United States
Department of
Agriculture

Forest Service

Pacific Northwest
Research Station

General Technical
Report
PNW-GTR-621
January 2005

Assessing the Volume of Wood Products Used to Build and Maintain Recreational Structures on the Tongass National Forest: Potential Opportunities for Alaska Wood Products Substitution

Randall A. Cantrell

The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

Author

Randall A. Cantrell was a research forester, U.S. Department of Agriculture, Forest Service, Alaska Wood Utilization Research and Development Center, 204 Siginaka Way, Sitka, AK 99835-7316. He now is a market research analyst, National Association of Home Builders Research Center, Upper Marlboro, MD 20772-8731.

Abstract

Cantrell, Randall A. 2004. Assessing the volume of wood products used to build and maintain recreational structures on the Tongass National Forest: potential opportunities for Alaska wood products substitution. Gen. Tech. Rep. PNW-GTR-621. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 20 p.

Although the Tongass National Forest (TNF) possesses abundant stands of redcedar (*Thuja plicata* Donn), yellow-cedar (*Chamaecyparis nootkatensis* (D. Don) Spach), Sitka spruce (*Picea sitchensis* (Bong.) Carr.), and western hemlock (*Tsuga heterophylla* (Raf.) Sarg), most of its buildings, bridges, and trails are constructed from imported materials. The costs incurred in importing lumber building materials to the TNF seemingly could be offset by manufacturing a slightly more costly product from within the region. To better understand the potential opportunities foregone by southeast Alaska's lumber manufacturers, this study explores the market volume of wood products required to build and maintain the recreational structures (buildings, bridges, and trails) on the TNF. Findings suggest that after accounting for the estimated 23 percent of native materials used in trail construction, the wood products market potential arising from an additional 77-percent Alaska wood species substitution could be, on average, approximately 1.1 million board feet annually. This volume represents 1.3 percent of the regional output for 2000 and increases overall demand in southeast Alaska by 13.9 percent for this same period. These same figures for 2002 are more dramatic with the TNF potential consumption representing 2.8 percent of the region's output and increasing its overall demand by 57 percent.

Keywords: Buildings, trails, trailways, pedestrian bridges, utility bridges, structures, infrastructure.

Contents

1 **Introduction**

1 **Methods**

1 Determining the Volume of Wood Products Used for Tongass National Forest Buildings

3 Determining the Volume of Wood Products Used for Tongass National Forest Trails

5 Assumptions and Estimates for Calculating Wood Use in a Typical Unit of Trail

6 Determining the Volume of Wood Products Used to Build Tongass National Forest Utility Bridges

8 Assumptions and Estimates in Calculating Wood Use in Tongass National Forest Bridges

9 **Results**

9 Number of Tongass National Forest Buildings

11 How Demand Is Dispersed for Wood Products Used in Tongass National Forest Buildings

11 Number of Miles of Trails on the Tongass National Forest

12 How Demand Is Dispersed for Wood Products Used on Tongass National Forest Trails

13 Number of Utility Bridges on the Tongass National Forest

13 How Demand Is Dispersed for Wood Products Used in Tongass National Forest Bridges

15 The Projected Annual Demand for Wood Products Use on the Tongass National Forest

16 The Volume of Regionally Produced Lumber for Potential Use on the Tongass National Forest

17 **Conclusion**

19 **Acknowledgments**

19 **Metric Equivalents**

19 **Literature Cited**

Introduction

The Tongass National Forest (TNF), a temperate rain forest in southeast Alaska, is the largest national forest in the United States (USDA FS 2003). As such, it requires extensive infrastructure and maintenance. This study finds that a disproportionate volume of imported wood is used to build and maintain the infrastructure of the TNF. If the TNF could be maintained exclusively with Alaska wood species, a substantial increase in demand for local building lumber would be realized. However, Alaska lumber production is plagued by high extraction, transportation, and manufacturing costs. One reason for the high manufacturing costs relates to substandard quality control that allows for sawing variation that adversely affects lumber uniformity (Kilborn 2002). Additionally, Alaska lumber products have not been used extensively in construction because, until recently, they were not manufactured in finished form (kiln dried, surfaced, and graded). This study focuses on the potential of using Alaska lumber products as building material in the construction and maintenance of buildings, trails, and bridges on the TNF.

A disproportionate volume of imported wood is used to build and maintain the infrastructure of the TNF.

The market potential for Alaska lumber products on the TNF may be more clearly understood by approximating the volume of wood that has been used to build existing structures, analyzing maintenance and replacement schedules, and considering future construction projections. Researching and assessing potential market size for building material substitution increase our understanding of how to best foster interest in manufacturing building materials in the region. However, it should be noted that this is an exploratory study and is therefore not intended for determining with precision (1) design specifications, (2) wood volumes required for the various types of designs included in this study, and (3) future production and consumption figures.

Methods

Determining the Volume of Wood Products Used for Tongass National Forest Buildings

The USDA Forest Service Infra Database was used to approximate the number of existing buildings and bridges on the TNF. The data-gathering and dissemination processes were conducted in collaboration with TNF engineers, landscape architects, and recreation lands planning staff.

