
- Power costs:
    - Residential = $0.20 / kW
    - Commercial = $0.60 / kW
- The community is working towards upgrading the sawmill to produce finished lumber, as well as rough cut lumber, slabs for firewood and specialty wood products for artwork.
- Building materials are imported as dry dimension lumber.
- Locally produced lumber is rough (not planed), and is not considered to be good for construction.
- Remote communities such as Fort Good Hope rely heavily on the imports of commodity products. These communities are usually only accessible by winter roads, barges (preferred by the Council) that run in the summer months and small aircraft (with a maximum capacity of 19 persons due to the size of the air strip).
- There is no full time employment available in the area except for service businesses.
- Many have attempted in the past to open small businesses, but failed due to lack of support and training.
- There is another one-man sawmill in town which is owned by an independent non-band member. He wants to build home packages, and is currently seeking approval to proceed. That sawmill is equipped with a saw and a planer, but is currently shut down.

Operations

- The community requested assistance in the establishing a pricing methodology for the products being sold.
- The sawmill operates only during the summer.
- The mill, which was established in 1999, only broke even in 2006.

Market Interests

- The traditional client base for the sawmill has included the band council, recreational groups, and individuals.
- Typical community project applications have included rough outdoor construction, fencing, seating areas, and a boardwalk to attract tourism.
- There may be local lumber supply opportunities for Fort Good Hope as the barges continue either up or down the river with empty space.

Recommendations Specific to K'asho Got'ine Sawmill

Operations

1) The information provided on the phone is not sufficient to make many recommendations for the mill or for the community. The mill is owned by the community and it is rated to produce up to 550 fbm/hr. It is understood that this production can only be expected under ideal conditions and the real productivity will be much less. It was indicated that the mill processes on average 10 or more logs per day, producing 2 to 6 pieces of lumber from each log. This production represents approximately 600+ fbm/day. Given that the mill is operated by two people, the productivity seems rather low. For instance, Norm Dievert at H&D Contracting produces 1000+ fbm of lumber per day in his one man operation. With a helper this volume nearly doubles. In order for Fort Good Hope to produce consistently 1000 fbm of lumber per day, the mill would have to process a minimum of 17 logs with 0.3 m^3 volume, assuming the lumber recovery of 200 fbm/ m^3. An effort should be made to identify reasons for such low productivity. The reasons may be many, including but not limited to inappropriate mill layout, inadequate material handling equipment, lack of training, mechanical and/or maintenance issues with the mill, or simply a lack of demand and/or marketing initiatives. It might be worthwhile for the community to hire a specialist to review the mill practices during the normal mill operations, and assist in improving production. Forintek could potentially assist in this area.

Marketing

1) Since water transportation is the least costly method, band members prefer to import the commodities via barges in the summer months. Upon unloading the cargos, these barges head back down the river empty. Instead of leaving Fort Good Hope unfilled, the community could consider stocking the barges with locally produced wood products. These products could range from lumber, which they currently produce, to hand crafted wooden souvenir sculptures or wooden furniture.

Appendix D

Visit to Deninu Kue First Nation, Fort Resolution, NWT
March 14, 2007

Visit to Deninu Kue First Nation, Fort Resolution, NWT
March 14, 2007

Attendance

- Deninu Kue First Nation – Gord Beaulieu (Economic Development Officer), Tom Unka (Environment Manager)
- NWT Government – Tom Lakusta, Kevin Todd
- Forintek Canada Corp Project Team – Dalibor Houdek, Denis Gagne, Chris Gaston, James Poon, Howard Gribble

Equipment

The installed mill includes a Coutts carriage, and a Coutts edger, but the mill has not operated for two years.

Figure D 1 Coutts Sawmill At Deninu Kue First Nation

State of Repair

- No protection or proper decommissioning was done at the time of shut down two years ago. As a consequence, a major overhaul would be required to start it up again.
- It will be very difficult to find parts for this mill, and the cost of machining some the parts will be restrictive.
- If replacement parts can be located, it is estimated that the repairs could cost as much as $100,000.

Figure D 2 Detailed Views of Coutts Carriage at Deninu Kue First Nation

Replacing or repairing this unit is not recommended for the following reasons:

- Few, if any parts are available for this mill, and the cost of machining some of the parts would be too expensive.
- This equipment was not designed to operate in frigid environments.
- Due to the age of the technologies there is better way to produce the same amount of lumber at lower cost using less energy and manpower.

Raw Material Supply

- 25,000 m^3 of white spruce logs were processed annually in the old mill prior to purchasing the current mill.
- The community also has access to large clear aspen.
- The region reportedly has some of the highest quality fibre in the NWT.

Figure D 3 Log And Lumber Storage

Logging & Transportation

- Good trees are only accessible by winter road within a 6 week window, and all the readily accessible trees have already been harvested. The winter road is generally not ready until mid-January each year.
- In the past, logging was done with the help of B.C. contractors as the community does not have any logging equipment.

Production

- The old sawmill operated prior to purchase of the current mill used to cut 5 million fbm of dimension lumber annually.

Waste Utilization

- When the mill was operational the waste was made available to band members free of charge for firewood.

Labour

- The previous sawmill used to employ between 25 and 30 workers.

Notes and observations:

General

- The community has a population of 550, and the Council would like to create employment for up to 30 people in some form of a wood products operation.
- The existing sawmill, which is owned by the community's Development Corporation, ran for two seasons after being set-up. It was shut down two years ago.
- The community is concerned about the potential impact of the oil and gas industry on the people and the local environment.

