Minnesota Logged Area Residue Analysis

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Introduction

This report summarizes the results of data collected on randomly selected forest harvest sites around Minnesota. Measurements were made on the sites after the merchantable timber was removed. Tables were assembled to show the residue from various harvest methods, logging types, and residue types commonly found in Minnesota and the Lake States, and are presented in the report. *Several of the residue volume tables on pages 8 and 9 in the original report had errors in per acre cubic foot to cord and green ton conversions. Corrections to the tables appear in red font in this version.* Tables showing estimates of average harvest acreage by county and forest type were also developed, using satellite imagery change detection analysis work done by DNR's Resource Assessment unit.

Logged area residue is the wood material remaining on a site after merchantable timber has been harvested. The type of material typically left is the tops of harvested trees, branches, leaves; standing trees too small to harvest or reserved clones within the harvest area; and wood that has an underdeveloped market or is a poor form and thus not marketable. There may be other reasons for leaving standing trees. Some may be reserved to provide a seed source for regeneration, provide wildlife habitat, or protect soil from erosion along stream corridors.

Current practice leaves most of the residue scattered on the harvest site or some piled on the landings. Private individuals may salvage small amounts of the residue for fuelwood.

Objectives of the Study

- Characterize forest residues on recently harvested sites by method of harvest, cover type, and geographic location within the state of Minnesota.
- Provide per acre volume, form, and weight estimates of downed woody debris, standing residual trees, and debris piles on harvested sites.
- Enable use of the per acre residue volume data to develop estimates of downed woody debris, debris piles and standing residual trees by county, forest type and harvest system.
- Provide general background on residue estimate development and reliability.

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Study Methods

Harvest areas to be sampled were determined by choosing a random subset of harvested areas detected through the use of satellite imagery. The detected sites are a minimum of five acres in size or larger and were harvested within the period of summer 2003 through summer 2004.

Statewide, 124 sites encompassing a total of 4,037 acres were field sampled. This amounts to a 2.5 percent sample of acreage harvested in 2003–2004. The survey sites were sorted by cover type, harvest type, and logging method. See the Appendix (Page 19) for a summary of harvest acreages by county and cover type.

Site data was collected using three randomly chosen beginning points for a three-sided line transect. Coarse woody debris (CWD) greater than 2 inches in diameter intersecting the transect was measured and tallied along with the species, diameter, and length. Fine woody debris (FWD) 1 inch to 2 inches was also tallied on every third transect line.

Debris piles were tallied by a visual estimate of height, length, and width. Piles on landings, as well as any scattered on the site, were recorded, along with visual estimates of their size.

Standing residuals (all live trees) were tallied using a 10 Basal Area Factor (BAF) plot. Information recorded for each standing residual tree tallied was species, diameter, merchantable height, and total height.

Some subpopulations were of interest, but in some cases there is not enough data to offer any meaningful, reliable sample. For example, there may not be enough site data for hardwoods in the southeast portion of the state to provide data with high confidence.

Expansion of the Current Study:
Another method for estimating residue volumes in an area of interest is being developed by Tom Burk at the University of Minnesota. The outcomes are applicable within the boundaries of the state of Minnesota. The application operates within the ArcGIS geographic information software. A user defines an area of interest as one or more counties or an arbitrarily specified polygon. Forest inventory data from the USDA Forest Service are queried to estimate standing volume and timberland area within the area-of-interest for forest types and age classes of interest to the user. The user then identifies (based on volume or area) the expected distribution of harvest amount by harvest method over a time period of interest. Residues from harvesting are predicted based on models derived from data collected in the present study. The application links best estimates of current standing inventory to these most recent utilization data to provide a means of estimating residue volumes under multiple harvesting methods and logging types. For more information on this project, contact Tom Burk. Phone: (612) 624-6741; Email: tburk@umn.edu

Corrections: *Several of the residue volume tables on pages 8 and 9 in the original report had errors in per acre cord conversions. Corrections to the tables appear in red font below.*

Findings

All volume figures are per acre averages over the harvest area

Tables contain totals. Amount actually available for recovery will be limited to approximately 25% to 75% of these totals by environmental and processing limitations.

