Timber Harvesting and Forest Management Guidelines on Minnesota Public and Private Forest Land

2022-2023 Monitoring Results

Lila Westreich, PhD
Guideline Monitoring Program Consultant
Minnesota Department of Natural Resources

DEPARTMENT OF NATURAL RESOURCES

Minnesota Forest Resources Council

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A report by the Minnesota Department of Natural Resources,
Forest Management Guideline Monitoring Program,
Respectfully submitted to the Minnesota Forest Resources Council

DEPARTMENT OF NATURAL RESOURCES

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Executive Summary

The Minnesota Forest Resources Council's (MFRC) Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers establishes best management practices, or guidelines, for timber harvesting and forest management (TH/FM) on forested lands in Minnesota. The Guideline Monitoring Program (GMP) is responsible for collecting data and documenting long-term trends for how guidelines are implemented on private and public forest land and publishes a 2-year report on their findings. Monitoring and data collection has been conducted on 1301 timber harvest sites across the state since 2000. This report provides results for monitoring that occurred in summer and fall of 2022 and 2023 and attempts to assess trends in implementation levels over time. For this reporting period, 144 sites were randomly selected from within six watershed sample units (10 major watersheds; eight-digit hydrologic unit codes) in the forested portions of Minnesota.

Throughout this document, watershed sample units will be abbreviated as follows: Crow Wing River watershed (CWR), St. Louis, Cloquet, and Nemadji River watersheds (SCN), Lake of the Woods, Rapid River, Roseau River, and Rainy River watersheds (LRRR), Mississippi River Brainerd (MRBS), Southeastern Minnesota (SEMN), and Saint Croix River, Kettle, and Snake River watersheds (SCKS).

Monitored sites had timber harvest occurring during summer of 2022 through summer of 2023. Highlights include:

- Trout stream buffer compliance was at 100% for four watersheds surveyed, including MRBS, SCKS, SCN, and SEMN.
- Non-trout stream buffer compliance ranged from 56% to 100%, with CWR, SCN, and SEMN at 100% compliance.
- Filter strip compliance ranged from 75% (LRRR) to 98%, with majority over 80%; highest compliance rates were in CWR and SEMN.
- Filter strips with erosion made up only 15% of all surveyed filter strips (80/512), with 96% of those with erosion related to infrastructure (77/80); zero filter strips demonstrated any noted sediment delivery to a waterbody, the majority of filter strips with erosion were associated with landings or skid trails and focused in LRRR and SCKS. Compliance was high for filter strip exposure and erosion, with only 12 filter strips with exposure out of 512, however the percent of landings in wetland filter strips or RMZs when alternative areas were available upland was high in multiple watersheds, ranging from 0-22.5%; the percent of sites with incorrectly placed landings was also high, ranging from 0-27%.
- Trees per acre and leave tree recommendations were high in compliance, ranging from 81.5% to 100% net compliance, with the lowest compliance rates in SCN and LRRR, and highest compliance rates in SEMN and MRBS.
- The majority of harvests took place in winter (100), followed by fall (31), summer (26), and spring (20).
- Approaches needing erosion control were relatively low (11/88), with only a single filter strip identified with clear sediment delivery to a waterbody.
- The majority of crossings were in wetlands (LRRR, SCKS, MRBS), 20 identified with rutting and 44 with avoidable crossings; six crossings had greater than 50% rutting, though zero impeded fish movement.
- Coarse woody debris (CWD) compliance was over 100% across all samples, the majority of which were over 200% of the recommended CWD ranging from 25.4-59.4 logs of appropriate size; GMP recommends that CWD requirements be re-examined due to possible detriment of excessive debris may pose for stream health and fish habitat and passage.

- Visual quality compliance was low, ranging from 61.8% (LRRR) to 80% (SCN), however visual quality guidelines do not paint a clear picture of forest health or regeneration success, erosion control, or habitat quality.

Additional opportunities for improved implementation at the watershed scale are noted throughout this report. Recommendations include general introductory training for new foresters and loggers, outreach to stakeholders to increase awareness and implementation of revised (2012) guidelines, targeted training related to wetland identification to aid in avoidance of wetland crossings, training to understand erosion control methods and future benefits of decreased erosion, and identification of situations where water diversion and erosion control practices need to be implemented. Continuing education programs, such as Minnesota Logger Education Program and the Sustainable Forestry Education Cooperative are encouraged to continue their efforts related to these recommendations, and work to develop new educational opportunities to address the specific topics identified above.

Table 1. Breakdown of sites by ownership across all watersheds.

Watershed	County	Federal	Forest Industry	NIPF	State	Total
CWR	6	0	0	5	10	21
LRRR	5	0	1	6	14	26
MRBS	12	0	0	9	7	28
SCKS	10	0	0	7	14	31
SCN	7	1	5	9	6	28
SEMN	0	0	0	3	7	10
Total	40	1	6	39	58	144

GMP plans to try new methods and collaboration with foresters, landowners, and other collaborators to increase the number of sites surveyed statewide in coming years, specifically centered on increasing non-industrial private forest sample sites and in areas of low sample number such as SEMN. A deeper analysis of long-term trends will be presented in the five-year report in 2025-2026. The following summarizes the opportunities for improvement and accomplishments from the 2022-2023 monitoring report for each watershed. The numbers in parenthesis after the filter strips associated with erosion denote the number of occurrences in which data collectors found non-compliance with the recommendations in the field and the reason for the non-compliant mark.

- In the Crow Wing River (CWR) watershed unit, opportunities to improve compliance for trout stream compliance (partially compliant at 100% of sites, see Table 8 for more information), and relatively high total numbers of filter strips with erosion associated with infrastructure such as roads (1 occurrence), landings (2), and slash (2), harvest timing (highest number of sites harvested in summer), avoidable crossings in wetlands and rutting on crossings; CWR had 100% compliance for non-trout streams and lake RMZ width recommendations, 98% compliance for overall filter strip guidelines, zero approaches with erosion or in need of control methods, and the highest overall number of sites checked for ETS species (90.5%).

- Lake of the Woods, Rapid River, Roseau River, and Rainy River (LRRR) watershed unit has opportunities to improve non-trout stream compliance (80%), trout stream and lake compliance (0%), filter strips with erosion associated with infrastructure (11) such as roads (4), landings (10), and slash (1) (overall compliance only 75% for filter strips), leave tree compliance (74.7%), and

avoidable crossings on wetlands (4); LRRR had a majority of sites harvested in winter (19) and only a single approach requiring erosion control with sediment delivery to a waterbody.

- Mississippi River Brainerd (MRBS) watershed unit could improve non-trout stream compliance (80%), filter strips with erosion associated with infrastructure (13) such as roads (6), landings (5), and skid trails (3) (overall compliance for filter strip erosion was 84%), avoidable crossings (12) especially in wetlands and rutting (12 sites with rutted approaches, 3 at greater than 50% rutted), and increasing the number of sites checked for ETS (67.9%); a majority of sites were harvested in winter (19), only one approach with erosion control needed and subsequent sediment delivery to a waterbody, and high leave tree compliance (97.9%).

- In the Saint Croix River, Kettle River, and Snake River (SCKS) watershed unit, opportunities to improve compliance for RMZ width recommendations, with 56% of sites meeting requirements for trout streams, filter strips associated with erosion from infrastructure (39) such as roads (6), landings (12), and skid trails (21) (overall filter strip compliance was 77%), approaches with erosion control (6 needed erosion control and rutted, 2 with greater than 50% rutting); SCKS had 100% compliance for trout streams, 100% compliance for leave tree recommendations, and a majority of sites were harvested in winter (20).

- St. Louis, Cloquet, and Nemadji (SCN) watershed unit has opportunities to improve lake compliance (0%), filter strips associated with erosion (10) with and without infrastructure, including roads (2), landings (7), and skid trails (3) (overall compliance rate for filter strips was 82%), leave tree compliance (69.9%), approaches requiring erosion control (3); SCN had 100% compliance for trout streams and non-trout streams, the highest number of sites harvested in winter of those surveyed (25), only two avoidable crossings and only one noted as rutted, and the second highest number of sites checked for ETS (90.3%).

- Southeastern Minnesota (SEMN) watershed unit has opportunities to improve non-trout streams (83% compliant), filter strips associated with erosion in infrastructure (2), both from skid trails (overall compliance for filter strips was 94% of only four surveyed), timing of harvest (4 in fall); SEMN had 100% leave tree compliance, trout streams, and lakes, zero approaches with erosion or in need of erosion control, and all crossings were appropriate placed without rutting (out of 2 surveyed).

Additional opportunities for improvement and suggestions for future analysis at the watershed scale are included in this report. Recommendations include general introductory training for new foresters and loggers, especially in areas with low participation and where data is unclear due to small sample size such as SEMN, targeted training related to wetland identification and guidelines to minimize wetland crossings and reduce rutting, and education around the ecological benefits to winter harvest in specific watersheds. Improved literature and training materials on trout and non-trout streams could provide long-term benefits for logger training and resources. Continuing education programs, such as Minnesota Logger Education Program and Sustainable Forestry Education Cooperative are encouraged to continue their efforts related to recommendations, and work with GMP to develop new educational opportunities to address the specific topics identified above.

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Introduction

This report is an update to the Minnesota Forest Resources Council (MFRC) and forest management stakeholders on the implementation of sustainable forest management practices as required by the Sustainable Forest Resources Act (SFRA). The SFRA (89A.07, subd. 2.) requires the Minnesota Department of Natural Resources (DNR) to monitor implementation of forest management guidelines (FMGs) on public and private forestlands. The MFRC was established under the SFRA to resolve important forestry policy issues through collaboration among a broad set of forest stakeholders. The SFRA requires the MFRC to develop and periodically revise voluntary guidelines for use on public and private forestland in Minnesota to minimize negative impacts of timber harvest and other forest management activities. This report summarizes the results of monitoring for the implementation of these guidelines.

The timber harvest and FMGs are a set of recommended voluntary practices designed to mitigate harvest-related impacts on water quality, wildlife, soil productivity, cultural resources, biodiversity, visual quality, and other forest resources. These guidelines were initially published in 1999 in the guidebook Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers (MFRC 1999). The guidelines have been revised twice since their inception, and new guidelines related to biomass harvesting were added in 2007. Substantial changes in recommendations related to riparian management zones (RMZs), allowable infrastructure, leave trees, and others, were made in the most recent revision (MFRC 2012). While not referenced within this report, a new update to the guidelines is expected to be published in 2024. Most recently, a subset of the guidelines commonly used during timber harvesting were published in a condensed, user-friendly pocket field guide for use in operational settings.

