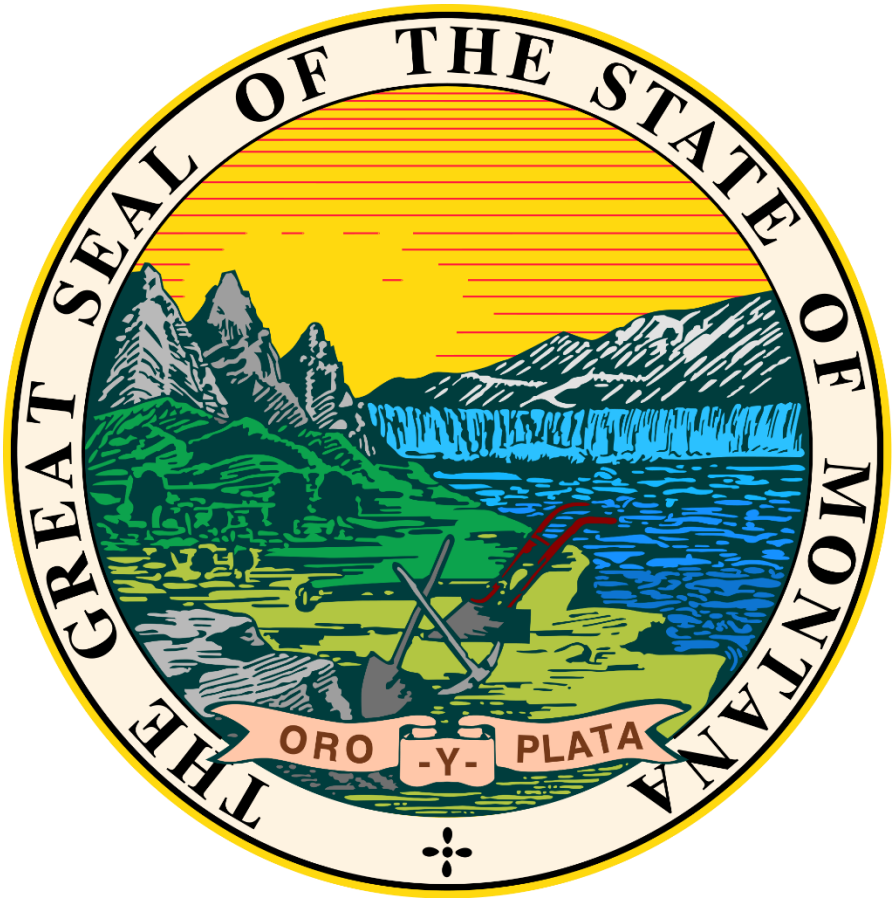
State of Montana

Department of Natural Resources and Conservation



STATE FOREST LAND MANAGEMENT PLAN

IMPLEMENTATION MONITORING REPORT

FISCAL YEARS 2011-2016

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EXECUTIVE SUMMARY

Since the adoption of the State Forest Land Management Plan (SFLMP) in 1996 and the Administrative Rules for Forest Management (Forest Management Rules or Rules; ARM 36.11.401 through 456) in 2003, the Montana Department of Natural Resources and Conservation (DNRC), Forest Management Program has implemented the philosophy and intent of the SFLMP and the requirements set forth in the Rules primarily through project development and implementation, Montana Environmental Policy Act (MEPA) review, and monitoring. The following is a summary of accomplishments and monitoring results from fiscal years 2011 through 2016 (July 2010 through June 2016).

PLAN IMPLEMENTATION

The State Forest Land Management Plan was implemented on 153 timber sales that treated 48,719 acres that yielded 353 mmbf for the 2011-2016 monitoring period. Table EX-1 below provides context to this level of harvest in comparison to previous monitoring periods.

Table EX-1; Harvest levels for the reporting period and since the inception of the SFLMP.

Land Office	1997-2000		2001-2005		2006-2010		2011-2016	
	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)
NWLO	9,963	55,408	19,216	121,918	18,020	159,361	27,230	217,998
SWLO	11,494	50,722	10,883	53,670	11,398	79,707	14,254	91,582
CLO	1,678	10,699	2,131	17,194	2,934	18,225	3,539	29,259
Eastern Offices (SLO/NELO/ELO)	5,319	10,719	2,996	10,179	2,776	8,937	3,696	14,836
Total	28,454	127,548	35,226	202,961	35,128	266,230	48,719	353,675
Average Annual	7,114	25,510	7,045	40,592	7,026	53,246	8,120	58,946

Timber Sale Inspection Reports

During the monitoring period, DNRC conducted 3,142 timber sale inspection reports on the above stated harvested acreage and volume which equates to 58,713 individual contract items that were inspected. Of these inspected items, 98.4% were rated as satisfactory in meeting the contract requirement demonstrating a high level of contractual compliance, and be default, exceptional implementation of the SFLMP mitigations as will be specifically detailed in this report.

MONITORING

Biodiversity

- 12 biodiversity field reviews were conducted on the Northwestern (7), Southwestern (4), and Central (1) Land Offices. Those reviews indicated that DNRC's forest management activities are typically successful in incorporating the biodiversity measures outlined by the SFLMP and ARM, and that those measures are readily integrated into the prescribed management activities without detriment to achieving silvicultural objectives. Three areas for improved application of biodiversity measures include snag retention, coarse and fine woody debris retention, and shape and appearance of cutting unit boundaries.
- Modeled an old growth constraint in the 2015 sustainable yield calculation that accurately reflects the Department's management of old growth and ensures that objectives for amounts of old growth will

be met over the sustainable yield planning horizon and at the specified annual sustainable harvest level. Provided training to field staff regarding management of old growth stands via a webinar series and associated handbook.

- Old growth amounts increased slightly from 2010-2016 due to updated inventory information that identified acres previously not classified as old growth as old growth. However, the percentage of acres identified as old growth decreased since 2010 due to the impact of forest land acquisitions, most of which contain timber in younger age classes.
- Management activities are generally having desired impacts of increasing deficient amounts of shade-intolerant forest types (ponderosa pine, western larch/Douglas-fir, western white pine) and decreasing excessive amounts of shade-tolerant forest types (Douglas-fir, mixed conifer, subalpine fir). However, there continues to be excessive amounts of shade tolerant types and deficient amounts of shade-intolerant types relative to desired amounts.
- Continued post-fire photo-point monitoring on the Coal Creek State Forest.
- Continued post-fire mortality monitoring on a section in the Clearwater Unit burned in the 2007 Jocko Lakes fire.

Silviculture

- Average annual harvest volumes and acres harvested increased because of revised sale planning targets following sustainable yield calculations.
- Tree planting decreased compared to the previous monitoring period, due in part to the completion of post-fire planting on many of the areas that burned in the early- and mid-2000s as well as increased levels of brush piling and scarification for site preparation to encourage natural regeneration.
- Amounts of precommercial thinning, slash pile burning, and use of biological agents to control noxious weeds increased substantially from the prior monitoring period.
- Tractor-based logging accounted for 90% of harvested acres, while cable logging accounted for the remaining 10%.
- The use of even-aged regeneration harvest methods (clearcut, seed tree, shelterwood) increased over the previous monitoring period, accounting for 61% of harvested acres. The overall amount of partial cutting declined due to a substantial decrease in the use of intermediate silvicultural methods; however, the use of selection harvesting increased compared to the previous monitoring period.
- Salvage harvesting declined compared to the previous monitoring period, occurring on 11% of harvested acres. About 78% of salvage harvesting was related to insect damage, with the remainder related to wildfire.

Watershed and Road Management

- Road construction activities continued at rates consistent with previous reporting periods.
- Road inventory process and procedures have been significantly assisted by mobile GIS technologies and as a result substantial gains in the miles of annual completed road inventory have been realized.
- The implementation and effectiveness of Best Management Practices and the Streamside Management Zone law continue to show high levels of successful compliance with substantial gains since the SFLMP inception.
- Long-term water quality monitoring was continued on six sites on the Stillwater State Forest

- Stream discharge monitoring was continued on six sites on the Stillwater State Forest and six sites on the Swan River State Forest, including installation of fixed staff gages to develop long-term rating curves for evaluation of water yield associated with timber sales.
- Stream temperature monitoring was conducted on a total of 41 sites including;
    - 26 sites associated with riparian timber harvest monitoring
        - Two sites indicated chronic temperature exceedances during post-timber harvest monitoring.
        - One site indicated acute temperature exceedances during post-timber harvest monitoring.
    - 3 sites associated with post-wildfire vegetation recovery
    - 3 sites associated with vegetation recovery following construction of grazing exclosures
    - 9 sites associated with long-term stream temperature trend monitoring

Fisheries

- Bull trout redd count monitoring was conducted in 11 streams on the Stillwater, Swan River, and Coal Creek State Forests. Trends suggest stable or increasing levels of adult spawning in the Stillwater and Coal Creek State Forests, while declines were noted in populations in the Swan River State Forest.
- Bull trout spawning habitat assessments were completed on 14 streams on the Stillwater, Swan River, and Coal Creek State Forests. Five sites were noted to be above thresholds of concern during the monitoring period for at least one year.
- Bull trout rearing habitat assessments were completed on 12 streams on the Stillwater, Swan River and Coal Creek State Forests. Two sites were noted to have rearing conditions below suitable thresholds for at least one year during the monitoring period.
- Lake trout suppression efforts in Swan Lake continued through 2016.
- Fish habitat inventories were conducted on four streams on the Swan River and Coal Creek State Forests.
- Large woody debris monitoring was completed as a part or riparian timber harvest monitoring on 14 sites on HCP covered lands.

Threatened, Endangered, and Sensitive Species and Big Game

- DNRC biologists participated on 10 interagency committees and working groups.
- During the monitoring period, DNRC completed the Forest Management Habitat Conservation Plan, launched implementation of the plan, completed four annual monitoring reports and the first five-year monitoring report.
- DNRC Biologists surveyed 4 to 15 territories annually, documenting 19 fledglings.
- DNRC biologists monitored breeding loons on 9 lakes annually in northwest Montana and supported the interagency Loon Ranger Program.
- DNRC co-authored six separate monitoring reports documenting required habitat metrics and compliance for the Swan Valley Grizzly Bear Conservation Agreement.
- During the monitoring period, DNRC field staff monitored from 507 to 586 primary road closure devices on state trust lands annually for effectiveness within grizzly bear recovery zones. At least 83 closures received repairs within one year of detecting damages.

- DNRC biologists monitored snags, coarse woody debris, and snag recruitment trees on 21 sale areas. Pre and post-harvest results were analyzed and reported for 14 timber sale projects.
- DNRC biologists obtained and reported to the Montana Natural Heritage Program 82 observation records for 17 species that included several threatened species, several sensitive species and other species of interest.
- DNRC biologists conducted project-related monitoring of raptor nests including nine goshawk nests, three red-tailed hawk nests, one bald eagle nest, and one golden eagle nest.
- A DNRC biologist conducted an avian study to examine bird responses to old growth maintenance logging treatments on the Swan River State Forest.

Grazing on Classified Forest Lands

- 495 parcels licensed for classified forest grazing were inspected for range and riparian condition during the monitoring period of which 342 (69%) had riparian features.
- Of the inspected parcels with riparian features, 80% met narrative standards favorable for functioning riparian systems, a slight increase over previous reporting periods.

Weed Management

- 153 timber sales were inspected and monitored for noxious weed presence, establishment, and spread.
- 18,328 acres of noxious weeds were treated by various means on DNRC lands and road right-of-ways. Additional, 2,763 acres were treated with biological controls.

REVIEW AND MANAGEMENT OF THE PLAN

- Since the previous reporting period, DNRC has successfully developed a Habitat Conservation Plan (HCP) with the United States Fish and Wildlife Service under Section 10 of the Endangered Species Act.
- The HCP complements the SFLMP by clarifying DNRC's responsibilities under the Endangered Species Act (ESA), providing additional mitigation measures for T&E species and by providing water quality protections.
- Based on this review of the SFLMP and the information provided in this report (following ARM 36.11.448), *no significant changes were noted* involving new legislation, land board direction, changes to original assumptions supporting the plan, cumulative minor changes, new science, or changes in baseline conditions that are incompatible with the philosophy, intent and implementation of the plan that would trigger further necessary review and amendment of the SFLMP at this time.
- For efficiency, DNRC chose to extend this monitoring period by one year to overlap DNRC's 5-year monitoring commitments within the HCP. Moving forward, the SFLMP monitoring report will continue to be 5-year monitoring periods in-sync with that of the HCP.

INTRODUCTION

STATE FOREST LAND MANAGEMENT PLAN AND ADMINISTRATIVE RULES FOR FOREST MANAGEMENT

The State Forest Land Management Plan (SFLMP), approved by the State Board of Land Commissioners (Land Board) in June 1996, is the plan under which the Montana Department of Natural Resources and Conservation (DNRC) manages approximately 780,000 acres of forested State trust land. The SFLMP provides the philosophical basis and technical rationale for DNRC's forest management program. The SFLMP is based on the philosophy that the best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests as summarized in the following excerpt:

"Our premise is that the best way to produce long-term income for the trust is to manage intensively for healthy and biologically diverse forests. Our understanding is that a diverse forest is a stable forest that will produce the most reliable and highest long-term revenue stream. Healthy and biologically diverse forests would provide for sustained income from both timber and a variety of other uses. They would also help maintain stable trust income in the face of uncertainty regarding future resource values. In the foreseeable future, timber management will continue to be our primary source of revenue and primary tool for achieving biodiversity objectives." (ROD page 2)

The DNRC Administrative Rules for Forest Management (Forest Management Rules or Rules; ARM 36.11.401 through 456) are the specific legal resource management standards and measures under which DNRC implements the SFLMP and subsequently its forest management program. The Rules were adopted in March 2003 and provide the legal framework for DNRC project-level decisions and provide field personnel with consistent policy and direction for managing forested State trust lands. The Rules subchapters correspond to resource areas identified by the SFLMP and incorporate language from the SFLMP Resource Management Standards (RMS). All forest management projects administered by DNRC on forested State trust lands must comply with both the SFLMP and the Forest Management Rules.

DNRC Land Offices, Administrative Units, and the Forest Management Bureau (FMB) continue to implement the philosophy and intent of the SFLMP and the requirements set forth in the Forest Management Rules primarily through project development and implementation, Montana Environmental Policy Act (MEPA) review, and monitoring.

PURPOSE OF THE MONITORING REPORT

According to the SFLMP (Record of Decision, page 11), beginning in 2000 and every five years thereafter, the Forest Management Bureau shall prepare a written report on the status and effectiveness of the SFLMP for the DNRC Director. ARM 36.11.448 reinforces this requirement and stipulates that DNRC shall monitor individual resources pursuant to the Forest Management Rules and compile the results of that monitoring into a report for the Land Board by 2005 and every five years thereafter. In October 2000 and 2005, DNRC published an Implementation and Monitoring Report that summarized SFLMP and Forest Management Rule monitoring results during fiscal years 1997 through 2000 and 2001 through 2005 respectively. In May 2011, DNRC published the monitoring report for fiscal years 2006 through 2010. This document summarizes SFLMP and Forest Management Rules monitoring results from fiscal years 2011

through 2016 and will be presented to the DNRC Director, Trust Land Administrator, and the Land Board.

IMPLEMENTATION CHECKLISTS

In January of 1997, an SFLMP Implementation Checklist was finalized for use in planning timber sales. The Checklist was comprised of specific Resource Management Standards pertinent to timber sale preparation and issues often raised concerning timber harvest. The Implementation Checklist was developed for two purposes: 1) as an internal check to ensure that the SFLMP philosophy and RMS are being incorporated in the project; and 2) for external accountability when presenting our projects to the Land Board.

In June 2003, the FMB revised this Implementation Checklist to correspond with the adoption of Forest Management Rules. The Rule Implementation Checklist identifies 48 items to address during timber sale planning. These include separate items from 9 of the 10 resource areas: Biodiversity, Silviculture, Road Management, Watershed, Fisheries, Threatened & Endangered Species, Sensitive Species, Big Game, and Weed Management. Rules for Grazing on Classified Forest Lands were excluded as not applicable.

A SFLMP/Administration Rule Implementation Checklist was filled out for all 153 timber sales that were sold from fiscal years 2011 through 2016. All sales complied with both the SFLMP and the Rules.

TIMBER SALE INSPECTIONS

DNRC field personnel oversee the implementation of timber sale contracts. Management foresters spend a substantial amount of time on the ground, visiting active sales to ensure contract compliance. Foresters communicate with purchasers and contractors and direct them in meeting stipulations and requirements of the contract. This often includes adjusting operations or prescribing actions to avoid contract deviations or resource impacts.

Table PM-1; SFLMP Implementation Monitoring through Timber Sale Contract Inspection Reports

Reporting Period	Number Of Sales	Number of Reports	Contract Items Inspected	Satisfactory	Needs Improvement	Violations
1998-2000	79	1,022	23,506	98.9%	1.0%	0.1%
2001-2005	106	2,224	16,881	97.3%	2.4%	0.3%
2006-2010	194	1,726	17,820	96.1%	3.6%	0.3%
2011-2016	153	3,142	58,713	98.4%	1.4%	0.2%

Many sales sold prior to fiscal year 2011 were implemented on the ground within the monitoring period of this report (fiscal years 2011 through 2016). Therefore, inspection monitoring results within this report also cover some sales sold prior to 2011. During fiscal years 2011 through 2016, management foresters documented 3,142 timber sale inspections for 153 timber sales. Timber sale contract terms often have indirect ties to the SFLMP and Rules, and they reflect multiple observations of all operating timber sales. See Biodiversity Monitoring – Timber Sale Inspection Reports for a complete summary of timber sale inspection reports and Road Management Monitoring and Watershed, Fisheries, and Soils Monitoring for brief discussions.

