

WOOD FIBER SUPPLY AVAILABILITY AND POTENTIAL UTILIZATION ANALYSIS

**Executive Summary
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Prepared for:

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Acknowledgments

A diverse set of organizations sponsored this analysis including:



TSS Consultants typically implements forest resource availability analysis utilizing in-house personnel and resources. This is a business model that our firm has utilized since it was founded in 1986. The Wood Fiber Supply and Potential Utilization Analysis project was unique in that Minnesota Power assembled and made available an array of knowledgeable staff, research institutions, agencies, fiber procurement managers and land managers that proved invaluable during the data gathering and analysis phase of this project. Minnesota Power executive management can be confident that the very best and most current information was made available to TSS Consultants in support of this work.

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List of Abbreviations

Organizations

MN DEED	Minnesota Department of Employment and Economic Development
MN DNR	Minnesota Department of Natural Resources
MP	Minnesota Power
TSS	TSS Consultants
USDA	United States Department of Agriculture
USFS	USDA Forest Service

Other Terms

cf	Cubic Feet
dbh	Diameter at Breast Height
FIA	Forest Inventory and Analysis National Program
GAP	Gap Analysis Program (United States Geological Survey)
GT	Green Tons
OSB	Oriented Strand Board
RES	Renewable Energy Standard
RFS	Renewable Fuel Standard
TMA	Target Market Area

Most of the forest resource availability data generated in this analysis utilized the USDA Forest Inventory and Analysis National Program (FIA) as a primary resource. The FIA consists of a relational database that allows users to determine the extent, condition, volume, growth, and depletion of timber on the nation's forestland. Using the interactive EVALIDator program, users can access detailed timber and forest stand information for specific geographic locations in the US.

Forest resource availability in this report is characterized as either roundwood or biomass. Roundwood includes logs down to a six-inch top diameter. Biomass is the roundwood harvest residuals typically made up of small non-merchantable trees and limbs and tops.

Throughout this report a variety of units are used to describe the quantities of wood fiber. Most data derived from USDA Forest Inventory Analysis (FIA) is typically referenced in cubic feet. For Minnesota and much of the Lake States, cords are the traditional unit of measure. Most bioenergy and biomass technology companies utilize the green ton (GT) or bone dry ton (BDT) unit of measure. The unit of measure used in each figure and table is clearly indicated, however the reader should take care when examining data as to which unit of measure is used. Standard conversions used throughout this report are:

- 1 cord = 79 cubic feet of solid wood
- 1 cord = 2.25 green tons (GT)

EXECUTIVE SUMMARY

INTRODUCTION

Minnesota Power (MP) and its regional economic development partners are interested in promoting new private sector investment to support forest resource processing and manufacturing operations in northeast Minnesota and northwest Wisconsin. The recent downturn in the forest products manufacturing sector within this region has significantly reduced commercial manufacturing infrastructure. In the last six years, several commercial-scale facilities have ceased or curtailed operation in northeast Minnesota including:

- Ainsworth - Bemidji;
- Ainsworth - Grand Rapids;
- Ainsworth - Cook;
- Boise Paper - International Falls;
- Georgia Pacific - Duluth;
- Verso Paper - Sartell.
- Wausau Paper - Brainerd;
- Weyerhaeuser - Deerwood; and

As the forest products manufacturing sector has constricted, so too has the number of family-wage jobs associated with manufacturing, logging, and the numerous indirect jobs that support this sector. MP is promoting expansion of existing, or recruitment of new, value-added processing/manufacturing enterprises that could step in and utilize sustainably available forest resources from selected areas of northeast Minnesota and northwest Wisconsin.