Coarse and Fine Woody Debris Residue Amounts by Logging Method				
	Ft^3	Cords	Green tons	% Fine woody debris
Shortwood	513.2	5.64	12.7	24.5
Tree length	519.5	5.71	12.8	26
Full tree	185.8	2.04	4.6	20
Unknown	437.5	4.81	10.8	36.6

Coarse and Fine Woody Debris Residue Amounts by Harvest Type				
	Ft^3	Cords	Green tons	% Fine woody debris
Clear-cut	523	5.75	12.9	25
Clear-cut w/reserve	499	5.48	12.3	27
Partial cut	491	5.40	12.2	26
Unknown	397	4.36	9.8	36.7

Coarse and Fine Woody Debris Residue Amounts by Cover Type**				
	Ft^3	Cords	Green tons	% Fine woody debris
Aspen	519	5.70	12.8	28
Other hardwoods	686	7.54	19.2	20
Lowland conifers	391	4.30	9.5	35
Upland conifers	429	4.71	10.9	31
Unknown	557	6.12	13.8	20

Residue Amounts in Debris Piles						
By logging method	Central landing			Scattered piles		
	Ft^3	Cords	Green tons	Ft^3	Cords	Green tons
Shortwood	53	0.58	1.3	24	0.26	0.59
Tree length	104	1.14	2.6	6	0.7	1.57
Full tree	***	***		***	***	***
Unknown	5.4	0.06	0.13	***	***	***

Residue Amounts in Debris Piles						
By harvest type	Central landing per acre			Scattered piles per acre		
	Ft^3	Cords	Green tons	Ft^3	Cords	Green tons
Clear-cut	79	0.87	1.96	24	0.26	0.59
Clear-cut w/reserve	35	0.38	0.86	12	0.13	0.29
Partial cut	51	0.56	1.26	16	0.18	0.40
Unknown	3	0.03	0.07	***	***	***

Residue Amounts in Debris Piles						
By cover type	Central landing per acre			Scattered piles per acre		
	Ft^3	Cords	Green tons	Ft^3	Cords	Green tons
Aspen	47	.52	1.17	7.6	.08	0.18
Other hardwoods	22	.24	0.61	1.8	.02	0.05
Lowland conifers	192	2.11	4.64	16.3	.18	0.40
Upland conifers	25	.27	0.63	32.7	.36	0.84
Unknown	***	***	***	***	***	***

*** No data

Standing Residual Amounts by Cover Type			
	Ft^3	Cords	Green tons
Aspen	241	2.65	5.96
Other hardwoods	477	5.24	13.36
Lowland conifers	6.8	0.07	0.15
Upland conifers	1016	11.16	25.89
unknown	9.7	0.11	0.25

Standing Residual Amounts by Harvest Type			
	Ft^3	Cords	Green tons
Clear-cut	227	2.49	5.60
Clear-cut w/reserve	353	3.88	8.73
Partial cut	1202	13.21	29.72
Unknown	736	8.09	18.20

Standing Residual Amounts by Logging Type			
	Ft^3	Cords	Green tons
Shortwood	317	3.48	7.83
Tree length	810	8.90	20.02
Full tree	***	***	***
Unknown	690	7.58	17.01

*** No data

Conversion factors: 91 cubic feet = 1 cord

Green tons/ cord by cover type: Aspen = 2.25; Other Hardwoods = 2.55; Lowland conifers = 2.20; Upland conifers = 2.32; Unknown = 2.25

All volume figures are per acre averages over the harvest area

Using the Data to Develop Residue Estimates

You may utilize the data in this report to calculate estimates for logging residue in a given area. Follow these steps.

- Use the "harvest area" tables in the appendix and find estimated annual harvest acreage for county(ies) of interest, either in total (Table 1), or by forest type (Table 3). For statewide forest type acreage estimates, use figures from Table 2.
- Find the residue volume data of interest in the appropriate tables in the "Findings" section of the report. Choose data from the table(s) appropriate to your search.
- Estimate the residue volume in the area by multiplying the per acre volume for your parameter of interest (for example, down woody debris residue volume in the aspen forest type) times the number of harvest acres in the area of interest (for example, in the aspen forest type in Aitkin County).

Example 1.
To estimate coarse and fine down woody debris residue volume for Aitkin County for the aspen forest type.

1. Look up the estimated annual aspen harvest acreage in Table 3. The number is 4,199 acres
2. Look up the residue volume in the "Coarse and Fine Woody Debris Residue Amounts by Cover Type" table on page 8. The figure is 5.70 cords per acre.
3. Then, multiply the volume per acre by the number of harvest acres: 5.70 X 4,199 = 23,934 cords of gross annual Coarse and Fine Woody Debris logging residue.
4. Note: This example is the volume for the Coarse and Fine Woody Debris logging residue in the harvest area and does not include the debris piles on the landing or in the harvest area.

