APPENDIX C - BIOLOGICAL EVALUATION – AQUATIC SPECIES

Biological Evaluation
For
Monument EIS
Malheur National Forest
Prairie City Ranger District

Aquatic Species Analysis

Malheur National Forest
Prairie City Ranger District

Prepared By _____ 2/24/2004
Alan Miller Date
Fisheries Biologist

Approved By _____ 2/25/04
Brooks Smith Date
District Ranger

Summary of Effects Determinations

Alternative	**Watershed**	**Redband Trout** *Oncorhynchus mykiss*	**Malheur Mottled Sculpin** *Cottus bendirei*	**Columbia Spotted Frog** *Rana luteiventris*	**Bull Trout** *Salvelinus confluentus*	**Proposed Critical Habitat – Bull Trout**
Alternative 1	Little Malheur	MIIH	MIIH	NI	NE	NAM
	Upper North Fork Malheur	NI	NI	NI	NE	NAM
Alternative 2	Little Malheur	MIIH/BI	MIIH/BI	MIIH	NE	NAM
	Upper North Fork Malheur	NI	NI	NI	NE	NAM
Alternative 3	Little Malheur	MIIH/BI	MIIH/BI	NI	NE	NAM
	Upper North Fork Malheur	NI	NI	NI	NE	NAM
Alternative 4	Little Malheur	MIIH/BI	MIIH/BI	NI	NE	NAM
	Upper North Fork Malheur	NI	NI	NI	NE	NAM
Alternative 5	Little Malheur	MIIH/BI	MIIH/BI	NI	NE	NAM
	Upper North Fork Malheur	NI	NI	NI	NE	NAM

Notes: MIIH = may impact individuals or habitat, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species; NI = no impact; NE = no effect; LAA = likely to adversely affect; NLAA = not likely to adversely affect: BI = Beneficial Impact; NAM = No Adverse Modification

I. Introduction

This Biological Evaluation (BE) satisfies requirements of Forest Service Manual 2672.4 requiring the Forest Service to review all its planned, funded, executed or permitted programs and activities for possible effects on proposed, endangered, threatened or sensitive species. The BE process is intended to review the Monument Fire Recovery project in sufficient detail to determine effects of alternatives on species in this evaluation and ensure proposed management actions would not:

likely jeopardize the continued existence, or cause adverse modification of habitat, for a species that is proposed (P) or listed as endangered (E) or threatened (T) by the USDI Fish and Wildlife Service or NOAA National Marine Fisheries Service; or

contribute to the loss of viability for species listed as sensitive (S) by USDA Forest Service, Region 6, or any native or desired, non-native species; nor cause any species to move toward federal listing (FSM 2672.4).

II. Proposed Action and Alternatives Considered

See Chapter 2 in the Final Environmental Impact Statement for description of the Monument Fire Recovery Project.

III. Effects On Aquatic Species

A. Prefield Review

The following sources were used during the prefield review phase to determine the presence or absence of PETS species in the Monument Fire Recovery project area:

1. Malheur N.F. GIS database
2. Regional Forester's (R6) sensitive animal list (1989, updated 11/15/2000)
3. ODFW stream survey and fish survey reports
4. Forest Service stream survey reports, Prairie City Ranger District, Prairie City, OR
5. Oregon Natural Heritage Program (ORNHP) database.
6. Natural Heritage Conservation database (Biosource)
7. Malheur Bull Trout Working Group annual reports
8. Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan: Malheur Recovery Unit

The analysis area encompasses all aquatic habitats that have the potential for effects from the Monument Fire Recovery project. Based on a preliminary effects analysis the analysis area includes all streams in the project area and the Little Malheur River downstream of the project area to its confluence with the N.F. Malheur River. In the Upper North Fork Malheur River Watershed, the analysis area includes Spring Creek to its confluence with the N.F. Malheur River.

There are three fish species with special management status in the project area (Table 1). Redband trout (*Oncorhynchus mykiss*) are a Malheur National Forest management indicator species (MIS) and a Region-6 sensitive species. Bull trout (*Salvelinus confluentus*) are a Malheur National Forest management indicator species and are listed as threatened under the

Endangered Species Act. The Malheur mottled sculpin (*Cottus bendirei*) and the Columbia spotted frog (*Rana luteiventris*) are Region 6 sensitive species and are present in the project area. There are no aquatic species in the project area that are listed by the state of Oregon as threatened or endangered.

Table 1. Aquatic species with special management status present or suspected to be in the project area.

Aquatic Species	Management Status	Stream	Distribution	Habitat
Redband trout *Oncorhynchus mykiss*	MIS, R6S	Little Malheur R.	P	P
		Camp Creek	P	P
		Hunter Creek	P	P
		Spring Creek	NP	NP
Bull trout *Salvelinus confluentus*	MIS, ESA-T	Little Malheur R.	NP-H[1]	PCH
		Camp Creek	NP	NP
		Hunter Creek	NP	NP
		Spring Creek	NP	NP
Malheur mottled sculpin Cottus bendirei[2]	R6S	Little Malheur R.	S	P
		Camp Creek	S	P
		Hunter Creek	NP	NP
		Spring Creek	S	P
Columbia spotted frog *Rana luteiventris*	R6S	Little Malheur R.	P	P
		Camp Creek	P	P
		Hunter Creek	P	P
		Spring Creek	P	P

NOTES: Management Status: MIS = Forest Plan management indicator species, R6S = Region 6 sensitive species, ESA-T = Threatened. Distribution: P=present, NP=not present, H=historical occurrence, S=suspected. Habitat: P=present, NP=not present, PCH=proposed critical habitat. 1) Fluvial adult bull trout are seasonally present in the lower mile of the Little Malheur River during the spring and may also be present during fall and winter months. 2) The Malheur mottled sculpin is listed as Cottus bardi on the Region 6 sensitive species list.

B. Region 6 Sensitive Aquatic Species

Redband Trout (Oncorhynchus mykiss)

Redband trout are a Region 6 sensitive species and a Malheur National Forest management indicator species. Redband trout with resident and fluvial life histories occur in the Little Malheur River and Upper North Fork Malheur River watersheds.

The upper Malheur Basin historically supported abundant populations of both resident redband and anadromous steelhead trout. It wasn't until the construction of Warm Springs Dam on upper Malheur River in 1919 and Agency Dam on N. F. Malheur River in 1935 that runs of Anadromous fish were blocked. Construction of the Hells Canyon Dam complex eliminated any access to the Malheur subbasin by steelhead or chinook salmon. Biological surveys conducted over the last 30 years indicate resident and fluvial redband trout still persist in most perennial streams in the subbasin, however, many populations are now isolated by impassable dams and water diversions.

The upper Malheur River, N.F. Malheur River, and the Little Malheur River were stocked with legal rainbow trout along Forest Service Road (FSR) 16 from the mid-1950s until 1993. The stocking program was discontinued after 1993. Several of the isolated populations of Malheur redband trout have been analyzed genetically. This analysis has demonstrated the uniqueness of the group, and also indicated that there has been little interbreeding with hatchery rainbow, at least in the populations sampled. Intensive fish and habitat surveys by ODFW were completed on the N.F. Malheur River and the upper Malheur River in 1992, 1993, and 1994.

Population Status

Little Malheur River Watershed

Rearing Habitat
Rearing habitat for redband trout is present in all fish bearing streams in the upper watershed (BE Map 1, Aquatics BE). Streams in the analysis area where project area habitat is present are: Little Malheur River, Camp Creek, and Hunter Creek. Other streams in the upper Littler Malheur subwatershed where rearing habitat is present are: South Bullrun Creek, Rock Creek, and Elk Flat Creek.

Spawning Habitat
Spawning habitat for redband trout is present in all perennial streams in the upper watershed. Streams in the analysis area where spawning habitat is present are: Little Malheur River, and Camp Creek. Spawning may occur in Hunter Creek in the vicinity of Hunter Spring. Other streams in the upper Littler Malheur subwatershed where spawning habitat is present are: South Bullrun Creek, Rock Creek, and Elk Flat Creek.

Migration Habitat
The Little Malheur River serves as a migration corridor for fluvial adult redband trout between Beulah Reservoir and streams in the upper watershed.

Condition and Trend of Population
No numerical estimates are available for the redband trout population in the upper portion of the Little Malheur River Watershed. Currently, the redband population is depressed due to recent drought conditions in the watershed (Ray Perkins, ODFW, personal communication).

Upper North Fork Malheur River Watershed

Rearing Habitat
Rearing habitat for redband trout is present in all fish bearing streams in the upper watershed including Spring Creek in the analysis area (BE Map 1, Aquatics BE).

Spawning Habitat
Spawning habitat for redband trout is present in all perennial streams in the upper watershed including Spring Creek in the analysis area (BE Map 1, Aquatics BE).

Migration Habitat
The N.F. Malheur River serves as a migration corridor for fluvial adult redband trout between Beulah Reservoir and streams in the upper watershed.

Condition and Trend of Population
ODFW conducted extensive fish surveys in the upper watershed in 1991 and 1992. Population levels of redband trout were estimated in seven streams (Table 2). Overall, the density level of the redband population in the early 1990's would be rated as moderate (Table

2). Currently the redband population is depressed due to recent drought conditions in the watershed (Ray Perkins, ODFW, personal communication).

Table 2. Population estimates of redband trout (Age 1+) for streams sampled in the Upper North Fork Malheur River Watershed, 1992. Density ratings based on Dambacher and Jones (In press).

Stream	Population Estimate	Density (#/m^2)	Density Rating
N.F. Malheur River	16,080	0.087	Moderate
Little Crane Creek	1,973	0.054	Low
Elk Creek (Includes N.F.)	744	0.061	Moderate
S.F. Elk Creek	16	0.023	Low
Sheep Creek	163	0.026	Low
Swamp Creek	675	0.063	Moderate
Flat Creek	495	0.107	Moderate
Total	**20,146**	**0.079**	**Moderate**

Life History Characteristics

Adult redband trout are generally associated with pool habitats, although various life stages require a wide array of habitats for rearing, hiding, feeding, and resting. Pool habitat functions as important refugia during low water periods. An increase in sediment lowers spawning success and reduces the quantity and quality of pool and interstitial habitat. Other important habitat features include healthy riparian vegetation, undercut banks and large woody debris (LWD).

Spawning occurs during the spring, generally from March to June. Redds tend to be located where velocity, depth and bottom configuration induce water flow through the stream substrate, generally in gravels at the tailouts of pools. Water temperatures influence emergence of fry, which is typically from June through July.

Environmental Baseline

Existing habitat conditions were determined from stream surveys, stream substrate surveys, and field observations. Streams are classified using INFISH stream categories (Table 3). Stream categories were verified in the field during the fall of 2002 by fishery and hydrology personnel. There are three Category 1 streams in the project area in the Little Malheur River Watershed: the Little Malheur River, Camp Creek, and Hunter Creek. There is one Category 1 stream, Spring Creek, adjacent to the project area in the Upper North Fork Malheur River Watershed.

Table 3. Description of INFISH stream categories.

Stream Category	Description
1	Fish bearing streams that are either perennial or intermittent
2	Non-fish bearing streams that are perennial
4	Non-fish bearing streams that are intermittent

Stream surveys (Region-6 Level II survey methodology) have been conducted on the Little Malheur River, Camp Creek, and Spring Creek (Table 4). To provide additional data on current stream conditions supplemental surveys were conducted on the Little Malheur River (LWD and substrate), and Camp Creek and Hunter Creek (pools, LWD, substrate) during the fall of 2002 (Table 4). Field observations of stream conditions were also made for the Little Malheur River from the Wilderness boundary upstream to just above South Bullrun Creek. Locations of surveyed stream reaches are shown in BE Map 2, Aquatics BE).

Table 4. Stream Habitat Surveys Conducted in the Monument Planning Area

Watershed	Stream	Survey Year	Agency	Methodology
Little Malheur	Little Malheur River	1999	USFS	Region-6 Level 2
	Little Malheur River	2002	USFS	Supplemental
	Camp Creek	1989	USFS	Region-6 Level 2
	Camp Creek	2002	USFS	Supplemental
	Hunter Creek	2002	USFS	Supplemental
N.F. Malheur	Spring Creek	2001	USFS	Region-6 Level 2

Critical aquatic habitat elements defined by the Malheur NF Forest Plan (Forest Plan Amendment 29, INFISH) and ODEQ water quality standards include: 1) pool frequency, 2) LWD, 3) replacement LWD, 4) bank stability, 5) width to depth ratio, 6) embeddedness (fine sediment), 7) shading, and 8) water temperature. These elements are important in maintaining the function and health of riparian and aquatic habitats. The eight elements can be combined into the following groups: physical habitat (LWD, replacement LWD, pool frequency, fine sediment), channel stability (width to depth ratio, bank stability), and water quality (shading, water temperature).

Physical Habitat Elements

Large Woody Debris

LWD plays an important role in forested stream reaches. LWD aids in dissipating stream energy, trapping sediment, and formation of pools and associated aquatic habitat. LWD also provides hiding cover for aquatic organisms.

The Forest Plan standard (Amendment 29) is based on expected frequencies of LWD by size classes based on ecosystem types (Table 5).

Table 5. Forest Plan standards (Amendment 29) for large woody debris (LWD).

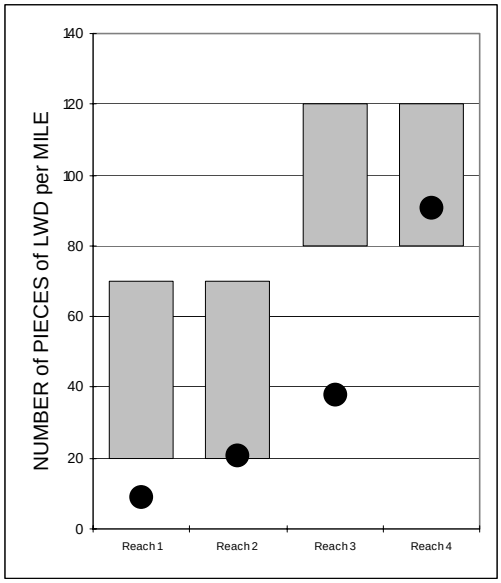
Ecosystem	Total Pieces/mile	Medium Size Class (#/mi)	Large Size Class (#/mi)
Ponderosa Pine	20 to 70	16 to 56	4 to 14
Mixed Conifer	80 to 120	64 to 96	16 to 24
Lodgepole Pine	100 to 350	90 to 315	10 to 35
Non-forested	No standard	No standard	No standard

Large pieces of woody debris generally account for the majority of pool formation and are the most stable pieces (compared to smaller pieces) of woody debris. Woody debris must be > 12" in diameter 35 ft from the large end to be classified as LWD under INFISH. Region 6 further divides LWD into two size classes on Forests east of the Cascades (Table 6). Malheur N.F. has an additional size standard for LWD in lodgepole pine ecosystems because of the smaller size potential for LWD in these ecosystems (Table 6).

Table 6. Size classes of large woody debris.

Ecosystem	Size Class	Size Standard	Description
Ponderosa Pine & Mixed Conifer	Medium	Region 6	Diameter > 12 in, at a length of 35 ft from the butt
	Large	Region 6	Diameter > 20 in, at a length of 35 ft from the butt
Lodgepole Pine	Medium	Malheur N.F.	Diameter > 6 in, at a length of 20 ft from the butt
	Large	Malheur N.F.	Diameter > 12 in, at a length of 35 ft from the butt

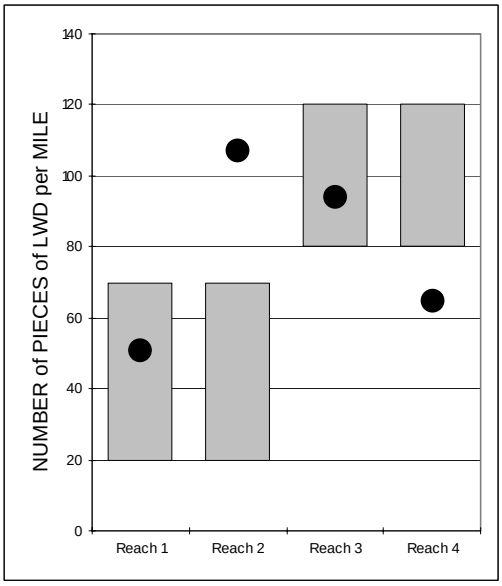
Little Malheur River: Data from the 2002 supplemental survey indicates that Reaches 1 and 3 of the Little Malheur River are below the expected range for LWD for their ecosystem type and do not meet the Forest Plan standard for LWD (Graphic 1). Reaches 2 and 4 are within the expected range for LWD for their respective ecosystem types and meet the Forest Plan standard for LWD (Graphic 1).



Graphic 1. Comparison of existing number of pieces of LWD to Forest Plan standards for reaches in Little Malheur River. Reaches 1 and 3 are not meeting the Forest Plan standard for LWD. Reaches 2 and 4 are meeting the Forest Plan standard. Reaches 1 and 2 are in ponderosa pine ecosystems. Reaches 3 and 4 are in mixed conifer ecosystems. Bars represent Forest Plan standards.

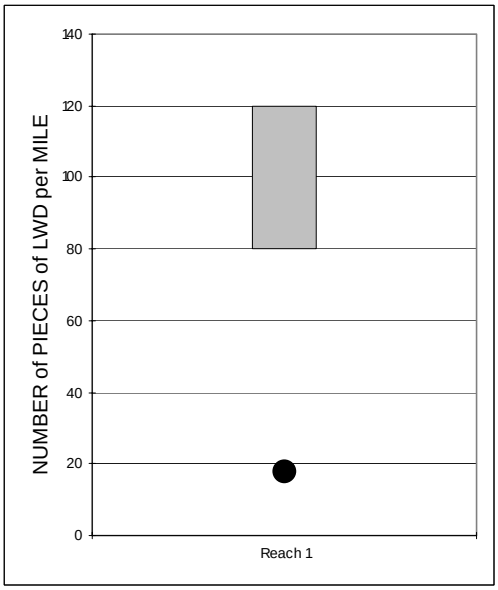
Camp Creek: Data from the 2002 supplemental survey indicates that Reaches 1 and 3 are within the expected range for LWD for their respective ecosystem types and meet the Forest Plan standard for LWD (Graphic 2). Reach 2 is above the expected range for LWD for its ecosystem type and exceeds the Forest Plan standard for LWD (Graphic 2). Reach 4 is

below the expected range for LWD for its ecosystem type and does not meet the Forest Plan standard for LWD (Graphic 2).



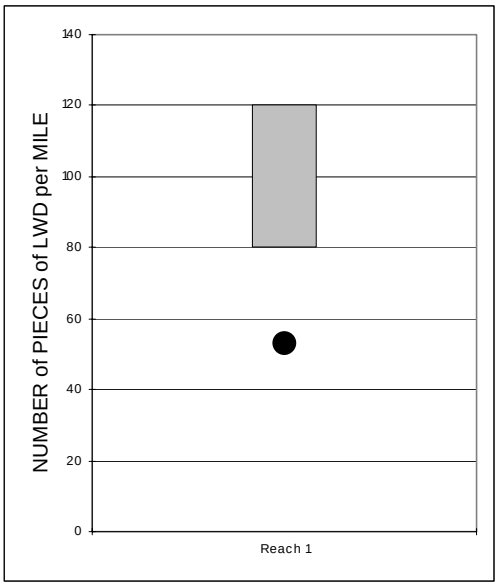
Graphic 2. Comparison of existing number of pieces of LWD to Forest Plan standards for reaches in Camp Creek. Reaches 1 and 3 are meeting the Forest Plan standard for LWD. Reach 2 exceeds the Forest Plan standard. Reach 4 does not meet the Forest Plan standard. Reaches 1 and 2 are in ponderosa pine ecosystems. Reaches 3 and 4 are in mixed conifer ecosystems. Bars represent Forest Plan standards.

Hunter Creek: Data from the 2002 supplemental survey indicates that Hunter Creek is below the expected range for LWD for its ecosystem type and does not meet the Forest Plan standard for LWD (Graphic 3).



Graphic 3. Comparison of existing number of pieces of LWD in Hunter Creek to Forest Plan standards. Reach 1 does not meet the Forest Plan standard. Reach 1 is in a mixed conifer ecosystem. Bars represent Forest Plan standards.

Spring Creek: Data from the 2001 stream survey indicates that Spring Creek is below the expected range for LWD for its ecosystem type and does not meet the Forest Plan standard for LWD (Graphic 4).



Graphic 4. Comparison of existing number of pieces of LWD in Spring Creek to Forest Plan standards. Reach 1 does not meet the Forest Plan standard. Reach 1 is in a mixed conifer ecosystem. Bars represent Forest Plan standards.

Summary: Of the nine surveyed stream reaches in the Little Malheur River watershed, five currently meet or exceed the Forest Plan standard for LWD (BE Map 3). The one surveyed stream reach in the Upper North Fork Malheur River watershed does not meet the Forest Plan Standard for LWD (BE Map 3).

Replacement Large Woody Debris

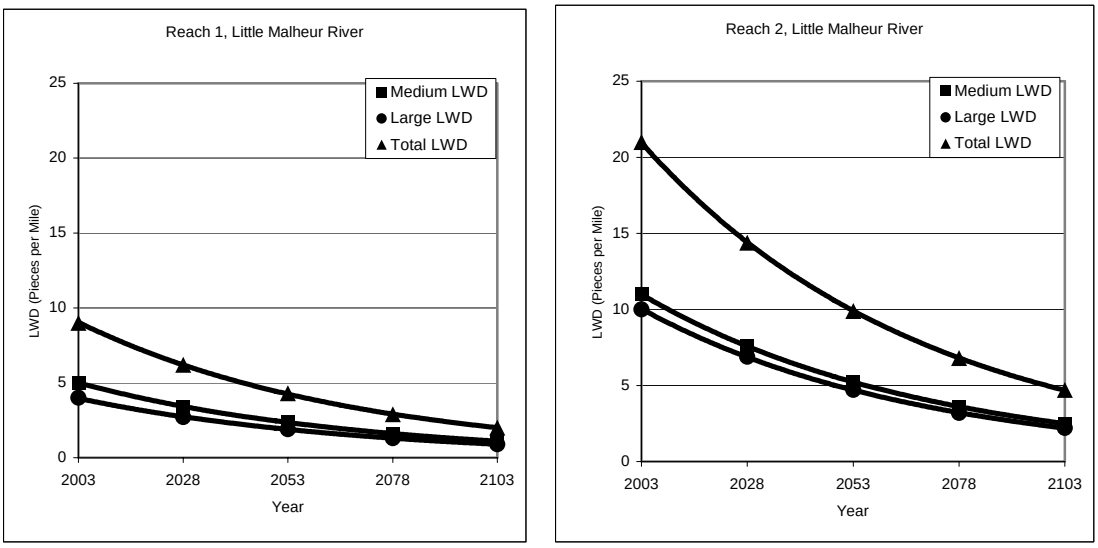
The Forest Plan requires that enough standing trees be available in forested stands adjacent to stream channels to provide for replacement of existing LWD as it is depleted through time. In order to determine if a sufficient supply of replacement LWD is available it is necessary to determine the depletion rate of existing LWD, and the predicted input rate of replacement LWD.

The following analysis is broken into the following sections: 1) predicted depletion of existing LWD, and 2) predicted input of replacement LWD. Predicted depletion of existing LWD and input of replacement LWD were not analyzed for stream reaches in the wilderness because management activities that would affect future levels of LWD in these reaches are not proposed.

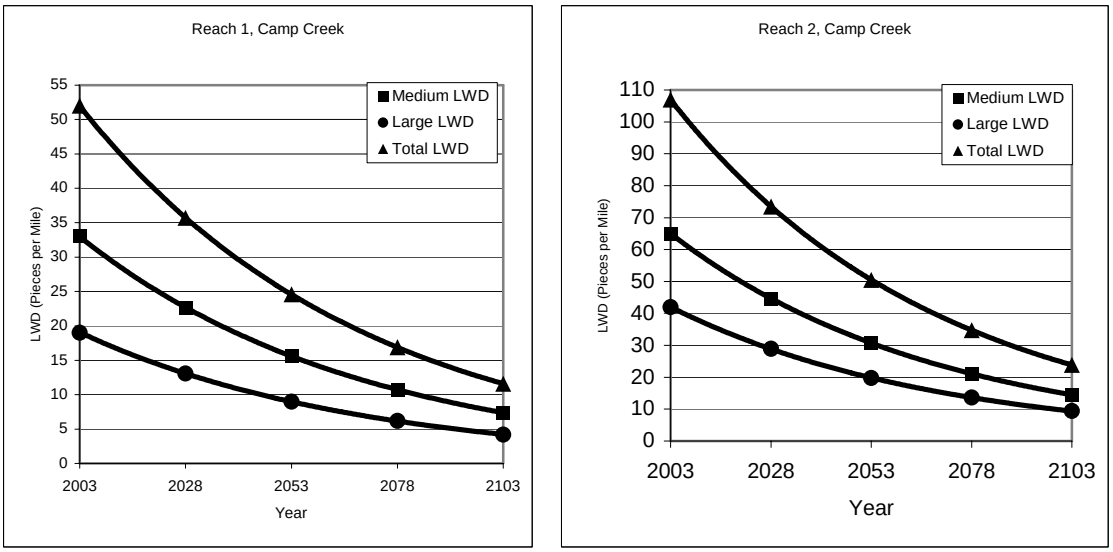
The amount of LWD currently present will decline through time due to decay, breakage, and flushing during floods. The depletion rate for LWD in streams is best represented by an exponential decay curve (Murphy and Koski 1989). Depletion rates are affected by size of LWD, species of LWD, and stream channel characteristics (width, slope, flow regimes, etc). Published depletion rates vary from 0.012 to 0.016 (mean: 0.015) for woody debris $\geq$ 12"in southeast Alaska (Murphy and Koski 1989).