The USDA Forest Service TNF intranet Web site for engineering facilities and recreation provides a conditions survey for all existing recreational structures within the TNF. However, for the purpose of this exploratory research, much of the detail within this segment of the database had to be condensed because the goal

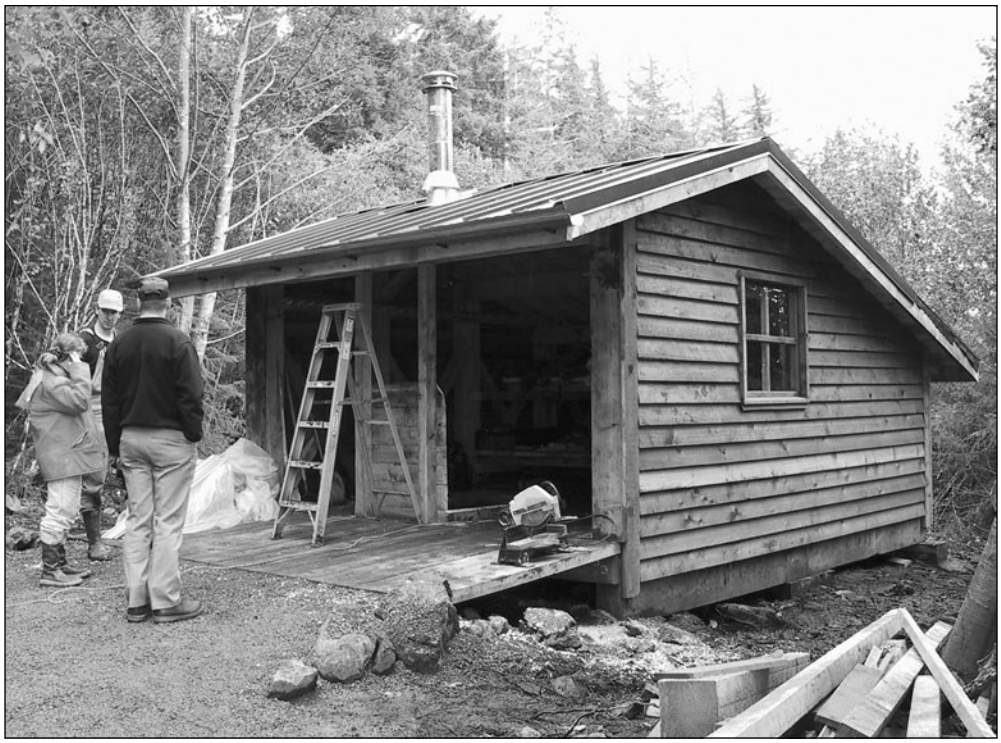

Figure 1—Construction of a Tongass National Forest recreational building.

was to approximate the volume of wood utilized in building and maintaining TNF recreational structures. Various types of structures were described in the database (for example, storage facility, duplex; see fig. 1), but most structures were distinguished as serving either housing or nonhousing functions.[1] After inspection of the design variation between these two categories of structures, and for purposes of comparison, certain assumptions were deemed necessary. First, the volume of dimensional framing lumber used in nonhousing structures was estimated to be one-half that used in structures identified within the housing category. Structures identified as nonhousing were generally open spaces with various storage functions, and therefore, did not incorporate the same degree of interior walls as did housing. Second, the volume (board feet [BF]) of flooring, roofing, and exterior siding for both categories of structures was estimated to be three-fourths the amount of the structure's area (square feet [SF]). Although a board foot measures 1 in thick, the typical application for roofing, flooring, and siding measures approximately three-fourths that thickness. Because square footage was the only unit of measure

[1] Only those buildings listed as having a wood-based exterior sheathing were considered within this study.

available within the database, totals were amassed for each category, and the aforementioned approximation multipliers were then assigned.

Estimates were converted from area measurements (SF) to volume measurements (BF) for specific types of building materials (National Association of Home Builders 2001). For instance, under the housing category, a structure measuring approximately 2,100 SF in area was typically built with the following quantities of wood: 13,127 BF of framing lumber, 2,325 SF of exterior siding, 6,212 SF of sheathing, and 3,100 SF of roofing (this study assumes an allocation of 2,100 SF for flooring). Furthermore, an additional wood volume of 20 percent of the whole was allocated for structures falling under the housing category and 10 percent for the nonhousing category to account for such material as doors, windows, millwork, and cabinetry.

Determining the Volume of Wood Products Used for Tongass National Forest Trails

The data used for this study were derived from the APPLIX trail data supplied by the USDA Forest Service, Alaska Region Program for Wilderness, Trails, and Recreation Special Uses. Specific assumptions and estimates had to be used during the first phase of this exploratory research.

After initial dialogue with many TNF designers and building professionals,[2] a USDA Forest Service landscape architect and I went on a site visit of a trail under construction (see fig. 2). This provided me with a fuller appreciation of the construction process and the materials used in trail building. After the construction site visit, contracts from previously completed work were reviewed for ideas on developing a profile of a "typical" trail used on the TNF. The challenge with this process is that according to trail designers and planners, there is no such thing as a typical trail on the TNF. This made the data-gathering process difficult, and alternative, less conventional methods had to be used for the trail estimates. Capital Investment Program (CIP) submittals from past projects were reviewed as a source for additional information. These submittals were largely for requests to build additional phases on existing trails.

According to trail designers and planners, there is no such thing as a typical trail on the TNF.

