

# MONTANA

## Forestry Best Management Practices Monitoring



## 2022 FORESTRY Best Management Practices FIELD REVIEW RESULTS

Department of Natural Resources & Conservation  
Forestry Division · Missoula, MT 59804-3199

**MONTANA  
FORESTRY BEST  
MANAGEMENT  
PRACTICES  
MONITORING**

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**2022 FORESTRY BMP  
FIELD REVIEW REPORT**

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## **ACKNOWLEDGMENTS**

In 2022 the Forestry Assistance Bureau (FAB), Forestry Division, Montana Department of Natural Resources and Conservation (DNRC) once again completed the Forestry Best Management Practices (BMP) Field Reviews. These reviews have been conducted on the even numbered years since 1990 (except 2020) as a way of determining whether or not Montana's voluntary Forestry Best Management Practices are effective in protecting Montana's forest, water and soil resources.

The Division graciously acknowledges the many people who gave their time and energy toward the review effort. Thanks to all the Field Review Team Members who traveled extensively, worked long days in the field, tackled many difficult decisions and conducted themselves in a highly professional manner. Thanks also go out to the Environmental Quality Council, the Governor's Office, those who supplied information to select the sites, and to those who gave us access to their private lands. Thanks also to the representatives from the Forest Products Industry, the U.S. Forest Service, the Bureau of Land Management, MT Department of Natural Resources and Conservation Trust Land Management Division, University of Montana - Lubrecht Experimental Forest, MT Fish, Wildlife, & Parks, and the Family Forest Landowners for their cooperation in providing field review site information and/or team members.

Special thanks to Beth Dodson who put in an extraordinary effort to lead all three teams and to assure the field work went smoothly. Also, thanks to Roger Ziesak for starting the 2022 BMP Review process before handing the project off. Roger has led the charge on the biennial monitoring since the 2008 cycle. His dedication to Forestry BMPs is outstanding.

Sincerely,  
Marc Vessar

## **EXECUTIVE SUMMARY**

The Forestry Best Management Practices (BMP) field review process is used to evaluate whether BMPs are being applied appropriately and correctly. They are also used to determine if the applied BMP's are effective in limiting non-point source pollution from timber harvest operations in Montana; i.e. is water quality being protected? As mentioned earlier, the DNRC Forestry Division evaluates forest practices for BMP implementation every two years and reports the findings to the Montana Environmental Quality Council (EQC), the Legislature, the Governor's Office, and the public at large. This report summarizes the findings of Montana's 2022 Forestry BMP Field Reviews.

In 2022, three interdisciplinary teams conducted the field reviews. Ideally, each team was composed of a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, a soil scientist, and a non-industrial private forest (NIPF) landowner or timber harvesting professional. The DNRC used established site selection criteria to select 38 timber harvest sites that completed harvest operations in 2020 or 2021. The field review teams evaluated a maximum of 61 BMPs, 49 of which are forestry BMPs and 12 are Streamside Management Zone (SMZ) BMPs, including one for fish passage which was formally adopted in 2014. At each site, the teams rated the application and effectiveness for each applicable BMP on a five-point scale.

A total of 38 field review sites were evaluated for **BMP Application**. Field review results showed that across all ownerships, **BMPs were properly applied 97% of the time**. Although many harvest sites had at least one instance where a BMP was inadequately applied, most of these departures (41 out of 46) were minor and did not cause erosion or deliver material to a stream. Four sites (11%) had one or more major BMP departures in application. In 2018, 7% had major BMP departures in application. The application of the eight high-risk BMPs were also evaluated separately because these BMPs are those most important for protecting soil and water resources. Of these high risk BMPs 90% were properly applied.

The teams evaluated the same 38 sites for **BMP effectiveness**. Results showed that across all ownerships, **BMPs were effective in protecting soil and water resources over 98% of the time**. Of the 38 sites, 13 (34%) had one or more impacts in BMP effectiveness. This compares with 36% in 2018. Minor impacts in effectiveness produce minor impacts to soil and water resources; for example, eroded material reaches draws, but not streams. Six (16%) of the sites had one or more major departures in BMP effectiveness compared to 17% in 2018. The majority (94%) of the eight high-risk BMPs evaluated were rated as providing adequate protection to soil and water resources.

Once again, the greatest frequency of departures from the BMPs, and the most identified impacts, were associated with inadequate road maintenance and insufficient road surface drainage. This report includes a list of the most problematic BMPs in Tables 14A and 14B.

The Field Review teams also evaluated application and effectiveness of the Montana SMZ Law. For both application and effectiveness, a total of 11 SMZ Rules departures were noted (6 for application and 5 for effectiveness) out of the 482 that were rated. For the application departure ratings, five were rated as minor and one was rated as a major departure. For effectiveness, four were rated as minor and temporary and one was rated as minor and prolonged.

### Summary of 2022 BMP and SMZ Application and Effectiveness, by Ownership Group

Practice	State	Federal	Industry	NIPF	Totals
BMP Application	97%	96%	98%	97%	96%
BMP Effectiveness	99%	97%	99%	99%	98%
SMZ Application	97%	96%	98%	100%	98%
SMZ Effectiveness	97%	96%	100%	100%	98%

## **INTRODUCTION**

### (History)

The forest lands of Montana are the headwaters for several major river basins which produce large quantities of high-quality water. This water nurtures some of the West's best fisheries and is used for irrigation and livestock, as well as for domestic, recreational and industrial purposes. These same lands grow the timber resources that sustain one of Montana's major industries, the forest products industry. All products from Montana's 22.5 million acres of forested land contribute - in an essential manner - to Montana's economy and way of life.

Montana's approach for protecting soils, habitat, and water quality during timber harvest operations involves a combination of regulatory and non-regulatory approaches. Since the 1970's, non-regulatory Forestry Best Management Practices have provided guidance as minimum protection standards. In 1987 Congress amended the Clean Water Act and added Section 319 to address non-point sources of pollution. Section 319 directed all states to develop non-point source pollution plans to address non-point source pollution problems. These Forestry BMPs provide Montana's Section 319 compliance.

At this same time, concern over the impacts of forest management on Montana's watersheds prompted the 1987 Montana Legislature to pass House Joint Resolution 49. This resolution directed the Montana Environmental Quality Council (EQC) to study "*how current forest management practices are affecting watersheds in Montana.*" (Zackheim, 1988). The EQC established a BMP technical committee that developed Montana's first statewide forestry BMPs in 1987. In 1989, after two years of work, an interdisciplinary working group (BMP Working Group) released the revised Forestry Best Management Practices. Since that time, the BMP Working Group has overseen the biennial review process. In the interim between 1996 and 2010 the BMP Working Group reviewed and revised the 1989 BMPs. The last revision was to address biomass in the BMPs – these changes are minor and have no direct impact on the methodology used in the field review process. The 2006 version of the Best Management Practices for Forestry in Montana (Appendix A) was adopted for use in the 2010 field reviews and has been used since.

Forestry BMP field reviews have been conducted previously in Montana. As part of HJR-49, field review teams conducted the first statewide assessment of forest practices for BMPs during the summer of 1988 (Zackheim, 1988). In 1989 the University of Montana, under the Flathead Basin Water Quality and Fisheries Cooperative, reviewed more sites for BMPs in the Flathead River drainage (Ehinger and Potts, 1990). The Montana Legislature has directed DNRC to conduct a further series of statewide BMP field reviews every two years in the even years from 1990 to the present; (Schultz, 1990 and 1992; Frank, 1994; Mathieus, 1996; Fortunate, et al., 1998; Ethridge and Heffernan, 2000; Ethridge, 2002 and 2004; Rogers, 2006; Ziesak 2008 through 2018).

Forestry BMPs, if properly applied, can limit non-point source pollution--the kind of diffuse pollution that forestry operations can produce, such as sediment from a road or timber harvest. The BMP field review process has been consistently used since 1990 to evaluate whether BMPs are being properly applied and if they are effective in limiting non-point source pollution.

Prior to 1989, forestry water quality was addressed through a voluntary approach as part of the State's 1988 non-point source assessment and management plan. In 1989 the Montana Legislature enacted the BMP Notification Law (76-13-101 MCA), which requires private landowners to notify DNRC prior to harvesting timber. DNRC then provides information and technical assistance on how to apply BMPs in the logging operation. Under this law, forestry BMP information is sent to landowners. Implementation of Forestry BMPs is administered within a non-regulatory framework.

Since October 1991 the Streamside Management Zone (SMZ) Law (77-5-301 307 MCA) has regulated forest practices along streams. This law prohibits certain forest practices along stream channels and describes/directs suitable streamside management practices. The SMZ Rules (36.11.301 - 310 ARM) became effective March 15, 1993 and were intended to help define and clarify the SMZ law. The 1992 BMP field reviews did not evaluate compliance with the SMZ law because most operations reviewed were completed prior to the effective date of the rules. Beginning in 1994, the field reviews were designed to provide information on the application and implementation of the SMZ law and rules, using a supplemental SMZ questionnaire. In 1998 the format and five-point scale used to evaluate the BMPs for application and effectiveness was also adopted for evaluating the SMZ law and rules.

The BMP field review process, which the EPA calls BMP implementation monitoring, is a widely used means of evaluating forest practices. Implementation monitoring is an acceptable surrogate for water quality monitoring which is a more quantitative, time consuming and expensive approach. Water quality varies naturally due to variable geology, landforms, soils, and weather/climatic events. Due to this variability, investigators have to collect large numbers of samples over a long period of time to accurately characterize water quality.

In Montana, interdisciplinary team members use qualitative implementation of field reviews to determine if BMPs are being applied and whether they are controlling erosion. Since BMPs are recognized by state and federal legislation as a method to control non-point source pollution, it makes sense to check the application and effectiveness of BMPs as part of such a program. States are increasingly relying on qualitative surveys, using interdisciplinary teams to assess forest practices on-site to monitor their silvicultural non-point source control programs (NCASI, 1988).

Montana, through the DNRC, has appointed a technical working group that has overseen the BMP process since its inception and provides recommendations to DNRC. The Working Group members represent a broad range of interests in forestry in Montana. Several members also serve on the field review teams and have been involved with the program for several years.

# **METHODS**

## **Objectives**

BMP field reviews have been conducted every two years beginning in 1990 with the exception of 2020 (due to the Covid pandemic); 2022 represents the sixteenth cycle. The 2022 field reviews were conducted with identical objectives and criteria as the previous field reviews to produce comparable results.



*BMP Field Review Team members evaluate a site.*

In 2022, as in the past cycles, the objectives of the BMP field reviews were to:

1. Determine if BMPs are being applied on timber harvest operations.
2. Evaluate the general effectiveness of BMPs in protecting soil and water resources.
3. Provide information on the implementation of the SMZ law and rules and assess general effectiveness of SMZs in protecting water quality.
4. Provide information to focus future educational or study efforts by identifying subjects and geographic areas in need of further attention or investigation.
5. Provide information on the need to revise, clarify, or strengthen BMPs.

## **The Study Area:**

The State of Montana is the study area. For 2022 the state was divided into three geographical regions, Northwest, West, and Central/Eastern. For administrative ease, the regional breaks are located along county lines.

## **Sample Size and Distribution:**

Historically the target for the number of sites to be reviewed was set at 45. This number was based on the interaction between the number of days the volunteer field review team members could be expected to commit to the review process and the number of field reviews a team could reasonably conduct in one day. The maximum time commitment for field review team members was established at 10 days. This is for all review-related activities, which includes calibration training, conducting the on-the-ground field reviews and a post-field season workshop. It was determined that a request exceeding 10 days

would likely jeopardize the ability of individuals to participate, thus restricting the ability to field the desired number of fully staffed teams. A field review team can be expected to complete one or two reviews per day depending on the regional distribution of sites and the travel time between sites. Based on the above expectations and assumptions, the target number was set at 45.

The targeted field review sites are distributed across the state by geographical region (see Study Area above) and land ownership group. The field review process recognizes four ownership groups: 1) State of Montana Trust Lands, Lubrecht Experimental Forest (U of M) and MT Fish Wildlife & Parks are (State); 2) U.S. Forest Service/Bureau of Land Management lands are (Federal); 3) private industrial forest lands are (Industry) and 4) non-industrial private forest lands are (NIPF). The basis for field review site distribution is the proportion of the total statewide harvest volume that is harvested within each region by each ownership group. The sites are allocated proportionally among the regions. Harvest volumes were obtained from the 2021 State of Montana “*Cut-By-County Report*” and USFS, BLM and DNRC annual harvest volume records.

A total of 41 sites were selected but three were dropped during the review period for various reasons primarily associated with logistical problems or failing to properly meet all necessary criteria. These issues were discovered during on-the-ground field review work by the Team and then a decision was made to include or drop the site. A total of 38 sites met all relevant criteria and were reviewed during the 2022 BMP cycle (see Table 1 for historical site information).

In general, it is still difficult to obtain the desired number of NIPF field review sites that meet the minimum or higher priority criteria (see Site Selection discussion below for criteria details). There is a continuing downward trend in the number of NIPF landowners constructing roads and installing stream-crossings. This trend can impact the number of NIPF sites that meet the minimum criteria.

The 38 sites are a representative sample of logging operations that concluded in 2020 or 2021 and **that meet specific selection criteria** (see Site Selection, below). The selection criteria restrict the sample to those sites where on-the-ground timber harvest and timber management-related activities have the potential to impact water quality.

**Table 1: Historical Number of Sites Reviewed by Ownership Group**

Ownership Group	2022	2018	2016	2014	2012	2010	2008	2006	2004	2002	2000	1998	1996	1994	1992	1990
State	9	12	9	8	6	6	6	5	4	5	5	5	5	5	5	5
Federal	14	9	10	10	13	16	8	5	9	5	9	12	12	14	16	16
Industrial	5	8	11	11	12	15	17	22	19	21	18	18	14	14	16	16
NIPF	10	13	10	13	11	8	11	12	7	12	10	12	13	13	9	7
Total	38	42	40	42	42	45	42	44	39	43	42	47	44	46	46	44

\*See Appendix B for the list of reviewed sites.

## **Site Selection:**

In January of 2022 the DNRC-FAB sent Industry, Federal and State ownership group representatives a letter requesting potential BMP field review candidate sites. Each letter included a BMP Field Review Site Information Form (see Appendix C) to be completed for each harvest operation that met the first tier or minimum selection criteria. As with past information requests, these ownership groups were very cooperative and provided essential and complete information to DNRC. To obtain potential field review site information for NIPF ownership, DNRC searched its Hazard Reduction Agreements database and sent out letters to NIPF landowners of qualified sites asking if they would participate in the field review process. A postcard was included in the mailing for returning a response. Responses could also be emailed or phoned in.

The following two pages outline the new selection criteria as it was used to determine eligibility. These criteria conform to a legislative audit of the procedure that was completed in 2008.

**The sample size and sites selected DO NOT represent a sample of all timber harvest operations in Montana - ONLY those meeting site selection criteria. The selected sites are those where the timber harvest is located in proximity to streams, lakes and other bodies of water, and therefore has the greatest potential for non-point source pollution to occur.**

### **Minimum Criteria**

- Sites harvested (and completed) within two years prior to the field review (2020 and 2021).
- Minimum harvest size is 5 acres.
- Minimum sawlog volume per acre:
  - west-side sites – 2,500 or more board feet per acre removed
  - east-side sites – 1,000 or more board feet per acre removed

A portion of the sale must be located within 200 feet of a stream **or** have at least one crossing of a Class I or II stream on the road system associated with the harvest (access route and/or haul route). Roads are either located on the ownership group's property within the field review project area **or** the stream crossings are located on roads for which the ownership group being reviewed had some maintenance responsibility that was associated with the site being reviewed.