Example 2.
To estimate the upland conifer residue from Cass County.

1. Find the appropriate harvest acreage figure for Cass County. This figure will come from Table 3 in the harvest acreage section of the appendix since we want only the upland conifer cover type. In this case the acreage is 1,456.
2. Now we look at the volume of upland conifer residue on the harvest area and the debris piles table. These two tables indicate the values 4.71 cds+.27 cds+.36cds = 5.34 cords
3. Calculate the volume by multiplying the acreage by the total average per acre residue volume or 5.34 X 1,456 = 7775 cords.

Availability Considerations

The reader needs to use caution when using the information in this report to develop residue estimates. Tables in this report contain gross residue volumes. Residue volume will only be partially recoverable. Breakage, small size and other handling difficulties will limit how much residue can be recovered from a site. Additionally, nutrient maintenance and habitat concerns limit amount of residue that should be utilized from a site. Rough guesses of the percentage of total residue volume that may actually be recoverable, obtained from literature, range from a low of 25 to 40% (Dahlman, 1994), to a high of 75% (Berguson, 2005).

Estimate Reliability

Standard error estimates for a particular residue estimate can be determined by statistical analysis of the data. In general, the reader should be aware that for large counties, and for forest types with large acreages, estimates will be far more reliable than for counties or forest types with relatively smaller areas of forest. For example, an estimate of annual harvest residue for the aspen-birch forest type for a 5 county area in northeastern Minnesota will be far more reliable than an estimate for the “other hardwoods” type in a single county in southern Minnesota.

Residue Recovery Considerations

Recovery of logging residue requires careful planning. Each harvest should be assessed regarding feasibility of biomass collection and transportation. Planning for biomass recovery should be part of the timber sale design where feasible. Land managers should consider integrated biomass recovery during logging operations in order to avoid re-trafficking sites after the original commercial logging activity.

Forest Management Guidelines

The Minnesota Forest Resources Council (MFRC) is currently developing new guidelines for the sustainable harvest of biomass from woodlands and brushlands. The new guidelines are scheduled for completion in June of 2007.

Current MFRC guidelines will provide direction for the harvest of woody residues during forest management activities until June 2007. Following are very brief summaries of the Guidelines with the most relevance to utilization of woody biomass. It is important to review the entire relevant Guidelines in the "Sustaining Minnesota's Forest Resources" handbook in order to see the full text and background: http://www.state.mn.us/ebranch/frc/FMgdline/Guidelines.html

Relating to the level of retention for logging residue on-site, there are three major issues: 1) Providing wildlife habitat, 2) Protecting soil productivity, and 3) Protecting riparian areas.

1) Providing wildlife habitat. The guidelines require retention of some coarse woody debris, snags and leave trees.

See guideline book for requirements and preferred characteristics of coarse woody debris, snags and leave trees.

2) Protecting soil productivity. The guidelines suggest that three types of sites are of greatest concern for removal of tops and logging residue: Aspen and other hardwoods on well-drained sandy soils; aspen and other hardwoods on shallow (8 inches or less) to bedrock soils; and organic peatland soils. These types of sites may require that more residue be left on site for maintenance of future site productivity.

Soil productivity is protected as well by following recommendations for slash distribution, concentrating traffic to designated skid trails on appropriate sites, and restricting the total road and landing infrastructure to no more than 3% of the harvest site.

3) Protecting riparian areas. The guidelines recommend retaining significant amounts of live vegetative cover in riparian areas, controlling equipment intrusion into these areas, and ensuring proper crossing of water bodies. In brushlands, where there are few or no trees, retaining the brush for shade, bank stability and habitat will likely limit availability of riparian areas for harvest.

Future Residue Considerations

Wood residue from logging and all other sources is likely to become a more important source for energy and heat production in the state. It is extremely important to plan carefully for any new production capacity.

As demand rises, cost for woody residue will also rise. Collection equipment can be expensive, so it will be helpful for woody residue suppliers to have some assurances of long-term availability of markets, in order for the collection and transport of biomass to be feasible and profitable. As fossil fuel costs increase, the ratio of alternative energy sources will also rise.