By using data from these sources, approximations were derived for determining the wood products used to construct a typical mile of TNF trail, the average number of units used per mile, and the conversion of BF per unit used in constructing typical components for building a trail. These approximations are not inclusive of every component but rather reflect the items that compose the greatest volume of wood.

[2] Although more than a dozen advisors were consulted, not all input used in this study was recorded as being attributable to specific individuals (that is, no citations).

Figure 2—Tongass National Forest wood trail.

Table 1 summarizes the assumptions and estimates that were used to approximate the amount of wood products. This analysis depicts the calculations as representing typical 1-ft sections of wood components used in trail construction.

Table 1—Assumptions made in estimating wood products used in a typical mile of Tongass National Forest trail[a]

Construction item	Unit	Units per mile	Board feet (BF) per unit	BF/mile
Bridge (log or lumber)	Lineal feet (LF)	44.1 LF	38.1 BF/LF	1,680.2
Boardwalk or puncheon	LF	704.2 LF	24.7 BF/LF	17,393.7
Stair tread (timber or lumber)	Each	18.3 each	17.7 BF/each	323.9
Sign post	Each	4.0 each	6.6 BF/each	26.4
Bench (timber or lumber)	Each	2.3 each	106.0 BF/each	243.8
Average volume of wood use	NA	NA	NA	19,668.1

NA = not applicable.
[a] This table does not include data for docks, picnic shelters, pavilions, tables, or signs.
Note: The volume of wood used and the product value are not insignificant. The cost of a new Douglas-fir picnic table ranges from $700 to $1,100.

Assumptions and Estimates for Calculating Wood Use in a Typical Unit of Trail

It was determined that a typical mile of trail on the TNF uses approximately 19.7 thousand board feet (MBF) of wood. This includes estimates of 1.7 MBF of bridge work, 17.4 MBF of walkway, 323.9 BF of stair treads, 26.4 BF of sign posts, and 243.8 BF of benches. The following calculations were used to arrive at these estimates.

- A typical pedestrian bridge uses 38.1 BF per lineal foot (LF), and there are 44.1 LF per mile. This includes:
  - A typical 37.9-BF-per-LF deck bridge, which uses on average, 28 in of 2-in planking per LF or 4.7 BF per LF; three 6- by 16-in stringers or 8.0 BF per LF; and 25.2 BF per LF of 4-in^2 posts and 2- by 6- by 4-in top and side railings.
  - A typical 38.2-BF-per-LF log bridge, which uses, on average, 20 in of log diameter, or 13.0 BF per LF; and 25.2 BF per LF in posts and top and side railing.
- A typical stretch of wood trail way uses 24.7 BF per LF, and there are 704.2 LF of wood trail per mile. This includes averages for a typical boardwalk or puncheon, which uses two 2- by 14-in planks[3] or 4.7 BF per LF and one 17-in diameter log, or 19.0 BF per LF.
- A typical stair tread uses 17.7 BF, and there are 18.3 of them, on average, used each mile. This includes 16.5 BF per lumber stair tread and 18.8 BF per log riser. These calculations approximate the volume of lumber for a single (3- by 12-in) 30-in-long stair tread or 7.5 BF, which includes two (3- by 18-in) 1-ft sections of connecting stringers or 9.0 BF. Each log riser is estimated to use, on average, a 2-ft section of 12-in-diameter log.
- A typical sign post uses 6.6 BF, and there are 4.0 of them, on average, used each mile. This calculation estimates the volume for a single 5-ft sign post to be made from a 4- by 4-in post.
- A typical log bench uses 106.0 BF, and there are 2.3 of them, on average, used each mile. This calculation estimates the volume of a single bench to be made from a 5-ft by 18-in log.

[3] Because 2- by 14-in planks are difficult to obtain and are considered a special order, they are not being used today as much as previously. More typical would be two 2- by 10-in or three 2- by 8-in planks.

Determining the Volume of Wood Products Used to Build Tongass National Forest Utility Bridges

TNF wood utility bridges can be categorized as being either timber log or timber lamina.

The Infra Database was sufficiently complete to determine bridge inventories. Attempts at using standard drawings to create "average units" of bridge work were not as effective as the assumptions used for buildings and trails, but it is clear that the TNF wood utility bridges can be categorized as being either timber log or timber lamina (see fig. 3). For estimation purposes, specific assumptions and estimates were used.

By using standard drawings from the TNF intranet Web site for engineering structures, approximations were derived for determining the wood products used to construct a typical 1-ft unit for log and lamina utility bridges as well as the associated timber decks used for log, lamina, and steel bridges (see fig. 4). Total lineal and board footage for each type of utility bridge was calculated. As was the case for buildings and trails, these approximations are not inclusive of every component but rather reflective of the items that make up the greatest volume of wood. Table 2 summarizes the assumptions and estimates that were used in deriving an approximation of the wood products used in TNF utility bridges. However, there were insufficient data available for including estimates for timber pilings.

Figure 3—Tongass National Forest wood bridge.

Figure 4—Tongass National Forest wood deck on steel superstructure.