Methods

The DNR has monitored guideline implementation at over 1,300 harvest sites since 2000 and has published reports summarizing the findings through 2018. For those reports, monitoring sites were randomly selected from all harvest sites and findings were summarized to estimate statewide implementation levels. In 2013, the program was modified by 1) focusing harvest site monitoring at the eight-digit hydrologic unit code (HUC-8) watershed scale, and 2) incorporating forest disturbance estimates into the assessment, recognizing that local disturbance patterns influence interpretation of implementation estimates. The overall objective of this watershed approach is to use the new assessment to conduct more targeted and effective education and outreach for improved FMG implementation. Statewide estimates calculated from the mean among watersheds are presented for comparison to previous years and for application to statewide policy development. Throughout this document, watershed sample units will be abbreviated as follows: Crow Wing River watershed (CWR), St. Louis, Cloquet, and Nemadji River watersheds (SCN), Lake of the Woods, Rapid River, Roseau River, and Rainy River watersheds (LRRR), Mississippi River Brainerd (MRBS), Southeastern Minnesota (SEMN), and Saint Croix River, Kettle, and Snake River watersheds (SCKS).

Watershed Sample Units

Starting in 2014, the guideline monitoring program (GMP) restructured monitoring efforts to focus on the US Geological Survey defined HUC-8 watershed scale. Sites monitored in 2022 and 2023 were selected from forest cover change detected within six watershed sample units, with each unit consisting of either a single watershed or a cluster of similar watersheds. This report summarizes the monitoring data for 144 harvest sites in 11 HUC-8 watersheds (Figure 1) that were monitored during 2022-23 with emphasis on key topics under MFRC review.

Attempts were made to select watersheds that were concurrently being evaluated in the Minnesota Pollution Control Agency (MPCA) watershed Restoration and Protection Plan (WRAP) process. Where appropriate, results have been reported by watershed sample unit. Where no substantial difference in implementation data is observed, results may be presented in statewide summaries. The Appendix provides a series of statistics related to each of the six watershed sample units.

Forest Cover Change Detection

Change detection is used to understand where harvests have occurred across public and private land in the state in a specific time period, as well as to understand levels of forest disturbance by watersheds. Disturbance provides additional context for field monitoring.

For 2022-2023, GMP and Resource Assessment Program (RAP) staff used National Land Cover Data (NLCD 2021) and Landsat 8 satellite images as well as additional imagery collected by RA flight staff to isolate images for summer 2020-2022. Sites monitored in these units had timber harvest activity noted in imagery between summer 2021 and summer 2023. RA and GMP staff visually inspected the sample of units with detected forest change, refining the list to a final group of potential monitoring sites of harvests with less than two growing seasons (one summer or less since harvest to aid monitoring data collection). RA staff reached out to landowners via mail and phone, typically collecting information from local county landowner information and publicly available layers to gain access to sites for summer data collection in 2023. The goal of site selection was to collect a representative sample of sites by ownership, with selection from the following categories of ownership:

- State: all lands owned by the state of Minnesota
- County: all lands owned or managed by a county
- Federal: all lands owned by the US Forest, Park, Fish and Wildlife service, or Corps of Engineers
- Forest Industry (and Corporate): all land owned by forest industry or corporations
- Non-industrial Private Forests (NIPF): all privately owned non-industry or corporation-owned lands, including tribal land

Landowner and/or manager contact information gathering was attempted for a large sample of potential monitoring sites (>250) to verify harvest occurred within target dates, harvest was completed, and to secure permission to access the site with field crews. Final monitoring sites were selected from the pool, with alternates selected as back-ups.

Field Data and Monitoring Data Collection

For both field years represented in this report, GMP staff used monitoring protocols identical to those described in previous monitoring reports, all of which are publicly available online. Field equipment and software use global positioning system (GPS) enabled Mesa 3 tablets running ArcGIS Collector and Survey123. All field data were uploaded to MNDNR Portal and immediately backed up to an online spatial database engine database following field observation.

Pre-Site Questionnaire

Prior to field monitoring, GMP staff contacted agency, industry, NIPF, and tribal land managers to gather critical background information on a pre-site data questionnaire including information about timber harvest planning, harvest practices, season of harvest, and various guideline implementation strategies. The pre-site form provides the opportunity for landowners and managers to relate critical information on how guidelines were implemented on a site. The goal of the questionnaire is to gather specific reasoning or strategies for harvest and understand how they may fit into guideline implementation.

Field Data Collection Crew

Requirements and information regarding the bid process for acquiring contractors can be found in previous versions of this report. Contractors are required to complete calibration training with GMP staff prior to the start of field monitoring. On-site field monitoring was conducted between May and October in both 2022 and 2023. The contractors used for the 2022-2023 data collection were Midwest Natural Resources Inc. monitoring contractors collected detailed information while on-site and delineated spatial features utilizing field observations, air photos, and site documentation. Data collection generally involved a ground survey of the entire site, with detailed measurements recorded for key features including leave trees and clumps, roads, landings, RMZs, filter strips, surface water and wetlands, crossings, and others. On-site features and observations were entered into Collector and Survey123 for upload and later analysis.

For quality control, both in-office and in-field review of site data was conducted by GMP staff on approximately 20% of monitoring sites to evaluate consistency and compliance with monitoring protocols. This process confirmed that data were being properly collected and provided useful insight for determining whether monitoring forms and field procedures needed modification. Where appropriate, changes were made to data based on quality control findings. Data referenced from previous monitoring reports may be found publicly available on the MFRC website.

Land and Water Characteristics by Watershed

Most data sources used by GMP and RA staff to ascertain sites is publicly available. Specifically, NLCD data analysis can be found through the Department of Natural Resources Watershed Health Assessment Framework (WHAF), as well as through the USGS public website. Since the information previously published as part of the 2-year biennial watershed reporting is also published by other DNR outfits, specifically the NLCD analysis, GMP staff have made the decision to not include it in the current report. Please refer to previous reports for analysis or contact WHAF for access to specific data. Forest Inventory Analysis (FIA) data, which depicts the harvests occurring across Minnesota, is publicly available and shared yearly.

The watersheds surveyed for the 2022-2023 season differed dramatically in topography, slope, and agricultural activity. For further information on the characteristics of each watershed, GMP recommends a number of available resources, including the DNR watersheds page which offers a wealth of information about watershed classification. GMP also recommends the National Wetland Inventory for Minnesota, which is publicly available. Finally, GMP recommends soil mapping resources, with detailed information about soil types across Minnesota, also publicly available. Topographical maps are available from the DNR, and Google Maps gives a view of the various topographical changes that occur across the state.

Monitoring Site Characteristics and Size

Acreage and Waterbodies Across Watersheds and Ownership Types

Mean site area was 72.2 acres across all watersheds but varied from 35 acres (SEMN) to 98.6 acres (LRRR). Although not a guideline, site size may influence site infrastructure and acreage of leave tree clumps. Table 3 reports statistics on monitoring site size by watershed unit.

Table 2. Summary of number of sites by ownership type, with and without water.

Ownership Type	Sites with water	Sites w/o water
County	86	8
Federal	38	2
Forest Industry	14	0
NIPF	52	10
State	98	9
Tribal	6	0
Total	296	29

Ownership type broken out by public and private categories with waterbodies for all sites visited during the biennial period of data collection (Table 2), was heavily weighted towards County and State sites, making up 62% of all sites visited across the two-year period. Private forest landowner sites with waterbodies made up only 18% of all sites with water, not including a sole 6 sites with water on tribal land. Considering the scope of waterbodies across Minnesota in forested areas, fewer sites without waterbodies is a likely result of sample selection. Low numbers of sites with water from private, non-industrial forest landowners is demonstrative of the lack of private landowners involved in the study rather than a lack of private ownership. GMP is currently reviewing previous methods for contacting landowners and working to establish new avenues to increase private landowner participation and communication.

Within each watershed, sample sizes varied for total number and acreage. A total of 144 sites were visited across all watersheds, covering a total of 10,402 acres of forestland. The average acreage of sites surveyed varied widely across watersheds, ranging from 35 acres to 98.6 acres (350 total acres to 2,562 total acres; Table 3).

Table 3. Total number of sites visited across all surveyed watersheds, with minimum, maximum, and mean acreage, as well as total acreage rounded to the nearest integer for each watershed.

Watershed	Sample Size	Minimum	Maximum	Mean	Total Acreage
LRRR	26	12.5	253.4	98.6	2,562
CWR	21	14.2	217.6	62.4	1,311
SCN	28	10	214.4	48.5	1,358
SCKS	31	21	298.9	97.3	3,018
MRBS	28	12.8	223.8	64.4	1,804
SEMN	10	10.8	75.6	35	350
Total	144	10	298.9	72.2	10,402

Distance from disturbance

The relative acreage and distance (in acreage) of a harvest, or disturbance, from a water body or riparian

water feature is an important marker of the importance of protective measures such as filter strips, riparian buffers, leave trees, and erosion avoidance tactics such as those outlined in the guidelines. Table 4 reports the average acreage associated with water features, thereby showing the acreage associated with disturbance near water features. The percentage of acreage shows the total percent associated with that feature, with lakes featured heavily as the main water feature nearby to harvests, followed by riverine and wetlands (in no particular order).

Table 4. Across all watersheds surveyed from 2022-2023, the average acreage of distance from a forest disturbance near a water feature include lakes or ponds, wetlands, and riverine areas, as well as the percentage of total acreage of disturbance near each water feature.