MONTANA DNRC HABITAT CONSERVATION PLAN

In December 2011, the USFWS issued DNRC an incidental take permit authorizing take of grizzly bear, Canada lynx, bull trout, and two other fish species incidental to DNRC's forest management activities. A Habitat Conservation Plan (HCP) is a long-term management plan prepared under the Endangered Species Act (ESA) to conserve threatened and endangered species. Section 10 of the ESA, authorizes a

landowner to develop a conservation plan to minimize and mitigate, to the maximum extent practicable, the impacts of related incidental take of threatened and endangered species while conducting lawful activities such as harvesting timber on State trust lands. The HCP is part of an application for obtaining an incidental take permit (Permit) from the USFWS in accordance with Section 10(a)(1)(B) of the ESA. The Permit authorizes DNRC to take federally listed species that are covered under the HCP.

During calendar years 2012 through 2016, DNRC has implemented the HCP. Monitoring is a requirement of the HCP, and DNRC has prepared the Montana DNRC Forested State Trust Lands HCP 5-Year Monitoring Report. That report will accompany this DNRC SFLMP Monitoring Report 2011-2016.

BIODIVERSITY MONITORING

BIODIVERSITY IMPLEMENTATION

The SFLMP and Forest Management Rules rely on forest management for biodiversity to accomplish the Department's fundamental management premise. Our efforts at implementing the coarse filter are focused on assessment and management of appropriate stand conditions at the landscape level, and emulation of natural disturbance processes in our selection of proper treatments. We have developed management tools for describing desired future conditions of our forests and for comparing them to current or existing conditions.

BIODIVERSITY FIELD REVIEWS

ARM 36.11.419 directs DNRC to conduct field reviews of forest management activities to evaluate the application of the biodiversity measures presented in the SFLMP and ARM. These reviews encourage accountability for considering and applying biodiversity measures in the timber sale planning process and provide a feedback mechanism between field staff and the Forest Management Bureau regarding such issues. The reviews are not intended to critique the work of individual foresters and field specialists, but are instead an opportunity to learn about, discuss, and refine management activities to better and more effectively accomplish DNRC's mission when managing forested Trust Lands. These reviews focus on several topics related to biodiversity, including selection and implementation of silvicultural systems, regeneration, age classes and old growth, forest health, patch characteristics, rare and unique habitats, sensitive plants, forest genetics, snag and nutrient retention, economics, and wildlife (threatened, endangered, sensitive, and big game species).

Between 2011 and 2016, DNRC conducted 12 biodiversity field reviews on the Northwestern (7), Southwestern (4), and Central (1) Land Offices. Those reviews indicated that DNRC's forest management activities are typically successful in incorporating the biodiversity measures outlined by the SFLMP and ARM, and that those measures are readily integrated into the prescribed management activities without detriment to achieving silvicultural objectives.

The reviews did identify three areas for improved application of biodiversity measures:

1. Snag Retention: In some cases, particularly those related to insect salvage in lodgepole pine cover types or when even-aged silvicultural methods, such as clearcutting, were used, snags left did not meet the intended numbers specified by the ARM, were left in sufficient numbers but in scattered patches within the cutting unit instead of throughout the unit, left in increased numbers outside the cutting unit to mitigate insufficient numbers inside the cutting unit, or felled because of safety concerns or expecting firewood cutting due to close proximity to roads. We have clarified that the intention of the snag recruit rules is that snags should be left throughout a cutting unit, and if there are factors present that prevent this, to consult with the area or Forest Management Bureau biologists to develop acceptable mitigations or alternatives.
2. Coarse/Fine Woody Debris Retention: The predominance of whole-tree yarding has forced field staff to be creative in ensuring that adequate amounts of coarse and fine woody debris are left on the site. With whole-tree yarding, processing of the tree into logs happens in isolated spots (landings) within a cutting unit where slash is often accumulated in large piles. Field staff have implemented several measures to ensure that adequate amounts of coarse and fine material remains on site, including

return skidding of coarse and/or fine material, and placement of numerous small slash piles within units.

3. Shape/Appearance of Cutting Unit Boundaries: On many of the reviews, the review teams observed cutting unit boundaries that followed straight lines and/or had "hard" edges or lines against untreated stands that do not appear natural or blend into the landscape. This is especially prevalent on scattered individual sections where cutting units often follow property ownership boundaries. We have encouraged field staff to incorporate natural terrain features, such as ridge lines or other topographical features, into cutting unit design, to "feather" edges between treated and untreated stands (increasing or decreasing the amount of leave trees at the edge of the cutting unit to blend in to adjacent stands), and to "back off" and slightly vary the shape of cutting units that are adjacent to property lines to avoid straight lines.

OLD-GROWTH

The ARM provides DNRC with a framework to manage old-growth stands to meet biodiversity and fiduciary objectives. This framework includes quantitative old-growth definitions adopted from Green et al. (1992) that require a minimum number and average age of large live trees for specific forest habitat types (Pfister et al., 1977) and cover types, and specifies the types of silvicultural treatments that the DNRC must consider when managing old growth stands.

In 2013, the Montana Legislature passed SB 154, requiring DNRC to conduct a new sustainable yield calculation. The calculation was completed in 2015. In the context of calculating annual sustainable yield, the requirements set forth by SFLMP, ARM, and HCP were applied as management constraints in an optimization model used to calculate the annual sustainable yield. Constraints are limitations placed on the model that restrict when, where, which, and how often harvesting treatments may be applied. The 2015 calculation included constraints related to operability, wildlife habitat, water resources, and timber harvest and silviculture—including old-growth.

The old-growth constraint modeled in the 2015 calculation required that each administrative unit within the Northwestern and Southwestern Land Offices maintain at least 8% of their acres as old-growth[1]. Each unit in the Central Land Office was required to maintain 4% of acres as old growth [2]. There was no specific constraint for old growth on Units in the ELO, NELO, and SLO[3]. The model was constrained to require units below the target old-growth percentage to be managed in a manner to meet the target percentage as soon as possible, and that units above the target percentage would remain above that target percentage over time. Units that currently have less than 8% old-growth were required to manage an

[1] The SFLMP Final EIS estimated a target amount of old growth between 7.2 and 9.9 percent. During initial implementation of the SFLMP, DNRC estimated that 19.8 percent of its western Montana lands were historically old growth; an 8 percent target represents just under half of that percentage and falls within the range described in the SFLMP Final EIS.

[2] An analysis conducted by DNRC in 2014 when developing the old growth constraint for the 2015 sustainable yield calculation indicated that 4 percent of DNRC's ownership in the CLO may have historically been old growth, and that was used as the target percentage.

[3] Limited amounts of both historic and current data prevent meaningful identification and comparison of old growth amounts to develop a target percentage. Additionally, most management in old growth stands in those areas would be expected to maintain the age class structure of the stand.

amount of non-old-growth acres needed to reach 8% using management pathways that would facilitate their development into old-growth stands. The constraint prohibited the selection of existing old-growth stands for regeneration harvesting that would remove them from old-growth status until the administrative unit had at least 8% old-growth. In all units, regardless of whether they were above or below the 8% threshold, old-growth maintenance and restoration treatments that would maintain a stand's old-growth status could be used in existing old-growth stands. This method of constraining the model ensured that the intended old-growth amount for each unit was met as quickly as possible and then maintained over time.

At the current annual sustainable harvest level of 56.9 MMBF, the model indicates that meeting and maintaining these objectives for old-growth on state trust lands is achievable.

In 2016, Forest Management Bureau staff conducted a series of webinars as a training/refresher for field staff regarding DNRC's approach to managing old growth stands. The material covered in those webinars was summarized in an Old Growth Handbook that was released in June 2016 to provide clear and consistent direction to implement the ARM related to old growth. Topics addressed in the webinars and Handbook include a review of the ARM and laws (MCA) related to old growth, procedures for determining a stand's old growth type according to the Green et al. (2002) definitions, procedures for identifying and field-verifying old growth stands, explanation of the target amounts of old growth and rationale for those amounts, an overview of the treatments applicable for old growth stands and strategies to design/implement them, old growth recruitment, tools for describing attribute development in old growth stands, and how to describe old growth in MEPA documents.

Old-growth Amounts

Table BD-1 compares the age class distribution for the Northwestern and Southwestern Land Offices over the past three monitoring periods (ending in 2005, 2010, and 2016)[4]. In general, the percentage of older age classes (150+ and old growth) have decrease compared to 2010, while the amount of younger age classes has increased. The increases in younger age classes are largely due to the acquisition of previously managed former industrial timberlands that are currently dominated by seedling/sapling (0-39 year) and pole timber (40-99 year) age classes. However, as Table BD-2 shows, the percentage decreases in old growth shown in Table BD-1 are somewhat artificial given that the overall acreage of old growth on State Trust Lands increased slightly between 2010 and 2016. The percentage decreases for old growth are due to the impact of land acquisitions adding acres to the total land base, while the increase in old growth acres is primarily due to updated inventory information that identified acres previously not classified as old growth to, in fact, be old growth.

Table BD-2 compares the acres of old growth on each administrative Unit in 2010 and 2016, as well as the percentage of old growth on each Unit. Updated forest inventory resulted in increases in old growth acres on some Units, particularly Dillon and Stillwater, between 2010 and 2016. On Units where old growth acres decreased, the primary causes are updated inventory information that confirmed acres previously thought to be old growth as not old growth, and timber harvesting. Relative to old growth target amounts described in the 2015 sustainable yield calculation, four Units—Dillon, Libby, Stillwater,

[4] Data for the Central, Eastern, Northeastern, and Southern Land Offices are not included, as much of those areas have not received detailed on-the-ground inventory that is necessary to determine age class.

and Swan—are above target amounts, while the remaining Units are below target amounts. On the Central, Eastern, Northeastern and Southern land offices, forest inventory is based on photo-interpreted stand data, which limits the ability to quantify detailed data for some old growth attributes. Thus, ensuring that >4% old growth amounts are maintained in these areas is addressed at the project level.

Table BD-1: Percentage of Age Class Distributions on the NWLO and SWLO by Reporting Period

Age Class (years)	SWLO			NWLO			Total		
	2005	2010	2016	2005	2010	2016	2005	2010	2016
No Age Data	5%	4%	4%	2%	2%	0%	2%	2%	2%
0-39	11%	16%	15%	12%	11%	16%	12%	13%	16%
40-99	27%	22%	27%	24%	21%	30%	25%	21%	29%
100-150	33%	33%	37%	23%	24%	33%	27%	27%	34%
150+	16%	19%	14%	28%	32%	11%	24%	28%	12%
Old-Growth	8%	6%	3%	11%	10%	10%	10%	9%	7%

Table BD-2: Old Growth Acres and Percentage by Administrative Unit, 2010 and 2016.

Land Office/Unit	Acres		Percentage	
	2010	2016	2010	2016
Central Land Office	763	2,726	1%	2%
Bozeman			0%	0%
Conrad			0%	0%
Dillon	542	2,488	2%	8%
Helena	221	238	0%	0%
Eastern Land Office			0%	0%
Miles City			0%	0%
Northeastern Land Office	68	263	0%	1%
Glasgow			0%	0%
Havre		56	0%	1%
Lewistown	68	207	0%	1%
Northwestern Land Office	29,935	30,684	10%	10%
Kalispell	2,471	1,898	5%	4%
Libby	2,652	2,721	9%	9%
Plains	420	617	1%	1%
Stillwater	12,180	16,971	10%	15%
Swan	12,211	8,477	32%	16%
Southern Land Office			0%	0%
Billings			0%	0%
Southwestern Land Office	8,649	6,289	6%	3%
Anaconda	1,612	1,373	6%	5%
Clearwater	3,090	3,355	7%	5%
Hamilton	1,386	316	7%	1%
Missoula	2,560	1,245	4%	1%
Summary Total	**39,415**	**39,962**	**5%**	**5%**

DESIRED FUTURE CONDITIONS

DNRC uses a site-specific model, described in ARM 36.11.405, to determine a desired future condition (DFC) for each forest stand it manages. Comparing a stand's current cover type to its desired cover type informs the management actions necessary to move a stand toward or maintain the desired cover type

and to meet biodiversity objectives. Table BD-3 compares current cover type percentage against desired cover type percentages for the Northwestern and Southwestern Land Offices[5]. Timberland acquisitions slightly changed DFC target percentages for some cover types between 2010 and 2016; however, overall trends remained similar to prior years. On the SWLO, there is excess in Douglas-fir, mixed conifer, and non-stocked cover types and deficiency in the ponderosa pine and western larch/Douglas-fir cover types. The non-stocked acres are burned areas, primarily in ponderosa pine types, that are in the process of regenerating. The percentage of Douglas-fir decreased slightly between 2010 and 2016, and the percentages of ponderosa pine and western larch/Douglas-fir increased, indicating that management activities are resulting in progress toward meeting desired conditions. On the NWLO, there is a large excess in the mixed conifer type and deficiencies in the ponderosa pine, western larch/Douglas-fir, and western white pine cover types. Percentages for each cover type remained relatively static between 2010 and 2016; this is likely due to the combined effects of re-inventory efforts that updated forest inventory information, timberland acquisition, and the time lag for the effects of some management activities to be observed in cover type changes.

Table BD-3: Percent of acres by cover type, 2000-2016, compared to DFC target for DNRC managed lands

Cover Type	SWLO (%)					NWLO (%)				
	2000	2005	2010	2016	DFC Target	2000	2005	2010	2016	DFC Target
Douglas Fir	21.5	21.7	23.8	22.2	14.9	2.4	5.2	5.2	5.9	1.7
Hardwoods	0.8	0.7	0.9	0.6	0.5	0.2	0.4	0.4	0.3	0.4
Lodgepole Pine	8.8	8.9	6.9	6.6	7.3	8.2	7.6	6.8	7.3	5.5
Mixed Conifer	4	4.2	4	7.7	1.4	23.8	25.1	21.9	23.9	6.2
NonStocked	0.7	6.6	11	4.3	0.0	0.7	1.8	2.7	1.5	0.0
Ponderosa Pine	45.3	39	34.4	38.3	52.5	19	18.6	18.8	17.2	24.4
Alpine Fir	3.7	3.4	3.5	3.8	0.8	13.6	13	13	13.4	8.2
Western Larch/ Douglas Fir	14.8	15.1	15.4	16.5	22.2	26.3	25.5	28.4	27.7	40.9
Western White Pine	0.2	0.1	0.1	0.1	0.5	5.6	2.9	2.9	2.7	12.7
Acres Included	157,271	158,127	157,746	206,084	206,084	284,647	293,223	293,169	304,279	-

Other Biodiversity-related Monitoring

During this monitoring period, DNRC continued with several prior monitoring efforts, including photo point monitoring on the Coal Creek State Forest of the Stillwater Unit and post-fire mortality monitoring in a Trust Lands section in the Clearwater Unit burned in the 2007 Jocko Lakes fire. The Coal Creek photo point monitoring project documents changes in vegetation and forest regeneration/growth since the 2001 Moose fire by periodically re-visiting established points to create a series of photos that show how the forest has changed since the fire. Photo points were re-visited in 2011. This monitoring effort will continue indefinitely. The Jocko Lakes post-fire mortality monitoring project was visited annually during the monitoring period to collect data regarding tree mortality, breakage, and wildlife use following the 2007 Jocko Lakes fire and subsequent salvage harvesting. Data from this project will be used to develop decision-criteria for leave-tree marking in post-fire salvage operations. This

[5] Sufficient inventory information is not yet available to make meaningful comparisons for the Central, Eastern, Northeastern, and Southern Land Offices.

monitoring effort is expected to last 10 years, with the final year of monitoring scheduled for 2017, after which time the data will be analyzed and summarized in a report for field staff.

RECOMMENDATIONS

- Continue doing biodiversity reviews to identify current issues and practices impacting biodiversity objectives and produce case-study reports or webinars highlighting individual reviews or recurrent themes that can be used to update and train field staff.

- Revise ARM 36.11.403 (48) to include the minimum requirement for basal area in each old growth types described by Green et al. (1992 and errata corrected versions). The language of the current rule does not reflect the most updated science or defining minimum criteria for old growth as described by Green et al. (1992 and errata corrected versions) and should be revised to include each of the minimum criteria. After the original Green et al. (1992) document was released, several updated versions were produced to correct errors in prior versions. One of the errors was the omission of basal area as a minimum requirement to identify potential old growth stands. Operationally, this would have no effect on DNRC's current procedures, as they began using the basal area minimum criteria in 2014 along with large tree and age requirements currently described in rule to identify and verify old growth stand on Trust Lands.

- Improve tracking of old growth maintenance, restoration, and removal for each timber sale. Currently, DNRC identifies the use of such treatments in MEPA documents, but prescriptions are often described with traditional silvicultural terminology, making it difficult to identify old growth acres treated without significant effort. DNRC has developed a harvest history shapefile, and that is a potential place where data on the usage of old growth maintenance, restoration, or removal could be easily stored and retrieved.

SILVICULTURE MONITORING

SILVICULTURE ACCOMPLISHMENTS - HARVEST BY LAND OFFICE

Table SI-1 shows timber volume and acres harvested by Land Office for each monitoring period. Average annual harvest volumes have increased steadily through each monitoring period in accordance with revised sale planning targets following sustainable yield calculations. State law requires that DNRC's annual sustainable yield also serves as its annual timber sale planning target (MCA 77-5-223). In the most recent monitoring period, the annual sustainable yield increased from 53.2 million board feet (MMBF) in 2006-2010 to 57.6 MMBF with the adoption of the HCP in 2011. In 2015, the sustainable yield decreased to 53.2 MMBF due to litigation regarding grizzly bear habitat in the Stillwater Unit. DNRC most recently calculated the annual sustainable yield in 2015, which resulted in a sale planning target of 56.9 MMBF. The most recent calculation incorporated the addition of former industrial timberland that DNRC acquired, primarily in the Blackfoot and Swan Valleys, as well as the settlement terms of the Stillwater Unit grizzly bear litigation. It is important to note that harvested volumes differ from sale planning targets for each fiscal year because harvesting often occurs in years after the sale date; as such, several sales sold during the most recent monitoring period have yet to be completed.