Table 2—Assumptions for estimating the volume of wood products used in Tongass National Forest utility bridges

Superstructure[a]		Deck[b]	
Item	**Volume**	**Item**	**Volume**
	Thousand board feet		*Thousand board feet*
Girder	1,100	Distribution beam	62.5
Footing[c]	96.8	Planking	3,200
Foundation	560	Curbing	768.4
Abutment	135	Blocking	307.4
Log stringer	462.6	Post and railing	211.4
Subtotal	2,318.4		4,549.7
Unlabeled (7.2%)[d]	3,300		
Total	10,168		

[a] Includes structural materials for glu-lam, stress-lam, nail-lam, and log bridges.
[b] Includes decking materials for timber and steel bridges.
[c] Does not include timber pilings.
[d] Database did not specify whether bridge was log, lamina, or steel.

Assumptions and Estimates in Calculating Wood Use in Tongass National Forest Bridges

There are approximately 125 lamina beam or stringer bridges (that is, glu-lam, stress-lam, and nail-lam) totaling approximately 8,128 LF, with average spans of 65 ft.

- A typical bridge of this type uses three 8 3/4-in by 5-ft girders or 131 BF per LF for a total of 1.1 million board feet (MMBF). These girders are supported by three 4- by 3-ft by 10 3/4-in footings at each end, or 774 BF, per bridge, for a total of 96.8 MBF of TNF footings. A typical footing rests on 768 BF (1 by 4 by 16 ft) of foundation, with an average of six footings per bridge or 4.6 MBF of foundation work for a typical bridge, for a total of 576.0 MBF of TNF lamina bridge foundation work.
- There is, on average, a 46.1-BF (that is, 5 1/8- by 6-in by 18-ft) lamina distribution beam spaced, every 6 LF of bridge work, for a total of 62.5 MBF of TNF lamina deck distribution beams. Each end of the bridge has, on average, a 60-BF (that is, 12- by 12-in by 5-ft) mud sill for a TNF total of 15.0 MBF. The abutment and backwall superstructure, on average, support each end of the bridge with eight 6- by 12-in girders of various lengths that average 10 ft for a TNF total of 120.0 MBF.

There are approximately 362 utility log bridges on the TNF with average spans of 41 ft, for a TNF total of 14,922 LF.

- The superstructure of a typical utility log bridge uses 31 BF per LF, or five 2-ft-diameter log stringers for a total of 462.6 MBF of log stringers.

A typical utility bridge (that is, log, lamina, and steel) uses wood for the deck and railing. A typical deck uses 4- by 12-in planking and is 18 ft wide. Therefore:

- A typical 1-foot cross section of deck uses 72 BF, and there is a total of 38,422 LF of utility bridge decking for a TNF total of 3.2 MMBF. A typical 1-ft cross section has 10 BF per LF of 10- by 12-in curbing on each side of the bridge for a TNF total of 768.4 MBF, and 20 BF of 6- by 12- by 40-in curb blocking on each side of the bridge that are spaced at 5-ft intervals for a TNF total of 307.4 MBF of curb blocking. Each side of a typical 1-foot cross section of utility deck bridge uses one 2- by 6-in top rail and two 2- by 4-in side rails, or 2.3 BF per LF, totaling 88.4 MBF of TNF deck railing. On both sides of a typical bridge, rails are affixed to an 8-BF (that is, 4- by 6- by 48-in vertical post, spaced at 5 ft (maximally), for a TNF total of 123.0 MBF.

Results

Number of Tongass National Forest Buildings

Buildings were aggregated into two categories according to general design function: housing and nonhousing. To gain a broader understanding of the volume of wood required for building and maintaining buildings on the TNF, each of its major land divisions is summarized and then the divisions are aggregated.

Seven district/multidistrict "areas" make up the TNF and contain an estimated 4.5 MMBF of wood products.

Table 3 shows that seven district/multidistrict "areas"[4] make up the TNF and contain an estimated 4.5 MMBF of wood products. This is the volume required to build and maintain the various buildings on the TNF. Of this total volume, 74 percent is made up of structures most closely aligned with having a housing design (for example, residence, office, cabin; see fig. 5), whereas the remaining 26 percent possesses designs more closely aligned with having a storage function. The average age for all buildings on the TNF is 28 years.[5] On average, housing units are 30 years old and nonhousing are 22 years old. Using these figures for a baseline allows for comparisons between the various district/multidistrict areas making up the TNF.

Table 3—Current regional totals and ages of Tongass National Forest buildings (housing and nonhousing)

	Tongass National Forest (TNF) district/multidistrict "areas"							
Attributes	TNF	Craig/Thorne Bay (Prince of Wales)	Wrangell-Petersburg	Yakutat (Skagway-Angoon)	Juneau/ Admiralty Island	Sitka	Ketchikan/ Misty Fiords	Hoonah
Housing								
MBF[a]	3,219.8	1072.1	772.9	523.8	322.7	332.7	292.4	3.0
Avg. age	30 yrs	30 yrs	28 yrs	30 yrs	26 yrs	32 yrs	32 yrs	31 yrs
Nonhousing								
MBF	1,162.4	132.8	266.9	76.6	226.8	163.7	198.5	0.1
Avg. age	22 yrs	16 yrs	17 yrs	33 yrs	25 yrs	21 yrs	21 yrs	22 yrs
Total								
MBF	4,482.2	1,205.0	1,039.8	600.4	549.5	496.6	490.9	3.1
% of TNF	100.0	26.9	23.2	13.4	12.3	11.8	11.0	0.07
Avg. age	28 yrs	28 yrs	26 yrs	31 yrs	26 yrs	29 yrs	27 yrs	31 yrs
% newer or older than TNF avg. age	0 (Baseline)	0 (Baseline)	7 (Newer)	11 (Older)	7 (Newer)	5 (Older)	5 (Newer)	11 (Older)

[a] Thousand board feet.