To predict the depletion of LWD through time for the lower reaches of the Little Malheur River and Camp Creek we used a depletion rate of 0.015. The level of existing LWD in Reach 2 of the Little Malheur River will likely drop below the Forest Plan standard for LWD

in 2006 (Graphic 5). Levels of existing LWD in Reaches 1 and 2 of Camp Creek will likely drop below the Forest Plan standard in 2065 and 2115 respectively (Graphic 6).



Graphic 5. Depletion of LWD through time for lower reaches of the Little Malheur River. Forest Plan standard for LWD is 20 to 80 pieces of LWD per mile for these reaches. Reach 1 is currently below the Forest Plan standard. Reach 2 is predicted to drop below the Forest Plan standard in 2005.



Graphic 6. Depletion of LWD through time for lower reaches of Camp Creek. Forest Plan standard for LWD is 20 to 80 pieces of LWD per mile for these reaches. Reach 1 is predicted to drop below the Forest Plan standard in 2050. Reach 2 is predicted to drop below the Forest Plan standard in 2087. Note different scales on Y-axis.

LWD is primarily recruited into stream channels from adjacent riparian forests. Recruitment is dependent on the height of a tree and distance from the tree to the stream channel. Stand exams were conducted in the RHCAs adjacent to the lower reaches of the Little Malheur River and Camp Creek to determine the number that potentially could fall into the stream channel (Table 7).

Table 7. Number of standing dead trees available for replacement LWD along the lower reaches of the Little Malheur River and Camp Creek.

Stream	Stream Reaches	Ecosystem	Number of Standing Dead Trees per Mile of Stream (> 20 dbh)
Little Malheur River	1 and 2	P-Pine	298
Camp Creek	1 and 2	P-Pine	595

Tree sizes used in the stand exam were converted to LWD size classes (Table 8). For this analysis we consider trees with a dbh $\geq$20 inches to be potential replacement LWD because the majority of trees in RHCAs adjacent to the lower reaches of the Little Malheur River and Camp Creek are ponderosa pine. Based on plot data we determined that that the outer limit for recruiting LWD into the Little Malheur River and Camp Creek is on average 100 ft from the stream channel.

Table 8. Conversion of stand exam tree size classes (dbh) to LWD size classes

Species	Medium LWD minimum dbh (in)	Large LWD Minimum dbh (in)
Ponderosa Pine	20	28
Western Larch	17	25
Douglas-Fir	18	26
White Fir	18	26

The probability of a tree falling into a channel is based on the height of the tree, and the distance to the channel. Other factors such direction of lean, location of the tree in regards to slope (i.e. trees tend to fall down slope), and the factor for the tree falling (e.g. bank cutting, wind throw) also influence the probability of a tree falling into a stream channel. The lowest probability for a tree to fall into the channel, assuming random tree fall and the tree is capable of reaching the channel, would be encountered where a tree is located on flat ground. In this scenario a tree has a 50% probability of falling towards the channel. If we assume for optimum effectiveness that a tree needs to fall into a channel at 45 degrees either side of perpendicular to the channel, the probability lowers to about 25%. We chose to use a probability of 23% to be conservative when estimating the number of trees needed to meet Forest Plan standards for replacement LWD.

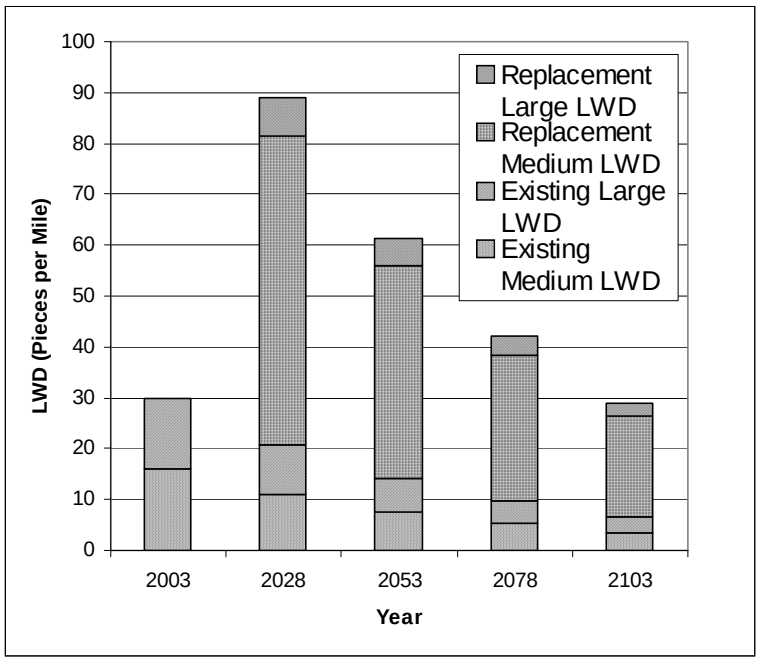
We estimate that to meet the minimum Forest Plan standard for LWD (i.e. 20 pieces per mile), 391 standing dead trees per mile would be needed for replacement of LWD in ponderosa pine ecosystems (Table 9).

Table 9. Number standing dead trees per mile needed to provide replacement LWD in ponderosa pine ecosystems to meet minimum Forest Plan standards.

Size Class	Number of Standing Dead Trees per Mile Needed to Meet Minimum Standard for Replacement LWD
Medium	313
Large	78
Total	391

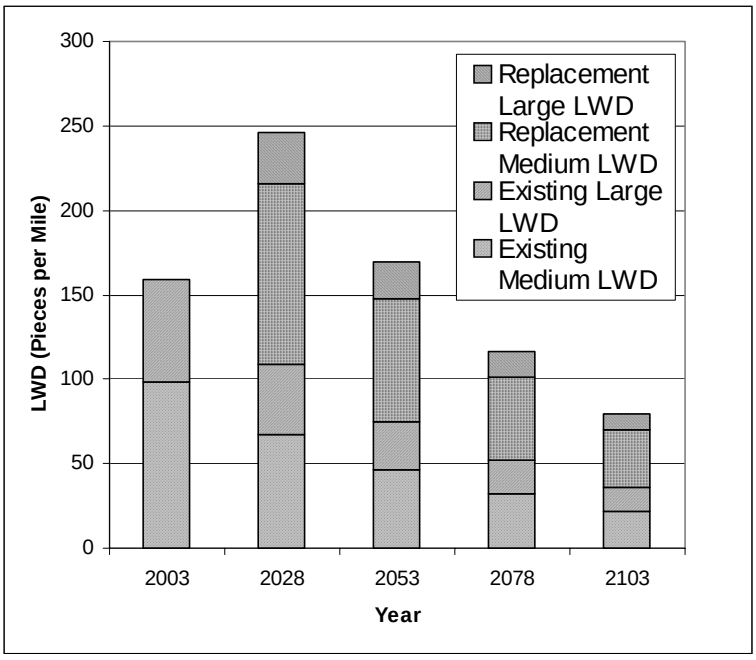
Because nearly all of trees adjacent to the lower reaches of the Little Malheur River and Camp Creek were killed during the fire a gap in the recruitment of LWD will occur in the future. This gap in recruitment will be present until the riparian forest has regenerated to the point where new trees have reached the size necessary to provide LWD (about 20" dbh). Based on growth data collected in a stand just downstream of the fire perimeter along the Little Malheur this recovery point will be in about 100 years (E. Werner, PCRD Silviculturalist, personal communication).

Based on the estimated depletion of existing LWD and the estimated recruitment of available replacement LWD, the Little Malheur River is likely to meet the Forest Plan standard for LWD for the next 100 years (Graphic 7). LWD levels will spike from 20 to 30 years after the fire when the majority of standing dead trees will have fallen. LWD in the lower reaches of the river in the fire area may reach as high 89 pieces per mile in the Little Malheur River around 2028 (Graphic 7). By 2103, about the time that new trees have reached the size necessary to provide new LWD (about 20" dbh), LWD levels will drop to about 30 pieces per mile in the Little Malheur River (Graphic 7).



Graphic 7. Predicted changes in LWD levels as existing LWD is depleted and replacement LWD is recruited into the Little Malheur River (Reaches 1 and 2) in the Monument planning area from 2003 through 2103. The Forest Plan standard is 20 to 70 pieces per mile.

Based on the estimated depletion of existing LWD and the estimated recruitment of available replacement LWD, Camp Creek is likely to meet the Forest Plan standard for LWD for the next 100 years (Graphic 8). Levels of LWD will spike from 20 to 30 years after the fire when the majority of standing dead trees will have fallen. LWD in the lower reaches of Camp Creek may reach as high 246 pieces per mile around 2028 (Graphic 8). By 2103, about the time that new trees have reached the size necessary to provide new LWD (about 20" dbh), LWD levels will drop to about 80 pieces per mile in Camp Creek (Graphic 8).



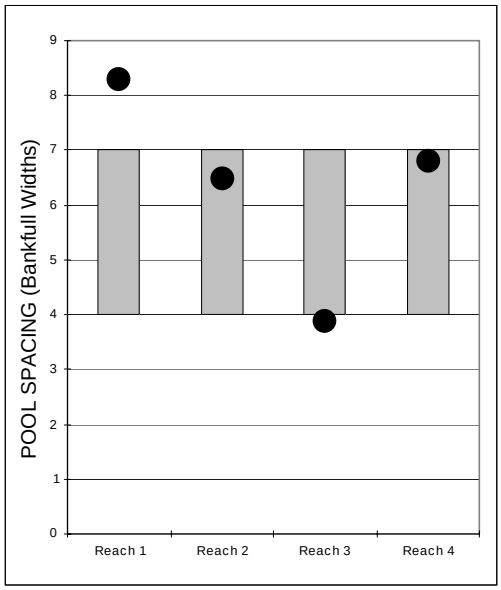
Graphic 8. Predicted changes in LWD levels as existing LWD is depleted and replacement LWD is recruited into Camp Creek (Reaches 1 and 2) in the Monument planning area from 2003 through 2103. The Forest Plan standard is 20 to 70 pieces per mile.

Pool Frequency

Pool frequency is a gauge of aquatic habitat diversity, and is an indicator of the degree to which streams are capable of supporting a varied and complex community of fish species. Pools are important for providing rearing habitat for juvenile fish and cool-water refugia areas for adult fish during periods of low flow and elevated temperatures.

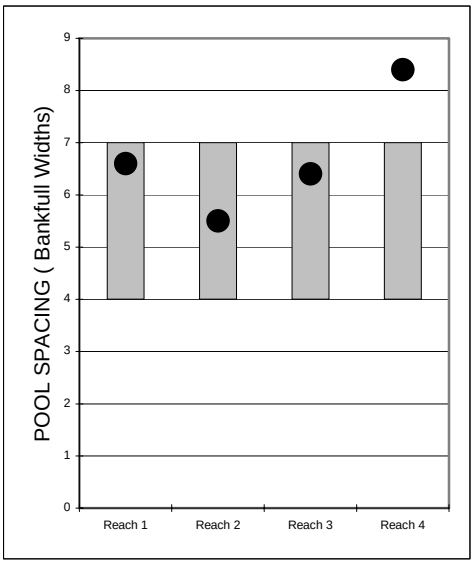
Pool spacing varies by channel morphology (Rosgen 1996). Spacing between pools is calculated based on the bankfull width of the stream channel. The Forest Plan standard for pools is based on expected spacing between pools from Rosgen (1994) for "B" and "C" channel types. The standard for pool spacing is a pool at least every 4 to 7 bankfull widths (BFWs).

Little Malheur River: Stream survey data from 1999 indicates that Reach 1 of the Little Malheur River is above the expected range for pool spacing and does not meet the Forest Plan standard for pools (Graphic 9). Reaches 2 and 4 are within the expected range for pool spacing and meet the Forest Plan standard (Graphic 9). Reach 3 is below the expected range for pool spacing and exceeds the Forest Plan standard for pools (Graphic 9).



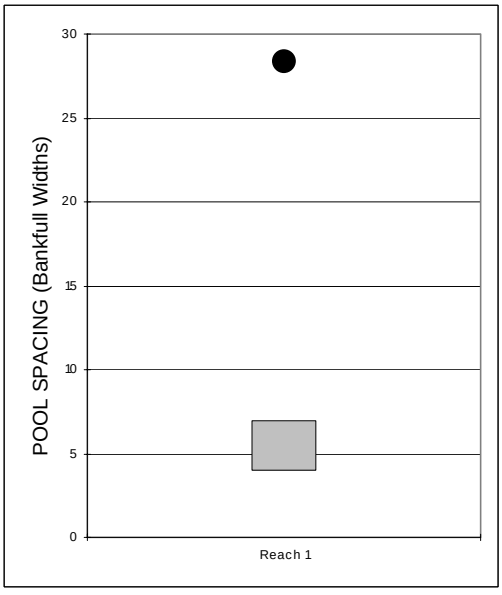
Graphic 9. Comparison of existing pool spacing to expected range for pool spacing for reaches in the Little Malheur River. Reach 1 is not meeting the Forest Plan standard for pool frequency. Reach 2 and Reach 4 meet the Forest Plan standard. Reach 3 exceeds the Forest Plan standard. Reaches 1 and 2 are "C" channel types. Reach 3 is a "B/C" channel type. Reach 4 is a "B" channel type. Channel types based on the Rosgen (1996) channel classification system. Bars represent pool spacing needed to meet Forest Plan standards for pool frequency.

Camp Creek: Data from the 2002 supplemental stream survey indicates that Reaches 1, 2, and 3 are within the expected range for pool spacing and meet the Forest Plan standard for pools (Graphic 10). Reach 4 is above the expected range for pool spacing and does not meet the Forest Plan standard for pools (Graphic 10).



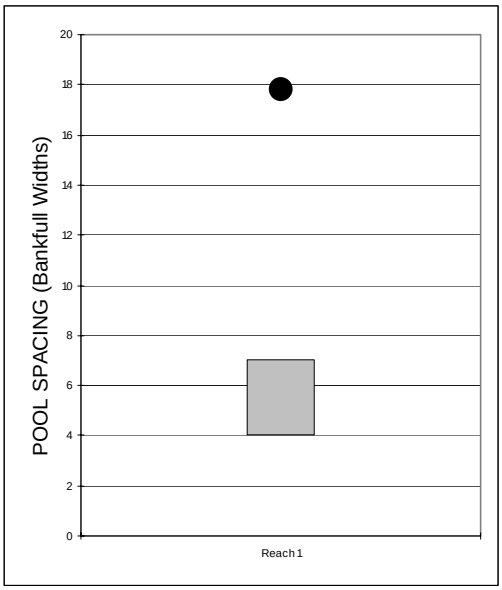
Graphic 10. Comparison of existing pool spacing to expected range of pool spacing for reaches in Camp Creek. Reaches 1, 2, and 3 are meeting the Forest Plan standard for pool frequency. Reach 4 does not meet the Forest Plan standard. Reaches 1 and 2 are "C" channel types. Reaches 3 and 4 are "B" channel types. Channel types based on the Rosgen (1996) channel classification system. Bars represent pool spacing needed to meet Forest Plan standards for pool frequency.

Hunter Creek: Data from the 2002 supplemental stream survey indicates that Reach 1 of Hunter Creek is above the expected range for pool spacing and does not meet the Forest Plan standard for pools (Graphic 11).



Graphic 11. Comparison of existing pool spacing to expected range of pool spacing for Hunter Creek. Reach 1 does not meet the Forest Plan standard for pools. Reach 1 is a "B/C" channel type. Channel type is based on the Rosgen (1996) channel classification system. Bars represent pool spacing needed to meet Forest Plan standards for pool frequency.

Spring Creek: Data from the 2001 stream survey indicates that Reach 1 of Spring Creek is above the expected range for pool spacing and does not meet the Forest Plan standard for pools (Graphic 12).



Graphic 12. Comparison of existing pool spacing to expected range of pool spacing for Spring Creek. Reach 1 does not meet the Forest Plan standard for pools. Reach 1 is a "C" channel type. Channel type is based on the Rosgen (1996) channel classification system. Bars represent pool spacing needed to meet Forest Plan standards for pool frequency.

Summary: Of the nine surveyed stream reaches in the Little Malheur River watershed, six currently meet the Forest Plan standard for pools (BE Map 4). The one surveyed stream reach in the Upper North Fork Malheur River watershed does not meet the Forest Plan Standard for pools (BE Map 4).

Embeddedness / Fine Sediment

Composition of the streambed substrate is an important feature of aquatic habitat. Cobble and gravel substrates provide habitat for a diverse assemblage of benthic macroinvertebrates as well as eggs and early life stages of numerous fish species. Macroinvertebrates represent a substantial portion of the diet available to various fish species.

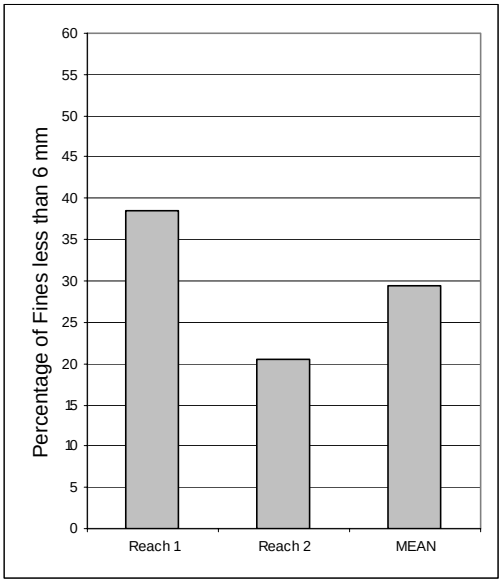
Filling of interstitial spaces (i.e. the gaps between rocks on the stream bottom) with fine sediment (particles < 6 mm in size) eliminates habitat for many macroinvertebrates. Fish eggs and early life stages can also be buried and smothered when interstitial spaces are embedded with fine sediment. Winter habitat for juvenile salmonids and hiding cover for sculpins are also lost as interstitial spaces between cobble substrate are embedded with fine sediment.

Embeddedness data is no longer collected as part of Region 6 stream surveys. Instead, stream substrate data is collected using pebble count procedures. Either methodology can be used to estimate the amount of fine sediment in streams. Adverse impacts to macroinvertebrates and fish can occur where fine sediment exceeds 20% of the surface area of the streambed or embeddedness exceeds 20% (Table 10).

Table 10. Potential effects to aquatic organisms from fine sediment.

Percentage of Fine Sediment <6 mm	Effects to Aquatic Organisms
0 to 15	None
>15 to 20	Potential for Adverse Effects
> 20	Adverse Effects Likely

Little Malheur River: Reaches 1 and 2 are currently exceeding the 20 percent threshold for fine sediment (Graphic 13). Fine sediment levels are likely to increase until ground cover is reestablished in the drainage area.



Graphic 13. Levels of fine sediment in the lower reaches of the Little Malheur River. Fine sediment levels in Reaches 1 and 2 exceed the Forest Plan standard (< 20 percent fines).

Field observations of the current fine sediment levels in Reaches 3 and 4, located in the Wilderness, were made in late 2003. Overall, fine sediment levels in Reach 3 were generally between 15 and 20 percent with some areas exceeding the 20 percent threshold. Fine sediment levels in Reach 4 were estimated to be around 50% in the fall of 2003.

Following the 2002 fire intense thunderstorms occurred in the project area on August 23 and 24, 2002. Large quantities of fine sediment and ash were transported to Camp Creek and the Little Malheur River from adjacent hill slopes and Category 4 tributaries.

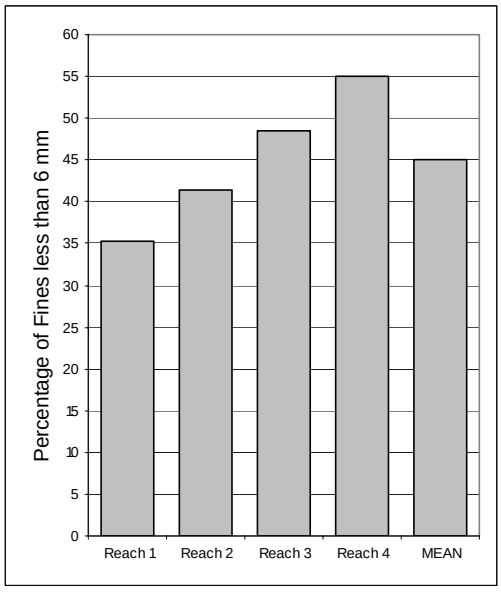
The effects of the 2002 fire combined with the late August thunderstorms on fine sediment levels in the Little Malheur River are evident. Fine sediment levels tripled for Reach 1 from 13.3% in 1999 to 38.5% in 2002 (Table 11). Based on field observations, fine sediment levels in Reach 4 have probably tripled too as a result of the fire and thunderstorms. Fine sediment levels will continue to increase as a result of increases in soil erosion rates due to the 2002 fire.

Table 11. Levels of fine sediment (particles < 6mm) in the Little Malheur River. Sites are arranged from downstream to upstream. Data for 1999 from stream survey. Data for 2002 from supplemental stream survey. Levels of fine sediment in italics are estimated.

Stream	Reach	Particles < 6mm (%)		Comments
		1999	2002	
Little Malheur R.	1	13.3	38.5	
	2	21.0	20.5	
	3	17.5	15 to 20	2002 level based on field observation
	4	17.0	50	2002 level based on field observation

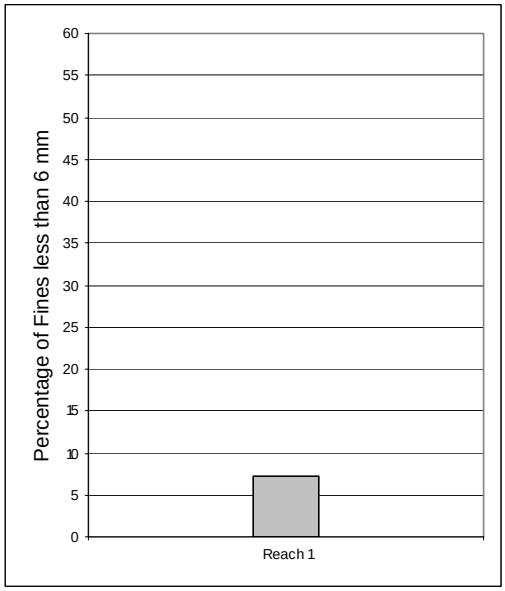
Additional fine sediment was transported into the Little Malheur River and Camp Creek during the spring melt off in late May of 2003 and during intense thunderstorms which occurred during late July of 2003.

Camp Creek: Currently all reaches of Camp Creek are exceeding the 20 percent threshold for fine sediment (Graphic 14). Fine sediment levels will continue to increase as a result of increased soil erosion rates resulting from the 2002 fire.



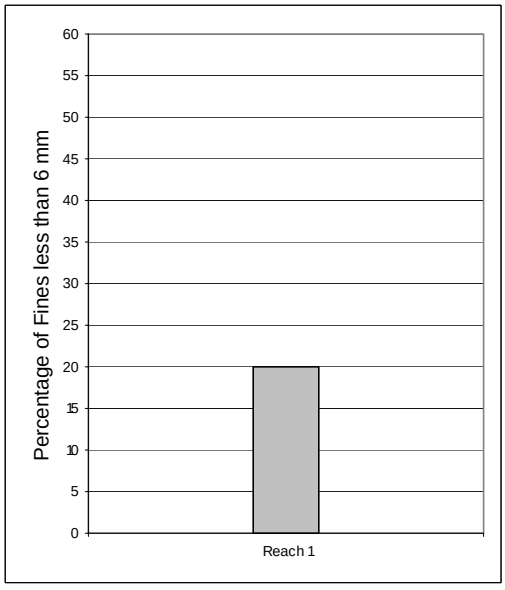
Graphic 14. Levels of fine sediment in Camp Creek. All reaches exceed the Forest Plan standard for fine sediment (< 20 percent fines).

Hunter Creek: Currently the 20 percent threshold for fine sediment is not being exceeded in Hunter Creek (Graphic 15). The 2002 fire will likely have little impact to fine sediment levels in Hunter Creek because the fire burned only a small area in the lower portion of the drainage area of Hunter Creek.