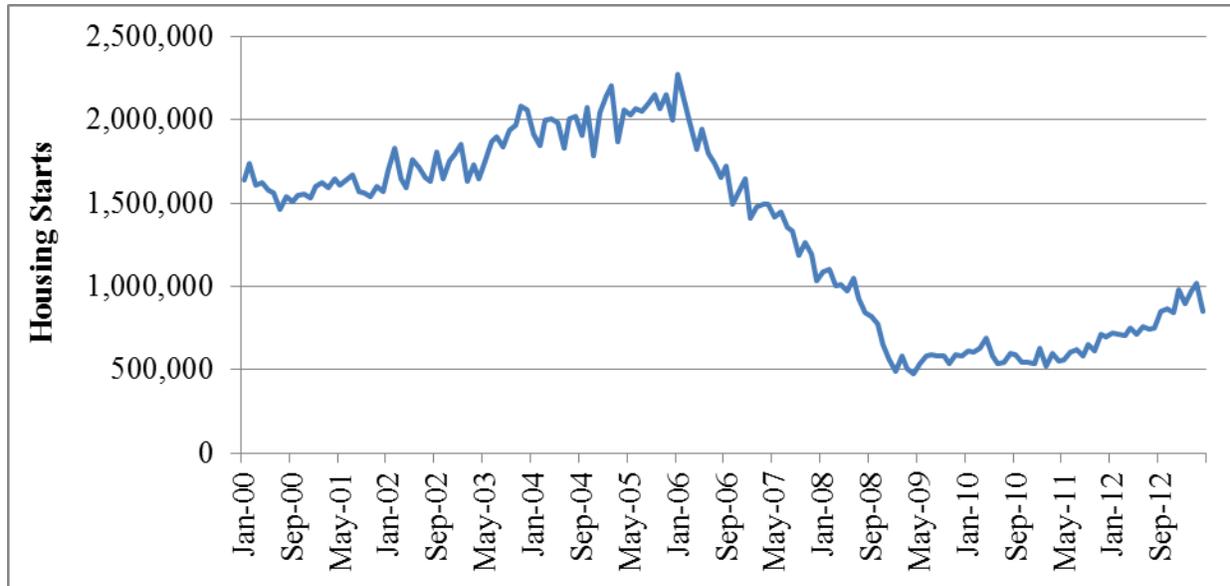
MP has requested that TSS Consultants (TSS) conduct a wood fiber supply analysis that addresses key factors and criteria regarding sustainable availability of forest resources (roundwood and biomass).

Beginning in 2007, TSS conducted an extensive investigation on behalf of MP into the feasibility of developing additional wood-fired power generation in the region. This work resulted in the Wood Fuel Availability Assessment for the Laskin Energy Center located in Hoyt Lakes, Minnesota. While this assessment did recommend several opportunities for developing additional biomass-fired power generation in the region, MP decided to postpone the plans for a stand-alone wood-fired power plant at Laskin. As recently as fall 2011, TSS was requested to investigate biomass energy opportunities within northeast Minnesota. The 2011 study concluded that additional biomass fuel resources were available to justify expansion of biomass-fired electrical generation at Minnesota Power's Hibbard Renewable Energy Center in Duluth and the Rapids Energy Center in Grand Rapids.

Dovetailing with this previous work for MP, TSS has undertaken this latest effort to review the current state of Minnesota's forest products industry during this very difficult five-year period. In the 2007 assessment, TSS forecasted that the Minnesota forest products industry would rebound to prior historical harvest levels by 2010-2011. Due in large part to the recession of 2008-2011, this has not been the case.

The past five years for the forest products industry in the U.S. have been some of the most difficult since the Great Depression. Beginning with the housing collapse in 2006 and extending through the recession, demand for lumber and wood panel products has dropped significantly. As Figure 1 illustrates, housing starts and permits have only recently begun to move back to prerecession numbers.