[4] The Infra Database for buildings listed seven district/multidistrict "areas"; therefore, for consistency, this "area" format is used throughout this study.

[5] Owing to various building components possessing differing design lifespans, it was infeasible to approximate a typical building design lifespan.

Figure 5—Tongass National Forest building interior.

The distribution of wood products volume used to build and maintain TNF buildings is:[6]

- 26.9 percent in the Craig/Thorne Bay (Prince of Wales) area,
- 23.2 percent in the Wrangell-Petersburg area,
- 13.4 percent in the Yakutat (Skagway-Angoon) area,
- 12.3 percent in the Juneau/Admiralty Island area,
- 11.8 percent in the Sitka area,
- 11 percent in the Ketchikan/Misty Fiords area, and
- a negligible amount in the Hoonah area.

The average age for TNF buildings is 28 years. In comparison,

- Yakutat (Skagway-Angoon) and Hoonah buildings are 11 percent older,

[6] Although not specified in the database, TNF buildings typically use spruce (*Picea* spp.) for larger beams, hemlock (*Tsuga* spp.) for framing, and redcedar (*Thuja plicata* Donn) for siding.

- Sitka buildings are 5 percent older,
- Craig/Thorne Bay (Prince of Wales) buildings are average age,
- Ketchikan/Misty Fiords buildings are 5 percent newer, and
- Juneau/Admiralty Island Wrangell-Petersburg buildings are 7 percent newer.

Table 3 summarizes the wood volume used and ages of buildings found throughout the various multidistrict areas of the TNF.

How Demand Is Dispersed for Wood Products Used in Tongass National Forest Buildings

Construction and maintenance of buildings in each area of the TNF differ according to the volume of wood products used and the age of the buildings. Although the Yakutat (Skagway-Angoon) area has the oldest buildings, it requires only about half as much wood products in its buildings as does the Prince of Wales area, which has buildings that are average age for a typical TNF building. Similarly, the Sitka and Hoonah areas have older than average-age buildings, but their use of wood products for buildings is approximately half the volume used in the Wrangell-Petersburg area, which has buildings that are 7 percent newer than average for the TNF. The Juneau/Admiralty Island and Ketchikan/Misty Fiords areas combine to use almost one-quarter of the demanded wood products for buildings on the TNF, and on average, the buildings in these regions are 6 percent newer than buildings found on the TNF.

Number of Miles of Trails on the Tongass National Forest

Trail is a general term for walkway. The National Trails Management Classes (USDA FS 2001) actually distinguish trails according to their general use. Trail classes are (1) primitive and underdeveloped, (2) simple/minor development, (3) developed/improved, (4) highly developed, and (5) fully developed. The significance of these classifications to this study is twofold. First, trail classes 1, 2, and 3 are constructed from native materials; class 4 uses a mix of native and imported materials; and class 5 uses imported materials. Second, the lower numerical class designations use less wood products in their construction. Table 1 shows that a typical mile of trail way on the TNF is estimated to use 19,668 BF of wood products in its construction.[7] If this volume is assumed to be a baseline figure, then

Trail classes 1, 2, and 3 are constructed from native materials; class 4 uses a mix of native and imported materials; and class 5 uses imported materials.

[7] Although not specified in the database, TNF trails typically use redcedar and yellow-cedar (*Chamaecyparis nootkatensis* (D. Don) Spach).

Table 4—Trail classes, quantities, wood volumes, and origins

Trail class	Number of trails	Miles of trails	TNF trails	Average baseline[a] wood use	Wood use on TNF trails	Typical origin of materials used
			- - - - - *Percent* - - - - -		*Thousand board feet*	
1	14	23	5	25	111	Native
2	86	166	36	50	1,630	Native
3	51	92	21	75	1,351	Native
4	49	130	28	100	2,557	Mix
5	44	47	10	100	922	Imported
Total	247	458	100	NA	6,571	NA

NA = not applicable.
[a] Baseline of 19,668.1 BF/mi.

approximations for volumes used in the various classes of trails are as shown in table 4. Based on their general-use classification, this study estimates that:

- Class 1 uses 25 percent of the baseline volume per mile
- Class 2 uses 50 percent of the baseline volume per mile
- Class 3 uses 75 percent of the baseline volume per mile
- Classes 4 and 5 each use 100 percent of the baseline volume per mile.

There are an estimated 458 mi of trails on the TNF, of which approximately 346 (75.5 percent) are constructed from 4,370.5 MBF of native materials. This leaves 112 mi (24.5 percent) that are constructed from 2,200.5 MBF of imported materials.

How Demand Is Dispersed for Wood Products Used on Tongass National Forest Trails

Demand dispersion for wood products on TNF trails is not dispersed uniformly throughout the various areas of the TNF.