Graphic 15. Levels of fine sediment in Hunter Creek. Hunter Creek is currently meeting the Forest Plan standard for fine sediment (< 20 percent fines).

Spring Creek: Spring Creek is currently at the 20 percent threshold for fine sediment (Graphic 16). The 2002 fire will likely have little impact to fine sediment levels in Spring Creek because the fire did not consume the organic layer in the RHCAs adjacent to Category 4 streams that flow into Spring Creek.



Graphic 16. Levels of fine sediment in Spring Creek. Spring Creek is at the threshold level for the Forest Plan standard for fine sediment (< 20 percent fines).

Summary: Of the nine surveyed stream reaches in the Little Malheur River watershed, two currently meet the Forest Plan standard for fine sediment (BE Map 5). However, fine sediment levels in Reach 3 of the Little Malheur River are expected to increase above the Forest Plan standard in 2003. The one surveyed stream reach in the Upper North Fork Malheur River watershed does not meet the Forest Plan Standard for fine sediment (BE Map 5).

Channel Stability Elements

Bank Stability

The Forest Plan standard for stream bank stability is for 90% of banks be stable. No decrease in bank stability is allowed as a result of management activities if bank stability is greater than 90%. Bank stability plays an important role in determining the stability of some types of stream channels present in the Monument project area (Table 12). "C" channel types, especially C4 channel types present in the project area, are very sensitive to disturbance due to the importance of bank vegetation in maintaining stable channels.

Table 12. Sensitivity of channel type to disturbance, bank erosion potential and influence of vegetation for channel types present in the Monument project area. Adapted from Rosgen 1996.

Channel Type	Sensitivity to Disturbance	Bank Erosion Potential	Vegetation Influence on Bank Stability
A	Very High	Very High	Negligible
B4	Moderate	Low	Moderate
C4	Very High	Very High	Very High

Riparian vegetation needs to consist of deeply rooted species typical of late seral riparian plant communities in order for C4 channel types to remain stable after large disturbance events such as the 2002 Monument Fire. C4 channel types are "C" channel types that have gravel as the dominant streambed substrate. "B" channel types are inherently more stable compared to "C" channel types and riparian vegetation plays less of a role in maintaining stable channels (Table 12).

Little Malheur River: Bank stability for the Little Malheur River ranged from 65 to 81% stable in 1999 (Table 13). Lowest bank stability was present along the lower two reaches, which are C4 channel types. The fire had very little effect on herbaceous species in the riparian area adjacent to the lower reaches of the Little Malheur River. Shrub species such as willows, alders and cottonwoods, experienced significant mortality in places, however a majority of the riparian shrubs appeared to have been top killed and these plants are likely to be capable of sprouting from undamaged root crowns.

Table 13. Bank stability for streams in the project area. The Forest Plan standard for bank stability is 90% stable banks. Data for the Little Malheur River from 1999 stream survey. Bank stability estimated for Camp Creek and Hunter Creek based on 2002 field observations.

Stream	Reach	Channel Type	Percent Stable Banks
Little Malheur River	1	C	65
	2	C	75
	3	C/B	81
	4	B/A	80
Camp Creek	1	C	<90
	2	C/B	<90
	3	B	≈90
	4	A	≈90
Hunter Creek	1	C/B	<90

Camp Creek: Field observations in 2002 indicated that the bank stability along the lower reaches of Camp Creek is well below the Forest Plan standard of 90% stable (Table 13). The riparian plant community adjacent to Reaches 1 and 2, primarily C4 channel types, appears to have been significantly impacted by the fire. Very little regeneration of herbaceous vegetation occurred after rain and warm temperatures during the fall of 2002 when regeneration should have been occurring. The majority of riparian shrubs along lower Camp Creek were burned down to root crowns and sprouting is not expected to occur. Given the importance of riparian vegetation in maintaining stable stream banks and the effects of the fire on riparian vegetation along lower Camp Creek, high rates of bank erosion are expected to occur until the riparian vegetation recovers.

Hunter Creek: Field observations in 2002 indicate that bank stability along lower Hunter Creek is meeting the Forest Plan standard. This section of Hunter Creek is a "B" channel type. However, the upper portion of Hunter Creek, outside of the project area, is below the Forest Plan standard (Table 13). This section is a C4 channel type and exhibits impacts from mechanical bank damage from livestock.

Spring Creek: Stream banks were 83% stable in 2001. This is below the Forest Plan standard of 90% stable banks.

Summary: Of the nine surveyed stream reaches in the Little Malheur River watershed, two currently meet the Forest Plan standard for bank stability (BE Map 6). The one surveyed stream reach in the Upper North Fork Malheur River watershed does not meet the Forest Plan Standard for bank stability (BE Map 6).

Width to Depth Ratio

The Forest Plan standard for width to depth ratio is based on wetted width and depth. Bankfull width to depth (W/D) ratio is one of the most sensitive indicators of channel stability (Rosgen 1996). W/D ratios are correlated to drainage area. Natural events and management activities can result in increases in W/D ratios due to increases in sediment

inputs to stream channels. As W/D ratios increase bank erosion rates increase leading to further increases in sediment supply thus perpetuating further increases in W/D ratios.

An important distinction between natural events and management activities is that increases in sediment supply resulting from natural events tend to be episodic. Stream channels can adjust to and recover from episodic increases in sediment inputs because the level of inputs eventually returns to pre-event levels.

In contrast, increases in sediment supply due to management activities tend to be more chronic in nature especially from activities such as road construction and grazing. Stream channels are less likely to recover to their former condition from chronic inputs of sediment due to the cyclic nature of the relationship between the increases in sediment supply, increases in W/D ratios, and increases in bank erosion. Rapid destabilization of channels occurs once they reach the threshold level for W/D resulting in significant adverse impacts to aquatic habitat and organisms.

Little Malheur River: Bankfull W/D ratios for the four reaches are within the normal range for their respective channel types (Table 14). W/D ratios will probably increase in response to increases in sediment as a result of the 2002 fire leading to an increase in stream bank erosion rates.

Table 14. Bankfull width to depth ratios for the Little Malheur River.

Stream	Reach	W/D	Normal Range
Little Malheur River	1	20.6	13.5 to 28.7
	2	21.9	13.5 to 28.7
	3	22.2	13.5 to 28.7
	4	19.4	12 to 20

Camp Creek: W/D ratio data are not available. Based on field observations, Reaches 1 and 2 appear to be in the upper portion of the normal range for W/D for C4 channel types. Reaches 3 and 4 appear to be in the middle portion of the normal range for their respective channel types.

Hunter Creek: W/D ratio data are not available. Based on field observations, the lower portion of Hunter Creek appears to be in the upper portion of the normal range for W/D for a "B" channel type. The upper portion of Hunter Creek appears to be in the upper portion of the normal range for a "C" channel type.

Spring Creek: The W/D ratio for Spring Creek is 22.3. This is within the normal range (13.5 to 28.7) for its channel type ("C" type channel).

Water Quality Elements

Shading

Little Malheur River: On the Little Malheur River, Reaches 1, 2, 3, and 4 burned severely (BE Map 7). However, shading along Reaches 1 and 2 should recovery relatively quickly because shrubs were top killed for the most part and should re-sprout and return to their former condition in four to five years. In contrast, Reaches 3 and 4 burned much like the lower reaches of Camp Creek and will take much longer to recover. Current shading along the lower reaches of the Little Malheur River is about 40% of pre-fire conditions. Current

shading along the upper reaches is about 3% and consists primarily of boles of standing dead trees.

Camp Creek: The 2002 fire greatly reduced shading along the majority of stream reaches in the fire perimeter. On Camp Creek, the RHCA adjacent to Reach 1 and about two thirds of the RHCA adjacent to Reach 2 burned severely during the fire (BE Map 7). Based on visual observations it is estimated that the current shading along the lower reaches of Camp Creek is about 3% of pre-fire conditions and consists primarily of boles of standing dead trees.

Water Temperature

Water temperature influences the metabolism, behavior, and mortality of fish and other aquatic organisms. Although fish may survive at temperatures near extremes of their suitable temperature range growth rates are greatly reduced. At low temperatures growth is reduced because all metabolic processes are slowed. At the opposite extreme, growth is reduced at high temperatures because most if not all energy from food must be used for maintenance needs. Other sub-lethal effects of high water temperatures on salmonids (trout, whitefish, char, and salmon) are: increase incidence of disease, inability to spawn, reduced survival of eggs, reduced growth and survival rates for juveniles, and reduced ability to compete with other fish species that are adapted to warmer temperatures.

Current Oregon Department of Environmental Quality (ODEQ) standards for water temperature are: seven day moving average of the daily maximum shall not exceed: 64° F (17.8° C) or 50° F (10° C) in waters that support Oregon bull trout.

Little Malheur River: The Little Malheur River, from the mouth to headwaters, is currently on the Oregon DEQ 303(d) list for exceeding the 64° F standard (Table 15).

Table 15. 303(d) listed streams in the project area.

Stream	Reach	Parameter	Season
Little Malheur River	Mouth to headwaters	Temp (>64°F)	Summer

Prior to the 2002 fire, data shows that the Little Malheur River exceeded the current ODEQ standard for salmon/trout by an average of about 10°F at the Forest Boundary and by about 9°F at the Wilderness boundary (Table 15). In 2003, the 7 day mean maximum temperature was 79°F at the Forest boundary, about 5°F higher than the average prior to the 2002 fire.

Table 16. Comparison of pre- and post fire 7-day-mean-maximum water temperatures in streams in the project area. ODEQ standard is 64°F for all streams.

Stream	Location	Mean 7 Day Mean Max Temp Prior to 2002 Fire	7 Day Mean Max Temp in 2003
Little Malheur R	100 yds above Forest Boundary	73.8°F1	79.0°F
	400 yds above Wilderness Boundary	72.5°F2	No Data
Camp Creek	Near confluence w/ Little Malheur River	No Data	80.4°F
	Near FSR 479	No Data	65.0°F
Spring Creek	Near confluence with N.F. Malheur River	60.7°F2	

Data periods: 1) 1993- 2001, 2) 2000 – 2001

The Little Malheur River was described as being "clear and cold" upstream of Hunter Creek in the late 1960's (USFS 1967). Rock Creek and South Bullrun Creek are potentially important contributors of cold water to the Little Malheur River above Hunter Creek.

Camp Creek: Water temperatures were not monitored in Camp Creek prior to the 2002 fire. In 2003, water temperature at the lower monitoring site exceeded the ODEQ standard. The water temperature at the middle-monitoring site was slightly above the ODEQ standard. A comparison of water temperatures at this site and the pre-fire water temperature at the monitoring site on the Little Malheur River in the wilderness indicates the potential of Camp Creek as an important contributor of cold water to the Little Malheur River.

Hunter Creek: Water temperatures have not been monitored in Hunter Creek. Hunter Creek, in its present condition, has little potential to contribute cold water to the Little Malheur River. Hunter Creek is perennial for about 0.7 miles downstream from Hunter Spring and is then intermittent to the confluence with the Little Malheur River; about 1.2 miles. The 1934 Forest map shows that Hunter Creek was perennial from Hunter Spring to the Little Malheur River.

Spring Creek: ODFW monitored water temperature in Spring Creek in 2000 and 2001. Spring Creek is currently meeting the ODEQ water standard for summer water temperatures (Table 16). Spring Creek also meets EPA's latest recommendation for juvenile salmon/trout rearing in core habitat ($\leq$ 61°F).

Effects and Determination

Alternative 1 – No Action

Direct / Indirect Effects to Aquatic Habitat

Little Malheur River Watershed

Channel Stability Elements: Alternative 1, the no action alternative, would allow channel stability elements to recover from the effects of the 2002 fire at natural rates.

Almost all the organic ground cover was consumed and ground cover was reduced to about 10% in areas that burned with high and moderate severities (Monument BAER Report).

Highly hydrophobic soil was found in about 10 to 15% of the high intensity burn and about 5% of the moderate intensity burn. The depth of the hydrophobic layer varied, but most often started about 0.5 inch below the surface, and was 1 to 2 inches thick. At one location, the hydrophobic layer started about 4 inches below the surface and was about 5 inches thick.

Both runoff and sedimentation are expected to increase in the Little Malheur River and Camp Creek due to the creation of hydrophobic soil conditions (Table 17). Peak flows are predicted to increase by 67% in Camp Creek and by 64% in the Little Malheur River. These increases in peak flows will decrease as hydrophobic soil conditions return to pre-fire conditions. This will likely occur over the next one to two years.

Table 17. Pre and post-fire estimated 25-year peak flows for the Little Malheur River and Camp Creek. Flows are expressed in cubic feet per second.

Stream	Estimated Pre-fire Peak Flow (25 yr event)	Estimated Increase in Runoff (%)	Estimated Post-fire Peak Flow (25 yr event)
Camp Creek	177 cfs	67	296 cfs
Upper Little Malheur River	514 cfs	64	842 cfs

Channel stability will likely decrease in the Little Malheur River and Camp Creek over the next three years due to increases in peak flows and fine sediment resulting from the 2002 fire. In urban watersheds stream channels become unstable due to increases in discharge when infiltration in the watershed is reduced by 10 percent or greater (Booth and Jackson 1997).

Streams tend to adjust to increases in discharge by widening or down cutting. Stream bank vegetation can buffer stream channels from effects from increases in discharge. Where late seral species are present, little adjustment of the channel may occur due to the high root-holding capacity. However, where bank vegetation is dominated by early seral species channel adjustments may be dramatic due to the lack of root-holding capacity.

Bank stability along the lower reaches of Camp Creek is well below 90%. Recovery of herbaceous vegetation along the lower Camp Creek will probably exceed 3 years due to the pre-fire condition of bank vegetation and the severity of the 2002 Monument Fire. Channel adjustments to increases in flow and fine sediment are likely; potentially resulting in formation of braided channels in low gradient areas and gullying in higher gradient areas. Areas of braided channels and gullying would provide little if any habitat for fish. Formation of braided channels or gullying are less likely along the lower reaches of the Little Malheur River compared to Camp Creek due to the lower severity burn and better pre-fire condition of bank vegetation.

Physical Habitat Elements: Alternative 1, the no action alternative, would allow physical habitat elements to recover from the effects of the 2002 fire at natural rates.

The Disturbed Water Erosion Prediction Project (WEPP) model (Elliott et al. 2000) predicts that about 107,078 tons of fine sediment from severely burned areas in the Little Malheur River watershed will be transported to Little Malheur River downstream of Camp Creek in 2003. This is in contrast to the 22,078 tons predicted by WEPP using the assumptions in the BAER report. We revised the assumptions used in the WEPP model based on our

observations of the fire area and conversations with Dr. William Elliot, Rocky Mountain Research Lab. Prior to the 2002 fire, we estimate that annual erosion contributed 5,520 tons of fine sediment to the Little Malheur River downstream of Camp Creek. We predict that in 2004 the amount of fine sediment from severely burned areas in the Little Malheur River watershed transported to Little Malheur River downstream of Camp Creek will likely drop to 19,870 tons and then likely return to pre-fire levels in 2005.

We developed a sediment impact model to predict the effect of fine sediment increases resulting from the 2002 fire on aquatic habitat. We used a relatively simple model that determined the length of stream impacted by a slug of sediment sufficient to completely fill interstitial spaces between cobble substrate. For each year following the 2002 fire the size of the sediment slug was calculated using the predicted amount of sediment eroded from the fire area and the average bankfull width of Camp Creek, the Little Malheur River upstream of Camp Creek, and the Little Malheur River downstream of Camp Creek. The depth of the sediment slug was based on the average size of cobble substrate; 5 inches.

There are two disadvantages of using this model. First, it represents a worst-case scenario. The sediment slug modeled assumes that all of the sediment stays within the bankfull channel. The depth of the sediment slug was chosen because a slug 5 inches deep is likely to completely fill interstitial spaces in cobble substrate eliminating habitat for macroinvertebrates, sculpins, and juvenile salmonids. In reality, fine sediment entering the Little Malheur River and Camp Creek from burned areas will be deposited on floodplains, trapped behind LWD, and incorporated into banks in addition to being deposited along the streambed.

Secondly, the sediment slugs for each year are based on the total estimated annual sediment yield. In reality fine sediment will enter stream channels during spring runoff and summer thunderstorms and will consist of multiple smaller erosion events. The sediment slugs are also treated as discreet annual events and interaction between the 2003 and 2004 sediment slugs was not estimated.

Based on the sediment impact model, all of the Little Malheur River and Camp Creek above their confluence could potentially be impacted in 2003 (Table 18). About 28 miles of the Little Malheur River below the confluence with Camp Creek could potentially be impacted in 2003, then declining to 5.2 miles in 2004, and then to pre-fire levels in 2005 (Table 17). Impacts from fine sediment from the fire area are likely to be present to Beulah Reservoir as sediment is transported through the system for the next few years.

Table 18. Estimated miles of stream impacted from soil erosion from severely burned areas in the Little Malheur River Watershed under Alternative 1 compared to pre-fire conditions (2002). Stream miles impacted based on the average bankfull channel width and a fine sediment depth of 5 inches. Note: Beulah Reservoir is about 30 miles downstream from the project area.

Stream	Miles of Stream Affected by Fine Sediment by Year			
	2002	2003	2004	2005
Camp Cr	1.0	18.5	3.4	1.0
Little Malheur R	1.6	31.2	5.8	1.6
Little Malheur R below Camp Cr	1.4	27.8	5.2	1.4

These predicted increases in fine sediment will likely result in decreases in pool depths, filling of interstitial spaces in cobble substrate, and degradation of spawning gravels. This likely will result in the loss of habitat for benthic macroinvertebrates, and winter habitat for juvenile salmonids. Increases in fine sediment in spawning gravels will reduce spawning success of salmonids.

Impacts from increases in fine sediment are likely to persist until ground cover returns to pre-fire conditions. While our WEPP modeling exercise indicated that erosion rates will decline to background levels in three years, Johnson (1998) found that in the Blue Mountains of Oregon ground cover in severely burned forests and grasslands normally recovers to pre-fire levels in about five years. Assuming that similar recovery rates hold for the Monument Fire area, recovery of ground cover will likely return to pre-fire levels and erosion rates will likely return to background levels sometime from 2005 to 2007. It will likely take at least two additional years for fine sediment levels to return to pre-fire levels in low gradient reaches of the Little Malheur River and Camp Creek as fine sediment is flushed through the system during spring runoff.

In areas that burned with moderate to high intensities the fire damaged some of the existing LWD. Damage ranged from partial to entire consumption of pieces reducing the effectiveness of LWD in stabilizing stream channels and floodplains. Partially damaged LWD is vulnerable to movement during high flow events. Where entire pieces of LWD were consumed, fine sediment deposits are vulnerable to erosion during high flow events.

Pools in the analysis area will likely decline as existing LWD is destabilized and floated away. This decline will likely last for 5 to 10 years when large amounts of replacement LWD will begin to be recruited into stream channels. A majority of replacement LWD will likely be recruited into channels from 20 to 30 years following the 2002 fire.

Pool frequency likely will increase as new LWD is recruited into stream channels. Based on research on the Forest, about 11% of LWD in channels is effective in creating pools (Cordova 1995). Based on the estimated number of trees likely to fall into the channel, 23 new pools may be formed by replacement LWD in the lower reaches of the Little Malheur River and 48 in the lower reaches of Camp Creek (Table19).

Table 19. Estimated number of pools likely to be formed in the Little Malheur River and Camp Creek as replacement LWD is recruited into stream channels.

Stream	Number of Standing Dead Trees per Mile (> 20” dbh)	Number of Trees Likely to be Recruited per Mile	Number of Pools Likely to be Formed per Mile	Total Number of Pools Likely to be Formed
Camp Creek	595	136.9	15.1	48
Little Malheur River	298	68.5	7.5	23

Cover and habitat complexity will increase as standing dead trees < 20” dbh fall into and over stream channels. Efficiency of LWD in creating pools will also increase as woody material < 20” in diameter is incorporated into LWD accumulations.

Water Quality Elements: Alternative 1 would allow water quality elements to recover from the effects of the 2002 fire at natural rates.

Currently, the Little Malheur River and Camp Creek are exceeding ODEQ standards for water temperature. Stream temperatures are expected to rise as a result of the Monument Fire. In 2003, water temperature in the Little Malheur River was about 5°F warmer at the Forest boundary compared to the pre-fire period (Table 16). The loss of shading along Category 1 and Category 2 streams will affect stream temperatures because flow is present in these stream types during the hottest months of the year. About 70% of the area of Category 1 RHCAs and about 55% of the area of Category 2 RHCAs burned severely during the fire (Table 20).

Table 20. Acres burned by RHCA Category in the Monument Fire Area.

Fire Severity	Acres Burned by RHCA Category		
	Category 1	Category 2	Category 4
Light	27	25	78
Moderate	328	136	179
Partial	2	0	13
Severe	839	199	358
Total	1196	360	628

The largest increases in water temperature in the analysis area will likely occur in Camp Creek. The majority of shade along the lower reaches of Camp Creek was lost during the fire. Current shading is estimated to be about 3% of pre-fire levels. Boles of standing dead trees adjacent to lower Camp Creek are currently the only source of shade.

Shade along the lower reaches of the Little Malheur River was affected less by the 2002 fire compare to Camp Creek. Current shading along the Little Malheur River in the project area is estimated to be about 40% of pre-fire levels. While trees in the over story were killed during the fire many shrubs adjacent to the channel appeared to be top-killed. Alders showed rapid sprouting following the fire and should be back to pre-fire conditions in 5 to 10 years, depending on the amount of browsing that occurs.

Water temperatures in the analysis area will remain elevated above pre-fire levels and will gradually decline to pre-fire levels as shrubs become reestablished and shading is restored. Significant shading by shrubs such as alders will likely occur in 5 to 10 years and by cottonwood in 10 to 15 years. Black cottonwood (*Populus trichocarpo*) can grow 30 to 50 ft tall in 7 to 10 years (Crowe and Clausnitzer 1997). Mountain alder (*Alnus incana*) can grow to 9 feet tall in 5 years. Significant shading by conifers will likely begin in 80 years.

Additional reductions in water temperature will occur as W/D ratios decrease. Stream channels will narrow as fine sediment is trapped behind woody debris and incorporated into stream banks. Narrowing of channels will reduce the surface area and amount of energy absorbed thus reducing the rate of heating of streams.

Upper North Fork Malheur River Watershed

Channel Stability, Physical Habitat, and Water Quality Elements: Adverse impacts to aquatic habitat in Spring Creek are not likely to occur as a result of Alternative 1. Impacts from the fire were relatively light with few impacts to RHCAs or stream channels. The 2002 fire did not occur along Category 1 or Category 2 streams in the Upper North Fork Malheur River Watershed. About 22 acres in Category 4 RHCAs burned during the fire of which 10

acres burned moderately and 12 acres burned lightly. Fine sediment transported off of burned areas will likely be trapped in Category 4 RHCAs before reaching Spring Creek, the nearest Category 1 stream. Fine sediment is currently at the 20% threshold level in Spring Creek. However, the majority of this fine sediment appears to be road related and additional fine sediment from the fire area is not likely to reach fish bearing portions of Spring Creek.

Road Closure and Decommission Activities
Failure or delaying for another environmental analysis the decommissioning of FSR 1672479 will impact aquatic habitat in Camp Creek. This road has essentially been abandoned and is contributing fine sediment to Camp Creek in its present condition.

Obliteration of Old Skid Trails
By not obliterating old skid trails in the Camp Creek drainage an opportunity to reduce chronic inputs of fine sediment into Camp Creek and the Little Malheur River will be missed. These old skid trails show evidence of continual erosion since their construction and use in the late 1960s. They are located adjacent to and in some places in Category 4 stream channels. Failure to obliterate these old skid trails will lengthen the recovery process of Camp Creek and to a lesser extent the Little Malheur River.

Cumulative Effects
Since there are no activities proposed under Alternative 1 there will be no cumulative effects associated with Alternative 1.

Effects to Redband Trout
Little Malheur River Watershed
Adverse effects to aquatic species are likely to occur in the Little Malheur and Camp Creek drainages as a result of the current and foreseeable conditions. Fine sediment levels are above the threshold for effects for redband trout and will likely reduce spawning success and survival. Fine sediment levels are high enough to fill interstitial spaces thus eliminating winter habitat for juvenile redband trout. Filling of interstitial spaces with fine sediment will also eliminate habitat for many macroinvertebrates thus reducing food supplies for fish. Pool habitat will also decline in the short-term due to filling of pools by fine sediment reducing habitat for adult redband trout. Spawning habitat will also be impacted from high levels of fine sediment and spawning success for redband trout will be lowered.

Fine sediment levels are likely to start declining in three to five years when groundcover recovers to pre-fire conditions. As this occurs habitat for the redband trout population will begin to recover to pre-fire levels. Redband populations in the Little Malheur River and Camp Creek will likely rebound from adverse effects from the 2002 fire relatively quickly due to their mobility and the lack of migration barriers.

