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Medicine Bow National Forest, USDA Forest Service, Region 2

Trout MIS Monitoring Protocol

(Picture from Canyon Ranch website: www.canyonranchbighorn.com)

Plan prepared by:

Gregory S. Eaglin
Medicine Bow National Forest, USDA Forest Service, Laramie, WY

Daniel C. Dauwalter and Frank J. Rahel
Department of Zoology and Physiology, University of Wyoming, Laramie, WY

Kenneth G. Gerow
Department of Statistics, University of Wyoming, Laramie, WY

Gregory D. Hayward
USDA Forest Service, Region 2, Denver, CO

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Table of Contents

List of Tables

List of Figures

Introduction

Overview and Purpose

This document outlines a plan for monitoring aquatic Management Indicator Species (MIS) on the Medicine Bow National Forest, Wyoming. The plan is based on MIS monitoring and viability requirements presented in the 2003 Medicine Bow National Forest Revised Land and Resource Management Plan (USFS 2003a). The aquatic MIS identified for the Medicine Bow National Forest is common trout, which collectively includes: brook trout *Salvelinus fontinalis*, brown trout *Salmo trutta*, and rainbow trout *Oncorhynchus mykiss*. Although these species are not indigenous to the area, they now exist as naturalized populations that are of major recreational importance. We begin with the plan background, followed by a list of plan objectives, and then a discussion of management trigger points, monitoring methods, and reporting.

Background and Key Concepts

Multiple-use activities such as timber harvest and associated road construction, livestock grazing, mining (recreational and commercial), recreation activities (camping, snowmobiling, and off-highway vehicle use), and residential and commercial development can directly and indirectly affect aquatic ecosystems (Kershner et al. 2004). Trout species are integral components of many aquatic ecosystems in the Medicine Bow National Forest and provide the basis for much recreational activity. The abundance, distribution, and demographics of trout populations can change in response to multiple-

use activities that affect the quality of aquatic habitats. Thus, trout are considered to be useful management indicator species (USFS 2003a).

Trout populations are sensitive to stream habitat conditions, and stream habitat reflects local and landscape features resulting from natural processes and forest management. Brook trout, brown trout, and rainbow trout inhabit cool, high-gradient mountain streams (Baxter and Stone 1995) that are typical of those in the Medicine Bow National Forest. Trout are often limited to streams with cool water temperatures and often have upper lethal tolerances of 25-29°C (Lee and Rinne 1980; Johnstone and Rahel 2003). Stream temperatures can increase if forested riparian areas are disturbed and solar radiation increases (Johnson and Jones 2000). The amount of habitat available for fishes in streams is influenced by the amount of water in the channel (Wolff et al. 1990). Water releases from reservoirs and changes to watershed hydrology from forest management can influence water levels (Keppeler and Ziemer 1990). Recruitment of wood into streams is also important because it forms pool habitats used by trout (Kozel et al. 1989), and is used directly as cover. Wood recruitment into streams can be reduced by timber harvest or when deadfall is collected for firewood. Trout also use gravel substrates for spawning (Baxter and Stone 1995), and fine sediment inputs from timber harvest or road construction can increase fine sediment in streams and embed spawning substrates (Eaglin and Hubert 1993; Waters 1995). Sediments can inundate spawning substrates such that developing trout embryos are deprived of hyporheic flows sufficient to provide dissolved oxygen and remove metabolic wastes.

Objectives

The Medicine Bow National Forest will monitor trout density and distribution of trout reproduction on the Forest to detect declines resulting from management activities. Monitoring is aimed at detecting a 2.5% or larger annual decline in trout density after four years or longer with 80% statistical power at $\alpha = 0.20$, and at detecting a 2.5% or larger annual reduction in distribution of trout reproduction (i.e., the proportion of reaches with age-0 trout present) after four years or longer with 80% statistical power at $\alpha = 0.20$. A 2.5% annual decline is equivalent to a 22.4% decline after ten years (i.e., $[1-0.025]^{10} = 0.776$ of the original population and therefore a 100%-77.6% = 22.4% decline). Annual population increases or decreases of 1-3% are most often of interest when monitoring (Urquhart et al. 1998), and a 20% increase or decrease between two time periods is a commonly used trigger point in monitoring programs (Vesely et al. 2006). Given that a trend is detected, the Forest will evaluate potential causes for the decline and develop or modify management activities to reverse the decline.

Trigger Points and Evaluation

Monitoring is necessary to evaluate management actions implemented as part of the Forest Management Plan. If monitoring reveals a decline in trout density or distribution of reproduction on the Forest, then the causes of decline need to be investigated. When Forest management is identified as being injurious to trout populations, then management can be adapted to circumvent or reduce impacts. This may result in a reevaluation of Forest Plan goals.

Given potential impacts from management activities, trigger points need to be identified to motivate management action by the Forest. We suggest that trout populations be monitored every two years and that all monitoring sites be sampled in the same year. Trend analyses should be conducted every four years, after the initial three monitoring periods, to determine if declines in trout density or distribution of trout reproduction are occuring. A 2.5% or larger annual rate of decline in density or distribution of reproduction is the recommended trigger point for management action (see Objectives above).

Forest-wide declines in trout density will be assessed by monitoring estimates of density over time at stream reaches within selected watersheds, and then estimating average trends among reaches. If the mean annual decline in trout density is 2.5% or greater over a minimum of four years (three monitoring periods), then action should be taken to determine probable causes of decline.

Forest-wide reduction in distribution of trout reproduction will be assessed by estimating the proportion of reaches where age-0 trout are present per monitoring period, and then testing for a decline in the proportion of reaches having age-0 trout over time. If the annual decline in the proportion of sites having age-0 trout is 2.5% or greater over after a minimum of four years (three monitoring periods), then action should be taken to determine probable causes of declining reproduction.

Although objective trigger points have been identified, failure to reach a trigger point should not prohibit management action from being taken if monitoring data suggest such action is needed. The data may suggest that management action is needed at one or a few monitoring sites even though there is no forest-wide trend in trout population

abundance. For example, increasing trends at some sites might offset decreasing trends at other sites.

Methods

Sampling Design

Detection of impacts to trout populations that result from Medicine Bow National Forest management activities will be based on monitoring trout density and the distribution of trout reproduction at a network of stream reaches in Forest watersheds. Several entities need to be defined explicitly in a sampling design. An *element* is an individual, object, or item of interest that is directly measured, counted, or recorded. A *sampling unit* is a site or plot that has a unique collection of elements; however, sampling units do not always contain elements. The *sampling frame* is a complete list of sampling units that are candidates for sampling. A *sample* is a list of selected sampling units. The *target population* is all elements within a defined space and time interval (Thompson et al. 1998). These terms apply directly to the sampling design for the Medicine Bow National Forest. Elements and sampling units in the sampling design for the Forest MIS monitoring plan are 8th level Hydrologic Unit Code watersheds; hereafter referred to as watersheds. The sampling frame consists of all 8th level watersheds on the Forest that: 1) have less than 50 percent alpine/subalpine land cover; 2) have one or more blue-line streams present at the 1:100,000 map scale on Forest land (non-private); and 3) have less than 50 percent private land. There are 445 such watersheds on the Forest in the sampling frame. A sample will be a list of 8th level watersheds selected using an unbiased procedure (e.g., random, systematic) that allows valid inferences to be made

regarding the target population. The target population in this case is the same as the sampling frame: i.e., all watersheds on the Forest that have less than 50% private land, less than 50% alpine/subalpine land cover, and have streams present on Forest land during the summer-fall baseflow period from mid-July to mid-September. These terms explicitly define the target population to which inference will be made regarding trends in trout populations on the Medicine Bow National Forest, Wyoming.

The Sampling Frame

There are 685 8th-level Hydrologic Unit Code (HUC) watersheds that are at least partially on the Medicine Bow National Forest. The sampling frame for monitoring trout was a subset of this list of watersheds. Because watersheds that are predominatly in alpine/subalpine habitat are often naturally fishless, seven watersheds that were greater than 50 percent alpine/subalpine landcover were excluded from the sampling (Figure 1). We excluded 136 watersheds that have greater than 50 percent private ownership from the sampling frame because trout populations in those watersheds could reflect land use activities by private land owners rather than the Forest (Figure 2). Watersheds without streams on Forest land (n = 167) were also excluded from the sampling frame because there are no streams within those watersheds that reflect forest management (Figure 3). In total, 240 watersheds on the Medicine Bow National Forest were excluded from the sampling frame due to one or more of the above screening criteria. Thus, the sampling frame consists of 445 of all 685 watersheds on the Forest, and represents 4,076 km^2 of the 5,617 km^2 within the general boundary of the Forest (Figure 4). Of the 3,339 km of

stream in the Medicine Bow National Forest, 2,496 km of stream are in watersheds included in the sampling frame.

Stratification—Stratification of sampling units can increase precision of estimates (Scheaffer et al. 1996; Thompson et al. 1998). Two factors were identified that potentially influence the abundance and biomass of trout on the Forest and that could be useful in interpreting future changes in trout abundance: land cover type and sedimentation potential due to roads and soils. We considered stratifying watersheds on the basis of three general land-cover types: alpine-subalpine, forested, and shrub-prairie. These land cover types reflect elevation gradients, are incorporated into management area prescriptions and affect stream ecosystem processes (Kozel and Hubert 1989; Larscheid and Hubert 1992; USFS 2003a). Because alpine and subalpine regions constitute only about 1% of the Forest area and have streams that often are naturally fishless, the seven watersheds dominated by this land cover type were excluded from the sampling frame and will not be monitored. We found no differences in trout biomass among forested and shrub/prairie land cover types (Appendix A); therefore, land cover will not be used to stratify the sampling frame. However, if trends in trout abundance and distribution of reproduction are detected, land cover information could be used for post hoc analyses to determine what is causing the decline. For example, trend estimates can be compared between forested and shrub/prairie dominated watersheds. There are 582 forest dominated watersheds on the Forest, and 409 are included in the sampling frame. There are 96 shrub or prairie dominated watersheds and 36 are included in the sampling frame.

Sedimentation potential is the risk of sediment entering streams due to roads and erosive soils. Sedimentation is a major detriment to the quality of stream habitat important to trout populations (Eaglin and Hubert 1993; Waters 1995). Watersheds with high levels of timber harvest, recreation, or livestock grazing typically have more roads than watersheds lacking such activities. In addition, roads built on highly erosive soils can lead to excessive sediment loading into streams (USFS 2003b). We developed an index of watershed risk due to roads and soils to determine the potential for sedimentation in each watershed. The watershed risk index is composed of six metrics that account for road density, erosible soils, or a combination thereof (Appendix A). The risk index scores range continuously from 0 for no risk to 24 for extreme risk. Trout population densities were not related to the watershed risk scores. Thus, the risk index was not used to stratify watersheds in the initial selection of which watersheds should be sampled. However, the watershed risk index might prove useful for post hoc analyses to determine what is causing declines in trout abundance and reproduction if declines are detected. For example, trend estimates for each reach in a watershed can be related to watershed risk using regression analysis, or another appropriate analysis.

Sampling design and schedule—The sampling design adopted for a monitoring program can affect trend detection capability (Reeves et al. 2004). Sampling designs for biomonitoring programs can range from revisiting the same sites every monitoring period to sampling a new set of sites each period. Intermediate to these two extremes are sampling designs where some or all sites are revisited but not during every monitoring

period. These latter approaches have become known as rotating panel or augmented serially alternating designs (Urquhart et al. 1998; Urquhart and Kincaid 1999).

Four sampling designs were evaluated for use in the MIS monitoring plan, while accounting for logistical constraints imposed by the Medicine Bow National Forest. One design involved sampling the same sites every monitoring period and three designs that were variations of a serially alternating design where all sites were revisited, but at different times and intervals (Appendix B). The constraints were that the Forest would monitor MIS every other year, and during a monitoring year they would sample 30 stream reaches; a minimum of 20 sites would be sampled if weather or fiscal constraints resulted in less than 30 being sampled. Each of the four designs was evaluated twice for its ability to detect declines in trout abundance, once with 20 sites sampled biennially and once with 30 sites sampled biennially. The always revisit design where the same sites were revisited every monitoring period typically had slightly better power to detect declines (details in Appendix B). An always revisit design will be implemented for monitoring trout on the Medicine Bow National Forest. This design has the highest statistical power to detect change, and it will be the easiest to implement and the most likely to be followed throughout the entirety of the monitoring program. Reaches within 30 watersheds will be selected, and those same reaches will be sampled during each monitoring period.

Selection of sample units—As discussed earlier, the sampling frame consists of all watersheds on the forest that are less than 50 percent alpine/subalpine land cover, less than 50 percent private ownership, and have at least one stream at the 1:100,000 map

scale on Medicine Bow National Forest land within the watershed. Watersheds can be selected in an unbiased manner (randomly or systematically) to ensure that the sample of watersheds is representative of all Forest watersheds (Vesely et al. 2006). If a random sampling protocol is followed, watersheds should be selected according to their inclusion probabilities (Table 1). Inclusion probabilities are the probability that a sample unit (i.e., watershed) will be selected from the sampling frame. The inclusion probability for each watershed incorporates total stream length so that watersheds with more streams have a higher probability of being sampled. Specifically, inclusion probabilities for watersheds are the total length of stream within a watershed divided by the total length of all streams in the sampling frame. For example, the Upper Douglas Creek watershed (HUC 1018000201040101) in the Snowy Range area has 11.2 km of stream, and its inclusion probability is the length of stream in the watershed divided by the total length of stream: 11.2 km / 2,496 km = 0.0045. Watersheds excluded from the sampling frame have inclusion probabilities of zero.

Sampling trout in watersheds—After 30 watersheds are selected as sampling units for monitoring, trout abundance should be estimated from stream reaches in the downstream extent of each 8th level watershed sampling unit. Streams route water and sediment downstream, and stream reaches reflect the state and function of its contributing watershed (Stanford 1996). Thus, establishing reaches and estimating trout abundance near the downstream end of a watershed will allow the cumulative influences of management activities in a watershed to be detected.

Data Collection

Trout will be sampled from identified reaches in selected watersheds after spring snowmelt. After approximate stream reach locations are identified in selected watersheds, stream reach boundaries will be identified in the field and trout will be sampled by electrofishing. The following equipment for sampling trout for MIS monitoring should be assembled for each sampling trip:

- battery-powered backpack electrofisher
- batteries
- electrodes
- rubber or neoprene gloves
- dip nets
- block nets, ¼ inch or less bar mesh
- felt-soled chest waders or hip boots
- five-gallon buckets or equivalent
- Spring scales, or mechanical or electronic scales
- fish measuring board (0.1-inch or 1-mm precision)
- anesthetic
- digital or film camera
- GPS receiver
- datasheets

Reach identification—Stream reaches will be identified within each 8th level watershed selected for monitoring and monumented to facilitate relocation for future revisits. One sample reach 150-m in length will be selected near the downstream portion of the selected watershed to estimate trout population parameters. The downstream and upstream extent of each reach will be monumented using an appropriate field method (e.g., rebar, benchmark, flagging, paint) and photo-documented to facilitate relocation during future revisits. Geographic coordinates for the downstream extent of each reach will also be recorded in Universal Transverse Mercator (UTM), Zone 13 coordinates using a global positioning system (GPS) receiver. Recording the location multiple times

and averaging location estimates is recommended if a recreational-grade GPS receiver is used (e.g., Garmin, Magellan). Reach coordinates can be entered into a GPS receiver, and then used to navigate directly to the downstream boundary of the reach during revisits. Precisely relocating each reach during revisits is important to reduce sampling variance and improve trend detection (Roper et al. 2003).

Reach characterization—Trout abundance and biomass within each reach will be estimated and then standardized as density estimates. The area of each stream reach must therefore be measured. Mean wetted width can be estimated by measuring wetted width systematically at a predetermined interval (e.g., every 20-m). Reach area is estimated as reach length × mean wetted width.

Trout sampling—Trout will be sampled using electrofishing. Personnel requirements for electrofishing depend, in part, on the width of the stream reach. Streams less than 2-m in width can typically be sampled by two field crew members. One person operates the electrofisher and nets stunned fish, and the other person is dedicated solely to netting fish. Wider streams may require more electrofishers and netters. The Wyoming Game & Fish Department requires that at least one person on each sampling crew be certified in electrofishing by the U.S. Fish and Wildlife Service. Certification is required by the Wyoming Game & Fish Department in order to obtain a scientific collection permit. Uncertified crew members are required to complete on-the-job training by a certified crew member. Training can reduce sampling variance attributable to different crews and crew members (Archer et al. 2004).

Prior to electrofishing, the upstream and downstream boundary of each reach will be blocked with block nets to ensure population closure. Trout will be collected in each 150-m reach by using a backpack electrofisher and a minimum of three electrofishing passes. If catchability appears to vary substantially among passes, then four or more passes are recommended (Riley and Fausch 1992). For example, more fish are sometimes captured during pass two than in pass one, which indicates that capture probability was higher during pass two. More subtly, capture probabilies are often higher during pass one, and then decrease thereafter (Riley and Fausch 1992; Peterson et al. 2004); the removal estimator of abundance recommended below allows capture probability to vary among removal periods (passes). Trout from each electrofishing pass will be anesthetized, measured for total length (±1 mm), and weighed (±1 g). If no age-0 trout are collected within the 150-m reach, the reach may be extended to a length up to 20 times the channel width and electrofished with one pass to determine if age-0 trout are present (Potyondy et al. 2006). Morphological or other anomalies will be photo-documented. Tissue samples from the adipose, anal, or caudal fin will be collected and stored in 2.0 mL plastic vials with 90% ethyl alcohol if needed to meet objectives of concurrent studies. Whole trout may be collected for disease analysis.

Data Analysis

Trout density and standing stock in a reach—Density and standing stock of all trout will be estimated for each reach. Both population parameters can be estimated using a variable probability removal estimator in Program CAPTURE (White et al. 1982); this estimator is model M(bh) in Otis et al. (1978). Program CAPTURE is available on the

Internet as a web-based version at: http://www.mbr-pwrc.usgs.gov/software/capture.html. Sample code for running the program and variable probability estimator is:

```
task read population  removal
5,'Ephemeroptera, stream insect. (data:u1,u2,u3,u4,u5)'
181,11,4,5,3
```

Lines 2 and 3 of this code can be changed to reflect reach-specific data, and then all 3 lines of code can be pasted into the Program CAPTURE input screen and run. In code line 2, "5" indicates the number of removal periods (electrofishing passes) followed by an output title in single quotations. Line 3 is the number or biomass of trout sampled during each removal period. Program CAPTURE will output an estimate of abundance $\hat{N}$ or biomass $\hat{B}$; standard error, SE = $\sqrt{\hat{Var}}$; and a profile likelihood confidence interval. Although we recommend use of Program CAPTURE to estimate abundance, other computer software that estimates abundance and biomass with a measure of precision using a removal estimator can be used: MicroFish (http://microfish.org/ ; VanDeventer and Platts 1989) or Pop/Pro (http://www4.ncsu.edu/~tkwak/pp.html ; Kwak 1992). Often, large fish are captured more effectively by electrofishing than small fish. Thus, abundance and biomass should be estimated separately for each size class, if possible, and then summed to remove the effect of size bias (Kwak 1992); variances for size classes are also added to estimate total variance. Age-0 trout should be excluded from abundance and biomass estimates because they can be difficult to sample with electrofishing and because their abundances can vary widely among years and prohibit trend detection. Abundance or biomass estimates can be converted into densities (N/m^2) or standing stock (kg/m^2) based on reach area.

In addition to trout density and standing stock, information on trout reproduction, size structure, and community composition should be collected. Trout reproduction can

be assessed via the presence or absence of age-0 trout. Trout population size structure should be measured as the mean length or weight of trout collected from the reach, or as a Proportional Stock Density (PSD). Because length criteria used in computing PSD values differ among trout species (Anderson and Neumann 1996), obtaining a single PSD value per reach when multiple species are present might be difficult. Trout community composition should be measured as the proportion of total estimated trout as brook trout, brown trout, and rainbow trout; proportions should be computed using the abundance and biomass estimates for each species, rather than the raw catch data per species because of potential size and species biases in electrofishing samples.

Trends in trout density and standing stock—Forest-wide trends in trout density and standing stock can be assessed by using regression analysis and an exponential model of population decline. This approach tests for a persistent annual percentage decline in trout density or standing stock over the time period of interest. For each reach in a watershed, trout density (or standing stock) will be $\log_e$-transformed and regressed on year:

$$\log_e\left(\hat{D}_{ij}\right) = b_{0i} + b_{1i}\left(Year_j\right)$$

where $\hat{D}_{ij}$ = the trout density (or standing stock) for watershed *i* in year *j*.

The regression slope estimates (estimates of percent annual change) from all the watersheds will then be used to compute a weighted mean of slope estimates $\hat{\bar{b}}_1$ as:

$$\hat{\bar{b}}_1 = \frac{\sum_{i=1}^{n} L_i \hat{b}_{1i}}{\sum_{i=1}^{n} L_i}$$

where $\hat{b}_{1i}$ = regression slope estimate (equivalent to percent annual change) from watershed *i*, L_i = the total stream length in watershed *i* (listed in Table 1), and *n* is the number of watersheds sampled. The variance estimate for mean slope $s^2_{\hat{\bar{b}}_1}$ is calculated as:

$$s^2_{\hat{\bar{b}}_1} = \frac{\sum_{i=1}^{n} L_i\left(\hat{b}_{1i} - \hat{\bar{b}}_1\right)^2}{\frac{(n-1)\sum_{i=1}^{n} L_i}{n}}\left(\frac{L-l}{L}\right)$$

where $\hat{b}_{1i}$, $\hat{\bar{b}}_1$, *n*, and L_i are as defined above. l = the total stream length in all watersheds sampled, and L = the total length of stream in the sampling frame (2,496 km). The expression $\left(\frac{L-l}{L}\right)$ is a finite population correction factor.

The variance estimate can be used to compute a confidence interval for the mean slope estimate. The lower confidence limit is:

$$\hat{\bar{b}} - t_{n-1,\alpha} \times \sqrt{s^2_{\hat{\bar{b}}_1} / n}$$

and the upper limit is:

$$\hat{\bar{b}} + t_{n-1,\alpha} \times \sqrt{s^2_{\hat{\bar{b}}_1} / n}$$

Where $\hat{\bar{b}}$ and $s^2_{\hat{\bar{b}}_1}$ are as before, *n* = the number of watersheds where trends were estimated, and $t_{n-1,\alpha}$ = the t-value from a t distribution table with n-1 degrees of freedom and specified α.

A one-tailed t-test can be used to determine if the mean slope $\hat{\bar{b}}$ is significantly less than zero. A type I error rate of α = 0.20 is recommended over a more conservative

rate (e.g., $\alpha = 0.05$) to reduce the chance of missing a decline that is real (type II error). However, a higher type I error rate will, by definition, increase the risk of detecting false changes. Type I error is asserting that the population is changing when, in fact, it is not. Type II error is failure to detect trends in trout populations that are, in fact, changing in abundance. Type I and II error rates are inversely related, but not proportional. Management context will determine what the acceptable levels of each risk are (Mulder et al. 1999). If the slope is significantly less than 0, and the estimated mean slope is -0.025 (equivalent to a 2.5% annual decline) or less, then management action should be taken to examine causes for population decline.