Table 5 summarizes the demand dispersion for wood products on TNF trails and shows that construction of trails is not dispersed uniformly throughout the various areas of the TNF. The Juneau/Admiralty Island area has the most miles of trails (158.4), accounting for 34.6 percent of all TNF trails and constructed from 3,112.5 MBF of wood products. The Wrangell-Petersburg area has 92.6 mi of trails, represents 20.2 percent of TNF trails, and used 1,821.3 MBF of wood products in its construction. The Ketchikan/Misty Fiords area makes up 16 percent of the TNF trails system, which is built with 1,443.6 MBF of wood products. The fourth longest trails system on the TNF is in the Sitka area, which represents 10.7 percent of the entire TNF trails system and is constructed from 961.8 MBF of wood products. The Craig/Thorne Bay (Prince of Wales) area has 7.3 percent of the TNF system and uses 654.9 MBF of wood products in its construction. Rounding out the sixth and seventh rankings are the Yakutat (Skagway-Angoon) and Hoonah areas, which combine to make up 11.25 percent of all TNF trails, using 622.5 MBF and 391.4 MBF of wood products, respectively, in their trails construction.

Table 5—Demand dispersion for wood products on Tongass National Forest (TNF) trails

TNF district/multidistrict areas	Trails	TNF	Total MBF at 100% of baseline[a]	Total MBF at 73% of baseline[b]
	Miles	*Percent*	*Thousand board feet*	
Juneau/Admiralty Island	158	35	3,113	2,270
Wrangell-Petersburg	93	20	1,821	1,329
Ketchikan/Misty Fiords	73	16	1,444	1,053
Sitka	49	11	962	702
Craig/Thorne Bay (Prince of Wales)	33	7	655	478
Yakutat (Skagway-Angoon)	32	7	623	454
Hoonah	20	4	391	286
Total miles of trails on the TNF	458	100		
Subtotal volume of wood use			9,009	
Total volume of wood use				6,571

[a] Baseline of 19,668.1 BF/mi.
[b] 73% of baseline is reflective of an approximate average used for the five trail classes (that is, somewhere around trail class 3).

Number of Utility Bridges on the Tongass National Forest

Utility bridges (see fig. 6) on the TNF use approximately 10.2 MMBF of wood.[8] This includes estimates for 2.3 MMBF of bridge superstructure, 4.5 MMBF of bridge deck work, and 3.3 MMBF of bridge work for which the stringer type (log, lamina, or steel) is not labeled in the Infra Database (approximately 7.2 percent). Therefore, when equally distributing these unlabeled bridge types, there are approximately 125 + 7.2 percent, or 134 lamina bridges (glu-lam, stress-lam, and nail-lam), totaling approximately 8,128 LF and having average spans of 65 ft. There are approximately 362 + 7.2 percent, or 388 utility log bridges on the TNF, with average spans of 41 ft or a total of 14,922 LF. Although the approximate 278 + 7.2 percent, or 298 steel bridge superstructures on the TNF do not account for wood usage, their deck work does. Table 6 summarizes the number of TNF utility bridges by type, total lengths, and average spans.

Construction of utility bridges (log, lamina, and steel) is not dispersed uniformly throughout the various areas of the TNF.

How Demand Is Dispersed for Wood Products Used in Tongass National Forest Bridges

Table 7 shows that construction of utility bridges (log, lamina, and steel) is not dispersed uniformly throughout the various areas of the TNF. The Wrangell-Petersburg area has 264 utility bridges, or 30 percent of all TNF utility bridges. The Sitka area has 225 or 25 percent; the Craig/Thorne Bay (Prince of Wales) area has 157 or 18 percent; the Hoonah area has 148 or 17 percent; the Ketchikan/Misty

[8] Although not specified in the database, TNF bridges typically use spruce (*Picea sitchensis* (Bong.) Carr) and western hemlock (*Tsuga heterophylla* (Raf.) Sarg.).

Figure 6—Tongass National Forest wood utility bridge.

Table 6—Number of lengths, and average spans of Tongass National Forest utility bridges

Bridge type	Number of bridges	Length of each bridge type	Average span
		Lineal foot	*Feet*
Log	362	14,992	41
Laminate	125	8,128	65
Steel	278	15,372	55
Subtotal	765		
Unlabeled	124		
Total	889	38,492	NA

Table 7—Demand dispersion for wood products on Tongass National Forest (TNF) utility bridges

TNF district/multidistrict areas	Number of bridges	Percentage of TNF utility bridges	Newest 50% built between:	Oldest 50% built between/before:
Juneau/Admiralty Island	27	3	1959–1981	1958
Wrangell-Petersburg	264	30	1982–2002	1965–1981
Ketchikan/Misty Fiords	62	7	1970–1982	NA
Sitka	225	25	1982–2002	19??–1981
Craig/Thorne Bay (Prince of Wales)	157	18	1982–2002	1965–1981
Yakutat (Skagway-Angoon)	6	Negligible	1975–1982	NA
Hoonah	148	17	1982–2003	19??–1981
Total	889	100		

NA = not available.

Fiords area has 62 or 7 percent; the Juneau/Admiralty Island area has 27 or 3 percent; and the Yakutat (Skagway-Angoon) area has 6, a negligible percentage.