Alternative 1 will result in elevated fine sediment levels compared to natural levels because old skid trails will not be obliterated and FSR 1672479 will not be decommissioned. The old skid trails and FSR 1672479 are chronic sources of fine sediment that have contributed to elevated levels of fine sediment in Camp Creek and the Little Malheur River.

Alternative 1 may impact individual redband trout or their habitat in the Little Malheur River Watershed but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Upper North Fork Malheur River Watershed
Alternative 1 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to redband trout in the North Fork watershed are unlikely.

Alternative 1 will have no impact to individual redband trout or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 2

Direct / Indirect Effects to Aquatic Habitat
Salvage Activities

Little Malheur River Watershed

Alternative 2 proposes to conduct salvage activities on about 3,821 acres and harvest of green trees on 382 acres in the Little Malheur subwatershed. Salvage activities in the upper Little Malheur River subwatershed will occur on steep unstable soils. These units will be salvaged using helicopters to reduce the potential for adverse effects to aquatic habitats and species from fine sediment.

About 0.6 miles of temporary road are proposed to be constructed for salvage activities. Temporary roads will be ripped and seeded following completion of salvage activities. Adverse effects to aquatic habitat and species from construction, use, and decommissioning of temporary roads are not likely because these activities will take place outside of RHCAs and it is unlikely that fine sediment will be transported to stream channels from the locations of proposed temporary roads.

Nineteen logging landings will be constructed during salvage activities under Alternative 2. These landings will be about 0.5 to 1 acre in size and disturb about a total of 10 to 19 acres. Adverse effects to aquatic habitat and species from construction and use of landings are not likely because these activities will take place outside of RHCAs and it is unlikely that fine sediment will be transported to stream channels.

Three service landings will to be constructed during salvage activities under Alternative 2. Adverse effects to aquatic habitat and species from construction, and use of service landings are not likely because these activities will take place outside of RHCAs and it is unlikely that fine sediment will be transported to stream channels. Spill kits and fuel containment systems will be used to reduce the potential for fuel reaching stream channels in the event of a fuel spill.

Activities proposed in uplands have little potential to directly affect aquatic habitat because they are located outside the zones of influence for LWD, shading, and sediment filtering. Ground disturbing activities that cause an increase in erosion and subsequent transport of fine sediment to stream channels have the greatest potential for indirect adverse effects to aquatic habitat and species.

Under Alternative 2, about 637 acres will be salvaged in RHCAs (Table 21). Activities in RHCAs have the potential to directly affect aquatic habitat because they will occur in the zones of influence for LWD, shading, and sediment filtering.

Table 21. Number acres salvaged in RHCAs, Little Malheur River Watershed.

Stream	Cat 1 RHCAs	Cat 2 RHCAs	Cat 4 RHCAs
Little Malheur River	161[1]	0	60
Camp Creek	196	20	84

1) The area below Camp Creek was dropped for FEIS (36 acres).

Channel Stability Elements: Direct effects to bank stability can occur during logging activities in RHCAs where trees are felled on to or yarded over weak and unstable stream banks. To reduce the likelihood of adverse effects to stream banks trees will be directional felled away from stream channels and yarded to landings using helicopters.

Woody debris in stream channels traps fine sediment. In stream channels the size of Camp Creek and the Little Malheur River woody debris accumulations are normally on or adjacent to stream banks. Fine sediment trapped by woody debris accumulations would normally be incorporated into stream banks increasing bank stability and narrowing channels.

Salvage harvest of standing dead trees < 20" dbh will reduce the amount of woody debris in the stream channels of Camp Creek and the Little Malheur River. Dead trees in this size range would normally fall down 5 to 10 years following the 2002 fire. This period will likely overlap with the movement of the last two years of fire related fine sediment through the system. In the short-term this would result in some reduction in the amount of fine sediment incorporated into stream banks compared to Alternative 1. It would result in a long-term reduction in the amount of woody debris that would be available to trap fine sediment from a future large erosion event such as a wildfire or flood event compared to Alternative 1. For example, following the eruption of Mount St. Helens the presence of large quantities of woody debris lessened the adverse effects of large increases in fine sediment on aquatic habitat compared to streams where woody debris was salvaged after the eruption (Lisle 1995). Streams where salvage occurred took longer to recovery from the effects of fine sediment compared to streams where salvage did not occur.

Physical Habitat Elements: Trees will be manually felled with chainsaws and yarded to landings by helicopter. Klock (1975) found little soil disturbance in burned areas where helicopters were used for yarding. In his helicopter study area 88% of the area had no soil disturbance, 11.3% was slightly disturbed, and 0.7% was severely disturbed (Klock 1975). Erosion occurred on 29.2% of the burned area logged with helicopters of which 3.4% was related to logging activities (Klock 1975). Based upon these findings, soil disturbance resulting from salvage activities using helicopter-logging techniques will not likely result in an increase in erosion rates.

Salvage activities will result in an increase in ground cover from the creation of slash. Ground cover reduces the potential for soil erosion to occur. The increase in ground cover is predicted to reduce erosion by 10% from salvage units. Based on a 10% reduction in erosion in salvage units, WEPP predicts that 17,440 tons of fine sediment from areas that were severely burned during the 2002 fire will be transported to the Little Malheur River downstream of Camp Creek in 2004 compared to 19,870 tons under Alternative 1.

Based on our sediment impact model, this could result in adverse impacts to about 4.5 miles of the Little Malheur River downstream of Camp Creek in 2004 under Alternative 2 compared to 5.2 miles under Alternative 1 (Table 22).

Table 22. Estimated miles of stream impacted from soil erosion from severely burned areas in the Little Malheur River Watershed under Alternative 2 compared to pre-fire conditions (2002). Stream miles impacted based on the average bankfull channel width and a fine sediment depth of 5 inches. Note: Beulah Reservoir is about 30 miles downstream from the project area.

Stream	Estimated Miles of Stream Affected by Fine Sediment by Year			
	2002	2003	2004	2005
Camp Cr	1.0	18.5	2.4	1.0
Little Malheur R	1.6	31.2	5.4	1.6
Little Malheur R below Camp Cr	1.4	27.8	4.5	1.4

Levels of LWD would be similar between Alternative 2 and Alternative 1 because standing dead trees < 20" dbh in RHCAs would not be salvaged under Alternative 2.

Compared to Alternative 1, Alternative 2 will result in a reduction of woody material in the Little Malheur River and Camp Creek due to removal of standing dead trees < 20" dbh. The mean height for trees in this size class is about 60 ft. This creates an influence zone for woody debris of about 25 ft wide on either side the channel for the Little Malheur River and Camp Creek for trees in this size range. About 5 trees per acre < 20" dbh adjacent to the Little Malheur River and about 35 per acre adjacent to Camp Creek will be removed from within this zone of influence.

Woody debris smaller than LWD is generally too small to be effective in directly forming pools. Smaller pieces of woody debris normally indirectly increase pool habitat by increasing the size of woody debris accumulations to a point where a pool is scoured or by increasing the size or depth of existing pools.

Under some circumstances woody debris smaller than LWD will directly form pools. Important factors determining the effectiveness of woody debris in creating pools is the relationship between the diameter of a piece of woody debris and the bankfull width of the channels (Beechie and Sibley 1997). Based on Beechie and Sibley (1997) the minimum effective size of woody debris for forming pools is estimated to be about 8.3 inches for the Little Malheur and about 5.5 inches for Camp Creek. Removal of standing dead trees < 20" dbh in RHCAs under Alternative 2 may result in a reduction in two pools (0.7 pools/mile) in the Little Malheur River and 18 pools (5.6 pools/mile) in Camp Creek compared to Alternative 1 (Table 23).

Table 23. Estimated number of pools that will be formed from small woody debris (< 20" diam) for the Little Malheur River and Camp Creek. Minimum diameter based on Beechie and Sibley (1997). Number of pools formed based on Cordova (1995).

Stream	Minimum Diameter for Effective Pool Formation	Minimum dbh for Effective Pool Formation (@35')	Total Number of Trees Available	Number Trees That Could Potentially Reach the Channel	Estimated Number Pools Created by Woody Debris
Little Malheur R.	8.3"	17"	95	22	2
Camp Cr.	5.5"	14"	700	161	18

Cover and habitat complexity will be decreased compared to Alternative 1 due to the removal of standing dead trees < 20" dbh. There are no Regional or Forest standards for cover and habitat complexity for aquatic habitat so it is difficult to quantitatively describe the effect of removing standing dead trees < 20" dbh except to say that levels of cover and complexity be will lower under Alternative 2 compared to Alternative 1.

FSR 1672 will be reconstructed along the Little Malheur River from the junction with FSR 16 to FSR 1672457; about 1 mile in length. The reconstruction will occur in the existing road prism. BMPs will be used to prevent fine sediment entering the river due to this activity. This activity will have a beneficial impact to aquatic habitat because it upgrades an existing native surface road and greatly reduces the potential for erosion from the road surface.

Majority of the proposed haul route occurs along FSR 16 and FSR 13. These are paved roads and adverse effects to aquatic habitat and species are not expected to occur. Dust abatement will be used to minimize creation of dust and fine sediment during haul activities on unpaved roads. Dust abatement will not occur within 50 feet of streams. Barring an accident where a log truck rolls into a stream, little to no adverse effects to aquatic habitat or species are likely to occur during haul activities.

Water Quality Elements: Removal of standing dead trees < 20" dbh will likely reduce shading along lower Camp Creek by 1% compared to Alternative 1. There is a very low likelihood of a measurable increase in water temperatures above post-fire levels by reducing shade from 3% of pre-fire conditions to 2% of pre-fire conditions.

Removal of standing dead trees < 20" dbh will likely reduce shading along the lower reaches of the Little Malheur River by 1% compared to Alternative 1. There is a very low likelihood of a measurable increase in water temperatures above post-fire levels by reducing shade from 40% of pre-fire conditions to 39% of pre-fire conditions.

Upper North Fork Malheur River Watershed

Channel Stability, Physical Habitat, and Water Quality Elements: Alternative 2 proposes to conduct salvage activities on about 490 acres in the Swamp Creek subwatershed. Units to be salvaged in the Swamp Creek subwatershed, the majority of which drain into Spring Creek, are relatively flat (slopes <30%) and have ash soils thus having low potential for erosion. These units will be tractor logged. Salvage activities are not planned for RHCAs in the Swamp Creek subwatershed under Alternative 2. Adverse effects to aquatic habitat and species are not expected to occur due to the low erosion potential on these units and the current condition of RHCAs.

Road Closure / Decommission Activities

Little Malheur River Watershed

Road closure and decommissioning activities are proposed under Alternative 2. These activities will result in the reduction in the miles of open roads by 41% in Category 1 RHCAs, by 63% in Category 2 RHCAs, and by 45% in Category 4 RHCAs (Table 24). These activities will result in a reduction in fine sediment levels in the Little Malheur River and Camp Creek over the long-term compared to pre-fire conditions. Alternative 2 will result in improved aquatic habitat conditions compared to Alternative 1 due to lowering fine sediment levels below pre-fire conditions. Improvement will be evident in about seven years

when the Little Malheur River and Camp Creek will likely have recovered from increased erosion rates from the 2002 fire.

Table 24. Number of miles of roads proposed to be closed and decommissioned in RHCAs, Little Malheur subwatershed.

Status	Cat 1 RHCA (mi)	Cat 2 RHCA (mi)	Cat 4 RHCA (mi)
Closed	0.0	0.2	0.3
Decommissioned	3.9	0.3	1.1
Open	5.5	0.3	1.7
Total	9.4	0.8	3.1

Upper North Fork Malheur River Watershed

There are no road closure or decommissioning activities proposed for the Spring Creek drainage under Alternative 2. A currently closed road, of which about 0.1 miles in length is located in a Category 4 RHCA, will be reopened for salvage activities. This road will revert to a closed road following completion of salvage activities.

Obliteration of Old Skid Trails

Little Malheur River Watershed

There are about 2.2 miles of old skid trails in the project area that date from timber harvest activities during the late 1960s. These skid trails have been chronic sources of fine sediment due to their location adjacent to or in Category 4 stream channels and have likely contributed to elevated levels of fine sediment in the lower reaches of Camp Creek and the Little Malheur River. Majority of these skid trails are located in the Camp Creek drainage (BE Map 8).

These old skid trails are proposed to be obliterated. About 5 acres of ground disturbance will occur during obliteration of the old skid trails. There is a potential for an increase in fine sediment in Camp Creek for up to two to three years from this activity because soil disturbance will occur adjacent to Category 4 stream channels in unstable soils. These potential adverse effects will likely be limited to the lower portions of Camp Creek. Mitigation measures (placement of LWD, seeding, and straw mulching) will be used to reduce the potential for erosion.

Obliteration of the old skid trails will result in a long-term reduction of fine sediment in the Camp Creek drainage because natural drainage patterns will be restored. Alternative 2 will result in improved aquatic habitat conditions compared to Alternative 1. Improvement will be evident in about seven years when streams recover from increased erosion rates from the 2002 fire.

Cumulative Effects

Past Management Activities

Monument Fire Suppression Activities

All fire lines were rehabilitated following the 2002 fire. Rehabilitation consisted of waterbarring, knocking down berms, and spreading material over disturbed areas. These measures plus the return of ground cover to near pre-fire levels by 2004, the earliest that salvage activities could begin, should be sufficient to reduce erosion from fire lines below the level where cumulative effects could occur.

Little Malheur River Watershed

Timber Harvest Activities: Aquatic habitat in the analysis area and downstream areas has been impacted by management activities on the Forest as well as from natural events. Timber harvest activities on the Forest first occurred in the Little Malheur area in 1953 when ponderosa pine was harvested along the Little Malheur River. Two more timber sales occurred in the Canteen Creek and Camp Creek area in 1967 and 1968. About 20,693 million board feet of timber were removed during these two sales. The sales covered about 3,262 acres along Canteen Creek and Camp Creek. During these two sales the current road system in the area was constructed. The logging systems for both sales were primarily ground based, using tractors to yard trees to landings. Skid trails were constructed up most Category 4 stream channels in the sale areas (see skid trail restoration discussion).

In 1964, the largest flood on record for the Malheur system occurred. This flood occurred during the memorable "December 1964" flood event that caused widespread flooding in the Pacific Northwest. Flood damage to the Little Malheur River is evident from the 1965 air photos of the area. The combination of effects from the 1964 flood and timber harvest activities in 1967 and 1968 probably resulted in increased fine sediment levels in Camp Creek and the Little Malheur River.

Obliterating old skid trails under Alternative 2 would eliminate continuing fine sediment impacts from timber harvest activities that occurred in the 1960's. The result would be a reduction in fine sediment levels from the baseline condition.

In 1977, timber was harvested along the Little Malheur River as part of the Bug Butte Sale. The sale area was primarily located along the Little Malheur River from the FSR 16 to the confluence with Hunter Creek. This sale likely resulted in reduced levels of LWD in the Reaches 1 and 2 of the Little Malheur River due to the removal of trees from along the river. Removal of standing dead trees <20" dbh as proposed under Alternative 2 will not result in a cumulative reduction in LWD below Forest Plan standards along the lower reaches of the Little Malheur River because standing dead trees large enough to serve as replacement LWD will not be salvaged.

Ongoing Management Activities

Little Malheur River Watershed

Roads: Majority of roads located in RHCAs in the analysis area are native surface roads (Table 25). Native surface roads are more likely to contribute fine sediment to streams that can adversely affect aquatic habitat compared to roads with other surface types. Adverse affects are more likely to occur where native surface roads are located adjacent to Category 1 streams. Over 80% of roads located in Category 1 RHCAs in the project area are native surface roads (Table 33).

Table 25. Miles of roads in RHCAs by surface type in the analysis area.

Surface Type	Miles in Cat 1 RHCAs	Miles in Cat 2 RHCAs	Miles in Cat 4 RHCAs
Crushed Rock	0.0	0.0	0.4
Improved Native	1.5	0.1	0.1
Native Material	7.8	0.7	2.8
Asphalt	0.1	0.0	0.2
Total	9.4	0.8	3.5

FSR 1672479 is located in the RHCA adjacent to Camp Creek and due to its current condition is a chronic source of fine sediment. Decommissioning FSR 1672479 would eliminate fine sediment impacts from this road and reduce fine sediment levels in Camp Creek and the Little Malheur River below the baseline condition.

FSR1672457 will remain closed in the near future. This is a native surface road that accesses the Little Malheur River trailhead.

Riparian Hardwood Planting: Hardwoods (cottonwood, willow, and dogwood) were planted in the riparian areas along the lower reaches of the Little Malheur River and Camp Creek in June 2003. Native rooted stock was used. As more rooted stock comes available additional plantings along the Little Malheur River and Camp Creek will occur. The objective of this activity is to speed the recovery of the riparian shrub community from the effects of the 2002 fire, restore hardwoods to areas where past management activities had previously eliminated them or reduced their numbers, improve stream bank stability, and increase stream shading.

Future Foreseeable Management Activities

Wallowa-Whitman National Forest Monument Fire Recovery Project:

The Monument Fire Recovery project on the Wallowa-Whitman National Forest portion of the fire is located in the Burnt River subbasin. The Monument Fire Recovery Project on the Malheur National Forest is located in the Malheur subbasin. There will be no cumulative effects to water quality, or aquatic habitat because these projects are located in different subbasins.

Livestock Grazing: Cumulative effects with the resumption of livestock grazing are unlikely if grazing occurs after hardwoods have reached a height above browse level, bank stability has reached 90%, and bank vegetation has recovered to mid to late seral conditions.

Resumption of grazing prior to these conditions may result in cumulative effects. Banks are likely to be damaged thus resulting in increased W/D ratios, increases in fine sediment, and increases in water temperature. Recovery of stream channels will be delayed and full recovery may not occur. Recovery of Camp Creek will be longer if grazing is resumed prior to recovery of channel stability under Alternative 2 compared to Alternative 1 because of the reduced amount of woody debris resulting from proposed salvage activities in RHCAs.

Upper North Fork Malheur River Watershed

Direct and indirect effects from activities proposed under Alternative 2 will not extend beyond the project area boundaries. Therefore, there will be no cumulative effects in the Upper North Fork Malheur River Watershed from Alternative 2.

Effects to Redband Trout

Little Malheur River Watershed

Removing standing dead trees < 20" dbh from RHCAs will result in a reduction in the amount of woody debris levels in the Little Malheur River and Camp Creek. Pool habitat will be reduced by an estimated 2 pools in the Little Malheur River and 18 pools in Camp Creek compared to Alternative 1. This would result in a reduction of 0.7 pools per mile in the Little Malheur River and 5.6 pools per mile in Camp Creek. However, since Forest Plan standard for LWD will be met for the next 100 years in both the Little Malheur River (Graphic 7) and Camp Creek (Graphic 8) it is likely that the Forest Plan standard for pools will also be met.

Removing standing dead trees < 20" dbh from RHCAs will also reduce cover and habitat complexity compared to Alternative 1. Reducing the amount of woody debris would also reduce the amount of woody debris available to buffer increases in fine sediment from future large erosion events.

Predicted erosion rates will be decreased by an estimated 10% as a result of increases in ground cover resulting from salvage activities compared to Alternative 1. This will result in a reduction of adverse impacts in 2004 to 0.7 miles of aquatic habitat in the Little Malheur River downstream from the confluence of Camp Creek based on our sediment impact model compared to Alternative 1.

Long-term reductions in fine sediment in the lower portion of the Little Malheur River and Camp Creek are likely to result from obliterating old skid trails and decommissioning FSR 1672479 compared to Alternative 1. The old skid trails and FSR 1672479 are chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels. However, there is potential for increases in fine sediment for 2 to 3 years following obliteration of the old skid trails because soil disturbance on about 5 acres will occur adjacent to Category 4 stream channels in unstable soils.

Alternative 2 will result in reducing existing shade levels along Camp Creek and the Little Malheur River by about 1% compared to Alternative 1 due to the removal of standing dead trees < 20" dbh. It is unlikely that the recovery of water temperatures to pre-fire levels will differ between Alternative 1 and Alternative 2.

Alternative 2 may impact individual redband trout or their habitat in the Little Malheur River Watershed but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species in the short-term. Alternative 2 will have a beneficial impact on redband trout and their habitat in the long-term due to a reduction in fine sediment levels.

Upper North Fork Malheur River Watershed

Alternative 2 will have no impact to individual redband trout or their habitat in the Upper North Fork Malheur River Watershed. Alternative 2 will not affect channel stability, physical habitat, or water quality elements. Therefore, affects to redband trout in the North Fork watershed are unlikely.

Alternative 3

Direct and Indirect Effects
Salvage Activities

Little Malheur River Watershed

Alternative 3 proposes to conduct salvage harvest activities on about 2,520 acres and in the Little Malheur subwatershed compared to 3,821 acres under Alternative 2. Helicopter logging will be used in all units in the watershed. Salvage activities are not planned for RHCAs in the Little Malheur River Watershed under Alternative 3.

The number of and locations of helicopter landings will be the same as proposed under Alternative 2. Haul routes for logs and fuel are the same as proposed under Alternative 2. Effects for these activities will be similar to those described for Alternative 2.

RHCAs on Category 2 and Category 4 streams in the Camp Creek drainage will have an additional buffer added to their normal widths in areas where Clarno soils are present. The erosion potential for this soil type is high. Category 2 streams will have an additional buffer of 50 ft added (200 ft total) and Category 4 streams will have an additional buffer of 100 ft added (200 ft total). The increased buffer widths will result in quantities of down wood in larger size classes (> 12" dbh) within 200 ft of channels being similar to levels as Alternative 1. This will increase the amount of fine sediment storage capacity in upslope areas. Since the majority of the larger down wood will be recruited 20 to 30 years from now this increase in sediment storage capacity will be available for future large erosion events (e.g. another large fire or an intense thunderstorm).

Channel Stability Elements: Channel stability elements will not be affected under Alternative 3 since standing dead trees < 20" dbh will not be salvaged from RHCAs. The recovery rate for channel stability will be the same as under Alternative 1.

Physical Habitat Elements: Felling and yarding activities in the uplands will be the same as proposed under Alternative 2. Impacts to aquatic habitat from salvage activities outside of RHCAs are unlikely based on Klock (1975).

Based on a 10% reduction in erosion in salvage units, WEPP predicts that about 18,000 tons of fine sediment from areas that were severely burned in the Little Malheur River watershed will be transported to Little Malheur River downstream of Camp Creek in 2004 under Alternative 3 compared to 19,870 tons under Alternative 1. Based on our sediment impact model, about 4.7 miles of the Little Malheur River downstream of Camp Creek would be impacted from fine sediment in 2004 compared to 5.2 miles under Alternative 1.

Table 26. Estimated miles of stream impacted from soil erosion from severely burned areas in the Little Malheur River Watershed under Alternative 3 compared to pre-fire conditions (2002). Stream miles impacted based on the average bankfull channel width and a fine sediment depth of 5 inches. Note: Beulah Reservoir is about 30 miles downstream from the project area.

Stream	Miles of Stream Affected by Fine Sediment by Year			
	2002	2003	2004	2005
Camp Cr	1.0	18.5	2.7	1.0
Little Malheur R	1.6	31.2	5.5	1.6
Little Malheur R below Camp Cr	1.4	27.8	4.7	1.4

Levels of LWD and woody debris would be similar to Alternaitve 1 because salvage harvest of standing dead trees would not occur in RHCAs. Level of pool habitat, cover, and habitat complexity will be similar to Alternative 1.

Water Quality Elements: There are no activities proposed under Alternative 3 that will affect shading or water temperatures. Recovery of shade and water temperatures will be the same as Alternative 1.

Upper North Fork Malheur River Watershed

Channel Stability, Physical Habitat, and Water Quality Elements: Alternative 3 proposes to conduct salvage activities on about 305 acres in the Swamp Creek subwatershed. No salvage activities are planned for RHCAs in the Swamp Creek subwatershed under Alternative 3. Effects to aquatic habitat and species will be the same as those described under Alternative 2.

Road Closure / Decommission Activities

Little Malheur River Watershed

Proposed activities in the Little Malheur River subwatershed are the same as those proposed under Alternative 2. Effects to aquatic habitat and species will be the same as those described under Alternative 2.

Upper North Fork Malheur River Watershed

Proposed activities in the Swamp Creek subwatershed are the same as those proposed under Alternative 2. Effects to aquatic habitat and species will be the same as those described under Alternative 2.

Obliteration of Old Skid Trails

Little Malheur River Watershed

Old skid trails dating from the late 1960s will be obliterated and restored to natural conditions. Effects to aquatic habitat and species will the same as those described under Alternative 2.

Cumulative Effects
Little Malheur River Watershed

Past Management Activities

Timber Harvest Activities: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Livestock Grazing: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Ongoing Management Activities

Roads: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Riparian Hardwood Planting: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Future Foreseeable Management Activities

Livestock Grazing: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Upper North Fork Malheur River Watershed
Direct and indirect effects from activities proposed under Alternative 3 will not extend beyond the project are boundaries. Therefore, there will be no cumulative effects in the Upper North Fork Malheur River Watershed from Alternative 3.