	Average Acreage			**Percentage of Acreage near Riparian Feature**		
Watershed	**Lakes or Ponds**	**Wetland**	**Riverine**	**Lakes or Ponds**	**Wetland**	**Riverine**
CWR	1209.5	1929.1	853.9	86.3%	8.7%	3.0%
LLP	1018.0	1235.6	1411.7	91.1%	2.9%	4.4%
LRRR	3790.7	3040.1	1772.4	90.6%	5.4%	2.2%
MGR	1991.8	1489.7	1580.0	87.1%	1.6%	9.4%
MH	1712.6	1247.9	1525.0	92.3%	2.6%	3.2%
MRBS	1819.7	725.3	1172.4	88.0%	1.0%	5.6%
RLB	2381.0	967.9	2116.0	85.8%	1.2%	12.7%
RLCW	2191.7	1941.2	2262.8	93.4%	3.5%	2.4%
ROL	1388.4	1357.6	1394.4	90.0%	6.0%	2.9%
RR	1765.3	421.1	768.2	87.5%	3.1%	5.4%
SCKS	3032.6	1515.4	2837.6	90.7%	1.9%	4.5%
SCN	3017.9	1772.9	2294.0	86.6%	0.5%	9.1%
SEMN	1922.8	0.0	424.4	93.6%	0%	3.5%
SUP	1747.7	1946.8	1606.9	96.3%	0.2%	3.3%
VRR	1850.2	2147.8	1259.1	88.3%	6.1%	5.5%

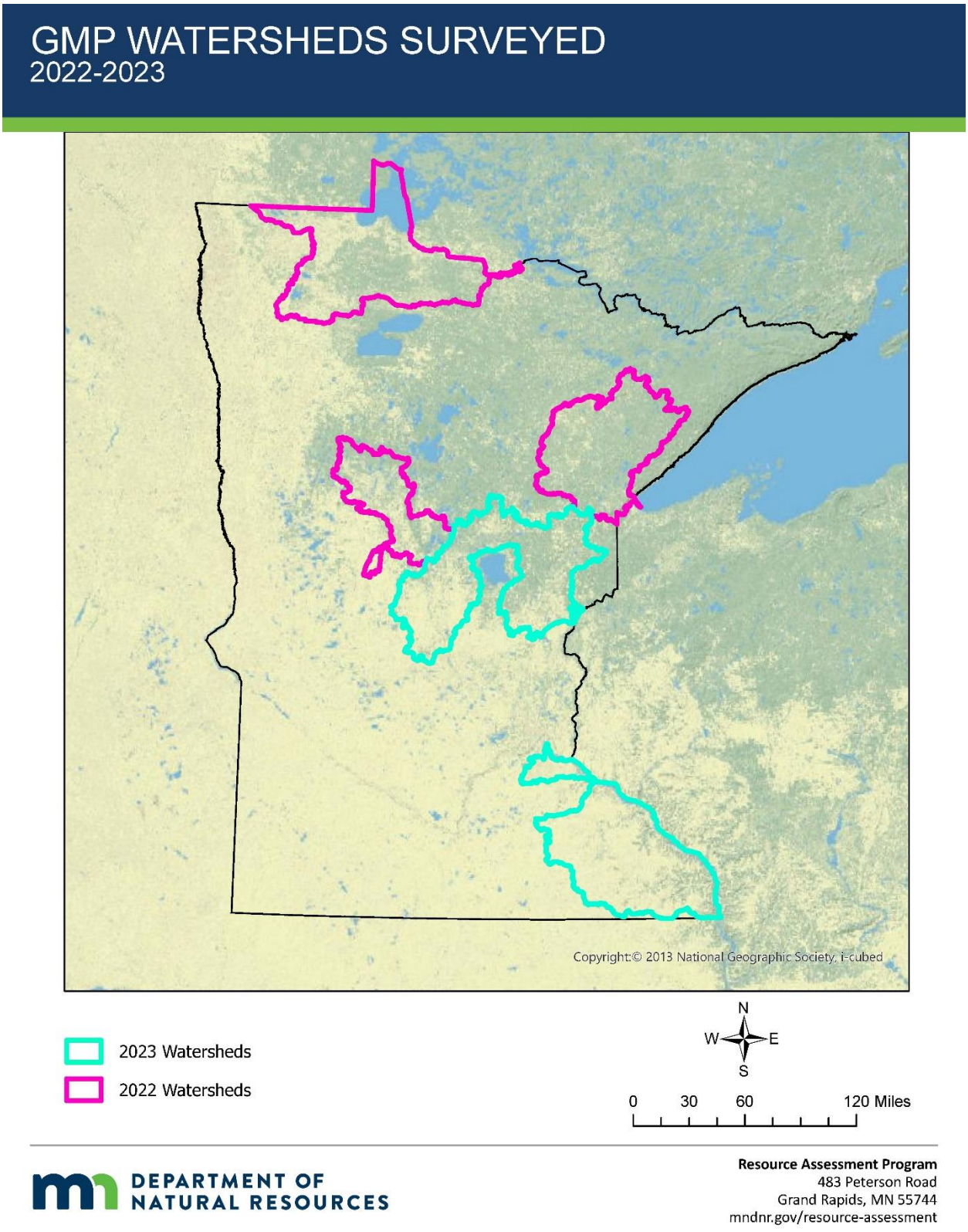

Figure 1. Map of the State of Minnesota with watersheds visited in 2022 and 2023 highlighted in dark purple (2022) and cyan blue (2023)

Results

Waterbody Type and Distribution

A majority of questions asked during field reviews of RMZ sites revolve around the number of feet within the RMZ that are clearcut, partial cut, forested, or non-forested. These questions give information as to how much of the site was cut, and how many trees were left on the landscape and the frequency of the species left to repopulate the next generation of forest. Several questions also revolve around blowdown, broken down by species. Finally, canopy and super canopy trees are recorded, also lending to the understanding of the next generation of forest following harvest. Certain types of RMZs require varying width buffers, such as trout and non-trout streams, and steep slopes parallel to stream beds.

Table 5. Summary of waterbodies by type and totals across all watersheds for biennial period.

Waterbody Type	CWR	LRRR	MRBS	SCKS	SCN	SEMN	Total
Sites with Waterbodies	**16**	**26**	**27**	**31**	**25**	**4**	**129**
Sites without Waterbodies	**5**	**0**	**1**	**0**	**3**	**6**	**15**
Total Waterbodies	**77**	**54**	**83**	**171**	**53**	**17**	**455**
Trout Streams	0	0	0	1	1	4	6
Non-Trout Streams	2	5	3	14	8	8	40
Intermittent Waterbodies	1	1	1	1	1	1	6
Lakes	7	0	2	1	0	0	10
OWW	2	2	3	6	3	0	16
NOWW	65	46	74	148	40	4	377

Type and Distribution of Waterbodies (Non-wetlands)

The types and numbers of waterbodies, including those associated with streams and lakes as well as with the monitoring sites are shown in Table 5. Most waterbodies were found on state and federal land, likely due to the numerous state and county lands with parks and conservation areas around waterbodies. Private non-industrial lands made up the third largest portion, and a high number of non-trout streams and lakes compared to forest industry, federal, and tribal ownership. A total of 91% of all monitoring sites had at least one waterbody present, adjacent, or along the logging road accessing the site. The most common form of waterbody present were non-trout streams, with 38% of the total waterbodies surveyed (not inclusive of wetlands, separated out into Table 6).

Table 6. Number of sites with overall waterbodies across ownership, trout and non-trout streams, and intermittent waterbodies and lakes.

Ownership Type	Trout streams	Non-trout streams	Intermittent	Lakes	Total Waterbodies
County	69	25	9	8	69
Federal	5	6	2	2	19
Forest Industry	0	4	1	0	5
Non-Industrial Private Forestland (NIPF)	5	17	6	6	46
State	8	27	2	6	55
Tribal	2	0	2	2	10
Total	31	79	22	24	204

Trout Stream, Non-Trout Stream, and Lake Compliance

The results for compliance ratings for guidelines regarding trout streams, non-trout streams, and lakefront RMZ buffers can be found in Table 7. A majority of watersheds had 100% compliance with all trout stream related guidelines, apart from CWR and LRRR. In total, 17 RMZs had less than 100% compliance for trout stream guidelines. Non-trout stream compliance was more variable, with 100% compliance for CWR, SCN, and SEMN watersheds. SCKS had only 56% compliance with non-trout stream guidelines. Lake front guidelines were 100% compliant for CWR, MRBS, and SCKS, but non-compliant for LRR, SCN, and SEMN.

Table 7. Watershed compliance results for RMZs including trout streams, non-trout streams, and lakes.

WSU	Sites	Sites with RMZs	Total RMZs	Percentage Trout Stream Compliance	Percentage Non-Trout Stream Compliance	Percentage Lake Compliance
CWR	21	6	10	NA	100%	100%
LRRR	26	5	7	NA	80%	NA
MRBS	28	7	8	100%	80%	100%
SCKS	31	13	20	100%	56%	100%
SCN	28	10	12	100%	100%	0%
SEMN	10	7	12	100%	100%	0%
Total	144	48	69	100%	83%	100%

As part of yearly reporting, GMP typically breaks down the results of compliance to understand how sites that did not meet 100% compliance marks may have partially met the guidelines. For example, MRBS had 83% of sites meet all requirements associated with basal area widths on RMZs, and 17% of MRBS sites met 76% of total basal area width requirements. Therefore, in LRRR, MRBS, and SCKS had low total compliance compared to other watersheds, but at least some partial compliance of guidelines. By reporting partial compliance, GMP can capture more information about whether certain watersheds are hitting an 'all or nothing' compliance rating, or a more complicated and optimistic breakdown of compliance with some (though not all) guidelines.

Table 8. Compliance broken down by total compliance (percent of sites that were compliant with 95% of width and basal area requirements), partial compliance (percent of sites that had >50% compliance but less than 95% compliance), and average partial compliance (average level of compliance for sites that were partially compliant).

Watershed	Total Compliance	Partial Compliance	Average Compliance for Partial Compliant Sites
CWR	100%	0%	0%
LRRR	80%	20%	64%
MRBS	83%	17%	76%
SCKS	56%	44%	83%
SCN	100%	0%	0%
SEMN	100%	0%	0%
Total	83%	17%	39%

Table 9 below shows the detailed information gathered by field data collection efforts about the number of sites with RMZs or without RMZs, as well as basal area and buffer width information for each watershed. Total acreage of lakes and open water wetlands, as well as widths of RMZs and streams is broken down by watershed and totaled. While this information does not directly relate back to guideline

monitoring, it gives an understanding of the forested landscape and acreage of RMZs surveyed by GMP.

Table 9. Breakdown of sites and acreage of detailed information about RMZs across watersheds surveyed for biennial period.

Watershed	CWR	LRRR	MRBS	SCKS	SCN	SEMN	Total
Number Sites	21	26	28	31	28	10	143
Number Sites with RMZ	6	5	7	13	10	7	48
Total RMZs	10	7	8	20	12	12	69
Average Residual Basal Area within RMZ	62.5	49	110.3	76.8	84.2	86.5	79
Average CWD per Acre	19.1	26.5	13.2	17.4	26.7	19.2	20
Average Width of Non-forested, No-cut, or Partial Cut	310.4	221.8	305.8	405.3	264.1	294	317
Average Width of RMZ	385.6	267.8	320.3	457.8	340.6	309.9	366
Average Width of Stream	78	24.4	79	12.2	17.3	11.3	31
Acreage of Lakes	10.9	0	23	95.5	0	0	32
Acreage of OWW	0	0	14.8	0.3	9.2	0	3

Wetlands Type and Distribution Across Watersheds and Ownership

The majority of waterbodies identified during field data collection across all types were overwhelmingly wetlands, specifically non-open water wetlands (NOWW) or forested wetlands. NOWW made up 84% of all waterbodies surveyed, and across all biennial reports collected by GMP over the last 4 years is constantly the most common waterbody found in the field. When examining only wetland sites, a total of 1,126 wetlands were found for all watersheds surveyed, with 96% of them being NOWW, and only 4% were open water wetlands (OWW).

Table 10. Breakdown of site numbers by waterbody type per ownership category.