Distribution of trout reproduction—Distribution of trout reproduction will be evaluated by determining whether the proportion of stream reaches in watersheds with age-0 trout present has declined. Age-0 trout presence or absence in a reach of a watershed is coded as y =1 if they are present and y = 0 if they are not. The estimate of proportion $\hat{p}$ of reaches in watersheds with trout reproduction is:

$$\hat{p} = \frac{\sum_{i=1}^{n} y_i}{n}$$

where y_i = the presence (presence = 1, absence = 0) of age-0 trout in watershed *i*, and *n* = the number of watersheds sampled.

The variance for the estimated proportion $s^2_{\hat{p}}$ is:

$$s^2_{\hat{p}} = \frac{\hat{p}\hat{q}}{n}\left(\frac{N-n}{N}\right)$$

where $\hat{p}$ and n are as defined above, and N = number of watersheds on the forest in the sample frame (445) and $\hat{q} = 1 - \hat{p}$.

Trends in distribution of trout reproduction—After forest-wide estimates are computed for a monitoring year, then time trends in the proportion of reaches in watersheds occupied by age-0 common trout can be determined. Linear regression can be used whereby the proportion of reaches occupied $\hat{p}_j$ for years 1 through j will be $\log_e$-transformed and regressed on year:

$$\log_e\left(\hat{p}_j\right) = b_0 + b_1\left(year_j\right)$$

The statistical test of interest is whether the estimated rate of change b_1 is significantly less than zero, using a one-tailed t-test. Again, a type I error rate of $\alpha = 0.20$ is recommended, but it should be set according to risks associated with making a type I versus a type II error.

Trout size structure—Size structure of all trout can also be monitored. Size structure can be quantified as the mean length or weight of trout per reach, or with a metric such as Proportional Stock Density (PSD). Again, obtaining a single PSD value per reach may be difficult when more than one trout species is present because of the different criteria used for calculating PSD values for each species (Anderson and Neumann 1996). Forest-wide estimates of population size structure can be made in the same way as for trout density by replacing trout density estimates with size structure estimates in the analysis outlined above. Trends can be estimated as a regression coefficient for individual reaches, and then the distribution of trends in size structure can be evaluated to

determine if there is a forest-wide trend in size structure. Size structure can be evaluated for all trout, or for individual species.

Trout community composition—Community composition of trout will also be monitored to determine if trends in trout density or standing stock are related to specific species, resulting in changes in community composition. In some cases, species replacement may occur due to competitive interactions without changes in density or standing stock. Species composition will be quantified as the proportion of individuals in the community as brook trout, brown trout, and rainbow trout. Forest-wide estimates can be made with the same methods used to monitor the distribution of trout reproduction.

Data Recording and Archiving

All data collected as part of the monitoring plan for the Medicine Bow National Forest will be stored in hardcopy and electronic form, maintained by North Zone and South Zone Medicine Bow National Forest fisheries biologists, and made available by each respective office. Aquatic habitat and geographic information system (GIS) data will be stored in the aquatic habitat and GIS sections of the Natural Resource Information System (NRIS)-WATER, respectively (Vesely et al. 2006; Potyondy et al. 2006). Trout data will be entered into the aquatic biota section of NRIS-WATER. Prior to archival in NRIS-WATER, data may be temporarily stored electronically by North Zone and South Zone, Medicine Bow National Forest fisheries. Data will also be submitted to Wyoming Game & Fish Department to comply with scientific collection permit requirements.

Reporting

Results from monitoring trout on the Medicine Bow National Forest will be synthesized in Biennial Reports and Evaluation Reports. Evaluation Reports will be prepared every five years after the initiation of MIS monitoring.

Format and Content

After every monitoring period, trout population data for each watershed and reach sampled will be summarized in a Biennial Report. Reports will consist of summary data on trout populations from each reach and watershed per monitoring period. Length and weight data will also be summarized in histograms.

Every four years an Evaluation Report will be prepared. Evaluation Reports will summarize data for each monitoring period since the plan was implemented. They will also report trend analyses to determine if trout density, distribution of trout reproduction, and other population parameters have declined since monitoring was initiated.

Peer Review

Biennial Reports and Evaluation Reports will both be subject to peer review. Evaluation reports will be submitted to and reviewed by the Forest Monitoring Coordinator, Medicine Bow National Forest.

Scope and Limitations

Biennial and Evaluation Reports will differ in their scope, but have similar limitations. The scope of Biennial Reports will be limited to one time period, and will summarize

data collected for one time period. Evaluation Reports will synthesize data from all time periods, including those prior to any previous Evaluation Reports.

References

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques. American Fisheries Society, Bethesda, Maryland.

Archer, E. K., B. B. Roper, R. C. Henderson, N. Bouwes, S. C. Mellison, and J. L. Kershner. 2004. Testing common stream sampling methods for broad-scale, long-term monitoring. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-122, Fort Collins, Colorado.

Baxter, G. T., and M. D. Stone. 1995. Fishes of Wyoming. Wyoming Game and Fish Department, Cheyenne.

Eaglin, G. S., and W. A. Hubert. 1993. Effects of logging and roads on substrate and trout in streams of the Medicine Bow National Forest, Wyoming. North American Journal of Fisheries Management 13:844-846.

Gerow, K. G. 2007. Power and sample size estimation techniques for fisheries management: assessment and a new computational tool. North American Journal of Fisheries Management 27:397-404.

Gibbs, J. P. 2000. Monitoring populations. Pages 213-252 *in* L. Boitani and T. K. Fuller, editors. Research techniques in animal ecology. Columbia University Press, New York, New York.

Johnson, S. L., and J. A. Jones. 2000. Stream temperature responses to forest harvest and debris flows in western Cascades, Oregon. Canadian Journal of Fisheries and Aquatic Sciences 57(Suppl. 2):30-39.

Johnstone, H. C., and F. J. Rahel. 2003. Assessing temperature tolerance of Bonneville cutthroat trout based on constant and cycling thermal regimes. Transactions of the American Fisheries Society 132:92-99.

Keppeler, E. T., and R. R. Ziemer. 1990. Logging effects on streamflow: water yield and summer low flows at Casper Creek in northwestern California. Water Resources Research 26:1669-1679.

Kershner, J. L., E. K. Archer, M. Coles-Ritchie, E. R. Cowley, R. C. Henderson, K. Kratz, C. M. Quimby, D. L. Turner, L. C. Ulmer, and M. R. Vinson. 2004. Guide to effective monitoring of aquatic and riparian resources. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-121, Fort Collins, Colorado.

Kozel, S. J., and W. A. Hubert. 1989. Factors influencing the abundance of brook trout (*Salvelinus fontinalis*) in forested mountain streams. Journal of Freshwater Ecology 5:113-122.

Kozel, S. J., W. A. Hubert, and M. G. Parsons. 1989. Habitat features and trout abundance relative to gradient in some Wyoming streams. Northwest Science 63:175-182.

Kwak, T. J. 1992. Modular microcomputer software to estimate fish population parameters, production rates and associated variance. Ecology of Freshwater Fish 1:73-75.

Larscheid, J. G., and W. A. Hubert. 1992. Factors influencing the size structure of brook trout and brown trout in southeastern Wyoming mountain streams. North American Journal of Fisheries Management 12:109-117.

Lee, R. M., and J. N. Rinne. 1980. Critical thermal maxima of five trout species in the southwestern United States. Transactions of the American Fisheries Society 109:635.

Mulder, B. S., B. R. Noon, T. A. Spies, M. G. Raphael, C. J. Palmer, A. R. Olsen, G. H. Reeves, and H. H. Welsh. 1999. The strategy and design of the effectiveness monitoring program for the Northwest Forest Plan. U.S. Department of Agriculture, Forest Service, Northwest Research Station, General Technical Report PNW-GTR-437, Portland, Oregon.

Otis, D. L., K. P. Burnham, G. C. White, and D. R. Anderson. 1978. Statistical inference from capture data on closed animal populations. Wildlife Monographs 62:1-135.

Peterson, J. T., R. F. Thurow, and J. W. Guzevich. 2004. An evaluation of multipass electrofishing for estimating the abundance of stream-dwelling salmonids. Transactions of the American Fisheries Society 133:462-475.

Platts, W. S., and R. L. Nelson. 1988. Fluctuations in trout populations and their implications for land-use evaluation. North American Journal of Fisheries Management 8:333-345.

Potyondy, J. P., B. B. Roper, S. E. Hixson, R. L. Leiby, R. L. Lorenz, and C. M. Knopp. 2006. Aquatic ecological unit and inventory technical guide: valley segment and river reach. U.S. Department of Agriculture, Forest Service, Washington Office,

Ecosystem Management Coordination Staff, General Technical Report [Draft], Washington, DC.

Quist, M. C., K. G. Gerow, M. R. Bower, and W. A. Hubert. 2006. Random versus fixed-site sampling when monitoring relative abundance of fishes in headwater streams of the upper Colorado River Basin. North American Journal of Fisheries Management 26:1011-1019.

Reeves, G. H., D. B. Hohler, D. P. Larsen, D. E. Busch, K. Kratz, K. Reynolds, K. F. Stein, T. Atzet, P. Hays, and M. Tehan. 2004. Effective monitoring for the aquatic and riparian component of the Northwest Forest Plan: conceptual framework and opinions. United States Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-577, Portland, Oregon.

Riley, S. C., and K. D. Fausch. 1992. Underestimation of trout population size by maximum-likelihood removal estimates in streams. North American Journal of Fisheries Management 12:768-776.

Roper, B. B., J. L. Kershner, and R. C. Henderson. 2003. The value of using permanent sites when evaluating stream attributes at the reach scale. Journal of Freshwater Ecology 18:585-592.

Scheaffer, R. L., W. Mendenhall III, and R. L. Ott. 1996. Elementary survey sampling, 5th ed. Duxbury Press, Boston, Massachusetts.

Stanford, J. A. 1996. Landscapes and catchment basins. Pages 3-22 *in* F. R. Hauer and G. A. Lamberti, editors. Methods in stream ecology. Academic Press, San Diego.

Thompson, W. L., G. C. White, and C. Gowan. 1998. Monitoring vertebrate populations. Academic Press, San Diego, California.

Urquhart, N. S., and T. M. Kincaid. 1999. Designs for detecting trend from repeated surveys of ecological resources. Journal of Agricultural, Biological, and Environmental Statistics 4:404-414.

Urquhart, N. S., S. G. Paulsen, and D. P. Larsen. 1998. Monitoring for policy-relevant regional trends over time. Ecological Applications 8:246-257.

USFS. 2003a. Medicine Bow National Forest revised land and resource management plan. U.S. Department of Agriculture, Forest Service, Rocky Mountain Region, Laramie, Wyoming.

USFS. 2003b. Roads analysis report, Medicine Bow National Forest. U.S. Department of Agriculture, Forest Service, Medicine Bow National Forest, Laramie, Wyoming.

VanDeventer, J. J., and W. S. Platts. 1989. MicroFish 3.0. Intermountain Research Station, INT-254, Boise, Idaho.

Vesely, D., B. C. McComb, C. D. Vojta, L. H. Suring, J. Halaj, R. S. Holthausen, B. Zuckerberg, and P. M. Manley. 2006. Development of protocols to inventory or monitor wildlife, fish, or rare plants. U.S. Department of Agriculture, Forest Service, General Technical Report WO-72, Washington, D.C., http://www.fs.fed.us/biology/wildecology/SpProtocolTechGuide.pdf.

Waters, T. F. 1995. Sediment in streams: sources, biological effects, and control. American Fisheries Society Monograph 7, Bethesda, Maryland.

White, G. C., D. R. Anderson, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, LA-8787-NERP, Los Alamos, New Mexico.

Wolff, S. W., T. A. Wesche, D. D. Harris, and W. A. Hubert. 1990. Brown trout population and habitat changes associated with increased minimum low flows in Douglas Creek, Wyoming. U.S. Department of the Interior, Fish and Wildlife Service, 90(11), Washington, D.C.

Table 1. Level 8 Hydrologic Unit Code (HUC) watersheds on the Medicine Bow National Forest by mountain range. Watersheds with no stream length have inclusion probabilities of zero.

Region / HUC8	HUC8 Name	Area (km^2)	% Private	Risk Score	Risk	% Shrub / Prairie	% Forest	Dominant Landcover	Total Stream (km)	Stream on NF Land (km)	Inclusion Probability
Laramie Range											
1018000501010102	North Prong	0.3	0.0	9	Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
1018000501010101	South Prong	4.8	19.4	16	High	0.0	100.0	Forest	3.7	2.6	0.00150
1018000501020100		15.2	83.4	7	Moderate	12.3	87.7	Forest	7.2	0.9	0.00000
1018000501020200		21.9	41.2	12	Moderate	6.2	93.8	Forest	11.1	4.3	0.00446
1018000501020300		0.1	66.4	7	Moderate	5.3	94.7	Forest	0.0	0.0	0.00000
1018000503010102	Chimney Ridge	5.5	82.4	14	High	0.0	100.0	Forest	4.2	0.8	0.00000
1018000503010101	Upper Sheep Creek	6.9	56.6	17	High	0.0	100.0	Forest	4.1	1.5	0.00000
1018000503010103	Parsons Canyon	18.9	52.4	9	Moderate	4.1	95.9	Forest	12.7	5.0	0.00000
1018000503010104	Bishop Creek	2.3	75.4	18	High	92.3	7.7	Shrub	1.2	0.7	0.00000
1018000503010201	Badger Creek	17.7	68.6	9	Moderate	19.5	80.5	Forest	11.6	3.5	0.00000
1018000503010202	Boulder Creek	10.4	67.4	17	High	87.1	12.9	Shrub	6.1	0.7	0.00000
1018000503010203	Manse Creek	0.0	100.0	11	Moderate	100.0	0.0	Shrub	0.0	0.0	0.00000
1018000702010201	East Fork Bates Creek	6.5	2.3	11	Moderate	0.0	100.0	Forest	3.4	3.4	0.00137
1018000702010202	Lornas Ponds	3.4	56.3	13	High	0.0	100.0	Forest	3.2	1.1	0.00000
1018000702010204	Spider Mountain	0.6	31.3	10	Moderate	0.0	100.0	Forest	0.2	0.2	0.00007
1018000702020204	North Fork Spruce Creek	0.0	0.0	3	Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000702020201	Spruce Creek	0.7	0.0	7	Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
1018000702020202	Ice Cave Draw	0.5	0.0	3	Low	0.0	100.0	Forest	0.4	0.4	0.00016
1018000703080000		0.1	76.5	3	Low	100.0	0.0	Shrub	0.0	0.0	0.00000
1018000710010100		18.1	45.8	12	Moderate	1.4	98.6	Forest	10.3	3.5	0.00412
1018000710010201	Texas Creek	3.8	53.3	12	Moderate	31.0	69.0	Forest	2.4	0.9	0.00000
1018000710010202	Curry Creek	5.3	84.8	16	High	83.4	16.6	Shrub	3.2	0.2	0.00000
1018000710010400		23.7	51.9	12	Moderate	4.8	95.2	Forest	20.0	6.9	0.00000
1018000710010500		17.1	57.5	8	Moderate	0.0	100.0	Forest	11.5	4.8	0.00000
1018000710010600		7.8	47.1	8	Moderate	1.7	98.3	Forest	5.7	2.3	0.00230

1018000710010700		12.4	13.1	12 Moderate	8.7	91.3	Forest	6.5	4.8	0.00260
1018000710020103	Jims Fork	1.9	94.5	3 Low	31.9	68.1	Forest	0.0	0.0	0.00000
1018000710020102	Davis Creek	13.6	65.6	13 High	30.6	69.4	Forest	10.3	1.2	0.00000
1018000710020101	Reno Hill	33.6	49.7	12 Moderate	22.3	77.7	Forest	32.4	11.2	0.01298
1018000710020202	Lower Deer Creek Canyon	1.4	99.0	3 Low	100.0	0.0	Shrub	0.5	0.0	0.00000
1018000710020201	Duck Creek	3.8	95.3	2 Low	48.8	51.2	Forest	3.2	0.4	0.00000
1018000710030300		1.5	0.0	5 Low	0.0	100.0	Forest	0.0	0.0	0.00001
1018000710030500		6.1	97.9	3 Low	100.0	0.0	Shrub	3.4	0.0	0.00000
1018000710030700		0.1	90.0	2 Low	100.0	0.0	Shrub	0.5	0.0	0.00000
1018000710030804	King Creek	6.2	83.0	3 Low	77.3	22.7	Shrub	5.3	0.0	0.00000
1018000710030803	Old Tobin Place	2.2	52.6	3 Low	2.3	97.7	Forest	0.3	0.1	0.00000
1018000710030802	Rainbow Canyon	1.2	7.0	7 Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
1018000710030801	Sensebough Canyon	1.9	0.0	7 Moderate	6.3	93.7	Forest	0.4	0.4	0.00016
1018000711010103	Breakneck Hill	8.4	80.3	7 Moderate	25.9	74.1	Forest	6.1	1.1	0.00000
1018000711010102	Little Beaver Creek	4.4	52.0	3 Low	0.0	100.0	Forest	3.3	0.4	0.00000
1018000711010101	Box Elder Creek	8.9	53.2	5 Low	15.3	84.7	Forest	6.3	2.6	0.00000
1018000711010200		8.3	48.9	10 Moderate	8.3	91.7	Forest	7.2	1.6	0.00287
1018000711010300		9.9	33.4	15 High	0.1	99.9	Forest	4.8	1.9	0.00191
1018000711010400		11.7	68.4	9 Moderate	38.4	61.6	Forest	5.0	0.0	0.00000
1018000711010500		6.9	42.1	14 High	23.9	76.1	Forest	3.9	1.3	0.00158
1018000711010600		8.5	50.3	6 Low	37.3	62.7	Forest	4.7	1.6	0.00000
1018000711010700		17.0	67.6	14 High	27.2	72.8	Forest	9.6	0.6	0.00000
1018000711020100		24.1	46.1	16 High	7.7	92.3	Forest	10.4	3.6	0.00416
1018000711020203	Peterson Mountain	1.3	96.1	3 Low	0.0	100.0	Forest	0.9	0.0	0.00000
1018000711020202	Four Pond Creek	6.9	53.1	5 Low	0.0	100.0	Forest	4.2	0.1	0.00000
1018000711020201	Elk Run Creek	4.9	60.0	8 Moderate	0.0	100.0	Forest	3.7	0.4	0.00000
1018000711020300		10.2	92.6	9 Moderate	22.8	77.2	Forest	6.2	0.0	0.00000
1018000711030201	Keely Draw	2.8	76.1	2 Low	34.8	65.2	Forest	0.0	0.0	0.00000
1018000711030203	Sullivan Mountain	11.3	99.5	3 Low	46.8	53.2	Forest	6.3	0.0	0.00000
1018000711030202	Snowshoe Creek	8.5	69.0	3 Low	76.9	23.1	Shrub	3.1	0.2	0.00000
1018000711030301	Virden Creek	10.8	93.3	11 Moderate	62.7	37.3	Shrub	8.0	0.0	0.00000
1018000711030302	Strawberry Creek	3.3	91.7	3 Low	59.5	40.5	Shrub	0.7	0.0	0.00000
1018000713010103	Bear Rock	11.5	94.0	8 Moderate	59.3	40.7	Shrub	6.7	0.0	0.00000
1018000713010106	Buffalo Creek	5.1	32.8	3 Low	3.2	96.8	Forest	3.8	1.8	0.00154

10180007130101 05	Meadow Creek	11.6	19.6	14	High	4.5	95.5	Forest	8.4	4.4	0.00337
10180007130101 02	Roaring Fork	8.2	30.8	7	Moderate	12.1	87.9	Forest	7.3	3.5	0.00294
10180007130101 04	Crazy Horse Creek	12.3	98.5	2	Low	52.6	47.4	Shrub	9.5	0.0	0.00000
10180007130101 01	Campbell Creek	31.2	67.4	14	High	2.6	97.4	Forest	17.5	3.1	0.00000
10180007130102 03	Dry Fork	6.6	94.9	3	Low	74.9	25.1	Shrub	3.6	0.3	0.00000
10180007130102 01	Horseshoe Bend Creek	10.2	98.0	3	Low	10.1	89.9	Forest	5.8	0.0	0.00000
10180007130102 02	Standing Rock Creek	8.7	84.0	3	Low	3.7	96.3	Forest	5.6	0.3	0.00000
10180007130103 00		1.5	98.0	2	Low	99.8	0.2	Shrub	0.0	0.0	0.00000
10180007130104 00		2.7	98.8	2	Low	68.6	31.4	Shrub	1.4	0.0	0.00000
10180007130201 02	Perry Creek	1.7	98.5	3	Low	89.2	10.8	Shrub	0.1	0.0	0.00000
10180008020101 03	Orville Draw	1.5	96.3	4	Low	17.6	82.4	Forest	0.7	0.0	0.00000
10180008020101 01	U. Wagon Hound Creek	13.0	82.4	9	Moderate	54.6	45.4	Shrub	10.1	0.6	0.00000
10180008020101 02	Jackson Creek	0.6	95.1	9	Moderate	100.0	0.0	Shrub	0.4	0.0	0.00000
10180008020105 00		9.6	72.9	11	Moderate	0.0	100.0	Forest	5.7	0.3	0.00000
10180008030101 05	Old Maids Draw	12.6	64.3	10	Moderate	0.0	100.0	Forest	5.8	2.4	0.00000
10180008030101 03	Arrowhead Creek	11.4	74.9	19	Extreme	4.1	95.9	Forest	7.4	0.4	0.00000
10180008030101 02	Flattop Creek	9.5	86.3	11	Moderate	5.0	95.0	Forest	6.7	0.4	0.00000
10180008030101 04	Fortymile Creek	1.6	96.9	7	Moderate	16.4	83.6	Forest	1.1	0.0	0.00000
10180008030101 01	Fortymile Peak	1.0	56.8	5	Low	0.0	100.0	Forest	0.5	0.0	0.00000
10180008030102 02	Corduroy Creek	2.8	89.3	16	High	0.0	100.0	Forest	2.3	0.0	0.00000
10180008030102 01	Indian Creek	9.9	77.9	15	High	0.0	100.0	Forest	7.5	0.6	0.00000
10180008030102 03	Pyramid Mine	1.7	61.3	5	Low	0.0	100.0	Forest	1.5	0.5	0.00000
10180008030103 01	La Bonte Canyon	18.5	4.5	15	High	0.0	100.0	Forest	8.9	8.8	0.00356
10180008030103 03	North Sawtooth Mountain	4.9	0.0	3	Low	0.0	100.0	Forest	2.8	2.8	0.00113
10180008030103 02	South Sawtooth Mountain	5.9	9.9	13	High	0.0	100.0	Forest	5.9	4.9	0.00235
10180008030104 00		15.2	1.7	16	High	0.0	100.0	Forest	10.5	10.3	0.00422
10180008030105 00		10.4	20.4	6	Low	0.0	100.0	Forest	5.8	4.1	0.00231
10180008030202 03	Hand in Hand Creek	2.6	99.9	2	Low	74.4	25.6	Shrub	1.6	0.0	0.00000
10180008030202 02	Spring Hill	11.5	81.9	9	Moderate	49.9	50.1	Forest	5.8	0.0	0.00000
10180008030202 01	Reid Creek	20.2	83.7	3	Low	61.9	38.1	Shrub	10.5	0.1	0.00000
10180008030203 00		18.0	74.9	10	Moderate	0.9	99.1	Forest	9.9	0.0	0.00000
10180008030204 01	Deer Canyon	15.8	8.2	13	High	0.0	100.0	Forest	6.3	5.3	0.00254
10180008030204 02	Little Bear Canyon	9.2	23.4	14	High	0.0	100.0	Forest	6.9	4.5	0.00276
10180008030301 00		14.9	71.7	13	High	2.0	98.0	Forest	6.2	0.6	0.00000