Note: These are essentially privately owned roads (although they could have public access such as USFS roads) accessing the site being reviewed: i. e. no county or state roads.

**Prioritization Criteria** – each site submitted would be given points based on the following matrix and the points for each site totaled.

**Explanation:** Relative Risk Rating – this was developed as a more equitable and trackable approach to identifying higher risk sites. Each site’s criteria would be assigned a point value – the more total points the higher the risk.

- Multiple new or replacement class 1 or 2 stream crossings 5 points
- Single new or replaced Class 1 or 2 stream crossing 4 points
- New road construction 3 points
- Reconstruction 2 points
- SMZ Harvest 2 points
- Existing stream crossings 1 point

- a. For the purposes of assigning risk - all stream crossings are class I & II only. Class 3 streams are not considered for risk factors but would be taken into account on the ground.
- b. The only stream crossings considered in determining risk are the stream crossings on the landowner’s property.

Note: new or replaced stream crossings must have been implemented in association with the harvest project within 5 years of the review year.

**Streams:**

**Stream and Streamside Management Zone (SMZ):** Definitions are from the Montana SMZ Administrative Rules; 36.11.301 2006 version). **For the purpose of BMP field reviews, an SMZ must have an associated stream as defined in the SMZ law.**

**Definition of a Stream** - A drainage feature with a defined channel, definite banks or a sandy or rocky bottom, and flows water either intermittently or continuously.

**Class 1 Stream** – Any stream with fish. OR Any stream that flows for more than 6 months per year and flows into another stream, lake or other body of water.

**Class 3 Stream** – Does not have fish. Flows less than 6 months per year and does not flow into another stream, lake or other body of water.

**Class 2 Stream** - All streams that do not meet the definitions for Class 1 or Class 3 streams.

**Roads:**

**New Construction** – Any roads constructed after January 1, 2017 used to access associated harvest areas.

**Reconstruction** – Reconstructing an existing road to a different set of design standards, such as widening roads, altering cut or fill slopes, culvert installation and/or replacement. For the purpose of field reviews, road work consisting of the installation of road drainage features and/or general road maintenance with no other reconstruction activities should not be submitted as “reconstruction”.

One associated site selection issue is that of access to potential field review sites. BMP field reviews are voluntary, and thus permission to access a site must be granted by the agency or landowner. In the case of NIPF lands, this is the individual landowner. The State, Federal and Industry ownership groups have all agreed to unrestricted access to BMP field review sites, and access is not an issue. In the case of non-industrial private land, DNRC must obtain permission from each individual landowner prior to conducting the field review on their property. In order to accomplish this, DNRC made contact by initial mailing containing a letter, a brochure explaining the process and a pre-paid post card to return to

DNRC notifying us if they agree to participate or decline. After selection, a follow-up notification and/or telephone call to confirm permission and grant access to perform the field review on their property was made. If permission and access was confirmed, a follow-up call was made by the team leader to finalize the field review date. Landowner(s), and the logger who did the work, were encouraged to attend.

**High Risk Sites:**

The goal of the field review process is to have approximately 2/3 of the reviewed sites classify as high risk. In 2022, only 39% (15 of 38) of the sites reviewed met the high-risk rating. This is due to limited sites with SMZ harvest and/or road construction/reconstruction.

**Table 2: Percentage of Sites with High Risk Criteria**

Ownership Group	Number of Sites	Number of High Risk Sites	Percentage of High Risk Sites	Number of Sites With SMZ Harvest	Percentage of Sites With SMZ Harvest
State	9	3	33%	1	11%
Federal	14	7	50%	1	7%
Industry	5	2	40%	2	40%
NIPF	10	3	30%	2	20%
All Sites	38	15	39%	6	16%

**The Field Review Teams (FRT):**

As in previous reviews, three FRT’s were formed to conduct the 2022 field reviews--one for the northwestern, one for the western, and one for the central/eastern part of the state. These teams were typically composed of seven members--a fisheries biologist, a forester, a hydrologist, a conservation group representative, a road engineer, a soil scientist, and a shared position of logging professional or NIPF landowners. Unlike previous review cycles, the 2022 FRTs were all lead by the *same* individual. The team leader was responsible for providing general in-the-field leadership and direction, contacting landowners, filling out the official rating form and coordinating the logistics of the team. Team members were generally employees of federal and state agencies, private industry, conservation organizations, independent consultants, and volunteers.

**The Rating Form:**

The 2022 FRT’s used a rating form identical to that of previous review cycles. They evaluated a maximum of 49 BMP practices and 12 SMZ practices including one for fish passage on new culvert installs at each site. As in the past, the rating of application and effectiveness for each practice was done on a five-point scale. See Appendix E for a copy of the rating form.

**Application:** The field review team rated the application of BMPs by first noting if the BMP was applicable to the site and, if so, whether it was applied to the correct technical standard, at the correct frequency, and in the proper locations. The field review teams utilize a decision tree (See Appendix G) to help rate application and effectiveness and maintain consistency.

The rating guide for BMP application is:

- 5 - Operation exceeds requirements of BMP.
- 4 - Operation meets requirements of BMP.
- 3 - Minor departure from intent of BMP.

2 - Major departure from intent of BMP.

1 - Gross neglect of BMP.

The following description of the rating guide is adapted from Ehinger & Potts, 1990. The “4” rating is self-explanatory. The “3” rating, minor departure, applies to departures of small magnitude distributed over a localized area, or over a larger area where potential for impact is low. The “2” rating, major departure, applies to departures of large magnitude or to BMPs being repeatedly neglected. The “1” rating, gross neglect, applies where risks to soil and water resources were obvious, yet there was no evidence indicating that operators had applied BMPs to protect these resources.

A “5” for Application is defined by Potts and Ehinger as “Improved protection of soil and water resources over pre-project conditions.” Thus, if a BMP is applied adequately and its application leads to improved protection over pre-project conditions, the application rating for that practice would be a “5.” In actuality, the Montana field review rating policy does not exactly follow the Potts and Ehinger definition. It was decided that if a BMP practice was applied in such a way that the requirements of the BMP were met, regardless of improvement over pre-existing conditions, this would provide adequate protection and thus receive an application rating of “4.” A “5” rating is basically going “above & beyond” in the application of the BMP.

**Effectiveness:** The effectiveness rating addresses how well the application of the applied BMP performed at limiting resource impacts and keeping soil out of water. This rating answers questions concerning impacts; for example, "Has the application or misapplication of a particular forest practice increased the likelihood of, or actual occurrence of, sediment delivery to streams?" The lack of “effectiveness” results in impacts.

The rating guide for BMP effectiveness is:

5 - Improved protection of soil and water resources over pre-project condition.

4 - Adequate protection of soil and water resources.

3 - Minor and temporary impacts on soil and water resources.

2 - Major and temporary, or minor and prolonged, impacts on soil and water resources.

1 - Major and prolonged impacts on soil and water resources.

Rating descriptions are essentially the same as above.

The BMP Working Group defined these terms prior to the 1990 field reviews to help the field teams use them consistently:

**Adequate**--Small amounts of material eroded; material does not reach draws, channels, or floodplain.

**Minor**--Some material erodes and is delivered to draws, but not to stream.

**Major**--Material erodes and is delivered to stream or annual floodplain.

**Temporary**--Impacts lasting one year or less; no more than one runoff season.

**Prolonged**--Impacts lasting more than one year.

Effectiveness ratings of “5” follow the same methodology as for Application. The effectiveness of the applied BMP exceeds what would be necessary to adequately protect soil and water resources.

Effectiveness ratings of “5” are in fact only given if the protection provided is extraordinary or more than adequate; for example, installing a bridge for fish passage when a CMP would have met the BMP requirement or obliterating an unnecessary road rather than merely putting in road drainage or gate.

In some cases, the BMP activities did not occur on a specific site or was not complete. In other situations, the field review team could not rate the BMP at the time of the review - BMPs having to do with timing of operations during the harvest cannot be judged post-harvest. When these situations occurred, the FRT noted on the form that the practice did not apply, and no rating was given. In 2022, a maximum of 1862 practices (38 sites, 49 BMPs) could have been rated. Sixty-seven percent of all possible BMP's were rated (1250 of 1862). Fifty-three percent of all possible SMZ practices – including fish passage - were rated (241 of 456).

In addition to the 49 BMPs evaluated, the field review form contains two general questions in Section VII (Appendix E) addressed by the FRT. One question addresses the issue of overall reductions in sediment delivery to streams because of road improvements to existing road systems. The second addresses the third-party road system. These are discussed later in this report. These questions were answered for all sites.

### **Field Review Site Inspections:**

The teams conducted the field reviews from early July through early August of 2022. The field review consists of team members, landowner representatives and observers meeting at a central location prior to each review. Teams and observers then travel to the field review site. When in the general area of the site, but before actually entering the road system to access the harvest area or the harvest area itself, there is a stop to discuss the specifics of the field review process. The team leader provides maps and field review forms. Usually the landowner/logger, or their representative, briefs the team by giving background information on the silvicultural prescription, time of operation, and associated practices. All decisions regarding which roads, SMZs, new culvert installations and harvest units to be reviewed are determined **before** the team enters the subject road system or harvest area. Once on site, all team members walk the site as a group, and review the practices conducted in the selected areas. Teams typically spend about two hours inspecting, discussing, and then rating each site. Observers attending the field review may give feedback when requested but are not allowed to participate in the ratings determination process or to lobby for a rating.

### **Limitations of the Field Review Methods:**

In analyzing field review results, readers need to consider the limitations of the techniques used in the field review. The review technique consists of a one-time field inspection and assessment. This approach documents erosion and sedimentation problems occurring in the first two years after harvest. This is generally the critical period for erosion associated with timber harvests. Some practices conducted during harvest cannot easily be evaluated during a post-harvest field review and are not considered during the field review. The assessment is based on visual appraisals of practices and impacts to surface soils and streams. The results are a “snapshot in time” of the practices and subsequent impacts. They do not necessarily reflect future impacts. During the 1998 field reviews, sites previously reviewed in 1996 and 1994–i.e., four- to six-year-old sites–were examined for long-term impacts. This information can be found in the 1998 Forestry BMP Audit Report (Fortunate et. al.)

Sites are split among the three teams. Although rating inconsistency between teams should not be overlooked, its effect is likely minor due to the interaction between teams and the continuity of experienced team members. Unlike previous review cycles, a single team leader was used for all teams. DNRC monitors each team to evaluate and promote consistency.

## RESULTS

This section presents the results of the 2022 BMP Field Reviews. Results will be presented in four parts: BMP Application, BMP Effectiveness, High Risk BMPs, and SMZ Results.

Results are also in three formats and does not include the SMZ ratings: summary data for BMP practices (Tables 3 and 6), summary data for reviewed sites (Tables 4 and 7), and a listing of the specific BMPs that had departures and/or impacts (Tables 5 and 8).

### BMP Application:

The application rating measures whether the BMP was applied and whether it was applied to the correct standards the appropriate number of times and in the proper locations. See "The Rating Form" section on page 12. Field review teams rated a total of 1250 practices to assess how landowners and operators applied BMPs. Tables 3, 4 and 5 present results relevant to BMP Application.

**Table 3: Application of BMPs to All Rated Practices  
by Ownership Group and Rating Category**

Ownership Group	Number of Practices Rated	Number and Percentage (%) of Practices Rated in Each Category			
		<i>Meet or Exceed</i>	<i>Minor Departures</i>	<i>Major Departures</i>	<i>Gross Neglect</i>
State	343	333 (97.1%)	10 (2.9%)	0%	0%
Federal	507	48 (95.6%)	19 (3.7%)	3 (0.6%)	0%
Industry	131	124 (94.7%)	7 (5.3%)	0%	0%
NIPF	269	262 (97.4%)	5 (1.9%)	2 (0.7%)	0%
All Sites	1250	1204 (96.3%)	41 (3.3%)	5 (0.4%)	0%

As illustrated in Table 3, practices were applied correctly 96.3% of the time. In terms of departures, of the 1250 practices evaluated, about 3.7% (46/1250) of the practices had departures; 41 ratings of 3 (**minor departures**) and 5 ratings of 2 (**major departures**). There were no ratings of 1 (**gross neglect**).

Table 4 details the **percentage of sites with application departures** and average number of departures per site. It shows that 55% (21 of 38) of sites reviewed had **departures** which results in an overall average of 1.1 minor departures per site and five sites had major departures which results in 0.1 major departures per site of the practices rated. Approximately 45% of the sites had **no departures**.

**Table 4: Field Review Sites with Departures from BMP Application  
with the Average Number of Departures per Site**

Ownership Group	Total Number of Sites	Number and Percentage of Sites with Adequate or Improved Protection	Percentage (%) of Sites with Departures			Average Number of Departures Per Site*		
			Minor	Major	Gross	Minor	Major	Gross
State	9	6/9 (67%)	3/9 (33%)	0%	0%	1.1	0	0
Federal	14	4/14 (29%)	10/14 (71%)	3/14 (21.4%)	0%	1.4	0.2	0
Industrial	5	1/5 (20%)	4/5 (80%)	0%	0%	1.4	0	0
NIPF	10	6/10 (60%)	4/10 (40%)	1/10 (10%)	0%	0.5	0.2	0
All Sites	38	17/38 (44.7%)	21/38 (55.3%)	4/38 (10.5%)	0%	1.1	0.1	0

\* Number of Departures/Total Number of Sites. In Table 4, each category of departures must be considered separately, since a site may have departures in more than one category.

Table 5 identifies the specific BMPs which had application departures.

It is noteworthy that in the 2018 cycle there were a total of 22 BMP's that had a total of 39 departures; 36 minor and 3 major. In 2022 those numbers of departures have slightly increased (46 departures; 41 minor and 5 major), but the number BMPs with departures decreased from 22 to 19.

**Table 5: Individual BMP Practices\* Where Application Departures Occurred with number of Departure Ratings Given**

SECTION	BMP SUBSECTION	BMP	“3” Rating Minor Departures	“2” Rating Major Departures	Total Departures
III	B	2	1	0	1
+ III	C	1	3	3	6
III	C	3	3	0	3
III	C	5	1	0	1
+ III	C	7	2	2	4
III	D	3	1	0	1
III	D	5	3	0	3
III	E	1	1	0	1
+ III	E	2	11	0	11
III	E	3	1	0	1
III	E	8	1	0	1
+ IV	A	5	1	0	1
IV	A	6	1	0	1
IV	B	1a	2	0	2
IV	B	1b	1	0	1
+ IV	B	5	1	0	1
+ IV	C	8	1	0	1
+ V	C	4	1	0	1
V	D	1	5	0	5
<b>Totals 19 BMP</b>			<b>41</b>	<b>5</b>	<b>46</b>

\* See Appendix A for a description of individual BMPs.