Table SI-1: Land office volume harvested and associated harvest acres by reporting period

Land Office	1998-2000		2001-2005		2006-2010		2011-2016	
	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)	Acres	Volume (MMBF)
NWLO	13,187	66,818	19,511	119,263	17,691	146,096	27,434	200,187
SWLO	7,191	27,739	15,202	72,205	11,277	73,815	15,437	88,371
CLO	1,611	8,525	1,900	16,190	2,625	14,883	5,447	30,936
Eastern Offices (SLO/NELO/ELO)	6,729	12,543	3,097	10,658	3,017	9,785	4,758	14,883
Total	28,718	115,625	39,710	218,316	34,610	244,579	53,076	334,377
Average Annual	9,573	38,542	7,942	43,663	6,922	48,916	8,846	55,730

FOREST IMPROVEMENT ACCOMPLISHMENTS

The FI program uses fees from harvested timber to fund management actions whose goal is to improve the health and productivity of forested lands, but that are not typically done concurrently with timber harvesting. Accomplishments of the FI program are tracked by year and activity and are shown in Table SI-1. Specific activities include piling of logging slash, prescribed burning, site preparation, seed collection, seedling production, tree planting, pre-commercial thinning, genetic tree improvement, erosion control, and culvert replacement. Net maintenance includes replacing, maintaining, or removing seedling netting used to protect against damage by big game browsing. Also included are various road maintenance activities, such as grading, snowplowing, and gate replacement.

Tree planting has decreased over the most recent monitoring period with the completion of most of the post-fire planting efforts undertaken on areas that burned in the early- and mid-2000s. The decrease in planting is also associated with an increase in the amount of brush piling for site preparation to encourage natural regeneration rather than relying on planting to regenerate harvested sites. Decreased planting levels have also allowed an increased portion of the FI program budget to be directed toward precommercial thinning (PCT), which is reflected in the increased amount of PCT compared to the past monitoring period.

The amount of slash pile burning increased compared to prior monitoring periods. The increase may be attributed to several factors, including a decreased market for pulpwood-sized material that has resulted in an increased amount of that material being left in slash piles instead hauled out for pulp, an increase in harvest levels associated with the adoption and implementation of the HCP, harvesting less volume per acre than in the prior monitoring period which requires treating more acres to reach volume targets, and from taking advantage of conducive weather/opportunities to complete leftover burning from prior years when conditions for burning were not as suitable.

Other noteworthy accomplishments of the FI program during this monitoring period include the establishment of a new tree improvement area in the Swan Unit to monitor, over a long term, the performance and survival of blister rust-resistant western white pine in an operational setting, a record cone crop collection from the Missoula ponderosa pine seed orchard in 2011, and increased use of biological control agents against noxious weeds.

Table SI-2: Forest improvement accomplishments in fiscal years 1998 through 2016.

FI Activity	Units	Reporting Period			
		1998-2000	2001-2005	2006-2010	2011-2016
Plantation Regeneration Surveys	Acres	1,778	7,421	11,531	11,426
Tree Planting	Seedlings	*	*	2,293,117	1,309,714
Tree Planting	Acres	1,509	5,103	10,400	6,623
Tree Browse Prevention	Acres	504	2,836	5,379	3,077
Precommerical Thinning	Acres	5,449	8,659	5,263	6,575
Noxious Weed Spraying	Acres	2,106	17,170	17,971	18,328
Herbicide Application	Acres	3,776	2,084	2,360	289
Brush Piling	Acres	2,214	3,064	8,280	14,653
Pile Burning	Acres	3,490	10,077	22,079	43,156
Broadcast Burning	Acres	1,782	1,207	839	665
Tree Improvement Areas Managed	Acres	58	97	130	273
Hand Brush Work	Acres	426	268	1,083	2,112
Bio-Control Treatments	Acres	0	32	1,308	2,763
Cone Collection	Bushels	195	1,237	1,282	1,588
*data not available for these periods					

LOGGING SYSTEMS

Table SI-3 compares the percentage of various logging systems used on DNRC timber sales sold in each monitoring period. This information is compiled from DNRC timber sale contracts and maintained in the DNRC's Trust Land Management System (TLMS). In the most recent monitoring period, the amount of tractor-based logging increased from 85 percent to 90 percent of harvested acres, while the amount of cable logging decrease from 13 to 10 percent. The were no sales sold that required helicopter logging between 2011 and 2016.

Table SI-3: Percentage of acres logged by logging system and monitoring period.

Period	Tractor	Cable	Helicopter
1998-2000	91	7	2
2001-2005	79	17	4
2006-2010	85	13	1
2011-2016	90	10	0

HARVEST ACREAGE BY SILVICULTURAL TREATMENT METHOD

For all timber sales sold from fiscal years 2011 through 2016, DNRC collected data on acreages that would be treated under the various silvicultural systems. This information comes from the silvicultural prescriptions prepared for each timber sale. Descriptions of these silvicultural systems can be found in the SFLMP (DNRC 1996: Appendix SCN, p. 17-18)

Table SI-4: Percentage of silvicultural treatment method based on acreage, compared to SFLMP estimate.

Silivcultural Method	SFLMP Objective	1998-2000	2001-2005	2006-2010	2011-2016
Salvage	N/A	0%	26%	17%	11%
Clearcut	10%	4%	4%	2%	4%
Seed Tree	25%	8%	13%	23%	29%
Shelterwood	5%	2%	6%	15%	22%
Selection	40%	55%	34%	24%	28%
Intermediate	20%	31%	17%	19%	6%

As with prior monitoring periods, salvage harvesting to recover timber damaged by insect and disease outbreaks and wildfire occurred on a substantial portion (11 percent) of harvested acres; however, the percentage decreased to less than half the level reported in the 2001-2005 monitoring period. Salvage harvesting occurred on 5,755 acres between 2011 and 2016. Salvage efforts related to insects and disease occurred on 4,470 acres, primarily to address damage caused by mountain pine beetle, western spruce budworm, and Douglas-fir beetle. Fire salvage took place on 1,285 acres, compared to 5,720 acres in the previous monitoring period.

All three types of even-aged regeneration harvesting—clearcut, seed, tree, and shelterwood—increased compared to the previous period, with shelterwood harvesting increasing 7 percent to 22 percent, and seed tree harvesting increasing 6 percent to 29%. Seed tree and selection harvesting are the most commonly used methods, with each used on 29% and 28% of acres harvested, respectively, during the monitoring period. The amount of partial cutting (selection and intermediate treatments) dropped from a combined 43 percent in 2006-2010 to 34 percent in the most recent monitoring period.

Excluding salvage acres, even-aged regeneration methods were used on 61 percent of acres, and partial cutting methods were used on 39 percent of acres. This is a substantially higher usage of even-aged treatments when compared to the levels estimated in the SFLMP of 40 percent for even-aged methods and 60 percent for partial cutting methods. Biodiversity field reviews have indicated that prescriptions are being selected and applied appropriately on most sites, so the increase in the usage of even-aged

methods is likely due to harvesting activities increasingly taking place in mid- and upper-elevation sites that have not been previously harvested. Mixed-severity and stand-replacing disturbance regimes are predominant on such sites, and even-aged methods are appropriately used to emulate those regimes.

RECOMMENDATIONS

- Begin storing data on harvest prescriptions in a central location. Currently, the record of harvest prescriptions for each timber sale resides on the silvicultural prescription form in each timber sale's file, making it difficult to readily compile data on the usage of harvest prescriptions. DNRC has developed a harvest history shapefile, and that is a logical place where data concerning harvest prescriptions could be easily stored and retrieve.

ROAD MANAGEMENT MONITORING

ROAD CONSTRUCTION AND MAINTENANCE

Road activities for the reporting period continued at rates previously reported which since 1998 have averaged approximately 31.8 miles of new road construction per year. Of note, road maintenance and BMP improvements increased significantly as well as road reclamation. Table RM-1 below outlines total road activities for the current reporting period as well as since the inception of the SFLMP while Table RM-2 shows road activities on a per year average.

Table RM-1: Total Road Activities by Reporting Period

Road Activity	Reporting Period			
	1998-2000	2001-2005	2006-2010	2011-2016
New Road Construction (mi)	105.9	149.0	146.7	197.0
Road Reconstruction (mi)	322.4	206.9	193.7	148.0
Road BMP Maintenance (mi)	86.4	411.7	520.6	1050.0
Road Reclamation (mi)	20.5	34.3	34.8	71.0
Total Road Activities	535.2	1836.9	2597.8	2999.0

Table RM-2: Road Activities by Reporting Period as a Per Year Average

Road Activity	Per Year Average			
	1998-2000	2001-2005	2006-2010	2011-2016
New Road Construction (mi)	35.3	29.8	29.3	32.8
Road Reconstruction (mi)	107.5	41.4	38.7	24.7
Road BMP Maintenance (mi)	28.8	82.3	104.1	175.0
Road Reclamation (mi)	6.8	6.9	7.0	11.8
Total Road Activities	178.4	160.4	179.2	244.3

ROAD INVENTORY AND MONITORING

Road inventory processes, procedures and data collection methods have been significant refined and improved during this reporting period resulting in significantly more road miles and associated infrastructure inspected. Table RM-3 below reports on the amount of road miles, crossing structures and closures that have been inventoried and inspected during the reporting period.

Table RM-3: Road Inventory Summary by Reporting Period

Inventory Feature	Reporting Period			
	1998-2000	2001-2005	2006-2010	2011-2016
Roads (miles)	225	456	681	1,949
Crossing Structures	259	325	584	5,597
Closures Inspected	606	1,035	1,702	1,533

INTERNAL BMP AUDITS

Another form of road monitoring is auditing the implementation and effectiveness of best management practices (BMPs) either during or after a timber sale is completed. BMP audit results for the current monitoring period remain consistent to those previously reported and overall, show slight improvements

since the inception of the SFLMP. Table RM-4 below shows BMP audit results for all previous and current monitoring periods while Table RM-5 shows audit results for the implementation of the Streamside Management Zone law during timber sale projects.

Table RM-4: Internal and Statewide BMP Audit Results on State Timber Harvest Projects by Reporting Period and Land Office

BMP Metric	1998-2000					2001-2005					2006-2010					2011-2016				
	NWLO	SWLO	CLO	Eastern Offices	All Lands	NWLO	SWLO	CLO	Eastern Offices	All Lands	NWLO	SWLO	CLO	Eastern Offices	All Lands	NWLO	SWLO	CLO	Eastern Offices	All Lands
Application	96%	94%	92%	97%	**96%**	98%	96%	96%	91%	**96%**	98%	97%	97%	94%	**97%**	97%	98%	95%	90%	**97%**
Effectiveness	98%	96%	95%	98%	**97%**	99%	97%	99%	91%	**97%**	99%	98%	98%	95%	**98%**	99%	98%	97%	93%	**98%**
Minor Departure	9	21	33	17	**80**	17	15	7	37	**76**	14	24	8	33	**79**	32	20	21	19	**92**
Major Departure	1	2	5	1	**9**	2	1	0	14	**17**	4	0	0	3	**7**	7	0	3	2	**12**
Gross Neglegent	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
Rated Practices	820	525	678	732	**2,755**	1,789	742	468	560	**3,559**	1,258	1,116	506	634	**3,514**	2,471	1,303	613	248	**4,635**

Table RM-5: Internal and Statewide BMP Audit Results for SMZ Law Implementation on State Timber Harvest Projects by Reporting Period and Land Office

SMZ Metric	1998-2000					2001-2005					2006-2010					2011-2016				
	NWLO	SWLO	CLO	Eastern Offices	All Lands	NWLO	SWLO	CLO	Eastern Offices	All Lands	NWLO	SWLO	CLO	Eastern Offices	All Lands	NWLO	SWLO	CLO	Eastern Offices	All Lands
Application	98%	93%	94%	78%	**91%**	99%	100%	96%	92%	**97%**	99%	97%	100%	96%	**98%**	97%	98%	98%	95%	**97%**
Effectiveness	100%	99%	100%	100%	**100%**	99%	100%	100%	100%	**100%**	100%	97%	100%	96%	**98%**	100%	99%	98%	100%	**99%**
Minor Departures	2	6	3	2	**13**	2	0	2	3	**7**	0	3	0	3	**6**	9	4	2	1	**16**
Major Departures	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	1	**1**	0	1	0	0	**1**
Gross Neglegent	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
Rated Practices	170	150	126	9	**455**	337	108	108	72	**688**	266	228	118	134	**746**	534	298	114	38	**984**

RECOMMENDATIONS

- Prioritize road inventory efforts to those watersheds that have the highest resource value as outlined in the Habitat Conservation Plan.
- Adaptatively incorporate information regarding sediment production from various road classifications (open, restricted, reclaimed) into the inventory priority and ultimately ARM's.
- Continue training and field workshops that help support the communication of roles, responsibilities and expectations of individual field staff in the road inventory process.

WATERSHED AND FISHERIES MONITORING

WATER QUALITY/QUANTITY MONITORING

Water Quality Monitoring – Stillwater State Forest

DNRC began monitoring water quality at selected sites on the Stillwater State Forest near Olney, Montana, in 1976 (Figure WS-1; Table WS-1). The objective of the monitoring program is to detect trends in discharge, nutrients, and sediments, to identify relationships between management activities and water quality, and to establish baseline values for comparison over time.

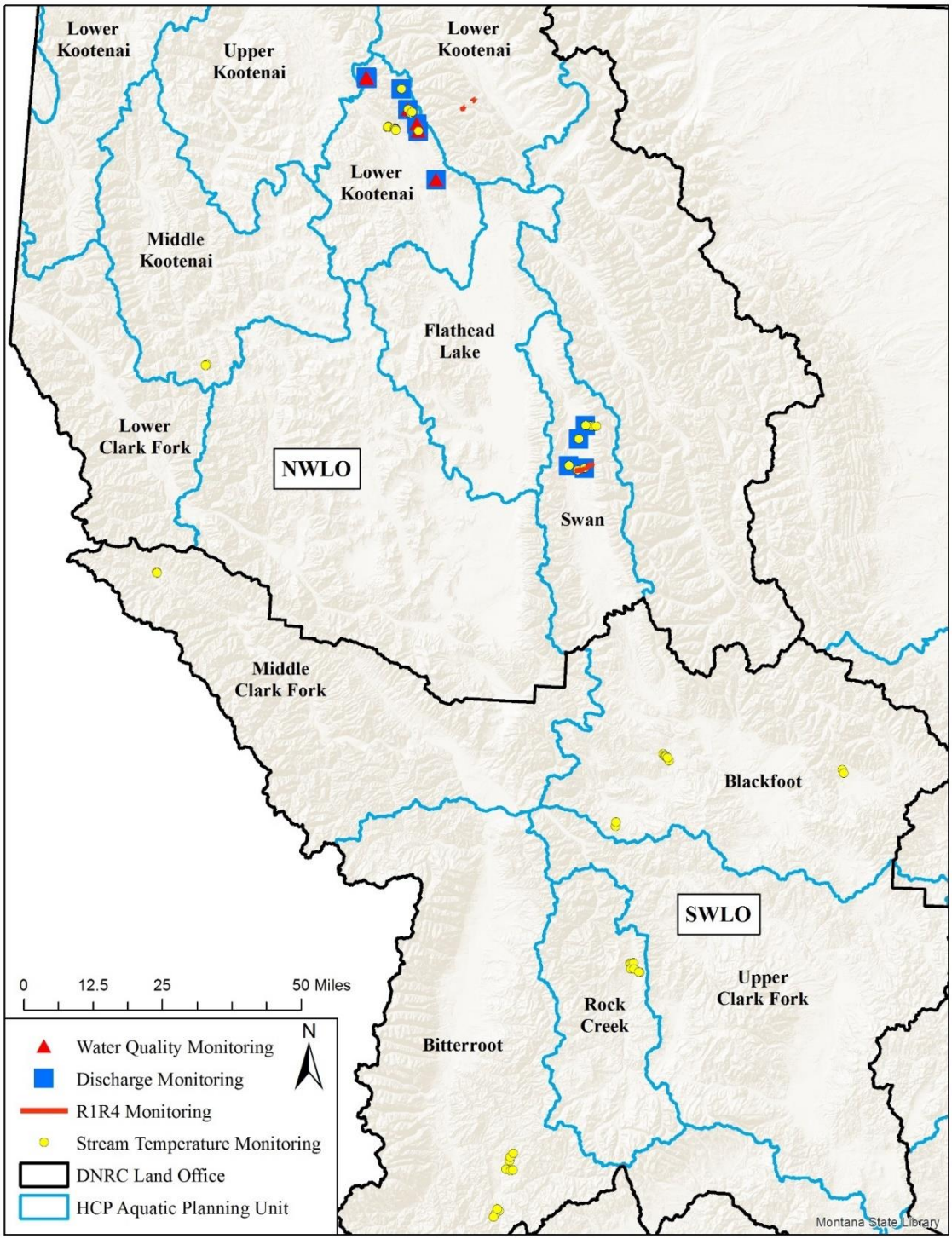
Sampling historically has occurred in both the Whitefish Lake and Stillwater River basins. During the 2011–2016 reporting period, water quality data were collected at six sites on the Stillwater State Forest weekly starting in early April and continuing through mid-June. Monitoring sites included watersheds where active forest management activities were occurring, as well as watersheds considered to be undisturbed due to the negligible amount of timber harvest and road building within the basins.

Sediments

Natural stream sediment load is largely determined by watershed soil type, the nature and extent of the streamside vegetation, stream discharge capacity, and precipitation events. Changes in any of these factors can alter the amount of sediment available to the stream, as well as the volume of sediment transported. Variation in suspended sediment concentration over time can indicate changes in water quality as phosphorus has been shown to be associated with sediment. Increases in fine sediment may also have detrimental effects on spawning success of fish, particularly native salmonids.

Yearly average total suspended solids (TSS; mg/L) on monitored streams in the Stillwater State Forest for the current reporting period are shown in Table WS-1. The majority of TSS concentrations observed during this period were within the observed range during the previous reporting period (Table WS-1). Increased levels of TSS were noted in samples collected in Lower Swift Creek in 2011, 2012, and 2016. These increases are associated with naturally-occurring mass wasting streambanks in the lower reaches of Swift Creek. Previous reports detail the relationship between the higher suspended sediment values in Swift Creek and the presence of large volumes of erosive glacial till in the lower part of the basin. Periodic increases in TSS may be explained by the lack of flushing flows followed by increased spring runoff volume during higher precipitation years. Sediment values in the upper parts of the watershed remain very low.