Effects to Redband Trout
Little Malheur River Watershed
Predicted erosion rates will be decreased by an estimated 10% as a result of increases in ground cover resulting from salvage activities compared to Alternative 1. This will result in a reduction of adverse impacts in 2004 to 0.5 miles of aquatic habitat compared to Alternative 1 in the Little Malheur River downstream from the confluence of Camp Creek based on our sediment impact model.

Long-term reductions in fine sediment in the lower portion of the Little Malheur River and Camp Creek are likely to result from obliterating old skid trails and decommissioning FSR 1672479 compared to Alternative 1. Old skid trails and FSR 1672479 have been chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels. However, there is potential for increases in fine sediment for 2 to 3 years because soil disturbance on about 5 acres will occur adjacent to Category 4 stream channels in unstable soils.

Pools and habitat complexity under Alternative 3 would be similar to Alternative 1 because removal of standing dead trees < 20” dbh in RHCAs would not occur. Alternative 3 will not adversely impact channel stability, physical habitat, or water quality elements.

Alternative 3 may impact redband trout in the short-term. Alternative 3 will have a beneficial impact on redband trout and their habitat in the long-term in the Little Malheur River Watershed.

Upper North Fork Malheur River Watershed
Alternative 3 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to redband trout in the North Fork watershed are unlikely.

Alternative 3 will have no impact to individual redband trout or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 4

Direct / Indirect Effects
Salvage Activities

Little Malheur River Watershed

Alternative 4 proposes to conduct salvage harvest activities on about 2,885 acres in the Little Malheur subwatershed compared to 3,821 acres under Alternative 2. Green tree harvest will occur on approximately 382 acres. Helicopter logging will be used in all units.

The number of helicopter landings will be reduced by one compared to Alternative 2. Haul routes for logs and fuel are the same as proposed under Alternative 2. Effects for these activities will be similar to those described for Alternative 2.

Salvage activities are not planned for RHCAs in the Little Malheur River subwatershed under Alternative 4.

Channel Stability Elements: Channel stability elements will not be affected under Alternative 4 since standing dead trees < 20" dbh will not be salvaged from RHCAs. The recovery rate for channel stability will be the same as under Alternative 1.

Physical Habitat Elements: Felling and yarding activities in the uplands will be the same as proposed under Alternative 2. Impacts to aquatic habitat from salvage activities outside of RHCAs are unlikely based on Klock (1975).

Based on a 10% reduction in erosion in salvage units, WEPP predicts that about 18,142 tons of fine sediment from areas that were severely burned in the Little Malheur River watershed will be transported to Little Malheur River downstream of Camp Creek in 2004 under Alternative 4 compared to 19,870 tons under Alternative 1. Based on our sediment impact model, this would result in adverse impacts in 2004 to about 4.7 miles of the Little Malheur River downstream of Camp Creek under Alternative 4 compared to 5.2 miles under Alternative 1 (Table 27).

Table 27. Estimated miles of stream impacted from soil erosion from severely burned areas in the Little Malheur River Watershed under Alternative 4 compared to pre-fire conditions. Stream miles impacted based on the average bankfull channel width and a fine sediment depth of 5 inches. Note: Beulah Reservoir is about 30 miles downstream from the project area.

Stream	Year			
	2002	2003	2004	2005
Camp Cr	1.0	18.5	2.8	1.0
Little Malheur R	1.6	31.2	5.5	1.6
Little Malheur R below Camp Cr	1.4	27.8	4.7	1.4

Levels of LWD and woody debris would be similar to Alternaitve 1 because salvage harvest of standing dead trees would not occur in RHCAs. Level of pool habitat, cover, and habitat complexity will be similar to Alternative 1.

Water Quality Elements: Activities proposed under Alternative 4 will not affect shading or water temperatures. Recovery of shade and water temperatures will be the same as Alternative 1.

Upper North Fork Malheur River Watershed

Channel Stability, Physical Habitat, and Water Quality Elements: Alternative 4 proposes to conduct salvage harvest activities on about 459 acres in the Swamp Creek subwatershed. Proposed activities in the Swamp Creek subwatershed are the same as those proposed under Alternative 2. Effects to aquatic habitat and species will be the same as those described under Alternative 2.

Road Closure / Decommission Activities

Little Malheur River Watershed

Proposed activities in the Little Malheur River subwatershed are the same as those proposed under Alternative 2. Effects to aquatic habitat and species will be the same as those described under Alternative 2.

Upper North Fork Malheur River Watershed

Proposed activities in the Swamp Creek subwatershed are the same as those proposed under Alternative 2. Effects to aquatic habitat and species will be the same as those described under Alternative 2.

Obliteration of Old Skid Trails

Little Malheur River Watershed

Old skid trails dating from the late 1960s will be obliterated and restored to natural conditions. Effects to aquatic habitat and species will the same as those described under Alternative 2.

Cumulative Effects
Little Malheur River Watershed

Past Management Activities

Timber Harvest Activities: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Livestock Grazing: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Ongoing Management Activities

Roads: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Riparian Hardwood Planting: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Future Foreseeable Management Activities

Livestock Grazing: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Upper North Fork Malheur River Watershed
Direct and indirect effects from activities proposed under Alternative 4 will not extend beyond the project are boundaries. Therefore, there will be no cumulative effects in the Upper North Fork Malheur River Watershed from Alternative 4.

Effects to Redband Trout
Little Malheur River Watershed
Predicted erosion rates will be decreased by an estimated 10% as a result of increases in ground cover resulting from salvage activities compared to Alternative 1. This will result in a reduction of adverse impacts in 2004 to 0.5 miles of aquatic habitat in the Little Malheur River downstream from the confluence of Camp Creek based on our sediment impact model compared to Alternative 1.

Long-term reductions in fine sediment in the lower portion of the Little Malheur River and Camp Creek are likely to result from obliterating old skid trails and decommissioning FSR 1672479 compared to Alternative 1. Old skid trails and FSR 1672479 have been chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels. However, there is potential for increases in fine sediment for 2 to 3 years because soil disturbance on about 5 acres will occur adjacent to Category 4 stream channels in unstable soils.

Pools and habitat complexity under Alternative 4 would be similar to Alternative 1 because removal of standing dead trees < 20" dbh in RHCAs would not occur. Alternative 4 will not adversely impact channel stability, physical habitat, or water quality elements.

Alternative 4 may impact redband trout in the short-term. Alternative 4 will have a beneficial impact on redband trout and their habitat in the long-term in the Little Malheur River Watershed.

Upper North Fork Malheur River Watershed
Alternative 4 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to redband trout in the North Fork watershed are unlikely.

Alternative 4 will have no impact to individual redband trout or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 5

Direct / Indirect Effects
Salvage Activities
Effects to aquatic habitat would be the same as those described for Alternative 1 because salvage activities would not occur.

Road Closure / Decommission Activities

Little Malheur River Watershed

Road closure and decommissioning activities on roads that are current sources of fine sediment are the same as those proposed under Alternative 2. Effects to aquatic habitat and species will be the same as those described under Alternative 2.

Upper North Fork Malheur River Watershed

Proposed activities in the Swamp Creek subwatershed are similar to those proposed under Alternative 2. Effects to aquatic habitat and species will be the same as those described under Alternative 2.

Obliteration of Old Skid Trails

Little Malheur River Watershed

Old skid trails dating from the late 1960s will be obliterated and restored to natural conditions. Effects to aquatic habitat and species will the same as those described under Alternative 2.

Cumulative Effects
Little Malheur River Watershed

Past Management Activities

Timber Harvest Activities: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Livestock Grazing: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Ongoing Management Activities

Roads: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Riparian Hardwood Planting: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Future Foreseeable Management Activities

Little Malheur River Watershed
Livestock Grazing: Cumulative effects to aquatic habitat and species will be the same as those described under Alternative 2.

Upper North Fork Malheur River Watershed
Direct and indirect effects from activities proposed under Alternative 4 will not extend beyond the project are boundaries. Therefore, there will be no cumulative effects in the Upper North Fork Malheur River Watershed from Alternative 4.

Effects to Redband Trout
Little Malheur River Watershed
Long-term reductions in fine sediment in the lower portion of the Little Malheur River and Camp Creek are likely to result from obliterating old skid trails and decommissioning FSR 1672479 compared to Alternative 1. Old skid trails and FSR 1672479 have been chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels. However, there is potential for increases in fine sediment for 2 to 3 years because soil disturbance on about 5 acres will occur adjacent to Category 4 stream channels in unstable soils.

Alternative 5 may impact redband trout in the short-term. Alternative 5 will have a beneficial impact on redband trout and their habitat in the long-term in the Little Malheur River Watershed.

Upper North Fork Malheur River Watershed
Alternative 5 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to redband trout in the North Fork watershed are unlikely.

Alternative 5 will have no impact to individual redband trout or their habitat in the Upper North Fork Malheur River Watershed.

Malheur Mottled Sculpin (Cottus bendirei)

Malheur mottled sculpin are a Region 6 sensitive species. Malheur mottled sculpin have recently been determined to be present in the Malheur River system including the N.F. Malheur River (Markle and Hill 2000). Prior to 2000, the distribution of Malheur mottled sculpin was thought to be limited to streams in the Harney basin.

Population Status

Little Malheur River Watershed

Malheur mottled sculpin have not been documented in the Little Malheur River or its tributaries. Suitable habitat for Malheur mottled sculpin was present in the Little Malheur River and Camp Creek in the analysis area prior to the 2002 fire (BE Map 9). However, the large amount of fine sediment in Camp Creek and the Little Malheur River resulting from thunderstorms after the 2002 fire has probably reduced the suitability of these streams to support Malheur mottled sculpin. Suitable habitat is not likely present in Hunter Creek due to intermittent flows in the lower portion.

Condition and Trend of Population
Sculpins were not found in the Little Malheur River above the Forest boundary or in Camp Creek during fish distribution surveys conducted by ODFW in 1990. However, in 1967 high

populations of sculpins were reported to be present in the Little Malheur drainage (USFS 1967).

Upper North Fork Malheur River Watershed

The distribution of Malheur mottled sculpin in the N.F. Malheur River and its tributaries is unknown at this time. However, large numbers of sculpins were found in the majority of streams sampled during fish distribution surveys by ODFW in 1992 (Table 28). Based on this information, suitable habitat for Malheur mottled sculpin is present in the majority of streams in the upper watershed (BE Map 24). Based on field observations, suitable spawning and rearing habitat for sculpins is present in Spring Creek.

Condition and Trend of Population

Sculpin were found in five out of the seven streams sampled by ODFW in 1992 (Table 32). Densities ranged from a low of zero to 0.988 per square meter in the streams sampled (Table 28). These data indicate that sculpin populations in the upper watershed are generally healthy. Sculpin populations are also present in Spring Creek, Cow Creek and Crane Creek (Buckman et al,. 1992).

Table 28. Population estimates of sculpin for streams sampled in the Upper North Fork Malheur River Watershed, 1992.

Stream	Population Estimate	Density (#/m2)
N.F. Malheur River	88,194	0.479
Little Crane Creek	7,254	0.358
Elk Creek (Includes N.F.)	10,778	0.988
S.F. Elk Creek	0	0.000
Sheep Creek	0	0.000
Swamp Creek	5,544	0.691
Flat Creek	4,104	0.889
Total	115,874	0.493

Life History Characteristics

Malheur mottled sculpin require cool-water streams with large gravel or rubble substrates for cover and spawning. They require water temperatures below 26°C with high dissolved oxygen and low turbidity. Malheur mottled sculpin are sensitive to changes in water quality including increases in water temperature and sediment. They are rarely found in areas with high levels of fine sediment. Spawning occurs in the spring generally from February through May. Sculpin attach their eggs in clumps to the underside of stones. Eggs hatch in about four weeks.

Environmental Baseline

Habitat requirements are similar for Malheur mottled sculpin and redband trout. See discussion of existing aquatic habitat conditions in the project area for redband trout.

Effects and Determination

Because of their similar habitat requirements, effects to Malheur mottled sculpin and their habitat will be similar as those to redband trout. See the discussion of direct, indirect, and cumulative effects to aquatic habitat for redband trout.

Alternative 1 – No Action

Little Malheur River Watershed

Of the two fish species with special management status currently present in the analysis area in the Little Malheur River watershed, Malheur mottled sculpin will probably be most impacted by current post-fire conditions due to the large increases in fine sediment resulting from the 2002 fire. Cobble substrate serves as spawning habitat, and rearing habitat for juvenile and adult sculpins. Habitat for sculpin will be eliminated where interstitial spaces between cobble substrate are filled.

Based on our sediment impact model, adverse effects to mottled sculpins are likely due to the amount of fine sediment that will be present in Camp Creek, and the Little Malheur River. In 2003, interstitial spaces between cobble substrate are likely be filled by fine sediment in Camp Creek and the Little Malheur above Camp Creek. Interstitial spaces between cobble substrate may be filled by fine sediment for up to 27.8 miles in the Little Malheur River below Camp Creek.

Effects from fine sediment will begin to decline in 2004. Interstitial spaces between cobble substrate are still likely be filled by fine sediment in Camp Creek and the Little Malheur above Camp Creek. However, impacts to mottled sculpin habitat will likely be reduced to 5.2 miles in the Little Malheur River below Camp Creek. Erosion rates will likely return to pre-fire levels sometime in 2005 through 2007. It will likely take an additional two years for fine sediment levels in the Little Malheur River to return to pre-fire levels; from 2007 to 2009.

While mottled sculpins are relatively long lived, about 5 years, the timeframe for impacts to mottled sculpin habitat in Camp Creek and the Little Malheur River above Camp Creek are potentially longer than 1 generation. Therefore there is the potential for the sculpin population to experience a major decline in these areas due to the lack of successful reproduction, and lack of habitat for juveniles and adults.

Road Closure and Decommission Activities

Failure or delaying for another environmental analysis the decommissioning of FSR 1672479 will impact aquatic habitat due to elevated levels of fine sediment in Camp Creek. This road has essentially been abandoned and is contributing fine sediment to Camp Creek in its present condition.

Obliteration of Old Skid Trails

By not obliterating old skid trails in the Camp Creek drainage an opportunity to reduce chronic inputs of fine sediment into Camp Creek and the Little Malheur River will be missed. These old skid trails show evidence of continual erosion since their construction and use in the late 1960s. They are located adjacent to and in some places in Category 4 stream channels. Failure to obliterate these skid trails will lengthen the recovery process of Camp Creek and to a lesser extent the Little Malheur River due to elevated levels of fine sediment.

Alternative 1 may impact individual Malheur mottled sculpin or their habitat in the Little Malheur River Watershed due to elevated levels of fine sediment resulting from

the 2002 fire but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species at the watershed scale.

Upper North Fork Malheur River Watershed
Alternative 1 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to Malheur mottled sculpin in the Upper North Fork Malheur River Watershed are unlikely.

Alternative 1 will have no impact to individual Malheur mottled sculpin or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 2

Little Malheur River Watershed
Compared to Alternative 1, Alternative 2 will reduce the impacts to sculpin from increases in fine sediment resulting from the 2002 fire. Based on our sediment impact model, in 2004 an estimated 4.5 miles of the Little Malheur River below Camp Creek may be adversely impacted under Alternative 2 from erosion from the fire area compared to 5.2 miles under Alternative 1.

Alternative 2 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided because old skid trails will be restored and FSR 1672479 will be decommissioned. The old skid trails and FSR 1672479 are chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels.

Reductions in woody debris, pool habitat, cover, and habitat complexity due to the proposal to salvage dead trees < 20" dbh in RHCAs will have less of an effect to sculpin compared to redband trout. These features of aquatic habitat are relatively less important to sculpin compared to the availability of cobble substrate with low levels of embeddness.

Alternative 2 may impact individual Malheur mottled sculpin or their habitat in the Little Malheur River Watershed but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species in the short-term. Alternative 2 will have a beneficial impact on Malheur Mottled sculpin and their habitat in the long-term due to an reduction in fine sediment levels.

Upper North Fork Malheur River Watershed
Alternative 2 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to Malheur Mottled sculpin in the North Fork watershed are unlikely.

Alternative 2 will have no impact to individual Malheur Mottled sculpin or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 3

Little Malheur River Watershed
Compared to Alternative 1, Alternative 3 will reduce the impacts to sculpin from increases in fine sediment resulting from the 2002 fire. Based on our sediment impact model, in 2004 an estimated 4.7 miles of the Little Malheur River downstream of Camp Creek may be adversely impacted under Alternative 3 from erosion from the fire area compared to 5.2 miles under Alternative 1.

Alternative 3 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided because old skid trails will be restored and FSR 1672479

will be decommissioned. The old skid trails and FSR 1672479 are chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels.

Alternative 3 will result in the similar levels of woody debris, pool habitat, cover, and habitat complexity as Alternative 1 because dead trees < 20" dbh would not be salvaged from RHCAs.

Alternative 3 may impact individual Malheur mottled sculpin or their habitat in the Little Malheur River Watershed. Alternative 3 will have a beneficial impact on Malheur Mottled sculpin and their habitat in the long-term.

Upper North Fork Malheur River Watershed
Alternative 3 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to Malheur mottled sculpin in the North Fork watershed are unlikely.

Alternative 3 will have no impact to individual Malheur mottled sculpin or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 4

Little Malheur River Watershed
Compared to Alternative 1, Alternative 4 will reduce the impacts to sculpin from increases in fine sediment resulting from the 2002 fire. Based on our sediment impact model, in 2004 an estimated 4.7 miles of the Little Malheur River downstream of Camp Creek may be adversely impacted under Alternative 4 from erosion from the fire area compared to 5.2 miles under Alternative 1.

Alternative 4 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided because old skid trails will be restored and FSR 1672479 will be decommissioned. The old skid trails and FSR 1672479 are chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels.

Alternative 4 will result in the similar levels of woody debris, pool habitat, cover, and habitat complexity as Alternative 1 because dead trees < 20" dbh would not be salvaged from RHCAs.

Alternative 4 may impact individual Malheur mottled sculpin or their habitat in the Little Malheur River Watershed. Alternative 4 will have a beneficial impact on Malheur Mottled sculpin and their habitat in the long-term.

Upper North Fork Malheur River Watershed
Alternative 4 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to Malheur mottled sculpin in the North Fork watershed are unlikely.

Alternative 4 will have no impact to individual Malheur mottled sculpin or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 5

Little Malheur River Watershed
Alternative 5 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided. Old skid trails and FSR 1672479 have been chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels. Long-term reductions in fine sediment in the lower portion of the Little

Malheur River and Camp Creek are likely to result from obliterating old skid trails and decommissioning FSR 1672479 compared to Alternative 1. However, there is potential for increases in fine sediment for 2 to 3 years because soil disturbance on about 5 acres will occur adjacent to Category 4 stream channels in unstable soils.

Alternative 5 will result in the similar levels of woody debris, pool habitat, cover, and habitat complexity as Alternative 1 because dead trees < 20" dbh would not be salvaged from RHCAs.

Alternative 5 may impact individual Malheur mottled sculpin or their habitat in the Little Malheur River Watershed. Alternative 5 will have a beneficial impact on Malheur Mottled sculpin and their habitat in the long-term.

Upper North Fork Malheur River Watershed
Alternative 5 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to redband trout in the North Fork watershed are unlikely.

Alternative 5 will have no impact to individual Malheur mottled sculpin or their habitat in the Upper North Fork Malheur River Watershed.

Columbia Spotted Frog (Rana luteiventris)

Population Status

Little Malheur River Watershed

Columbia spotted frogs were observed along the Little Malheur River during the 1999 stream survey and along Camp Creek in 2002 (BE Map 10). Spotted frogs are also likely to be present along other low gradient streams as well as to be present in ponds and springs in the upper Little Malheur subwatershed (BE Map 10).

Condition and Trend of Population
No data are available to determine the present status of the spotted frog population in the subwatershed. Adverse effects to frogs from wildfires are generally relatively benign. Frogs have the ability to escape direct adverse effects by seeking shelter during fires (FEIS 2002). Short-term adverse effects may occur following large fires due the loss of hiding cover along streams and ponds resulting in an increase in predation rates. A decrease in the spotted frog population along Camp Creek is likely due to the loss of habitat that resulted from the 2002 fire.

Upper North Fork Malheur River Watershed

Columbia spotted frogs have been observed along low gradient streams in the Upper North Fork Malheur River Watershed. Spotted frogs are likely to be present along Spring Creek (BE Map 25). There are no known ponds or springs in the project area in the Upper North Fork Malheur River watershed.

Condition and Trend of Population
Data are not available to determine the present status of the spotted frog population in the subwatershed. It is unlikely the 2002 fire impacted the spotted frog population in Spring Creek because the fire occurred outside of potential habitat areas.

Life History Characteristics

Spotted frogs are highly aquatic and are rarely found far from permanent water. They are usually found along the grassy margins of streams, lakes, ponds, springs, and marshes.

Breeding occurs in the spring varying with elevation. In the Columbia basin of Washington, breeding occurs from March to April in lower elevations, and from May to June in the higher elevations. Breeding habitat is usually found in shallow water in ponds or other quiet waters along streams. Breeding may also occur in flooded areas adjacent to streams and ponds. Adults may disperse overland in the spring and summer after breeding. During winter, spotted frogs burrow into banks adjacent to streams, ponds, and springs.

Environmental Baseline

Suitable habitat for Columbia spotted frogs was present along perennial streams and ponds in the analysis area prior to the 2002 fire. Habitat conditions for spotted frogs along the lower reaches of the Little Malheur River should return to pre-fire conditions because of the relative light impacts to herbaceous vegetation adjacent to the river. Habitat for spotted frogs along Camp Creek will take longer to return to pre-fire conditions because of the intensity of the burn and the slowness of recovery of streamside vegetation.

Effects and Determination

Alternative 1 – No Action

Little Malheur River Watershed

Alternative 1 will not impact individual Columbia spotted frogs or their habitat in the Little Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Habitat for Columbia spotted frogs in the project area would recover from the effects of the 2002 fire at natural rates. Habitat would recover relatively quickly along the lower reaches of the Little Malheur River due to the low effects of the fire on streamside vegetation. Recovery of habitat along the lower reaches of Camp Creek will take longer due to the severe effects of the 2002 fire on streamside vegetation. Spotted frog populations will rebound to pre-fire conditions as habitat recovers.

Upper North Fork Malheur River Watershed

Alternative 1 will not impact individual Columbia spotted frogs or their habitat in the Upper North Fork Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Spotted frogs were unlikely to have been impacted by the 2002 fire because the fire occurred outside of potential habitat areas. Alternative 1 will have no impact to spotted frogs or their habitat.

Alternative 2

Little Malheur River Watershed

Direct / Indirect Effects

There are four ponds, two undeveloped springs, and five developed springs where activities are proposed in the project area in the Little Malheur River watershed (BE Map 11). There are an additional two ponds, one spring and 2 developed springs in the project area where no activities are proposed (BE Map 11). Ponds and large springs in salvage activity areas will be protected from disturbance with 100 ft no cut buffers. Smaller springs and seeps in salvage activity areas will be protected with 50 ft no cut buffers.

Harvesting of standing dead trees < 20” dbh along the Little Malheur River and Camp Creek has the potential to disturb habitat and impact individuals where trees are felled into and yarded through habitat areas. However, directional falling of trees away from stream channels and the use of helicopters to yard trees will reduce the potential for adverse impacts.

Habitat in upland areas associated with ponds, springs, and seeps will be protected with no-cut areas. Ponds and large springs in salvage activity areas will be protected from disturbance with 100 ft no cut buffers. Smaller springs and seeps in salvage activity areas will be protected with 50 ft no cut buffers.

Cumulative Effects
Direct and indirect effects to spotted frog habitat from activities proposed under Alternative 2 will not extend beyond the project are boundaries. Therefore, there will be no cumulative effects in the Little Malheur River watershed from Alternative 2.

Determination
Alternative 2 may impact individual Columbia spotted frogs or their habitat in the Little Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Generally, proposed activities will not occur in habitat for spotted frogs (streams, stream margins, ponds, and springs). However, adverse impacts to individual Columbia spotted frogs may occur during felling and yarding activities in RHCAs. Directional falling of trees away from stream channels and the use of helicopters to yard trees will mitigate potential impacts to habitat adjacent to streams. Potential impacts to habitat associated with ponds, springs, and seeps will be protected with no-cut areas. Ponds and large springs in salvage activity areas will be protected from disturbance with 100 ft no cut buffers. Smaller springs and seeps in salvage activity areas will be protected with 50 ft no cut buffers.

Upper North Fork Malheur River Watershed
Direct / Indirect Effects
Habitat for Columbia spotted frogs is not present in the Upper North Fork Malheur River Watershed portion of the project area. Salvage activities are not planned for RHCAs in the Swamp Creek subwatershed under Alternative 2. Adverse effects to spotted frog habitat in Spring Creek outside of the project area is not expected to occur due to the low erosion potential on these units and the current condition of RHCAs.

Cumulative Effects
Direct and indirect effects to spotted frog habitat from activities proposed under Alternative 2 will not extend beyond the project are boundaries. Therefore, there will be no cumulative effects in the Upper North Fork Malheur River Watershed from Alternative 2.