+ Denotes “High Risk BMP”

**BMP Effectiveness:**

The effectiveness rating evaluates how well BMPs protect soil and water resources. See pages 9 and 10 for further explanation of the effectiveness rating. The FRT’s also evaluated a total of 1250 practices for effectiveness. Table 6 provides a summary of the effectiveness of all practices reviewed by ownership group.

Adequate protection was provided 98.1% of the time. In terms of impacts (Table 6), of 1250 practices evaluated, 24 practices resulted in impacts; 14 with ratings of “3” (**minor and temporary** impacts), 6 with ratings of “2” (**major and temporary or minor and prolonged** impacts), and four with a rating of “1” (**major and prolonged** impacts).

**Table 6: Effectiveness of BMPs for All Rated Practices by Ownership Group and Rating Category**

Ownership Group	Number of Practices Rated	Number and Percentage (%) of Practices Rated in Each Category			
		Adequate Protection	Minor/Temporary Impacts	Major/Temporary or Minor/Prolonged	Major/Prolonged
State	343	338/343 (98.5%)	5/343 (1.5%)	0	0
Federal	507	493/507 (97.2%)	7/507 (1.4%)	5/507 (1%)	2/507 (0.4%)
Industrial	131	130/131 (99.2%)	1/131 (0.8%)	0	0
NIPF	269	265/269 (98.5%)	1/269 (0.4%)	1/269 (0.4%)	2/269 (0.7%)
All Sites	1250	1226/1250 (98.1%)	14/1250 (1.1%)	6/1250 (0.5%)	4/1250 (0.3%)

Table 7 lists the percentage of sites with impacts and average number of impacts per site. The table shows that 34.2% (13 of 38) of the sites reviewed had impacts. A total of 9 **minor/temporary** impacts were recorded which gives an overall average of 0.37 impacts per site. Approximately 16 percent (6 of 38) of all sites had a total of 6 major/temporary impacts which gives an overall average of 0.16 impacts per site. Three sites of the 38 had a major and prolonged impact which results in 8% of the sites and an average of 0.11 impacts per site. Table 8 identifies the specific BMPs which were rated with impacts.

**Table 7: Field Review Sites with Impacts (BMP Effectiveness)  
and the Average Number of Impacts per Site**

Ownership Group	Number of Practices Rated	Percentage (%) of Sites with Adequate or Improved Protection	Percentage (%) of Sites With Impacts			Average Number of Impacts per Site*		
			Minor/Temp.	Major/Temp. or Minor/Prolonged	Major/Prolonged	Minor/Temp.	Major/Temp. or Minor/Prolonged	Major/Prolonged
State	9	7/9 (77.8%)	2/9 (22.2%)	0	0	0.56	0	0
Federal	14	6/14 (42.9%)	5/14 (35.6%)	5/14 (35.6%)	2/14 (14.3%)	0.50	0.36	0.14
Industrial	5	4/5 (80%)	1/5 (20%)	0	0	0.2	0	0
NIPF	10	8/10 (80%)	1/10 (10%)	1/10 (10%)	1/10 (10%)	0.1	0.1	0.2
All Sites	38	25/38 (65.8%)	9/38 (23.7%)	6/38 (5.8%)	3/38 (7.9%)	0.37	0.16	0.11

\* Number of Impacts/Total Number of Sites

**Table 8: Individual BMP Practices\* Where Effectiveness Impacts Occurred  
With the Number of Departure Ratings Given**

Section	BMP Subsection	BMP	Minor 3 Rating	Major & Temp 2 Rating	Major & prolonged 1 Rating	Total Effects Impacts
+ III	C	1	2	2	1	5
+ III	C	7	1	2	1	4
III	D	3	1	0	0	1
III	D	5	2	0	0	2
+ III	E	2	4	1	0	5
+IV	A	5	1	0	0	1
IV	B	1a	1	0	0	1
+ IV	C	4	0	1	0	1
V	D	1	2	0	2	4
<b>TOTALS</b>			<b>14</b>	<b>6</b>	<b>4</b>	<b>24</b>

\*See Appendix A for a description of individual BMPs.

+ Denotes High Risk BMP

Table 9 provides an overall numeric summary by ownership group of all departures and impacts.

**Table 9: Overall Summary of Reviewed BMP Practices**

<b>Practices Information</b>				
<b>Group</b>	<b>Reviewed Sites</b>	<b>Total Practices Possible *</b>	<b>Number Practices Rated</b>	<b>Number Practices Not Rated **</b>
State	9	441	343	98
Federal	14	686	507	179
Industry	5	245	131	114
NIPF	10	490	269	221
<b>Total</b>	<b>38</b>	<b>1862</b>	<b>1250</b>	<b>612</b>

<b>Application/Departures</b>					<b>Effectiveness/Impacts</b>			
<b>Group</b>	<b>Exceeds Required (5)</b>	<b>Minor (3)</b>	<b>Major (2)</b>	<b>Gross neglect (1)</b>	<b>Exceeds (5)</b>	<b>Minor-Temp (3)</b>	<b>Major-Temp/Minor-Prolonged (2)</b>	<b>Major Prolonged (1)</b>
State	0	10	0	0	0	5	0	0
Federal	2	19	3	0	3	7	5	2
Industry	0	7	0	0	0	1	0	0
NIPF	0	5	2	0	0	1	1	2
<b>Totals</b>	<b>2</b>	<b>41</b>	<b>5</b>	<b>0</b>	<b>3</b>	<b>14</b>	<b>6</b>	<b>4</b>

\* Total practices possible based on the number of field review sites for each ownership; i.e. 49 X # of sites)

\*\* Practices not rated because the practice did not apply to the site. For example, there was no new culvert installation

**High Risk BMPs:**

Percentages alone will not give a clear picture of the application and effectiveness of Montana’s forestry BMPs. Even a low percentage of misapplied BMPs can still result in major impacts. Additionally, all practices evaluated can affect water quality, but the magnitude of their potential impacts can vary greatly. For example, drainage from a skid trail half a mile from a stream may not have as direct an impact on water quality as providing adequate road surface drainage at a stream crossing. In an effort to gain insight regarding the practices with the higher potential to directly impact water quality, eight high risk BMPs have been identified and analyzed separately. They are among the most important for protecting Montana's watersheds. They include:

**BMP**

**Number**

**Practice Description**

- III.C.1 Provide adequate road surface drainage for all roads.
- III.C.7 Route road drainage through adequate filtration zones before entering a stream.
- III.D.2 Stabilize erodible soils (i.e., seeding, benching, mulching).
- III.E.2 Maintain erosion control features (dips, ditches and culverts functional).
- IV.A.5 Design and locate skid trails to avoid concentrating runoff.
- IV.B.5 Adequate drainage for temporary roads, skid trails, fire lines.
- IV.C.8 Limit water quality impacts of prescribed fire.
- V.C.4 Prevent erosion of culvert and bridge fills (i.e., armor inlet and outlet).

The results for application and effectiveness of the eight high-risk BMPs are presented in Tables 10 and 11. Table 12 shows a comparison between All BMPs and High Risk BMPs.

Table 10 shows the BMP application for the eight high-risk BMPs. The percentage of practices with departures is higher for the high-risk group (10% vs. 4%) than for all reviewed practices, as shown in Table 12.

**Table 10: Application of High-Risk BMPs by Ownership Group and Rating Category\***

Ownership Group	Number of Practices Rated	Number and Percentage (%) of Practices Rated in Each Category			
		Adequate Application	Minor Departures	Major Departures	Gross Neglect
State	67	61/67 (91%)	6/67 (9%)	0%	0%
Federal	98	85/98 (87%)	10/98 (10%)	3/98 (3%)	0%
Industrial	30	27/30 (90%)	3/30 (10%)	0%	0%
NIPF	64	61/64 (95%)	1/64 (2%)	2/64 (3%)	0%
All Practices	259	234/259 (90%)	20/259 (8%)	5/259 (2%)	0%

*\*percentages were rounded to equal 100% and therefore may not be exact*

Table 11 shows the effectiveness of the eight high-risk BMPs. The percentage of practices with impacts is higher for the high-risk group (6% vs. 2%) than for all reviewed practices, as shown in Table 12.

**Table 11: Effectiveness of High-Risk BMPs by Ownership Group and Rating Category**

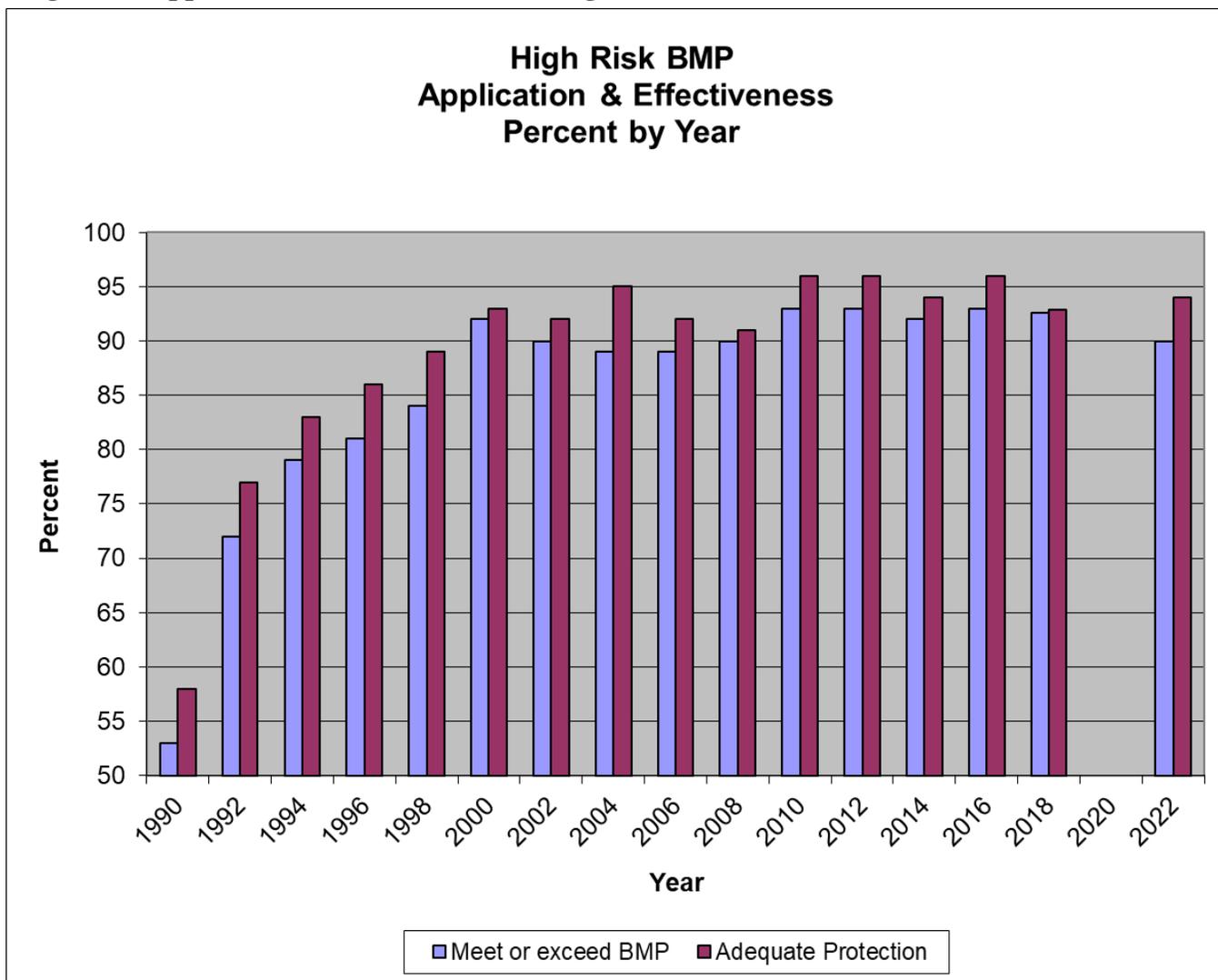
Ownership Group	Number of Practices Rated	Adequate Protection	Minor/Temp. Impacts	Major/Temp. Minor/Prolonged	Major/Prolonged
State	67	64/67 (96%)	3/67 (4%)	0	0
Federal	98	88/98 (90%)	4/98 (4%)	5/98 (5%)	1/98 (1%)
Industrial	30	30/30 (100%)	0	0	0
NIPF	64	61/64 (95%)	1/64 (2%)	1/64 (2%)	1/64 (2%)
All Practices	259	243/259 (94%)	8/259 (3%)	6/259 (2%)	2/259 (1%)

*\*percentages were rounded and may not add up to exactly 100%.*

**Table 12: BMP Application and Effectiveness - All vs. High Risk**

<b>Application</b> (Table 3 vs Table 10)				
BMPs	Meet or Exceed	Minor Departure	Major Departure	Gross Neglect
All	96.3%	3.3%	0.4%	0%
High Risk	90%	8%	2%	0%
<b>Effectiveness</b> (table 6 vs table 11)				
BMPs	Meet or Exceed	Minor impacts	Major/ Temp Impacts	Major Impacts
All	98.1%	1.1%	0.5%	0.3%
High Risk	94%	3%	2%	1%

Figure 1: Application and Effectiveness of High Risk BMPs 1990-2022



## Streamside Management Zones

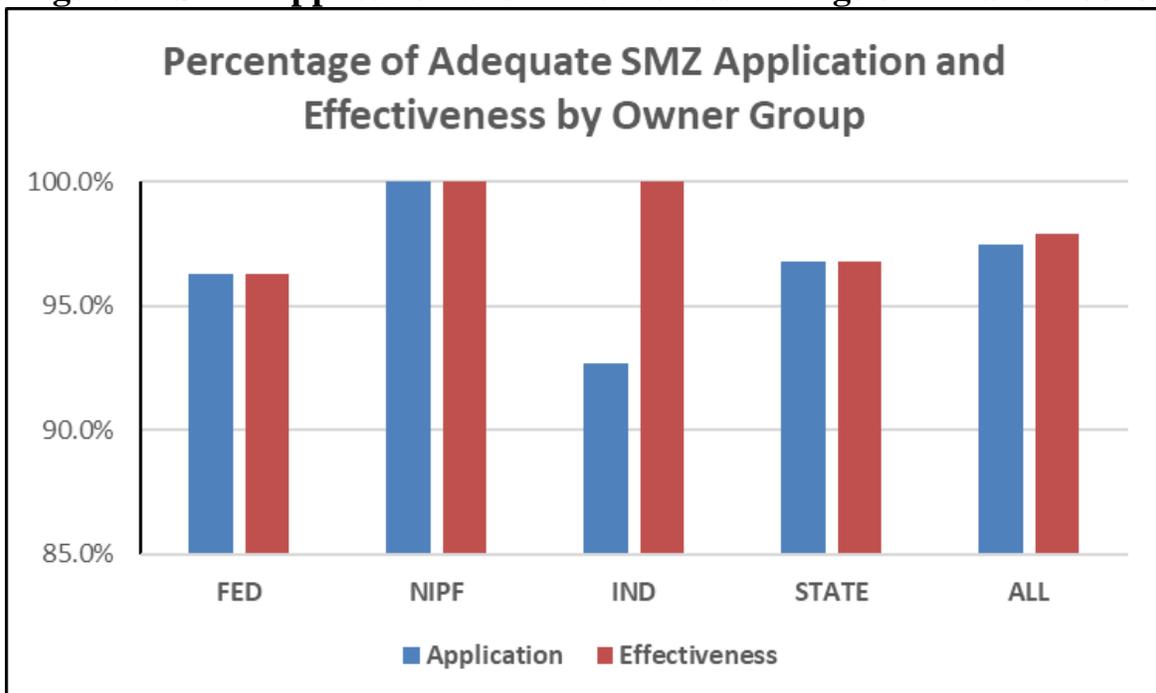
There is a different purpose in reviewing SMZ rules compared to BMP practices. Although they are both designed to protect water quality, the SMZ Law and Rules are a regulated activity. Conducting these field reviews is a non-regulatory look at SMZ rules compliance; BMPs are non-regulatory by design.