Figure WS-1: Stream temperature, water quality, water quantity, and stream habitat surveys conducted on state trust lands 2011–2016. Overlapping symbols indicate multiple parameters collected at the same site.



Project Specific Turbidity Monitoring

Forest Management Bureau has monitored continuous instream turbidity levels below various forest management activities for the past 8 years. The objective of these monitoring projects was to document; 1.) the magnitude and spatial extent of instream turbidity events associated with forest management projects, 2.) the effectiveness of timber sale mitigations and Best Management Practices (BMPs) and 3.) to inform adaptive management.

The forest management activities that were monitored with continuous, instream turbidity sondes include; 1.) culvert removal, 2.) stream emulation culvert installations, 3.) fish passage barrier installation, 4.) temporary and permanent bridge installations and removals, 5.) channel restoration, and 6.) riparian buffer effectiveness following regeneration harvest and prescribed burning on steep slopes. Concentration-duration-frequency analysis was performed to describe the magnitude of instream turbidity events directly below project activities and, at some monitoring locations, the spatial extent downstream.

Monitoring results have largely validated project level environmental effects assessments that forecast impacts to water quality that result from instream construction activities, such as culvert replacement. Impacts to water quality were found for very short durations and typically returned to background levels within 24 hours of instream activities. The spatial extent of downstream water quality impacts were localized at the reach scale and rapidly diminish as sediment plumes translate downstream. Results also demonstrate that timber sale mitigation measures, riparian buffers and BMPs are highly effective at mitigating effects to instream turbidity during timber harvest and instream construction activities. These findings have refined DNRC practices during instream construction activities and advised resource specialists in the design of timber sale mitigation measures, resulting in the reduction of water quality impacts during road-stream crossing construction. Future monitoring efforts hope to document annual turbidity signals at various watershed scales and management histories.

Table WS-2; Project Specific Watershed Scale Turbidity Monitoring Results

Site Name	Sample Size (days)	Turbidity Thresholds (NTU)																	
		7			20			55			150			400			1000		
		Events	Duration	% Sample	Events	Duration	% Sample	Events	Duration	% Sample	Events	Duration	% Sample	Events	Duration	% Sample	Events	Duration	% Sample
Sweede - Upper (2011)	137.4	601	7.08	5.2%	22	0.18	0.1%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Sweede - Lower (2011)	135.9	34	0.54	0.4%	2	0.01	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Harris Creek (2012)	148.9	3	0.03	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Harris Creek (2013)	182.9	55	44.17	24.1%	6	0.08	0.0%	1	0.03	0.0%	1	0.02	0.0%	0	0	0.0%	0	0	0.0%
Harris Creek (2014)	189.0	328	54.85	29.0%	189	30.69	16.2%	27	2.49	1.5%	14	0.34	0.2%	1	0.05	0.0%	0	0	0.0%
Harris Creek (2015)	168.3	2	0.01	0.0%	0	0.00	0.0%	0	0.00	0.0%	0	0.00	0.0%	0	0.00	0.0%	0	0	0.0%
Harris Creek (2016	208.0	28	0.91	0.4%	13	0.10	0.1%	2	0.01	0.0%	0	0.00	0.0%	0	0.00	0.0%	0	0	0.0%
Whitetail - Lower (2010)	176.4	39	15.9	9.3%	52	10.1	5.9%	41	5.7	3.3%	19	2	1.2%	7	0.9	0.5%	0	0	0.0%
Whitetail - Upper (2011)	170.3	5	0.09	0.1%	1	0.01	0.0%	1	0.01	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Whitetail - Middle (2011)	148.5	4	0.05	0.0%	2	0.01	0.0%	2	0.01	0.0%	0	0	0.0%	0	0	0.0%	0	0	0.0%
Whitetail - Lower (2011)	141.6	5	0.06	0.0%	4	0.06	0.0%	3	0.03	0.0%	3	0.02	0.0%	0	0	0.0%	0	0	0.0%
Ashby Creek Lower (2012)	135.5	255	14.07	6.1%	33	1.62	0.7%	16	0.63	0.3%	6	0.3	0.1%	1	0.07	0.0%	0	0	0.0%
Ashby Creek Lower (2013)	230.1	402	46.67	21.8%	209	13.97	6.5%	156	6.85	3.0%	130	4.81	2.2%	85	3.37	1.6%	51	2.40	1.1%
Ashby Creek Lower (2014)	213.9	367	85.74	40.1%	110	30.28	14.2%	26	4.53	2.1%	12	0.65	5.6%	2	0.04	0.9%	0	0.00	0.0%
Ashby Creek Lower (2015)	189.7	205	14.79	7.8%	17	1.69	0.9%	10	0.51	0.3%	1	0.07	0.0%	0	0.00	0.0%	0	0.00	0.0%
Ashby Creek Upper (2014)	214	360	75.06	35.1%	182	38.03	17.8%	43	15.90	7.4%	58	7.78	3.6%	10	3.06	1.4%	6	1.28	0.6%
Ashby Creek Upper (2015)	181.3	188	9.20	5.1%	19	1.50	0.8%	12	0.56	0.3%	5	0.13	0.1%	3	0.03	0.0%	2	0.01	0.0%

Nutrients

Studies of Whitefish and Flathead Lakes have concluded that increases in nutrient concentrations will further stimulate algal productivity and should be minimized. Currently, Montana DEQ does not have a numeric standard for phosphorous and other nutrients in surface water during the portion of the year when samples are collected (MTDEQ 2014) because adequate information is not yet available to develop specific numeric standards. The Environmental Protection Agency (EPA) recognizes that numerical water quality standards for phosphorus must be developed on a site-specific basis. For comparison purposes, the phosphorus and total nitrogen targets for the Clark Fork River below the confluence with the Blackfoot River are 39 and 300 parts per billion respectively (Tristate Implementation Council 2010).

Phosphorus

One of the primary objectives of the water quality monitoring on the Stillwater State Forest is to attempt to understand the relationship between forest management activities and phosphorus concentrations being delivered to downstream waterbodies. Table WS-1 shows the values for average total phosphorus and soluble reactive phosphorus (SRP) concentrations collected during the period of record for each station. There appears, from this data, to be poor correlation between forest management activities and SRP concentrations. For example, Chicken Creek (STSF03) and Chepat Creek (STSF08), which have had very little timber harvest and road building activity, show concentrations near or above those of streams where recent timber harvest and road construction have taken place. During this reporting period, total phosphorus levels exceeded 39 ppb in 84 samples (20.5% of total), the majority of which occurred during 2015 and 2016. Exceedances were noted in both managed and unmanaged watersheds during this reporting period. Over 90% of the observed exceedances occurred at three sites in West Fork Swift and Swift creeks. No correlation between total phosphorus and TSS was noted during the current reporting period.

Nitrogen

From the data collected, nitrate-nitrite levels do not correlate with TSS or phosphorus. Monitoring data show the general decrease through the season, independent of discharge. This likely reflects the ability of riparian plants to take up nitrates and nitrites as the growing season progresses.

Since 2011, DNRC has collected 408 samples on the Stillwater State Forest at the 6 monitoring sites. Approximately 70 percent of these samples (276 of 408) had nitrate-nitrite levels at or below the reporting level of 0.05 milligrams per liter (also reported as parts per million). One sample collected during the current reporting period exceeded levels identified for the Clark Fork River (300 ppb) and occurred in West Fork Swift Creek in April 2011 (910 ppb). All samples exhibited levels well below the limit for drinking water standards in Montana, which is 10 milligrams per liter (parts per million) or 10,000 micrograms per liter (parts per billion).

Table WS- 2: Period of record for water quality monitoring stations on the Stillwater State Forest.

			Reporting Period													
			2006-	2011		2012		2013		2014		2015		2016	
Metric	Site Name	Period of Record	2010	Avg	Range	Avg	Range	Avg	Range	Avg	Range	Avg	Range	Avg	Range
TSS (mg/L)	West Fk Swift	1976-97, 2006-16	6.0	4.8	(0.5–14)	10.4	(0.5–41)	2.5	(0.5–8)	3.3	(0.5–9)	3.9	(1–18)	3.5	(1–11)
	Chicken	1976-2016	3.5	3.0	(0.5–20)	2.4	(1–10)	1.5	(0.5–10)	1.1	(0.5–2)	1.3	(0.5–3.0)	1.9	(0.5–7)
	Middle Swift	1980-2016	10.6	11.0	(0.5–37)	16.1	(0.5–53)	7.1	(0.5–25)	8.8	(2–19)	5.3	(1–18)	10.8	(3–67)
	Lower Swift	1976-2016	59.2	80.5	(6–447)	87.6	(6–384)	48.2	(4 –278)	57.6	(9–138)	22.8	(7–153)	254.6	(10–2150)
	Chepat	1976-2007, 2014-16	3.7	-	-	-	-	-	-	1.1	(0.5–2)	1.0	(0.5–3)	2.5	(0.5–15)
	Fitzsimmons	1976-2007, 2014-16	4.0	-	-	-	-	-	-	2.7	(0.5–8)	2.0	(0.5–6)	2.3	(0.5–6)
Total Phosphorus (ppb)	West Fk Swift	1976-97, 2006-16	6.8	3.5	(1–7)	11.5	(2–38)	4.4	(0.5–14)	5.1	(3–9)	68.5	(40–90)	59.2	(20–130)
	Chicken	1976-2016	11.5	7.4	(6–11)	11.6	(4–19)	9.2	(6–16)	11.4	(9–14)	13.9	(0.5–30)	11.9	(0.5–60)
	Middle Swift	1980-2016	10.8	3.8	(0.5–12)	16.4	(4–48)	5.6	(2–18)	6.8	(4–14)	63.8	(40–80)	58.5	(30–90)
	Lower Swift	1976-2016	29.4	13.1	(4–51)	40.1	(7–209)	16.2	(3–76)	20.9	(7–42)	42.3	(30–60)	58.5	(20–290)
	Chepat	1976-2007, 2014-16	8.3	-	-	-	-	-	-	5.6	(4–9)	1.2	(0.5–10)	3.5	(0.5–30)
	Fitzsimmons	1976-2007, 2014-16	6.1	-	-	-	-	-	-	4.4	(2–7)	25.4	(10–50)	23.1	(0.5–70)
Soluble Phosphorus (ppb)	West Fk Swift	1976-97, 2006-16	5.5	1.1	(0.5–3)	3.9	(2–6)	1.3	(0.5–5)	2.9	(1–4)	2.8	(2–4)	2.4	(0.5–4)
	Chicken	1976-2016	8.2	5.2	(4–8)	7.8	(2–12)	6.4	(5–8)	8.7	(3–11)	8.4	(2–10)	7.6	(4–9)
	Middle Swift	1980-2016	4.3	1.5	(0.5–3)	5.4	(3–10)	1.9	(0.5–3)	2.9	(2–4)	2.8	(2–7)	2.0	(1–4)
	Lower Swift	1976-2016	5.9	3.2	(0.5–5)	8.9	(3–27)	2.9	(2–4)	4.1	(2–6)	2.9	(2–5)	4.0	(2–11)
	Chepat	1976-2007, 2014-16	3.0	-	-	-	-	-	-	3.9	(2–6)	3.4	(2–5)	2.5	(0.5–3)
	Fitzsimmons	1976-2007, 2014-16	2.7	-	-	-	-	-	-	2.7	(2–4)	2.8	(2–9)	1.6	(0.5–3)
Nitrate-Nitrite (ppb)	West Fk Swift	1976-97, 2006-16	80.5	95.4	(5–170)	104.3	(50–180)	63.6	(20–90)	94.3	(50–130)	3.6	(2–5)	7.5	(4–21)
	Chicken	1976-2016	16.4	8.2	(5–50)	51.1	(5–100)	11.4	(5–30)	35.4	(5–60)	9.2	(2–14)	13.1	(9–23)
	Middle Swift	1980-2016	50.2	54.3	(5–70)	78.6	(30–100)	50.7	(30–70)	87.1	(60–130)	4.4	(2–9)	12.9	(4–57)
	Lower Swift	1976-2016	38.5	61.8	(5–290)	57.9	(10–100)	26.4	(5–50)	50.7	(30–70)	5.9	(2–19)	103.0	(5–910)
	Chepat	1976-2007, 2014-16	12.8	-	-	-	-	-	-	20.4	(5–40)	4.2	(3–8)	6.4	(3–16)
	Fitzsimmons	1976-2007, 2014-16	20.0	-	-	-	-	-	-	49.3	(20–80)	3.5	(2–9)	5.3	(2–12)

Discharge Monitoring

Discharge monitoring on the Stillwater and Swan River state forests have been collected intermittently between 1976 and 2017 (Figure WS-1; Table WS-3). Monitoring efforts prior to 2015 utilized fixed staff gages which were utilized to develop rating curves to estimate discharge during weekly water quality sample collections between April and June. Beginning in 2015, stage height recorders were used to collect water level at 30-minute intervals between March and November. Increasing the sensitivity of discharge monitoring will provide more robust estimates of stream discharge data by identifying short-term increases in discharge resulting from precipitation events which may not have been captured by the previous monitoring methodology. Stage height recorders were installed in the six sites on the Stillwater State Forest in 2015, with the additional six sites on the Swan River State Forest installed in 2016 and 2017. Due to the change in methodology, rating curves have not been fully established for these sites and early monitoring data will not be presented in this report. Discharge monitoring results will be included during the next reporting period.

RECOMMENDATIONS

- Continue collection of long-term water quality datasets in the Stillwater State Forest
- Develop potential partnerships to analyze and synthesize DNRC water quality data to evaluate forest management practices in relation to sediment, nutrient, and discharge data
- Continue to utilize remote stage height data recorders to increase the accuracy of discharge data.
- Establish precipitation monitoring data in concert with discharge estimates to establish more robust estimates of water yield.

Table WS-3: Ongoing stream discharge monitoring sites on the Stillwater and Swan River state forests.

Watershed	Site	Period of Record
Stillwater	Fitzsimmons Creek	1976-2007, 2014-2017
	Chepat Creek	1976-2007, 2014-2017
	East Fork Swift Creek	1976-1983, 2003-2007, 2009-2013, 2015-2017
	West Fork Swift Creek	1976-1983; 2006-2017
	Swift Creek; Middle	1976-2017
	Swift Creek; Lower	2007-2017
Swan	South Fork Lost Creek	2016-2017
	Soup Creek	2016-2017
	Goat Creek	2016-2017
	Whitetail Creek	2016-2017
	South Woodward Creek	2016-2017
	Woodward Creek	2016-2017

FISHERIES MONITORING

Bull Trout Monitoring on the Coal Creek, Stillwater, and Swan River state forests

In August 1988, the Flathead Basin Commission sponsored a study to address questions regarding potential impairment of water quality and fisheries from past and present forest management in the Flathead Basin. The fisheries study module was completed in 1991 and suggested direct or indirect linkages between measures of on-the-ground activity and fish habitat parameters and fish populations. Results from FY11 to FY16 are detailed in this subsection.

Spawning redd counts were conducted in streams where spawning by bull trout and known or suspected. Substrate score is a subjective assessment of streambed surface conditions and is an indicator of juvenile bull trout rearing habitat quality. Juvenile bull trout prefer streambed substrate in the cobble to boulder particle size range for daytime cover (Baxter and McPhail 1997). Particle size and the percentage of fine materials filling interstitial spaces (embeddedness) at the streambed surface are visually assessed. Low substrate scores indicate smaller streambed particles and greater embeddedness. Bull trout rearing habitat may be threatened when substrate scores are below 10 and may be impaired when substrate scores are below 9. McNeil coring is a measurement of the proportion of various particle sizes within streambed gravels (McNeil and Ahnell 1964). McNeil core results are an indicator of risk of bull trout alevin entombment and general bull trout and westslope cutthroat trout spawning habitat quality. Bull trout and westslope cutthroat trout spawning habitat may be threatened or impaired when McNeil core results indicate that the percentage of fine particles (<6.35 mm) are greater than 35% or 40%, respectively.

Bull trout redd counts are one measure of the species' population status, results from the FY11 to FY16 monitoring period are shown in Table F-1. During the current reporting period, redd counts generally decreased across both state-owned lands and lands held in other ownership. These findings are similar to results from the previous reporting period, indicating continuing basin-wide declines in bull trout in the Swan River watershed. While these findings indicate general declines in bull trout spawning abundance, the mechanism behind those declines may be related to broader watershed conditions. Results from both substrate score and McNeil core samples indicate generally stable trends in the spawning and rearing environment during the current reporting period, suggesting that declines may be driven by factors other than habitat suitability. Bull trout redd counts in the Flathead River watershed were generally stable or increasing slightly during the reporting period. Observed declines in the Swan River indicate that the lake trout population in Swan Lake may be having an impact on the overall population in the watershed.

Since 1996, bull trout and westslope cutthroat trout spawning habitat conditions have been monitored in streams throughout the Swan River, Stillwater, and Coal Creek State Forests. Streambed habitat conditions for bull trout rearing (substrate score) during this monitoring period were greater than thresholds of concern, with the exceptions of Coal and Soup creeks. Substrate scores observed in Coal Creek were greater than 10.0 from 2010–2012 and 2014, however values fell below 10.0 into the threatened range in 2013 (9.7) and 2015 (9.8). The average during this monitoring period was above the threshold of 10.0 and increased in comparison to the previous 10-year period. Soup Creek substrate scores remained in the threatened range (9.0-10.0) throughout this reporting period and have declined in comparison to the previous 10-year period. During the previous 10-year period, substrate scores in Squeezer and South Woodward creeks were in the threatened category. During this monitoring period, substrate scores increased in both watersheds, improving the status to no longer being threatened.

Table F-1: Bull trout redd counts, substrate score, and McNeil Core results from the Coal Creek, Stillwater, and Swan River state forests. Threatened (orange) or impaired (red) spawning or juvenile rearing habitat metrics are identified for each monitoring site.