Ownership Type	NOWW	OWW
County	341	21
Federal	113	2
Forest Industry	57	1
Non-Industrial Private Forestland (NIPF)	190	12
State	349	14
Tribal	23	0
Total	1,076	50

Given the need for logging to go around open water, and both the issues associated with as well as the guidelines surrounding crossing open water or wetland areas, most harvests will occur adjacent to open water. Therefore, it is less common to find open water wetlands on-site. Non-open water wetlands are typically easier to cross or move through and are more often found on-site. Non-open water wetlands can be varying sizes, from quite small (under an acre) to multiple acres or more, leading to more situations in which harvest could occur without issues.

Table 11. Breakdown of site numbers by waterbody type per ownership category

Watershed	NOWW	OWW
CWR	65	2
LRRR	46	2

MRBS	74	3
SCKS	148	6
SCN	40	3
SEMN	4	0
Total	377	16

The highest number of wetlands across both NOWW and OWW were found on County and State lands, mimicking the results of non-wetland waterbodies in the previous section. Similarly, non-industrial private forestland had the third highest number of wetlands in either category (Table 10 and Table 11).

Across watersheds, the results for wetlands are mixed. The highest number of overall wetlands was identified in the SCKS watershed unit in both categories, while the lowest was found in SEMN. It should be noted that the lowest number of overall sites were surveyed in SEMN, potentially skewing any results associated with the watershed.

Considering the prevalence of NOWW, and the lack of easily accessible information regarding forested wetlands, the GMP will pursue further education and information regarding how to treat and monitor NOWW across the state. This project will be ongoing, and GMP plans to release a separate report to dive deeper into NOWW statistics and guideline compliance statewide.

Filter Strips Results

Filter strips are monitored for their possible soil erosion, and monitoring erosion associated with and without a road, landing, or skid trail – also considered infrastructure. Finally, filter strips are monitored for their possible delivery of sediment to a waterbody. A majority of filter strips had no erosion (84%), and of those with erosion (16%), the majority (77 filter strips) were associated with a road, landing, or skid trail (96% of filter strips with erosion associated with infrastructure). Zero filter strips were found to deliver sediment to the waterbody, though it should be noted that data is gathered as only a snapshot in time following harvest and may not fully capture sediment delivery to waterbodies over long periods of time.

Table 12. Breakdown of soil exposure, filter strips with and without erosion associated with and without infrastructure (road, landing, or skid trail) and possible sediment delivery to waterbody, separated out by watershed; in the second column, in the second column, this table is also broken down by the category of soil exposure present. Total filter strips for each watershed can be found in other tables.

Watershed	Soil Exposure	FS with Erosion	FS with Erosion Not Associated with Infrastructure	FS with Erosion Associated with Infrastructure	FS with Sediment to a Waterbody
CWR	Erosion	1	1	0	0
CWR	No Soil Exposure	5	2	3	0
LRRR	No Soil Exposure	12	1	11	0
MRBS	No Soil Exposure	13	0	13	0
SCKS	Concentrated	1	0	0	0
SCKS	No Soil Exposure	38	0	38	0
SCN	No Soil Exposure	10	0	10	0
SEMN	Concentrated	1	0	0	0
SEMN	Greater	1	0	0	0
SEMN	No Soil Exposure	2	0	2	0
Total	Total	80	3	77	0

The following table (Table 13) breaks down the reason for monitoring the filter strip (erosion noted, landing, road construction, slash buildup, or skid trail) and breaks down the filter strips with and without erosion.

Table 13. A breakdown of the reasons for monitoring a filter strip within a specific watershed, as well as the number of filter strips associated with the monitoring reason and more detailed information about associations with infrastructure and sediment delivery to a waterbody.

Watershed	Reason for Monitoring	Filter Strips with Erosion	FS with Erosion Not Associated with Infrastructure	FS Associated with Infrastructure
CWR	Landing	2	0	2
CWR	Road Constructed	1	0	1
CWR	Slash	2	2	0
LRRR	Landing	10	0	10
LRRR	Road Constructed	4	0	4
LRRR	Slash	1	1	0
MRBS	Landing	5	0	5
MRBS	Road Constructed	6	0	6
MRBS	Skid Trail	3	0	3
SCKS	Landing	12	0	12
SCKS	Road Constructed	6	0	6
SCKS	Skid Trail	21	0	21
SCN	Landing	7	0	7
SCN	Road Constructed	2	0	2
SCN	Skid Trail	3	0	3
SEMN	Skid Trail	2	0	2

When examining filter strips in more detail as shown in Table 13 above, very few filter strips with erosion were not associated with infrastructure. A majority were associated with construction or maintenance of landings, roads, and skid trails. Slash piles following harvest also contributed to erosion. The maintenance and continued usage of landings, roads, and skid trails – especially during fall and winter months or wet springs can result in the movement of soil. This can be particularly detrimental on steeper slopes or trails without erosion control features.

Soil Exposure, Erosion, Landings, and Sediment Delivery to a Waterbody

Soil erosion is a large issue for managing forestry and harvests and ensuring that infrastructure remains stable and usable into the future. Near waterbodies, erosion control prohibits sediment delivery to water, thereby protecting fish habitat and stream and lake health.

Table 14. Soil exposure associated with filter strips (FS), including those associated with roads, possible

sediment delivery to a waterbody, and total compliance.

Watershed	Filter Strip (FS)	FS Exposure	FS without Exposure	FS with Roads	FS with Erosion	Sediment Delivery to Waterbody	Compliance
CWR	90	3	2	3	0	0	98%
LRRR	80	2	8	4	0	0	75%
MRBS	90	0	5	9	0	0	84%
SCKS	175	2	9	27	0	0	77%
SCN	61	3	6	4	0	0	82%
SEMN	16	2	0	2	0	0	94%
Total	512	12	30	49	0	0	82.7%

Compliance rates across filter strip exposure and erosion was high, ranging from 82 (SCN) to 98% (CWR), with an average of 82.7% across all watersheds sampled. When examining compliance rates of landings, can contribute to erosion in variety of ways including slow expansion over time (landing-creep), the percent of landings in wetland filter strips or RMZs ranged from 0% (SEMN) to 22.45% (SCKS), a relatively high rate of about one out of five landings in an incorrect area when a better area was available on site. Of all sites, percentage with landings in wetland filter strips or RMZs was higher across watersheds, again where an alternative upland site was available for the landing.

Table 15. Total number of landings across sites surveyed in 2022-2023, including percent of landings located in a wetland filter strip (FS) or RMZ, and percent of the total sites with a landing in a wetland FS or RMZ where an alternative upland landing site was available (note: one site in SCN did not have an identified landing, likely due to cut-to-length methods, lack of debris, and using small piles of decked wood along the main road where logging trucks can easily pick up).

Watershed	Sites	Landings	Number Sites without Upland Available	Percent Landings in FS/RMZs	Percent Sites with Landing in FS/RMZs
CWR	21	30	0	10%	14.3%
LRRR	26	63	18	19%	26.9%
MRBS	28	36	4	8.3%	10.7%
SCKS	31	49	1	22.5%	29%
SCN	28	48	4	20.8%	25.9%
SEMN	10	10	0	0%	0%

Total area of landings and roads tends to shift by survey year, with trends showing the percentage of area taken up by landings and roads has changed from the most recent statewide survey (2014-2018; Figure 2). For the survey years of 2022-2023, the acreage taken up by landings and roads across sites averaged to be higher than the statewide average, though those two years only covered five watershed units (in comparison to a statewide survey inclusive of all watershed units across five years of data collection). In 2022-2023, average acreage and percentage of the total site area decreased across the watershed units surveyed, dropping by almost a third overall from the previous biennial period, and a smaller drop from the previous 5-year survey period (Figure 2). These numbers will become clearer in terms of long-term trends once they are analyzed and published in the 5-year statewide report, expected in late 2025.

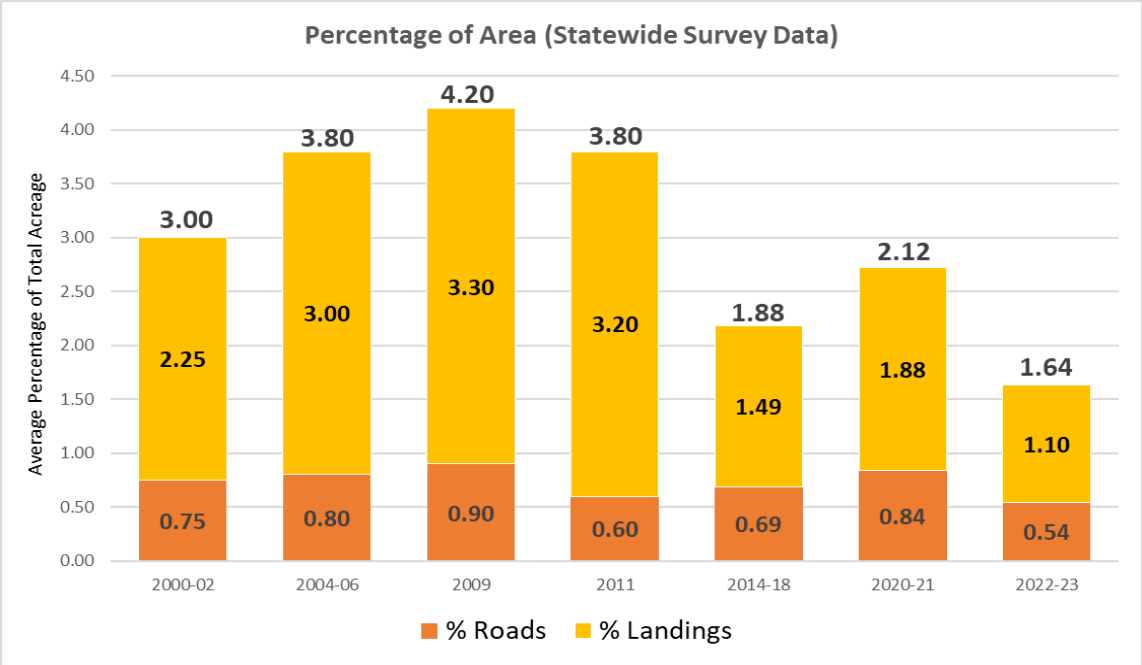

Figure 2 . Average percentage of area taken up by roads and landings, stretching over all statewide surveys prior to 2020 (five-year survey inclusive of 2020-2024 data will be published in late 2025).

Based on short term trends, it would benefit all watersheds and landowners to increase training around landing size and placement, road construction, and how to decrease the overall area taken up by infrastructure on a site. Keeping this topic at the forefront may eventually decrease numbers overall, leading to more stable downward trends in landing and road size and percentage of the total site acreage.