**Figure 1. U.S. Housing Starts, January 2000 to April 2013
(units per year equivalent)**

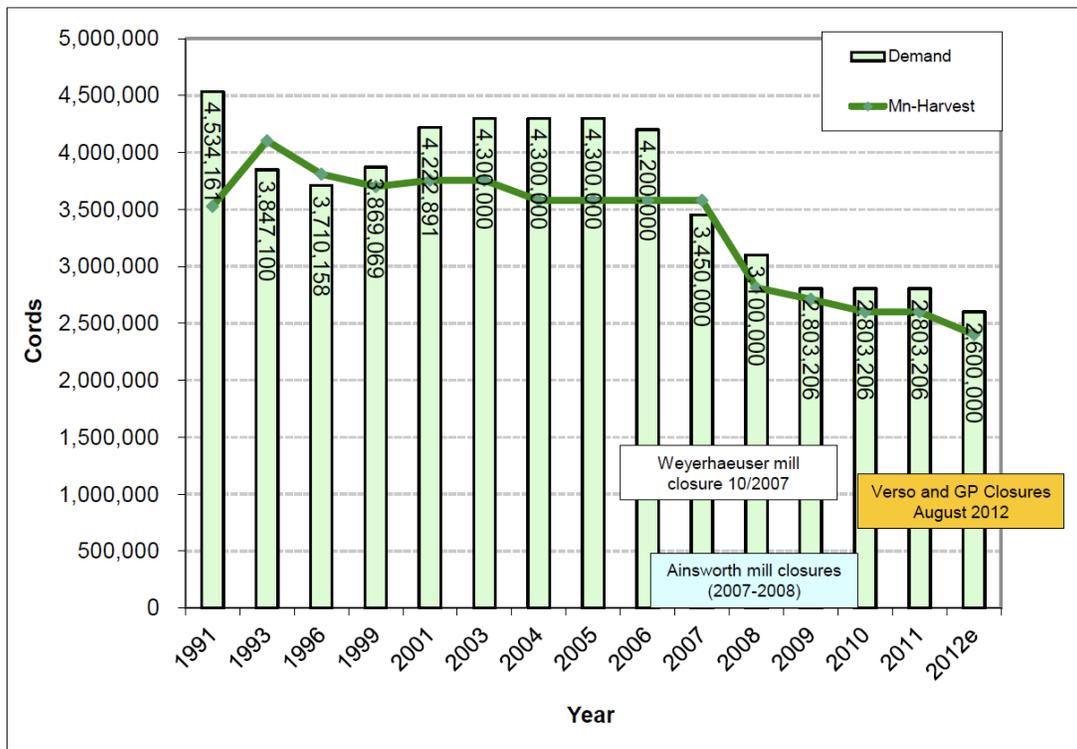


Source: U.S. Census Bureau

The Minnesota forest products industry has mirrored this national crisis and has been severely impacted. Since 2007, numerous closures and curtailments have hit the forest products industry in northeast Minnesota, including the loss of three oriented strand board (OSB) mills, one hardboard mill, one composite board plant, one pulp and paper mill, and numerous sawmilling operations. The loss of these wood fiber users has resulted in an estimated annual decline in demand of over one million cords in Minnesota. In addition to this declining demand, there is also the opportunity to increase Minnesota’s timber harvest rates over and above those of the past decade. Numerous researchers and state sponsored studies have estimated Minnesota’s forest could generate as much as 5.5 million cords per year on a long-term sustainable basis. Harvest levels used in this study should not be considered the maximum sustainable harvest levels.

Figure 2 shows Minnesota timber harvest and utilization over the past 20 years.