As in past years, the BMPs listed for the SMZ were taken from the formal SMZ Rules adopted in 1993 and modified in 2006. The scoring was the same as the BMP five-part rating scale. **As with the BMPs in general, these ratings did not constitute an investigation or a DNRC enforcement action, nor were/will they be used as a basis for future enforcement actions.** The FRT evaluated departures based on their best professional judgment.

The SMZ law and rules were theoretically applicable to all 38 field review sites since they are regulations that pertain to timber harvesting. Certain activities would be prohibited regardless of whether or not harvest activities occurred within or near the SMZ, such as side casting road material or the storage of hazardous material. Of the 38 sites, 30 sites received ratings. Only 6 sites had actual harvest within the SMZ and therefore had the potential for impacts. A total of 9 SMZ departures were noted on 6 of the sites. A total of 241 SMZ evaluations were made including fish passage. SMZ rules were applied correctly 97.5% of the time. Of the 6 application departures, 5 were minor impacts and one was a major departure.

SMZ effectiveness was also very high; 97.9% for all ownerships combined. Of the 241 SMZ evaluations, 236 provided adequate protection (a 4 or 5 rating). Four of the impacts were rated Minor/Temporary (“3” rating) and one was rated Major/Temporary or Minor/Prolonged (“2” rating). There were there no ratings of Major and Prolonged impacts (1 rating). Figure 2 depicts the application adequacy and resulting effectiveness by ownership category and Table 13 provides a summary of SMZ departures by practice.

**Figure 2: SMZ Application and Effectiveness Ratings of “4” and Above**



**Table 13: SMZ Application Departures by Practice**

Practice (SMZ #)	Number of Departures (# rated)
SMZ width maintained (1a)	1 (23)
SMZ tree retention (3)	2(23)
Equipment Operation in SMZ (4)	1(27)
Exclusion of slash in streams (8)	2 (28)
<b>TOTAL</b>	<b>6</b>

## **DISCUSSION**

### **Application Across All Ownerships:**

The vast majority (96.3%) of the BMP practices rated were properly applied according to BMP standards (Table 3). This percentage is slightly below the 2018 overall rating of 97%, however it continues to exhibit an extremely high level of compliance. Variations in these statistics are to be expected given the variation in the number of sites evaluated each review and the variation in practices employed, topography, stream type, and so on. This very high compliance percentage demonstrates the strong commitment all ownership groups and the logging community in general, have for properly applying Montana’s BMPs and practicing sound forest management particularly along rivers, streams and wetlands. The logging community has a robust training program that emphasizes BMP and SMZ compliance and the on-the-ground loggers have taken the time to learn these lessons and diligently apply them in their daily work.

**Table 14a. Application Impacts Associated with BMP’s with Multiple Departures**

BMP	Minor Departure (3)	Major Departure (2)	Gross Neglect (1)	Total
III.E.2 +	11	0	0	11
III.C.1 +	3	3	0	6
V.D.1	5	0	0	5
III.C.7 +	2	2	0	4
III.C.3	3	0	0	3
III.D.5	3	0	0	3
IV.B.1a	2	0	0	2
Totals	29	5	0	34

+ Indicates “High Risk” BMP

### **Effectiveness Across All Ownerships:**

Over 98% of applied BMPs were shown to be effective in preventing sediments from reaching draws or streams (Table 6). The lowest percentage was 97.2% on Federal lands with most issues attributable to “legacy roads”. These roads were built decades ago typically along a stream. The costs today to relocate many of these mainline system roads are extreme and cannot fit into today’s budgets even if the topography were favorable. The State and NIPF 98%, and Industry came in over 99%.

The most frequent departures and impacts, once again, were associated with road surface drainage maintenance as documented in tables 5 and 8 above. For a description of the individual BMP’s please refer to Appendix A. There were 7 BMP’s with multiple departures and are listed in Table 14b.

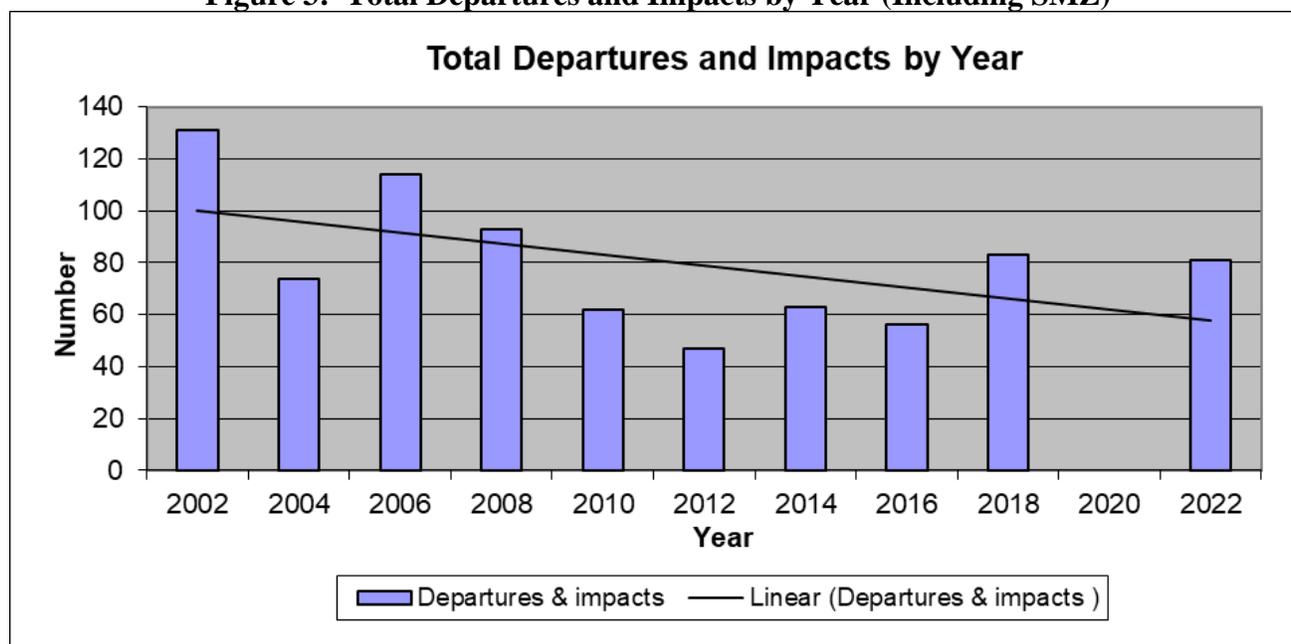
**Table 14b. Effectiveness Impacts Associated with BMP's with Multiple Departures**

BMP	Minor Impact (3)	Major/Temp or Minor & Prolonged Impact (2)	Major & Prolonged Impact (1)	Total
III.E.2 +	4	1	0	5
III.C.1 +	2	2	1	6
V.D.1	2	0	2	4
III.C.7 +	1	2	1	4
III.C.3	0	0	0	0
III.D.5	2	0	0	2
IV.B.1a	1	0	0	1
Totals	12	5	4	22

Practice III.E.2 is listed first in Tables 14a and 14b because it had more total departures *and* impacts than any other practice. The remainder were listed in order of # of departures and the significance of the BMP (i.e. whether High Risk or not).

The top four ranked BMPs on the above list account for 64% of all departures and impacts. When compared to previous reviews it can be seen that departures and impacts generally occur within the same BMP's cycle after cycle. This is due to the expense of bringing something such as a stretch of “legacy” road up to current BMPs or trying to adapt to the challenges of topography, legal access, and stream variability. Figure 3, graphically illustrates that although the total departures and impacts have varied somewhat, the overall trend is positive; an overall reduction in the total number.

**Figure 3: Total Departures and Impacts by Year (Including SMZ)**



Combining application and effectiveness, the 2022 field reviews rated a total of 2,500 (1250 x 2) BMP practices for the 38 sites. There was a combined total of 70 ratings with a departure or impact. **Which translates to a departure or an impact occurring on 2.8% (70/2500) of all practices rated.**

### Comparisons with Previous Field Reviews:

The 2022 reviews show a consistent high level of compliance that has been the norm for the past several review cycles; See Table 17 & 18 below. There were slight decreases in some categories and increases in other, however the changes were small and could reflect statistical variation. This is to be expected when compliance rates consistently exceed 95%. Figures 3, 4 & 5 depict a graphical representation of the continued progress in reducing the number of departures and impacts in Montana's timber harvesting operations.

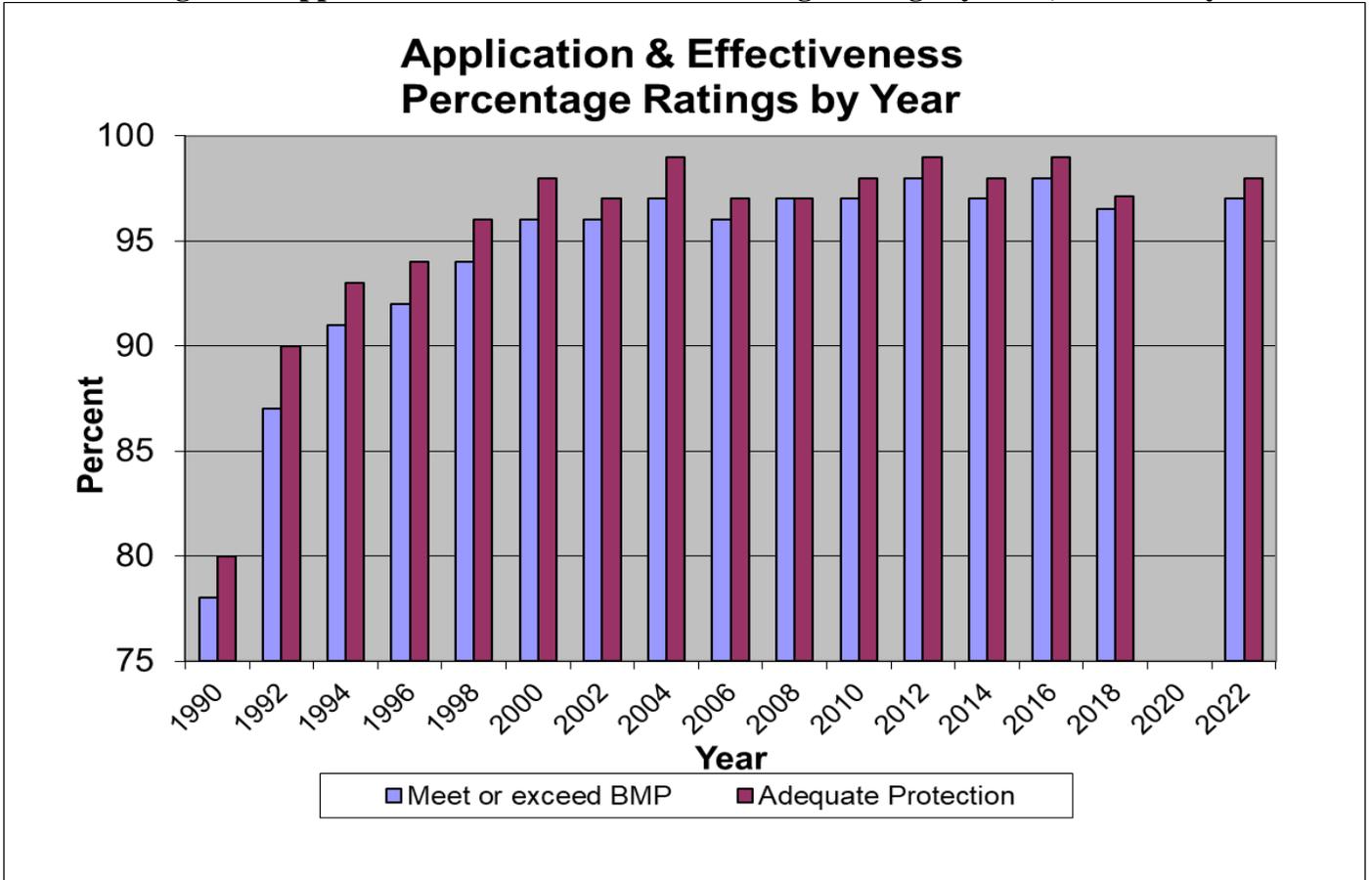
**Table 15: Comparison of 2022 BMP Field Review Findings with All Previous Results**

Category	2022	2018	2016	2014	2012	2010	2008	2006	2004	2002	2000	1998	1996	1994	1992	1990
Application of all practices that meet or exceed BMP requirements.	96%	97%	98%	97%	98%	97%	97%	96%	97%	96%	96%	94%	92%	91%	87%	78%
Application of high risk practices that meet or exceed BMP requirements.	90%	92%	93%	92%	93%	93%	90%	89%	89%	90%	92%	84%	81%	79%	72%	53%
Number of sites with at least one major departure in BMP application.	4/38 (11%)	3/42 (7%)	1 of 40 (2.5%)	2 of 42 (5%)	3 of 42 (7%)	5 of 45 (11%)	8 of 42 (19%)	4 of 44 (9%)	5 of 39 (13%)	10 of 43 (23%)	4 of 42 (10%)	8 of 47 (17%)	12 of 44 (27%)	17 of 46 (37%)	20 of 46 (43%)	27 of 44 (61%)
Average number of all departures in BMP application, per site.	1.21	0.928	0.925	0.93	0.76	0.87	1.19	1.52	1.30	1.80	1.40	2.00	3.00	3.90	5.60	9.00
Percentage of all practices providing adequate protection.	98%	98%	99%	98%	99%	98%	97%	97%	99%	97%	98%	96%	94%	93%	90%	80%
Percentage of high risk practices providing adequate protection.	94%	93%	96%	94%	96%	96%	91%	92%	95%	92%	93%	89%	86%	83%	77%	58%
Number of sites having greater than a minor impact	6/38 (16%)	7/42 (17%)	1/40 (2.5%)	3/42 (7%)	5/42 (12%)	7/45 (16%)	8/42 (19%)	7/44 (16%)	10/39 (25%)	15/43 (35%)	9/42 (21%)	12/47 (26%)	15/44 (34%)	13/46 (28%)	17/46 (37%)	28/44 (64%)
Average number of impacts per site.	0.63	0.69	0.325	0.57	0.38	0.47	1.02	1.05	0.56	1.30	1.00	1.50	2.30	3.00	4.60	8.00