There is still an undetermined amount of wood residue from non-forest management activities currently going to waste. An example is road construction. Contractors that do this work often find it cheaper to salvage some merchantable log material and then push the remainder into piles and burn it on site. As biomass markets further develop, this practice could be changed through education and contract manipulation by the Minnesota Department of Transportation and county highway departments.

The facilities currently utilizing biomass for heat and energy production are not fully known. A DNR survey in the late 1980s revealed more than 200 facilities using some form of wood biomass as a fuel source in Minnesota. Even with current interest and new technologies, accurate information on the current state of biomass usage is missing. Determining this information would be a good next step in understanding the woody biomass supply-demand situation.

Appendix

A) Definitions

Coarse Woody Debris: Down Woody Debris greater than 2 inches in diameter.

Fine Woody Debris: Down Woody Debris from 1 to 2 inches in diameter.

Harvest Systems
Harvesting systems are distinguished by the form in which wood is delivered to the access road, and by the amount of processing that occurs in the cutover. The different harvesting methods are:
Shortwood (Cut to Length): Trees are felled, delimbed, and bucked to length directly in the stump area. Logging can be fully mechanized or by chain saw. Off-road transport is usually by forwarding (i.e., wood is carried off the ground), although cable skidders are sometimes used. The cut-to-length method can be utilized in all silvicultural systems (e.g., clear felling, thinning, individual tree selection logging). Slash at landings is minimal since processing is done in the cutover.

Tree Length: Trees are felled, delimbed, and topped in the cutover. Crawler tractors and clam-bunk skidders are also used to some extent. The tree lengths are bucked to pulpwood and logs at the landing, or can be left as is for tree-length hauling to the mill. The tree-length method is most applicable for clear-cuts and can be used in row thinning. Landing requirements are usually greater than for the cut-to-length method.

Full Tree: Trees are felled and transported to the landing with branches and top intact. Transport to the landing is mainly by cable or grapple skidders. Generally, the full trees are processed at the landing, which may include:

- Full-tree chipping and hauling of full-tree chips to the mill
- Delimbing and topping to produce tree lengths for hauling to the mill
- Delimbing, topping, and bucking to produce wood assortments for hauling as pulpwood to pulpmills or pulpwood-using panel mills, and logs to sawmills or veneer mills
- Chain flail-delimbing, -debarking, or -chipping to produce clean chips for transport to pulp and paper or panel mills.

With the full-tree method, the limbs, tops, and wood residue are left in piles at the landing and must be disposed of. If debarking equipment is used on the landing the bark is added to the piles for disposal. The slash can be raked into piles and burned, left as is for natural breakdown, or spread back into the cutover. The full-tree method is most applicable to clear-cut operations, and in some cases, to the first commercial thinning where the material is transported to a landing by the forwarder. The landing is often the highest with this method.

Adapted from, *Cut-to-Length, Tree Length or Full Tree Harvesting,* Dr. Reino Pullkki, R.P.F., Lakehead University, Faculty of Forestry.

B) Study Design

The study design chose three sampling parameters for defining the sample. 1) Cover type: aspen-birch-balsam poplar, other hardwoods, upland conifers, and lowland conifers; 2) Harvest type: clear-cut and partial cut including thinnings; 3) Logging method: short wood, tree length, and full tree.

Site Selection: Sample sites were chosen from imagery from 2004 using Gap Analysis Program (GAP) data. Approximately 3,700 sites greater than five acres were in the field to select from. A stratified random sample was utilized to define the final sample. If one category proved to be under represented, a quota sampling approach would be used to strengthen the representation, such as the southeastern Minnesota region, which could be under-represented.

Logging Method	# Sample Sites
Shortwood	93
Tree length	22
Unknown	8
Full tree	1
Total	124

Type of Harvest	# Sample Sites
Clear-cut	61
Clear-cut w/reserve	37
Partial cut	23
Unknown	3
Total	124

Cover Type of Harvest Sites From MN DNR Resource Assessment GAP Data	
Cover Type	# Sample Sites
Aspen	72
Other hardwoods	16
Lowland conifers	9
Upland conifers	26
Unknown	1
Total	124

Data Recorded:

- Coarse Woody Debris (CWD)—Species, diameter, and length recorded on all transects for CWD
- Fine Woody Debris (FWD)—A tally of FWD on every third transect.
- Debris Piles—An estimate of average height, width, and length recorded on all debris piles.
- Standing Residuals—A tally using a 10 Basal Area Factor (BAF) plot at each transect vertices. Information recorded; species, diameter, and tree height.