1018000803030200		10.1	63.1	10 Moderate	0.0	100.0	Forest	5.5	0.2	0.00000
1018000803030300		0.0	96.9	0 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000803030400		0.1	0.0	3 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000803050000		7.5	98.3	3 Low	0.8	99.2	Forest	7.7	0.0	0.00000
1018000803060103	Downey Park	1.7	65.4	13 High	7.2	92.8	Forest	0.3	0.0	0.00000
1018000803060101	Rocky Ford Creek	19.6	84.4	9 Moderate	4.7	95.3	Forest	13.3	1.6	0.00000
1018000803060102	Pearl Branch	2.4	86.9	5 Low	6.6	93.4	Forest	0.7	0.0	0.00000
1018000803060200		4.7	99.6	4 Low	40.1	59.9	Forest	4.3	0.0	0.00000
1018000803060300		20.4	74.1	14 High	6.9	93.1	Forest	13.1	0.0	0.00000
1018000803060400		5.8	92.9	4 Low	0.0	100.0	Forest	4.7	0.3	0.00000
1018000803060500		6.9	78.2	16 High	0.0	100.0	Forest	5.4	0.1	0.00000
1018000809010100		28.0	29.2	15 High	1.0	99.0	Forest	19.9	12.7	0.00796
1018000809010200		20.7	40.6	16 High	0.0	100.0	Forest	16.7	8.5	0.00668
1018000809010300		15.4	63.8	14 High	16.6	83.4	Forest	12.2	1.7	0.00000
1018000809010400		16.7	65.2	13 High	8.0	92.0	Forest	10.3	2.2	0.00000
1018000809010500		7.7	68.8	4 Low	77.2	22.8	Shrub	5.3	1.5	0.00000
1018000809010600		32.0	66.1	15 High	41.3	58.7	Forest	18.1	5.8	0.00000
1018000809010700		8.6	75.4	8 Moderate	100.0	0.0	Shrub	3.7	1.8	0.00000
1018000809020103	Squaw Peaks	8.6	23.6	4 Low	19.3	80.7	Forest	5.7	3.9	0.00230
1018000809020101	Wagon Wheel Spring	23.4	63.9	12 Moderate	64.1	35.9	Shrub	18.5	3.8	0.00000
1018000809020102	South Roaring Fork	9.0	0.2	4 Low	0.0	100.0	Forest	4.0	3.9	0.00159
1018000809020203	Janets Corner	2.4	0.0	2 Low	0.0	100.0	Forest	2.0	2.0	0.00079
1018000809020204	Saltlick Creek	8.3	2.5	4 Low	0.0	100.0	Forest	5.8	5.8	0.00232
1018000809020202	Lost Creek	8.7	0.0	3 Low	0.0	100.0	Forest	5.6	5.6	0.00224
1018000809020201	Ashenfelder Creek	5.3	0.0	3 Low	0.0	100.0	Forest	3.9	3.9	0.00156
1018000809020300		11.0	26.6	12 Moderate	0.0	100.0	Forest	3.4	1.4	0.00138
1018000809030100		25.3	50.5	12 Moderate	36.2	59.7	Forest	14.1	4.0	0.00000
1018000809030200		3.0	80.6	3 Low	13.8	86.2	Forest	0.4	0.0	0.00000
1018000809030300		11.2	34.7	14 High	14.8	85.2	Forest	6.5	4.1	0.00261
1018000809030400		12.0	57.3	8 Moderate	24.7	72.6	Forest	6.8	0.3	0.00000
1018000809030500		8.0	71.1	4 Low	24.3	75.7	Forest	3.0	0.0	0.00000
1018000809030600		4.1	57.2	6 Low	69.3	30.7	Shrub	2.3	0.6	0.00000
1018000809030700		0.2	100.0	2 Low	100.0	0.0	Shrub	0.0	0.0	0.00000
1018000809040400		6.6	61.7	4 Low	9.8	90.2	Forest	0.9	0.0	0.00000

1018000810010100		40.1	43.4	8	Moderate	8.9	75.0	Forest	19.5	8.4	0.00780
1018000810010200		12.9	47.8	7	Moderate	11.7	75.6	Forest	5.6	0.0	0.00000
1018000810010300		18.7	24.4	10	Moderate	0.0	89.6	Forest	8.5	4.6	0.00340
1018000810010400		7.7	39.7	14	High	0.0	100.0	Forest	3.7	1.6	0.00147
1018000810010500		21.1	68.1	12	Moderate	18.6	66.1	Forest	14.2	1.2	0.00000
1018000810010600		7.5	76.4	15	High	4.0	95.4	Forest	6.1	0.0	0.00000
1018000810010700		3.6	81.2	8	Moderate	13.9	85.1	Forest	2.2	0.0	0.00000
1018000810020100		0.0	81.3	0	Low	100.0	0.0	Shrub	0.0	0.0	0.00000
1018000810020200		0.1	87.9	0	Low	61.7	38.3	Shrub	0.0	0.0	0.00000
1018001101030100		16.3	62.5	3	Low	28.8	71.2	Forest	11.2	3.7	0.00000
1018001101050100		3.9	72.0	8	Moderate	67.4	32.6	Shrub	2.1	0.0	0.00000
1018001101050200		0.1	55.4	0	Low	100.0	0.0	Shrub	0.3	0.0	0.00000
1018001101050300		8.4	92.9	2	Low	92.9	7.1	Shrub	4.7	0.0	0.00000
1018001101050400		3.7	26.4	3	Low	2.5	97.5	Forest	0.0	0.0	0.00000
1018001101060102	Hobbs Creek	3.6	94.4	3	Low	0.0	100.0	Forest	2.7	0.0	0.00000
1018001101060101	Rabbitt Creek	9.9	88.1	5	Low	0.1	99.9	Forest	5.8	0.0	0.00000
1018001101060200		4.7	77.9	15	High	60.2	39.8	Shrub	3.0	0.4	0.00000
1018001101070100		14.6	88.5	6	Low	3.0	97.0	Forest	9.6	1.4	0.00000
1018001101070200		5.6	92.0	13	High	9.2	90.8	Forest	6.2	0.3	0.00000
1018001101070300		8.9	99.9	5	Low	12.6	87.4	Forest	6.1	0.0	0.00000
1018001101080200		8.6	96.9	3	Low	14.4	85.6	Forest	6.1	0.0	0.00000
1018001101080300		0.8	98.5	2	Low	53.7	46.3	Shrub	0.0	0.0	0.00000
1018001101090100		25.1	74.4	7	Moderate	0.4	99.6	Forest	13.8	2.4	0.00000
1018001101090200		3.1	100.0	6	Low	0.0	100.0	Forest	1.4	0.0	0.00000
1018001101090300		7.1	99.5	11	Moderate	18.8	81.2	Forest	7.5	0.0	0.00000
1018001101090601	U. Collins Cutoff Creek	2.2	83.4	3	Low	0.0	100.0	Forest	0.1	0.0	0.00000
1018001101090602	Shapley Draw	4.5	86.1	3	Low	18.7	81.3	Forest	1.6	0.4	0.00000
1018001106020100		26.9	55.3	15	High	10.7	79.0	Forest	20.3	2.5	0.00000
1018001106020200		0.2	0.0	3	Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018001106020300		5.6	19.9	13	High	0.0	100.0	Forest	5.0	4.8	0.00202
1018001106020400		2.6	68.3	17	High	4.6	95.4	Forest	1.5	0.0	0.00000
1018001106020500		24.1	64.1	16	High	16.6	67.5	Forest	19.2	4.2	0.00000
1018001106030100		19.6	77.9	13	High	33.2	52.8	Forest	12.9	0.8	0.00000
1018001106030200		0.1	87.2	3	Low	0.0	100.0	Forest	0.0	0.0	0.00000

1018001106040100		18.1	31.0	12 Moderate	0.0	100.0	Forest	10.5	4.9	0.00420
1018001106040202	Willow C/Owl C/Muddy	3.7	18.8	18 High	0.0	100.0	Forest	3.6	2.3	0.00144
1018001106060100		23.7	48.6	11 Moderate	13.2	84.6	Forest	13.7	8.3	0.00549
1018001106060200		7.5	39.1	6 Low	12.3	84.3	Forest	5.5	2.0	0.00220
1018001106060300		12.1	76.5	11 Moderate	43.3	56.7	Forest	6.2	0.7	0.00000
1018001106060600		2.9	85.0	5 Low	100.0	0.0	Shrub	0.4	0.0	0.00000
1018001106060800		2.6	28.3	3 Low	40.4	59.6	Forest	0.3	0.0	0.00000
1018001106070100		15.8	49.2	14 High	22.1	61.8	Forest	14.4	4.2	0.00579
1018001106070200		7.4	50.6	18 High	4.0	95.8	Forest	3.7	1.3	0.00000
1018001106070300		25.9	40.0	13 High	3.6	91.1	Forest	19.6	5.2	0.00784
1018001106070400		7.1	33.8	4 Low	12.1	87.9	Forest	3.7	2.1	0.00148
1018001106070500		28.7	24.5	15 High	10.8	89.2	Forest	19.3	12.2	0.00772
1018001106070600		6.6	5.2	14 High	0.0	100.0	Forest	4.2	4.2	0.00168
1018001106070700		22.2	13.5	10 Moderate	0.0	100.0	Forest	11.0	6.7	0.00442
1018001106080100		0.0	100.0	0 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018001106080200		1.7	99.1	9 Moderate	0.0	100.0	Forest	0.8	0.0	0.00000
1018001106080300		4.5	100.0	11 Moderate	2.0	85.8	Forest	5.2	0.0	0.00000
1018001107010100		29.6	63.8	8 Moderate	16.8	82.9	Forest	27.5	5.9	0.00000
1018001107010200		13.4	100.0	12 Moderate	24.8	75.2	Forest	10.6	0.0	0.00000
1018001107010300		38.0	86.1	10 Moderate	62.2	37.8	Shrub	36.4	3.8	0.00000
1018001107010400		2.4	59.3	3 Low	99.3	0.7	Shrub	0.0	0.0	0.00000
1018001107010600		0.9	68.2	3 Low	34.8	65.2	Forest	0.0	0.0	0.00000
1018001107010700		15.4	96.2	13 High	3.4	96.6	Forest	11.7	0.6	0.00000
1018001107030104	Fletcher Park	0.3	76.3	2 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018001107030101	Mill Creek	12.5	61.5	10 Moderate	12.7	86.5	Forest	9.9	4.1	0.00000
1018001107030201	South Fish Creek	6.8	55.1	9 Moderate	13.0	83.9	Forest	6.0	2.3	0.00000
1018001107030202	Lone Tree Creek	5.4	91.8	2 Low	36.6	63.4	Forest	3.6	0.0	0.00000
Pole Mountain										
1018001004060000		1.1	0.0	5 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018001004070000		3.7	0.0	9 Moderate	9.2	90.8	Forest	0.0	0.0	0.00000
1018001005010000		0.3	0.0	3 Low	100.0	0.0	Shrub	0.0	0.0	0.00000
1018001005020100		9.9	0.0	8 Moderate	16.6	83.4	Forest	2.0	2.0	0.00081
1018001005020200		2.9	0.2	6 Low	0.0	100.0	Forest	1.2	1.2	0.00048
1018001005020300		0.1	0.0	0 Low	0.0	0.0		0.0	0.0	0.00000

1018001201010000		4.6	0.2	4 Low	13.0	87.0	Forest	1.6	1.6	0.00064
1019000705010000		1.9	0.0	4 Low	93.0	7.0	Shrub	1.8	1.8	0.00070
1019000801010000		0.1	0.0	0 Low	100.0	0.0	Shrub	0.0	0.0	0.00000
1019000901010100		54.2	0.0	14 High	5.1	94.9	Forest	16.4	16.4	0.00658
1019000901010200		7.6	0.0	8 Moderate	34.5	65.5	Forest	5.8	5.8	0.00231
1019000901030000		3.9	0.0	9 Moderate	54.8	45.2	Shrub	1.4	1.4	0.00057
1019000901040103	Upper Crow Creek C	0.9	0.0	6 Low	65.2	34.8	Shrub	0.0	0.0	0.00001
1019000901040101	North Branch Crow Creek	16.1	0.0	10 Moderate	51.4	48.6	Shrub	10.0	10.0	0.00401
1019000901040102	South Branch Crow Creek	26.9	0.0	9 Moderate	49.1	50.9	Forest	9.8	9.8	0.00393
1019000901040201	Upper Brush Creek	12.8	0.0	9 Moderate	59.7	40.3	Shrub	5.5	5.5	0.00222
1019001501010100		8.3	0.1	3 Low	50.6	49.4	Shrub	4.3	4.3	0.00171
1019001501010203	Middle Lodgepole C	3.1	0.0	7 Moderate	88.2	11.8	Shrub	1.3	1.3	0.00051
1019001501010204	Mckechnie Meadow	6.9	0.0	7 Moderate	91.4	8.6	Shrub	5.3	5.3	0.00212
1019001501010202	N Br Lodgepole Creek	16.7	0.0	14 High	38.5	61.5	Forest	11.3	11.3	0.00453
1019001501010201	Wildcat Gulch	15.5	0.0	8 Moderate	23.3	76.7	Forest	11.7	11.7	0.00469
1019001501020000		27.6	0.0	14 High	41.0	59.0	Forest	12.9	12.9	0.00517
Sierra Madre										
1018000202050200		6.4	0.6	11 Moderate	0.0	100.0	Forest	5.5	5.5	0.00219
1018000202050304	Beaver Creek	5.6	8.3	3 Low	33.0	67.0	Forest	3.8	3.5	0.00151
1018000202050307	Addison Gulch	0.7	0.0	3 Low	0.0	100.0	Forest	0.4	0.4	0.00014
1018000202050306	Collins Draw	3.6	0.0	11 Moderate	7.2	92.8	Forest	3.4	3.4	0.00138
1018000202050305	Flohr Creek	2.8	0.0	10 Moderate	39.9	60.1	Forest	2.6	2.6	0.00104
1018000202050303	Etna Creek	5.5	11.8	5 Low	44.8	55.2	Forest	3.3	2.9	0.00134
1018000202050301	Upper Beaver Creek	14.7	1.0	8 Moderate	11.1	88.9	Forest	5.9	5.7	0.00237
1018000202050302	Camp Creek	7.6	2.5	11 Moderate	0.0	100.0	Forest	4.4	4.4	0.00176
1018000202050401	North Fork Indian Creek	2.4	0.0	12 Moderate	25.0	75.0	Forest	0.9	0.9	0.00037
1018000202050402	South Fork Indian Creek	2.7	0.0	4 Low	18.9	81.1	Forest	1.1	1.1	0.00045
1018000202050500		0.2	0.0	3 Low	1.8	98.2	Forest	0.0	0.0	0.00000
1018000203010300		6.3	0.0	10 Moderate	81.6	18.4	Shrub	4.4	4.4	0.00177
1018000203010500		3.8	0.0	9 Moderate	56.5	43.5	Shrub	3.6	3.6	0.00146
1018000203010600		4.5	0.0	9 Moderate	42.9	57.1	Forest	0.0	0.0	0.00000
1018000203020103	Southwest Bear Mountain	7.9	0.0	10 Moderate	38.1	61.9	Forest	3.8	3.8	0.00153
1018000203020101	North Fork Big Creek	12.3	2.0	10 Moderate	0.0	100.0	Forest	6.0	5.4	0.00241
1018000203020104	Cunningham Park	14.7	0.0	10 Moderate	46.6	53.4	Forest	7.1	7.1	0.00285

1018000203020102	McAnulty Creek	9.0	3.8	12 Moderate	0.0	100.0	Forest	3.9	2.9	0.00156
1018000203020201	Middle Fork Big Creek	20.9	4.6	11 Moderate	7.2	92.8	Forest	12.9	10.9	0.00518
1018000203020203	L M Fork Big Creek Trib	6.0	11.8	12 Moderate	48.4	51.6	Forest	6.4	4.7	0.00257
1018000203020202	Casteel Creek	8.1	18.9	5 Low	24.9	75.1	Forest	4.7	2.6	0.00187
1018000203020303	Lower Beaver Creek	1.6	25.2	5 Low	44.3	55.7	Forest	0.8	0.0	0.00030
1018000203020401	Lower Line Creek	1.4	53.2	4 Low	55.5	44.6	Shrub	1.6	0.0	0.00000
1018000203030100		2.6	0.0	13 High	96.1	3.9	Shrub	2.8	2.8	0.00113
1018000203030200		3.6	0.0	11 Moderate	33.6	66.4	Forest	2.4	2.4	0.00096
1018000203030300		8.1	0.2	10 Moderate	96.6	0.0	Shrub	3.7	3.7	0.00147
1018000203040203	Lower Six Mile Creek	0.0	0.0	3 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000203040204	Six Mile Creek Trib	2.0	0.0	5 Low	3.4	96.6	Forest	1.0	1.0	0.00040
1018000203040302	Henry Ditch	2.4	0.0	5 Low	100.0	0.0	Shrub	0.0	0.0	0.00000
1018000203040307	Long Lake	2.4	0.0	7 Moderate	59.7	40.3	Shrub	0.7	0.7	0.00030
1018000203040305	Spring Creek Trib #2	1.3	0.0	12 Moderate	70.3	29.7	Shrub	0.9	0.9	0.00036
1018000203040303	Spring Creek Trib #1	2.9	0.0	10 Moderate	13.0	87.0	Forest	2.0	2.0	0.00081
1018000203050102	Little Bear Creek	4.8	18.8	4 Low	0.0	99.9	Forest	3.8	2.3	0.00151
1018000203050101	Bear Creek	4.6	0.0	4 Low	0.9	98.8	Forest	2.5	2.5	0.00102
1018000203050201	South Trent Creek	2.2	0.0	8 Moderate	5.3	94.7	Forest	2.1	2.1	0.00083
1018000203050203	Trent Creek Trib	3.2	0.0	8 Moderate	21.0	79.0	Forest	2.6	2.6	0.00105
1018000203050202	Deer Creek	1.2	0.0	3 Low	0.0	100.0	Forest	1.1	1.1	0.00043
1018000203050402	Skyline Ranch	0.2	0.0	4 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000203050401	North Bear Creek	3.1	47.0	12 Moderate	0.0	100.0	Forest	3.8	1.9	0.00154
1018000205020500		2.5	0.0	4 Low	0.0	79.3	Forest	1.9	1.9	0.00074
1018000205030102	Broadway Mine	4.4	0.0	4 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000205030101	E Fork Encampment Rvr	3.7	0.0	4 Low	0.0	100.0	Forest	2.3	2.3	0.00094
1018000205030103	Lower East Fork Trib	3.1	0.0	3 Low	0.0	100.0	Forest	1.2	1.2	0.00050
1018000205030202	North Trib Coon Creek	3.6	0.0	7 Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
1018000205030203	Coon Creek	3.3	0.0	9 Moderate	0.0	100.0	Forest	3.7	3.7	0.00150
1018000205030201	East Trib Coon Creek	4.7	0.0	11 Moderate	0.0	100.0	Forest	1.6	1.6	0.00063
1018000205030204	South Trib Coon Creek	5.2	4.0	12 Moderate	0.0	100.0	Forest	2.3	2.3	0.00094
1018000205030303	Damfino Creek	5.0	30.6	4 Low	0.9	99.1	Forest	1.9	1.9	0.00076
1018000205030302	North Trib Damfino Creek	3.5	22.3	4 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000205030301	Damfino Park	1.8	0.0	3 Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000205030400		8.7	0.0	9 Moderate	2.0	97.9	Forest	6.9	6.9	0.00276

1018000205030500		0.4	0.0	14	High	0.0	100.0	Forest	0.8	0.8	0.00031
1018000205030600		4.3	0.0	6	Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000205040203	Purgatory Creek	3.7	9.2	14	High	73.7	26.3	Shrub	4.2	4.0	0.00167
1018000205040201	Lower Encampment C	1.8	0.6	3	Low	40.2	59.8	Forest	2.1	2.1	0.00085
1018000205040204	Dunkard Creek	6.7	0.0	3	Low	40.2	59.8	Forest	4.2	4.2	0.00168
1018000205040202	Jordan Creek	4.0	0.0	1	Low	65.7	34.3	Shrub	3.6	3.6	0.00142
1018000205040300		17.9	13.8	7	Moderate	13.2	86.8	Forest	9.5	7.6	0.00379
1018000205040407	Middle Encampment C	11.1	0.0	4	Low	0.0	100.0	Forest	6.0	6.0	0.00241
1018000205040408	Cascade Creek	8.0	0.0	4	Low	0.0	100.0	Forest	4.1	4.1	0.00164
1018000205040405	Miller Creek	5.7	0.0	3	Low	0.0	100.0	Forest	3.1	3.1	0.00125
1018000205040406	Box Canyon	5.1	0.0	3	Low	0.0	100.0	Forest	2.9	2.9	0.00115
1018000205040403	Grady Creek	3.2	0.0	4	Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000205040402	Olson Creek	3.9	0.0	7	Moderate	0.0	100.0	Forest	3.0	3.0	0.00122
1018000205040404	Dudley Creek	5.9	36.0	3	Low	0.0	100.0	Forest	2.9	1.2	0.00115
1018000205040401	U M Encampment Rvr	8.6	5.6	6	Low	0.0	99.7	Forest	7.7	7.7	0.00310
1018000205040503	Soldier Creek	10.0	0.0	4	Low	5.1	94.9	Forest	6.7	6.7	0.00268
1018000205040501	North Soldier Creek	6.1	0.0	8	Moderate	0.0	100.0	Forest	4.1	4.1	0.00166
1018000205040502	South Soldier Creek	7.0	0.0	8	Moderate	0.0	100.0	Forest	4.2	4.2	0.00168
1018000205050101	Robinson Creel	7.5	0.0	6	Low	0.0	100.0	Forest	4.1	4.1	0.00166
1018000205050102	NW Trib Hog Park Res	6.1	0.0	2	Low	0.0	96.9	Forest	0.0	0.0	0.00000
1018000205050103	Upper Hog Park Creek	4.5	0.1	10	Moderate	0.0	92.5	Forest	2.7	2.7	0.00109
1018000205050104	SW Trib Hog Park Res	6.6	1.1	6	Low	0.0	96.5	Forest	3.9	3.9	0.00157
1018000205050105	Hog Park Reservoir	7.0	0.0	4	Low	0.0	68.8	Forest	5.9	5.9	0.00235
1018000205050202	Hog Park Creek C	5.7	0.0	5	Low	0.0	97.2	Forest	0.0	0.0	0.00000
1018000205050201	N Trib Hog Park Creek	7.3	0.0	17	High	0.0	73.1	Forest	4.1	4.1	0.00164
1018000205050300		5.7	43.5	10	Moderate	0.0	68.6	Forest	3.1	1.1	0.00123
1018000205060104	Copper Creek	1.5	0.4	12	Moderate	0.0	100.0	Forest	1.3	1.3	0.00051
1018000205060103	North Fork Miners Creek	2.3	0.0	11	Moderate	0.0	100.0	Forest	1.6	1.6	0.00065
1018000205060102	N Trib N Miners Creek	4.6	0.0	8	Moderate	0.0	100.0	Forest	2.9	2.9	0.00115
1018000205060101	S Trib North Miners Cree	5.9	0.0	10	Moderate	0.0	100.0	Forest	5.0	5.0	0.00202
1018000205060200		20.1	0.0	10	Moderate	0.0	100.0	Forest	11.0	11.0	0.00442
1018000205070100		13.8	0.3	4	Low	0.0	56.4	Forest	9.6	9.6	0.00383
1018000205070203	Sierra C	2.3	0.0	4	Low	0.0	100.0	Forest	2.0	2.0	0.00078
1018000205070201	Green Mountain Trail	11.1	0.0	3	Low	0.0	99.5	Forest	3.9	3.9	0.00157