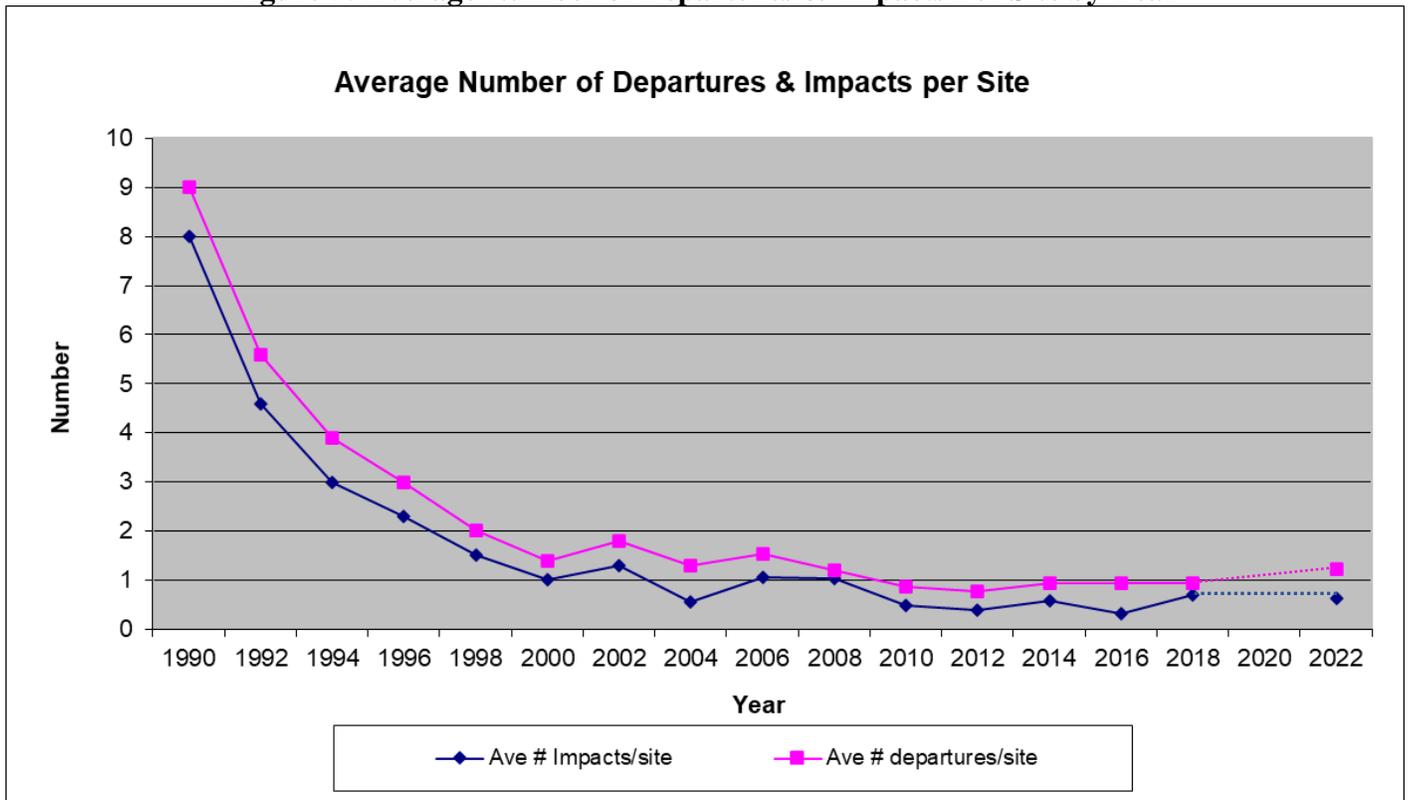
**Table 16**  
**Summarized Field Review Site Results 1990 Through 2022**

		2022	2018	2016	2014	2012	2010	2008	2006	2004	2002	2000	1998	1996	1994	1992	1990
Application	Meets/Exceeds	96.3%	97.2%	97.6%	96.9%	97.6%	97%	96%	96%	97%	96%	96%	94%	92%	91%	87%	78%
	Minor Departures	3.3%	2.6%	2.2%	2.5%	2.1%	2%	4%	4%	3%	3%	3%	5%	7%	7%	8%	14%
	Major Departures	0.4%	0.2%	0.2%	0.6%	0.3%	<1%	<1%	<1%	<1%	1%	0.3%	1%	1%	3%	4%	8%
Effectiveness	Adequate Protection	98.1%	97.9%	98.9%	98.2%	99.8%	98%	97%	97%	99%	97%	98%	96%	94%	93%	90%	80%
	Minor Impacts	1.1%	1.3%	0.9%	1.2%	0.5%	<1%	2%	2%	<1%	1%	2%	3%	4%	5%	6%	11%
	Major Impacts	0.8%	0.8%	0.2%	0.6%	0.7%	2%	<1%	<1%	<1	2%	.07%	1%	2%	2%	4%	8%
% Sites	With Major Departures	13.2%	7%	5%	7%	7%	11%	19%	9%	13%	23%	10%	17%	27%	37%	43%	61%
	With Major Impacts	15.8%	14%	5%	7%	12%	16%	19%	16%	25%	35%	21%	26%	34%	28%	37%	64%
Average Departures	Minor Per Site	1.1	.85	.675	.76	0.67	0.76	0.90	1.32	1.1	1.4	1.3	1.7	2.5	2.7	3.7	5.5
	Major Per Site	0.1	.07	.05	.16	0.09	0.11	0.29	.20	0.26	0.39	0.12	0.34	0.55	1.1	1.4	2.5
Average Impacts	Minor Per Site	0.37	.43	.275	.36	0.14	0.18	0.74	.66	0.26	0.58	0.71	1	1.6	2.1	2.8	4.4
	Major Per Site	0.26	.26	.05	.16	0.24	0.29	0.29	.32	0.31	0.75	0.29	0.51	0.66	0.8	1.4	3.0

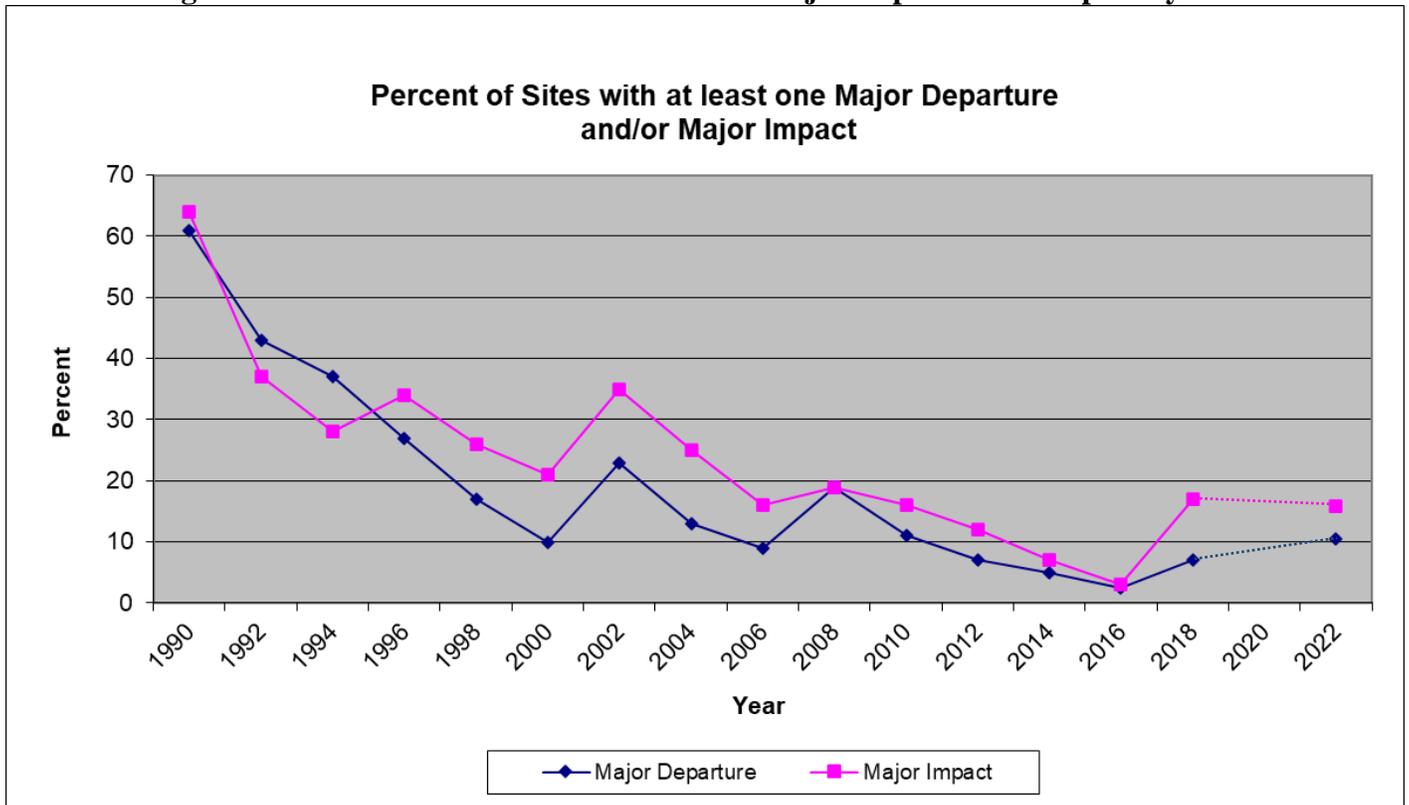
**Figure 4: Application and Effectiveness Percentage Ratings by Year, BMPs Only**



**Figure 5: Average Number of Departures & Impacts Per Site by Year**



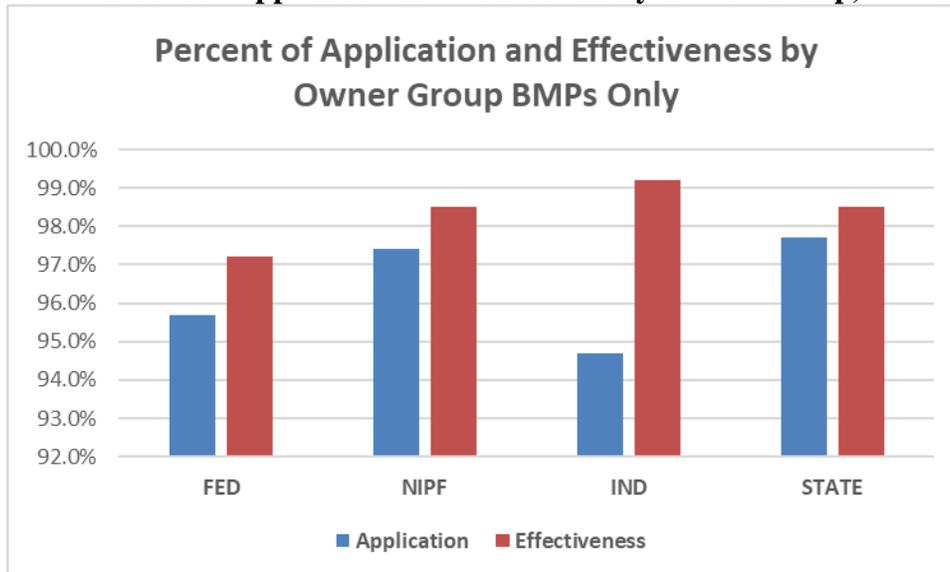
**Figure 6: Percent of Sites with at Least One Major Departure or Impact by Year**



**Results by Ownership Group:**

The 2022 field review results across all ownership groups for application were 97.2% for all BMP and SMZ categories combined. Across all ownerships 2982 ratings were made for both application and effectiveness (1250 BMP’s plus 241 SMZ times two for app & eff). There was a total of 81 departures and impacts (70 BMP and 11 SMZ). This translates to an overall compliance rating of over 97%.

**Figure 7: Percent of Application & Effectiveness by Owner Group, BMPs Only**



Given that all ownership groups demonstrated excellent overall compliance at the sites reviewed in 2022, there are some general observations that can be made for each ownership group.

### **State:**

2022 BMP field reviews on State managed lands resulted in over 97% adequate application ratings; the remaining ratings indicated minor departures. Effective protection of resources was achieved on over 98% of the applied practices. Number of sites with departures were 6 out of 9 and the number of sites with impacts were 2 out of 9. No impacts of BMPs were rated as major. Two SMZ departures were identified during the reviews that result in one minor and one major impact. For the high risk BMPs, Application “meets or exceeds” scores remained very high at 91% while the adequate protection was 96%.

### **Federal:**

In 2022 there were a total of 14 federal sites, 13 were U.S. Forest Service and one was Bureau of Land Management. Four of the USFS sites were implemented under the Good Neighbor Authority. The BMP application and effectiveness scores on federal lands were high at 96% and 97%, respectively. Three departures were noted the SMZ ratings; all departures resulted in minor/temporary impacts. For high risk BMPs, the Federal agencies applied BMPs adequately on 87% of the rated practices; 90% of the rated practices were effective to protect soil and water resources. Federal ownership was the only category that improved application and effectiveness ratings in all categories over the 2018 BMP field review ratings. These ratings are encouraging given the fact that many of the federal roads were built long before the implementation of BMP’s or even their development. As discussed previously, to bring these “legacy” roads up to current BMP standards, in some cases, would require significant work.

### **Industry:**

Industry’s five sites scored nearly 98% for BMP application and the review-high of 99.2% for effectiveness of BMPs. Industry had only one SMZ departure that did not result in any impacts to streams. Industrial forest landowners in Montana have placed a high priority on proper SMZ work and expect their loggers to conduct their operations accordingly. Several mills in Montana are SFI members and highly qualified loggers with a thorough knowledge of BMPs and SMZ rules are a requirement. Industry application scores for high risk BMPs was average for the review cycle at 90%, however, effectiveness was rated at a perfect 100%.

### **Non-Industrial Private Forest Landowners (NIPF):**

The 10 NIPF sites again scored high marks and stayed relatively consistent in 2018 for their BMP/SMZ scores compared to previous reviews. Overall scores for BMP Application were 97% and BMP Effectiveness scores were 99%. SMZ ratings were 100% for both application and effectiveness. For high risk BMPs, NIPF sites were rated at 95% for application and effectiveness.

### **Third Party Road and Other Use Implications**

Third party road impacts were observed at several field sites. Third party roads are roads not owned or directly controlled by the landowner being reviewed. Since the roads are not under the direct control of the participating landowner third party roads are not rated in the field review process. To qualitatively monitor BMPs associated with third party roads there is a location in Section VII of the field review form (Appendix E) where teams can record observations regarding third party roads.

### **Reductions in Overall Sediment Delivery**

The question was asked as to how this could be evaluated and the results presented in the Field Review Report. The BMP Working Group decided to add a new question to the BMP Field Review Form (Appendix E). The new question is in Section VII of the Field Review Form and reads, “Project included road improvements to existing road system that reduced overall sediment delivery to streams.” The teams were asked to do a visual qualitative assessment of each reviewed project’s post-project road system and, when possible, determine if

improvements resulted in a reduction in sediment delivery to streams. The 2022 field review results for this question are provided in Table 17.