Figure 2. Minnesota Harvest and Utilization



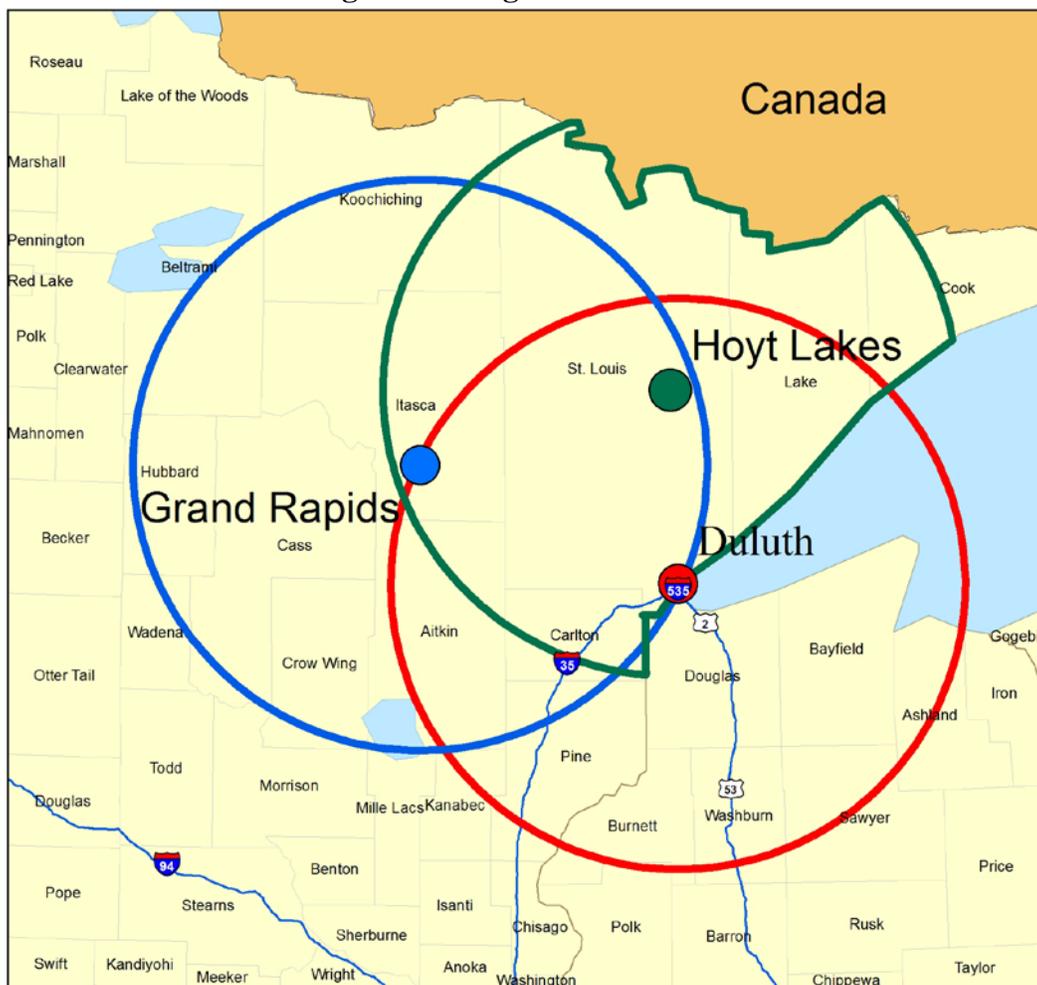
Source: U.S. Department of Agriculture, Forest Service, Northern Research Station.

As the forest resource harvest levels have dropped by almost two million cords since 1991, there is a potential opportunity to enhance production at existing facilities and to site new value-added utilization facilities that have the capacity to convert underutilized species to specialty chemicals and transportation fuels. While these technologies continue to evolve and innovate (with many not yet considered to be commercially viable), it is timely to consider outreach to this sector. This analysis is designed to confirm which tree species are currently underutilized and may provide long-term feedstock for value-added conversion processes. Lastly, TSS conducted a review of existing policy barriers that might provide a template for Minnesota to consider.

TARGET MARKET AREAS

Considerable research and investigation has been conducted regarding the forest resources of Minnesota in recent years. Most of this work has focused at the statewide level and appears to portray an underutilized and aging forest resource with fairly high levels of stand mortality.^{1,2} In an effort to provide a more directed assessment, TSS and MP have focused on three key Target Market Areas within northeast Minnesota centered around Grand Rapids, Duluth, and Hoyt Lakes (see Figure 3). These TMAs represent an area within a 75-mile radius and are considered economically viable for raw material haul distances. Note that the Hoyt Lakes TMA does not include the portion of the 75-mile radius in Wisconsin or Canada due to transportation constraints around Lake Superior and the limited availability of feedstock across the Quetico Provincial Park in Canada.

Figure 3. Target Market Areas



¹ Minnesota's Forest Resources, 2011. USDA Forest Service, Northern Research Station, Research Note NRS-134. 2012.

² Minnesota's Forests 2008. USDA Forest Service, Northern Research Station, Research Bulletin NRS-50. 2011.

FINDINGS

Summarized below are findings from this wood fiber supply availability and potential utilization analysis for northeast Minnesota.