Metric	Watershed	Site	Period of Record	2006-2010 Average	Reporting Period					
					2011	2012	2013	2014	2015	2016
Bull Trout Redd Counts	NF Flathead	Coal	1980-2016	5.4	4	6	11	23	4	9
		Cyclone	1993-2016	0.0	4	3	4	2	0	0
	Stillwater	Swift	1994-2016	6.3	5	3	6	5	8	5
		West Fork Swift	1993-2016	6.6	7	8	4	7	6	6
		Stillwater	1994-2016	17.6	17	24	13	25	19	29
		Fitzsimmons	2007-2016	6.0	6	14	11	17	12	16
	Swan	Squeezer	1982-2016	91.6	36	39	55	55	47	35
		Goat	1982-2016	68.6	57	13	27	19	37	18
		Soup	1991-2016	8.2	4	3	4	3	--	6
		South Lost	2012-2016	--	--	--	25	11	14	14
		Woodward[1]	1991-2016	80.0	67	42	56	80	102	94
Substrate Score	NF Flathead	Coal	1984-2016	9.5	10.2	10.5	10.8	9.7	10.0	9.8
		Cyclone	1995-2016	10.4	10.4	10.7	11.0	11.4	11.2	11.0
	Stillwater	Swift	2002-2016	12.3	12.1	12.4	12.7	12.7	12.5	12.4
		West Fork Swift	1994-2016	11.6	11.8	12.1	11.9	12.6	12.2	12.0
		Stillwater	1992-2016	11.7	12.3	12.5	12.8	12.7	12.6	12.5
		Fitzsimmons	2008-2016	13.6	13.1	12.9	13.2	13.3	12.9	12.7
	Swan	Squeezer	1988-2016	9.8	10.9	11.1	10.8	10.4	10.1	10.0
		Goat	1988-2016	11.3	11.4	11.7	11.4	11.1	11.4	11.2
		Soup	1992-2016	9.2	9.0	9.2	9.0	9.1	9.2	9.0
		South Lost	1994-2016	11.7	11.5	11.9	12.0	11.8	12.0	11.7
		South Woodward	1996-2016	10.4	10.9	11.4	11.8	11.5	11.0	10.7
		Woodward	1997-2016	10.0	10.4	10.9	10.6	10.4	10.2	10.0
McNeil Core	NF Flathead	Coal	1981-2016	40.5	31.6	33.8	32.8	35.5	35.8	nd
		Cyclone	1995-2016	33.8	32.2	33.4	35.1	36.8	--	nd
	Stillwater	Chepat	2014-2015	--	--	--	--	25.1	26	nd
		Swift	2001-2016	32.3	32.6	31.3	34.1	27.4	28.7	nd
		West Fork Swift	1997-2016	31.1	31.1	30.1	29.4	27.9	31	nd
		Lower Stillwater	1992-2016	27.5	29.2	30.8	28.7	31.2	32.7	nd
		Upper Stillwater	1992-2016	25.0	--	29.5	27.4	30.8	32	nd
		Fitzsimmons	2011-2016	--	28.1	26.9	25.1	26	26.3	nd
	Swan	Squeezer	1987-2016	32.7	30.6	33.4	29.7	30.4	31.2	30.8
		Goat	1987-2016	32.8	28.9	28	31.4	29	31.2	30
		Soup	1993-2016	36.2	39.4	38.4	37.6	35.4	35.6	29.3
		South Lost	1994-2016	31.3	32.1	27.5	24.2	26.6	31	30.3
		South Woodward	1996-2016	30.5	28.2	35.4	32.2	29	30.5	29.8
		Woodward	1996-2016	34.2	36.4	38.8	32.8	41.3	41.7	35.3

[1] Redd Count includes South Woodward Creek

Evaluating long-term trends in substrate score remains imprecise, however, evolving datasets from continuously surveyed reaches allow for inference in comparing state ownership to adjacent non-state owned lands. Generally, substrate scores have been lower on state trust lands than on adjacent ownership. Results may be a consequence of watershed geology, fire, forest management history, or sample size. Substrate scores in the Coal Creek, Stillwater, and Swan state forests generally were stable or improved during this reporting period in comparison the previous 5 years of data (Table F-1). Declines in average substrate score during the reporting period were noted in Soup (-0.7), and Fitzsimmons (-0.6) creeks.

McNeil core samples provide an index of spawning substrate conditions available to bull trout during spawning. Core sample values greater than 35% fine sediment are considered threatened, while values greater than 40% are considered impaired (Weaver and Fraley 1991). Samples are collected during the spring following spawning, prior to snowmelt and runoff, but after bull trout emergence. During this monitoring period, core results indicated threatened status in streams on the Coal Creek and Swan state forests (Table F-1). Both Coal and Cyclone creeks exhibited threatened levels for spawning years 2012–2015, these exceeded the 35% threshold by less than 2% in all cases and were similar to, or dramatically improved on average during the reporting period. Several streams in the Swan State Forest fell into the threatened status including; Soup (2012–2014), South Woodward (2011), Squeezer (2010, 2011–2012), and Woodward (2010–2011, 2015) creeks. Woodward Creek was the only stream surveyed on forested state trust lands that exceeded 40%, exceeding the impaired threshold in 2013 (41.3%) and 2014 (41.7%).

Similar to substrate score, evaluating long-term trends McNeil core trends on forested state trust lands remains difficult due to the number of factors influencing this variable. Average annual McNeil core results for streams within or immediately adjacent to forested state trust lands appear to be consistently lower than those found in adjacent streams with other ownerships in the Flathead River headwaters (Big, North Coal, South Coal, Whale, Trail, Granite, Challenge, Langford, and Meadow creeks) and Swan River drainage (Lion, Jim, and Elk creeks). This result may be the consequence of those variables described above for substrate score. Average McNeil core results on forested state lands has generally been stable over the last decade, while streams on adjacent land ownerships have shown a gradual increase (Table F-1).

Inconsistencies observed in the trends in bull trout redd count, substrate scores, and McNeil core samples suggests that the bull trout populations in both the Flathead and Swan river basins are likely affected through a combination of episodic climate events and local stream habitat conditions. Additionally, adfluvial bull trout in the Swan River basin have been subject to increased competitive effects of non-native species through competition, predation, and hybridization. These effects have impacted all life stages of bull trout in the watershed including spawning and rearing habitat in the headwaters, as well as lower elevation habitat in the mainstem Swan River and Swan Lake (MFWP 2017).

R1/R4 Fisheries Habitat Inventory

The R1/R4 Fish Habitat Standard Inventory (Overton et al 1997) is a widely used protocol for describing existing conditions and temporal changes in the different stream habitats used by bull trout, westslope cutthroat trout, and other native fisheries. The variable amounts of slow and fast fish habitats, large woody debris frequency and volume, sediment class abundance, and streambank stability are some of the important variables assessed during the inventories. All data has been georeferenced for the fisheries program monitoring database - especially for rapid utilization in project-level assessments, the Fish Passage Assessment Project, and pre- and post- project RMZ monitoring.

The data obtained from the R1/R4 inventories is primarily from known bull trout and westslope cutthroat streams, and this information has been used in the analyses of various DNRC project-level environmental assessments. Inventory data collected during FY11 through FY16 in Goat and Squeezer creeks was used in the Scout Lake Multiple Timber Sale Project Environmental Impact Statement. Surveys in the unnamed

tributaries to Coal and Cyclone creeks provided data to support proposals and design of fish passage improvements on those two creeks. Large woody debris data from stream inventories has been integral in the development of aquatic conservation strategy analysis for the Habitat Conservation Plan for Forested State Trust Lands (DNRC 2010). These data will also be used in the future to monitor habitat and large woody debris trends, and therefore, the accuracy of past and present environmental analyses of potential impacts to bull trout and westslope cutthroat habitat (DNRC 2010).

Table F-2: R1/R4 stream habitat inventory collected on the Swan River and Coal Creek state forests.

Watershed	Stream	Objective	Length Surveyed (miles)	LWD / 1000 ft	% Fast Water Habitat	% Slow Water Habitat
Swan	Goat Creek	Timber Sale	4.6	32.4	70	30
	Squeezer Creek	Timber Sale	4.8	37.3	69	31
NF Flathead	Tributary to Coal Creek	Fish Habitat	0.75	45.4	54	46
	Tributary to Cyclone Creek	Fish Habitat	0.75	45.3	76	24

Riparian Harvest Monitoring

The effects of riparian management zone (RMZ) timber harvest on stream habitat typically occurs through alteration of recruitment regimes of large woody debris (LWD) to streams or through the reduction of stream shading by riparian vegetation. Pre-harvest data were collected to establish baseline stream habitat conditions, with post-harvest data collected at least one year after completion of timber harvest prescriptions. Monitoring sites were established to encompass timber harvest treatment units. After establishment of each site, LWD surveys were conducted according to R1/R4 monitoring protocol during which any piece of woody material greater than 0.1 m diameter and at least 3.0 m or two-thirds of the wetted width was counted. Stream shading (ACD) was measured using a Solar Pathfinder, which provides hourly measurements of solar radiation inputs to the stream during June, July, August, and September. Shade measurements were taken at a minimum of 4 locations at each RMZ site, at a set distance interval in an effort to collect representative samples throughout the monitoring site.

Large woody debris RMZ monitoring was completed at 13 sites during the current reporting period. LWD loading levels generally met targets for various forest types based on modelling conducted during development of the HCP (DNRC 2009). Across all monitoring sites, LWD pre-harvest loading rates averaged 70.8 pieces/1000' of stream (Range: 7.6–138.1). Baseline conditions at one pre-harvest monitoring site did not reach target loading levels for the forest type, however, post-harvest LWD monitoring indicated a significant increase in LWD associated with the timber harvest with current levels exceeding target loading rates. Average post-harvest LWD loading rates were 81.7 pieces/1000' of stream (Range: 17.9–150.2). Three sites indicated reductions in LWD loading, two of which were less than 5.2%, with the remaining site decreasing by 21.8%. While reductions were noted, loading rates remained above goals identified for the respective forest types. Based on these results, current riparian timber harvest strategies are meeting goals for maintaining adequate levels of LWD recruitment to streams.

Pre-harvest ACD measurements were collected at 12 sites during the current reporting period. Average pre-harvest ACD at all monitoring sites was 69.8% (Range; 43.5–89.3%). Average post-harvest ACD at the 12 monitoring sites was 69.1% (Range; 48.0–83.8%). The average change in ACD was a reduction of 0.7%, with declines noted in 8 sites (Average: -8.4%; Range: -2.0 – -26.8%) Increased shading was noted in 4 sites (Average: 14.6%; Range: 0.8–29.3%). In combination with RMZ stream temperature monitoring results,

these results indicate that riparian timber harvest strategies are providing sufficient stream shading to maintain suitable stream temperature ranges capable of supporting aquatic species.

Table F-3: Large woody debris and stream shade monitoring conducted in stream reaches adjacent to riparian management zone harvest on the NWLO, SWLO, and CLO.

Watershed	Site Name	LWD/1000' stream			Average Monthly Shade		
		Pre	Post	% Change	Pre	Post	% Change
Stillwater	Dog Creek, Upper	122.6	135.5	10.5	89.3	82.3	-7.0
	Dog Creek, Lower	96.5	91.5	-5.2	83.3	77.5	-5.8
	Tributary to Dog Creek, North	73.4	114.0	55.3	85.8	83.8	-2.0
	Tributary to Dog Creek, South	87.3	105.1	20.4	--	--	--
	Swede Creek	138.1	150.2	8.8	77.3	78.8	1.5
Rock Creek	Tributary to Willow Creek	7.6	28.8	278.9	74.8	48.0	-26.8
	Beaver Creek, Upper	63.9	107.4	68.1	82.5	70.8	-11.8
	Beaver Creek, Lower	9.2	17.9	94.6	55.5	56.3	0.8
	Bear Creek	28.7	34.4	19.9	56.0	53.3	-2.8
Upper Missouri	Dingley Creek, Upper	120.4	94.1	-21.8	47.3	76.5	29.3
	Dingley Creek, Lower	112.1	107.7	-3.9	43.5	70.5	27.0
Blackfoot	Bear Creek	28.7	34.4	19.9	72.3	65.3	-7.0
Middle Clark Fork	East Fork Timber Creek	31.8	41.1	29.2	70.5	66.3	-4.3
Middle Kootenai	Colonite Creek	139.0	--	--	87.0	--	--

Stream Temperature Monitoring

The DNRC stream temperature monitoring program on state trust lands began June 2001 in an effort to monitor land management activity effects on stream shading and subsequently stream temperature. Stream temperature monitoring sites included in this report are found in Table F-4, and include ongoing, completed, or discontinued efforts on 26 streams, focused on management actions including; 1) riparian management zone timber harvest, 2) post-wildfire recovery, 3) grazing exclosure, and 4) long-term trend monitoring.

Post-timber sale stream temperature monitoring has been completed at 10 sites on 7 streams, which include a variety of forest cover types ranging from lodgepole dominated, semi-arid watersheds, to cedar dominated temperate watersheds. Initial results indicate that the majority of timber harvest in the riparian management zone has had minimal effect on stream temperature.

Post-fire monitoring of Lyman, North Fork Cameron, and Praine creeks indicates that the riparian community had largely recovered within the first 3–4 years post-fire and temperatures continue to be stable or generally cooling.

Monitoring of the grazing exclosure in North Fork Blanchard Creek indicates that this stream is generally cooling and contributing to significantly lower rates of change in stream temperature. Temperatures trends have remained stable in mainstem Blanchard Creek since construction of a grazing exclosure. Monitoring in the Ashby Creek grazing exclosure has not shown the cooling effect that was observed during the first few years of cattle exclusion in Blanchard and North Fork Blanchard Creek. One season of monitoring data was collected in 2014 in Andrews Creek following completion of a grazing exclosure.

Complete status reports for all stream temperature monitoring on state trust lands can be found in DNRC FMB – Stream Temperature Monitoring and Summary (DNRC 2017).

RECOMMENDATIONS

- Continue to provide support for collection of bull trout population metrics in the Stillwater and Swan River state forests.
- Remain involved in the Swan Valley Bull Trout Work Group and associated Lake Trout Suppression efforts in Swan Lake.
- Evaluate potential restoration of sites designated as threatened or impaired for bull trout spawning and rearing habitat.
- Increase post-harvest LWD and ACD data collections at RMZ sites on 5-, 10-, and 25-year intervals to evaluate long term LWD loading and ACD following timber harvest.
- Establish a 5-year planning list for continued collection of R1/R4 datasets to inform forest management activities and fisheries monitoring.
- Establish several RMZ monitoring sites to continue to build monitoring datasets to inform timber management activities.
- Develop a stream temperature monitoring protocol to continue to grow long-term datasets to monitor trends associated with climate change.

Table F-4: Stream temperature monitoring sites on DNRC lands associated with riparian timber harvest, post-wildfire recovery, grazing exclosure construction, and long-term trend monitoring between 2011–2016.

Watershed	Site	Period of Record	Monitoring Locations	Monitoring Objective	Status
Stillwater	Dog Creek	2013–2016	4	Riparian Timber Harvest	Complete
	North Tributary to Dog Creek	2007–2012	2	Riparian Timber Harvest	Complete
	South Tributary to Dog Creek	2007–2012	2	Riparian Timber Harvest	Complete
	Swede Creek	2012–2015	2	Riparian Timber Harvest	Complete
	East Fork Swift Creek	2001–present	1	Long Term Trend	Ongoing
	West Fork Swift Creek	2001–present	1	Long Term Trend	Ongoing
	Swift Creek	2001–present	1	Long Term Trend	Ongoing
Swan	South Fork Lost Creek	2004–2011	3	Riparian Timber Harvest	Complete
	South Fork Lost Creek	2001–present	1	Long Term Trend	Ongoing
	Woodward	2003–present	1	Long Term Trend	Ongoing
	Goat Creek	2001–present	1	Long Term Trend	Ongoing
	Squeezer Creek	2001–present	1	Long Term Trend	Ongoing
	Soup Creek	2001–present	1	Long Term Trend	Ongoing
Bitterroot	Lyman Creek	2001–2015	3	Post-wildfire Recovery	Discontinued
	North Fork Cameron Creek	2001–2015	3	Post-wildfire Recovery	Discontinued
	Praine Creek	2001–2015	3	Post-wildfire Recovery	Discontinued
	Andrews Creek	2014	1	Grazing Exclosure	Discontinued
Blackfoot	Beaver Creek	2009–2011	2	Riparian Timber Harvest	Discontinued
	Blanchard Creek	2003–2015	3	Grazing Exclosure	Discontinued
	North Fork Blanchard Creek	2003–2015	3	Grazing Exclosure	Discontinued
	Ashby Creek	2012–15, 2017	2	Grazing Exclosure	Discontinued
Rock Creek	Bear Creek	2010–2014	2	Riparian Timber Harvest	Complete
	Beaver Creek	2010–2014	4	Riparian Timber Harvest	Complete
	Tributary to Willow Creek	2010–2014	2	Riparian Timber Harvest	Complete
Middle Clark Fork	East Fork Timber Creek	2013–2016	2	Riparian Timber Harvest	Complete
Middle Kootenai	Colonite Creek	2014–present	2	Riparian Timber Harvest	Ongoing

WILDLIFE MONITORING

DNRC PARTICIPATION IN WILDLIFE WORKING GROUPS

During the monitoring period from 2011 to 2016, DNRC biologists participated on the following interagency committees and working groups: the Grizzly Bear Northern Continental Divide Ecosystem (NCDE) Subcommittee, NCDE Conservation Strategy Team, the Swan Valley Grizzly Bear Conservation Agreement Technical Monitoring Team, Swan Liaison Team, U.S. Fish and Wildlife Service Fisher Stakeholder Information Acquisition Group, Western States Wolverine Conservation Baseline Survey Team, Montana Bald and Golden Eagle Work Group, Harlequin Duck Working Group, Partners in Flight, and the Montana Common Loon Work Group.