**Table 17: Overall Sediment Reduction – Pre vs. Post Project Condition**

Landowner	# Sites Reviewed	Number Yes	Number No
STATE	9	7	2
FEDERAL	14	5	9
INDUSTRY	5	1	4
NIPF	10	3	7
TOTALS	38	16	22

Existing roads are defined as road systems in place prior to the start of activities on the sale being reviewed. This question did not apply to project areas where roads were not in place prior to the activity start-up. Results indicated 42% (16 out of 42) of the applicable sites reduced sediment delivery to streams from existing roads. This was compared to pre-project conditions and was based on what the teams could actually see or from conversations with the logger and/or landowner. In these comparisons, an existing road system was in place prior to project commencement, and some sedimentation was occurring. During the project, BMPs were implemented or brought up to current BMP standards such that sediment delivery to draws or streams was reduced.

A “Yes” determination does not necessarily mean that there was no sediment delivery occurring post-project. A “Yes” indicates that the post-operations status regarding delivery has been improved over the original conditions. Likewise, a “No” determination does not mean that conditions have worsened, nor that no improvements were made to the existing road system. A “No” indicates that any improvements made did not lead to reductions over pre-project conditions.

## **OTHER BMP ISSUES OF NOTE**

### **Field Review Site Selection Process:**

The site selection criteria described on page 6 of this report has been the most substantial change in the BMP Field Review process. Due to lesser amounts of harvest per acre for a variety of reasons, the pool of available sites to select presents a challenge (see Table 18). Additionally, the number of high-risk sites substantially diminished from the 2018 to the 2022 field reviews. This may be attributed to less SMZ harvest or less road construction/reconstruction.

**Table 18: Available Sites for 2022 BMP Field Reviews and Number Selected**

Ownership Group	Number of Available Sites	Number of Sites Selected	Comments
Federal	18	16	(2 dropped due to access issues)
NIPF	21	11	(1 dropped due to access issues)
Industry	25	5	
State	10	9	
Total	74	41	38 sites reviewed

## **Fish Passage BMPs:**

The BMP Working Group has created a matrix for measuring the effectiveness of newly installed Fish Passage culverts. The final process measures four separate parameters of the culvert installation. These are 1) The installation accommodates bank-full width (the mean high water level) of the stream; 2) The installation mimics the natural slope of the stream; 3) The installation retains substrates (gravels, cobbles, etc.) that are representative of the typical streambed for the stream in that location; and 4) the installation retains water depth through the culvert that is consistent with the surrounding stream.

These four criteria are assessed on a Less Favorable – More Favorable scale. An average 1 – 5 rating for the installation is developed based on these four ratings.

This year (2022) three sites were rated as applicable and were reviewed for fish passage. Of those sites, two were on federal lands and one was on state ownership. All sites received 4/4 ratings.

## **CONCLUSIONS**

This final section addresses the data collected and analyzed. Conclusions will address the objectives of the Best Management Practices field reviews as outlined on page five.

### **Determine if BMPs are being applied on timber harvest operations.**

When considering sites meeting site selection criteria, it can be conclusively stated that BMPs are being applied correctly at a very high rate. This has been ongoing for several review cycles. Great care is taken to conceal the identity/location of field review sites in order to prevent activity that may alter the site from what it normally would have looked like. Steps are also taken to make the selection process as random as possible. Having someone do “tune up” work they wouldn’t ordinarily do on a field review site prior to a review has not been an issue but taking precautions will continue to ensure the integrity of the process. There were no sites reviewed where evidence of BMP application was not present. Informational handouts and local expertise from DNRC Service and Trust Lands Foresters, forestry consultants, loggers, MSU Extension Forestry, mill foresters, and knowledgeable landowners have all contributed to improving BMP application rates. It is very reasonable to conclude that voluntary Forestry BMPs will continue to be the standard for timber harvest operations in Montana.

### **Evaluate the general effectiveness of BMPs in protecting soil and water resources.**

Conclusions drawn from the field review results since the 2000 review cycle inclusive are very straightforward and consistent; when BMPs are applied correctly, they are very effective in protecting soil and water resources. This combined with the efforts of many loggers, landowners, agencies, and mills to go above and beyond the standards to minimize sediments and impacts has kept overall results high and has brought real improvements on the ground, where it counts. When teams review a site, they don’t just look at the actual BMP. They look at whatever the BMP was designed to protect as well. Is there silt entering the stream? Are roads rutted beyond typical usage patterns? And so forth. The idea is to look at all aspects of any particular BMP and see if it is working and if not, why. Teams note if it is a fault of the operation, outside factors, or of the BMP itself. The BMP Working Group reviews the combined results and determines if any changes to the BMPs themselves need to be made.

**Provide information on the implementation of the SMZ law and rules and evaluate the general effectiveness of SMZs in protecting water quality.**

The 2022 field review data once again shows that the SMZ law and rules are being effectively and consistently applied across the state. This coincides with what we see in DNRC's SMZ enforcement program. DNRC enforcement records continue to show that the SMZ law and rule violations across the state are generally few and that the impacts associated with these violations are generally minor and that they can be very effectively mitigated. As with previous review cycles, the 2022 field review data supports the contention that the SMZ law and rules are highly effective in protecting water quality and streamside habitat and structure during timber harvest operations.

**Provide information to focus future educational or study efforts by identifying subjects and geographic areas in need of further attention or investigation.**

When a BMP is consistently being missed by loggers/landowners it is noted by the Team Leaders and is shown by the data collected. This information is factored into the agenda for the annual BMP/SMZ Workshops put on for the public and specific training may be devised by the DNRC to address the issue.

**Provide information on the need to revise, clarify, or strengthen BMPs.**

Opportunities to strengthen the BMPs are always assessed by the teams during "in-the-field" reviews. If a particular BMP appears to have gaps or needs additional language to properly respond to a new harvest methodology that observation gets reported back to the Field Reviews Coordinator who investigates and prepares a write-up for the BMP Working Group to consider.

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# APPENDIX A

## BEST MANAGEMENT PRACTICES FOR FORESTRY IN MONTANA January 2006

\* BMPs Not Monitored During Field Reviews

### DEFINITIONS

1. "Hazardous or toxic material" means substances which by their nature are dangerous to handle or dispose of, or a potential environmental contaminant, and includes petroleum products, pesticides, herbicides, chemicals, and biological wastes.
2. "Stream," as defined in 77-5-302(7), MCA, means a natural water course of perceptible extent that has a generally sandy or rocky bottom or definite banks and that confines and conducts continuously or intermittently flowing water.
3. "Streamside Management Zone (SMZ)" or "zone" as defined at 77-5-302(8), MCA means "the stream, lake, or other body of water and an adjacent area of varying width where management practices that might affect wildlife habitat or water quality, fish, or other aquatic resources need to be modified." The streamside management zone encompasses a strip at least 50 feet wide on each side of a stream, lake, or other body of water, measured from the ordinary high water mark, and extends beyond the high water mark to include wetlands and areas that provide additional protection in zones with steep slopes or erosive soils.
4. "Wetlands" mean those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include marshes, swamps, bogs, and similar areas.
5. Adjacent wetlands are wetlands within or adjoining the SMZ boundary. They are regulated under the SMZ law.
6. Isolated wetlands lie within the area of operation, outside of the SMZ boundary, and are not regulated under the SMZ law.

### II. STREAMSIDE MANAGEMENT

The Streamside Management Law (77-5-301 through 307 MCA) provides minimum regulatory standards for forest practices in streamside management zones (SMZ). The "Montana Guide to the Streamside Management Zone & Rules" is an excellent information source describing management opportunities and limitations within SMZs.

### III. ROADS

#### A. Planning and Location

1. Minimize the number of roads constructed in a watershed through comprehensive road planning, recognizing intermingled ownership and foreseeable future uses. Use existing roads, unless use of such roads would cause or aggravate an erosion problem.

2. Review available information and consult with professionals as necessary to help identify erodible soils and unstable areas, and to locate appropriate road surface materials.\*
3. Fit the road to the topography by locating roads on natural benches and following natural contours. Avoid long, steep road grades and narrow canyons.
4. Locate roads on stable geology, including well-drained soils and rock formations that tend to dip into the slope. Avoid slumps and slide-prone areas characterized by steep slopes, highly weathered bedrock, clay beds, concave slopes, hummocky topography, and rock layers that dip parallel to the slope. Avoid wet areas, including moisture-laden or unstable toe slopes, seeps, wetlands, wet meadows, and natural drainage channels.
5. Minimize the number of stream crossings and choose stable stream crossing sites.
6. Locate roads to provide access to suitable (relatively flat and well-drained) log landing areas to reduce soil disturbance.\*

**B. Design**

1. Properly design roads and drainage facilities to prevent potential water quality problems from road construction.\*
2. Design roads to the minimum standard necessary to accommodate anticipated use and equipment. The need for higher engineering standards can be alleviated through proper road-use management.
3. Design roads to balance cuts and fills or use full bench construction (no fill slope) where stable fill construction is not possible.\*
4. Design roads to minimize disruption of natural drainage patterns. Vary road grades to reduce concentrated flow in road drainage ditches, culverts, and on fill slopes and road surfaces.

**C. Road Drainage. Road Drainage is defined as all applied mechanisms for managing water in a non-stream crossing setting, road surface drainage, and overland flow; ditch relief, cross drains and drain dips)**

1. Provide adequate drainage from the surface of all permanent and temporary roads. Use outsloped, insloped or crowned roads, and install proper drainage features. Space road drainage features so peak flow on road surfaces or in ditches will not exceed capacity.
  - a. Outsloped roads provide a means of dispersing water in a low-energy flow from the road surface. Outsloped roads are appropriate when fill slopes are stable, drainage will not flow directly into stream channels, and transportation safety can be met.
  - b. For in-sloped roads, plan ditch gradients steep enough, generally greater than 2% but less than 8%, to prevent sediment deposition and ditch erosion. The steeper gradients may be suitable for more stable soils; use the lower gradients for less stable soils.

- c. Design and install road surface drainage features at adequate spacing to control erosion; steeper gradients require more frequent drainage features. Properly constructed drain dips can be an economical method of road surface drainage. Construct drain dips deep enough into the subgrade so that traffic will not obliterate them.
2. Design all ephemeral draw culverts with adequate length to allow for road fill width. Minimum culvert size is 15 inch. Install culverts to prevent erosion of fill, seepage and failure as described in V.C.4 and maintain cover for culverts as described in V.C.6.
3. Design all relief culverts with adequate length to allow for road fill width. Protect the inflow end of all relief culverts from plugging and armor if in erodible soil. When necessary construct catch basins with stable side slopes. Unless water flows from two directions, skew ditch relief culverts 20 to 30 degrees toward the inflow from the ditch to help maintain proper function.
4. Where possible, install culverts at the gradient of the original ground slope; otherwise, armor outlets with rock or anchor downspouts to carry water safely across the fill slope.
5. Provide energy dissipaters (rock piles, slash, log chunks, etc.) where necessary to reduce erosion at outlet of drainage features. Crossdrains, culverts, water bars, dips, and other drainage structures should not discharge onto erodible soils or fill slopes without outfall protection.
6. Prevent downslope movement of sediment by using sediment catch basins, drop inlets, changes in road grade, headwalls, or recessed cut slopes.\*
7. Route road drainage through adequate filtration zones or other sediment-settling structures to ensure sediment doesn't reach surface water. Install road drainage features above stream crossings to route discharge into filtration zones before entering a stream.

**D. Construction** (see also Section IV on stream crossings.)

1. Keep slope stabilization, erosion and sediment control work current with road construction. Install drainage features as part of the construction process, ensuring that drainage structures are fully functional. Complete or stabilize road sections within same operating season.\*
2. Stabilize erodible, exposed soils by seeding, compacting, riprapping, benching, mulching, or other suitable means.
3. At the toe of potentially erodible fill slopes, particularly near stream channels, pile slash in a row parallel to the road to trap sediment (example, slash filter windrow). When done concurrently with road construction, this is one method that can effectively control sediment movement, and it can also provide an economical way of disposing of roadway slash. Limit the height, width and length of "slash filter windrows" so wildlife movement is not impeded. Sediment fabric fences or other methods may be used if effective.

4. Minimize earthmoving activities when soils appear excessively wet. Do not disturb roadside vegetation more than necessary to maintain slope stability and to serve traffic needs.\*
5. Construct cut and fill slopes at stable angles to prevent sloughing and other subsequent erosion.
6. Avoid incorporating potentially unstable woody debris in the fill portion of the road prism. Where possible, leave existing rooted trees or shrubs at the toe of the fill slope to stabilize the fill.
7. Consider road surfacing to minimize erosion.\*
8. Place debris, overburden, and other waste materials associated with construction and maintenance activities in a location to avoid entry into streams. Include these waste areas in soil stabilization planning for the road.
9. Minimize sediment production from borrow pits and gravel sources through proper location, development and reclamation.
10. When using existing roads, reconstruct only to the extent necessary to provide adequate drainage and safety; avoid disturbing stable road surfaces. Prior to reconstruction of existing roads within the SMZ, refer to the SMZ law. Consider abandoning existing roads when their use would aggravate erosion.

**E. Maintenance**

1. Grade road surfaces only as often as necessary to maintain a stable running surface and adequate surface drainage.
2. Maintain erosion control features through periodic inspection and maintenance, including cleaning dips and crossdrains, repairing ditches, marking culvert inlets to aid in location, and clearing debris from culverts.
3. Avoid cutting the toe of cut slopes when grading roads, pulling ditches, or plowing snow.
4. When plowing snow, provide breaks in snow berm to allow road drainage.\*
5. Haul all excess material removed by maintenance operations to safe disposal sites and stabilize these sites to prevent erosion. Avoid sidecasting in locations where erosion will carry materials into a stream.\*
6. Avoid using roads during wet periods if such use would likely damage the road drainage features. Consider gates, barricades or signs to limit use of roads during spring break up or other wet periods.
7. Upon completion of seasonal operations, ensure that drainage features are fully functional. The road surface should be crowned, outsloped, insloped, or water-barred. Remove berms from the outside edge where runoff is channeled.\*

8. Leave abandoned roads in a condition that provides adequate drainage without further maintenance. Close these roads to traffic; reseed and/or scarify; and, if necessary, recontour and provide water bars or drain dips.

#### **IV. TIMBER HARVESTING, AND SITE PREPARATION**

##### **A. Harvest Design**

1. Plan timber harvest in consideration of your management objectives and the following\*:
  - a. Soils and erosion hazard identification.
  - b. Rainfall.
  - c. Topography.
  - d. Silvicultural objectives.
  - e. Critical components (aspect, water courses, landform, etc.).
  - f. Habitat types.
  - g. Potential effects on water quality and beneficial water uses.
  - h. Watershed condition and cumulative effects of multiple timber management activities on water yield and sediment production.
  - i. Wildlife habitat.
2. Use the logging system that best fits the topography, soil type, and season, while minimizing soil disturbance and economically accomplishing silvicultural objectives.
3. Use the economically feasible yarding system that will minimize road densities.\*
4. Design and locate skid trails and skidding operations to minimize soil disturbance. Using designated skid trails is one means of limiting site disturbance and soil compaction. Consider the potential for erosion and possible alternative yarding systems prior to planning tractor skidding on steep or unstable slopes.\*
5. Locate skid trails to avoid concentrating runoff and provide breaks in grade. Locate skid trails and landings away from natural drainage systems and divert runoff to stable areas. Limit the grade of constructed skid trails on geologically unstable, saturated, highly erosive, or easily compacted soils to a maximum of 30 percent. Use mitigating measures such as water bars and grass seeding to reduce erosion on skid trails.
6. Minimize the size and number of landings to accommodate safe, economical operation. Avoid locating landings that require skidding across drainage bottoms.