Forest Resource Availability Analysis

TSS identified roundwood and biomass annual availability for each of the three Target Market Areas (TMA). Using the Forest Inventory and Analysis National Program data and published work from the Minnesota Department of Natural Resources (MN DNR), TSS identified forest resources potentially available for utilization in each region while taking into account resource ownership, size and age class, annual growth, and historic harvest data. Note that each of the three TMAs is analyzed separately and distinctly from the other TMAs. Also note that this forest resource availability analysis is a high level overview and is not intended as an investment-grade or due diligence-grade analysis. Table 1, Table 2, and Table 3 summarize the findings for each target market area. These Tables reflect best estimates of available forest resource that exists due to the recent decline in market demand, plus additional forest harvest potential.

Table 1. Opportunity across the Grand Rapids TMA

Feedstock Type	Species	Available Feedstock (GT/year)	Comments
Roundwood	Quaking Aspen	981,000	Aspen is the most abundant species type throughout the TMA. Aspen is available across all ownership types, but has the greatest availability on federal and private lands for medium and large diameter trees.
	Red Pine	191,250	Red pine represents over 55% of the total Renewable Fuel Standard (RFS)-eligible whole tree feedstock types as an artificially regenerated species available on all three ownership types, but specifically on private lands for large diameter trees.
	Paper Birch	130,500	Significant opportunities for paper birch are on federal lands. Additionally, paper birch is a short-lived species that has opportunities across all land-ownership types to reduce mortality rates for medium and large diameter trees.
	Black Ash	99,000	Black ash is currently not harvested on federal lands and represents a significant opportunity for additional harvesting on both state/county and private lands for medium diameter trees. Potentially major mortality impact from Emerald Ash Borer. Significant volume requires winter harvest.
	Balsam Fir	74,250	Balsam fir represents an opportunity due to its heavy presence in aspen and birch stands on private lands. A 25% decrease in annual harvests over the last five-years expresses the potential opportunity for balsam fir utilization for medium and large diameter trees.
	Northern White Cedar	67,500	Northern white cedar is an underutilized species with some challenges with harvest due to slow and inconsistent regeneration patterns; however, there is significant opportunity on both state/county and private lands for medium and large diameter trees. Some concerns regarding NWC retention due to sensitive habitat issues. Much of the volume requires winter harvest conditions.
	Red Maple	63,000	Red maple shows opportunity across all ownership types, but specifically with federal and private lands. However, harvest levels have been on the rise over the past five-years and availability of this resource may be limited for medium and large diameter trees.
	Tamarack	36,000	Tamarack is an underutilized species with limited opportunity primarily on state/county and private lands for medium diameter trees. Winter harvest only.
	Subtotal	1,642,500	
Biomass	Total Availability	612,627	Despite significant demand for woody biomass throughout the TMA, there is still a substantial opportunity to utilize forest thinning and harvest byproducts.
TOTAL		2,255,127	

Table 2. Opportunity across the Duluth TMA

Feedstock Type	Species	Available Feedstock (GT/year)	Comments
Roundwood	Quaking Aspen	1,086,750	Aspen harvest levels have dropped 16% over the last five years and have availability primarily on state/county and private land for medium and large diameter trees.
	Red Pine	153,000	Total red pine acreage is evenly distributed across all ownership types; however the opportunity appears to lie on federal and private lands for large diameter trees.
	Paper Birch	191,250	Paper birch has limited opportunity on private lands, and increased harvest levels are expected to be derived primarily from state/county lands for medium and large diameter trees.
	Black Ash	72,000	Black ash offers opportunity on federal and private lands with limited opportunities on state/county lands for medium diameter trees. Significant volumes require winter harvest.
	Balsam Fir	114,750	Balsam fir shows promise particularly on federal lands; however as the stands continue to age, harvest removal opportunities will be significant across all ownerships to limit mortality for medium and large diameter trees. Significant volume in the aspen and birch forest type.
	<i>Subtotal</i>	<i>1,617,750</i>	
Biomass	Total Availability	448,908	Despite significant demand for biomass, a large volume of biomass remains available throughout the TMA.
TOTAL		2,066,658	