Mill site

- The community recognizes that the mill is obsolete, old, and not well located (too far from the wood supply).

Operations

- Although the council is still interested in operating a viable/sustainable sawmill operation, they would like to limit its size, catering to the needs of small customers and minimizing the impact on the environment.
- Before making any firm investment decisions, the community needs to determine the amount and accessibility of the wood they are prepared to harvest.
- The community expressed a keen interest in replacing the existing Coutts equipment with a portable Wood-mizer.

Market interests

- Construction materials used within the community are all imported from Hay River, and all buildings are stick-built, rather than pre-fab.
- In the past, the sawmill supplied wood for the mines and for steamers.

Community expectations

The community has the following expectations with respect to their Community Sawmill Project:

- Provide employment for up to 30 people
- Provide cheaper lumber to the community
- Although the immediate desire is to replace the Coutts sawmill with a Wood-mizer, the community expressed an interest in identifying what opportunities might exist for them in the start-up of either a small value-added or log home building operation.

Recommendations Specific to Deninu Kue First Nation

General

1. When the community has decided what manufacturing path it wishes to pursue, Forintek could help with the plant layout and machinery selection, as well as with basic training in some areas.

Mill site

2. Once a decision is made as to the type of operation, a solid foundation for equipment and shelters should be installed.

Operations

3. All production machinery should be installed on a concrete footing or floor, and located inside a building, or at least protected under a separate structure (see photo included in the General Conclusions and Recommendations of this report).
4. The establishment of a portable narrow band sawmill will likely not meet the expectation of the community to create employment for 30 community members. Such a high level of employment in a small scale manufacturing operation can only be achieved with some type of value-added venture (e.g. a small log home operation), that might in addition include a small portable mill to produce the raw material needed for further manufacturing.

Appendix E

Visit to Patterson Sawmill Ltd., Hay River, NWT
March 14, 2007

Visit to Patterson Sawmill Ltd., Hay River, NWT
March 14, 2007

Attendance

- Patterson Sawmill Ltd. – Dan Patterson
- NWT Government – Tom Lakusta, Kevin Todd
- Forintek Canada Corp Project Team – Dalibor Houdek, Denis Gagne, Chris Gaston, James Poon, Howard Gribble

Equipment

- The Morbark carriage installed by this company is a good system, and is widely used throughout North America.
- An edger is also mounted on the work platform after the main saw.

Figure E 1 Morbark Carriage Sawmill

State of Repair

The mill was installed about 2 years ago, and has been well cared for.

Raw material supply:

- 4,500m^3 of spruce logs are processed annually

Figure E 2 Log Storage at Patterson Sawmill Ltd.

Logging & Transportation

- Presently all the log preparation is done manually with a chain-saw, and the process is too labour intensive.

Figure E* 3 *Manual Log Bucking

Lumber Recovery

The Patterson lumber recovery factor averages around 200 fbm/m^3.

Production

Only rough green lumber and cants up to 12”x12” are produced at Patterson Sawmill Ltd.

Waste Utilization

More than half of the processed volume ends up as sawdust or firewood.

- Sawdust is burned
- Off-cuts and slabs are sold for firewood

Labour

The operation employs 4 to 5 workers @ $52,000/year

Notes and observations:

- Attracting employees is an issue for Patterson’s - the diamond mines reportedly pay $91,000 per year (plus bonuses and benefits) for 26 weeks of work, while the sawmill can only offer $52,000 for 52 weeks.
- The company tried to produce dimension lumber through a working arrangement with a local planer operator, but gave it up 15 years ago finding that it was too labour intensive and end product quality was inconsistent.

- With the current annual volume allocation of about 5000m^3, the return on any capital investment is of concern, and the company is reluctant to acquire newer and more efficient equipment. If the mill was able to secure a larger volume of timber it would allow improvements and investments. However, Patterson's allocation agreement is in its final year and it is uncertain if the mill will be successful in securing timber for upcoming years. It appears as though the regulatory framework around securing access to logs and the 5 year timber access term make it difficult for even small operations to plan for the future.

- An number of new ventures are being considered for the future including:

    - A log home manufacturing operation of up to 25 units per year. The issues requiring clarification include: a) policies of insurance companies regarding the fire insurability of this form of construction in the NWT, and b) acceptance of log construction by the NWT Housing Corp. with regards to financing and mortgage insurance.
    - The establishment of a wood pellet manufacturing facility. The issues requiring clarification include: a) the equipment needed, b) the raw material volume required to be viable, c) market potential, d) prices, and e) set-up costs.

Recommendations Specific to Patterson Sawmill Ltd.

- In order to provide a future for Patterson's mill, the long term access to wood has to be secured. The mill's growth can be realized by processing a larger volume, which could allow additional capital investment to improve lumber recovery and create additional employment.

- Once the mill gains access to additional timber the productivity of the existing sawmill could be improved by adding a combination edger. The estimated installed cost for a new gang edger is $225,000; however a used machine can be found and installed for $35,000.

- Also, the addition of a slashing deck and a firewood processor would help to reduce labor costs, and would also help increase productivity.

- Depending on the application, a new slasher is estimated to cost between $250,000 and $400,000. A used slasher can be found and installed for $75,000 to $125,000. Firewood processors are available for this application, and range in price from $2,000 to $50,000.

- All the residues from the slasher and the saw line could be hogged and sold as fuel or bedding (a typical hog can be seen in the main body of the report). The installed cost of a used hog system is approximately $15,000.