10180002050702	Winns Run	5.1	0.0	3	Low	0.0	85.3	Forest	0.0	0.0	0.00000
10180002050703	Beaver Creek	4.1	1.7	12	Moderate	0.0	100.0	Forest	2.4	2.4	0.00097
10180002050703	Slaughterhouse Gulch	9.7	7.6	12	Moderate	0.0	100.0	Forest	7.9	7.6	0.00315
10180002050704		8.5	32.9	12	Moderate	0.0	100.0	Forest	3.3	2.4	0.00131
10180002050705	N FK Encampment Rvr C	2.4	5.8	11	Moderate	0.0	100.0	Forest	1.5	1.5	0.00062
10180002050705	Bottle Creek	4.0	8.3	12	Moderate	0.0	100.0	Forest	2.5	1.9	0.00102
10180002060201	Cow Creek	14.0	6.0	6	Low	0.0	99.6	Forest	9.8	9.8	0.00392
10180002060201	Otto Creek	2.4	0.0	13	High	15.5	84.5	Forest	1.8	1.8	0.00073
10180002060201	Teddy Creek	7.5	7.9	10	Moderate	0.0	100.0	Forest	5.0	4.4	0.00200
10180002060201	Upper Cow Creek	15.9	18.7	15	High	0.0	91.6	Forest	9.5	6.8	0.00380
10180002060201	Nellie Creek	5.0	27.1	6	Low	0.0	98.6	Forest	3.3	2.8	0.00133
10180002060202	Calf Creek	8.0	0.0	10	Moderate	21.8	78.2	Forest	3.6	3.6	0.00145
10180002070101	Upper North Spring Creek	11.9	0.3	8	Moderate	2.8	97.2	Forest	9.6	9.6	0.00386
10180002070101	U North Spring Creek Trib	5.0	0.0	5	Low	0.0	100.0	Forest	0.0	0.0	0.00000
10180002070101	U E Trib North Spring C	11.0	0.6	6	Low	0.0	90.8	Forest	0.0	0.0	0.00000
10180002070101	U W Trib North Spring Cr	5.1	8.1	7	Moderate	0.0	83.5	Forest	5.2	4.7	0.00206
10180002070102	Nugget Creek	2.6	0.0	4	Low	0.0	100.0	Forest	2.0	2.0	0.00079
10180002070102	East Nugget Creek	8.8	0.3	11	Moderate	0.0	100.0	Forest	5.6	5.6	0.00226
10180002070102	West Nugget Trib	7.1	0.0	5	Low	0.0	100.0	Forest	0.0	0.0	0.00000
10180002070103		6.0	0.2	5	Low	42.4	57.6	Forest	2.5	2.5	0.00099
10180002070104		2.6	0.0	11	Moderate	15.9	84.1	Forest	1.6	1.6	0.00062
10180002070106		3.7	0.0	5	Low	47.4	52.6	Forest	0.8	0.8	0.00030
10180002070202	Snow Creek	3.2	0.0	5	Low	15.8	84.2	Forest	0.0	0.0	0.00000
10180002070202	North Spring Creek C	0.0	0.0	3	Low	97.5	2.5	Shrub	0.0	0.0	0.00000
10180002070301	South Spring Creek C	1.3	0.0	4	Low	9.3	90.8	Forest	1.0	1.0	0.00041
10180002070301	Owl Gulch	1.3	0.0	11	Moderate	32.3	67.7	Forest	1.2	1.2	0.00048
10180002070301	Chippewa Creek	5.8	3.2	12	Moderate	5.1	94.9	Forest	2.4	2.2	0.00097
10180002070301	East Fk South Spring Cr	3.8	0.2	4	Low	17.4	82.6	Forest	1.7	1.7	0.00070
10180002070301	Mowry Creek	4.2	3.9	12	Moderate	0.0	100.0	Forest	3.2	2.8	0.00127
10180002070301	Upper South Spring Creek	14.5	21.9	15	High	0.0	78.4	Forest	8.1	4.7	0.00325
10180002070302	off forest composite	0.1	0.0	4	Low	100.0	0.0	Shrub	0.0	0.0	0.00000
10180002070302	Heather Creek	7.7	0.0	11	Moderate	6.7	93.3	Forest	6.7	6.7	0.00270
10180002070302	Shingle Creek	3.0	0.0	10	Moderate	0.7	99.3	Forest	1.9	1.9	0.00075
10180002070303	Antelope Springs Draw	0.3	0.0	3	Low	59.1	40.9	Shrub	0.7	0.7	0.00029

10180002070303 01	Centennial Creek	4.2	0.7	7 Moderate	19.5	80.5	Forest	3.6	3.6	0.00145
10180002080101 02	Alameda Creek	3.6	0.0	7 Moderate	14.3	85.7	Forest	2.9	2.9	0.00114
10180002080101 01	Upper Jack Creek	41.3	3.7	8 Moderate	1.9	90.3	Forest	14.9	14.9	0.00597
10180002080102 00		10.2	0.6	9 Moderate	1.5	98.5	Forest	5.0	5.0	0.00201
10180002080104 00		0.5	0.0	3 Low	100.0	0.0	Shrub	0.1	0.1	0.00004
10180002080201 01	Willow Creek	5.5	0.5	9 Moderate	21.6	78.4	Forest	0.0	0.0	0.00000
14050003010101 03	West Whiskey Trib	3.0	2.4	4 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003010101 05	Upper Whiskey Creek	3.8	0.0	6 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003010101 04	Whiskey Creek Trib	1.1	0.0	4 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003010301 00		0.2	0.0	7 Moderate	0.0	100.0	Forest	0.1	0.1	0.00005
14050003010304 00		0.4	34.2	5 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003010402 04	W Br N Fk L Snake Rvr	14.5	0.0	6 Low	0.0	65.2	Forest	7.5	7.5	0.00302
14050003010402 03	Upper West Branch Trib	4.6	0.0	3 Low	1.1	98.9	Forest	0.0	0.0	0.00000
14050003010402 01	West Branch C	13.6	6.3	9 Moderate	0.0	100.0	Forest	8.6	7.8	0.00345
14050003010402 02	Lower West Branch Trib	7.4	36.9	8 Moderate	11.6	88.4	Forest	0.0	0.0	0.00000
14050003010402 05	N Fk Little Snake Rvr C	1.6	11.4	3 Low	0.0	100.0	Forest	1.3	1.3	0.00053
14050003010403 05	North Trib C	9.6	0.0	11 Moderate	0.0	100.0	Forest	4.5	4.5	0.00180
14050003010403 08	Upper North Fork Trib	4.1	0.0	6 Low	0.0	100.0	Forest	2.8	2.8	0.00111
14050003010403 09	Deadman	5.4	0.0	9 Moderate	0.6	99.4	Forest	3.8	3.8	0.00153
14050003010403 07	U N Fk Little Snake Rvr	8.3	0.0	4 Low	0.0	100.0	Forest	6.3	6.3	0.00251
14050003010403 02	Solomon Creek	7.8	1.4	9 Moderate	25.0	75.0	Forest	6.6	6.5	0.00266
14050003010403 06	U Green Timber Creek	6.2	0.0	5 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003010403 01	L North Fk L Snake Rvr	12.3	18.8	11 Moderate	0.0	100.0	Forest	5.1	4.2	0.00204
14050003010403 04	L Green Timber Creek	8.6	1.0	2 Low	0.0	100.0	Forest	4.7	4.7	0.00189
14050003010403 03	Rose Creek	5.7	38.9	5 Low	0.0	100.0	Forest	4.7	3.1	0.00188
14050003010403 10	Green Timber Trib	4.0	5.4	8 Moderate	27.6	72.4	Forest	3.1	3.1	0.00125
14050003010601 07	U Roaring Fk Little Snake	13.0	2.6	1 Low	0.0	62.3	Forest	8.5	8.4	0.00339
14050003010601 05	Fletcher Park	5.9	29.4	4 Low	0.0	100.0	Forest	0.7	0.0	0.00000
14050003010601 06	Upper Roaring Fork Trib	4.1	1.4	7 Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
14050003010601 04	Roaring Fk Little Snake C	11.2	11.0	11 Moderate	0.0	100.0	Forest	4.3	2.4	0.00171
14050003010601 03	StoCreek Driveway	4.6	0.0	4 Low	0.0	100.0	Forest	0.0	0.0	0.00001
14050003010601 02	Roaring Fk L Snake Rvr	10.5	11.6	9 Moderate	5.9	94.1	Forest	5.7	4.0	0.00227
14050003010601 01	Lower N Fork Little Snake	3.8	47.9	3 Low	22.5	77.5	Forest	0.0	0.0	0.00000
14050003010602 03	Spring Creek	7.9	5.6	8 Moderate	99.0	1.0	Shrub	2.4	2.4	0.00094

14050003010602 02	Road Gulch	2.3	0.0	3	Low	100.0	0.0	Shrub	0.0	0.0	0.00000
14050003010602 01	Little Snake C	5.9	25.1	16	High	82.4	17.6	Shrub	1.2	1.1	0.00047
14050003010603 01	Upper Cottonwood Creek	6.8	36.4	8	Moderate	0.0	100.0	Forest	5.4	2.9	0.00215
14050003010603 02	Upper Cottonwood Trib	8.8	23.0	3	Low	19.6	80.4	Forest	0.0	0.0	0.00002
14050003010603 03	Lower Cottonwood Creek	5.6	13.4	11	Moderate	22.1	77.9	Forest	5.0	4.1	0.00202
14050003010603 04	Lower Cottonwood Trib	3.9	5.0	5	Low	6.5	93.5	Forest	3.0	2.6	0.00121
14050003010801 02	Smith Creek	4.9	13.8	11	Moderate	0.0	98.3	Forest	2.9	2.6	0.00117
14050003010801 01	Upper Battle Creek	12.0	40.0	8	Moderate	0.0	90.6	Forest	6.5	1.2	0.00261
14050003010801 03	Upper Battle C	3.7	8.9	6	Low	0.0	100.0	Forest	2.2	2.2	0.00087
14050003010802 00		10.7	11.8	6	Low	0.0	93.2	Forest	5.2	5.2	0.00210
14050003010803 00		16.3	0.0	2	Low	0.0	100.0	Forest	8.4	8.4	0.00336
14050003010804 00		16.0	0.0	2	Low	0.0	87.3	Forest	7.8	7.8	0.00312
14050003010805 00		4.4	0.0	3	Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003010806 00		14.1	0.9	7	Moderate	0.7	99.3	Forest	6.4	6.4	0.00258
14050003010901 00		28.1	22.4	8	Moderate	0.0	96.1	Forest	11.2	7.4	0.00448
14050003010902 00		11.0	2.9	8	Moderate	0.0	76.9	Forest	7.8	6.6	0.00313
14050003010903 00		18.3	1.7	7	Moderate	0.0	100.0	Forest	7.5	7.0	0.00299
14050003011001 00		11.6	16.2	10	Moderate	28.1	71.9	Forest	6.4	5.9	0.00256
14050003011002 00		4.4	20.6	4	Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003011003 00		12.3	17.4	9	Moderate	9.9	90.1	Forest	5.0	3.5	0.00199
14050003011004 00		9.3	0.8	13	High	96.6	3.4	Shrub	5.5	5.0	0.00220
14050003011005 00		11.1	59.9	3	Low	69.1	30.9	Shrub	0.0	0.0	0.00000
14050003011006 00		8.5	32.9	7	Moderate	79.1	17.9	Shrub	4.2	0.0	0.00000
14050003011007 00		5.7	22.7	8	Moderate	19.9	80.1	Forest	4.4	2.6	0.00178
14050003011008 00		8.2	2.4	11	Moderate	94.2	5.8	Shrub	5.4	5.2	0.00217
14050003020101 00		5.3	1.2	4	Low	38.8	61.2	Forest	0.0	0.0	0.00000
14050003020102 00		3.2	0.0	4	Low	23.6	76.4	Forest	0.4	0.4	0.00014
14050003040101 00		29.2	0.0	9	Moderate	11.3	88.7	Forest	18.7	18.7	0.00750
14050003040102 00		3.4	0.0	2	Low	0.0	100.0	Forest	0.9	0.9	0.00037
14050003040103 00		0.3	0.0	4	Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040104 00		4.7	0.0	9	Moderate	26.0	74.0	Forest	1.9	1.9	0.00075
14050003040201 01	Trib #3	2.5	0.0	8	Moderate	0.0	100.0	Forest	1.5	1.5	0.00061
14050003040201 02	Trib #4	6.4	0.0	7	Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040202 03	Trib #8	0.1	0.0	3	Low	0.0	100.0	Forest	0.0	0.0	0.00000

14050003040202	Trib #7	1.5	0.0	5 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040201	Trib #6	4.2	0.0	4 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040300		5.0	0.0	5 Low	0.0	100.0	Forest	1.5	1.5	0.00058
14050003040400		1.9	0.0	3 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040500		1.0	0.0	2 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040600		0.0	0.0	0 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040300		3.0	0.0	5 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040100		0.9	0.0	4 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040201	Hell Canyon	4.9	0.0	6 Low	0.0	100.0	Forest	2.8	2.8	0.00111
14050003040101	North Fork Savory Creek	12.1	0.8	9 Moderate	0.0	100.0	Forest	5.8	5.8	0.00233
14050003040102	Mill Creek	4.4	0.0	10 Moderate	1.8	98.2	Forest	3.2	3.2	0.00126
14050003040103	Deep Gulch	5.9	0.0	4 Low	3.2	96.8	Forest	0.0	0.0	0.00000
14050003040103	Douglas Creek	5.6	0.0	9 Moderate	0.0	100.0	Forest	4.0	4.0	0.00161
14050003040102	U Big Sandstone North	6.8	5.5	4 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040104	U Big Sandstone Creek	12.9	0.5	8 Moderate	0.0	100.0	Forest	8.3	8.3	0.00334
14050003040101	U Big Sandstone South	8.1	1.0	9 Moderate	0.0	100.0	Forest	3.8	3.8	0.00152
14050003040201	Upper Mill Creek	7.8	8.2	8 Moderate	0.0	100.0	Forest	3.4	2.6	0.00136
14050003040203	Mill Creek	3.8	0.0	8 Moderate	0.0	100.0	Forest	4.5	4.5	0.00178
14050003040202	Mill Creek Trib	4.7	0.0	6 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040300		7.9	0.5	7 Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040400		15.5	1.3	5 Low	0.0	97.1	Forest	6.9	6.8	0.00278
14050003040500		16.3	0.0	14 High	0.0	99.8	Forest	11.7	11.7	0.00470
14050003040600		3.7	0.0	3 Low	0.0	99.6	Forest	0.0	0.0	0.00000
14050003040700		18.3	0.0	5 Low	0.0	92.4	Forest	6.3	6.3	0.00251
14050003040800		4.9	58.5	5 Low	34.7	65.3	Forest	0.0	0.0	0.00000
14050003040801	Belvidere Ditch	9.4	23.6	9 Moderate	17.4	82.6	Forest	0.9	0.0	0.00000
14050003040802	Battle Highway	4.4	68.4	4 Low	88.6	11.4	Shrub	0.0	0.0	0.00000
14050003040104	Reader Basin	2.2	24.7	4 Low	31.2	68.8	Forest	0.0	0.0	0.00000
14050003040200		7.6	2.8	3 Low	30.2	69.8	Forest	0.0	0.0	0.00000
14050003040300		2.7	5.5	3 Low	91.7	8.3	Shrub	0.0	0.0	0.00000
14050003040901		16.4	9.4	9 Moderate	0.0	100.0	Forest	8.9	6.3	0.00356
14050003040902		13.0	7.1	8 Moderate	0.0	100.0	Forest	5.8	4.9	0.00230
14050003040903		7.2	0.1	4 Low	0.0	100.0	Forest	0.0	0.0	0.00000
14050003040904		11.6	0.0	4 Low	0.0	93.9	Forest	7.1	7.1	0.00285

1405000304090500		7.3	0.0	3 Low	0.0	99.7	Forest	0.0	0.0	0.00000
1405000304090600		11.5	3.2	6 Low	0.3	91.3	Forest	3.9	3.3	0.00156
Snowy Range										
1018000201010100		28.8	0.0	4 Low	68.7	31.3	Shrub	18.8	18.8	0.00753
1018000201010200		10.8	0.0	4 Low	11.3	88.7	Forest	7.0	7.0	0.00281
1018000201010303	North Platte C	7.1	0.0	10 Moderate	38.0	62.0	Forest	5.7	5.7	0.00230
1018000201010301	Sixmile Creek	14.9	0.0	10 Moderate	92.4	7.6	Shrub	11.9	11.9	0.00476
1018000201010302	Porter Creek	5.7	0.0	9 Moderate	14.8	85.2	Forest	4.0	4.0	0.00160
1018000201010401	North Trib Elkhorn Creek	9.2	0.0	10 Moderate	3.5	96.5	Forest	6.7	6.7	0.00270
1018000201010402	Elkhorn Creek	13.1	0.0	9 Moderate	6.8	93.2	Forest	7.1	7.1	0.00283
1018000201010403	Elkhorn Creek C	1.7	0.0	5 Low	80.2	19.8	Shrub	1.2	1.2	0.00049
1018000201010501	Teepee Creek	5.6	0.0	5 Low	63.7	36.3	Shrub	3.7	3.7	0.00149
1018000201010503	North Platte C	2.8	0.0	10 Moderate	39.3	60.7	Forest	0.5	0.5	0.00021
1018000201020000		0.4	0.0	7 Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
1018000201040101	Upper Douglas Creek	26.5	0.0	10 Moderate	0.0	100.0	Forest	11.2	11.2	0.00449
1018000201040102	Elk Creek	12.1	6.1	10 Moderate	0.0	100.0	Forest	5.8	5.0	0.00230
1018000201040103	Bear Creek	5.1	28.4	12 Moderate	0.0	100.0	Forest	4.6	3.2	0.00184
1018000201040104	Rob Roy Reservoir	10.6	22.6	6 Low	0.0	91.3	Forest	7.9	1.9	0.00316
1018000201040202	Horse Creek	7.5	0.1	10 Moderate	0.0	100.0	Forest	5.5	5.5	0.00220
1018000201040204	Little Beaver Creek	6.2	1.4	12 Moderate	0.0	100.0	Forest	4.5	4.4	0.00179
1018000201040201	Douglas Creek C	26.7	5.0	11 Moderate	0.0	99.8	Forest	17.8	12.8	0.00715
1018000201040203	Bear Creek	6.2	1.2	10 Moderate	0.0	100.0	Forest	3.7	3.2	0.00147
1018000201050101	Upper Muddy Creek	17.9	0.0	11 Moderate	0.0	100.0	Forest	7.0	7.0	0.00279
1018000201050102	Spring Creek	5.2	0.5	11 Moderate	0.0	100.0	Forest	3.8	3.8	0.00151
1018000201050103	Muddy Creek	5.6	0.0	10 Moderate	0.0	100.0	Forest	4.0	4.0	0.00160
1018000201050201	Lower Lake Creek	12.7	0.0	10 Moderate	0.0	100.0	Forest	6.0	6.0	0.00239
1018000201050203	Hay Creek	4.6	0.0	10 Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
1018000201050204	Lake Creek	12.0	1.7	11 Moderate	0.0	100.0	Forest	6.8	6.5	0.00272
1018000201050202	Collins Creek	13.1	2.6	12 Moderate	0.0	100.0	Forest	10.6	10.4	0.00425
1018000201050205	Lake Creek Trib	4.0	0.1	10 Moderate	0.0	100.0	Forest	0.0	0.0	0.00001
1018000201050301	Smith Creek	6.7	0.0	12 Moderate	0.0	100.0	Forest	8.5	8.5	0.00342
1018000201050302	Middle Douglas Creek C	16.8	0.6	11 Moderate	0.0	98.2	Forest	12.4	12.4	0.00495
1018000201050303	Mowberg Creek	4.8	25.4	12 Moderate	0.0	100.0	Forest	4.6	4.6	0.00185
1018000201060101	Upper Illinoise Creek	7.0	20.3	11 Moderate	0.0	100.0	Forest	5.2	4.6	0.00210