Future TNF timber sales may necessitate bridge construction. However, when viewed strictly from date of construction, the most significant maintenance and replacement of utility bridges will be required in the Sitka and Hoonah areas. Of the oldest half of the bridges in these two areas (132 and 74, respectively), some were built as far back as the early 1900s and through 1981. Although the Juneau/Admiralty Island area has bridges similar in age to those of the Sitka and Hoonah areas, it has far fewer bridges than these areas. The Wrangell-Petersburg area will require almost as much attention in the future because it has the second highest number of bridges on the TNF, of which half (132) were built between 1965 and 1981. In the Craig/Thorne Bay (Prince of Wales) area 78 bridges will require substantial attention because they also were built between 1965 and 1981. The Ketchikan/Misty Fiords and Yakutat (Skagway-Angoon) areas may not require substantial bridge replacement in the foreseeable future because together they make up only about 7 percent of the bridges on the TNF, all built since 1970.

Future TNF timber sales may necessitate bridge construction.

The Projected Annual Demand for Wood Products Use on the Tongass National Forest

One of this study's original objectives was to estimate the number of new and replacement buildings, trails, and bridges needed as well as the volume of wood products required to maintain these existing structures. However much of these data are either currently being amassed or simply nonexistent and, therefore, the estimation ultimately proved to be beyond the scope of this study for the following reasons:

- The average service life for subassemblies in buildings on the TNF (for example, roofing, flooring) varies in duration. However, buildings on the TNF are between 21 and 31 years old, with an average age of 24 years. This indicates that in many instances, the first phase of subassembly replacement already has been required to maintain these buildings, and the second phase of subassembly replacement is imminent.
- The amortization schedule for trails has been adjusted so that their service life is equated to their economic payback period, typically 30 years.
- Experts who could indeed qualify their estimates regarding necessary future maintenance and replacement needs suggested that despite associated planning intentions, all future construction was dependent on government budgeting.

Table 8—Current volume and projected annual demand for wood products use on the Tongass National Forest (TNF)

Wood use classification	Current volume of wood products used on the TNF	Percentage of projected annual demand			
		2.5	5.0	7.5	10.0
	Million board feet (percentage of total)	*- - - - - - Thousand board feet - - - - - -*			
Buildings	4.5 (21)	113	225	338	450
Trails	6.6 (31)	165	330	495	660
Bridges	10.2 (48)	225	510	765	1,020
Total TNF wood use	21.3 (100)	NA	NA	NA	NA
Total potential annual demand for TNF wood use	NA	533	1,065	1,598	2,130

NA = not applicable.

Table 8 shows that the three classifications of structures studied were built with an estimated 21.3 MMBF of wood products. This estimate is, most probably, conservative because of the broad generalizations used in calculating "typical units" of structures. As previously stated, inventories of TNF structures have been and continue to be amassed in an effort to update the Infra Database. Given that these current estimates of TNF structures are most probably conservative, and components of the Infra Database currently remain under construction, an alternative method for projecting future demand of wood products use (that is, new and replacement construction as well as maintenance) is used to forecast various growth scenarios. These growth scenarios represent feasible ranges of occurrences from low to high. Table 8 displays the results of a 2.5- to 10-percent annual demand schedule for wood products used to maintain and construct new and replacement buildings, trails, and bridges on the TNF. A low assumed demand of 2.5 percent would require an associated supply of 533 MBF per year, 5.0-percent assumed demand requires 1,065 MBF, 7.5-percent demand equates to a 1.6 MMBF annual supply, and an optimistic demand scenario of 10 percent would result in a required supply of 1.9 MMBF per year. In total, the annual demand for wood products used to build and maintain the TNF structures is estimated to be between 533 MBF and 2.1 MMBF or, on average, 1.3 MMBF per year.

The annual demand for wood products used to build and maintain the TNF structures is estimated to be between 533 MBF and 2.1 MMBF or, on average, 1.3 MMBF per year.

The Volume of Regionally Produced Lumber for Potential Use on the Tongass National Forest

Although mill closures have dramatically reduced the volume of lumber produced in southeast Alaska (McDowell Group 1998), a limited output is still generated and distributed throughout the state. The most recent data available suggest a decline in

southeast Alaska lumber mill production and regional sales between 2000 and 2002 (Kilborn and others 2004)—and more recent anecdotal evidence indicates that this trend is continuing.[9]

Because the trend appears to be downward, table 9 addresses the multiple changes occurring from 2000 to 2002 rather than focusing on the averages for this period. There was a 54.3 percent decrease in regional output during this 2-year period, but more remarkably, regional sales fell by 76.1 percent. However, after deducting the estimated 4.4 MMBF of native materials used in trail construction from the total 21.3 MMBF of TNF wood use (see table 8), the wood products market potential for Alaska wood species substitution is estimated to be approximately 1.1 MMBF annually. This volume represents 1.3 percent of the regional output for 2000 and would have increased overall demand in southeast Alaska by 13.9 percent. These same figures for 2002 are more dramatic, with the TNF potential consumption representing 2.8 percent of the region's output and potentially increasing its overall demand by 57.1 percent. However, even with the inclusion of the TNF projected demand, overall regional market potential reflects a net decrease of nearly 28 percent between 2000 and 2002.

The wood products market potential for Alaska wood species substitution is estimated to be approximately 1.1 MBF annually.