Slash and Coarse Woody Debris (CWD)

Out of 144 total sites assessed for slash, 134 had distributed slash across the site, 74 used slash to stabilize roads, 4 had erosion on roads or landings, and 26 had biomass harvest. A total of 12 sites used a retention strategy of some kind, with an average of 39.5 CWD logs per acre (in relation to the guideline requirement of 4-10 CWD logs per acre). Across all sites, an average of 4.2 snags per acre were also observed. Table 13 has broken down these statistics by watershed, demonstrating that all watersheds went above and beyond the recommendations for CWD logs per acre. Taking the guideline recommendations at the highest degree of severity – 10 CWD logs per acre – the lowest number of CWD logs in SCKS watershed is still over 150% of the required logs per acre, and the highest number of logs in SEMN is over 500% of the required logs. GMP has no concerns or recommendations surrounding increasing the number of logs per acre of CWD, but there is interest in understanding the size of CWD currently left by landowners. Larger CWD can be associated with increased habitat and promotion of old-growth forest features and benefits, while overabundance of smaller logs may dam up streams or alter stream orientations over time. GMP looks to pursue adding information to CWD data collection to get a better understanding of the landscape across watersheds in coming years.

Table 16. Sites broken down by use of distributed slash, slash on roads or landings, biomass harvest, retention strategy, and snags and logs per acre of CWD.

WSU	Sites	Distributed Slash	Slash Stabilizing Roads	Erosion on Roads or Landings	Sites with Biomass Harvest	Retention Strategy Used	Number CWD Logs per Acre	Snags per Acre

CWR	21	17	17	3	0	0	38.8	4
LRRR	26	25	26	0	1	1	38.7	2.8
MRBS	28	26	2	0	12	6	28	4
SCKS	31	30	1	0	9	3	25.4	3.2
SCN	28	26	28	1	4	2	47	2.9
SEMN	10	10	0	0	0	0	59.4	8.5
Total	144	134	74	4	26	12	39.5	4.2

Leave Tree Compliance

Only even aged harvests are examined for leave tree recommendations by GMP, and statistics are reported below across watersheds. The total number of leave trees and strategies – both scattered, clumped, and both – are noted across watersheds. This information contributes to the understanding of what strategies are most common for landowners statewide and gives an understanding of how dense and common leave trees are per acre. The guidelines recommend 6-12 trees per acre for clearcut harvest strategies, and a large proportion of watersheds assessed easily met these requirements (7.43-22.7 TPA; Table 17). LRRR and SCN were the sole watersheds falling below this TPA requirement with 3.23 and 5.7 TPA respectively. Combinations of scattered and clumped leave trees are recommended and were found across all watersheds (note: forested RMZs count toward leave tree acreage).

Table 17. Leave tree (LT) strategies across sites/watersheds; forested RMZs count toward LT acreage.

Watershed	Sites	Sites Evaluated	Acres	Leave Trees (LT)	Scattered LT	Clumped LT	Both Strategies	TPA Scattered and Clumped
CWR	21	14	787.2	14	13	11	10	7.43
LRRR	26	25	2,355.5	25	25	14	14	3.23
MRBS	28	15	857.5	15	15	12	12	12.39
SCKS	31	23	2,468.1	23	23	19	19	13.99
SCN	28	27	1,143.8	27	27	9	9	5.7
SEMN	10	3	92.3	3	3	3	3	22.7
Total	144	107	7,704.4	107	106	68	67	10.9

Compliance ratings for recommendations on leave trees were very high statewide, ranging from 81.5% (SCN) to 100% (SCKS, SEMN) with the majority of average compliance ratings for watersheds above 87% (Table 18). Leave trees do not seem to be an issue with landowners in any watershed surveyed during the biennial period, and while the percent of sites compliant was low for SCN (69.6%) and LRRR (74.7%), further information is necessary to establish specific areas of c.

Table 18. Percentage compliance across watersheds for leave tree requirements.

WSU	Sites	Sites Evaluated	Percent LT Composition	Percentage of Site Composed of RMZ	Net Compliance	Percent of Sites Compliant
CWR	21	14	7.8%	3%	95.9%	92.1%
LRRR	26	25	9.6%	16.3%	87.6%	74.7%
MRBS	28	15	12.6%	3.7%	99%	97.9%
SCKS	31	23	5.9%	16.5%	100%	100%
SCN	28	27	2.1%	10.4%	81.5%	69.6%
SEMN	10	3	15%	3.7%	100%	100%
Total	144	107	8.8%	8.9%	92.9%	86.7%

The most common species was aspen, followed by red maple, paper birch, northern red oak, and black ash. Given the associations between wet areas and certain species, such as black ash, the species present are spread over wet and upland areas. A majority of species were rated as excellent, and the lowest rating possible for any tree noted was fair.

Table 19. Leave trees by most common species and species in the top 5 percent and the appropriate wildlife rating for that species.

Species	# LTC with Stated Species in Top 5%	Percent LTC Present	Wildlife Rating
Ash, Black	61	31.44	Excellent
Aspen	130	67.01	Excellent
Balm of Gilead	17	8.76	Excellent
Balsam Fir	35	18.04	Fair
Basswood	48	24.74	Excellent
Cedar	17	8.76	Good
Elm	36	18.56	Excellent
Maple, Red	72	37.11	Good
Maple, Sugar	29	14.95	Excellent
Oak, Burr	45	23.2	Excellent
Oak, Northern Red	63	32.47	Excellent
Paper birch	66	34.02	Fair
Pine, Jack	5	2.58	Fair
Pine, Norway	28	14.43	Good
Pine, White	5	2.58	Excellent
Spruce, Black	23	11.86	Fair
Spruce, White	17	8.76	Good
Tamarack	20	10.31	Good

Harvest Methods and Planning

The percent of sites that were clear-cut remains similar to past reports at ~91%. Other methods reported include thinning, seed tree, single and group selection, and shelterwood. Some sites utilized mixed harvest methods. Almost all clear cuts included some reserve or leave trees on or adjacent to the clear cut.

Timing and Season of Harvest

The majority of harvests were conducted in winter, with 100 sites or 56% of sites visited by GMP, followed up by fall season with 31 sites (18%). Very few harvests were conducted in spring (20 sites, 11%) or summer (26 sites, 15%). A significant portion of harvests were conducted in winter across all watersheds apart from CWR and SEMN (Table 20). SCKS had the highest percentage of winter harvests (95.1%), followed by SCN (92.9%), LRRR (85.5%), and MRBS (85.2%). SEMN had the lowest percentage of harvests conducted in winter (27%), but only 11 total sites were surveyed in SEMN, and any results determined from the region should be considered alongside that low site number. More discussion of SEMN can be found in the conclusion.

Table 20. Breakdown of the number and sites and acres harvested per season.

Season	Sites Assessed	Harvest (Acres)

Spring	20	604.24
Summer	26	1496.18
Fall	31	10,158.9
Winter	100	6,763.9
Total	177	19,023.22

Table 21. Sites assessed across watersheds with dominant harvest season, and sites harvested by the dominant season with acreage.

Watershed	Sites Assessed	Dominant Harvest Season	Sites Harvested in Dominant Season	Harvest (Acres)
CWR	28	Summer	11	1,310.8
LRRR	33	Winter	25	2,562.4
MRBS	32	Winter	19	1,704.1
SCKS	37	Winter	20	3,073.8
SCN	36	Winter	25	1,358.2
SEMN	11	Fall	4	349.6

Crossings and Approaches

Crossings are an unavoidable result of logging operations for a majority of harvest types, and the Forest Management Guidelines recommend minimizing water crossings through streams, wetlands, and lakes as much as possible to avoid disruption of habitat, limit water runoff, and minimize sediment delivery to waterbodies. It's also important to use appropriate structures and techniques to minimize impacts to streams and wetlands and avoid rutting.

Crossings consist of the crossing itself, plus an approach on either side of the crossing. Two approaches, one coming in and one going out, are associated with each crossing. Approaches are assessed by GMP for their installation of erosion control devices of any kind as needed based on topography and soils, with the goal of diverting water away from streams, wetlands, and other waterbodies. Across all assessed watersheds, a little over half of all sites had approaches on-site (Table 22). Of the total approaches across all sites (336), 6 had erosion control measures installed and 11 needed erosion control. Still, only 4 sites had approaches demonstrating erosion, and only one site had erosion on an approach with sediment delivery to a waterbody. While these numbers are very low compared to the total approaches over all sites, it is likely that further education would be beneficial for loggers about erosion control installation and long-term benefits.

Table 22 . Approaches broken down by watershed, with erosion control, in need of erosion control and demonstrating effects of erosion and approaches with sediment delivery to a waterbody.

WSU	Sites	Sites w/ Approaches	Total Approaches	Approaches w/ Erosion Control	Approaches Need Erosion Control	Approaches with Erosion	Approaches with Sediment Delivery to Waterbody
CWR	21	4	23	0	0	0	0
LRRR	26	26	72	0	1	1	0
MRBS	28	16	85	1	1	1	1
SCKS	31	25	131	4	6	2	0
SCN	28	15	21	1	3	0	0
SEMN	10	2	4	0	0	0	0

Total	144	88	336	6	11	4	1

Crossings were associated with a wide variety of waterbodies across all watersheds, including more unique types of waterbodies such as peatland and dry washes. A relatively large number of crossings were considered avoidable, and of those a large number had rutting associated with the crossing or greater than 50% of width of crossing. However, none of the crossings were considered an impediment to fish passage and/or water flow in wetlands or peatlands. Rutting is still a major concern, especially given the importance of many waterbody types such as wetlands and peatland, and the potential to alter habitat or stream health in the future. A total of 44 crossings had rutting (17% of all crossings), and 6 crossings were greater than 50% of the width of the crossing (2% of all crossings). Crossings and approaches can make a large difference in the health of a site when placed correctly and with the correct water diversion measures, and further education should be promoted to loggers about how and where to place crossings to avoid future issues.

Table 23. Crossings and their associations with types of waterbodies and whether rutting is present and greater than 50% of width of crossing (or more than 300 feet) and whether crossing impedes fish.

Watershed	Crossings	Stream	Wetland	Peatland	Dry Wash	Spring	Avoidable	Rutted	Rutting > 50%	Impedes Fish
CWR	13	0	12	0	0	0	5	1	1	0
LRRR	91	1	89	0	1	0	4	0	0	0
MRBS	51	0	43	8	0	0	12	12	3	0
SCKS	71	2	61	5	0	0	21	6	2	0
SCN	29	0	29	0	0	0	2	1	0	0
SEMN	2	0	0	0	2	0	0	0	0	0

Table 24. Crossings and types of waterbodies where crossings occurred broken down by watershed.