Table 3. Opportunity across the Hoyt Lakes TMA

Feedstock Type	Species	Available Feedstock (GT/year)	Comments
Roundwood	Quaking Aspen	654,750	Aspen has substantial overall availability and the opportunity is expected to be from federal and private lands for medium and large diameter trees.
	Paper Birch	137,250	Paper birch has a limited opportunity that is expected to be primarily from federal lands for medium and large diameter trees.
	Black Ash	103,500	Black Ash opportunity is primarily on state/county lands. There was no record of black ash coming off federal lands in the FIA data for medium diameter trees. Significant volume requires winter harvest.
	Red Pine	94,500	Red pine opportunity is evenly distributed across all ownership types for large diameter trees.
	Balsam Fir	60,750	Balsam fir has the most abundant opportunity on federal lands, but state/county and private lands are promising opportunities for balsam fir to help provide value to the aging stands. Significant volume in the aspen and birch forest type.
	White Spruce	40,500	White spruce harvest opportunities are expected to be greatest on federal and private lands and for medium and large diameter trees. Significant volume requires winter harvest.
	Tamarack	22,500	The opportunity for tamarack is expected to be greatest on federal and private lands and for medium diameter trees. Winter harvest only.
	<i>Subtotal</i>	<i>1,113,750</i>	
Biomass	Total Availability	365,206	Throughout the Hoyt Lakes TMA there is a relatively low demand for biomass material compared to the other TMAs.
	TOTAL	1,478,956	

Throughout all three TMAs, there are opportunities for development of enterprises that are able to use a variety of tree species feedstocks. While the Duluth TMA represents the second highest quantity of available forest resource, it is the TMA that has been least affected by the regional decline in the forest-products industry. Interviews with resource managers and forest products industry representatives confirmed that there are a number of underutilized tree species in northeast Minnesota. In addition, over eight million acres of forests are certified as sustainably managed under the Forest Stewardship Council and/or the Sustainable Forestry Initiative programs. Table 4 provides a summary of all three TMAs.

Table 4. Summary for All Three TMAs

Feedstock Type	Species	Grand Rapids Available Feedstock (GT/year)	Duluth Available Feedstock (GT/year)	Hoyt Lakes Available Feedstock (GT/year)
Roundwood	Quaking Aspen	981,000	1,086,750	654,750
	Red Pine	191,250	153,000	94,500
	Paper Birch	130,500	191,250	137,250
	Black Ash	99,000	72,000	103,500
	Balsam Fir	74,250	114,750	60,750
	Northern White Cedar	67,500	-	-
	Red Maple	63,000	-	-
	Tamarack	36,000	-	22,500
	White Spruce	-	-	40,500
		Subtotal	1,642,500	1,617,750
Biomass	Total Availability	612,627	448,908	356,206
TOTAL		2,255,127	2,066,658	1,478,956

Regional Pricing for Roundwood

As a result of this review TSS found that delivered prices for wood fiber, which includes stumpage, logging and transport costs, in Minnesota and the Lake States tend to run higher than other timber producing regions of the United States. While actual stumpage prices are currently very comparable amongst the Southeastern and South Central regions of the country, the big difference appears to be in the logging and transportation costs. For example, much of the harvest activity in the Southern states is based on tree length delivery of roundwood to facilities that are located within a 30 to 40 mile haul. Northeast Minnesota harvest operations are typically delivering roundwood in cord length (100 inches) at haul distances of 80 plus miles.

Longer term TSS believes that increased competition for wood fiber and concerns with age class distribution in the certain parts of the Southeast could increase wood fiber prices. Already during the past year pine pulpwood stumpage prices for the Southeast have escalated by 22% to \$13 per GT.

Policy Barrier Recommendations

While there has been impressive forest policy review already conducted (e.g., Governor's Task Force on Competitiveness of Minnesota's Primary Forest Products Industry) TSS recommends additional review of policy barriers that may limit out of state investment or could provide for existing Minnesota enterprises to make new capital investments. For example:

- Create longer-term and more equitable tax credits allocated to large private timberland owners that are certified as sustainably managed.
- Provide low interest loans and/or investment tax credits for logging contractors to upgrade logging equipment to utilize more efficient harvesting techniques.
- Minnesota DNR should work with local timber purchasers to reduce average transportation distances between mills and selected harvest sites.
- Minnesota DNR should prioritize timber harvest locations that provide for summer operations.
- Consider development of white papers that provide examples of the economic impacts if new sectors (biofuel/biochemical) invest in conversion facilities located in northeast Minnesota.