##### **B. Other Harvesting Activities**

1. Tractor skid where compaction, displacement, and erosion will be minimized. Avoid tractor or wheeled skidding on unstable, wet, or easily compacted soils and on slopes that exceed 40 percent unless operation can be conducted without causing excessive erosion. Avoid skidding with the blade lowered. Suspend leading ends of logs during skidding whenever possible.
2. Avoid operation of wheeled or tracked equipment within isolated wetlands, except when the ground is frozen (see Section VI on winter logging).

3. Use directional felling or alternative skidding systems for harvest operations in isolated wetlands.\*
4. For each landing, provide and maintain a drainage system to control the dispersal of water and to prevent sediment from entering streams.
5. Ensure adequate drainage on skid trails to prevent erosion. On gentle slopes with slight disturbance, a light ground cover of slash, mulch or seed may be sufficient. Appropriate spacing between water bars is dependent on the soil type and slope of the skid trails. Timely implementation is important.
6. When existing vegetation is inadequate to prevent accelerated erosion, apply seed or construct water bars before the next growing season on skid trails, landings and fire trails. A light ground cover of slash or mulch will retard erosion.\*

**C. Slash Treatment and Site Preparation**

1. Rapid reforestation of harvested areas is encouraged to reestablish protective vegetation.\*
2. When treating slash, care should be taken to preserve the surface soil horizon by using appropriate techniques and equipment. Avoid use of dozers with angle blades.
3. Minimize or eliminate elongated exposure of soils up and down the slope during mechanical scarification.\*
4. Scarify the soil only to the extent necessary to meet the resource management objectives. Some slash and small brush should be left to slow surface runoff, return soil nutrients, and provide shade for seedlings.
5. Carry out brush piling and scarification when soils are frozen or dry enough to minimize compaction and displacement.
6. Carry out scarification on steep slopes in a manner that minimizes erosion. Broadcast burning and/or herbicide application is preferred means for site preparation, especially on slopes greater than 40%.
7. Remove all logging machinery debris to proper disposal site.\*
8. Limit water quality impacts of prescribed fire by constructing water bars in firelines; not placing slash in drainage features and avoiding intense fires unless needed to meet silvicultural goals. Avoid slash piles in the SMZ when using existing roads for landings.

**V. STREAM CROSSINGS**

**A. Legal Requirements**

1. Under the Natural Streambed and Land Preservation Act of 1975 (the "310 law"), any activity that would result in physical alteration or modification of a perennial stream, its bed or immediate banks must be approved in advance by the supervisors of the local

conservation district. Permanent or temporary stream crossing structures, fords, riprapping or other bank stabilization measures, and culvert installations on perennial streams are some of the forestry-related projects subject to 310 permits.

Before beginning such a project, the operator must submit a permit application to the conservation district indicating the location, description, and project plans. The evaluation generally includes on-site review, and the permitting process may take up to 60 days.

2. Stream-crossing projects initiated by federal, state or local agencies are subject to approval under the "124 permit" process (administered by the Department of Fish, Wildlife and Parks), rather than the 310 permit.
3. A short-term exemption (3a authorization) from water quality standards is necessary unless waived by the Department of Fish, Wildlife and Parks as a condition of a 310 or 124 permit. Contact the Department of Environmental Quality in Helena at 444-2406 for additional information.

**B. Design Considerations** (Note: 310 permit required for perennial streams)

1. Cross streams at right angles to the main channel if practical. Adjust the road grade to avoid the concentration of road drainage to stream crossings. Direct drainage flows away from the stream crossing site or into an adequate filter.
2. Avoid unimproved stream crossings. Depending on location, culverts, bridges and stable/reinforced fords may be used.

**C. Installation of Stream Crossings** (Note: 310 permit required for perennial streams.)

1. Minimize stream channel disturbances and related sediment problems during construction of road and installation of stream crossing structures. Do not place erodible material into stream channels. Remove stockpiled material from high water zones. Locate temporary construction bypass roads in locations where the stream course will have minimal disturbance. Time construction activities to protect fisheries and water quality.
2. Design stream-crossings for adequate passage of fish (if present) with minimum impact on water quality. When using culverts to cross small streams, install those culverts to conform to the natural stream bed and slope on all perennial streams and on intermittent streams that support fish or that provides seasonal fish passage. Ensure fish movement is not impeded. Place culverts slightly below normal stream grade to avoid outfall barriers.
3. Do not alter stream channels upstream from culverts, unless necessary to protect fill or to prevent culvert blockage. On stream crossings, design for, at a minimum, the 25-year frequency runoff. Consider oversized pipe when debris loading may pose problems. Ensure sizing provides adequate length to allow for depth of road fill.
4. Install stream-crossing culverts to prevent erosion of fill. Compact the fill material to prevent seepage and failure. Armor the inlet and/or outlet with rock or other suitable material where feasible.

5. Consider dewatering stream crossing sites during culvert installation.\*
6. Maintain a 1-foot minimum cover for stream-crossing culverts 15 to 36 inches in diameter, and a cover of one-third diameter for larger culverts, to prevent crushing by traffic.
7. Use culverts with a minimum diameter of 15 inches for permanent stream crossings.\*

**D. Existing Stream Crossing**

1. Ensure stream crossing culverts have adequate length to allow for road fill width and are maintained to preserve their hydrologic capacity. To prevent erosion of fill, provide or maintain armoring at inlet and/or outlet with rock or other suitable material where feasible. Maintain fill over culvert as described in V.C. 6.

**VI. Winter Logging**

**A. General**

1. Consider snow-road construction and winter harvesting in isolated wetlands and other areas with high water tables or soil erosion and compaction hazards.\*
2. Conduct winter logging operations when the ground is frozen or snow cover is adequate (generally more than one foot) to prevent rutting or displacement of soil. Be prepared to suspend operations if conditions change rapidly, and when the erosion hazard becomes high.\*
3. Consult with operators experienced in winter logging techniques.\*

**B. Road Construction and Harvesting Considerations**

1. For road systems across areas of poor bearing capacity, consider hauling only during frozen periods. During cold weather, plow any snow cover off of the roadway to facilitate deep freezing of the road grade prior to hauling.\*
2. Before logging, mark existing culvert locations. During and after logging, make sure that all culverts and ditches are open and functional.\*
3. Use compacted snow for road beds in unroaded, wet or sensitive sites. Construct snow roads for single-entry harvests or for temporary roads.\*
4. In wet, unfrozen soil areas, use tractors or skidders to compact the snow for skid road locations only when adequate snow depth exists. Avoid steeper areas where frozen skid trails may be subject to erosion the next spring.\*
5. Return the following summer and build erosion barriers on any trails that are steep enough to erode.\*

**VII. HAZARDOUS SUBSTANCES**

**A. General**

1. Know and comply with regulations governing the storage, handling, application (including licensing of applicators), and disposal of hazardous substances. Follow all label instructions.
2. Develop a contingency plan for hazardous substance spills, including cleanup procedures and notification of the State Department of Environmental Quality.\*

**B. Pesticides and Herbicides**

1. Use an integrated approach to weed and pest control, including manual, biological, mechanical, preventive and chemical means.\*
2. To enhance effectiveness and prevent transport into streams, apply chemicals during appropriate weather conditions (generally calm and dry) and during the optimum time for control of the target pest or weed.\*

## APPENDIX B

### 2022 BMP FILED REVIEWS REVIEWED SITES BY OWNERSHIP

SITE #	SITE NAME	COUNTY	OWNER
FED-1	Gold Creek Salvage	Granite	USFS - Beaverhead-Deerlodge NF
FED-2	Smith Shields	Park	USFS - Custer-Gallatin NF
FED-3	Red Shiner	Flathead	USFS - Flathead NF
FED-4	Martin Radnor	Flathead	USFS - Flathead NF
FED-5	Upper Ten Mile	Lewis & Clark	USFS – Helena-Lewis & Clark
FED-6	Telegraph	Powell	USFS – Helena-Lewis & Clark
FED-8	West Pipe Salvage	Lincoln	USFS – Kootenai NF
FED-9	Young Fork Salvage	Lincoln	USFS – Kootenai NF
FED-10	Burnt Beam Fire Salvage	Sanders	USFS – Lolo NF
FED-12	Half Moon	Fergus	BLM
FED-13	GNA Liger	Flathead	USFS - Flathead NF
FED-14	GNA Boulder Lowlands	Jefferson	USFS – Beaverhead-Deerlodge NF
FED-15	GNA Elk Gem	Sanders	USFS – Kootenai NF
FED-16	GNA Skidale	Lincoln	USFS – Kootenai NF
IND-1	Luscher Place	Lincoln	Stimson Lumber Co.
IND-2	Fawn Leibowitz	Lincoln	Stimson Lumber Co.
IND-3	Trumbull 24 WW Sel	Flathead	F.H. Stoltze Land and Lumber Co.
IND-4	Little Meadows	Flathead	Flathead Ridge Ranch (Southern Pines Plantation at time of harvest)
IND-5	The Bees Knees	Sanders	Green Diamond
NIPF-1	Private	Flathead	Private
NIPF-2	Private	Madison	Private
NIPF-3	Private	Sanders	Private
NIPF-5	Private	Sanders	Private
NIPF-6	Private	Sanders	Private
NIPF-7	Private	Gallatin	Private
NIPF-8	Private	Sanders	Private
NIPF-9	Private	Lake	Private
NIPF-10	Private	Missoula	Private
NIPF-11	Private	Lincoln	Private
STATE-1	Curly's Gold	Missoula	MT Forest and Conservation Experiment Station (Lubrecht)
STATE-2	Threemile	Ravalli	MT Fish, Wildlife & Parks
STATE-3	Bull Moose	Powell	DNRC
STATE-4	Six Shooter	Missoula	DNRC
STATE-5	Bear Square	Missoula	DNRC
STATE-6	Skookum Creek	Sanders	DNRC
STATE-7	Ten Lions	Lake	DNRC
STATE-8	Schmidt Creek Salvage	Lake	DNRC
STATE-9	Lynch Lake	Lincoln	DNRC

# APPENDIX C

## BMP FIELD REVIEW SITE INFORMATION FORM ALL OWNERSHIPS

- A)** Please complete this sheet for each site that meets minimum criteria (see page 2 for instructions).  
**B)** Please attach a sale area map for each site. Highlight or otherwise identify new road construction and/or reconstruction and Streamside Management Zones.  
**C)** All references to streams and Streamside Management Zones (SMZ) are based on SMZ Law and 2006 Rules update, (see attached sheet).

### Minimum Criteria

- 1) Timber harvested during **Calendar Years 2016 and 2017 and**
- 2) Some portion of the sale (cutting unit) is located within 200 feet of a stream or an access road crosses a class I or class II stream, **and**
- 3) Minimum size of 5 harvested acres with 2,500 BF/acre (westside), or 1,000 BF/acre (eastside) actually harvested. Continental divide determines east and west sides.

Sale Name \_\_\_\_\_

Landowner Type (circle one)      Federal      NIPF      Industry      State

Landowner Name \_\_\_\_\_ Phone # \_\_\_\_\_

MHRA Attachment      Yes      No      MHRA Holder Name \_\_\_\_\_

HRA Agreement Number      \_\_\_\_\_      County \_\_\_\_\_

HRA Holder Name      \_\_\_\_\_      Phone # \_\_\_\_\_

Legal Description      Section \_\_\_\_\_      TWN \_\_\_\_\_      RNG \_\_\_\_\_

Acres Harvested      \_\_\_\_\_      Primary Drainage \_\_\_\_\_

New Road Construction (Since 2003)      Yes      No      Miles \_\_\_\_\_

Road Reconstruction/Deconstruction      Yes      No      Miles \_\_\_\_\_

Slash Disposal Complete      Yes \_\_\_\_      No \_\_\_\_

Average MBF Volume/Acre Removed From Harvested Area      \_\_\_\_\_ MBF/Ac

New Stream Crossing Culvert Installation      Yes      No      Number of crossings \_\_\_\_\_

Is new crossing on a fish bearing stream      Yes      No

Pre-Existing Stream Crossings On Access Road System Yes \_\_\_\_ No \_\_\_\_

Stream Within 200 Feet of a Harvest Unit      Yes \_\_\_\_      No \_\_\_\_

Riparian (SMZ) Harvest      Yes \_\_\_\_      No \_\_\_\_

Month/Year Harvest Conducted: From \_\_\_\_\_ To \_\_\_\_\_

Local Contact \_\_\_\_\_ Ph # \_\_\_\_\_

## APPENDIX D

# 2022 BMP FIELD REVIEW TEAM MEMBERS

	<b>NORTHWEST</b>	<b>WEST</b>	<b>CENTRAL / EAST</b>
<b>FISHERIES</b>	Leo Rosenthal, <i>DFWP</i> Kenneth Breidinger, <i>DFWP</i> Brian Stephens, <i>DFWP</i>	Shane Hendrickson, <i>USFS</i> Mike Anderson, <i>DNRC</i>	Trevor Selch, <i>DFWP</i>
<b>HYDROLOGY</b>	Brian Sugden, <i>Sudgen Forest Environmental</i> Marc Vessar, <i>DNRC</i> Keith Karoglanian, <i>USFS</i> Tony Nelson, <i>DNRC</i>	Kris Richardson, <i>USFS</i>	Scott Nagel, <i>USFS</i> Marc Vessar, <i>DNRC</i>
<b>SOILS</b>		Wayne (Skip) Barndt Jeremy Back, <i>USFS</i>	Kelsey Martin, <i>USFS</i> Robert Ray
<b>FORESTRY</b>	Tye Sundt, <i>Weyerhaeuser</i> Cameron Wohlschlegel, <i>Stoltze</i> Paul Donnellan, <i>USFS</i> Nick Aschenwald, <i>DNRC</i>	Brad French, <i>DNRC</i> Kyle Johnson, <i>BLM</i> Mike Lilly, <i>IFG</i>	Dale Kerkvliet
<b>ENGINEERING AND ROADS</b>	Tye Sundt, <i>Weyerhaeuser</i> Cameron Wohlschlegel, <i>Stoltze</i> Paul Donnellan, <i>USFS</i> Nick Aschenwald, <i>DNRC</i> <b>*Beth Dodson, U of M</b>	Steve Hayes, <i>BBER</i> <b>*Beth Dodson, U of M</b>	Don Kasten <b>*Beth Dodson, U of M</b>
<b>CONSERVATION</b>			
<b>NIPF/LOGGER</b>	Nick Aschenwald, <i>DNRC</i> Tye Sundt, <i>Weyerhaeuser</i>	Dyrk Krueger, <i>NIPF</i> Henry Fassnacht, <i>NIPF</i> Willy Peck, <i>Sun Mtn. Lumber</i>	Doug Mote, <i>Mote Lumber</i> Rex Anderson, <i>Sun Mtn. Lumber</i>
<b>OBSERVER</b>			

\*Beth Dodson served as the leader for all teams.