Determination
Alternative 2 will not impact individual Columbia spotted frogs or their habitat in the Upper North Fork Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Activities proposed will not occur in spotted frog habitat therefore adverse impacts to spotted frogs will not occur in the Upper North Fork Malheur River Watershed.

Alternative 3

Little Malheur River Watershed
Direct / Indirect Effects
There is one pond, two undeveloped springs, and three developed springs where activities are proposed in the project area in the Little Malheur River watershed (BE Map 12). There are an additional five ponds, one spring and four developed springs in the project area where no activities are proposed (BE Map 12).

Cumulative Effects
Activities are not proposed in RHCAs under Alternative 3. Habitat in upland areas associated with ponds, springs, and seeps will be protected with no-cut areas. Ponds and large springs in salvage activity areas will be protected from disturbance with 100 ft no cut buffers. Smaller springs and seeps in salvage activity areas will be protected with 50 ft no-cut buffers.

Direct and indirect effects to spotted frog habitat from activities proposed under Alternative 3 will not extend beyond the project are boundaries. Therefore, there will be no cumulative effects in the Little Malheur River watershed from Alternative 3.

Determination
Alternative 3 will not impact individual Columbia spotted frogs or their habitat in the Little Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Potential impacts to habitat associated with riparian areas and stream channels will be protected from disturbance by foregoing salvage activities in RHCAs. Potential impacts to habitat associated with ponds, springs, and seeps will be protected with no-cut areas. Ponds and large springs in salvage activity areas will be protected from disturbance with 100 ft no cut buffers. Smaller springs and seeps in salvage activity areas will be protected with 50 ft no cut buffers.

Upper North Fork Malheur River Watershed
Direct / Indirect Effects
Habitat for Columbia spotted frogs is not present in the Upper North Fork Malheur River Watershed portion of the project area. Salvage activities are not planned for RHCAs in the Swamp Creek subwatershed under Alternative 3. Adverse effects to spotted frog habitat in Spring Creek outside of the project area is not expected to occur due to the low erosion potential on these units and the current condition of RHCAs. Therefore effects from activities proposed in this portion of the project area will not extend beyond the project area.

Cumulative Effects
Direct and indirect effects to spotted frog habitat from activities proposed under Alternative 3 will not extend beyond the project are boundaries. Therefore, there will be no cumulative effects in the Upper North Fork Malheur River Watershed from Alternative 3.

Determination
Alternative 3 will not impact individual Columbia spotted frogs or their habitat in the Upper North Fork Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Activities proposed will not occur in spotted frog habitat therefore adverse impacts to spotted frogs will not occur in the Upper North Fork Malheur River Watershed.

Alternative 4

Little Malheur River Watershed
Direct / Indirect Effects
There are three ponds, two undeveloped springs, and five developed springs where activities are proposed in the project area in the Little Malheur River watershed (BE Map 13). There are an additional three ponds, one spring and two developed springs in the project area where no activities are proposed (BE Map 13).

Activities are not proposed in RHCAs under Alternative 4. Habitat in upland areas associated with ponds, springs, and seeps will be protected with no-cut areas. Ponds and

large springs in salvage activity areas will be protected from disturbance with 100 ft no cut buffers. Smaller springs and seeps in salvage activity areas will be protected with 50 ft no cut buffers.

Cumulative Effects
Direct and indirect effects to spotted frog habitat from activities proposed under Alternative 4 will not extend beyond the project are boundaries. Therefore, there will be no cumulative effects in the Little Malheur River watershed from Alternative 4.

Determination
Alternative 4 will not impact individual Columbia spotted frogs or their habitat in the Little Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Potential impacts to habitat associated with riparian areas and stream channels will be protected from disturbance by foregoing salvage activities in RHCAs. Potential impacts to habitat associated with ponds, springs, and seeps will be protected with no-cut areas. Ponds and large springs in salvage activity areas will be protected from disturbance with 100 ft no cut buffers. Smaller springs and seeps in salvage activity areas will be protected with 50 ft no cut buffers.

Upper North Fork Malheur River Watershed
Direct / Indirect Effects
Habitat for Columbia spotted frogs is not present in the Upper North Fork Malheur River Watershed portion of the project area. Salvage activities are not planned for RHCAs in the Swamp Creek subwatershed under Alternative 4. Adverse effects to spotted frog habitat in Spring Creek outside of the project area is not expected to occur due to the low erosion potential on these units and the current condition of RHCAs. Therefore effects from activities proposed in this portion of the project area will not extend beyond the project area.

Cumulative Effects
Direct and indirect effects to spotted frog habitat from activities proposed under Alternative 4 will not extend beyond the project are boundaries. Therefore, there will be no cumulative effects in the Upper North Fork Malheur River Watershed from Alternative 4.

Determination
Alternative 4 will not impact individual Columbia spotted frogs or their habitat in the Upper North Fork Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Activities proposed will not occur in spotted frog habitat therefore adverse impacts to spotted frogs will not occur in the Upper North Fork Malheur River Watershed.

Alternative 5

Little Malheur River Watershed
Direct / Indirect Effects
Proposed activities will not occur in habitat areas for Columbia spotted frogs therefore there will be no direct or indirect effects to Columbia spotted frogs.

Cumulative Effects
Since there are no direct or indirect effects to Columbia spotted frogs from activities proposed under Alternative 5 there will by no cumulative effects associated with Alternative 5.

Determination
Alternative 5 will not impact individual Columbia spotted frogs or their habitat in the Little Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Activities proposed will not occur in spotted frog habitat therefore adverse impacts to spotted frogs will not occur in the Little Malheur River Watershed.

Upper North Fork Malheur River Watershed
Direct / Indirect Effects
Proposed activities will not occur in habitat areas for Columbia spotted frogs therefore there will be no direct or indirect effects to Columbia spotted frogs.

Cumulative Effects
Since there are no direct or indirect effects to Columbia spotted frogs from activities proposed under Alternative 5 there will by no cumulative effects associated with Alternative 5.

Determination
Alternative 5 will not impact individual Columbia spotted frogs or their habitat in the Upper North Fork Malheur River Watershed and will not contribute to a trend towards federal listing or cause a loss of viability to the population or species. Activities proposed will not occur in spotted frog habitat therefore adverse impacts to spotted frogs will not occur in the Upper North Fork Malheur River Watershed.

C. Proposed, Threatened, and Endangered Aquatic Species

Bull Trout (Salvelinus confluentus)

On June 10, 1998, the U.S. Fish and Wildlife Service issued a final rule listing the Columbia River and Klamath River populations of bull trout as threatened (63 FR 31647) under the authority of the Endangered Species Act of 1973. This decision conferred full protection of the Endangered Species Act on bull trout occurring in four northwestern States. Bull trout are also a Malheur National Forest management indicator species. Bull trout in the Upper North Fork Malheur River Watershed are part of the Malheur River metapopulation that includes local populations in both the upper Malheur River and the N.F. Malheur River systems.

Population Status

Little Malheur River Watershed

Bull trout do not currently rear in the Little Malheur River or its tributaries on the Malheur National Forest (Buchanan et al. 1997; Ray Perkins, ODFW, personal communication) (BE Map 14).

Bull trout were last reported in the Little Malheur River on the Malheur National Forest near FSR 16 crossing in the late 1960's (Goetz 1989, Hanson et al. 1990, USFS 1967). Fluvial bull trout were observed to migrate into the lower reach of the Little Malheur River from Beulah Reservoir, then return to the N.F. Malheur River and continue to spawning areas in the upper N.F. Malheur River and tributaries during a radio-telemetry study in the late 1990's (BPTDFW 2000).

The Little Malheur River from the confluence with the N.F. Malheur River to its headwaters has been proposed to be designated as critical habitat for the North Fork Malheur River

population of bull trout (Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan: Malheur Recovery Unit). Effects to proposed critical habitat for bull trout are discussed in Section D of this BE.

Upper North Fork Malheur River Watershed

Rearing Habitat

Rearing habitat for juveniles and resident adult bull trout occurs in the main stem N.F. Malheur River from the headwaters downstream to the mouth of Crane Creek. Tributaries with rearing habitat are Swamp Creek, Elk Creek, N.F. Elk Creek, S.F. Elk Creek, Little Crane Creek, Sheep Creek, and Flat Creek (BE Map 14).

Rearing habitat for fluvial adult and subadult bull trout is present in the N.F Malheur River downstream of Crane Crossing to Beulah Reservoir. Beulah Reservoir also serves as winter rearing habitat for fluvial subadults and adults.

Spawning Habitat

ODFW has conducted annual spawning ground surveys since 1992 in the Upper North Fork Malheur River Watershed (Perkins 1998, 1999). Currently, bull trout spawning habitat is present in six tributaries and the upper reaches of the N.F. Malheur River (Table 29).

Table 29. Miles of Bull Trout Spawning in the North Fork Population area

Stream Name	Use	Miles of Bull Trout Spawning
Crane Cr.	Current	1.2
Deadhorse Cr.	Potential	0.7
Elk Cr.	Current	4.5
Flat Cr.	Potential	0.6
Fopian Cr.	Potential	0.4
Horseshoe Cr.	Current	1.3
Little Crane Cr.	Current	6.7
N. F. Malheur R.	Current	5.4
Sheep Cr.	Current	3.9
Swamp Cr.	Current	4.3

Migration Habitat

The main stem N.F. Malheur River serves as a migratory corridor for movement between rearing and spawning areas in tributaries and the upper River, and Beulah Reservoir. Seasonal thermal barriers occur on the main stem from river mile (RM) 21 to RM 59 (Bowers et al. 1993).

Condition and Trend of Population

The estimated Age 1+ population of bull trout in the North Fork population was 2,586 (±30%, 95% CI) in the early 1990's (Buchanan et al. 1997). Status of the local population was classified as "of special concern" in 1992 during the initial review of bull trout populations in Oregon (Ratliff and Howell 1992). In 1997, this classification remained unchanged during the second status review of bull trout populations in Oregon (Buchanan et al. 1997).

Based on redd count data, the North Fork population rapidly increased from 1996 and peaked in 2000 (Table 30). However, since 2001 the population has been declining (Table 30). Total number of redds declined from 158 in 2000 to 99 in 2002. Preliminary results indicate there were 61 redds in 2003 (Ray Perkins, ODFW, personal communication).

Table 30. Number of bull trout redds in N.F. Malheur River streams from 1996 through 2001. Numbers in parenthesis are percentage of total redds. N/S = Not surveyed

Stream	Number of Redds by Year						
	1996	1997	1998	1999	2000	2001	2002
Cow Cr	N/S	N/S	N/S	N/S	0 (0)	0 (0)	N/S
Deadhorse Cr	N/S	N/S	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Elk Cr	6 (15)	9 (14)	6 (8)	12 (10)	5 (2)	3 (2)	7 (7)
Flat Cr	N/S	N/S	N/S	N/S	N/S	0 (0)	N/S
Horseshoe Cr	N/S	N/S	4 (5)	4 (4)	9 (6)	6 (5)	3 (3)
Little Cow Cr	N/S	N/S	N/S	N/S	31 (2)	0 (0)	N/S
Little Crane Cr	8 (20)	16 (25)	20 (27)	33 (29)	60 (37)	74 (59)	45 (45)
N.F. Malheur R.	6 (15)	10 (16)	3 (4)	9 (8)	16 (8)	5 (4)	8 (8)
Sheep Cr	13 (32)	8 (13)	17 (23)	22 (19)	25 (14)	15 (12)	17 (17)
Swamp Cr	8 (20)	21 (33)	24 (32)	35 (30)	40 (25)	22 (18)	19 (19)
Total	41	64	74	115	158	125	99

Notes: 1) Observed by USFS.

Life History Characteristics

Bull trout (*Salvelinus confluentus*) are a member of the char family. Bull trout exhibit three life history forms in Oregon: resident, fluvial and adfluvial (Buchanan et al 1997). Resident life history forms spawn and rear in their natal streams. Fluvial life history forms migrate and rear to maturity in larger rivers. Adfluvial life history forms migrate and rear to maturity in lakes. Resident and fluvial life history forms are present in the North Fork Population (W. Bowers, ODFW, personal communication 1997). Migratory forms are larger and have a higher fecundity compared to resident forms (Goetz 1989).

Bull trout spawn from August through November when water temperatures drop to 5 to 9° C (Fraley and Shepard 1989). Bull trout require clean gravel with little silt for spawning (Weaver and White 1985). Increases in fine sediment can reduce embryo survival and fry emergence. Embryos incubate over winter and hatching occurs in January. Fry emerge from

the gravel in early spring. The extended incubation period suggests that embryos and fry are susceptible to highly variable stream flows, bed load movement and channel instability (Rieman and McIntyre 1993).

Bull trout fry utilize side channels, stream margins and other low velocity areas (Rieman and McIntyre 1993). As juveniles increase in size they utilize pools, undercut banks, areas with large wood and other highly complex habitat. Optimum juvenile growth occurs in water temperatures from 4 to 10° C (Buchanan and Gregory 1997). Feeding habits of juveniles change as size increases (Shepard et al. 1984). Juveniles less than 110 mm feed almost exclusively on aquatic insects. Juveniles from 110 to 140 mm begin to feed on fish. Resident fish rear to maturity in natal or nearby streams. Migratory life history forms generally migrate from natal streams to larger rivers or lakes at 2 to 3 years of age. Migration can occur in spring, summer or fall (Shepard et al. 1984).

Bull trout mature between 5 and 7 years of age (Rieman and McIntyre 1993). Fluvial adults require large pools with abundant cover in rivers. Adfluvial adults utilize all areas of lakes for rearing habitat (Hanzel 1986). Adults are found in water temperatures from 4 to 20° C with optimum temperatures $\leq$ 12° C (Buchanan and Gregory 1997). Feeding habits of adults vary according to life history form and food availability (Shepard et al. 1984). Resident adults feed on both insects and fish. Fluvial and adfluvial adults are predominantly piscivorous. Adults begin migrating to spawning areas in late spring through early fall (Martin 1985). Adults generally return to rearing areas within a month of spawning (Thiesfield et al. 1996).

USFS, ODFW, Bureau of Reclamation and Burns Paiute Tribe began a life history study on the North Fork population in 1998. Preliminary data analysis indicates that fluvial adult bull trout begin migrating from Beulah Reservoir in June and occupy habitat in the main stem below the Forest boundary. By July, majority of fluvial adults have migrated to areas in the main stem above Crane Creek. Fluvial adults begin entering tributaries in July and most are holding at or near spawning areas by early August.

Spawning is spread fairly evenly from late August through late September. Majority of spawning occurs in Swamp Creek, Little Crane Creek and Sheep Creek (Table 31). Seven-day average maximum water temperatures from August 15 through August 31 range from 10.6 to 11.0° C for these three streams (Table 31). Fluvial adults reenter the main stem following spawning and slowly move downstream to Beulah Reservoir from September through October.

Table 31. Distribution of bull trout redds in the Upper North Fork Malheur River Watershed in 2001 and 7-day mean maximum water temperatures from August 15 through August 31, 1998.

Stream	Percentage of Total Redds	7 Day Mean Maximum Temperature (°C)
Swamp Creek	18	No data available
Little Crane Creek	59	10.6
Sheep Creek	12	11.0
Elk Creek	2	10.9
Horseshoe Creek	5	No data available
N.F. Malheur R.	4	17.0

Environmental Baseline

Upper North Fork Malheur River Watershed

1. Subpopulation Characteristics

Subpopulation Size: ODFW conducted bull trout population surveys in the Upper North Fork Malheur River Watershed in 1991 and 1992 (Table 32). Highest numbers of age 1+ bull trout were found in Swamp and Little Crane creeks. These streams also had the highest estimates of age 0 bull trout. Bull trout ranged in size from 30 to 400 mm indicating all life history stages were present. Angling for bull trout has been restricted to catch and release since 1991. Since 2000, the total number of redds has declined from 158 to 99 in 2002 (Table 32). This criterion is **functioning at risk**.

Table32. Population estimates of bull trout in the Upper North Fork Malheur River Watershed, summer 1991 and 1992. Adapted from Buchanan et al. 1997.

Year	Stream	Age 1+
1991	Elk Creek	175
	S.F. Elk Creek	113
	N.F. Malheur River (RK 92-96)	227
1992	Flat Creek	12
	Little Crane Creek	703
	N.F. Malheur River (RK 70-92)	161
	Sheep Creek	247
	Swamp Creek	948
	1991/92 Total Estimate	2,586 (± 30%, 95% CI)

Growth and Survival: No growth and survival data has been collected. However, survival has improved compared to the early 90s based on the increase in redds since 1992. Based on the data requirements for this element, this criterion is functioning at risk.

Life History Diversity and Isolation: Migratory form is present in North Fork Population. Rearing habitat for fluvial adults is present. Fluvial adults have access to all known spawning areas in the watershed. This criterion is functioning appropriately.

Persistence and Genetic Integrity: North Fork Population is rated at low risk of extinction (Buchanan et al. 1997). Brook trout are not present in the subbasin. There are no isolated local populations in the North Fork Population area. However, at this time there is no genetic exchange occurring between the North Fork and Upper Malheur subpopulations. This criterion is functioning at risk.

2. Water Quality

Temperature: Seven streams in the North Fork Population area are on the Oregon 303(d) list for not meeting temperature or other standards (Table 33). Water temperatures during summer months in streams with juvenile rearing habitat are generally functioning appropriately (Table 33). This criterion is **functioning at unacceptable risk**.

Table 33. Streams in North Fork Population area that do not meet Oregon water quality standards (Oregon Dept. Environmental Quality 303(d) list, 1998, data current as of 1/2001)

Stream	Reach	Criteria
Bear Creek	Mouth to Headwaters	> 64 F, summer rearing
Crane Creek	Mouth to Headwaters	> 50 F, Bull Trout
Elk Creek	Mouth to Headwaters	> 50 F, Bull Trout
Little Crane Creek	Mouth to Headwaters	> 50 F, Bull Trout
Little Malheur River	Mouth to Headwaters	> 64 F, summer rearing
North Fork Malheur River	Beulah Res. to Crane Creek	Flow Modification and > 64 F, summer rearing
North Fork Malheur River	Crane Creek to headwaters	> 50 F, Bull Trout
Sheep Creek	Mouth to Headwaters	> 50 F, Bull Trout

Table 34. Water temperatures recorded during summer months for streams in the North Fork Malheur River population area. Data from 1997.

Stream	No. Days w/ Temp. Data	No. Days FA (% Of days)	No. Days FAR (% Of days)	No. Days FUR (% Of days)	Max. 7-Day Max. Avg. Temp. (Date[s])	Rating
Crane Cr	140	22 (16%)	30 (21%)	88 (63%)	66.1 (7/26)	FUR
Elk Cr	234	231 (99%)	3 (1%)	0 (0%)	53.9 (8/7-8)	FA
Little Crane Cr	151	145 (96%)	6 (4%)	0 (0%)	54.1 (7/26)	FA
Sheep Cr	149	124 (83%)	20 (13%)	5 (4%)	55.3 (8/8)	FA
N.F. Malheur R (upper)	150	119 (79%)	31 (21%)	0 (0%)	55.7 (8/8)	FAR

N.F. Malheur R (lower)	119	26 (22%)	13 (11%)	80 (67%)	72.5 (8/6)	FUR

FA = Functioning Appropriately, FAR = Functioning as Risk, FUR = Functioning at Unacceptable Risk

The following streams were identified as occupied habitat within the North Fork Malheur River Subpopulation, but the Forest Service has no temperature data: South Fork Elk Creek, North Fork Elk Creek, Swamp Creek and Flat Creek.

Sediment: Fine sediment estimates ranged from 31% to 40% in tributary streams surveyed (Table 35). Swamp Creek, Sheep Creek, Elk Creek, and the upper N.F. Malheur River are known spawning streams for the N.F. Malheur subpopulation. Spawning may also occur in Flat Creek. This criterion is **functioning at unacceptable risk**.

Table 35. Percent fines (sand, silt and organics) (ODFW) and percentage of units with sand as dominant substrate (USFS). Data from ODFW stream surveys (1991) and USFS stream surveys (1989 - 90)

Bull Trout Presence	Stream	Percent Fine Sediment	Units with Sand Substrate Dominant (%)	Functionality
Occupied*	Crane Creek	-	4	FA
	Elk Creek**	40	-	FUR
	N.F. Elk Creek**	40	-	FUR
	S.F. Elk Creek**	41	-	FUR
	Flat Creek**	41	-	FUR
	N.F. Malheur River1	38	2	FUR
	Sheep Creek**	31	-	FUR
	Swamp Creek**	40		FUR
	Mean	39		FUR
Unoccupied	Bear Creek	-	18	FAR
	Buttermilk Creek	-	0	FA
	Halfway Creek	-	9	FA
	Little Malheur River	-	2	FA
	N.F. Malheur River2	-	1	FA
	Mean		6	
	Watershed Mean	39		FUR

* Summer rearing habitat
** ODFW Stream Survey
1) Upstream of Crane Creek. Percent fine data from ODFW survey from Horseshoe Creek to headwaters.
2) Forest boundary to Crane Creek

Chemical Contamination\Excess Nutrients: Oregon Department of Environmental Quality has identified no streams on National Forest lands in the North Fork Population area for chemical contamination or excess nutrients. This criterion is **functioning appropriately**.

3. Habitat Access

Physical Barriers: While no man-made barriers have been reported by USFS or ODFW stream survey crews, it is likely that some road culverts may impede juvenile fish passage at base flows. Therefore, this criterion is **functioning at risk**.

4. Habitat Elements

Substrate embeddedness: Percentage of habitat units with embeddedness greater than 35% ranged from 0 to 49% in streams surveyed by USFS (Table 36). Embeddedness data was not collected during ODFW surveys. High percentages of fine sediment in streams surveyed by ODFW suggest that embeddedness rates are also high. This criterion is **functioning at unacceptable risk**.

Table 36. Percentage of units embedded >35%. Data from USFS stream surveys (1989 - 90). Embeddedness data was not collected during ODFW surveys.

Bull Trout Presence	Stream	% Units Embedded >35%	Functionality
Occupied*	Crane Creek	15	FA
	Elk Creek**	-	FUR
	N.F. Elk Creek**	-	FUR
	S.F. Elk Creek**	-	FUR
	Flat Creek**	-	FUR
	N.F. Malheur River1	40	FUR
	Sheep Creek**	-	FUR
	Swamp Creek**	-	FUR
	Mean	28	FUR
Unoccupied	Bear Creek	49	FUR
	Buttermilk Creek	0	FA
	Halfway Creek	25	FAR
	Little Malheur River	24	FAR
	N.F. Malheur River2	100	FUR
	Mean	40	FUR
	Watershed Mean	36	FUR

* Summer rearing habitat
** ODFW Stream Survey
1) Upstream of Crane Creek
2) Forest boundary to Crane Creek

Large Wood: LWD size classes differ between USFS and ODFW surveys. ODFW classifies LWD as being > 6" in diameter and > 10ft. in length. This results in LWM data collected by ODFW including LWM smaller than USFWS and USFS criteria. We used ODFW habitat benchmarks to determine functionality for ODFW surveyed streams. ODFW considers greater than 20 pieces of LWD per 100 meters as desirable and less than 10 pieces of LWD per 100 m as undesirable. We converted these to: 1) Functioning Appropriately: > 20 pieces per mile, 2) Functioning at Risk: 10 to 20 pieces of per 100 m, and 3) Functioning at Unacceptable Risk: < 10 pieces per 100 m. Overall streams are **functioning at risk** for LWD (Table 37).

Table 37. Number of pieces of LWD[3] per mile. Data from ODFW stream surveys (1991) and USFS stream surveys (1989, 1990 & 2001)

Bull Trout Presence	Stream	Pieces of LWM per Mile3	Functionality
Occupied*	Crane Creek	56	FA
	Elk Creek**	264	FAR
	N.F. Elk Creek**	235	FAR
	S.F. Elk Creek**	202	FAR
	Flat Creek**	204	FAR
	N.F. Malheur River1	45	FA
	Sheep Creek**	225	FAR
	Swamp Creek**	337	FA
	Horseshoe Creek	20	FA
	Mean	176	FAR
Unoccupied	Bear Creek	14	FUR
	Buttermilk Creek	26	FA
	Halfway Creek	68	FA
	Little Malheur River	25	FA
	N.F. Malheur River2	21	FA
	Deadhorse Creek	26	FA
	Spring Creek	37	FA
	Mean	31	FA
	Watershed Mean	113	FAR

* Summer rearing habitat
** ODFW Stream Survey
1) Upstream of Crane Creek
2) Forest boundary to Crane Creek
3) ODFW LWM: ≥6"Diam & ≥10'Long, USFS LWM: >12"Diam & >35'Long

Pool Frequency and Quality: Pool frequency ranged from 7 to 77 pools per mile in streams surveyed (Table 38). Majority of streams are below USFWS matrix benchmarks. This criterion is functioning at unacceptable risk.