THREATENED AND ENDANGERED SPECIES MONITORING

In 2011, DNRC initiated implementation of the DNRC Forest Management Habitat Conservation Plan (HCP). Compliance with the HCP requires that DNRC conduct annual and 5-year monitoring and reporting on implementation of conservation measures and their effectiveness to the U.S. Fish and Wildlife Service (USFWS). This monitoring now provides the primary basis for the monitoring of federally listed threatened and endangered species associated with the DNRC forest management program for the 50-year life of the plan. DNRC conducted annual meetings with the USFWS from 2012 to 2016. Annual monitoring reports were also provided to the USFWS during this period and the first 5-year monitoring report was completed and submitted in June 2018.

BALD EAGLE MONITORING

From 2011 to 2016 DNRC biologists on the NWLO and SWLO surveyed 4 to 15 territories annually. During this period, at least 19 young bald eagles were reared to fledgling age. Results were submitted to the MFWP bald eagle monitoring coordinator for inclusion in interagency annual reports.

During the monitoring period from 2011 to 2014, the number of known territories monitored by the Bald Eagle Working Group expanded from 627 to 713. In 2014, there were 376 known active nests of which 199 were successful in fledging young (MBEWG 2016). Between 2011 and 2014, nesting success averaged 81% and ranged from 78% in 2014 to 85% in 2013. To date, bald eagle conservation has been very successful in Montana (MBEWG 2016).

With the increase in Bald Eagle nesting pairs in Montana, the Bald Eagle Working Group found it necessary to streamline data collection for this species. Fish, Wildlife & Parks and the Montana Natural Heritage Program (MNHP) are collecting and reporting monitoring data through the online MNHP data collection and reporting website. In conjunction with these changes, only observations of nests and individual eagles are now recorded. Territory names and numbers are generally not tracked. DNRC will continue to report incidental observations of nests, nesting activity and individual sightings of birds.

MONTANA COMMON LOON WORKING GROUP

DNRC biologists actively participated in the Montana Common Loon Working Group and monitoring efforts from 2011 to 2016. A DNRC biologist also served as co-chair of the working group from 2013 to 2016. This working group supports activities related to the conservation and management of common loons. During the monitoring period, DNRC biologists monitored 9 lakes annually in northwest

Montana, and participated in monitoring efforts for chick survival, capturing and tagging studies, nest platform construction, and information/education efforts. Monitoring information was reported to the Montana Common Loon Working Group annually.

In 2002, DNRC became a cooperator in the Loon Ranger Program and has continued to support these efforts. The Loon Ranger Program provides support and direction for several Loon Rangers that regularly monitor loon activity on over 30 lakes in western Montana, locate nests, maintain awareness signs, assist with banding efforts, provide public education at lakes where nesting has been documented, and provide evening-fireside talks for the public. Field reports are completed at the end of each field season. This program has been successful in providing valuable monitoring information and public outreach. From 2011 to 2016 the population of common loons in Montana has been increasing and appears to be doing well (CLWG 2017).

NORTHERN CONTINENTAL DIVIDE ECOSYSTEM (NCDE)

DNRC remains an active cooperator on the NCDE Subcommittee of the Interagency Grizzly Bear Committee (IGBC). During the monitoring period, DNRC continued to support and partially fund ongoing cooperative habitat monitoring and road updating efforts of the subcommittee. Primary involvement during the monitoring period included participation of DNRC staff in the development and finalization of the Post-Delisting NCDE Grizzly Bear Conservation Strategy. The strategy contains a comprehensive set of conservation and monitoring commitments of all cooperating entities (including DNRC) that will ensure the grizzly bear population will remain healthy and viable into the future.

SWAN VALLEY GRIZZLY BEAR CONSERVATION AGREEMENT AND COOPERATION

The Swan Valley Grizzly Bear Conservation Agreement (SVGBCA) is a conservation strategy supported by the U.S. Fish and Wildlife Service that enables cooperators to comply with the Endangered Species Act, while practicing forestry and multiple use management on timberlands in the Conservation Area. To ensure compliance with the Agreement, cooperating parties monitor the application and effectiveness of the conservation measures annually, and provide results to the U.S. Fish and Wildlife Service. Monitoring commitments are documented in the *Monitoring Agreement for the Swan Valley Conservation Agreement* (August 21, 1998). A Technical Monitoring Team comprised of three biologists with the cooperating entities developed five monitoring reports (covering years 2010 to 2015) during the 2011 to 2016 monitoring period. The reports were distributed annually to the USFWS and interested members of the public when requested.

During the monitoring period, Swan Agreement cooperators continued to support the MFWP long-term Grizzly Bear Trend Monitoring Study for the NCDE. Cooperators also continued outreach and education efforts to increase awareness of the importance of bear-safe food storage on State and National Forest Lands. In cooperation with Swan Valley Connections, DNRC provided contributions for education and assistance to private landowners in the valley to raise awareness and reduce the availability of attractants to bears.

During the monitoring period, DNRC also continued to support the Swan Valley Bear Ranger Program. Bear rangers are field representatives affiliated with Agreement Cooperators that provide the public with information on grizzly bear biology, bear identification, and management efforts. The primary duties of the position are to interact with Swan Valley land owners and visitors, monitor adherence to food storage requirements, and provide information and assistance to reduce bear attractants around human residences, campsites, and other high public-use areas. Other duties include assisting MFWP with the

long-term trend monitoring project by working with the trappers, monitoring collared bears, and tracking bear survival and overall movements in the valley. Hundreds of campers, hunters, and visitors to the Swan Valley were contacted, and approximately 200 bear-resistant garbage containers were loaned to valley residents during the monitoring period as a part of this program.

SWAN VALLEY GRIZZLY BEAR CONSERVATION AGREEMENT MONITORING

The SVGBCA Monitoring Agreement requires cooperators to report information pertaining to the Agreement Area on open road densities, total road densities, secure habitat, cover, levels of administrative use in inactive subunits, closure effectiveness, commercial activity in active subunits, levels of administrative use on restricted roads within linkage zones during the spring period, road amounts in "preferred habitat" and exceptions to the agreement. Two of these parameters (i.e., open road densities and cover) are monitored to ensure that cooperators are managing within specific identified standards contained in the agreement. At the close of the monitoring period in 2015 all grizzly bear subunits had "open route density" estimates well below the 33% level required under the Agreement (range = 6% to 27%, average = 18.9%) (SVGBCA 2015). Six of the 11 subunits in the Agreement Area met the ≤21% voluntary standard contained in Section 3.(a)(i) of the Agreement. During the six-year monitoring period, DNRC checked all identified primary road closure devices annually and made repairs to ineffective closures. From 187 to 242 closures were checked annually (average = 219), and the percentage effectively restricting access annually ranged from 95% to 99% (average 97.7%). Several other parameters that are monitored do not address specific numeric standards that must be met. However, they provide valuable information about commercial activity and disturbance in the valley and human-induced changes in baseline habitat conditions. Specific details are contained in a complete set of monitoring reports published for years 2011 to 2016. Each annual report was provided to the USFWS for their review and files. All land management cooperators fully complied with the Swan Agreement during the 2010 to 2016 monitoring period.

On August 3, 2018, DNRC notified the USFWS and U.S. Forest Service Flathead National Forest that it was requesting termination of the SVGBCA. Under the terms of the conservation agreement (Section 7a) cooperating parties may cancel the conservation agreement with 30 days written notice to the other cooperators. In the notification, DNRC indicated that their participation in the Agreement would be effectively cancelled upon the date the USFWS issued DNRC an Amended Incidental Take Permit for the Forest Management Habitat Conservation Plan (HCP). The USFWS issued DNRC the Amended Permit on August 31, 2018, which officially cancelled DNRC's participation in the Agreement. As of the effective termination date, forest management projects planned and implemented on the Swan River State Forest will be required to incorporate all applicable measures contained in the HCP.

FOREST ROAD CLOSURE MONITORING ON HCP-COVERED LANDS IN GRIZZLY BEAR RECOVERY ZONES

Following adoption of the Forest Management HCP in February 2012, DNRC initiated efforts to identify and monitor all primary road closure devices located in grizzly bear recovery zones for effectiveness as required by HCP commitment GB-RZ3. Primary closure devices are those devices typically situated immediately off open road systems. They are closures identified as being primarily responsible for restricting access on particular roads and/or road systems. Six DNRC unit offices (including Swan River State Forest) conducted annual checks during the monitoring period. Considerable effort was spent in 2012 and 2013 to locate and identify the pool of closures requiring checks annually. An average of 556 primary road closures were checked for effectiveness annually from 2012 to 2016 (range 507 to 586) (Table WL-1). Annual differences in the number of closures checked was primarily due to locating, mapping

and refining the key closures that needed to be checked across all work units. Overall closure effectiveness during the period averaged 95% in grizzly bear recovery zones, and effectiveness at the Unit-level ranged from 83% to 99% (Table WL-1). Approximately 83 closures received repairs during the monitoring period.

Table WL-1. Number of road closure devices checked annually in grizzly bear recovery zones from 2012 to 2016, and the percentages that were deemed to be effectively restricting access.

Unit	2012		2013		2014		2015		2016	
	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)	Closures Inspected	Effective (%)
Clearwater	15	87%	16	88%	24	96%	24	100%	23	100%
Kalispell	45	93%	46	96%	45	100%	45	98%	33	91%
Libby	41	98%	49	94%	48	83%	51	86%	48	94%
Plains	35	97%	29	93%	27	96%	28	96%	28	100%
Stillwater	178	90%	180	92%	200	96%	198	96%	196	96%
Swan	193	93%	223	98%	242	99%	240	99%	229	95%
Totals and Weighted Average Percentages	**507**	**92%**	**543**	**95%**	**586**	**96%**	**586**	**97%**	**557**	**96%**

SNAG, SNAG RECRUITMENT, AND COARSE WOODY DEBRIS MONITORING

Snags, snag recruitment trees, and coarse woody debris (CWD) are important habitat attributes for many species. Pre-harvest and post-harvest abundance of snags, snag recruitment trees and CWD were sampled to evaluate compliance with minimum retention levels for snags, residual live trees, and CWD specified in the Biodiversity Rules (36.11.411), and to gain broader insight into the effects of our management activities on these habitat components. ARM 36.11.411(1)(e) allows for the substitution of snags and recruitment trees to help ensure the retention of the largest legacy structures available on each particular site (e.g. in stand-replacing burn areas live trees are absent and additional snags may be retained to meet the numeric requirement for live recruitment trees).

Methods

During the monitoring period from 2011 to 2016, sampling was conducted on 21 stands within 21 sale areas (Table WL-2). The stands were located on representative unit and land offices, and occurred within various cover types and treatment types. Pre-harvest data for snags, CWD, and large live trees were collected on each selected project. Data on tree species, diameter, height and wildlife use were collected on all live trees $\geq$15 inches dbh and snags $\geq$8 inches dbh. The same data were then also collected on the same identical plots for comparison relatively soon after logging had taken place. Fourteen sales/stands were sampled both pre-harvest and post-harvest (Table WL-2).

Accurate snag estimates are difficult to obtain with reasonable levels of sampling effort due to their distribution and relatively low density across the landscape (Bull et al. 1990). Consistent with prior monitoring from 2000 to 2010, methods similar to those used by Bevis (1996) were used. DNRC SLI data collection procedures with increased sample transect length (660 ft.) were used to estimate CWD amounts. Weight estimates for CWD (in tons) continue to follow those developed by Brown (1974).

Results – Snags

Consistent with earlier findings, reported snags/acre values by size class suggest that existing snag densities on pre-harvest sites are occasionally lower than guidance recommendations -- even before logging occurs. This is not surprising as factors that may contribute to this include: past harvest that emphasized the removal of unhealthy and larger trees, stands of young age with few large trees, firewood cutting, and natural variation in snag distribution such as that noted by Harris (1999). The

stands sampled reflect a range of stand types and harvest intensities across Units on the NWLO and SWLO.

Snags Pre-harvest

Snags that were ≥8 inches dbh were present on all sample units but one; the Tarkio project (Table W-2). Of the 21 stands sampled during the monitoring period prior to harvest, only 6 had one or more snags greater than 21 inches dbh per acre -- hereafter termed "Large Snags" (Table WL-2). Of these 6 stands, only 3 contained two or more Large Snags per acre. Six of the 21 stands contained no Large Snags. Thus, 15 stands prior to scheduled harvest were limited in their ability to provide minimum required numbers of Large Snags. Medium-sized snags (16 to 21 in. dbh) were generally more abundant on sample plots within sample stands (Table WL-2). Seven of the 21 stands sampled (i.e., 33%) possessed averages of ≥ 2.0 snags per acre in this size class, 5 of which supported averages ≥4.0 snags per acre. As expected, very large snags ≥27 inches dbh were more rare and only 2 stands of the 21 sampled pre-harvest (9.5%) possessed densities of greater than 1 per acre (Table WL-2). Snag totals for all medium and large snags >16" dbh per acre for the 14 projects that also were sampled post-harvest, ranged from 0 to 7.4 per acre (Table WL-2) and averaged 3.4 snags per acre.

Snags, Post-harvest

Of the 3 sample stands that contained 1 or more Large Snags per acre prior to harvest, all either maintained or were close to their pre-harvest levels (Scout Lake II, Liverstone Park, Lower McGinnis--Table WL-2). Post-harvest, medium-sized (16-21 in. dbh) snag densities ranged from 0 to 2.7 per acre and averaged 0.8 per acre. Density of the combined large and very large snag classes (≥22 inches dbh) ranged from 0 to 1.8 snags per acre but averaged 0.4 snags per acre (calculated from Table WL-2). Snag totals for all medium and large snags >16" dbh per acre for the 14 projects sampled post-harvest ranged from 0 to 3.3 per acre (Table WL-2) and averaged 1.2 snags per acre. Four harvest units had post-harvest estimates of 0.0 snags per acre and 3 of these 4 units possessed snags of medium or large size prior to harvest.

Table WL-2. Pre and post-harvest snag retention summary results on selected DNRC timber sales sampled during the 2011-2016 monitoring period.

Sale Name (Sample Years Pre/Post)	Area Office	Cover Type	Plots Sampled	Total Snags ≥8" dbh Recorded		Snags/Acre 16"-21" dbh		Snags/Acre 22"-27" dbh		Snags/Acre >27" dbh		Total Snags ≥16" dbh/Ac	
				Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Fortine-Old Highway (2008/2011)	NWLO	ES	3	14	9	1.0	0.3	0.0	0.3	0.0	0.0	1.0	0.6
Cliff Lakes (2008/2012)	NWLO	L/DF	4	15	10	0.3	1.0	0.3	0.0	0.0	0.0	0.6	1.0
Iron School House (2012/2013)	NWLO	L/DF	3	50	5	6.7	0.7	0.7	0.0	0.0	0.0	7.4	0.7
Scout Lake II (2012/2015)	NWLO	L/DF	3	53	18	4.7	2.7	0.3	0.3	0.7	0.3	5.7	3.3
Shiloh Road (2009/2012)	NWLO	PP/DF	4	19	5	1.0	0.5	0.3	0.0	0.3	0.0	1.6	0.5
Liverstone Park (2012/2014)	SWLO	PP/DF	3	63	10	1.0	1.0	1.3	1.0	0.7	0.7	3.0	2.7
Tarkio (2012/2015)	SWLO	PP	3	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lower McGinnis (2013/2015)	NWLO	PP/DF	4	27	8	1.3	0.3	1.8	1.0	0.8	0.8	3.9	2.1
County Line (2013/2016)	SWLO	PP/DF	3	11	0	0.3	0.0	0.7	0.0	0.0	0.0	1.0	0.0
Good Shepherd (2013/2016)	SWLO	PP/DF	3	7	1	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Wildhorse Mountain (2005/2013)	NWLO	L/DF	4	184	30	7.0	1.8	0.0	0.5	0.0	0.0	7.0	2.3
Deep Blue (2014/2016)	NWLO	PP/DF	4	10	2	2.5	0.0	0.0	0.0	0.0	0.0	2.5	0.0
Scout Lake III (2014/2016)	NWLO	MC	4	38	25	1.5	1.0	0.5	0.3	0.3	0.0	2.3	1.3
Spencer South (2014/2015)	NWLO	L/DF	5	52	44	1.8	1.6	0.6	0.4	0.0	0.0	2.4	2.0
Additional Pre-Harvest Sites Monitored	**Area Office**	**Cover Type**	**Plots Sampled**	**Total Snags ≥8" dbh Recorded**		**Snags/Acre 16"-21" dbh**		**Snags/Acre 22"-27" dbh**		**Snags/Acre >27" dbh**		**Total Snags ≥16" dbh/Ac**	
				Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Upper Indian (2016/	NWLO	MC	3	77	n/a	4.3	n/a	3.0	n/a	1.7	n/a	9.0	n/a
Rhodes Draw (2016/	NWLO	MC	4	10	n/a	0.0	n/a	0.3	n/a	0.0	n/a	0.3	n/a
Dirty Donovan (2015/	SWLO	DF	3	30	n/a	0.7	n/a	0.3	n/a	0.0	n/a	1.0	n/a
Ewing Central (2013/	NWLO	WRC/GF,L/DF	3	53	n/a	2.3	n/a	0.3	n/a	1.3	n/a	3.9	n/a
Belmont (2014/	SWLO	L/DF	3	18	n/a	0.7	n/a	0.0	n/a	0.0	n/a	0.7	n/a
Fish Bull Face (2014/	NWLO	MC	3	28	n/a	0.7	n/a	0.3	n/a	0.3	n/a	1.3	n/a
King Hemlock (2015/	NWLO	MC	3	71	n/a	5.3	n/a	0.7	n/a	0.3	n/a	6.3	n/a

Results – Snag Recruitment Trees

ARM 36.11.411 (a) and (b) requires DNRC to retain an average of two snag recruitment trees greater than 21 inches dbh on stands in the "warm and moist," and the "wet" Habitat Type Groups (Green et al. 1992). For all other Habitat Type Groups retention of an average of one snag recruitment tree >21 in. dbh is required. Retention of snag recruitment trees is intended to ensure that Large Snags will be recruited and available through time on managed lands.