Watershed	Infrastructure Type	Sites	Sites w/ Crossings	Crossings	Streams	Wetlands	Peat-lands	Dry Washes
CWR	Forest road	21	3	3	0	3	0	0
CWR	Skid trail	21	3	10	0	9	0	0
CWR	WSU Subtotal	21	4	13	0	12	0	0
LRRR	Forest road	26	26	76	1	74	0	1
LRRR	Skid trail	26	2	2	0	2	0	0
LRRR	Landing	26	9	13	0	13	0	0
LRRR	WSU Subtotal	26	26	91	1	89	0	1
MRBS	Forest road	28	7	15	0	12	3	0
MRBS	Skid trail	28	13	32	0	27	5	0
MRBS	Landing	28	3	4	0	4	0	0
MRBS	WSU Subtotal	28	16	51	0	43	8	0
SCKS	Forest road	31	14	30	2	23	3	0

SCKS	Skid trail	31	18	37	0	34	2	0
SCKS	Landing	31	4	4	0	4	0	0
SCKS	WSU Subtotal	31	25	71	2	61	5	0
SCN	Forest road	28	11	22	0	22	0	0
SCN	Skid trail	28	7	7	0	7	0	0
SCN	WSU Subtotal	28	14	29	0	29	0	0
SEMN	Skid trail	10	2	2	0	0	0	2
SEMN	WSU Subtotal	10	2	2	0	0	0	2

Table 25. Average length of crossings, total number of rutted features, and percentage of features rutted for each watershed.

Watershed	Average Length of Crossings	Rutted Features	Percent Rutted
CWR	329	8	21.1%
LRRR	615.5	2	4%
MRBS	173.6	20	24.6%
SCKS	173.1	18	15.4%
SCN	584.5	2	2.5%
SEMN	24	4	2.5%
Total	1,899.7	54	11.7%

The highest number of avoidable crossings and rutting occurred in MRBS (10 avoidable, 10 rutted; Table 21) and SCKS (19 avoidable, 4 rutted; Table 25) associated with skid trails. In total, SCKS had 21 crossings noted to be avoidable, and MRBS had a total of 12 crossings noted to be avoidable across all types of infrastructure. The length of crossings is a relatively important factor in understanding how common and how much of the landscape can be associated with crossings or impacted by the mishandling of crossings on a site. Overall, about 1,900 feet are associated with crossings across all watersheds surveyed for the biennial period. The highest amount of space is associated with LRRR (615.5 feet) and SCN (584.5 feet), while the lowest is associated with SEMN (24 feet). A total of 34 sites had rutting out of all sites surveyed. Monitored features with the possibility of rutting include steep slopes, OWW and NOWW, cultural resources, crossings, landings, skid trails, and filter strips. The majority of rutted features across all watersheds were found in crossings or skid trails, with zero in filter strips, cultural resources, steep slopes, streams, and OWW across all watersheds. A total of 20 rutted features were found in crossings, 4 in landings, 7 in NOWW, 17 in skid trails, and 6 in roads.

Results – Visual Quality, Endangered, Threatened, and Concerned Species

Visual Quality

The goal of visual quality assessments is to minimize the ability of passersby to note heavy clearcut and visually poor operating techniques, thereby reducing the opportunity for public opinion against forest management in the state to become an issue for foresters, land managers, and private landowners. Landowners are expected to minimize impacts to visual quality using recommended practices, especially at visually sensitive sites. Visual quality maps can be found through the Minnesota Logger Education

Program website. Discouraging poor public perception of clear cuts from vantage points such as high ground, highways, trout streams, or recreational areas is beneficial for the continuation of logging in Minnesota and its numerous benefits for the people of Minnesota.

Watersheds surveyed for the biennial period had varying rates of compliance for vistas and sensitive visual quality sites, all relatively low, ranging from 61.8% (LRRR) to 80% (SCN). The majority of vistas were labeled as less sensitive. There is no association between the percent of sites that were considered moderately sensitive or more and the overall compliance rating.

It should be noted that while visual quality and vista compliance with the recommendations is relatively low, there is no identifiable environmental benefit to the recommendations surrounding vistas and visual quality. The guidelines for visual quality were added during the original creation of the guidelines and have not been updated since that point. GMP proposes a revisit of the guidelines and recommendations surrounding visual quality to reassess whether there is still a benefit to spending time and efforts to collect data on these guidelines. GMP is interested to further explore whether compliance rates in visual quality assessments are directly correlated to number of complaints from the public surrounding forestry activities in each watershed.

Table 26. Overview of vistas and their rating as less, moderate, and more sensitive, and the percent moderately sensitive and the compliance rating.

Watershed	Sites	Vistas	Less Sensitive	Moderately Sensitive	More Sensitive	Percent Moderate to More Sensitive	Compliance
CWR	21	15	10	1	4	33.3	76.5%
LRRR	26	10	10	0	0	0	61.8%
MRBS	28	20	18	2	0	10	69.7%
SCKS	31	13	12	1	0	7.7	69.1%
SCN	28	16	14	2	0	12.5	80%
SEMN	10	6	3	0	3	50	68.2%
Total	144	80	67	6	7	18.9	70.9%

Endangered, Threatened, and Concerned Species (ETS)

The goal of the ETS recommendations is to increase awareness of ETS and manage forests to maintain or enhance existing populations of these species and their habitats. Checking for ETS serves as a large proportion of the recommendations, as identifying habitats and species should result in the required protections applied. Other recommendations contribute to ETS protections, including CWD, leave trees and snags, patterns of cutting, and retention of certain tree species.

Table 27. Endangered, Threatened, and Concerned Species (ETS) sites by ownership, including those protected by a management plan (FMP).

Ownership Category	Sites	Checked	ETS	Protected FMP	Checked	Percent Protected	Percent Total
County	94	93	15	7	98.9	46.7%	7.4%
Federal	40	40	1	1	100	100%	2.5%
Forest Industry	15	14	0	0	93.3	NA	0
Non-Industrial Private Forestland (NIPF)	63	16	4	4	25.4	100%	6.3%
State	107	107	7	6	100	85.7%	5.6%

Tribal	6	6	0	0	100	NA	0
Total	325	276	27	18	84.9	66.7%	5.5%

Table 27 shows that a total of 27 ETS were identified across 276 checked sites over all ownerships, with 18 protected by an FMP, with a wide range of accurate protections ranging from 46.7-100%. NIPF had the highest percent protection for ETS, alongside federal sites. State and County sites were much lower in percent protection. Across watersheds, SCN had the lowest compliance with protections at zero, followed by SCKS, CWR, and MRBS with 100%.

Table 28. Endangered, Threatened, and Concerned Species (ETS) sites by watershed, including those protected by a management plan (FMP).

Watershed	Sites	Checked	ETS	Protected FMP	Percent Checked	Percent Protected	Percent Total
CWR	21	19	3	2	90.5%	66.7%	9.5%
LRRR	26	21	0	1	80.8%	Inf	3.8%
MRBS	28	19	1	1	67.9%	100%	3.6%
SCKS	31	28	6	2	90.3%	33.3%	6.5%
SCN	28	20	1	0	71.4%	0%	0%
SEMN	10	7	0	0	70%	NA	0%
Total	144	114	11	6	79.2%	54.5%	4.2%

Table 29. Scattered leave tree (LT) and snag characteristics, including species richness (SR) across sites and watersheds, and a mean wildlife preference rating.

Watershed	Sites	Mean Snags/Acre	Max Snags	Mean SR Scattered LTs (Sites)	Total SR Scattered LTs (Watershed)	Max SR	Mean Wildlife Rating
CWR	18	3.95	18	4.25	15	8	2.4
LRRR	26	2.84	28	3.4	14	9	2.18
MRBS	20	3.96	20	4.14	16	8	2.16
SCKS	27	3.15	18	4.25	15	8	2.4
SCN	28	2.89	28	3.4	14	9	2.18
SEMN	6	8.5	30	4.14	16	8	2.16

Mean snags per acre were highest in SEMN with 8.5/acre, and lowest in LRRR with 2.84/acre, the majority of average snags ranged from 2-4 per acre. Species richness was relatively consistent across all sites (Table 29) and across all watersheds. Increasing awareness of ETS may result in higher compliance rates in the future, including more information about FMPs and their ability to protect species.

Results – Pre-harvest Planning

The FMGs recommend the development of written plans for all forest management activities, including timber harvest. One of the most effective tools for communicating the details of a harvest plan is a site map identifying the location of critical site features. NIPF landowners reported that site maps were developed for only 43.5% of the sites, which is slightly higher than in past reports. Site maps were developed for 99.3% of federal, state, county and forest industry sites. Approximately 62% of NIPF sites indicated that there was a general forest management plan for their property written by a forestry consultant or natural resource professional, and most of these also had a written timber harvest plan for

the site. Of the NIPF sites without written plans, four indicated an oral harvest plan was developed by the logger through discussion with the landowner, and six sites indicated no plan was developed. This emphasizes that for many NIPF harvests, the logging professional is key to informing landowners about site-level guidelines and is also the implementer of those guidelines on the site. Targeted outreach to loggers in watersheds with high NIPF harvest activity would be an effective approach to increase implementation of site-level guidelines.

Silvicultural objectives for landowners were predominantly for clear cuts, with 129 sites noting a type of clear cut as their main objective for the harvest on their land. Other objectives included single tree selection, group selection, thinning, and seed trees among others. Tree species removed across sites were predominantly aspen and birch, followed by red maple and black ash amongst many others. It should be noted that due to the possible threat to ash from invasive species, removal of black ash and replacement with another species that will perform similar water table stabilization is key for wetland areas in northern Minnesota. Aspen clear cuts are common across watersheds in Minnesota, with many landowners working to establish aspen stands for future cuts.