Table 38. Number of pools per mile in surveyed streams in the Upper North Fork Malheur River Watershed. Data from ODFW stream surveys (1991) and USFS stream surveys (1989, 1990 & 2001)

Bull Trout Presence	Stream	Pools per Mile	Functionality
Occupied*	Crane Creek	7	FUR
	Elk Creek**	27	FUR
	N.F. Elk Creek**	47	FUR
	S.F. Elk Creek**	70	FA
	Flat Creek**	24	FUR
	N.F. Malheur River1	3	FUR
	Sheep Creek**	38	FUR
	Swamp Creek**	77	FA
	Horseshoe Creek	59	FAR
	Mean	39	FUR
Unoccupied	Bear Creek	5	FUR
	Buttermilk Creek	6	FUR
	Halfway Creek	4	FUR
	Little Malheur River	3	FUR
	N.F. Malheur River2	<<1	FUR
	Deadhorse Creek	61	FA
	Spring Creek	30	FAR
	Mean	16	FUR
	Watershed Mean	27	FUR

* Summer rearing habitat
** ODFW Stream Surveys
1) Upstream of Crane Creek
2) Forest boundary to Crane Creek

Large Pools: Large pools (> 3 ft deep) are not abundant in the watershed (Table 39). This criterion is functioning at unacceptable risk.

Table 39. Number of large pools (> 3 ft deep) per mile in surveyed streams in the Upper North Fork Malheur River Watershed. Data not available for ODFW stream surveys. Data from USFS stream surveys (1989, 1990 & 2001)

Bull Trout Presence	Stream	Large Pools per Mile	Functionality
Occupied*	Crane Creek	0.2	FUR
	Elk Creek**	-	-
	N.F. Elk Creek**	-	-
	S.F. Elk Creek**	-	-
	Flat Creek**	-	-
	N.F. Malheur River1	0.0	FUR
	Sheep Creek**	-	-
	Swamp Creek**	-	-
	Horseshoe Creek	0	FUR
	Mean	0.06	FUR
Unoccupied	Bear Creek	0.9	FAR
	Buttermilk Creek	0.0	FUR
	Halfway Creek	0.0	FUR
	Little Malheur River	0.5	FUR
	N.F. Malheur River2	0.4	FUR
	Deadhorse Creek	0.2	FUR
	Spring Creek	0.0	FUR
	Mean	0.4	FUR
	Watershed Mean	0.3	FUR

* Summer rearing habitat
** ODFW Stream Surveys
1) Upstream of Crane Creek
2) Forest boundary to Crane Creek

Off-channel Habitat: Off-channel habitat in the form of secondary channels and side channels ranges from 0 to 23% of available habitat in streams that have been surveyed (Table 40). Off-channel habitat averages about 12% of total habitat area in streams occupied by bull trout. Off-channel habitat in unoccupied streams averages about 2% of total habitat area. This criterion is functioning at risk.

Table 40. Percentage of channel area in secondary channels (ODFW) and side channels (USFS) in streams in the Upper North Fork Malheur River Watershed. Data from ODFW stream surveys (1991) and USFS stream surveys (1989, 1990 & 2001)

Bull Trout Presence	Stream	Area in Off Channel Habitat (%)	Functionality
Occupied*	Crane Creek	6.4	FAR
	Elk Creek**	7.4	FAR
	N.F. Elk Creek**	23.1	FA
	S.F. Elk Creek**	20.2	FA
	Flat Creek**	0.3	FUR
	N.F. Malheur River1	13.3	FA
	Sheep Creek**	11.0	FA
	Swamp Creek**	16.7	FA
	Horseshoe Creek	8.2	FAR
	Mean	11.8	FA
Unoccupied	Bear Creek	1.5	FUR
	Buttermilk Creek	0.0	FUR
	Halfway Creek	0.2	FUR
	Little Malheur River	5.1	FAR
	N.F. Malheur River2	2.9	FUR
	Deadhorse Creek	7.77	FAR
	Spring Creek	5.62	FAR
	Mean	3.3	FUR
	Watershed Mean	8.1	FAR

* Summer rearing habitat
** ODFW Stream Surveys
1) Upstream of Crane Creek
2) Forest boundary to Crane Creek

Refugia: There are four large-scale refugia areas in the North Fork Population area: Bear Creek Semi-primitive Area (2,127 acres), Glacier Mountain Semi-primitive Area (9,313 acres), N.F. Malheur River Wild and Scenic area (7,018 acres), and Monument Rock Wilderness Area (13,010 acres). The majority of tributaries to the N.F. Malheur River that are spawning areas for bull trout are in the Glacier Mountain Semi-primitive Area. The headwaters of the Little Malheur River are located in Monument Rock Wilderness. This criterion is functioning appropriately.

5. Channel Condition & Dynamics

Wetted Width/Maximum Depth Ratio: Mean width to depth ratios for surveyed streams ranged from 8 to 33 in streams with summer rearing habitat (Table 41). This criterion is functioning at risk.

Table 41. Mean width to depth ratios for in streams in the Upper North Fork Malheur River Watershed. Data from ODFW stream surveys (1991) and USFS stream surveys (1989, 1990 & 2001).

Bull Trout Presence	Stream	Width to Depth Ratio	Functionality
Occupied*	Crane Creek	15.8	FAR
	Elk Creek**	15.2	FAR
	N.F. Elk Creek**	8.5	FA
	S.F. Elk Creek**	8.0	FA
	Flat Creek**	11.5	FAR
	N.F. Malheur River1	18.4	FAR
	Sheep Creek**	10.0	FA
	Swamp Creek**	11.0	FAR
	Horseshoe Creek	12.8	FAR
	Mean	12.4	FAR
Unoccupied	Bear Creek	8.6	FA
	Buttermilk Creek	8.1	FA
	Halfway Creek	7.6	FA
	Little Malheur River	14.5	FAR
	N.F. Malheur River2	33.0	FUR
	Deadhorse Creek	10.1	FAR
	Spring Creek	17.3	FAR
	Mean	14.2	FAR
	Watershed Mean	13.1	FAR

* Summer rearing habitat
** ODFW Stream Surveys
1) Upstream of Crane Creek
2) Forest boundary to Crane Creek

Stream bank Conditions: Majority data for stream bank stability is 10 years old. Stream banks stability can change drastically from year to year depending upon soil types, grazing intensity and occurrence of large floods. Stream bank stability ranged from 92 to 100 percent stable for surveyed streams in 1991 (Table 42). Stream bank stability was less than 90% for some reaches. This criterion is functioning at risk because of the age of the data and presence of known problem areas.

Table 42. Percentage of stable stream banks for in streams in the Upper North Fork Malheur River Watershed. Data from ODFW stream surveys (1991) and USFS stream surveys (1989, 1990 & 2001).

Bull Trout Presence	Stream	Stable Banks (%)	Functionality
Occupied*	Crane Creek	-	-
	Elk Creek**	100	FA
	N.F. Elk Creek**	95	FA
	S.F. Elk Creek**	92	FA
	Flat Creek**	100	FA
	N.F. Malheur River1	95	FA
	Sheep Creek**	100	FA
	Swamp Creek**	99	FA
	Horseshoe Creek	90	FA
	Mean	96	FA
Unoccupied*	Bear Creek	-	-
	Buttermilk Creek	-	-
	Halfway Creek	-	-
	Little Malheur River	-	-
	N.F. Malheur River2	-	-
	Deadhorse Creek	98	FA
	Spring Creek	83	FAR
	Mean	91	FA
	Watershed Mean	95	FA

* Summer rearing habitat
** ODFW Stream Surveys
1) Upstream of Crane Creek. Percent stable bank data from ODFW survey from Horseshoe Creek to headwaters.
2) Forest boundary to Crane Creek

Floodplain Connectivity: Most streams in this assessment are not incised channels and over bank flows occur. This criterion is functioning appropriately.

6. Flow/Hydrology

Change in Peak/Base Flows: ECA for Upper North Fork Malheur River Watershed is 11 % therefore changes in peak and base flows are unlikely. This criterion is functioning appropriately.

Drainage Network Increase: Road density for the Upper North Fork Malheur River Watershed is 2.8 mi/mi^2 and 2.2mi/mi^2, depending on land management allocation for open and closed roads. There are 16 miles of roads within Category 1 RHCAs in bull trout habitat. Interception and concentration of runoff is likely to occur on roads with drainage structures. This criterion is functioning at risk.

7. Watershed Conditions

Road Density & Location: Road density ranges from 1.61 to 2.71 mi/mi^2 for all known roads (as seen on aerial photos) for the two watersheds in this population area (Table 43). The overall road density of all known roads is 2.22 mi/mi^2. There are about 18 miles of road

in Category 1 RHCA where bull trout are present. This criterion is **functioning at risk** based on matrix criteria.

Table 43. North Fork Population Area Road Density of All Roads (including open, closed, and decommissioned roads, and all known roads of any ownership). Data based on 1994 aerial photos.

Watershed Name	Total Miles of Road	Total Road Density
Little Malheur R.	218	1.61
Upper. N.F. Malheur R.	466	2.71
Total	684	2.22

Disturbance History: ECA for Upper North Fork Malheur River Watershed is 11%. This criterion is **functioning appropriately**.

Riparian Conservation Areas: Riparian areas on National Forest lands are believed to be essentially intact and are providing adequate shading to stream channels in most areas. However, there are some reaches on streams in the watershed where riparian conditions are poor and do not provide adequate shading. Recent data for determining actual condition of riparian vegetation is not available. In 1989 and 1990, shrub cover ratings ranged from 10 to 30% along some reaches of the N.F. Malheur River. Problem areas are also present along some reaches of tributaries such as Bear Creek. This criterion is **functioning at risk.**

Disturbance Regime: Soil hazard ratings for the Upper North Fork Malheur River Watershed are predominately rated at low level of risk (56% low, 24% moderate, and 20% severe hazard rating). Major fires occurred in the watershed in 1989, 1990, and 1994. These fires affected Sheep, Swamp, North and South Fork Elk Creek, upper Little Crane, and Bear creeks. The 1989 and 1990 fires occurred in areas that contain the majority of bull trout spawning areas and summer rearing habitat. A long-term drought occurred in the area from 1985 to 1995. A 100-year flood event occurred in 1964 in the watershed. This flood widened the channel in the canyon reach of the N.F. Malheur River and resulted in higher width to depth ratios. The North Fork Malheur River watershed appears to lack refugia at both reach and watershed scales required to insure the persistence of the subpopulation. This criterion is **functioning at risk**.

8. Species and Habitat

Integration of Species and Habitat Conditions: This criterion is rated functioning at risk due to the seasonal isolation of subpopulations from high water temperatures, unknown trend of population, and low subpopulation estimates for the subbasin (Buchanan et al. 1997). Migratory life history form is present downstream to Beulah Reservoir. Fluvial fish do pass through Agency Valley Dam and are essentially lost to the subpopulation due to the lack of upstream passage around the dam. The population is increasing at this time. Stream channel conditions are generally functioning at risk and there is a lack of refugia at the reach scale in the subpopulation area. Fires in the watershed in 1985 and 1990 occurred in the major spawning and summer rearing areas. This criterion is **functioning at risk**.

Table 44. Summary of the environmental baseline for the Upper North Fork Malheur River Watershed.

DIAGNOSTICS/ PATHWAYS INDICATORS	**POPULATION AND ENVIRONMENTAL BASELINE**		
	Functioning Appropriately	Functioning At Risk	Functioning at Unacceptable Risk
Subpopulation Characteristics:			
Subpopulation Size		X	
Growth and Survival		X	
Life History Diversity and Isolation	X		
Persistence and Genetic Integrity		X	
Water Quality:			
Temperature			X
Sediment			X
Chem. Contam./Nutrients	X		
Habitat Access:			
Physical Barriers		X	
Habitat Elements:			
Substrate Embeddedness			X
Large Woody Debris		X	
Pool Frequency and Quality			X
Large Pools			X
Off-channel Habitat		X	
Refugia[4]	X		
Channel Cond. & Dynamics:			
Wetted Width/Max. Depth Ratio		X	
Streambank Condition		X	
Floodplain Connectivity	X		
Flow/Hydrology:			
Change in Peak/Base Flows	X		
Drainage Network Increase		X	
Watershed Conditions:			
Road Density & Location		X	
Disturbance History	X		
Riparian Conservation Areas		X	
Disturbance Regime		X	
Integration of Species and Habitat Conditions		X	

Effects and Determination

Alternative 1

Little Malheur River Watershed

Bull trout are not currently present in the upper Little Malheur River watershed. Migratory habitat for fluvial bull trout is present in the lower portion of the Little Malheur River and bull trout have been documented in the lower mile of the Little Malheur River. Alternative 1 will result in elevated fine sediment levels above natural levels because old skid trails will not be obliterated and FSR 1672479 will not be decommissioned. The old skid trails and FSR 1672479 are chronic sources of fine sediment. However, pre-fire levels of fine sediment were generally below the 20% threshold level and would not likely preclude reestablishment of a bull trout population in the upper Little Malheur River. Fine sediment from these sources would also not likely affect habitat for migrating bull trout in the lower Little Malheur River due to the distances involved.

Alternative 1 will have no effect on bull trout or their current habitat in the Little Malheur River Watershed.

Upper North Fork Malheur River Watershed

Alternative 1 will have no effect on bull trout or their habitat in the Upper North Fork Malheur River Watershed. Alternative 1 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to bull trout in the upper North Fork watershed are unlikely.

Alternative 2

Little Malheur River Watershed

Bull trout are not currently present in the upper Little Malheur River watershed. Reestablishment of a resident population of bull trout depends on the lowering of water temperatures by about 20°F below pre-fire levels. Water temperatures in the project area are likely to begin declining in about 10 to 15 years when recovery of hardwoods from the effects of the 2002 fire is likely to occur. Activities proposed under Alternative 2 will result in a slight reduction in existing shading due to the removal sanding dead trees but will not impact recovery of shading provided by future streamside vegetation. Therefore, Alternative 2 will not preclude the reestablishment of bull trout.

Alternative 2 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided because old skid trails will be obliterated and FSR 1672479 will be decommissioned. The old skid trails and FSR 1672479 are chronic sources of fine sediment. Reducing the levels of fine sediment in Camp Creek and the Little Malheur River would improve the spawning success of a reestablished bull trout population.

Alternative 2 will have no effect on bull trout or their current habitat in the Little Malheur River Watershed.

Upper North Fork Malheur River Watershed

Alternative 2 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to bull trout in the upper North Fork watershed are unlikely.

Alternative 2 will have no effect on bull trout or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 3

Little Malheur River Watershed
Bull trout are not currently present in the upper Little Malheur River watershed. Reestablishment of a resident population of bull trout depends on the lowering of water temperatures by about 20°F below baseline levels. Water temperatures in the project area are likely to begin declining in about 10 to 15 years when recovery of hardwoods from the effects of the 2002 fire is likely to occur. Activities proposed under Alternative 3 will not adversely impact channel stability, physical habitat, or water quality elements. Therefore, Alternative 3 will not preclude the reestablishment of bull trout.

Alternative 3 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided because old skid trails will be obliterated and FSR 1672479 will be decommissioned. The old skid trails and FSR 1672479 are chronic sources of fine sediment. Reducing the levels of fine sediment in Camp Creek and the Little Malheur River would improve the spawning success of a reestablished bull trout population.

Alternative 3 will have no effect on bull trout or their current habitat in the Little Malheur River Watershed.

Upper North Fork Malheur River Watershed
Alternative 3 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to bull trout in the upper North Fork watershed are unlikely.

Alternative 3 will have no effect on bull trout or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 4

Little Malheur River Watershed
Bull trout are not currently present in the upper Little Malheur River watershed. Reestablishment of a resident population of bull trout depends on the lowering of water temperatures by about 20°F below baseline levels. Water temperatures in the project area are likely to begin declining in about 10 to 15 years when recovery of hardwoods from the effects of the 2002 fire is likely to occur. Activities proposed under Alternative 4 will not adversely impact channel stability, physical habitat, or water quality elements. Therefore, Alternative 4 will not preclude the reestablishment of bull trout.

Alternative 4 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided because old skid trails will be obliterated and FSR 1672479 will be decommissioned. The old skid trails and FSR 1672479 are chronic sources of fine sediment. Reducing the levels of fine sediment in Camp Creek and the Little Malheur River would improve the spawning success of a reestablished bull trout population.

Alternative 4 will have no effect on bull trout or their current habitat in the Little Malheur River Watershed.

Upper North Fork Malheur River Watershed
Alternative 4 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to bull trout in the upper North Fork watershed are unlikely.

Alternative 4 will have no effect on bull trout or their habitat in the Upper North Fork Malheur River Watershed.

Alternative 5

Little Malheur River Watershed
Bull trout are not currently present in the upper Little Malheur River watershed. Reestablishment of a resident population of bull trout depends on the lowering of water temperatures by about 20°F below baseline levels. Water temperatures in the project area are likely to begin declining in about 10 to 15 years when recovery of hardwoods from the effects of the 2002 fire is likely to occur. Activities proposed under Alternative 5 will not adversely impact channel stability, physical habitat, or water quality elements. Therefore, Alternative 5 will not preclude the reestablishment of bull trout.

Alternative 5 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided because old skid trails will be obliterated and FSR 1672479 will be decommissioned. The old skid trails and FSR 1672479 are chronic sources of fine sediment. Reducing the levels of fine sediment in Camp Creek and the Little Malheur River would improve the spawning success of a reestablished bull trout population.

Alternative 5 will have no effect on bull trout or their current habitat in the Little Malheur River Watershed.

Upper North Fork Malheur River Watershed
Alternative 5 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to bull trout in the upper North Fork watershed are unlikely.

Alternative 5 will have no effect on bull trout or their habitat in the Upper North Fork Malheur River Watershed.

Table 45. Summary of the environmental baseline for the Upper North Fork Malheur River Watershed and effects of the proposed alternatives

DIAGNOSTICS/ PATHWAYS INDICATORS	POPULATION AND ENVIRONMENTAL BASELINE			EFFECTS OF THE ALTERNATIVES(S)			
	Functioning Appropriately	Functioning At Risk	Functioning at Unaccept-able Risk	Restore[1]	Maintain[2]	Degrade[3]	Com-pliance with ACS
Subpopulation Characteristics:							
Subpopulation Size		X			All		All
Growth and Survival		X			All		All
Life History Diversity and Isolation	X				All		All
Persistence and Genetic Integrity		X			All		All
Water Quality:							
Temperature			X		All		All
Sediment			X		All		All
Chem. Contam./Nutrients	X				All		All
Habitat Access:							
Physical Barriers		X			All		All
Habitat Elements:							
Substrate Embeddedness			X		All		All
Large Woody Debris		X			All		All
Pool Frequency and Quality			X		All		All
Large Pools			X		All		All
Off-channel Habitat		X			All		All
Refugia[4]	X				All		All
Channel Cond. & Dynamics:							
Wetted Width/Max. Depth Ratio		X			All		All
Streambank Condition		X			All		All
Floodplain Connectivity	X				All		All
Flow/Hydrology:							
Change in Peak/Base Flows	X				All		All
Drainage Network Increase		X			All		All
Watershed Conditions:							
Road Density & Location		X			All		All
Disturbance History	X				All		All
Riparian Conservation Areas		X			All		All
Disturbance Regime		X			All		All
Integration of Species and Habitat Conditions		X			All		All

[1] For the purposes of this checklist, "restore" means to change the function of a "functioning at risk" indicator to "functioning appropriately," or to change the function of a "functioning at unacceptable risk" indicator to "functioning at risk" or "functioning appropriately" (i.e., it does not apply to "functioning appropriately" indicators). Restoration from a worse to a better condition does not negate the need to consult/confer if take will occur.

[2] For the purposes of this checklist, "maintain" means that the function of an indicator does not change (i.e., it applies to all indicators regardless of functional level).

[3] For the purposes of this checklist, "degrade" means to change the function of an indicator for the worse (i.e., it applies to all indicators regardless of functional level). In some cases, a "functioning at unacceptable risk" indicator may be further worsened, and this should be noted.

[4] Refugia = watersheds or large areas with minimal human disturbance having relatively high quality water and fish habitat, or having the potential of providing high quality water and fish habitat with the implementation of restoration efforts. These high quality water and fish habitats are well distributed and connected within the watershed or large area to provide for both biodiversity and stable populations. (Adapted from discussions on "Stronghold Watersheds and Unroaded Areas" in Lee, D.C., J.R. Sedell, B.E. Rieman, R.F. Thurow, J.E. Williams and others. 1997. Chapter 4: Broadscale Assessment of Aquatic Species and Habitats. I*n* T.M. Quigley and S.J. Arbelbide eds "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins Volume III." U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management, Gen. Tech. Rep. PNW-GTR-405).

D. Proposed, and Designated Critical Habitat

Proposed Critical Habitat for Bull Trout

In accordance with section 3(5)(A)(i) of the Endangered Species Act and regulations at 50 CFR424.12, in determining which areas to propose as critical habitat, USFWS are required to base their proposal on the best scientific data available, and to consider those physical and biological features that are essential to the conservation of the species and that may require special management considerations or protection. These physical and biological features include, but are not limited to: space for individual and population growth, and for normal behavior; food, water, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. All areas proposed as critical habitat for bull trout are within the historic geographic range of the species and contain one or more of these physical or biological features essential to the conservation of the species. The regulations also require that we include a list of known primary constituent elements with the critical habitat description. As described in the regulations, the primary constituent elements may include, but are not limited to, features such as spawning sites, feeding sites, and water quality or quantity.

Little Malheur River Watershed

The Little Malheur River has been proposed by USFWS as critical habitat for bull trout from its confluence with the N.F. Malheur River to its headwaters.

Environmental Baseline

The current conditions of primary constituent elements that USFWS will use to designate critical habitat are:

(1) Permanent water having low levels of contaminants such that normal reproduction, growth and survival are not inhibited;

There are no known sources of chemical contaminants in the Little Malheur River in the project area.

(2) Water temperatures ranging from 2 to 15°C (36 to 59°F), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence;

Water temperatures in the Little Malheur River prior to the fire were outside of the range specified by USFWS (36 to 59°F) and EPA ($\leq$ 55°F) for supporting bull trout populations. To support spawning and juvenile rearing in the Little Malheur River, the water temperature would have to be reduced by about 19°F at the Forest boundary based on the latest recommendations of EPA (Table46).

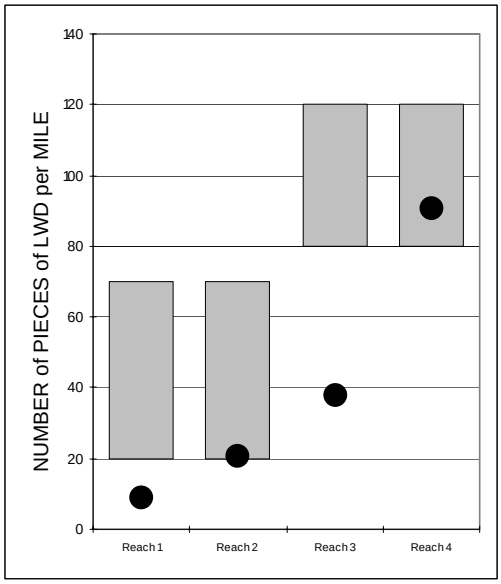
Table 46. Mean water temperature of the Little Malheur River compared to USFWS primary constituent element (PCE) and EPA's recommendation for bull trout rearing and spawning habitat.

Location	Years Monitored	Mean 7 Day Mean Max Temp	USFWS PCE Standard	EPA Recommendation
Forest Boundary	1993- 01	73.8°F	36 to 59°F	< 55°F
Wilderness Boundary	2000 - 01	72.5°F	36 to 59°F	< 55°F

Water temperatures will rise in response to the loss of shading adjacent to the Little Malheur River and tributaries due to the 2002 fire. Based on visual observations it is estimated that the current shading along the lower reaches of Camp Creek is about 3% of pre-fire conditions. Current shading along the lower reaches of the Little Malheur River is about 40% of pre-fire conditions. Reductions in shading also occurred along Rock Creek and South Bullrun Creek. These streams are potentially important contributors of cold water to the Little Malheur River above Hunter Creek.

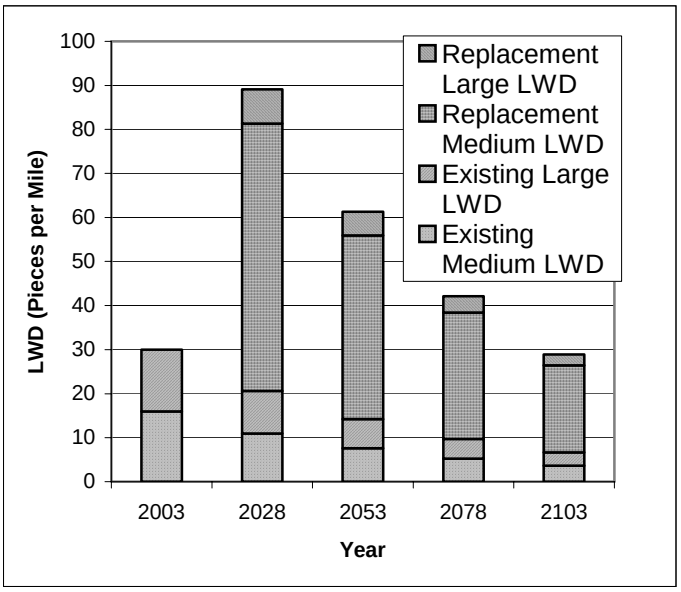
(3) Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures;

LWD: Currently Reaches 2 and 4 are meeting the Forest Plan standard for LWD (Graphic 16). Reaches 1 and 3 are not meeting the Forest Plan standard for LWD.