C) Weight Conversions

Weight conversions for the species were calculated using "cord-weight" averages of conversion factors set forth in the Minnesota DNR, Division of Forestry Scaling Manual (page H2.2, revised 12/2/2002). Green tons/cord by cover type: Aspen = 2.25; Other Hardwoods = 2.55; Lowland conifers = 2.20; Upland conifers = 2.32; Unknown = 2.25

D) Harvest Acreages

Harvest acreages by cover type and county were determined using Forest Change Detection Project data. The Forest Change Detection Project is a product of the Minnesota DNR Resource Assessment unit.

The harvest acreages represent an annual average for the period 2002–2005. Satellite images were analyzed, and harvest activity was located on each set of images using classification algorithms and visual inspection. Average annual statewide harvest acreage for 2002-2005 was found to be 143,250 acres. Individual county and cover type harvest acreages were determined by mapping each harvest area to a county or forest type. For cover type determination, the 1991–1992 GAP vegetation map was used and only areas classified as forest were included.

Tables included: Harvest area by county (Table 1); by cover type (Table 2 GAP cover types condensed to reflect cover types used in the logging residue survey); and by cover type within each county (Table 3, GAP cover types condensed to reflect cover types used in the logging residue survey).

Table 1. Average forest harvest acreages by county based on analysis of four years (2002–2005) of LandSat imagery.

County	*Harvest (ac)*	*County*	*Harvest (ac)*
Aitkin	6718	McLeod	0
Anoka	270	Meeker	8
Becker	1863	Mille Lacs	174
Beltrami	12787	Morrison	437
Benton	47	Mower	0
Big Stone	0	Murray	0
Blue Earth	4	Nicollet	5
Brown	16	Nobles	0
Carlton	2822	Norman	20
Carver	19	Olmsted	31
Cass	8533	Otter Tail	494
Chippewa	0	Pennington	300
Chisago	86	Pine	3674
Clay	5	Pipestone	0
Clearwater	3383	Polk	117
Cook	2629	Pope	0
Cottonwood	0	Ramsey	5
Crow Wing	2473	Red Lake	59
Dakota	58	Redwood	0
Dodge	5	Renville	20
Douglas	5	Rice	0
Faribault	16	Rock	0
Fillmore	124	Roseau	2901
Freeborn	9	Saint Louis	35793
Goodhue	41	Scott	42
Grant	0	Sherburne	406
Hennepin	35	Sibley	0
Houston	215	Stearns	50
Hubbard	8921	Steele	0
Isanti	123	Stevens	0
Itasca	13281	Swift	0
Jackson	0	Todd	188
Kanabec	312	Traverse	0
Kandiyohi	12	Wabasha	61
Kittson	1480	Wadena	2462
Koochiching	16496	Waseca	5
Lac Qui Parle	4	Washington	34
Lake	6902	Watonwan	0
Lake of the Woods	4144	Wilkin	0
Le Sueur	0	Winona	355
Lincoln	0	Wright	26
Lyon	0	Yellow Medicine	8
Mahnomen	0	**Total**	**143248**
Marshall	618		
Martin	1117		

Table 2. Average forest harvest acreages by GAP cover type based on analysis of four years (2002–2005) of LandSat imagery.

Cover type	*Harvest (ac)*
Aspen/White Birch	89138
Other Hardwoods	13827
Lowland Conifer	9728
Upland Conifer	30556

Table 3. Average annual forest harvest acreages, by county and logging residue survey cover types.