10180002010601 03	Lower Illinoise Creek	10.4	2.9	9	Moderate	0.0	99.2	Forest	5.9	5.9	0.00236
10180002010601 02	Grindstone Park	12.2	0.0	13	High	0.0	100.0	Forest	8.8	8.8	0.00351
10180002010602 07	Lower Pelton Creek	10.0	0.0	10	Moderate	0.0	93.0	Forest	5.1	5.1	0.00205
10180002010602 06	Spruce Gulch	6.3	0.0	13	High	0.0	100.0	Forest	5.0	5.0	0.00201
10180002010602 01	North Pelton Creek	9.6	0.7	12	Moderate	0.0	100.0	Forest	7.9	7.6	0.00315
10180002010602 05	Middle Pelton Creek	9.9	1.6	10	Moderate	0.0	88.4	Forest	5.2	4.8	0.00207
10180002010602 04	Badger Creek	5.9	0.0	10	Moderate	0.0	99.8	Forest	4.8	4.8	0.00193
10180002010602 02	Upper Pelton Creek	11.5	10.2	12	Moderate	0.0	100.0	Forest	8.2	6.5	0.00328
10180002010602 03	Pelton Creek	11.1	7.4	12	Moderate	0.0	96.2	Forest	4.8	2.5	0.00192
10180002010603 00		1.0	0.0	7	Moderate	0.0	81.3	Forest	1.0	1.0	0.00038
10180002010701 01	Devils Gate Creek	8.9	0.0	10	Moderate	0.0	100.0	Forest	4.8	4.8	0.00191
10180002010701 04	W Fork Devils Gate Creek	8.8	0.0	11	Moderate	0.0	100.0	Forest	6.2	6.2	0.00247
10180002010701 02	W Fork Devils Gate Creek	5.1	0.0	11	Moderate	0.0	100.0	Forest	3.2	3.2	0.00126
10180002010701 03	Devils Gate Creek C	5.4	0.0	10	Moderate	0.0	100.0	Forest	4.1	4.1	0.00163
10180002010701 05	Devils Gate Creek C	1.1	0.0	3	Low	0.0	100.0	Forest	1.0	1.0	0.00039
10180002010702 05	Sheep Creek	10.3	0.0	10	Moderate	17.2	82.8	Forest	8.0	8.0	0.00321
10180002010702 04	Lower Douglas Creek	15.4	0.0	8	Moderate	35.3	64.7	Forest	6.9	6.9	0.00277
10180002010702 03	Hans Creek	5.1	0.0	11	Moderate	0.0	100.0	Forest	5.4	5.4	0.00215
10180002010702 02	Douglas Creek C	22.4	0.0	5	Low	0.0	99.7	Forest	12.4	12.4	0.00497
10180002010702 01	Anderson Creek	4.4	0.0	9	Moderate	0.0	100.0	Forest	4.5	4.5	0.00180
10180002020101 01	Upper Sagage Run Creek	15.4	0.0	4	Low	0.0	100.0	Forest	11.5	11.5	0.00461
10180002020101 02	Savage Run Trib	4.4	0.0	1	Low	0.0	100.0	Forest	6.6	6.6	0.00266
10180002020101 03	Savage Run Creek	5.4	0.0	3	Low	66.9	33.1	Shrub	4.7	4.7	0.00187
10180002020102 01	Upper Cottonwood Creek	7.1	0.0	4	Low	0.0	100.0	Forest	4.7	4.7	0.00190
10180002020102 04	N Trib Cottonwood Creek	3.6	0.0	3	Low	0.0	100.0	Forest	4.2	4.2	0.00167
10180002020102 02	Cottonwood Cr South Trib	4.2	0.0	5	Low	0.0	100.0	Forest	3.4	3.4	0.00138
10180002020102 03	Middle Cottonwood Creek	6.6	0.0	5	Low	0.0	100.0	Forest	5.9	5.9	0.00236
10180002020102 05	Lower Cottonwood Creek	5.9	1.4	9	Moderate	31.1	68.8	Forest	7.3	6.8	0.00292
10180002020103 02	North Platte C	5.3	4.5	10	Moderate	87.9	0.0	Shrub	8.9	7.8	0.00357
10180002020103 03	Boat Creek	4.3	3.5	10	Moderate	43.0	56.8	Forest	3.9	3.7	0.00158
10180002020103 04	North Platte Trib	2.7	0.0	15	High	100.0	0.0	Shrub	3.4	3.4	0.00136
10180002020103 01	Prospect Mountain	0.5	0.0	5	Low	100.0	0.0	Shrub	0.0	0.0	0.00000
10180002020104 02	Bear Gulch	1.6	0.0	6	Low	81.2	18.8	Shrub	0.2	0.2	0.00008
10180002020104 01	North Platte Trib	0.0	0.0	3	Low	100.0	0.0	Shrub	0.0	0.0	0.00000

10180002020201 03	Upper West Mullen Creek	6.2	0.0	11	Moderate	0.0	100.0	Forest	4.6	4.6	0.00185
10180002020201 02	U Middle Mullen Creek	3.8	0.0	13	High	0.0	100.0	Forest	3.7	3.7	0.00149
10180002020201 01	Upper South Mullen Creek	7.2	0.0	11	Moderate	0.0	100.0	Forest	3.1	3.1	0.00124
10180002020201 04	North Mullen Creek	24.3	0.0	11	Moderate	23.3	76.7	Forest	17.3	17.3	0.00693
10180002020202 00		22.8	0.0	7	Moderate	31.0	69.0	Forest	18.3	18.3	0.00735
10180002020203 00		0.0	0.0	0	Low	100.0	0.0	Shrub	0.0	0.0	0.00000
10180002020301 01	Upper South French Creek	18.7	0.0	7	Moderate	0.0	45.1	Alp/Subalp	16.2	16.2	0.00000
10180002020301 02	NE Trib U So French Cr	4.0	0.0	5	Low	0.0	51.5	Forest	2.9	2.9	0.00115
10180002020301 04	SW Trib U So French Cr	4.5	0.0	10	Moderate	0.0	90.5	Forest	3.4	3.4	0.00138
10180002020301 05	Silver Lake	6.8	0.0	9	Moderate	0.0	96.0	Forest	6.8	6.8	0.00273
10180002020301 03	South French Creek C	21.7	0.0	11	Moderate	0.0	100.0	Forest	11.2	11.2	0.00450
10180002020301 07	Lower South French Creek	22.6	0.0	16	High	10.6	89.0	Forest	19.2	19.2	0.00768
10180002020301 06	South French Creek Trib	5.2	0.0	12	Moderate	0.0	100.0	Forest	3.9	3.9	0.00156
10180002020302 02	French Creek	4.7	13.2	10	Moderate	64.1	22.1	Shrub	1.8	0.8	0.00073
10180002020302 01	French Creek	6.3	0.0	14	High	13.1	86.6	Forest	3.4	3.4	0.00137
10180002020303 01	Upper North French Creek	20.0	0.0	10	Moderate	0.0	90.6	Forest	12.7	12.7	0.00508
10180002020303 02	North French Creek Trib	5.7	0.0	11	Moderate	0.0	100.0	Forest	3.0	3.0	0.00120
10180002020303 03	North French Creek C	18.8	0.0	11	Moderate	7.3	92.5	Forest	6.3	6.3	0.00254
10180002020303 04	Middle French Creek	13.0	0.0	12	Moderate	0.0	100.0	Forest	12.5	12.5	0.00502
10180002020403 00		2.5	0.0	13	High	57.1	42.9	Shrub	1.9	1.9	0.00077
10180002020404 00		3.0	0.0	12	Moderate	38.9	61.1	Forest	3.0	3.0	0.00120
10180002020406 01	North Cottonwood Creek	8.1	0.0	12	Moderate	7.0	93.0	Forest	4.1	4.1	0.00163
10180002020406 02	South Cottonwood Creek	5.4	0.0	6	Low	6.9	93.1	Forest	2.4	2.4	0.00098
10180002020407 01	Corral Creek	6.6	0.0	11	Moderate	18.2	81.8	Forest	3.5	3.5	0.00139
10180002020407 02	South Fork Corral Creek	3.1	0.0	10	Moderate	42.7	57.3	Forest	2.2	2.2	0.00087
10180002030401 00		1.9	0.0	12	Moderate	100.0	0.0	Shrub	0.1	0.1	0.00002
10180002030403 06	Bench Mark 7778	0.1	0.0	4	Low	100.0	0.0	Shrub	0.0	0.0	0.00000
10180002030403 04	Spring Creek C	0.0	0.0	7	Moderate	100.0	0.0	Shrub	0.0	0.0	0.00000
10180002040101 00		12.7	0.0	11	Moderate	0.0	100.0	Forest	10.7	10.7	0.00431
10180002040102 00		30.7	5.6	12	Moderate	0.0	87.1	Forest	27.4	24.7	0.01097
10180002040103 00		12.4	3.7	10	Moderate	0.0	100.0	Forest	10.2	8.8	0.00407
10180002040104 00		6.3	0.4	15	High	0.0	100.0	Forest	7.6	7.6	0.00304
10180002040201 03	U North Brush Creek Trib	3.1	0.0	8	Moderate	0.0	100.0	Forest	1.6	1.6	0.00063
10180002040201 02	Harden Creek	7.3	9.4	9	Moderate	0.0	100.0	Forest	5.7	5.7	0.00230

1018000204020101	Upper North Brush Creek	27.9	0.0	9	Moderate	0.0	94.5	Forest	18.4	18.4	0.00736
1018000204020200		6.0	0.0	10	Moderate	0.0	100.0	Forest	5.8	5.8	0.00234
1018000204020301	Upper Fish Creek	7.2	0.0	13	High	0.0	100.0	Forest	5.5	5.5	0.00222
1018000204020302	Fish Creek Trib	5.0	0.0	13	High	0.0	100.0	Forest	3.0	3.0	0.00121
1018000204020303	Fish Creek C	1.0	0.0	13	High	0.0	100.0	Forest	1.2	1.2	0.00047
1018000204020400		34.3	19.1	10	Moderate	0.0	100.0	Forest	13.1	7.4	0.00523
1018000204020501	Mullison Creek	8.3	0.0	12	Moderate	0.0	100.0	Forest	6.8	6.8	0.00273
1018000204020502	Lincoln Creek	8.5	1.5	15	High	0.0	100.0	Forest	8.0	8.0	0.00319
1018000204020503	Mullison/Lincoln C	0.9	0.1	7	Moderate	0.0	100.0	Forest	1.1	1.1	0.00044
1018000204030105	Uilein Creek	1.4	0.0	6	Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018000204030101	Stump Hollow	1.8	10.4	12	Moderate	0.0	100.0	Forest	1.7	1.7	0.00070
1018000204030102	Brush Creek C	0.2	100.0	2	Low	0.0	100.0	Forest	0.4	0.0	0.00000
1018000204030103	Jim Draw	2.6	0.0	11	Moderate	0.0	100.0	Forest	1.8	1.8	0.00071
1018000204030104	Little Beaver	0.4	0.0	7	Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
1018000204030203	Barret Creek	8.5	16.5	6	Low	12.2	87.8	Forest	6.9	6.9	0.00275
1018000204030202	Ryan Park	9.9	4.9	12	Moderate	5.0	95.0	Forest	6.7	5.6	0.00267
1018000204030201	Upper Barret Creek	11.7	2.3	6	Low	2.7	97.3	Forest	4.6	4.6	0.00184
1018000204030300		2.2	0.0	5	Low	0.0	100.0	Forest	1.3	1.3	0.00052
1018000206030101	Iron Creek	22.1	8.6	10	Moderate	0.6	99.1	Forest	13.1	8.7	0.00523
1018000206030102	Bitter Creek	2.6	0.0	5	Low	0.0	100.0	Forest	2.1	2.1	0.00085
1018000206030206	Troublesome Creek	6.1	0.0	8	Moderate	0.0	88.4	Forest	5.0	5.0	0.00199
1018000206030201	Middle Cedar Creek	5.8	0.0	11	Moderate	0.0	89.4	Forest	5.1	5.1	0.00202
1018000206030203	Sage Brush Park	6.3	0.0	11	Moderate	1.7	98.3	Forest	3.8	3.8	0.00150
1018000206030202	Red Park	5.4	0.0	10	Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
1018000206030204	South Cedar Creek C	1.2	0.0	14	High	55.9	44.1	Shrub	0.8	0.8	0.00031
1018000206030205	South Cedar Creek	3.4	0.0	14	High	0.0	100.0	Forest	3.1	3.1	0.00126
1018000206050103	Deer Creek	5.3	0.0	4	Low	16.3	83.7	Forest	4.1	4.1	0.00165
1018000206050101	South Fork Lake Creek	7.7	0.0	4	Low	23.8	76.2	Forest	5.7	5.7	0.00228
1018000206050102	Goetze Creek	5.1	0.0	5	Low	57.8	42.2	Shrub	5.1	5.1	0.00204
1018000206050205	Lemoine Creek	0.1	0.0	3	Low	0.0	0.0		0.0	0.0	0.00000
1018000206050201	North Fork Dry Creek	1.3	0.3	8	Moderate	92.6	7.4	Shrub	0.1	0.1	0.00003
1018000206050203	South Fork Dry Creek	2.1	0.0	5	Low	28.7	71.3	Forest	0.8	0.8	0.00031
1018000206050202	Headquarters Creek	1.4	0.0	3	Low	45.5	54.5	Forest	1.0	1.0	0.00039
1018000206060000		0.7	0.0	14	High	46.6	53.4	Forest	0.5	0.5	0.00021

10180002110101 03	Upper Pass Creek C	7.5	0.0	18	High	0.0	68.3	Forest	4.3	4.3	0.00172
10180002110101 05	Kennaday Peak North	5.2	0.0	8	Moderate	0.0	98.4	Forest	6.0	6.0	0.00241
10180002110101 04	Kennaday Peak South	4.1	0.0	3	Low	0.0	89.8	Forest	0.0	0.0	0.00000
10180002110101 01	Upper Pass Creek	7.0	0.0	9	Moderate	0.0	98.0	Forest	4.7	4.7	0.00188
10180002110101 02	Upper Pass Creek Trib	4.5	0.0	11	Moderate	0.0	99.8	Forest	3.2	3.2	0.00130
10180002110102 00		14.6	6.4	8	Moderate	3.2	74.6	Forest	6.8	6.8	0.00273
10180002110103 00		10.5	0.5	9	Moderate	2.6	60.6	Forest	3.2	3.2	0.00128
10180002110104 00		10.7	0.0	8	Moderate	0.0	90.0	Forest	9.1	9.1	0.00365
10180002110105 03	Rankin Creek C	3.1	0.4	5	Low	0.0	66.1	Forest	0.0	0.0	0.00000
10180002110105 02	North Rankin Creek	6.1	0.1	4	Low	0.0	98.9	Forest	0.0	0.0	0.00000
10180002110105 01	Upper Rankin Creek	7.7	0.0	9	Moderate	0.0	89.6	Forest	4.4	4.4	0.00175
10180002110106 00		2.9	0.4	11	Moderate	3.1	96.9	Forest	1.2	1.2	0.00046
10180002110203 00		8.0	0.1	11	Moderate	0.0	100.0	Forest	3.8	3.8	0.00152
10180002110204 00		3.6	32.3	3	Low	5.1	57.0	Forest	0.2	0.1	0.00008
10180002110300 00		5.4	12.9	3	Low	15.5	84.4	Forest	1.7	1.7	0.00069
10180004010101 06	Lower Medicine Bow Rvr	25.1	3.9	8	Moderate	0.0	100.0	Forest	22.5	21.3	0.00902
10180004010101 05	Johnson Park	8.1	0.0	9	Moderate	0.0	91.2	Forest	6.7	6.7	0.00267
10180004010101 04	Pine Butte	9.3	0.0	13	High	0.0	59.6	Forest	10.8	10.8	0.00433
10180004010101 03	Deep Lake	19.7	0.0	6	Low	0.0	62.0	Forest	18.1	18.1	0.00725
10180004010101 02	Upper Medicine Bow Rvr	6.7	0.0	2	Low	0.0	11.5	Alp/Subalp	14.1	14.1	0.00000
10180004010101 01	Quealy Lake	9.1	0.0	3	Low	0.0	17.8	Alp/Subalp	9.4	9.4	0.00000
10180004010102 02	Turpin Creek	24.3	8.4	9	Moderate	0.0	96.9	Forest	13.5	12.1	0.00543
10180004010102 01	Upper Turpin Creek	12.5	5.0	10	Moderate	0.0	94.9	Forest	14.4	12.7	0.00578
10180004010103 00		0.8	0.0	5	Low	0.0	100.0	Forest	0.0	0.0	0.00000
10180004010201 00		7.6	3.6	12	Moderate	0.0	100.0	Forest	5.3	4.7	0.00214
10180004010202 00		8.5	4.1	9	Moderate	0.0	100.0	Forest	3.8	3.1	0.00153
10180004010203 00		6.7	34.5	9	Moderate	0.0	100.0	Forest	6.3	4.6	0.00251
10180004010204 00		10.3	2.3	9	Moderate	0.0	100.0	Forest	3.9	3.9	0.00158
10180004010205 00		2.0	0.0	6	Low	0.0	100.0	Forest	2.7	2.7	0.00109
10180004010206 00		5.2	0.0	8	Moderate	0.0	100.0	Forest	2.4	2.4	0.00098
10180004010601 00		16.5	2.8	10	Moderate	3.5	96.5	Forest	5.6	5.6	0.00226
10180004010602 00		12.4	1.4	9	Moderate	12.0	88.0	Forest	5.4	5.4	0.00216
10180004010603 00		0.0	0.0	7	Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
10180004010605 00		0.6	0.0	3	Low	100.0	0.0	Shrub	0.0	0.0	0.00000

1018000401090100		5.6	0.0	10 Moderate	38.8	61.2	Forest	3.1	3.1	0.00124
1018000402010103	Rock Creek C	2.6	0.0	3 Low	0.0	100.0	Forest	1.7	1.7	0.00066
1018000402010101	Upper Rock Creek	12.3	0.0	9 Moderate	0.0	96.7	Forest	5.2	5.2	0.00207
1018000402010102	South Fork Rock Creek	8.5	0.0	7 Moderate	0.0	49.9	Alp/Subalp	8.2	8.2	0.00000
1018000402010200		11.9	0.0	7 Moderate	0.0	83.8	Forest	8.4	8.4	0.00336
1018000402010303	Middle Rock Creek	7.8	0.0	5 Low	0.0	100.0	Forest	3.8	3.8	0.00154
1018000402010301	Fire Box Lake	9.4	0.0	4 Low	0.0	100.0	Forest	3.5	3.5	0.00138
1018000402010302	Middle Fork Rock Creek	4.9	0.0	8 Moderate	0.0	100.0	Forest	4.9	4.9	0.00198
1018000402010400		21.8	0.0	9 Moderate	0.0	92.9	Forest	11.9	11.9	0.00477
1018000402010500		20.3	0.0	5 Low	0.0	96.0	Forest	14.7	14.7	0.00588
1018000402010600		17.5	0.0	4 Low	0.0	99.9	Forest	8.1	8.1	0.00326
1018000402010700		18.7	1.7	10 Moderate	0.0	100.0	Forest	8.7	8.7	0.00348
1018000402010800		5.7	0.0	4 Low	0.0	91.9	Forest	3.0	3.0	0.00121
1018000402010900		18.9	0.0	9 Moderate	7.3	78.4	Forest	11.8	11.8	0.00472
1018000402040000		11.0	0.0	9 Moderate	0.0	100.0	Forest	3.5	3.5	0.00141
1018001002010100		6.8	0.0	5 Low	25.5	74.5	Forest	6.6	6.6	0.00266
1018001002010200		6.9	0.0	12 Moderate	3.1	96.9	Forest	6.2	6.2	0.00250
1018001002010400		14.5	0.6	11 Moderate	0.4	99.6	Forest	11.9	11.8	0.00475
1018001002010500		4.9	0.0	12 Moderate	19.0	81.0	Forest	5.7	5.7	0.00227
1018001002010600		5.8	0.8	5 Low	37.3	62.7	Forest	0.0	0.0	0.00000
1018001002010700		9.1	0.0	10 Moderate	14.2	85.8	Forest	6.5	6.5	0.00261
1018001002010800		14.8	0.0	12 Moderate	29.3	70.7	Forest	10.7	10.7	0.00430
1018001002020000		2.1	8.8	6 Low	37.9	62.0	Forest	0.0	0.0	0.00000
1018001002030000		44.8	5.3	10 Moderate	4.7	95.3	Forest	25.8	24.3	0.01033
1018001002040102	Fence Creek	9.7	0.0	5 Low	26.5	73.5	Forest	9.4	9.4	0.00377
1018001002040101	Lake Owen	23.0	5.4	8 Moderate	34.6	62.9	Forest	14.8	12.4	0.00591
1018001002040203	Squaw Creek	9.2	0.0	11 Moderate	49.5	50.5	Forest	9.0	9.0	0.00361
1018001002040202	Squaw Creek	23.3	0.1	11 Moderate	0.1	99.9	Forest	14.9	14.9	0.00597
1018001002040201	Fox Creek	25.2	3.4	10 Moderate	1.7	98.3	Forest	18.5	17.4	0.00740
1018001002050000		0.2	0.0	3 Low	100.0	0.0	Shrub	0.0	0.0	0.00000
1018001004020101	Chokecherry Creek	9.2	32.2	4 Low	91.0	9.0	Shrub	0.0	0.0	0.00000
1018001004020102	Johns Creek	9.0	51.2	5 Low	53.4	46.6	Shrub	12.0	4.3	0.00000
1018001004020103	Table Mountain	6.1	16.3	6 Low	37.0	63.0	Forest	5.2	3.3	0.00210
1018001004020200		25.2	15.6	7 Moderate	33.5	65.8	Forest	5.0	2.0	0.00200