# APPENDIX E

DS-49  
Rev 6/06

## BMP FIELD AUDITS SITE INFORMATION

Site Number: \_\_\_\_\_ Meets Selection Criteria: Y/N \_\_\_\_\_  
High Hazard: Y/N \_\_\_\_\_; Riparian \_\_\_\_\_ Matrix \_\_\_\_\_

Site Name: \_\_\_\_\_

Owner(s): \_\_\_\_\_

Legal Description: \_\_\_\_\_ County: \_\_\_\_\_

Primary Drainage: \_\_\_\_\_ Month/Year Harvested: \_\_\_\_\_

Stream Within 200 Ft.? Y/ N Name: \_\_\_\_\_ Bankfull Width: \_\_\_\_\_

Unit Size: \_\_\_\_\_ Volume Removed: \_\_\_\_\_

Road Construction: \_\_\_\_\_ Length: \_\_\_\_\_

Road Reconstruction: \_\_\_\_\_ Length: \_\_\_\_\_

Slash Disposal Complete: \_\_\_\_\_ Method: \_\_\_\_\_

Logging Method: \_\_\_\_\_

Slope: 0-5% \_\_\_\_\_; 5-20% \_\_\_\_\_; 20-40% \_\_\_\_\_; 40%+ \_\_\_\_\_

Parent Material: \_\_\_\_\_

### Rating Guide

Soil Erodibility: High Medium Low

Harvest in SMZ: Y/ N

Stream Class: \_\_\_\_\_

APPLICATION
5—Operation Exceeds Requirements <u>Of</u> Bmp
4—Operation Meets Requirements <u>Of</u> Bmp
3—Minor Departure <u>From</u> Bmp
2—Major Departure <u>From</u> Bmp
1—Gross Neglect <u>Of</u> Bmp

Comments:

EFFECTIVENESS
5—Improved Protection <u>Of</u> Soil And Water Resources Over Pre-Project Condition
4—Adequate Protection <u>Of</u> Soil And Water Resources
3—Minor <u>And</u> Temporary Impacts On Soil & Water Resources
2—Major <u>And</u> Temporary Or Minor And Prolonged Impacts On Soil And Water Resources.
1—Major <u>And</u> Prolonged Impacts On Soil And Water Resources.
DEFINITIONS (BY EXAMPLE)
Adequate—Small amount of material <u>eroded</u> ; Material does not reach draws, channels, or floodplain.
Minor—Erosion and delivery of material to draws but not stream.
Major—Erosion and subsequent delivery of sediment to stream or annual floodplain.
Temporary—Impacts lasting one year or less; no more than one runoff season.
Prolonged—Impacts lasting more than one year.

FIELD AUDIT

Date:

Team Leader/Recorder:

Team Members:

Observers Present:

NR – Not Reviewed      NA – Not Applicable

## MONTANA FOREST PRACTICES REVIEW WORKSHEET

BMPs Applicable to:

- + New Road Construction
- # Existing Roads
- > Reconstruction

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N) APPLICATION EFFECTIVENESS				COMMENTS
<b>SECTION III—ROADS</b>					
<b>ROAD PLANNING &amp; LOCATION</b>					
<b>SECTION III. A.</b>					
>+ 1a. Minimize number of roads necessary.					
# 1b. Use existing roads unless aggravated erosion.					
+ 3. Avoid long, sustained, steep road grades.					
+ 4. Locations avoid high-hazard sites (i.e., wet areas and unstable slopes).					
+ 5a. Minimize number of <u>stream</u> crossings. Number					
+ 5b. Choose stable stream crossing sites.					
<b>ROAD DESIGN</b>					
<b>SECTION III. B.</b>					
>+ 2. Design roads to minimum standard necessary to accommodate anticipated uses.					
+ 4. Vary road grade to reduce concentrated drainage.					
<b>ROAD DRAINAGE –</b>					
<b>SECTION III. C.</b>					
+># 1. Provide adequate road surface drainage for all roads.					
+> 2. Design ephemeral draw culverts with adequate length and size and to prevent erosion of fill. Minimum size 15" maintain cover.					
+># 3. Design all relief culverts with adequate length and appropriate skew. Protect inflow end from erosion. Catch basins where appropriate.					
+># 4. Install culverts at original gradient, <u>otherwise</u> rock armour or anchor downspouts.					
+># 5. Provide energy dissipaters at drainage structure outlets <u>where</u> needed.					
+># 7. Route road drainage through adequate filtration zones before entering a stream.					

**MONTANA FOREST PRACTICES REVIEW WORKSHEET**

BMPs Applicable to:

- + New Road Construction
- # Existing Roads
- > Reconstruction

<u>CONSTRUCTION/RECONSTRUCTION</u>				
<u>SECTION III. D.</u>				
+>	2.	Stabilise <u>erodible soils</u> (i.e., seeding, benching, mulching).		
+>	3.	Provide effective sediment control on erodible fill slopes (ex. Slash filter windrow).		
+>	5.	Cut and fill slopes at stable angles. Slope ratio: _____.		
+>	6.	Avoid incorporating woody debris in road fill.		
+>	8.	Excess materials (waste) placed in locations that avoid entering stream.		
+>	9.	Sediment from borrow pits and gravel pits minimized.		
>	10.	Reconstruct only to the extent necessary to provide adequate drainage and safety.		
<u>ROAD MAINTENANCE</u>				
<u>SECTION III. E.</u>				
+>#	1.	Grade roads as necessary to maintain drainage.		
+>#	2.	Maintain erosion control features ( <u>dips</u> , ditches and culverts functional).		
#	3.	Avoid cutting the toe of cut slopes.		
+>#	6.	Avoid use of roads during wet periods and spring breakup.		
+>#	8.	Abandoned roads in condition to provided adequate drainage without further maintenance.		
<b>SECTION IV – TIMBER HARVESTING</b>				
<u>HARVEST DESIGN</u>				
<u>SECTION IV. A.</u>				
	2.	Suitable logging system for topography, soil type and season of operation.		
	5.	Design and locate skid trails to avoid concentrating runoff.		
	6.	Suitable location, size, and number of landings.		

**MONTANA FOREST PRACTICES REVIEW WORKSHEET**

BMPs Applicable to:

- + New Road Construction
- # Existing Roads
- > Reconstruction

<u>OTHER HARVESTING ACTIVITIES</u>			
<u>SECTION IV. B.</u>			
1a.	Skidding operations minimizes soil compaction and displacement.		
1b.	Avoid tractor skidding on unstable slopes and slopes that exceed 40% unless not causing excessive erosion.		
2.	Avoid operation of equipment within isolated wetlands.		
4.	Adequate drainage for landing.		
5.	Adequate drainage for skid trails.		
<u>SLASH TREATMENT AND SITE PREPARATION</u>			
<u>SECTION IV. C.</u>			
2.	Treat slash so as to preserve the surface soil horizon.		
4.	Scarify only to the extent necessary to meet resource management objective.		
5.	Activities limited to frozen or dry conditions to minimize soil compaction and displacement.		
6.	Equipment operations on suitable slopes only.		
8.	Limit water quality impact of prescribed fire.		
<b>SECTION V – STREAM CROSSINGS</b>			
<u>LEGAL REQUIREMENTS</u>			
<u>SECTION V. A.</u>			
>+	1. Proper permits for stream crossings.		
<u>DESIGN CONSIDERATIONS</u>			
<u>SECTION V. B.</u>			
>+	1a. Cross streams at right angles, if practical.		
>+	1b. Direct road drainage away from stream crossing site.		
>+	2. Avoid unimproved stream crossings.		

**MONTANA FOREST PRACTICES REVIEW WORKSHEET**

BMPs Applicable to:

- + New Road Construction
- # Existing Roads
- > Reconstruction

<b><u>INSTALLATION OF STREAM CROSSINGS</u></b>			
<b><u>SECTION V. C.</u></b>			
>+	1.	Minimize stream channel disturbance.	
>+	2.	Stream crossing culverts conform to natural streambed and slope.	
>+	3.	Proper sizing for stream crossing structures.	
>+	4.	Prevent erosion of stream crossing culverts and bridge fills (i.e., armor inlet and outlet).	
>+	6.	Minimum cover for stream crossing culverts provided.	
<b><u>EXISTING STREAM CROSSING</u></b>			
<b><u>SECTION V. D.</u></b>			
#	1.	Culverts are maintained to preserve their hydrologic capacity. Adequate length to allow for road fill width. Rock armoring. Maintain fill over culvert.	
<b>SECTION VII – HAZARDOUS SUBSTANCE</b>			
<b><u>GENERAL</u></b>			
	1.	Know and comply with regulations governing the storage, handling, etc. of hazardous substances.	
#		Project included road improvements to existing road system that reduced overall sediment delivery to streams.	Y/N Comment(s):
+>#		Road system contains third party road systems.	Y/N Comment(s)
<b>ADDITIONAL COMMENTS:</b>			

**MONTANA FOREST PRACTICES REVIEW WORKSHEET**

BMPs Applicable to:

- + New Road Construction
- # Existing Roads
- > Reconstruction

STREAMSIDE MANAGEMENT ZONE SITE INFORMATION				
RECOMMENDED BEST MANAGEMENT PRACTICES				COMMENTS
1. Adequate SMZ width maintained, avg. width				
2. Exclusion of broadcast burning in SMZ.				
3. SMZ retention tree requirements met. (# of trees, representative of pre-harvest stand, favor bank-edge and leaning trees, shrubs and sub merchantable).				
4. Exclusion of equipment operation in SMZ except on established roads.				
5. Exclude construction of roads in the SMZ except when necessary to cross a Stream or wetland.				
6. Exclusion of road fill material deposited in SMZ except as needed to construct crossings.				
7. Exclusion of side-casting of road material into a stream, lake, wetland or other body of water during road maintenance.				
8. Exclusion of slash in streams, lakes or other bodies of water.				
9. Exclude the handling, storage, application or disposal of hazardous or toxic materials in the SMZ in a manner that pollutes or causes damage or injury.				
10. <u>Pre-approved</u> alternative practices				
11. DNRC approved site specific alternative practices.				

ADDITIONAL COMMENTS:

# APPENDIX F

## FISH PASSAGE FIELD REVIEW FORM

Date: \_\_\_\_\_

Field Review Site Name: \_\_\_\_\_

Field Review Site Number: \_\_\_\_\_

<b>INSTALLATION OF STREAM CROSSINGS</b>				
SECTION V. C.	COMMENTS			
2. Design stream-crossings for adequate passage of fish (if present) and ensure fish passage is not impeded.				
** Stream crossing type and/or structure modification (fords, baffles, bridges).				
a. Structure width accommodates bankfull width. <div style="margin-left: 20px;">Bankfull width            _____</div> <div style="margin-left: 20px;">Culvert width            _____</div> <div style="margin-left: 20px;">Constriction ratio        _____</div>				
b. Structure slope mimics upstream and downstream slope <div style="margin-left: 20px;">Channel slope            _____</div> <div style="margin-left: 20px;">Culvert slope            _____</div> <div style="margin-left: 20px;">Difference                _____</div>				
c. Structure retains <u>substrates</u> representative of the upstream and downstream reaches and/or design material. <div style="margin-left: 20px;">% of culvert bottom with substrate        _____</div>				
d. Structure retains water depth representative of upstream and downstream reaches. <div style="margin-left: 20px;">Channel water depth    _____</div> <div style="margin-left: 20px;">Culvert water depth    _____</div> <div style="margin-left: 20px;">Difference                _____</div>				
<b>FISH PASSAGE SCORING TOTAL</b>	Application to Site (Y/N)	Application	Effectiveness	<b>OVERALL COMMENTS</b>
<b>Design stream-crossings for adequate passage of fish (if present) with minimum impact on water quality. Ensure fish passage is not impeded</b>				

# Application and Effectiveness Guidelines for the Fish Passage BMP Field Reviews

## Application Rating

Design Criteria	Rating Guidelines (Examples)	Application Rating
V.c.2.a. - structure <u>width</u> accommodates bankfull width	$W_{struct}$ meets $W_{bkf}$ (Constriction Ratio $\geq 0.9$ ) <sup>1</sup>	MORE FAVORABLE
	$W_{struct}$ slightly constricts $W_{bkf}$ (Constriction Ratio 0.7 – 0.89) <sup>2</sup>	↓
	$W_{bkf}$ obviously not taken into consideration (Constriction Ratio $<0.5$ )	LESS FAVORABLE
V.c.2.b. - Structure <u>slope</u> mimics upstream and downstream slope	Structure placed at stream grade (within $\pm 1\%$ ) <sup>2</sup>	MORE FAVORABLE
	Structure placed steeper/shallower than stream ( $\pm 1\% - 3\%$ )	↓
	Structure slope obviously not taken into consideration ( $> \pm 5\%$ )	LESS FAVORABLE
V.c.2.c. - Structure retains <u>substrates</u> representative of the upstream and downstream reaches and/or design material	Structure retaining material throughout the structure. (90-100%) <sup>2</sup>	MORE FAVORABLE
	Structure retaining material throughout a portion of structure (10-90%)	↓
	No substrate being retained and substrate not taken into consideration.	LESS FAVORABLE
V.c.2.d. - Structure retains <u>water depth</u> representative of upstream and downstream reaches	Water depth representative of stream channel <sup>2</sup>	MORE FAVORABLE
	Water depth slightly altered compared to stream channel (<50% change in depth)	↓
	No surface water found within structure or excessive surface water	LESS FAVORABLE MORE FAVORABLE
<p>1 - Constriction Ratio = structure width divided by bankfull width (ex. 5' culvert/10' stream width = 0.5)</p> <p>2 – Representative of the natural stream channel outside the zone of crossing-structure influence.</p>		

## Application and Effectiveness Guidelines for Fish Passage BMP Field Reviews

### Effectiveness Rating

Fish Passage	Rating Guidelines (Examples)	Rating
<b>Design stream-crossings for adequate passage of fish (if present) with minimum impact on water quality. Ensure fish passage is not impeded</b>	Not applicable or possibly in the case of a replacement	5 - Improved Passage
	No passage concerns for local species at any time of year	4 - Adequate Passage
	Passage concerns due to minor application departures	3 - Minor and temporary Passage Impediment
	Passage concerns due to major application departures	2 - Major and temporary Passage Impediment
	Passage concerns for both low and high water flow	1 - Major and Prolonged Passage Impediment

#### Field Review procedures and measurements:

All measurements will be taken outside the zone of structure influence. (Except for culvert slope)

- Tape measurements of structure width and bankfull width.
  - Calculate constriction ratios (structure width/bankfull width)
    - Minimum of three measurements upstream and/or downstream at riffle sections, at bankfull width.
- Measurement of stream and structure slope (Clinometer)
  - Measure stream slope upstream and downstream of structure
    - Minimum of three measurements upstream and downstream, from riffle to riffle, measured in same direction.
- Substrate will be visually estimated, minimally
  - Keeping mind it is a human tendency to overestimate substrate size.
    - Consider substrates within 200 feet below and above structure. Estimate proportions of various size classes.
- Water depth will be measured with a wading staff
  - Minimum of three measurements upstream and downstream, measured at thalweg depth at bankfull width measure locations.

Detailed comments are required in order to elaborate and/or defend the effectiveness rating.

# APPENDIX G

## BMP FIELD REVIEW RATING FLOW CHART