County	*Cover Type*	*Harvest (ac)*	*County*	*Cover Type*	*Harvest (ac)*
Aitkin	Aspen/White Birch	4198	Dakota	Other Hardwoods	51
	Other Hardwoods	1025		Upland Conifer	6
	Lowland Conifer	533	Dodge	Other Hardwoods	5
	Upland Conifer	962	Douglas	Other Hardwoods	5
Anoka	Aspen/White Birch	45	Faribault	Other Hardwoods	16
	Other Hardwoods	212	Fillmore	Other Hardwoods	124
	Upland Conifer	14	Freeborn	Other Hardwoods	9
Becker	Aspen/White Birch	1221	Goodhue	Other Hardwoods	34
	Other Hardwoods	143		Upland Conifer	6
	Lowland Conifer	6	Hennepin	Aspen/White Birch	4
	Upland Conifer	494		Other Hardwoods	31
Beltrami	Aspen/White Birch	6053	Houston	Other Hardwoods	215
	Other Hardwoods	2249	Hubbard	Aspen/White Birch	3514
	Lowland Conifer	302		Other Hardwoods	363
	Upland Conifer	4182		Lowland Conifer	31
Benton	Aspen/White Birch	4		Upland Conifer	5012
	Other Hardwoods	4	Isanti	Other Hardwoods	29
	Upland Conifer	39		Upland Conifer	94
Blue Earth	Other Hardwoods	4	Itasca	Aspen/White Birch	8511
Brown	Other Hardwoods	16		Other Hardwoods	1284
Carlton	Aspen/White Birch	1935		Lowland Conifer	866
	Other Hardwoods	189		Upland Conifer	2620
	Lowland Conifer	95	Kanabec	Aspen/White Birch	250
	Upland Conifer	603		Other Hardwoods	56
Carver	Other Hardwoods	14		Upland Conifer	6
	Upland Conifer	5	Kandiyohi	Other Hardwoods	12
Cass	Aspen/White Birch	5935	Kittson	Aspen/White Birch	1014
	Other Hardwoods	819		Other Hardwoods	466
	Lowland Conifer	149	Koochiching	Aspen/White Birch	9640
	Upland Conifer	1631		Other Hardwoods	947
Chisago	Aspen/White Birch	6		Lowland Conifer	3675
	Other Hardwoods	45		Upland Conifer	2234
	Upland Conifer	36	Lac Qui Parle	Other Hardwoods	4
Clay	Other Hardwoods	5	Lake	Aspen/White Birch	5119
Clearwater	Aspen/White Birch	1689		Other Hardwoods	119
	Other Hardwoods	1236		Lowland Conifer	559
	Lowland Conifer	31		Upland Conifer	1104
	Upland Conifer	427	Lake of the Woods	Aspen/White Birch	2162
Cook	Aspen/White Birch	1891		Other Hardwoods	4
	Other Hardwoods	57		Lowland Conifer	442
	Lowland Conifer	288		Upland Conifer	1536
	Upland Conifer	393	Mahnomen	Aspen/White Birch	289
Crow Wing	Aspen/White Birch	1956		Other Hardwoods	218
	Other Hardwoods	266		Upland Conifer	112
	Upland Conifer	251			

Table 3 (Continued)

County	*Cover Type*	*Harvest (ac)*	*County*	*Cover Type*	*Harvest (ac)*
Marshall	Aspen/White Birch	897	Saint Louis	Aspen/White Birch	26347
	Other Hardwoods	193		Other Hardwoods	1469
	Lowland Conifer	11		Lowland Conifer	2631
	Upland Conifer	17		Upland Conifer	5345
Meeker	Other Hardwoods	8	Scott	Other Hardwoods	42
Mille Lacs	Aspen/White Birch	122	Sherburne	Aspen/White Birch	26
	Other Hardwoods	53		Other Hardwoods	202
Morrison	Aspen/White Birch	356		Upland Conifer	178
	Other Hardwoods	52	Stearns	Aspen/White Birch	10
	Upland Conifer	28		Other Hardwoods	40
Nicollet	Other Hardwoods	5	Todd	Aspen/White Birch	101
Norman	Aspen/White Birch	13		Other Hardwoods	87
	Other Hardwoods	6	Wabasha	Other Hardwoods	61
Olmsted	Other Hardwoods	31	Wadena	Aspen/White Birch	377
Otter Tail	Aspen/White Birch	37		Other Hardwoods	81
	Other Hardwoods	416		Lowland Conifer	4
	Upland Conifer	41		Upland Conifer	1999
Pennington	Aspen/White Birch	170	Waseca	Other Hardwoods	5
	Other Hardwoods	130	Washington	Other Hardwoods	34
Pine	Aspen/White Birch	3116	Winona	Other Hardwoods	355
	Other Hardwoods	150	Wright	Other Hardwoods	26
	Upland Conifer	408	Yellow Medicine	Other Hardwoods	8
Polk	Aspen/White Birch	76			
	Other Hardwoods	42			
Ramsey	Other Hardwoods	5			
Red Lake	Aspen/White Birch	48			
	Other Hardwoods	11			
Renville	Other Hardwoods	20			
Roseau	Aspen/White Birch	2005			
	Other Hardwoods	19			
	Lowland Conifer	104			
	Upland Conifer	773			