1018001006010100		15.2	0.0	8	Moderate	0.0	100.0	Forest	11.8	11.8	0.00473
1018001006010200		9.4	0.0	10	Moderate	0.0	92.9	Forest	4.8	4.8	0.00194
1018001006010300		18.5	1.2	8	Moderate	0.0	100.0	Forest	9.1	9.1	0.00363
1018001006010400		5.5	0.0	2	Low	0.0	100.0	Forest	4.6	4.6	0.00183
1018001006010500		9.2	0.0	4	Low	0.0	100.0	Forest	6.3	6.3	0.00251
1018001006010600		12.5	0.4	6	Low	0.0	100.0	Forest	5.7	5.6	0.00229
1018001006010700		8.1	0.0	8	Moderate	0.0	100.0	Forest	3.8	3.8	0.00152
1018001006010800		3.3	41.1	1	Low	28.9	71.1	Forest	2.2	1.2	0.00088
1018001006010900		8.3	20.7	2	Low	13.6	86.4	Forest	4.8	3.6	0.00191
1018001006020104	S Fork Little Laramie Rvr	5.8	0.6	9	Moderate	0.0	100.0	Forest	1.9	1.7	0.00076
1018001006020105	trib S Fk L Laramie Rvr	0.2	0.0	3	Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018001006020101	U So Fk L Laramie Rvr	8.7	0.0	13	High	0.0	100.0	Forest	4.7	4.7	0.00189
1018001006020102	S Fk L Laramie Rvr Trib	4.6	0.0	11	Moderate	0.0	100.0	Forest	0.0	0.0	0.00000
1018001006020103	Albany	5.5	6.0	8	Moderate	0.0	100.0	Forest	2.7	1.7	0.00107
1018001006020200		9.1	7.2	4	Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018001006020302	North Trib Hecht Creek	5.7	0.0	1	Low	0.0	100.0	Forest	3.2	3.2	0.00128
1018001006020303	Lower Hecht Creek	1.0	39.6	3	Low	10.2	89.8	Forest	0.0	0.0	0.00000
1018001006020301	Upper Hecht Creek	4.1	1.2	3	Low	0.0	100.0	Forest	3.4	3.1	0.00134
1018001006020402	N Br Trib L Laramie Rvr	3.5	0.0	6	Low	0.0	100.0	Forest	2.5	2.5	0.00100
1018001006020401	S Br Trib L Laramie Rvr	6.6	0.0	6	Low	0.0	99.5	Forest	4.6	4.6	0.00184
1018001006030102	North Twin Lakes	10.8	0.0	8	Moderate	0.0	88.2	Forest	6.0	6.0	0.00240
1018001006030101	U No Fork L Laramie Rvr	7.9	0.0	4	Low	0.0	70.7	Forest	6.6	6.6	0.00264
1018001006030104	E Tr U No Fk L Laramie R	6.0	0.0	11	Moderate	0.0	100.0	Forest	4.0	4.0	0.00162
1018001006030105	Upper Nash Creek	5.8	0.0	12	Moderate	0.0	64.8	Forest	7.5	7.5	0.00300
1018001006030103	N Fork Little Laramie C	13.6	0.0	11	Moderate	0.0	100.0	Forest	5.6	5.6	0.00223
1018001006030106	Telephone Creek	5.6	0.0	9	Moderate	0.0	25.0	Alp/Subalp	11.0	11.0	0.00000
1018001006030107	Nash Creek	11.1	0.0	11	Moderate	0.0	100.0	Forest	9.8	9.8	0.00392
1018001006030108	N Fork Little Laramie Rvr	3.0	0.0	10	Moderate	3.8	96.2	Forest	1.9	1.9	0.00077
1018001006030201	Libby Lake	10.7	0.0	8	Moderate	0.0	7.0	Alp/Subalp	14.5	14.5	0.00000
1018001006030203	Libby Creek	10.1	0.0	10	Moderate	0.0	98.7	Forest	9.2	9.2	0.00369
1018001006030202	Upper Libby Creek	4.9	0.0	3	Low	0.0	21.3	Alp/Subalp	0.0	0.0	0.00000
1018001006030206	Libby Creek C	2.3	0.0	15	High	0.0	100.0	Forest	2.3	2.3	0.00093
1018001006030204	Silver Run Creek	8.1	0.0	3	Low	0.0	99.1	Forest	6.7	6.7	0.00267
1018001006030205	Gold Run Creek	12.5	0.0	9	Moderate	0.0	100.0	Forest	6.4	6.4	0.00256

1018001006030300		0.6	0.0	6	Low	1.8	94.5	Forest	0.0	0.0	0.00000
1018001006030400		10.9	2.9	13	High	1.6	91.7	Forest	4.3	4.3	0.00171
1018001006030500		1.1	0.8	3	Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018001006040100		6.8	36.4	4	Low	35.5	64.2	Forest	0.0	0.0	0.00000
1018001006040200		5.8	0.0	11	Moderate	28.0	72.0	Forest	3.6	3.6	0.00142
1018001006040300		0.3	0.0	4	Low	100.0	0.0	Shrub	0.0	0.0	0.00000
1018001006050000		2.5	22.7	4	Low	73.1	26.9	Shrub	0.0	0.0	0.00000
1018001006060000		1.9	0.0	3	Low	3.6	96.4	Forest	0.2	0.2	0.00008
1018001006060102	Middle Fork Mill Creek	9.3	0.0	8	Moderate	0.0	94.6	Forest	2.7	2.7	0.00110
1018001006060101	South Fork Mill Creek	9.9	0.0	8	Moderate	5.9	94.1	Forest	4.5	4.5	0.00181
1018001006060200		3.2	0.0	8	Moderate	0.0	100.0	Forest	1.9	1.9	0.00075
1018001007020000		10.4	0.0	9	Moderate	0.0	100.0	Forest	4.2	4.2	0.00170
1018001007030000		11.0	0.1	6	Low	0.0	100.0	Forest	2.4	2.4	0.00096
1018001008010102	North Fork Cooper Creek	2.4	12.0	11	Moderate	9.4	90.6	Forest	2.4	2.2	0.00095
1018001008010101	Upper Cooper Creek	11.5	0.0	12	Moderate	0.0	100.0	Forest	7.7	7.7	0.00309
1018001008010200		0.3	0.0	2	Low	0.0	100.0	Forest	0.0	0.0	0.00000
1018001008030103	Dutton Creek C	0.2	14.8	3	Low	63.9	36.1	Shrub	0.0	0.0	0.00000
1018001008030101	West Fork Dutton Creek	5.8	0.0	3	Low	0.0	100.0	Forest	1.1	1.1	0.00045
1018001008030102	East Fork Dutton Creek	4.2	1.0	3	Low	0.0	100.0	Forest	0.3	0.3	0.00012

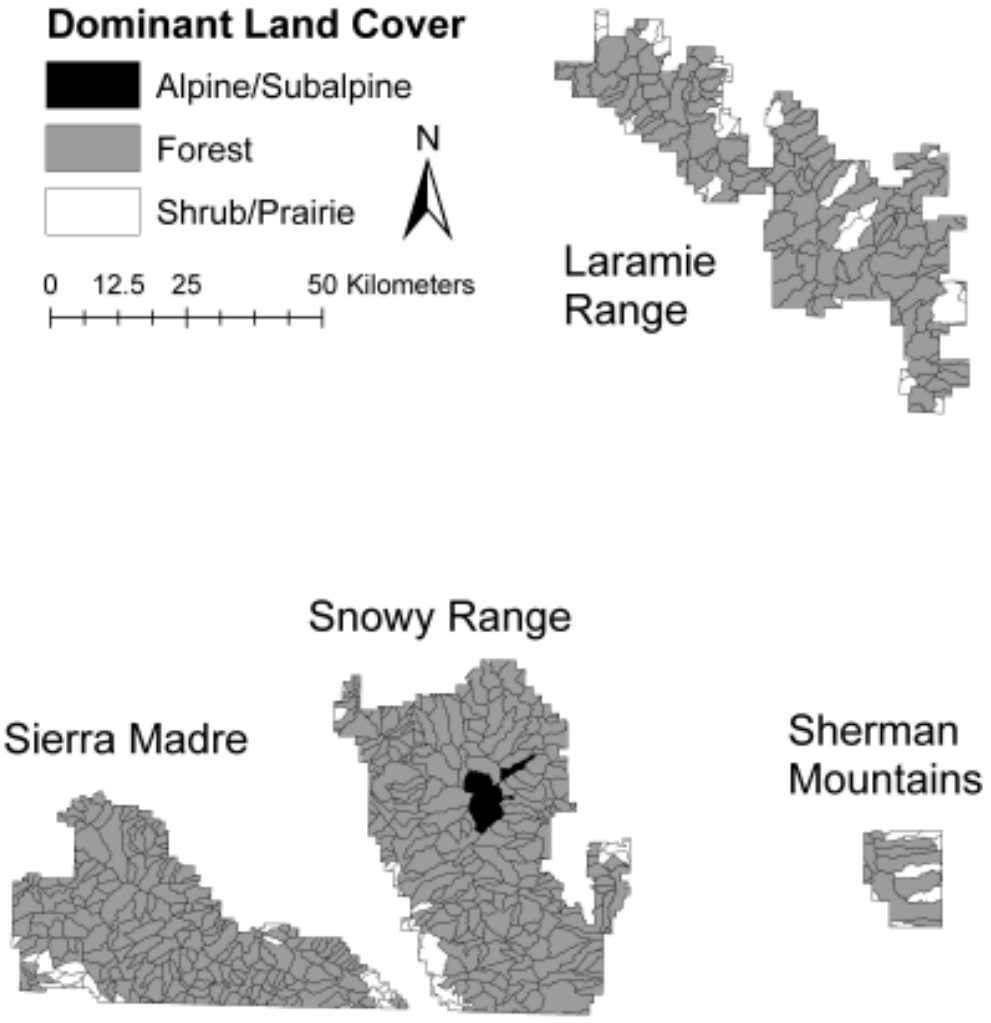

Figure 1. Dominant land cover of 8th level Hydrologic Unit Code (HUC) watersheds, Medicine Bow National Forest, Wyoming. Seven watersheds dominated (>50%) by alpine or subalpine land cover were excluded from the sampling frame for MIS monitoring.

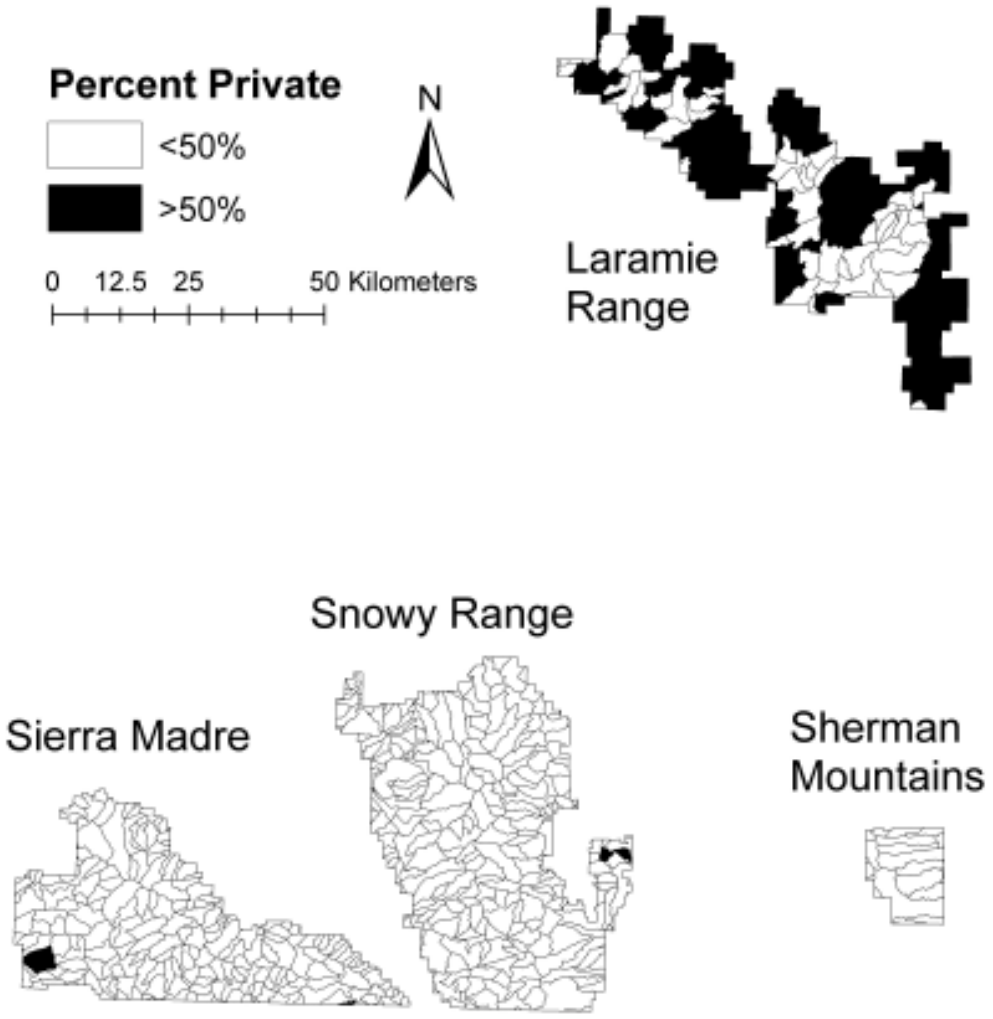

Figure 2. Percent private land of 8th level Hydrologic Unit Code (HUC) watersheds, Medicine Bow National Forest, Wyoming. Watersheds dominated (>50%) by private land were excluded from the sampling frame for MIS monitoring.

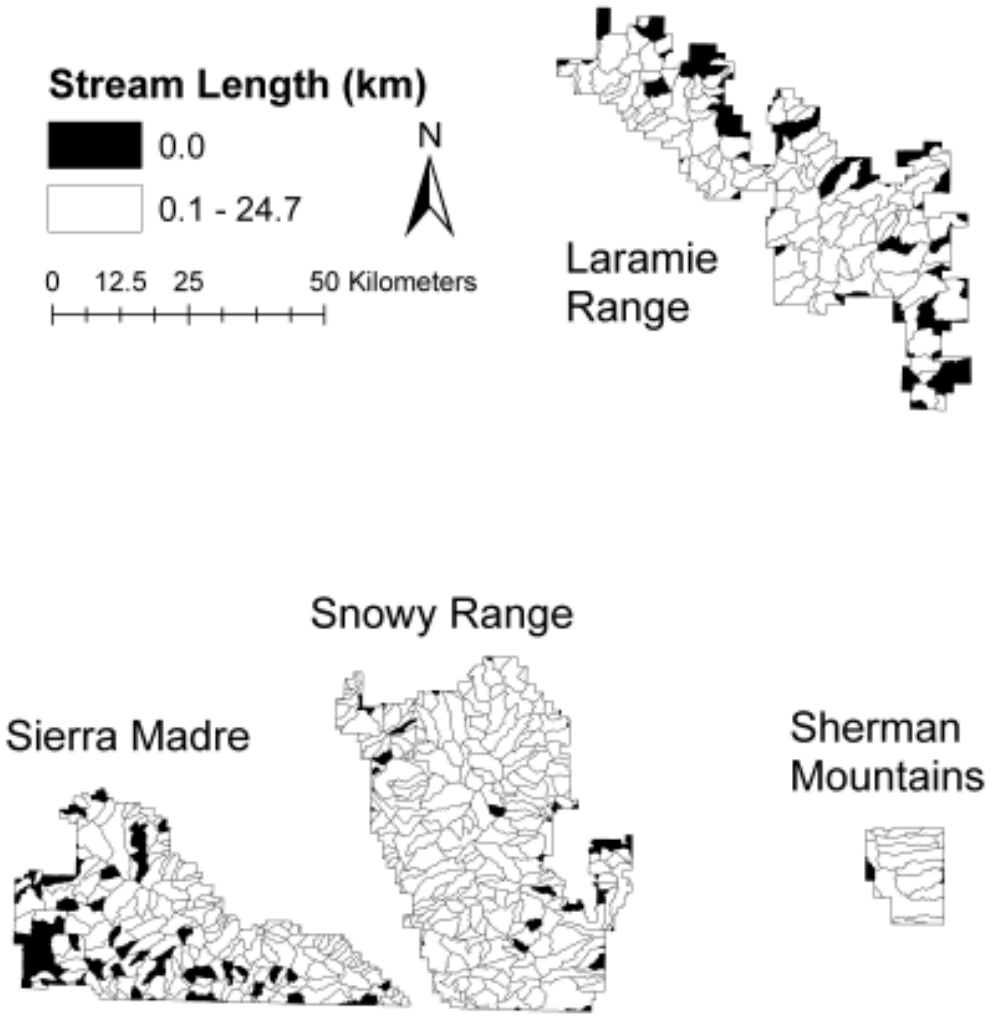

Figure 3. 8th level Hydrologic Unit Code (HUC) watersheds on the Medicine Bow National Forest, Wyoming that have no streams on Forest land. Watersheds with no streams on Forest land were excluded from the sampling frame for MIS monitoring.

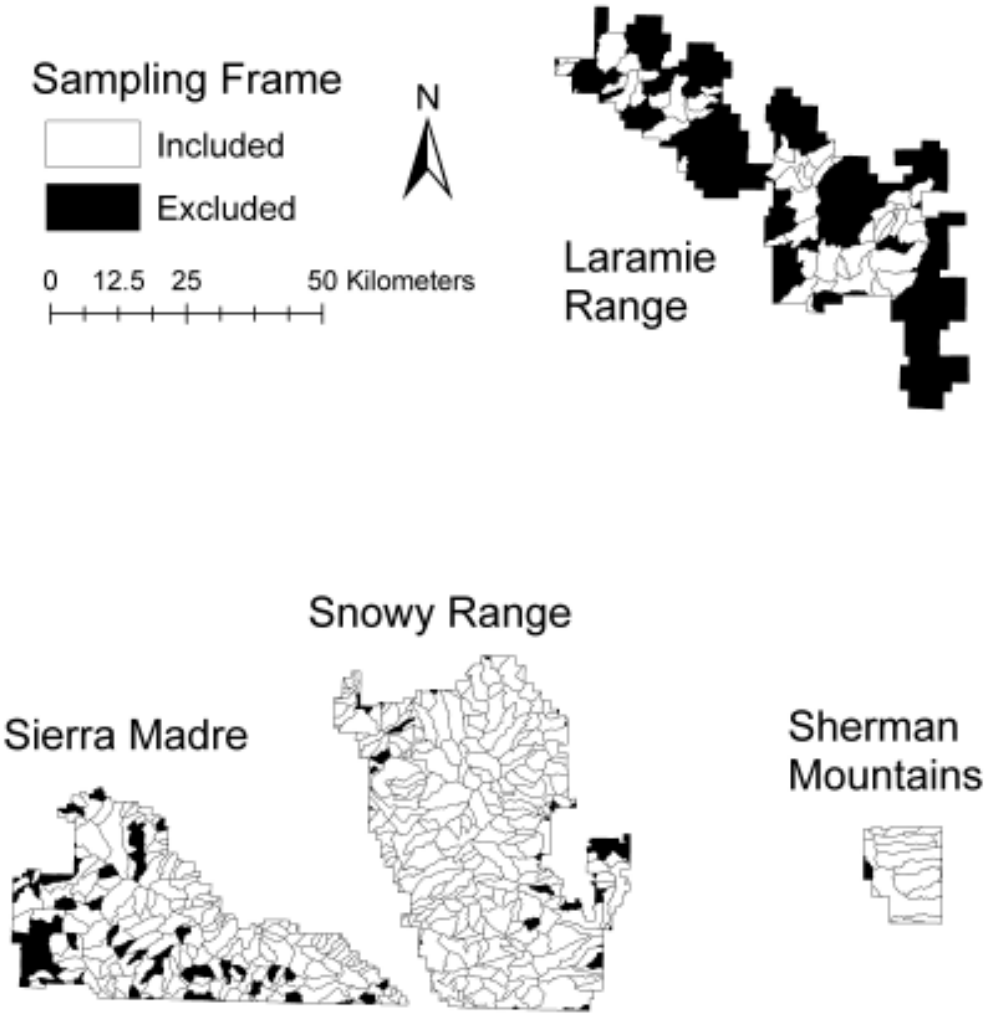

Figure 4. The sampling frame of 8th level Hydrologic Unit Code (HUC) watersheds, Medicine Bow National Forest, Wyoming. Watersheds excluded from the sampling frame (Excluded) were either dominated (>50%) by alpine/subalpine land cover or private land, or had no blue-line streams at the 1:100,000 map scale on Forest land.

Appendix A. Development of an index of watershed risk, and the effects of watershed risk and land cover on trout standing stock, Medicine Bow National Forest, Wyoming.

Many of the management activities on the Medicine Bow National Forest can potentially impact aquatic ecosystems, and the magnitude of impacts can be determined by general land cover because the characteristics of streams differ among land cover types. Roads built to facilitate activities such as logging, grazing or recreation can adversely affect physical properties of streams by routing sediment into streams and changing hydrology (USFS 2003b). Changes in the physical properties of streams can impact aquatic habitats, and trout populations are good indicators of aquatic habitat conditions. The types and density of roads and the erosibility of soils within a watershed should be related to risk that aquatic ecosystems could be damaged by forest management activities. Here, we develop an index of watershed risk based on road and soil characteristics, and then determine the relationships between watershed risk and land cover metrics and trout standing stock on the Medicine Bow National Forest.

Roads Analysis for the Medicine Bow National Forest

Methods—Watershed risk associated with roads and soil characteristics was determined for the Medicine Bow National Forest. Risk was determined by using the same approach used for the Roads Analysis Report completed by the Forest (USFS 2003b). The Report combined information on road densities, road crossings on streams, and soil sensitivity in 6^{th} level HUC watersheds in an index used to classify watershed risk due to forest

management. The watershed risk index consisted of five metrics: watershed road density, class 1 and 2 road density in the watershed, 61-m buffer road density in the watershed, 61-m buffer class 1 and 2 road density in the watershed, and watershed road crossing density. Those metrics were incorporated into an index of overall risk. In addition to risk from roads, mass wasting potential and soil erosion risk were used as supplemental information; percent watershed as high mass wasting potential and percent watershed as high erosion risk were the respective metrics.

The seven road and soil risk metrics included in the original watershed risk index were evaluated again as measures of watershed risk due to roads and soil erosibility on the Forest. In addition to the original seven metrics, we evaluated other candidate risk metrics: road density on high erosion risk soils, 61-m buffer road density on high erosion risk soils, and road crossing density on high erosion risk soils. Although original metrics were applied to 6th level watersheds in the Roads Analysis Report (USFS 2003b), we evaluated each metric for 8th level watersheds on the Medicine Bow National Forest because trout populations sampled in a stream reach would better reflect management activities within a smaller watershed area.

Metric values were computed using spatial data and a geographic information system (GIS). Road density, class 1 and 2 road density, and road crossing density were calculated for each 8th level watershed. The GIS coverage for 8th level watersheds (watersheds) was obtained from the Forest ftp site in July 2006 (ftp://ftp2.fs.fed.us/incoming/r2/mbr): 8th level watershed boundaries were defined in the coverage. A GIS coverage for Forest roads (roads_mb) was also obtained from the Forest ftp site; roads were classified using the OPER_MAINT field. Road densities were

determined by intersecting the roads and watershed GIS coverages, summing the length of roads in each watershed, and dividing by watershed area. Densities of class 1 and 2 roads were computed by querying class 1 and 2 roads from the roads GIS coverage, intersecting the roads and watershed GIS coverages, summing the length of class 1 and 2 roads in each watershed, and dividing by watershed area. Densities of road crossings were determined by intersecting road and stream coverages. A GIS coverage of streams at a scale of 1:100,000 was obtained from the Wyoming Geographic Information Science Center (WYGISC) website. This streams layer is the same scale and resolution as that used in the original Roads Analysis Report (USFS 2003b), and matches medium resolution data from the National Hydrography Dataset (NHD). High resolution NHD data were not available for the entire spatial extent of the Medicine Bow National Forest at the time of analysis (August 8, 2006). Road crossing points were then intersected with the watershed GIS coverage. Numbers of crossings per watershed were determined, and counts were divided by watershed area to determine densities. All analyses were done using ArcGIS version 9.1 (ESRI, Redlands, California), and coverages were projected as Universe Transverse Mercator (UTM) Zone 13, North American Datum (NAD) 27.

Road densities in a 61-m stream buffer were calculated using roads and streams GIS coverages. The roads GIS coverage was the same as that used to calculate the watershed road densities above. Road densities within a 61-m buffer were determined by buffering the streams GIS coverage, intersecting the buffer and watershed GIS coverages, intersecting the buffer and roads coverages, recalculating road segment lengths, summing road length by watershed, and then dividing by buffer area within each watershed. Buffer

densities of class 1 and 2 roads were determined in the same manner as for all roads, but using only roads of class 1 and 2.