Recruitment Trees, Pre-harvest

Of the 21 total stands sampled pre-harvest during the monitoring period, all had large live trees present, only 2 had densities of large live trees of less than 2 per acre (Cliff Lakes and County Line), and 19 had densities of 2 or more per acre (Table WL-3). Densities of large, live trees suitable for future snag recruitment on the 21 sample stands indicated that ample numbers were generally present to meet snag recruitment requirements. However, all large trees were not necessarily healthy and/or desirable for retention. Large live tree density on the 21 stands ranged from 1.3 to 12.5 trees per acre (Table WL-3) and averaged 6.0 per acre. For the 14 stands sampled both before and after logging, pre-harvest density also ranged from 1.3 to 12.5 large trees available per acre but averaged 6.4 trees per acre.

Recruitment Trees, Post-harvest

Thirteen of the 14 stands that were sampled after logging during the monitoring period possessed an average of at least 1.0 large live trees per acre (Table WL-3). The Wildhorse Mountain project that had a post-harvest estimate of 0.3 large live trees retained per acre possessed an additional 1.0 medium-sized tree per acre yielding a total of 1.3 per acre. Post-logging tree density estimates for the 13 stands that supported ample large live trees ranged from 1.5 to 10.3 large trees per acre (Table WL-3) and averaged 4.3 per acre. Ample numbers of additional smaller live trees were retained in the 15 to 21 in dbh class on all the 14 stands sampled after logging. Species composition of retained trees was weighted to those species that tend to make desirable future snags (i.e., ponderosa pine, western larch and Douglas-fir) (Table WL-3).

Given that some substitution of dead snags and live recruitment trees is allowable under ARMs to ensure that larger legacy material remains in harvest unit's post-treatment, snag and live tree estimates were combined to derive total snag/recruit estimates for each of the 14 stands with post-harvest data. Post-harvest estimates of combined medium snags, large snags and large live trees ranged from 1.7 to 13.8 per acre and averaged 5.5 per acre. Only one sample unit (County Line at 1.7 per acre) had an estimate that fell below the minimum required for snags and recruitment trees of 2 total per acre (1 large snag and 1 large recruit in various combinations). However, looking further into the data, this unit also contained numerous medium-sized live trees from 16 to 21 inches dbh at 11.0 per acre. Of these 11.0 trees per acre in the medium-size class, 4.0 per acre were 20 to 21-inch dbh trees. Additional medium-sized trees were present on all harvest units sampled during the monitoring period, further ensuring that large legacy trees and snags would be present in treated stands through time.

Table WL-3. Pre and post-harvest large live tree retention summary results for selected DNRC timber sales from 2011 to 2016.

Sale Name (Sample Years Pre/Post)	Area Office	Cover Type	Plots Sampled	Total Large Trees >21"		Average Trees per Acre >21"		Post Harvest Species Composition Trees ≥ 15"
				Pre	Post	Pre	Post	
Fortine-Old Highway (2008/2011)	NWLO	ES	3	116	16	8.7	3.4	CW 38%, DF 25%, L 19%, ES 12%, PP 6%
Cliff Lakes (2008/2012)	NWLO	L/DF	4	7	8	1.8	2.0	DF 82%, L 15%, PP 3%
Iron School House (2012/2013)	NWLO	L/DF	3	30	8	10.0	2.7	DF 73%, L 27%
Scout Lake II (2012/2015)	NWLO	L/DF	3	34	31	11.3	10.3	L 53%, DF 37%, ES 6%, PP 2%, GF 2%
Shiloh Road (2009/2012)	NWLO	PP/DF	4	8	6	2.0	1.5	PP 64%, L 23%, DF 13%
Liverstone Park (2012/2014)	SWLO	PP/DF	3	15	16	5.0	5.3	PP 60%, DF 37%, LP 3%
Tarkio (2012/2015)	SWLO	PP	3	23	19	7.7	6.3	PP 100%
Lower McGinnis (2013/2015)	NWLO	PP/DF	4	50	38	12.5	9.5	PP 86%, L 9%, DF 5%
County Line (2013/2016)	SWLO	PP/DF	3	4	5	1.3	1.7	PP 76%, DF 24%
Good Shepherd (2013/2016)	SWLO	PP/DF	3	13	8	4.3	2.7	PP 68%, DF 23%, L 9%
Wildhorse Mountain (2005/2013)	NWLO	L/DF	4	10	1	2.5	0.3	L 80%, PP 20%
Deep Blue (2014/2016)	NWLO	PP/DF	4	38	30	9.5	7.5	DF 50%, PP 45%, L 2%, WRC 2%
Scout Lake III (2014/2016)	NWLO	MC	4	42	20	10.5	5.0	L 88%, DF 9%, LP 3%
Spencer South (2014/2015)	NWLO	L/DF	5	11	8	2.2	1.6	DF 90%, L 10%
Additional Pre-Harvest Sites Monitored	**Area Office**	**Cover Type**	**Plots Sampled**	**Total Large Trees >21"**		**Average Trees per Acre >21"**		**Post Harvest Species Composition Trees ≥ 15"**
				Pre	Post	Pre	Post	
Upper Indian (2016/	NWLO	MC	3	19	na	6.3	na	na
Rhodes Draw (2016/	NWLO	MC	4	12	na	3.0	na	na
Dirty Donovan (2015/	SWLO	DF	3	10	na	3.3	na	na
Ewing Central (2013/	NWLO	WRC/GF,L/DF	3	29	na	9.7	na	na
Belmont (2014/	SWLO	L/DF	3	9	na	3.0	na	na
Fish Bull Face (2014/	NWLO	MC	3	23	na	7.7	na	na
King Hemlock (2015/	NWLO	MC	3	9	na	3.0	na	na

CONCLUSIONS AND RECOMMENDATIONS REGARDING SNAG AND RECRUITMENT TREE RETENTION

Consistent with previous findings, results from this monitoring period also suggest that Large Snags are typically not abundant even prior to logging on stands selected for sampling. Thus, continued attention by forest managers to the retention of Large Snags over time remains an important consideration. It further stresses the importance of retaining ample recruitment trees, which was accomplished on projects monitored during this period. In general, total snags of all sizes recorded in logged stands are reduced considerably from pre-harvest levels (Table WL-2, columns 5 and 6). Such reductions are not unexpected as snags are often removed for their commercial value, are inadvertently felled by equipment during harvest operations, are intentionally felled for human safety reasons, are vulnerable to windthrow, and are removed for firewood etc. Thus, balancing these attrition factors and demands in managed forests will likely remain a reoccurring challenge for forest managers over time.

Given the relatively low density and availability of Large Snags to retain in harvest units, ARM 36.11.411 provides flexibility to retain the next smaller-sized snags and recruitment trees when larger ones are not available. ARM 36.11.411 also allows for some substitution of snags and large trees for one another if availability is poor. For example, in stand replacement burns with no live trees, the entire recruitment tree requirement must be met with charred snags, because live trees are often not available under these circumstances. Given these factors, our analysis of compliance considers the collective post-harvest abundance of all snags >15 inches dbh and all live recruitment trees ≥ 21 inches dbh. All 14 of the projects where both pre and post-harvest snag and recruitment tree sampling was conducted complied with the requirements of ARM 36.11.411.

Given the general rarity of large snags and numerous attrition factors that influence the presence of snags in managed stands, we recommend that foresters continue to work diligently to meet Large Snag and large live tree recruitment density requirements on each project. We also recommend only substituting between snags and live recruitment trees when necessary to help ensure ample densities of larger snags and replacements are present over time. We also continue to stress retention of the larger snags and recruits when available on each site. That is, leaving 18-inch dbh live trees or snags in stands where trees greater than 21 inches dbh are present should not be the norm. Leaving smaller material should generally be incorporated *only* when larger trees and snags are not available. Preference should always be given first on any site to larger snags and recruits of desirable species, particularly given their apparent rarity.

Results – Coarse Woody Debris

Downed logs and woody material are important for providing long-term soil structure, nutrients, and habitat structure important for many species of wildlife. ARM 36.11.414 specifies that will maintain adequate levels of coarse woody debris at the project level using scientifically accepted technical references. For this purpose, DNRC considers suitable amounts to be those based on Graham et al. (1994).

Coarse Woody Debris, Pre-harvest

Five of the 14 stands sampled both before and after harvest (Cliff Lakes, Tarkio, County Line, Good Shepherd, and Deep Blue) had a pre-harvest CWD estimate that was less than that recommended by Graham et al. (1994) for maintenance of site productivity (Table WL-4). The remaining stands had estimates that fell well within or exceeded Graham et. al.'s recommended ranges. Factors that may have contributed to pre-harvest low levels of coarse woody debris detected on some sites include: past harvest in some stands that emphasized the removal of unhealthy trees and older trees; young stand age; amount, type and timing of past natural disturbances; firewood cutting; and natural variation in distribution of downed wood. The average weight of material found on each site before logging ranged from 1.7 to 19.3 tons per acre (Table WL-4) with an overall average of 8.9 tons per acre. The total number of large logs (≥15-inch diameter at large end) found on the 14 sample stands pre-harvest ranged from 0.0 to 6.5 per transect and averaged 2.4 large logs per transect. The total number of small logs (<15-inch large end diameter) found on the 14 sites pre-harvest ranged from 9.3 to 48.5 logs per transect and averaged 26.7 small logs per transect (Table WL-4).

Coarse Woody Debris, Post-harvest

As for snag and recruitment tree monitoring described above, 14 of the 21 stands sampled during the 2011-2016 monitoring period were also sampled after logging (Table WL-4). On 5 of the 14 stands sampled following logging, a greater amount of woody material was left than that observed on the same sites before harvest (Tarkio, Lower McGinnis, County Line, Good Shepherd, Wildhorse Mountain; Table WL-4). Woody debris weight estimates following logging ranged from 2.0 to 16.8 tons per acre and averaged 7.2 tons per acre. The total number of large logs (≥15-inch diameter of large end) found on the 14 sites post-harvest ranged from 0.0 to 3.8 per transect and averaged 1.1 large logs per transect. The total number of small logs (<15-inch large end diameter) found on the14 sites post-harvest ranged from 10.0 to 50.3 logs per transect and averaged 27.3 small logs per transect (Table WL-4). Consistent with monitoring conducted from 2001 to 2010, retained logs post-logging were primarily in the small diameter class (Table WL-4).

Table WL-4. Summary results of pre and post-harvest coarse woody debris (CWD) and downed log retention within selected DNRC timber sales (2011-2016). Shaded cells indicate relatively low amounts observed.

Sale Name (Sample Years Pre/Post)	Area Office	Cover Type	Transects Sampled	Total CWD ≥3" Tons/Acre		Average Count of Large Logs per 660 ft. Transect >15.5" Large End Dia.		Average Count of Small Logs per 660 ft. Transect <15.5" Large End Dia.	
				Pre	Post	Pre	Post	Pre	Post
Fortine-Old Highway (2008/2011)	NWLO	ES	3	15.1	6.2	3.7	1.3	45.7	20.3
Cliff Lakes (2008/2012)	NWLO	L/DF	4	4.4	4.4	1.3	1.5	9.3	12.3
Iron School House (2012/2013)	NWLO	L/DF	3	14.4	9.0	5.3	1.0	35.7	50.3
Scout Lake II (2012/2015)	NWLO	L/DF	3	16.6	13.2	6.3	2.7	26.3	29.3
Shiloh Road (2009/2012)	NWLO	PP/DF	4	5.7	3.9	0.5	0.3	31.5	28.3
Liverstone Park (2012/2014)	SWLO	PP/DF	3	10.2	6.0	2.7	0.3	28.3	26.3
Tarkio (2012/2015)	SWLO	PP	3	1.7	2.0	0.0	0.0	10.7	10.0
Lower McGinnis (2013/2015)	NWLO	PP/DF	4	6.0	6.1	1.3	0.8	18.0	28.3
County Line (2013/2016)	SWLO	PP/DF	3	4.0	4.5	0.3	0.0	22.3	20.7
Good Shepherd (2013/2016)	SWLO	PP/DF	3	2.6	4.3	0.3	0.7	13.0	24.3
Wildhorse Mountain (2005/2013)	NWLO	L/DF	4	15.1	16.8	2.5	3.8	47.0	46.5
Deep Blue (2014/2016)	NWLO	PP/DF	4	3.1	2.8	0.3	0.0	15.0	14.5
Scout Lake III (2014/2016)	NWLO	MC	4	19.3	16.5	6.5	3.0	48.5	48.0
Spencer South (2014/2015)	NWLO	L/DF	5	6.3	5.7	2.2	0.4	21.8	22.4
Additional Pre-Harvest Sites Monitored	**Area Office**	**Cover Type**	**Transects Sampled**	**Total CWD ≥3" Tons/Acre**		**Average Count of Large Logs per 660 ft. Transect >15.5" Large End Dia.**		**Average Count of Small Logs per 660 ft. Transect <15.5" Large End Dia.**	
				Pre	Post	Pre	Post	Pre	Post
Upper Indian (2016/	NWLO	MC	3	19.4	na	5.7	na	60.3	na
Rhodes Draw (2016/	NWLO	MC	4	10.1	na	0.3	na	56.3	na
Dirty Donovan (2015/	SWLO	DF	3	12.2	na	0.3	na	41.7	na
Ewing Central (2013/	NWLO	WRC/GF,L/DF	3	28.1	na	8.3	na	62.0	na
Belmont (2014/	SWLO	L/DF	3	9.8	na	1.0	na	38.3	na
Fish Bull Face (2014/	NWLO	MC	3	16.2	na	4.0	na	56.3	na
King Hemlock (2015/	NWLO	MC	3	17.2	na	3.0	na	54.7	na

CONCLUSIONS AND RECOMMENDATIONS REGARDING RETENTION OF COARSE WOODY DEBRIS

Under current practices, forest managers are generally meeting or exceeding recommendations of Graham et al. (1994). Of the 14 stands sampled after logging, 9 possessed ample tons per acre, however, 5 of the 14 were relatively low (Table WL-4). Three harvest unit transects sampled had no large >15.5- inch large logs (Tarkio, County Line, and Deep Blue), and three units also had low counts on transects of small <15.5-inch diameter logs (Cliff Lakes, Tarkio, Deep Blue -- <15 pieces per 660-foot transect). As a general observation, the relative amounts of coarse woody debris on sample units post-logging appeared to be related to levels onsite pre-logging.

A difference observed when comparing results from this monitoring period with those from the last two monitoring periods was that 7 of 7 harvest units (100%) sampled from 2001 to 2005 and 7 of 9 units (78%) sampled from 2006 to 2010 had greater post-logging levels of downed wood than pre-harvest levels. However, of the 14 units sampled from 2011 to 2016, only 5 (36%) had post-logging downed wood levels greater than pre-harvest levels, potentially indicating less effort overall being placed on maintaining and/or returning material back to harvest units. Given these findings and the relatively low number of

large logs detected in the harvest units sampled from 2011 to 2016, managers need to continue to be diligent about retaining ample large snags, snag recruitment trees and downed logs in harvest units.

REPORTING OF TERRESTRIAL SPECIES OBSERVATIONS

During the monitoring period, DNRC compiled notable terrestrial species observations reported by DNRC biologists and field personnel. Most of these observations were obtained incidentally while conducting normal work-related activities. Data entries documenting: species, observation date, observer, number of adults and young, general habitat association, location of sighting, associated project area and unit office were reported to the Montana Natural Heritage Program (MNHP) September 2018 for inclusion in their state-wide database. Observation data will continue to be collected and reported in a cooperative effort to improve understanding of the distribution and occurrence of various species of interest.

Results

A total of 82 records were reported during the monitoring period, which contained sightings obtained from 2011 to 2016. Of the 82 records reported, 17 were of threatened and endangered species or candidate species, 19 were of DNRC listed sensitive species, and 46 were of other species of interest. A summary list of the species reported and number of records is as follows:

T& E and Candidate Species

Grizzly Bear (11)
Canada Lynx (2)
Wolverine (4)

DNRC Sensitive Species

Bald Eagle (2)
Black-Backed Woodpecker (3)
Common Loon (3)
Pileated Woodpecker (4)
Gray Wolf (7)

Other Species

Bats (unknown spp.) (1)
Cooper's Hawk (1)
Golden Eagle (1)
Great Gray Owl (2)
Northern Goshawk (24)
Osprey (3)
Pika (1)
Red-Tailed Hawk (12)
Trumpeter Swan (1)

FOLLOW-UP MONITORING FOR MISCELLANEOUS MITIGATION

Occasionally, situations arise where mitigations are developed for specific habitat elements such as nest sites, foraging areas, rookeries etc. Reviewing the application and effectiveness of such mitigations is important for determining if adjustments are necessary to recommendations made in the future in order to achieve desired results. During the monitoring period, DNRC monitored and collected information on

two project sites to evaluate the application and effectiveness of specified mitigations pertaining to wildlife habitat. Methods and timing of monitoring efforts were tailored to the specific species, site and habitat element (e.g. nest, cover patch, etc.). The project biologist was responsible for developing and maintaining a monitoring schedule and compiling results of monitoring efforts. These results are summarized below:

- Goshawk nest monitoring was conducted for nine total goshawk nests during the 2011 to 2016 monitoring period. Six nests were on the NWLO including Jones Berger, Scout Lake, Meadow Ridge, Evers Creek, Martin Camp, and the Bitter Herrig goshawk nests (two nests were not occupied before operations began, one nest was not occupied one year after operations began, one nest was occupied during and after operations, and one nest was occupied and operations had not begun) -- 2013 to 2016. Three additional nests were monitored in conjunction with timber sale projects including Cramer (Sliver Me Timber), Donovan (Dirty Donovan), and Crater (Moose Crater).
- Follow up territory occupancy monitoring on NWLO for two red-tailed hawk nests associated with the Deep Blue and Bitter Herrig Timber Sales (Both territories were occupied – the Deep Blue red-tailed hawks were not successful; Bitter Herrig red-tailed hawk reproductive success is unknown) -- 2014 to 2016. Monitoring of a red-tailed hawk nest also occurred on the SWLO in conjunction with the Deadman Timber Sale. The nest was occupied at the time logging was taking place and the following year. A pair has been present in the same nest location vicinity from 2012 to 2016.
- Follow up territory occupancy and productivity monitoring for the White Pine bald eagles associated with the Deep Blue Timber Sale (eagles fledged a total of 5 chicks before and during operations) -- 2013 to 2015.
- Follow up Slocum Creek golden eagle nest monitoring during and after management activities. Nest was successful each year from 2014 to 2016.