Table 9—Most recent southeast Alaska lumber production versus regional sales

Calendar year	Lumber production	Regional sales	Regional sales as a percentage of total production	TNF regional demand as a percentage of total production	TNF potential percentage increase on regional demand	Regional market potential as a percentage of total production
	Thousand board feet		*Percent*			
2000	87,117.0	8,135.5	9.3	1.3	13.9	10.6
2002	39,801.6	1,942.5	4.9	2.8	57.1	7.7

Conclusion

This study's findings provide the following insights regarding the potential for Alaska wood products substitution.

- The average annual estimated demand projection for maintenance and replacement of buildings, trails, and bridges on the TNF would have represented an increase in regional market potential of nearly 14 percent for 2000 and 57 percent for 2002. This suggests that there is potential for manufacturers in southeast Alaska to increase capacity or reallocate their current production and distribution to meet overall demand on the TNF.

[9] Parrent, D.J. 2004. Personal communication. Wood utilization specialist, Juneau Economic Development Council, 204 Siginaka Way, Sitka, AK 99835.

- Craig/Thorne Bay (Prince of Wales) and Wrangell-Petersburg areas make up over 50 percent of all buildings on the TNF (26.9 percent and 23.2 percent, respectively), and buildings in these areas are, on average, 27 years old. This suggests that there is potential for local manufacturers who specialize in residential-type wood products to increase capacity or reallocate their current production and distribution to meet demand in these specific areas of the TNF.
- It is estimated that over three-quarters of the wood products used in constructing TNF trails are native materials (23 percent of all wood products used to build and maintain the TNF). This suggests that local manufacturers that produce wood products used for constructing trails would be best served not by attempting to meet overall demand for trail building supplies, but rather by focusing on the 25 percent of required imported trail materials.[10] Additionally, the 75-percent native supply may suggest a niche market for regional producers interested in meeting these market demands.
- Utility bridge construction requires the greatest volume of wood consumption for building and maintaining TNF structures (48 percent of the total demand for wood products on the TNF). This suggests that bridges account for approximately 2.3 times more wood than do buildings on the TNF and nearly 1.5 times more wood than required for trail work that uses nonnative material.
- Wrangell-Petersburg and Sitka areas make up 55 percent of all the bridge work on the TNF that involves wood products, and 245 bridges are at least 23 years old. Craig/Thorne Bay (Prince of Wales) and Hoonah areas account for another 35 percent, of which 153 bridges are at least 23 years old. Thus, the strongest likelihood for future bridge maintenance and repair is in these areas.[11]

Utility bridge construction requires the greatest volume of wood consumption for building and maintaining TNF structures.

[10] Much of the 25 percent of imported trail material requires pressure treating and is not available from Alaska manufacturers because pressure treatment facilities currently do not exist within the state. However, this study is intended to point out the volume of Alaska species that could be used if such facilities and processes were made available.

[11] Note that, in general, bridge designs require longer service life than trails and buildings. Therefore, their replacement schedules may not have as much impact as their maintenance demands.

The findings produced by this study appear to warrant future research that examines the presumably greater market potential for maintaining and replacing buildings, trails, and bridges in southeast Alaska that are external to TNF jurisdiction. Additionally, a similar analysis conducted and applied to other Alaska forest land would serve as a means for understanding how Alaska wood manufacturers, in general, can be made aware of their local and regional projected demand.

Acknowledgments

The author thanks Barth Hamberg, Dom Monaco, Molly Murphy, Eleanor Oman, and Dan Parrent for their technical assistance.

Metric Equivalents

When you know:	Multiply by:	To find:
Inches (in)	2.54	Centimeters
Feet (ft)	0.3048	Meters
Square inches (in^2)	645	Square millimeters
Board feet (BF)	0.002358	Cubic meters
Square feet (SF)	0.0929	Square meters
Lineal feet (LF)	0.3048	Lineal meters

Literature Cited

Kilborn, K.A. 2002. Lumber recovery studies of Alaska sawmills, 1997 to 1999. Gen. Tech. Rep. PNW-GTR-544. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 15 p.

Kilborn, K.A.; Parrent, D.; Housley, R.D. 2004. Estimating sawmill processing capacity for Tongass timber. Res. Note PNW-RN-545. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 16 p.

McDowell Group. 1998. The Alaskan market for value-added lumber products. The Forest Products Manufacturing Project: a joint project prepared for the Alaska Science and Technology Foundation and Industry Network Corporation, Anchorage, AK. [Pages unknown].

National Association of Home Builders. 2001. National association of home builders (NAHB). www.nahb.com. (April 15, 2004).

U.S. Department of Agriculture, Forest Service. 2001. Makin' TRACS: Forest Service guide to trail assessment and condition surveys. [Pages unknown]. On file with: Alaska Wood Utilization Research and Development Center, 204 Siginaka Way, Sitka, AK 99835-7316.

U.S. Department of Agriculture, Forest Service. 2003. Tongass National Forest (TNF). http://www.fs.fed.us/r10/Tongass/. (May 15, 2004).

Pacific Northwest Research Station

Web site	http://www.fs.fed.us/pnw
Telephone	(503) 808-2592
Publication requests	(503) 808-2138
FAX	(503) 808-2130
E-mail	pnw_pnwpubs@fs.fed.us
Mailing address	Publications Distribution Pacific Northwest Research Station P.O. Box 3890 Portland, OR 97208-3890

U.S. Department of Agriculture
Pacific Northwest Research Station
333 SW First Avenue
P.O. Box 3890
Portland, OR 97208-3890