Percent of watershed as sensitive soils was also determined. A soils GIS coverage (sri_mb) was obtained from the Forest ftp site. Prior to analyses, a revised soils coverage was obtained from Derrick Milner (Soil Scientist, Medicine Bow National Forest). Derrick had reclassified the EROSION field for the Snowy Range and Sierra Madre forest areas. The revised coverage contained only soil units from the Sierra Madre and Snowy Range forest areas, and was merged with the Laramie Range and Sherman Mountains areas from the original coverage (sri_mb). The 'MWASTE' field was reclassified by classifying all soil units with 100% hydric soils (HYDRIC_P field) as "L" (low) mass wasting potential. All other soil units with hydric soils present were evaluated for reclassification, and any linear soil units along streams and representing riparian areas were reclassified as "M" (moderate). The reclassified soils GIS coverage was used to determine the percentage of a watershed having very high mass wasting potential using coverage field 'MWASTE' and records classified as 'V.' The soils coverage was queried for all 'V' records in the 'MWASTE' field, and then intersected with the watershed coverage. Areas of intersected polygons were recalculated, areas were summed by watershed, and then divided by watershed area. Percentage of each watershed having severe erosion potential was also calculated. The modified soils coverage was queried for all 'severe' records in the 'EROSION' field, and then intersected with the watershed coverage. Areas of intersected polygons were recalculated, areas were summed by watershed, and then divided by watershed area. The

relationship between percent high mass wasting potential and percent high erosion potential was evaluated.

Because the effects of roads on sediment yield might be highest for roads built on highly erosible soils, we also determined road density, road density in 61-m stream buffers, and stream crossing density for that portion of each watershed having high erosion risk soils.

Metric redundancy was determined using correlation analysis. Pearson's correlations were run between all pairwise comparisons of candidate watershed risk metrics. Metrics were considered correlated and therefore redundant if $r > 0.5$.

Results—There are 687 8th level watersheds on the Forest, and 7238.6 km of roads; 5436.6 km are class 1 and 2 roads (75.1%). We evaluated 10 candidate metrics for use in defining watershed risk due to roads and soils for the Medicine Bow National Forest. A scatter plot of percent watershed as high erosion risk soils versus percent watershed as high mass wasting potential soils revealed no relationship (Figure A1). Because of questions regarding the validity of the classification category termed "mass wasting risk" (Derrick Milner, Medicine Bow National Forest, personal communication), we decided not to incorporate that metric into watershed risk due to soils – only percent watershed as high erosion risk was used.

Only two watershed risk metrics were highly correlated (Table A1); road density and class 1 and 2 road density metrics had a high correlation of $r = 0.957$. Therefore, all metrics considering only class 1 and 2 roads were removed from consideration. Distributions of data for all remaining metrics were left-skewed, except for percent

watershed high erosion risk soils (Figure A2). Many watersheds had no roads, no roads in stream buffers, or no road crossings on high erosion risk soils.

Metric rankings—Each watershed was ranked according to its value for each risk metric. Each metric was given a risk rank of: none, low, moderate, high, or extreme based on categories in Table A2. Category thresholds from the Roads Analysis Report were used if possible (Appendix F in USFS 2003b).

Metric risk rankings exhibited a variety of distributions (Figure A3). Metrics emphasizing roads on high erosion soils exhibited little variation in risk, with most watersheds having no or low risk. However, many watersheds had over 50% high erosion risk soils and thus fell into the high risk category for that metric. Few watersheds had any road crossings on high erosion risk soils, so that metric did not add any information on watershed risk and was removed from consideration. Six metrics were retained as indicators of watershed risk: road density, 61-m buffer road density, road crossing density, road density on high erosion risk soils, 61-m buffer road density on high erosion risk soils, and percent watershed as high erosion risk soils.

Watershed risk rating—The six risk metrics retained from the pool of candidate metrics were combined into an overall index of watershed risk. Metric rankings were given numeric values of: none = 0, low = 1, moderate = 2, high = 3, extreme = 4. Numeric values of metrics were summed for an overall watershed risk index score. These overall scores were used to create the following watershed risk ratings: 0 = none, 1-6 = low, 7-12 = moderate, 13-18 = high, and 19-24 = extreme.

There were no watersheds in the no risk category. Most watersheds were in the moderate risk category, and only one watershed was in the extreme risk category (Figure A4). All Forest areas had watersheds with low risk, and the one watershed with extreme risk was the Arrowhead Creek watershed (HUC: 101800803010103) in the Laramie Range area (Figure A4).

Trout standing stock versus land cover and risk—We compared trout standing stock between forested and shrub-prairie land cover and among watershed risk scores. Land cover information was acquired from the Medicine Bow National Forest, and generalized into alpine/subalpine, forested, and shrub/prairie land cover types. Watershed risk was defined as above. Trout standing stock data came from the Wyoming Game and Fish Department (WGFD) fisheries database. We determined the 8^{th} level watershed that each sampling site was located in, and assigned the land cover class and watershed risk of that watershed to that site. If multiple sites were sampled in an 8^{th} level watershed, only data from the site with the lowest elevation were used. If multiple samples were taken at that site, data from the most recent sample were used. Analysis of covariance (ANCOVA) was used to determine differences in trout standing stock (kg/ha) by land cover and watershed risk scores. Standing stock was the response variable, and it was $\log_e$-transformed ($\log_e[X + 1]$) for analysis. Land cover was the class variable and overall watershed risk score was the covariate. Analysis was conducted using PROC MIXED, SAS Version 9.1 (SAS Institute Inc., Cary, North Carolina). A Kenward-Roger degrees of freedom approximation was used if variances were unequal. Type I error rate was $\alpha = 0.05$.

There were no differences in trout standing stock between land cover classes, nor was there an effect of watershed risk on trout standing stock. In all, 270 sites in the WGF database were unique to one of the 867 8th level watersheds and used for analysis. Standing stock of all trout ranged from 0 to 973.54 kg/ha and averaged 15.6 kg/ha (SD = 8.5). There was no difference between land cover types ($F_{1,266} = 0.02$; $P = 0.893$), no influence of watershed risk ($F_{1,266} = 0.04$; $P = 0.834$), and no interaction ($F_{1,266} = 0.07$; $P = 0.792$; Figure A5).

Table A1. Pairwise Pearson's correlations (*r*) between watershed risk metrics for 8th level watersheds on the Medicine Bow National Forest, Wyoming. n = 687 for all correlations.

	Class 1 and 2 Road Density	Buffer Road Density	Buffer Class 1 and 2 Road Density	Road Crossing Density	Road Density High Erosion Soils	Buffer Road Density High Erosion Soils	Road Crossing Density High Erosion Soils	% Watershed High Erosion Soils
Road Density	0.957	0.243	0.203	0.258	0.232	-0.004	0.010	-0.093
Class 1 and 2 Road Density		0.210	0.210	0.238	0.236	-0.005	-0.008	-0.065
Buffer Road Density			0.935	0.454	0.093	0.220	0.055	0.020
Buffer Class 1 and 2 Road Density				0.384	0.104	0.186	0.046	0.010
Road Crossing Density					-0.002	0.113	0.031	0.050
Road Density High Erosion Soils						0.267	0.255	-0.075
Buffer Road Density High Erosion Soils							0.350	-0.025
Road Crossing Density High Erosion Soils								-0.054

Table A2. Risk categories for various watershed risk metrics for the Medicine Bow National Forest, Wyoming. Categories are based on information presented in USFS (2003b).

		Risk				
Metric	Units	None	Low	Moderate	High	Extreme
All road density	mi / mi^2 (km / km^2)	0 (0)	0-1 (0-0.62)	1-3 (0.62-1.86)	3-5 (1.86-3.11)	5+ (3.11+)
All road density high risk soils	mi / mi^2 (km / km^2)	0 (0)	0-1 (0-0.62)	1-3 (0.62-1.86)	3-5 (1.86-3.11)	5+ (3.11+)
All road density, 200-ft buffer	mi / mi^2 (km / km^2)	0 (0)	0-0.2 (0-0.12)	0.2-0.6 (0.12-0.37)	0.6-0.9 (0.37-0.56)	0.9+ (0.56+)
All road density high risk soils, 200-ft buffer	mi / mi^2 (km / km^2)	0 (0)	0-0.2 (0-0.12)	0.2-0.6 (0.12-0.37)	0.6-0.9 (0.37-0.56)	0.9+ (0.56+)
Road crossing density	no. / mi^2 (no. / km^2)	0 (0)	0-1 (0-0.39)	1-2 (0.39-0.77)	2-3 (0.77-1.16)	3+ (1.16+)
Road crossing density high risk soils	no. / mi^2 (no. / km^2)	0 (0)	0-1 (0-0.39)	1-2 (0.39-0.77)	2-3 (0.77-1.16)	3+ (1.16+)
Sensitive soils	%	0 (0)	1-20	20-50	50-100	

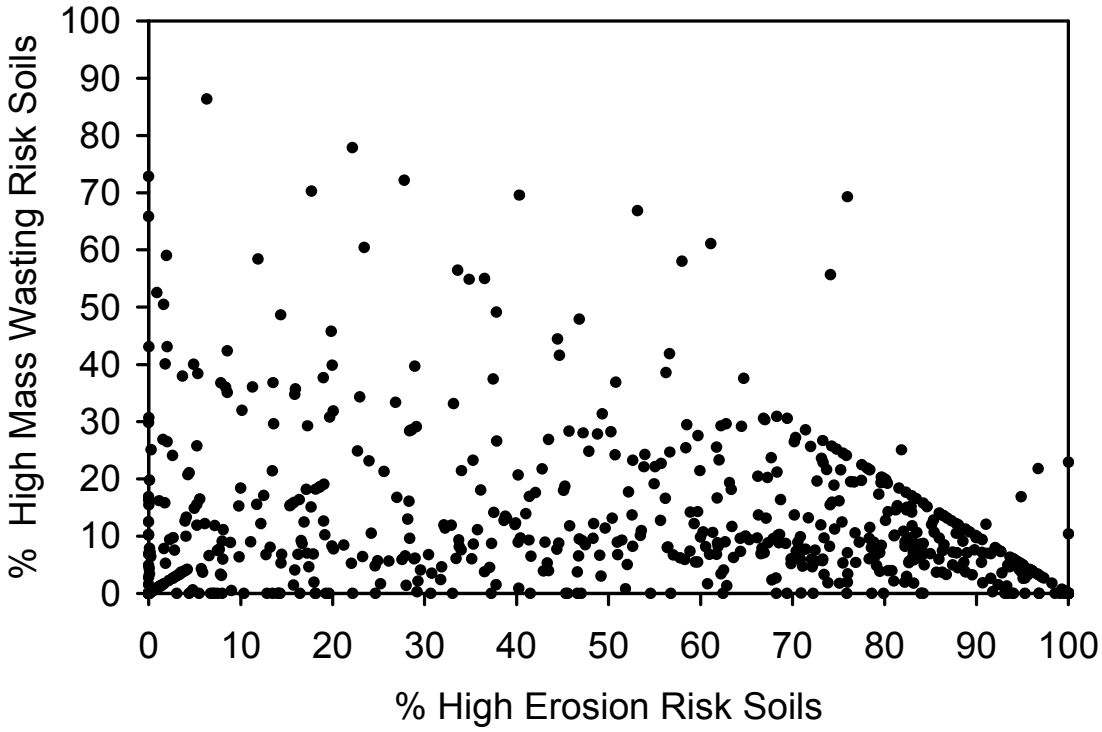

Figure A1. Percent watershed as high erosion risk soils versus percent watershed as high mass wasting risk soils, Medicine Bow National Forest, Wyoming. n = 687 8th level watersheds. Watersheds on the 1:1 line indicate watersheds where soil units were always classified as both high erosion risk and high mass wasting potential. Watersheds where soil units were never classified as both high erosion risk and high mass wasting potential fall on the -1:1 line.

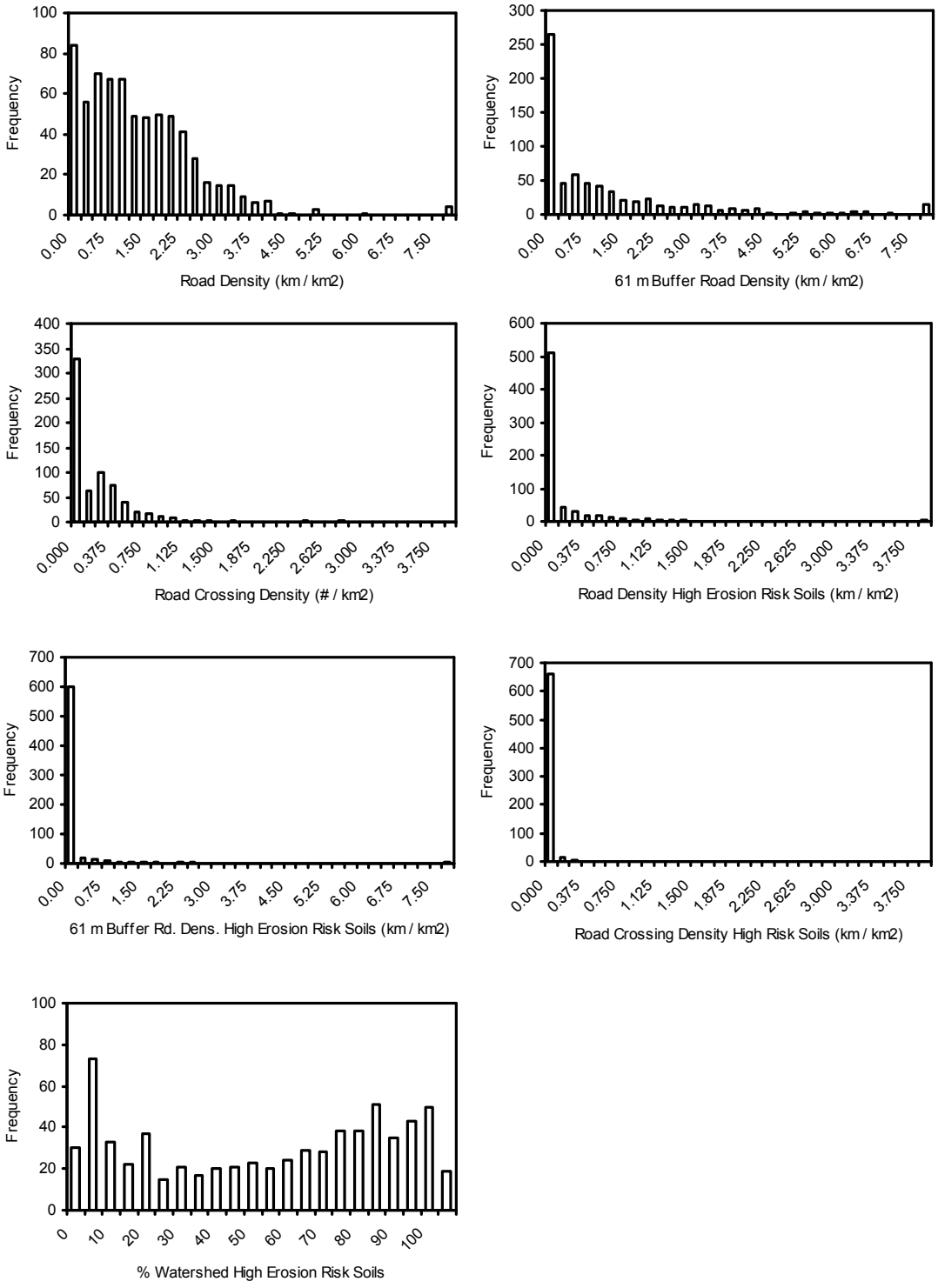

Figure A2. Histograms of watershed risk metrics, Medicine Bow National Forest, Wyoming. n = 687 8th level watersheds.

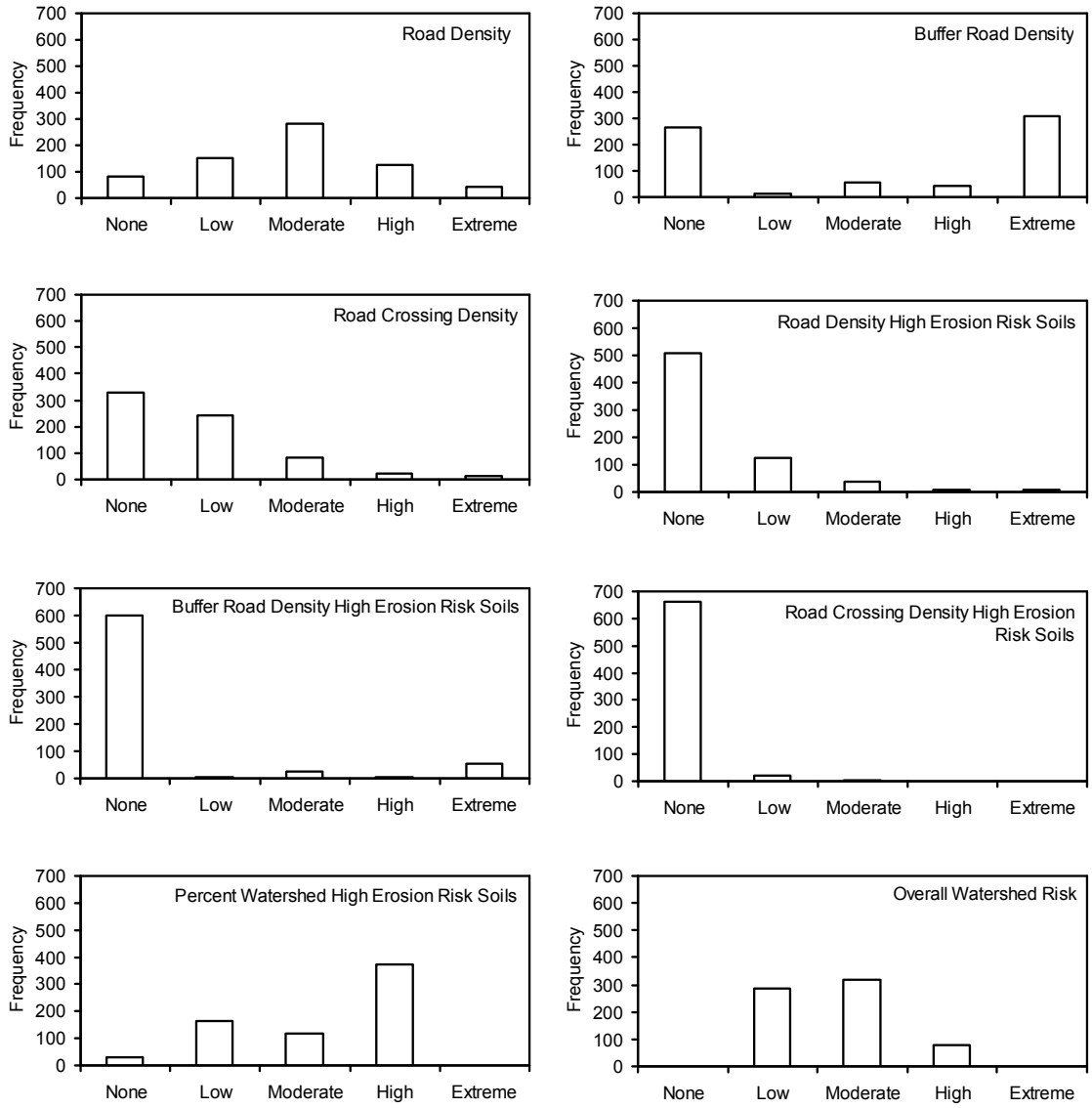

Figure A3. Watershed risk frequency for road density, road density in a 61-m stream buffer, road crossing density, road density in high erosion risk soils, road crossing density in high erosion risk soils, and percent watershed as high erosion risk soils, Medicine Bow National Forest, Wyoming. n = 687 8th level watersheds.

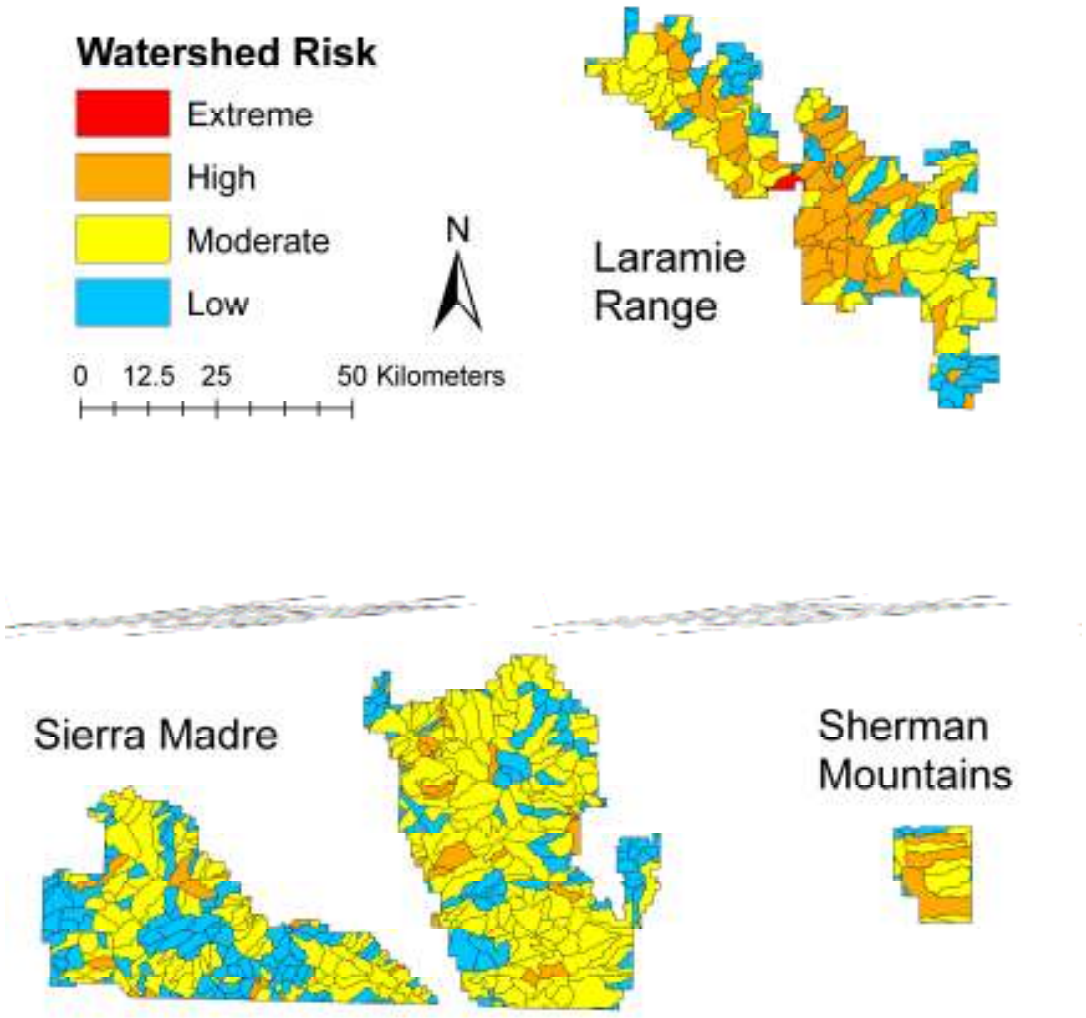

Figure A4. Spatial distribution of watershed risk due to roads and soils on Medicine Bow National Forest, Wyoming.