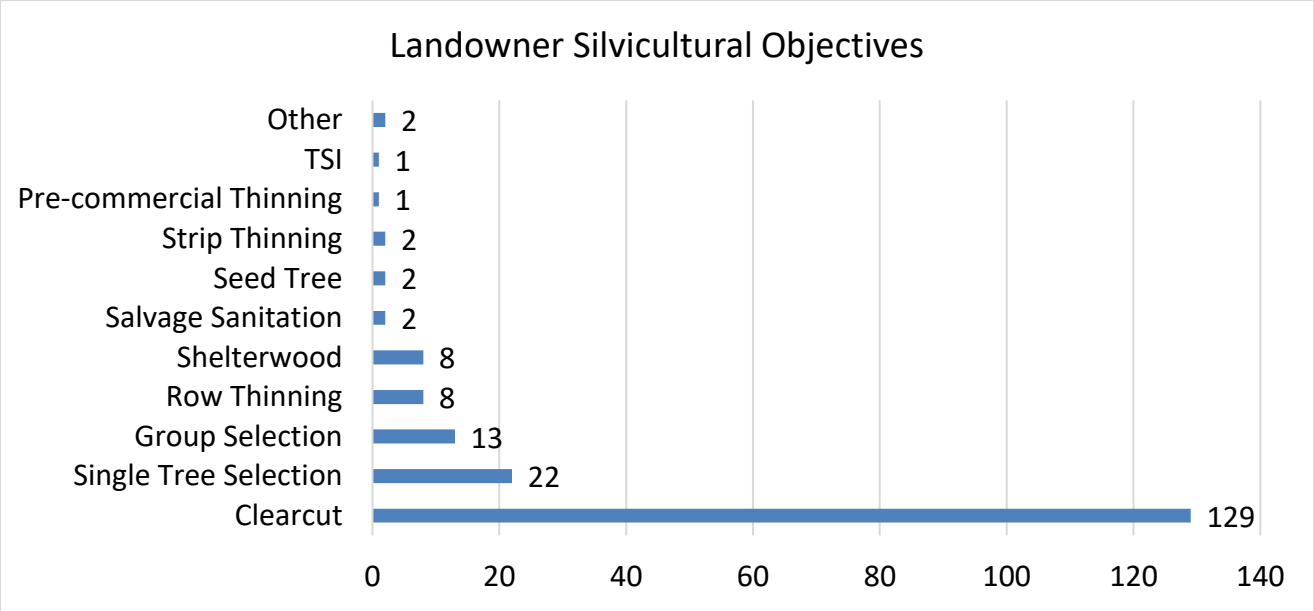

Figure 3 – Landowner silvicultural objectives as noted from responses to the pre-site survey sent to landowners prior to site visitation.

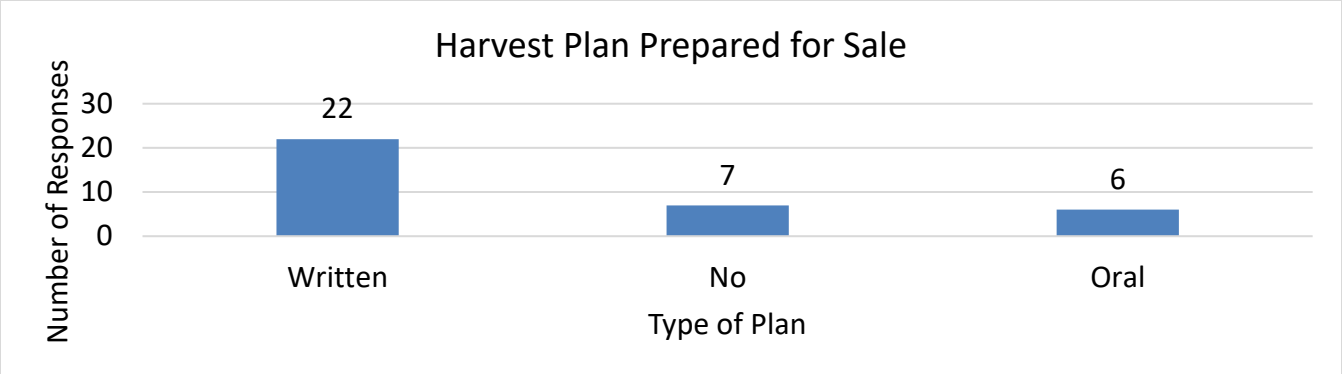

Figure 4 – Responses to whether a harvest plan was prepared with the logger or other individual prior to the sale and cut of the timber from the pre-site survey sent to landowners; figure displays plan responses across all ownerships.

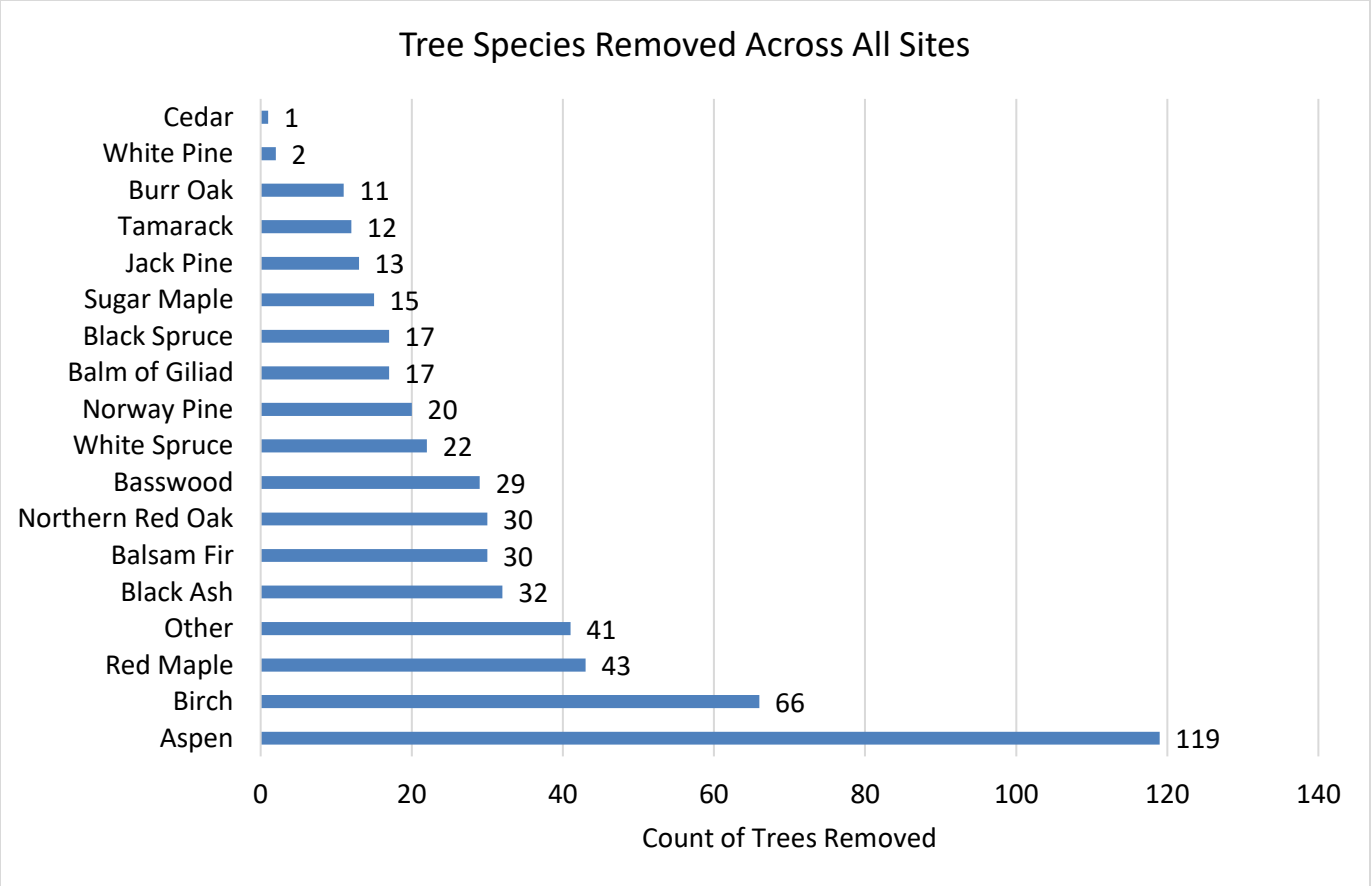

Figure 5 – Number and type of tree species removed at sites as noted in the pre-site survey sent to landowners.

Discussion and Conclusion

The overall compliance findings varied widely by focus area, but overall compliance is being adhered to across all surveyed watersheds. Areas of high compliance include leave trees, coarse woody debris (CWD), filter strips unrelated to erosion and landing placement, and trout and non-trout stream buffers. Areas that could use improvement to education and logger training, and landowner awareness, including filter strip erosion associated with infrastructure, placement of landings outside of filter strips and RMZs, and crossings to avoid riparian areas and reduce rutting and placement in avoidable areas.

Even with areas of improvement, very little to no sediment delivery to waterbodies was found across all watersheds, and zero impediment to fish was identified across all sites. Areas that may be considered lower priority for education and improvement include CWD, which was so high across all sites it may be necessary to investigate the possible detriment of high degrees of logs in streams and riparian areas. Timing of harvest was mainly in winter for a majority of surveyed sites, a topic of interest that GMP plans to analyze in more depth in coming reports.

Total number of samples was slightly below target thresholds for the current biennial period, totaling 144 sites across six watershed units. In certain areas such as SEMN, samples were very low (10 total sites) due to lack of landowner information and lack of outreach resources for GMP staff to identify and connect with private landowners about recent harvests. SEMN forests are also mostly on steeper, non-agricultural land, and contain well-drained soil with fewer wetlands due to topographic changes to the landscape of Minnesota. Efforts to increase sample size in all watersheds will be conducted over the coming years, with planned updates to the change detection methodology and re-examination of the current process to increase efficiency, as well as reaching out to local foresters and forest management planning individuals to identify private landowners interested in voluntary guideline monitoring for spring of 2026.

Visual quality assessments, while giving insight into what the general public may see from a roadway or public area, does not contribute any measures of environmental health, habitat quality, or forest regeneration potential. Visual quality compliance was considered relatively low to medium in adherence, but this does not paint a clear measure of guideline monitoring or ecological health of the forested landscape of Minnesota.

Appendix

Breakdown of the distance of harvest from riparian features, as depicted from the DNR Hydrology layers publicly available, for each watershed analyzed as part of the 2022-2023 season.