OTHER MONITORING AND COOPERATIVE PARTICIPATION

During the monitoring period, DNRC biologists and staff participated in a number of additional monitoring efforts for species associated with forested habitats in western Montana. A listing of these efforts is provided below:

- DNRC Biologists Northern bog lemming habitat tour and evaluation, Stillwater State Forest, November 4, 2015.
- MFWP Cooperative wolf presence camera monitoring on the Swan River State Forest – 2013.
- Avian Response to Old Growth Maintenance Logging in the Swan River State Forest -- 2012 to 2016 ongoing. Final report anticipated in 2019.
- Contributor -- Lolo National Forest/Crown of the Continent Carnivore monitoring -- 2012 to 2014.
- Participant --Harlequin duck brood surveys on Swift Creek (2012, 2015) and the Stillwater River (2016).
- Participant --Harlequin Duck Habitat Use, Migration, and Connectivity Research Project (2014 to 2016 ongoing).
- Participant –Western States Wolverine Conservation Baseline Survey (2016, ongoing).
- Stillwater State Forest Winter Carnivore Monitoring (2014, 2015).

RECOMMENDATIONS

- Remain involved in cooperative work groups and continue funding and participation in monitoring efforts that support management for biodiversity and compliance with ARMs 36.11.428 and 36.11.436.
- Remain attentive to new sensitive species listings, particularly those most likely to be adversely affected by forest management activities.
- Consistent with previous findings, results from this monitoring period also suggest that large snags are not abundant even prior to logging in many stands. Continued attention by forest managers to the retention of large snags and large downed logs over time remains an important consideration.
- Recommend simplification of current snag and snag recruitment tree retention requirements in ARM 36.11.411 to include two snags and two live recruitment trees per acre >21 inches dbh (or largest available) on all sites regardless of habitat type group (continue to allow substitutions of snags and live trees based on availability).
- Continue reporting notable species observations to the Montana Natural Heritage Program for inclusion in their statewide species observation database.

GRAZING MANAGEMENT MONITORING

GRAZING EVALUATIONS

The SFLMP and Rules (ARM 36.11.444) established the goals of maintaining healthy and functional riparian areas and preventing non-point source pollution on State Trust Lands licensed for grazing. Specific objectives under these goals include:

- Minimize loss of riparian and streambank vegetation;
- Minimize structural damage to streambanks;
- Maintain or restore healthy and vigorous riparian-wetland plant communities;
- Leave sufficient vegetation to filter sediment and protect streambanks from erosion; and
- Minimize physical damage to streambanks to maintain channel stability and morphological characteristics.

These objectives were quantified into a set of numeric criteria that are utilized as a course filter to indicate the potential for unacceptable adverse impacts. The numeric criteria are as follows:

- Continuous season-long grazing will only be authorized when the levels of forage utilization do not exceed 59 percent and healthy riparian function is maintained;
- No percentage of shrubs will be in the heavily hedged form class and less than 25 percent of the shrubs will be in the moderately hedged form class;
- Streambank disturbance induced by livestock trampling will be limited to less than 10 percent alteration.

Riparian condition on classified forest state lands licensed for summer woodland grazing is evaluated prior to the license being issued and renewed as well as at the midpoint of the license term. Riparian function metrics that are evaluated include browse utilization, forge utilization and streambank alteration. For the current reporting period, riparian condition was found to be functional an 80% of the parcels that were evaluated over the six-year period. Summary results of these riparian inspections can be found in Table GZ-1 below.

Table GR-1: Grazing License Inspection Results by Land Office and Inspection Year

Year	SWLO		NWLO		CLO		All Lands	
	Parcels Evaluated	Acceptable Riparian Conditions	Parcels Evaluated	Acceptable Riparian Conditions	Parcels Evaluated	Acceptable Riparian Conditions	Parcels Evaluated	Acceptable Riparian Conditions
2011	91	90%	20	90%	3	100%	114	90%
2012	75	79%	15	67%	9	100%	99	79%
2013	26	81%	42	79%	15	100%	83	83%
2014	44	70%	10	60%	5	60%	59	68%
2015	25	72%	22	86%	3	100%	50	80%
2016	77	71%	9	78%	4	100%	90	73%
Total	338	79%	118	79%	39	95%	495	80%

Since the inception of the SFLMP, riparian condition on classified forest parcels licensed for grazing has had a stable if not improving trend over the past 20 years. Table GR-2 below shows this trend with the

rise in total evaluations attributed to the Potomac block land acquisition on Missoula unit. Much of these parcels are high elevation lands that lack riparian features and thus the decline in riparian habitats.

Table GR-2: Grazing License Inspection Results by Reporting Period

Reporting Period	Parcels Evaluated	Parcels Containing Riparian Habitats	Acceptable Riparian Condition
1997-2000	30	83%	70%
2001-2005	228	80%	78%
2006-2010	250	78%	72%
2011-2016	495	69%	80%

RECOMMENDATIONS

- Continue to assess riparian conditions at both license renewal and at midterm of the license to provide information to support license stipulations that support riparian function.
- Prioritize the development and implementation of mobile technology to complete grazing evaluations and facilitate timely information sharing across the program.
- Continue to prioritize grazing corrective actions on parcels supporting cold-water fisheries and/or HCP covered species.
- Continue annual training and support for field staff completing riparian assessments.

WEED MANAGEMENT MONITORING

COOPERATIVE AGREEMENTS AND WEED MANAGEMENT PLANS

DNRC completed cooperative agreements with all County Weed Districts where both forested and non-forested State lands occur. These plans typically span a 6-year period and are updated every two years. These cooperative agreements must include:

- a 6-year integrated noxious weed management plan
- the goals for noxious weed management
- a specific plan of operations and a budget for the biennium
- a biennial performance report, completed by the district weed board and submitted to the Department of Agriculture's State Weed Coordinator regarding the success of the plan.

DNRC Area Offices have also developed weed management plans under the guidance of the Montana Weed Management Plan which was revised in 2008. These plans are used to prioritize follow up reviews and inspections of weed infestations, and to help prioritize what weed management projects are funded with our limited financial resources.

One hundred fifty-three (153) timber sale project records were reviewed for noxious weeds for the period of 2011-2016. Results indicate that approximately 18,328 acres of noxious weeds were treated by various means on DNRC lands and road right-of-ways. Additionally, 2,763 acres were treated with biological controls. Weeds were principally located along roadside edges and timber harvest landing areas. Most projects that had existing noxious weed infestations occurred on western Montana timber project areas. Noxious weeds are less extensive on forest sites in the Central and Eastern Montana.

PREVENTION

All timber sale projects focused on use of weed-free equipment by requiring washing and inspection of equipment prior to entry to sale areas. DNRC was one of the first agencies to require clean equipment as part of harvest operations. Compliance is recorded on timber sale inspection forms.

DNRC proactively manages timber sale contracts to avoid excessive soil disturbance and thus the aerial extent of potential noxious weed establishment and spread.

All new roads (average 32.8 miles/year) and newly disturbed reconstructed roads were revegetated with site-adapted grasses to provide competition with weeds and reduce erosion. All grass seed mixtures utilized included native species. On weed competitive sites, more resilient introduced grasses comprised a higher percentage of grass mixes.

EDUCATION

DNRC has cooperated with County Weed Districts to provide training in weed identification, safe herbicide application and weed management to field personnel.

As of 2017, 13 DNRC personnel are certified herbicide applicators for spot and field infestations of noxious weeds and numerous other employees have attended training on how to evaluate and oversee weed control projects.

TREATMENT

DNRC has adapted an integrated weed management plan that uses various treatment methods to prevent the establishment and spread of noxious weeds. All DNRC timber sale contracts included stipulations and control measures with the intent of controlling the spread of noxious weeds.

Herbicide treatments for roadside weed control have been primarily completed through contracts with County Weed Districts and licensed applicators. Priorities for herbicide treatment are new invaders, small infestations of new weeds and to control or contain the leading edge of established weeds based on site evaluation.

DNRC has an active role in establishing new insectectories of approved biocontrol insects on State lands to aid in the control of noxious weeds and seed production. Most biocontrol agents are better adapted to open forest or range sites. DNRC continues to redistribute insects on State lands and share available insects with County Weed Districts, Montana FWP and private landowners.

MONITORING

As part of ongoing forest management activities, DNRC project administrators monitor the implementation of noxious weed control measures on all timber sales. Through sale administration DNRC attempts to minimize the levels of ground disturbance to those that are needed to achieve silvicultural objectives.

On forest management projects where noxious weeds are a concern, DNRC periodically monitors for new invaders and follow-up treatments as needed or may enlist the assistance of County Weed Districts.

DNRC administrators also record weed infestations with grazing licenses on classified forest land as part of license renewal and midterm inspections. When weeds are noted during these reviews, administrators are to fill out a Weed Monitoring form and complete a weed control plan with grazing licensee.

RECOMMENDATIONS

- Continue contract requirement that stipulates all sale projects use weed-free equipment by requiring washing and inspection of equipment prior to entry to sale areas.
- Continue to proactively manage timber sale contracts to avoid excessive soil disturbance and thus the aerial extent of potential noxious weed establishment and spread.
- Continue to use mobile technology that was designed to map noxious weed infestations and track treatment history.

REVIEW AND MANAGEMENT OF THE STATE FOREST LAND MANAGEMENT PLAN

The Record of Decision for the SFLMP, under Managing the Plan (ROD page 10; ARM 36.11.448), described circumstances under which the SFLMP might be revised. The SFLMP recognizes the importance of adaptive management and identifies that the FMB Chief can change management direction if the change is compatible with the fundamental intent as reflected in the SFLMP. The SFLMP supports the use of new scientific information to adjust management.

The SFLMP can be reviewed and changed to comply with new legislation, new direction from the Land Board, or if the FMB Chief judges that original assumptions supporting the Plan no longer apply. Part of our responsibilities are to identify emerging issues and challenges to implementing the SFLMP and evaluate the potential need for amendments to the SFLMP to adapt to these circumstances. Considerations that DNRC examined to evaluate potential need to revise or amend the plan are included below.

- **Legislation** – No additional legislation has been passed affecting DNRC that would be inconsistent with the original assumptions supporting the Plan or would be incompatible with the philosophy, intent, or implementation of the plan.
- **Direction from the Board of Land Commissioners** -- No direction from the Board of Land Commissioners has been provided to DNRC that would be inconsistent with the original assumptions supporting the Plan or would be incompatible with the philosophy, intent, or implementation of the plan.
- **DNRC Land Acquisitions and Disposals** – Within the last 10 years, DNRC has acquired approximately 95,000 additional acres of forest land in western Montana. While these acquisitions have expanded DNRC's manageable forest land base by approximately 13%, expanding the land base upon which the Plan and ARMs applies has not proven to be inconsistent with original assumptions supporting the Plan, nor is managing an expanded land base incompatible with the philosophy, intent or implementation of the Plan.
- **DNRC Forest Management HCP and Amendment –** In February 2012, the U.S. Fish and Wildlife Service issued DNRC an Incidental Take Permit (ITP) associated with a Habitat Conservation Plan under Section 10 of the Endangered Species Act (ESA) for DNRC Forest Management Activities across 548,500 acres. An additional 81,000 acres of forest land were included for coverage under the HCP and ITP in November 2018, which addressed several recent land acquisitions. While the HCP represents a sizable programmatic commitment and added requirements for the Forest Management Program, adopting and implementing the HCP is consistent with the SFLMP Resource Management Standards pertaining to federally listed Threatened and Endangered Species and ARM 36.11.428, and the HCP clarifies DNRC's obligations and requirements under the ESA. Adopting the HCP is consistent with original assumptions supporting the Plan and managing under the HCP is compatible with the philosophy, intent and implementation of the Plan.
- **DNRC Conservation Easements** – During the last 10 years DNRC has acquired approximately 45,000 acres of land that possess conservation easements held by other agencies or parties. While the conservation easements require additional commitments and monitoring, acquiring and managing the lands containing conservation easements is consistent with the SFLMP Resource Management

Standards pertaining to wildlife and fisheries. Acquiring lands possessing conservation easements and additional conservation protection measures is not inconsistent with original assumptions supporting the Plan, nor is managing under the HCP incompatible with the philosophy, intent or implementation of the Plan.

- **Species Listings** – The federal listing status for several species has changed during the last 10 years. In this time, bald eagles, peregrine falcons, and gray wolves were delisted. The northern long-eared bat and yellow-billed cuckoo were recently listed as threatened species in parts of Montana, however, these two species are minimally affected by DNRC's Forest Management Program. The wolverine and fisher are currently proposed for federal listing. Canada lynx and grizzly bears are currently being considered for de-listing. While these species listings and de-listings can influence the suite of mitigation measures and requirements applied to projects at the local level, such changes were anticipated at the time the SFLMP was adopted. Thus, additions and deletions from federal lists do not create inconsistencies with original assumptions supporting the Plan, nor is adjusting suites of required mitigations over time for such species incompatible with the philosophy, intent or implementation of the Plan. Such changes are consistent with requirements for federally listed Threatened and Endangered Species as required under ARM 36.11.428.
- **Climate Change** – During the last 5 years, the science, conversations and concerns surrounding climate change have expanded. In 2017 a Montana Climate Assessment was published (http://montanaclimate.org/chapter/executive-summary), which was compiled in an effort to synthesize, evaluate, and share credible and relevant scientific information about climate change in Montana. The Assessment is the result of a two-year effort by university faculty, students, state and federal agency researchers, non-profit organizations, resource managers and citizens from across Montana. Impacts to forests of Montana are expected to be variable and may positively affect forest productivity and growth in wet areas and increase forest mortality in warmer, more arid regions. Climate change may also exacerbate indirect effects to forests such as, increasing mortality associated with larger fires during longer fire seasons, and increased mortality due to increases in insects such as the mountain pine beetle and forest pathogens. By managing forests to emulate natural conditions prior to European settlement in Montana, DNRC continues to implement many of the adaptation strategies identified in the 2017 report (MCA 2017:183-184). These include actions such as regenerating multiple tree species from diverse seed sources, retaining diversity of native tree species, promoting legacy trees, managing for a variable mosaic of tree species and ages, managing for landscape connectivity, favoring species adapted to disturbance, retaining woody debris to retain soil moisture and promote nutrient cycling, conducting fire suppression and using prescribed fire and thinning to minimize fuel loading and favor fire-resistant species, managing insect pests and diseases, and maintaining an active planting and regeneration program. Through the use of those actions and by managing to emulate conditions that plant and animal species evolved with in Montana, DNRC's Forest Management Program is maintaining consistency with the original assumptions supporting the Plan and is compatible with the philosophy, intent and implementation of the Plan as originally envisioned. Thus, no amendment or revision of the SFLMP is warranted.

- **Sustainable Yield Calculations** – During the monitoring period, two sustainable yield calculations, as required by MCA 77-5-222, were conducted by Mason, Bruce & Girard, Inc. These calculations were conducted in 2011 and 2015 and provided yield estimates of 57.6 and 56.9 MMBF respectively. These calculations included the constraints contained in the ARM for Forest Management

and additional constraints associated with the Forest Management HCP. The 2015 calculation was based on improved stand data and included over 67,000 acres of newly acquired lands. Applicable constraints associated with all rules, laws, and regulations DNRC must adhere to are included as a part of each calculation, and they influence the level of harvest that can be removed during each period between calculations. While the calculations themselves fluctuate with the many different parameters that are modeled each period, they remain consistent with the original assumptions supporting the Plan, and are compatible with the philosophy, intent and implementation of the Plan as originally envisioned. Thus, no amendment or revision of the SFLMP is warranted because of these calculations.

In Summary, a number of noteworthy program-level events have occurred since the last monitoring report was published in May 2011. However, none of these changes or events are inconsistent with the original assumptions supporting the Plan or would be incompatible with the philosophy, intent, or implementation of the plan. Revisions to Forest Management ARMs have also occurred during this period and will continue to occur as a part of necessary "housekeeping and maintenance" over time. Any future revisions to ARMs will occur through the Montana Administrative Procedures Act (MAPA) process and may address such things as definition revisions, revisions to listed and down-listed species, and HCP-related requirements where the department deems revisions may be necessary.

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ACRONYMS AND ABBREVIATIONS

ALPFIRsubalpine fir

ARM	Administrative Rules of Montana
BMP	Best Management Practices
CWD	coarse woody debris
dbh	diameter at breast height
DF	Douglas-fir
DFC	Desired Future Conditions
DNRC	Montana Department of Natural Resources and Conservation
ESA	Endangered Species Act
FI	Forest Improvement
FIA	Forest Inventory and Analysis
GIS	geographic information system
HCP	Habitat Conservation Plan
Land Board	Board of Land Commissioners
LP	lodgepole pine
MBF	thousand board feet
MC	mixed conifer
MEPA	Montana Environmental Protection Act
MFWP	Montana Department of Fish, Wildlife and Parks
MNHP	Montana Natural Heritage Program
MMBF	million board feet
MOU	Memorandum of Understanding
NWLO	Northwest Land Office
PP	ponderosa pine
RMS	Resource Management Standards
RP	reference point

ROD	Record of Decision
Rules	Administrative Rules for Forest Management
sd	standard deviation
SFLMP	State Forest Land Management Plan
SLI	stand-level inventory
SMZ	streamside management zone
SWLO	Southwest Land Office
T&E	threatened and endangered (species)
TMDL	total maximum daily load
USFWS	United States Fish and Wildlife Service
WL	western larch
WWP	western white pine

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