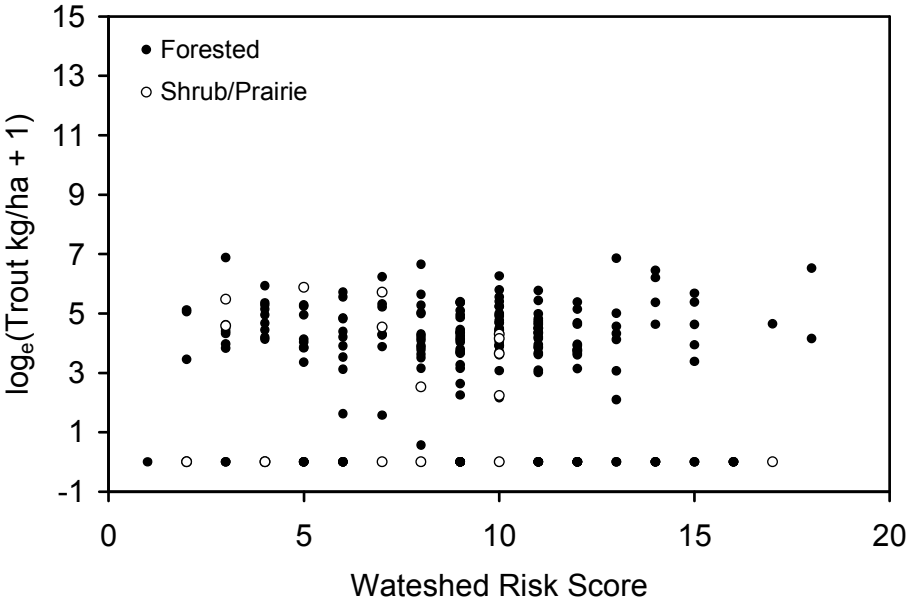

Figure A5. Trout standing stock (kg/ha) by watershed risk score and land cover type. n = 270 watersheds.

Appendix B. Evaluation of potential sampling designs for the Medicine Bow National Forest, Wyoming.

Several sampling designs exist for monitoring trout populations on the Medicine Bow National Forest, Wyoming. There are two designs that represent opposite ends of the design spectrum; revisit the same sites every monitoring period, or sample a new set of sites each period. Intermediate designs, where some or all sites are revisited but not during every monitoring period, are referred to as rotating panel or serially alternating designs (Urquhart et al. 1998; Urquhart and Kincaid 1999).

Four designs were evaluated for their statistical power to detect changes in trout standing stock (kg/ha) on the Medicine Bow National Forest, and all four designs specified revisiting sites over time. Designs were evaluated by using a simulation analysis based on the structure of each design. Level 8 Hydrologic Unit Code watersheds were the sample units, and the measurement protocol involved sampling trout from a stream site near the downstream extent of each watershed. Fiscal and logistical constraints imposed by the Forest limited the designs that could be evaluated for use. One constraint involved the number of sites that could be sampled during a monitoring year with 20 and 30 sites evaluated as the minimum and maximum number that would be sampled. The second constraint was that aquatic MIS sampling would be conducted every other year. Based on those constraints, four sampling designs were evaluated for monitoring aquatic MIS on the Forest that incorporated the power of paired sampling to detect changes in fish populations (Quist et al. 2006; Gerow 2007). Design 1 was termed *Always Revisit* and involved sampling the same 30 sites each monitoring period (every two years). Design 2 was termed *Augmented Serially Alternating with 20 sites sampled*

every period and involved sampling 1 panel of 20 sites each monitoring period (every two years), and alternating between 2 panels of 10 sites every other monitoring period so that each panel was resampled every four years. Design 3 was termed *Augmented Serially Alternating with 10 sites sampled every period* and involved sampling 1 panel of 10 sites each sampling period and alternating between 2 panels of 20 sites every other sampling period so that each panel was resampled every four years. Design 4 was termed *Serially Alternating* and involved alternating between 2 panels of 30 sites every other monitoring period (every four years). The same four designs were also evaluated with the constraint that only 20 sites could be sampled in a year. The numbers of sites included in each panel per design are specified in Figures B1 and B2 for 20 and 30 sites sampled per monitoring period, respectively. Each design was evaluated for its ability to detect declines in trout standing stock, with statistical power being the measure of design efficiency (see below). Although trends in biomass (standing stock) of all trout were evaluated, variation in biomass and abundance are similar so results of design efficiency are applicable to detecting trends in abundance also (D. Dauwalter, University of Wyoming, unpublished data).

All four designs were evaluated for power to detect declines in trout standing stock (kg/ha) by using simulation analysis and trout data collected from the Medicine Bow National Forest. The simulation analysis to determine statistical power followed the procedure outlined by Gibbs (2000):

1. Define structure of monitoring program (number of sites, frequency of monitoring, duration of monitoring).

2. Simulate initial abundance for each site from defined spatial distribution of abundance
3. Project trend onto initial abundance per site for duration of monitoring
4. Abundance for each monitoring period at a site is a random deviate, with mean equal to projected abundance estimate and variance defined from a measure of temporal variation
5. The trend in abundance is estimated for each site using linear regression
6. The mean and variance of trends among sites is calculated
7. A statistical test is used to determine whether the mean trend (i.e. slope of the regression line) is significantly different from zero
8. Repeat steps 1 through 7 many times, and the proportion of repititions in which the mean trend differs significantly different from zero is determined. This proportion represents the statistical power to detect change (ranges from 0 to 1), and indicates how often the monitoring program correctly detects ongoing trends in abundance.

To apply this process to the four monitoring designs being evaluated, we had to define the spatial and temporal variability to be simulated, and use that data within the structure of each design to determine if trends could be detected. First, mean standing stock per site was generated from a log-normal distribution (mean = 79.3, SD = 2.88); the distribution was defined using trout data for the Medicine Bow National Forest in the Wyoming Game and Fish Department fisheries database. Temporal variation was also randomly selected for each site based on a log-normal distribution of coefficients of variation of trout standing stock over time (mean = 54.5, SD = 2.11). This distribution

was defined from a summarization of literature reporting time-series data on trout standing stock (e.g., Platts and Nelson 1988). Then, standing stock was simulated for each time period (up to 30 years) for each site by first applying a time trend to the initial standing stock per site (1, 2.5, or 5% annual declines), and then adding random variation using the distribution of temporal variation. After data were simulated for each time period for each site, $\log_e$-standing stock was regressed on year to estimate trends in standing stock over time for individual sites. A one-sample t-test was used to determine if the average trend among all sites was less than zero, employing a one-tailed test at three type I error rates ($\alpha = 0.05$, 0.10, or 0.20); a finite population correction was applied to the variance of trends prior to statistical testing. This process was repeated 1,000 times, and statistical power was computed as the proportion of times that the known trends were detected. In essence, we were asking if we could detect a decline in trout standing stock (mean of regression coefficients significantly less than zero) for a known percentage decline in the face of simulated year to year random variation in trout biomass. Power was evaluated for each design using time trends of 1, 2.5, and 5% annual declines, type I error rates of 0.05, 0.10 and 0.20, and after 6, 10, 20, and 30 years of monitoring. Simulation analyses were conducted using SAS, version 9.1 statistical software (SAS Institute, Inc, Cary, North Carolina).

All four designs showed similar statistical power to detect declines in trout standing stock over time. The always revisit design typically had the highest power to detect change after six years of monitoring, but only slightly more so than the other designs (Figures B3, B4). There was more power to detect larger annual declines in standing stock, and more power after more years of monitoring. Consider for example

the ability to detect a decline at $\alpha = 0.05$ and $n = 30$ sites (the left column of simulations in Figure B4). The length of time required to detect a known decline with high power (≥ 0.80) was greater than 30 years for a 1% annual decline, less than 20 years for a 2.5% annual decline, and only 10 years for a 5% annual decline.

An always revisit design will be implemented for monitoring trout on the Medicine Bow National Forest. This design has the highest statistical power to detect change, and it will be the easiest to implement and the most likely to be followed throughout the entirety of the monitoring program because the same sites are revisited every monitoring period. Using the revisit design, the power to detect a forest-wide decline in trout standing stock increases when more sites are monitored, monitoring occurs over a longer time period, and standing stock declines at a higher rate (Figure B5).

		Time Period (years)							
Panel	No. Sites	0	2	4	6	8	10	…	30
Design 1 = Always Revisit									
1	20	X	X	X	X	X	X	…	X
Design 2 = Augmented Serially Alternating									
1	15	X	X	X	X	X	X	…	X
2	5	X		X		X		…	
3	5		X		X		X	…	X
Design 3 = Augmented Serially Alternating									
1	10	X	X	X	X	X	X	…	X
2	10	X		X		X		…	
3	10		X		X		X	…	X
Design 4 = Serially Alternating									
1	20	X		X		X		…	
2	20		X		X		X	…	X

Figure B1. Four sampling designs for monitoring trout as aquatic management indicator species on the Medicine Bow National Forest, Wyoming. The assumption is that 20 sites could be monitored during a year, and monitoring would occur every other year. X's indicate the time period when sites in each panel would be sampled.

		Time Period (years)							
Panel	No. Sites	0	2	4	6	8	10	…	30
Design 1 = Always Revisit									
1	30	X	X	X	X	X	X	…	X
Design 2 = Augmented Serially Alternating									
1	20	X	X	X	X	X	X	…	X
2	10	X		X		X		…	
3	10		X		X		X	…	X
Design 3 = Augmented Serially Alternating									
1	10	X	X	X	X	X	X	…	X
2	20	X		X		X		…	
3	20		X		X		X	…	X
Design 4 = Serially Alternating									
1	30	X		X		X		…	
2	30		X		X		X	…	X

Figure B2. Four sampling designs for monitoring trout as aquatic management indicator species on the Medicine Bow National Forest, Wyoming. The assumption is that 30 sites could be monitored during a year, and monitoring would occur every other year. X's indicate the time period when sites in each panel would be sampled.

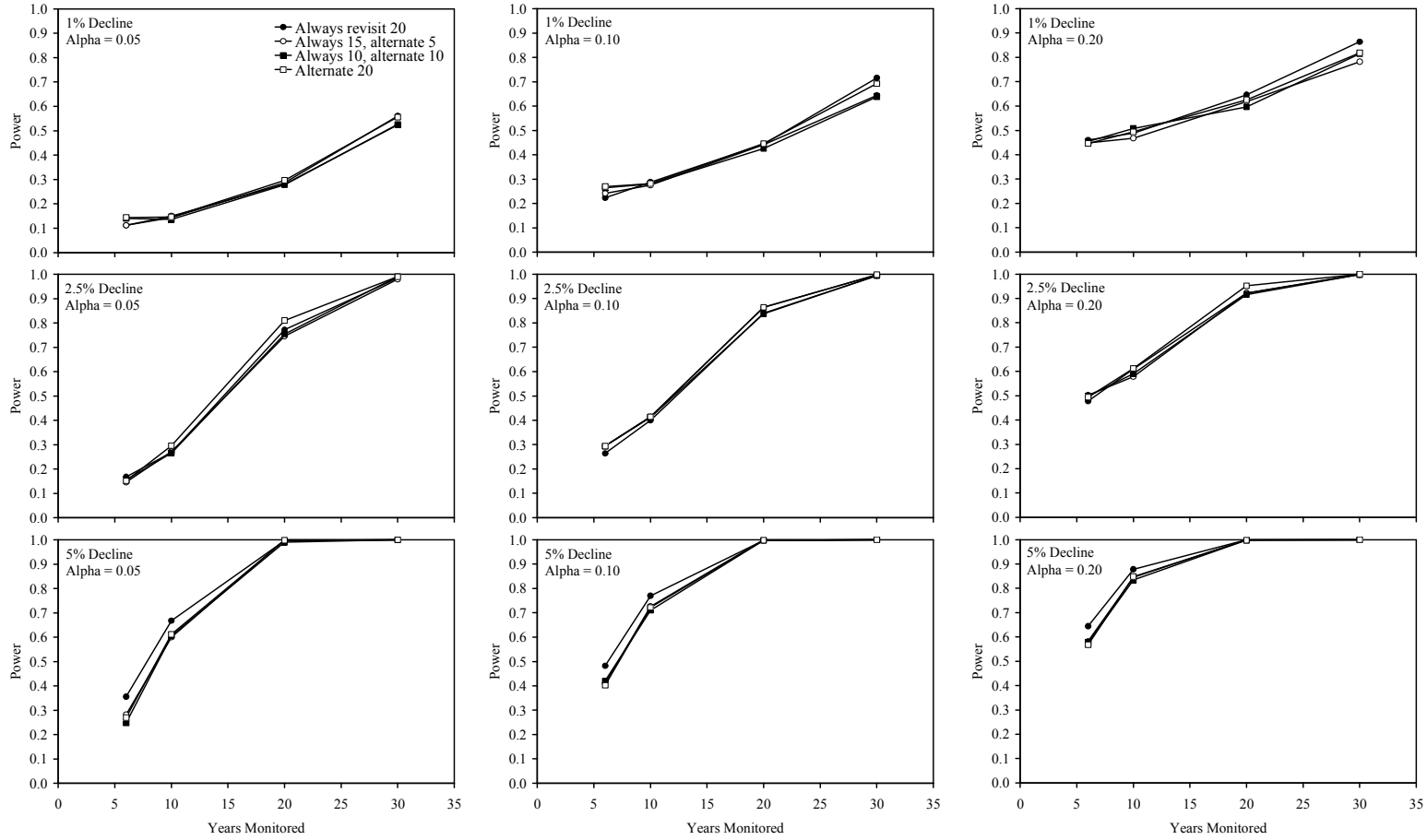

Figure B3. Statistical power (n = 1,000) to detect 1, 2.5 and 5% annual declines in trout standing stock at alpha = 0.05, 0.10, and 0.20 under four different monitoring designs, Medicine Bow National Forest, Wyoming. Sampling was limited to 20 sites per year where monitoring would occur every other year. The four designs were: always revisit the same 20 sites each monitoring period; always revisit 15 sites each period, and alternate 2 panels of 5 sites; always revisit 10 sites, and alternate 2 panels of 10 sites; alternate 2 panels of 20 sites every period.

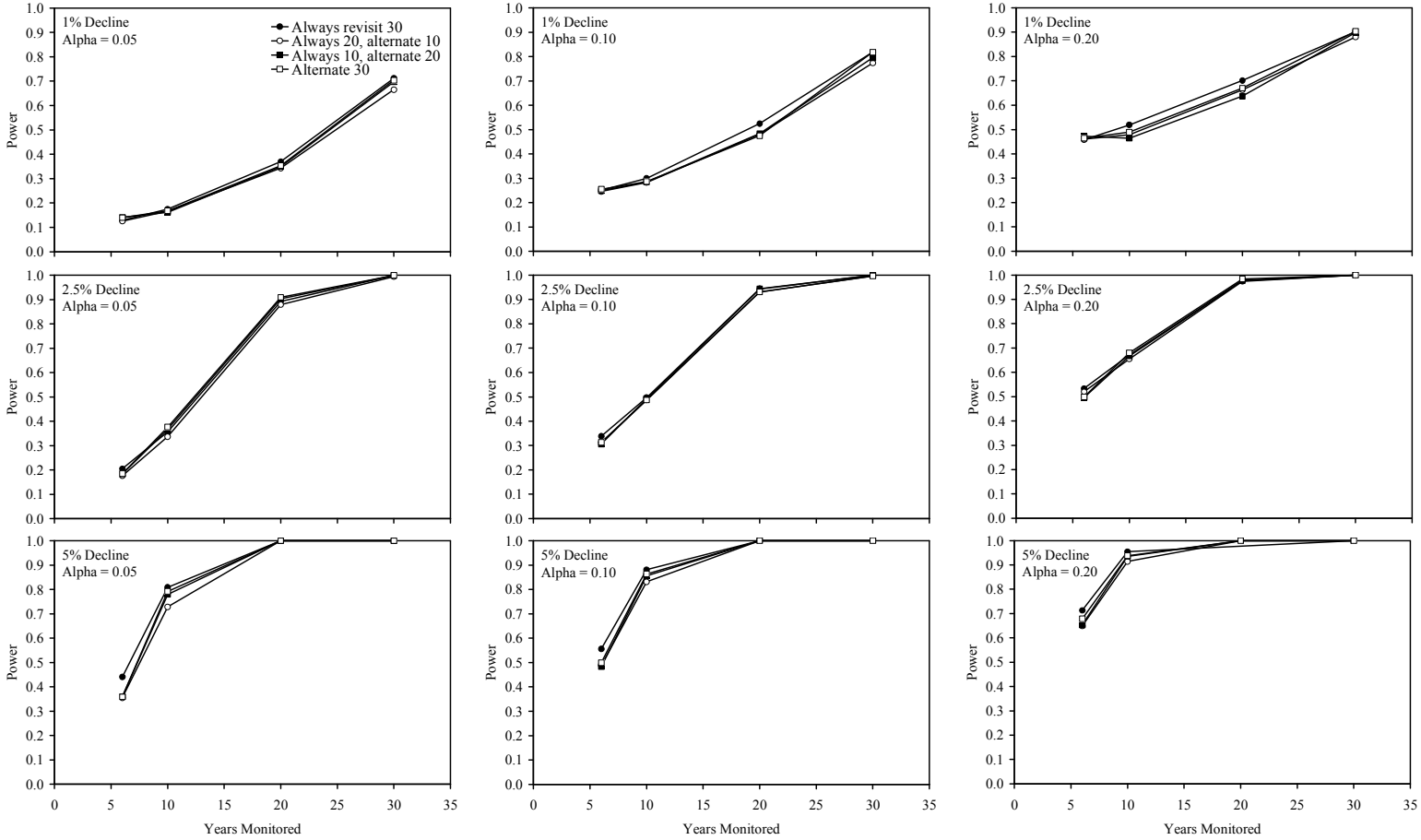

Figure B4. Statistical power (n = 1,000) to detect 1, 2.5 and 5% annual declines in trout standing stock at alpha = 0.05, 0.10, and 0.20 under four monitoring designs. Sampling was limited to 30 sites per year where monitoring would occur every other year. The four designs were: always revisit the same 30 sites each monitoring period; always revisit 20 sites each period, and alternate 2 panels of 10 sites; always revisit 10 sites, and alternate 2 panels of 20 sites; alternate 2 panels of 30 sites every period.

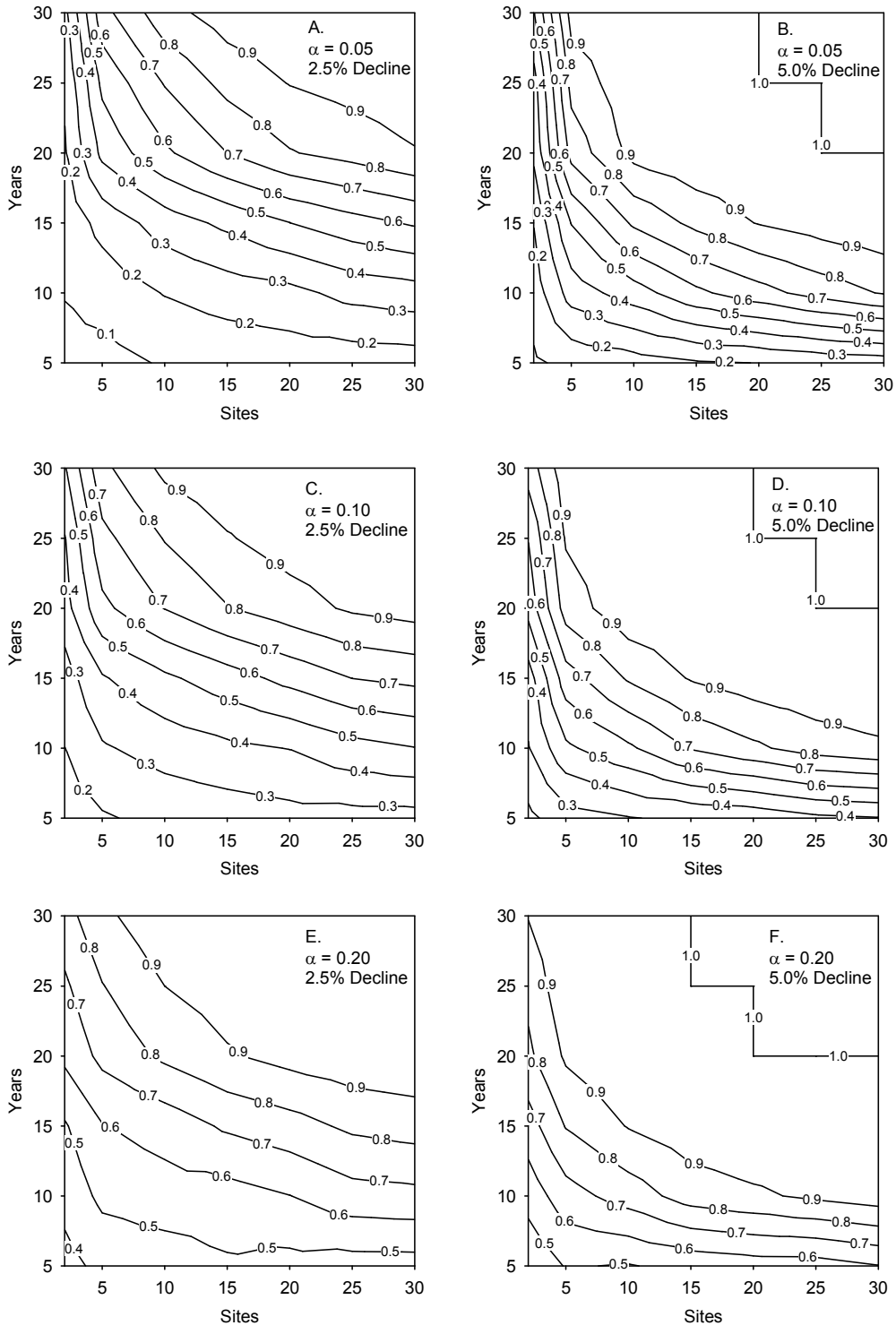

Figure B5. Isopleths of simulated power (1 – β) to detect 2.5% and 5% annual declines in trout biomass using an always revisit design when the number of sites and number of years monitored were varied. Type I error rates evaluated were: α = 0.05, 0.10, and 0.20.

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