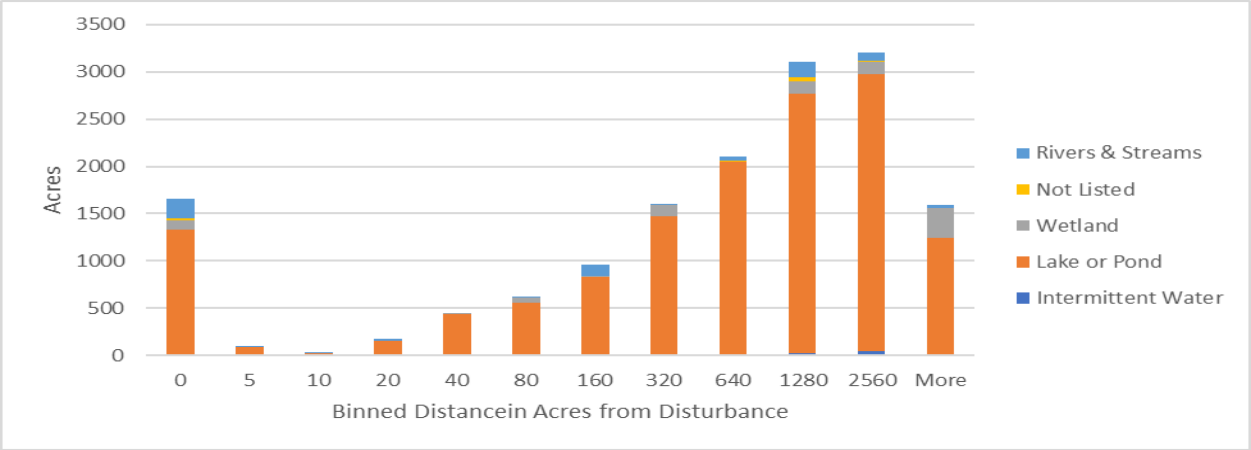

Figure 6. CWR

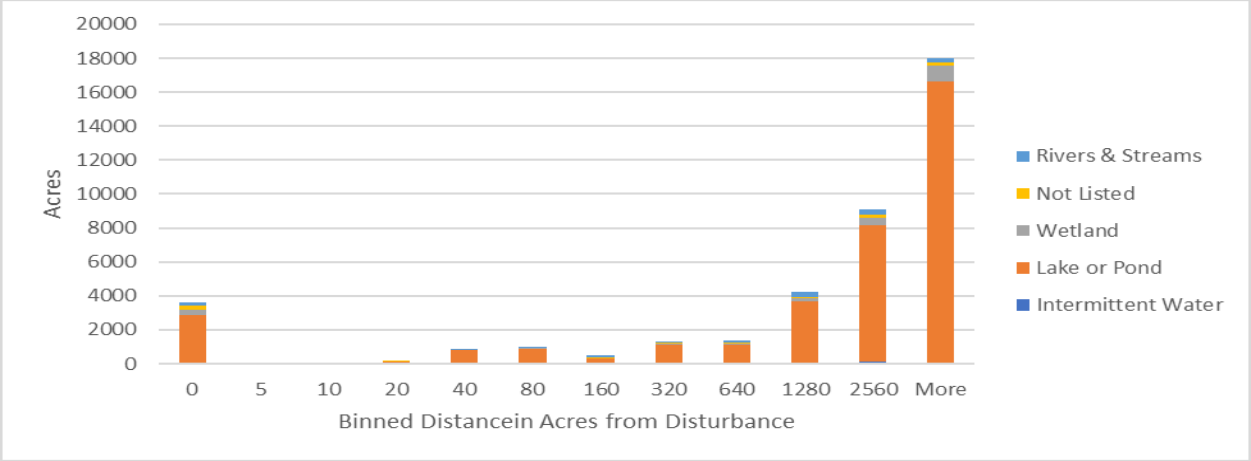

Figure 7. LRRR

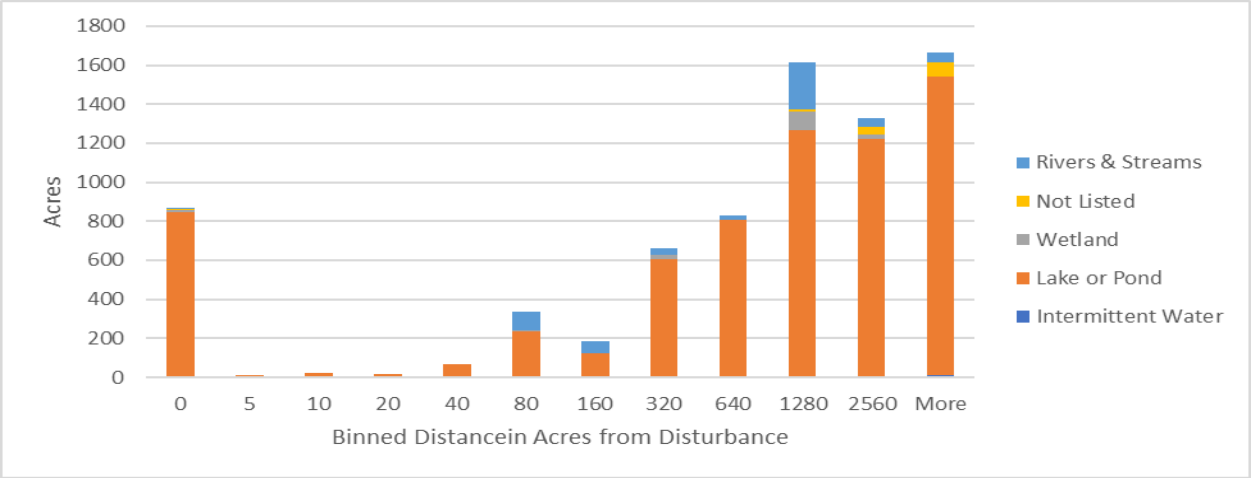

Figure 8. MRBS

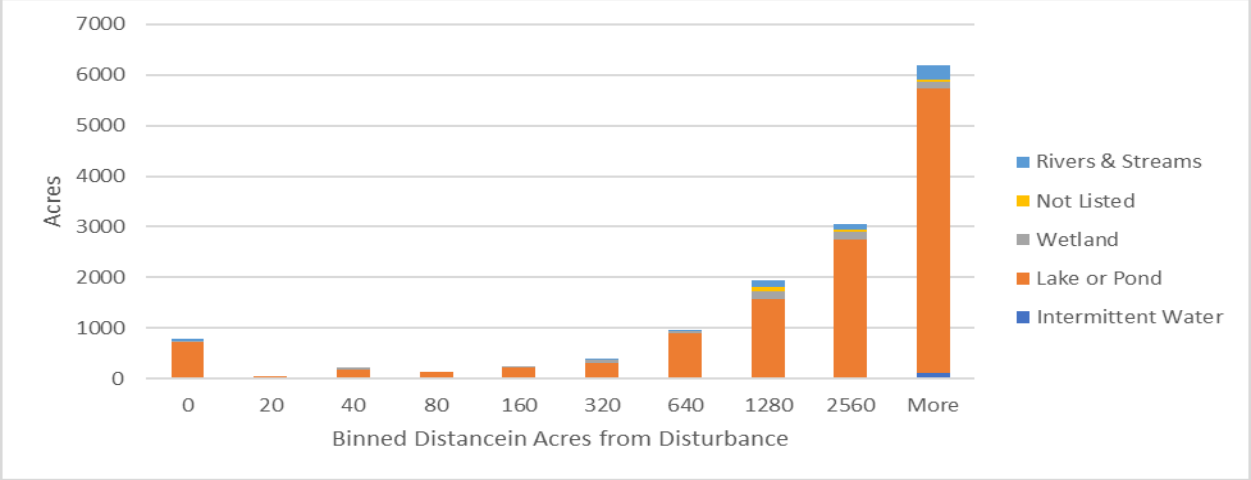

Figure 9. SCKS

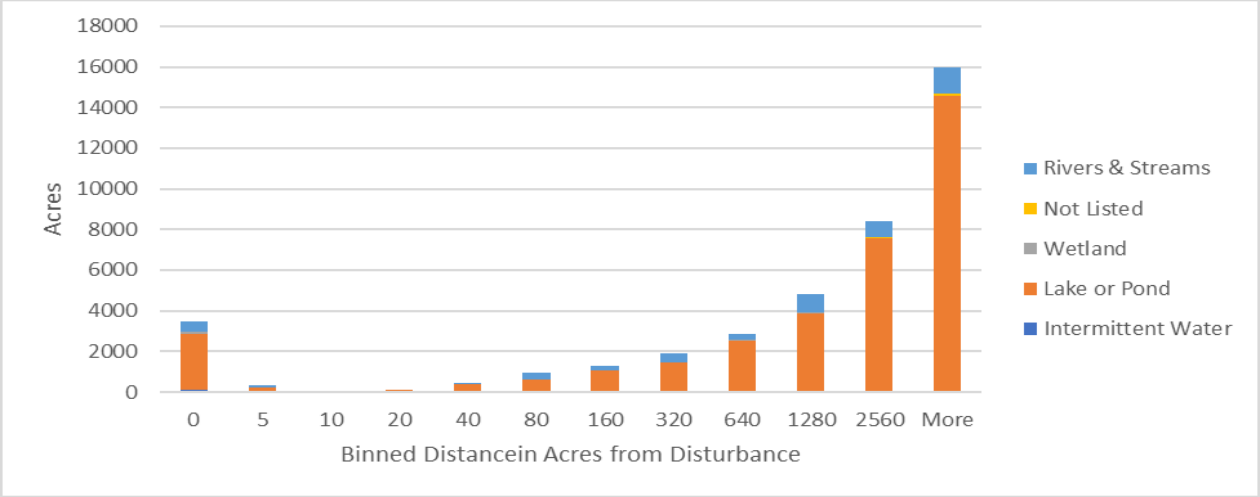

Figure 10. SCN

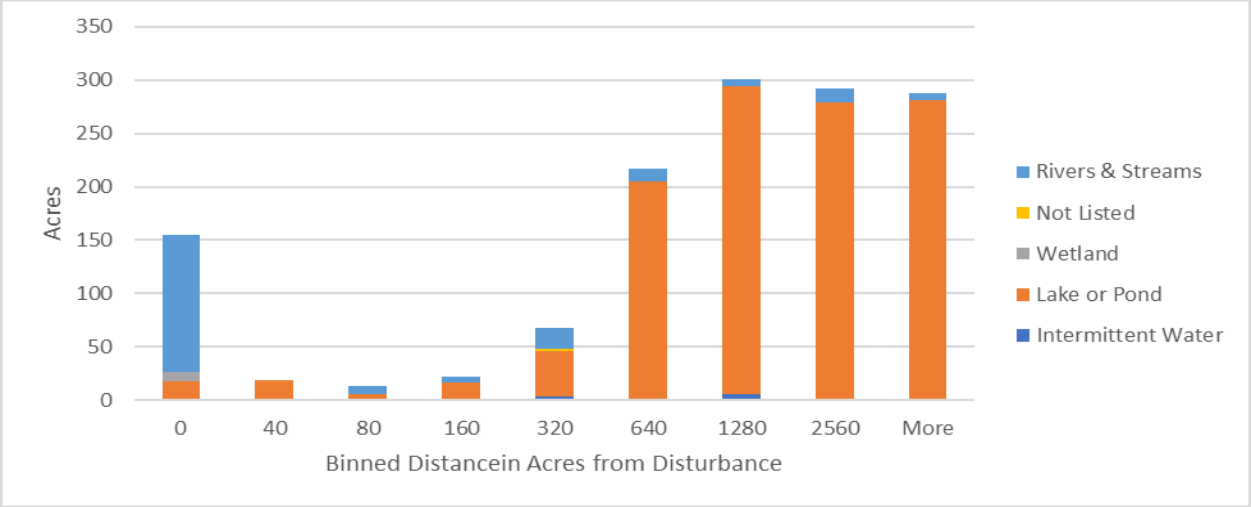

Figure 11. SEMN