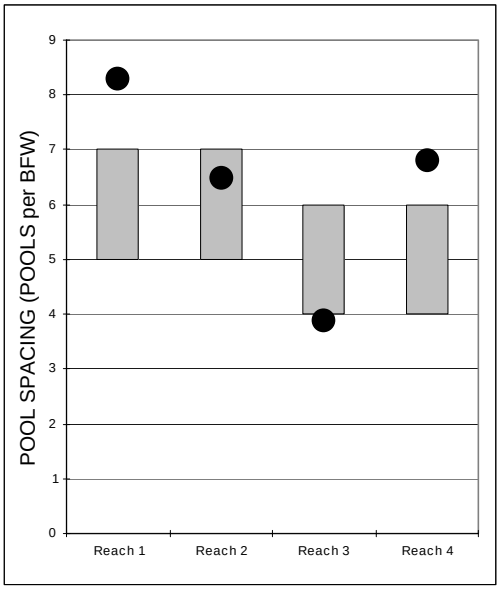
Graphic 16. Comparison of existing number of pieces of LWD to Forest Plan standards for reaches in Little Malheur River. Reaches 1 and 3 are not meeting the Forest Plan standard for LWD. Reaches 2 and 4 are meeting the Forest Plan standard. Reaches 1 and 2 are in ponderosa pine ecosystems. Reaches 3 and 4 are in mixed conifer ecosystems. Bars represent Forest Plan standards.

LWD levels in the Little Malheur River will likely spike from 20 to 30 years after the 2002 fire. LWD in the lower reaches of the river in the fire area may reach as high 89 pieces per mile in about 2028 (Graphic 17). LWD levels will drop to about 30 pieces per mile in about 2103, about the time that new trees have reached the size necessary to provide LWD (about 20" dbh).



Graphic 17. Predicted changes in LWD levels as existing LWD is depleted and replacement LWD is recruited into the Little Malheur River (Reaches 1 and 2) in the Monument planning area from 2003 through 2103. The Forest Plan standard is 20 to 70 pieces per mile.

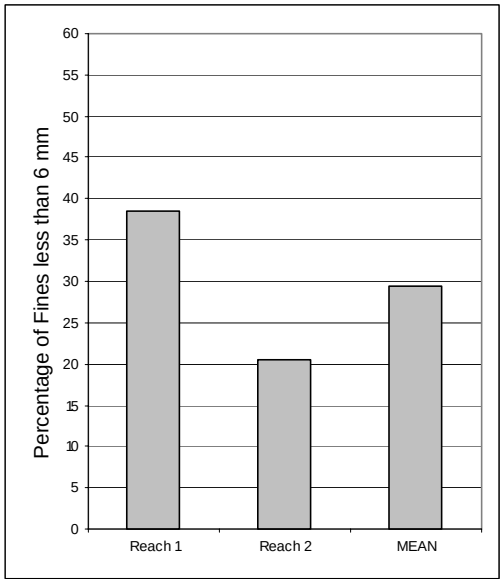
Pools: Stream survey data from 1999 indicates that reaches 1 and 4 of the Little Malheur River have fewer pools then would be expected for their respective channel types and do not meet the Forest Plan standard for pools. Reach 2 is within the expected range for pool spacing for its channel type and meets the Forest Plan standard (Graphic 18). Reach 3 has slightly more pools then expected for its channel type and exceeds the Forest Plan standard for pools (Graphic 18).



Graphic 18. Comparison of existing pool spacing to expected range for pool spacing for reaches in the Little Malheur River. Reaches 1 and 4 are not meeting the Forest Plan standard for pool frequency. Reach 2 meets the Forest Plan standard. Reach 3 exceeds the Forest Plan standard. Reaches 1 and 2 are "C" channel types. Reach 3 is a "B/C" channel type. Reach 4 is a "B" channel type. Channel types based on the Rosgen (1996) channel classification system. Bars represent Forest Plan standards.

(4) Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine substrate less than 0.63 cm (0.25 in) in diameter and minimal substrate embeddedness are characteristic of these conditions;

Reaches 1 and 2 are currently exceeding the 20 percent threshold for fine sediment (Graphic 19). Fine sediment levels are likely to increase until ground cover is reestablished in the drainage area.



Graphic 19. Levels of fine sediment in the lower reaches of the Little Malheur River. Fine sediment levels in reaches 1 and 2 exceed the Forest Plan standard (< 20 percent fines).

Field observations of the current fine sediment levels in reaches 3 and 4, located in the Wilderness, were made in late 2003. Overall, fine sediment levels in Reach 3 are similar to Reach 2 with fine sediment levels between 15 and 20 percent with some areas exceeding the 20 percent threshold. Fine sediment levels in Reach 4 greatly exceed the 20 percent threshold.

The effects of the fire combined with the late August thunderstorms on fine sediment levels in the Little Malheur River are evident. Fine sediment levels tripled for Reach 1 from 13.3% in 1999 to 38.5% in 2002 (Table 47). Fine sediment levels in Reach 4 have probably tripled too as a result of the fire and thunderstorms.

Table 47. Levels of fine sediment (particles < 6mm) in the Little Malheur River. Sites are arranged from downstream to upstream. Data for 1999 from stream survey. Data for 2002 from supplemental stream survey. Levels of fine sediment in italics are estimated.

Stream	Reach	Particles < 6mm (%)		Comments
		1999	2002	
Little Malheur R.	1	13.3	38.5	
	2	21.0	20.5	
	3	17.5	15 to 20	2002 level based on field observation
	4	17.0	50	2002 level based on field observation

(5) A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, a hydrograph that demonstrates the ability to support bull trout populations;

Runoff is expected to increase in the Little Malheur River and Camp Creek due to the creation of hydrophobic soil conditions during the 2002 fire (Monument BAER Report). Peak flows are predicted to increase by 20% in Camp Creek and by 15% in the Little Malheur River (Table 48).

Table 48. Pre and post-fire estimated 25-year peak flows for subwatersheds most influenced by the Monument Fire. Flows are expressed in cubic feet per second.

Subwatershed	Estimated Pre-fire Peak Flow (25 yr event)	Estimated Increase in Runoff (%)	Estimated Post-fire Peak Flow (25 yr event)
Camp Creek	467 cfs	20	519 cfs
Upper Little Malheur	501 cfs	15	569 cfs

Additional modifications to the hydrograph of the Little Malheur River below the Forest boundary have resulted from irrigation withdrawals and degradation of Squaw Creek. Gullying has occurred along Squaw Creek and its tributaries in response to past improper grazing management practices on the Forest and in response to land management practices on private lands following the 1994 Ironside Fire.

(6) Springs, seeps, groundwater sources, and subsurface water connectivity to contribute to water quality and quantity;

Numerous springs and seeps are located adjacent to the Little Malheur River and tributaries. Water flow from springs and seeps should increase over the next few years in response to the decrease in vegetation following the 2002 fire and then return to normal as vegetation recovers. Conditions around springs and seeps should also improve due to the temporary cessation of livestock grazing in the fire area.

(7) Migratory corridors with minimal physical, biological, or chemical barriers between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows;

The potential migratory corridor for a reestablished bull trout population would be the Little Malheur River from the Forest boundary to the confluence with the N.F. Malheur River. Conditions along this portion of the river are believed to be marginal. The majority of this portion of the river flows through private lands.

(8) An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish;

Aquatic macroinvertebrate populations are expected to decline for the next 5 years in response to increases in fine sediment resulting from the 2002 fire. Populations will begin increasing to pre-fire levels as the fire area revegetates and erosion levels return to normal.

(9) Few or no predatory, interbreeding, or competitive nonnative species present.

Brook trout are not present in the Little Malheur River.

Effects and Determination

Alternative 1
Alternative 1 will slow the recovery of proposed critical habitat for bull trout in the Little Malheur River. Fine sediment levels in the Little Malheur River will remain elevated due chronic inputs of fine sediment from old skid trails and FSR 1672479 in the Camp Creek drainage. Prior to the 2002 fire fine sediment levels in the Little Malheur River were between 13 and 21% and would be rated as functioning at risk.

Determination
Alternative 1 would not result in adverse modification to proposed critical habitat for bull trout for the Columbia distinct population segment (DPS).

Alternative 2
Removing standing dead trees < 20" dbh from RHCAs will result in a reduction in the amount of woody debris levels in the Little Malheur River and Camp Creek. Pool habitat will be reduced by an estimated 2 pools in the Little Malheur River and 18 pools in Camp Creek compared to Alternative 1. This would result in a reduction of 0.7 pools per mile in the Little Malheur River and 5.6 pools per mile in Camp Creek. However, since Forest Plan standard for LWD will be met for the next 100 years in both the Little Malheur River (Graphic 17) it is likely that the Forest Plan standard for pools will also be met.

Removing standing dead trees < 20" dbh from RHCAs will also reduce cover and habitat complexity compared to Alternative 1. Reducing the amount of woody debris would also reduce the amount of fine sediment trapped and incorporated into stream banks.

Alternative 2 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided. The old skid trails and FSR 1672479 are chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels. Long-term reductions in fine sediment in the lower portion of the Little Malheur River and Camp Creek are likely to result from obliterating old skid trails and decommissioning FSR 1672479 compared to Alternative 1. However, there is potential for increases in fine sediment for 2 to 3 years because soil disturbance on about 5 acres will occur adjacent to Category 4 stream channels in unstable soils.

Alternative 2 will result in reducing existing shade levels along Camp Creek and the Little Malheur River by about 1% compared to Alternative 1 due to the removal of standing dead trees < 20" dbh. It is unlikely that the recovery of water temperatures to pre-fire levels will differ between Alternative 1 and Alternative 2.

Determination
Alternative 2 would not result in adverse modification to proposed critical habitat for bull trout for the Columbia DPS.

Alternative 3
Alternative 3 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided. Old skid trails and FSR 1672479 have been chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels. Long-term reductions in fine sediment in the lower portion of the Little Malheur River and Camp Creek are likely to result from obliterating old skid trails and decommissioning FSR 1672479 compared to Alternative 1. However, there is potential for increases in fine sediment for 2 to 3 years because soil disturbance on about 5 acres will occur adjacent to Category 4 stream channels in unstable soils.

Pools and habitat complexity under Alternative 3 would be similar to Alternative 1 because removal of standing dead trees < 20" dbh in RHCAs would not occur. Alternative 3 will not adversely impact channel stability, physical habitat, or water quality elements.

Determination
Alternative 3 would not result in adverse modification to proposed critical habitat for bull trout for the Columbia DPS.

Alternative 4
Alternative 4 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided. Old skid trails and FSR 1672479 have been chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels. Long-term reductions in fine sediment in the lower portion of the Little Malheur River and Camp Creek are likely to result from obliterating old skid trails and decommissioning FSR 1672479 compared to Alternative 1. However, there is potential for increases in fine sediment for 2 to 3 years because soil disturbance on about 5 acres will occur adjacent to Category 4 stream channels in unstable soils.

Pools and habitat complexity under Alternative 3 would be similar to Alternative 1 because removal of standing dead trees < 20" dbh in RHCAs would not occur. Alternative 3 will not adversely impact channel stability, physical habitat, or water quality elements.

Determination
Alternative 4 would not result in adverse modification to proposed critical habitat for bull trout in the Little Malheur River watershed.

Alternative 5
Alternative 5 will result in fine sediment levels lower than Alternative 1 once the effects from the 2002 fire have subsided. Old skid trails and FSR 1672479 have been chronic sources of fine sediment and have likely resulted in elevation of fine sediments levels above background levels. Long-term reductions in fine sediment in the lower portion of the Little Malheur River and Camp Creek are likely to result from obliterating old skid trails and decommissioning FSR 1672479 compared to Alternative 1. However, there is potential for increases in fine sediment for 2 to 3 years because soil disturbance on about 5 acres will occur adjacent to Category 4 stream channels in unstable soils.

Determination
Alternative 5 would not result in adverse modification to proposed critical habitat for bull trout in the Little Malheur River watershed.

Upper North Fork Malheur River Watershed

The N.F. Malheur River has been proposed by USFWS as critical habitat for bull trout from Agency Valley Dam to its headwaters. An additional 12 tributaries to the N.F. Malheur River have also been proposed as critical habitat for bull trout. Spring Creek was not one of the tributaries proposed as critical habitat.

Environmental Baseline

See environmental baseline for the North Fork Malheur subpopulation.

Effects and Determination

Alternative 1
Alternative 1 will not affect channel stability, physical habitat, or water quality elements. Therefore affects to proposed critical habitat for bull trout in the North Fork Malheur River watershed are unlikely.

Determination
Alternative 1 would not result in adverse modification to proposed critical habitat for bull trout for the Columbia DPS.

Alternatives 2, 3, 4, and 5
Activities are not proposed in RHCAs in the Upper North Fork Malheur River Watershed under Alternatives 2, 3, 4, and 5. Therefore, Alternative 2 will not affect channel stability, physical habitat, or water quality elements and affects to proposed critical habitat for bull trout in the North Fork watershed are unlikely.

Determination
Alternatives 2, 3, 4, and 5 would not result in adverse modification to proposed critical habitat for bull trout for the Columbia DPS.

IV. References

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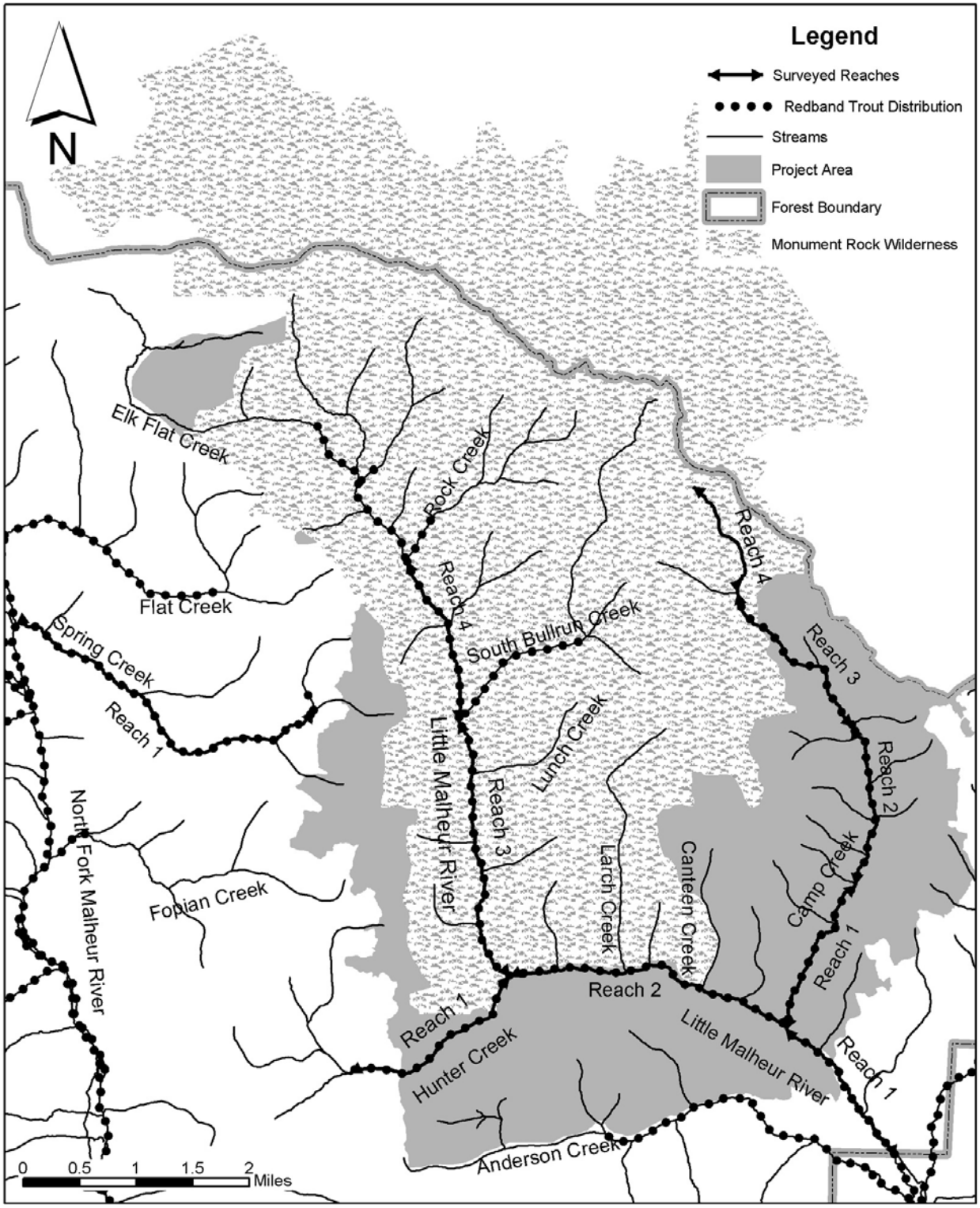
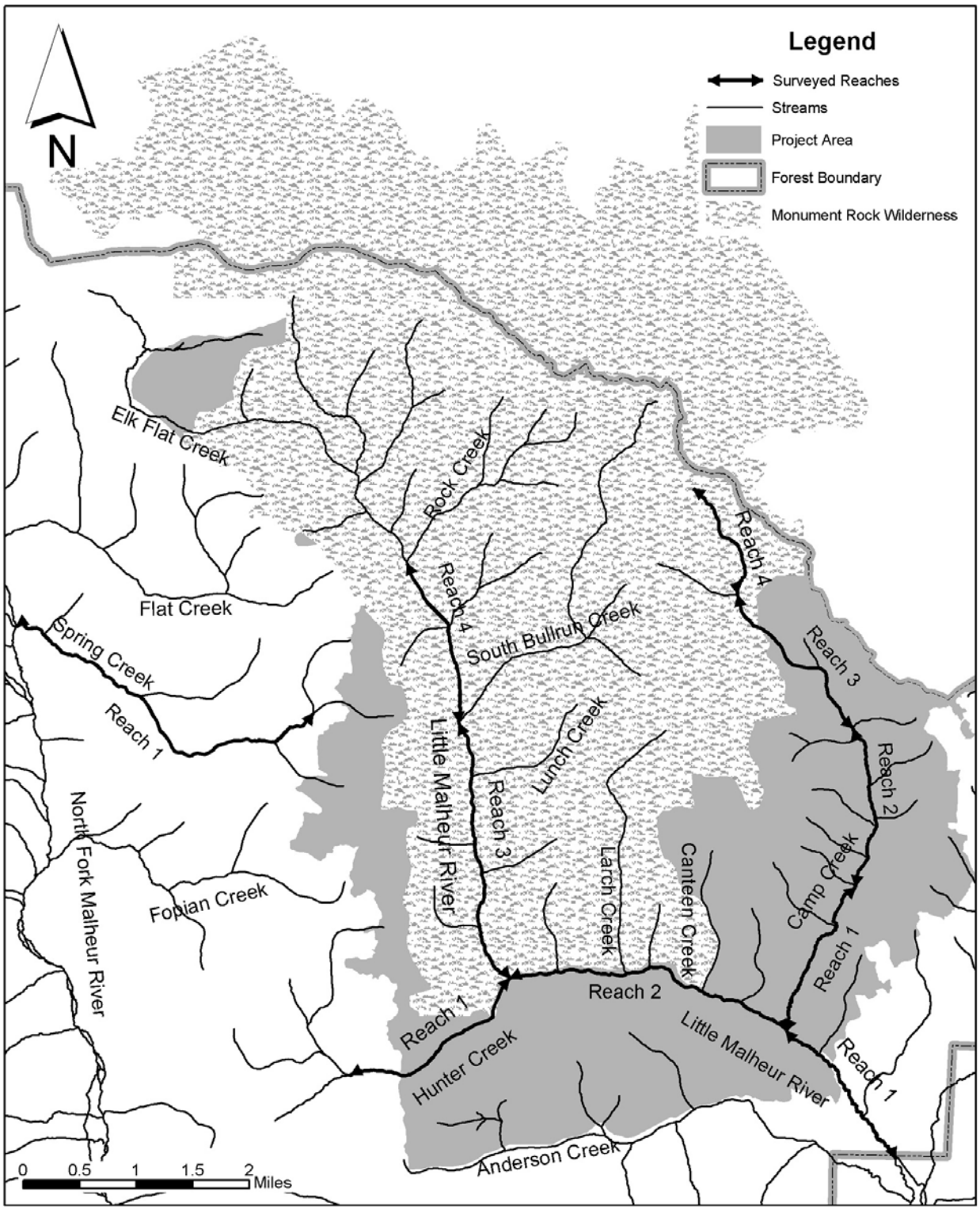
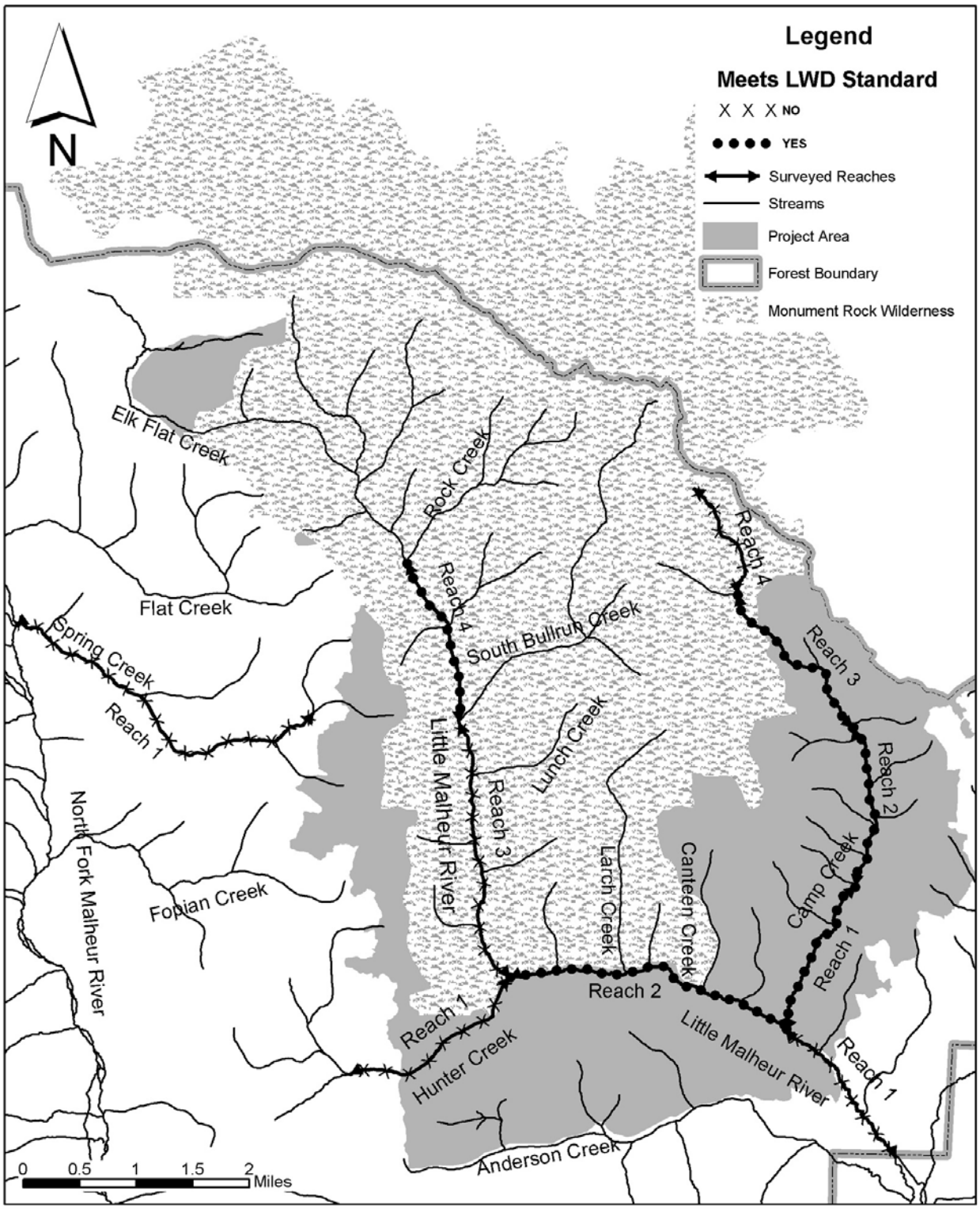
V. Maps



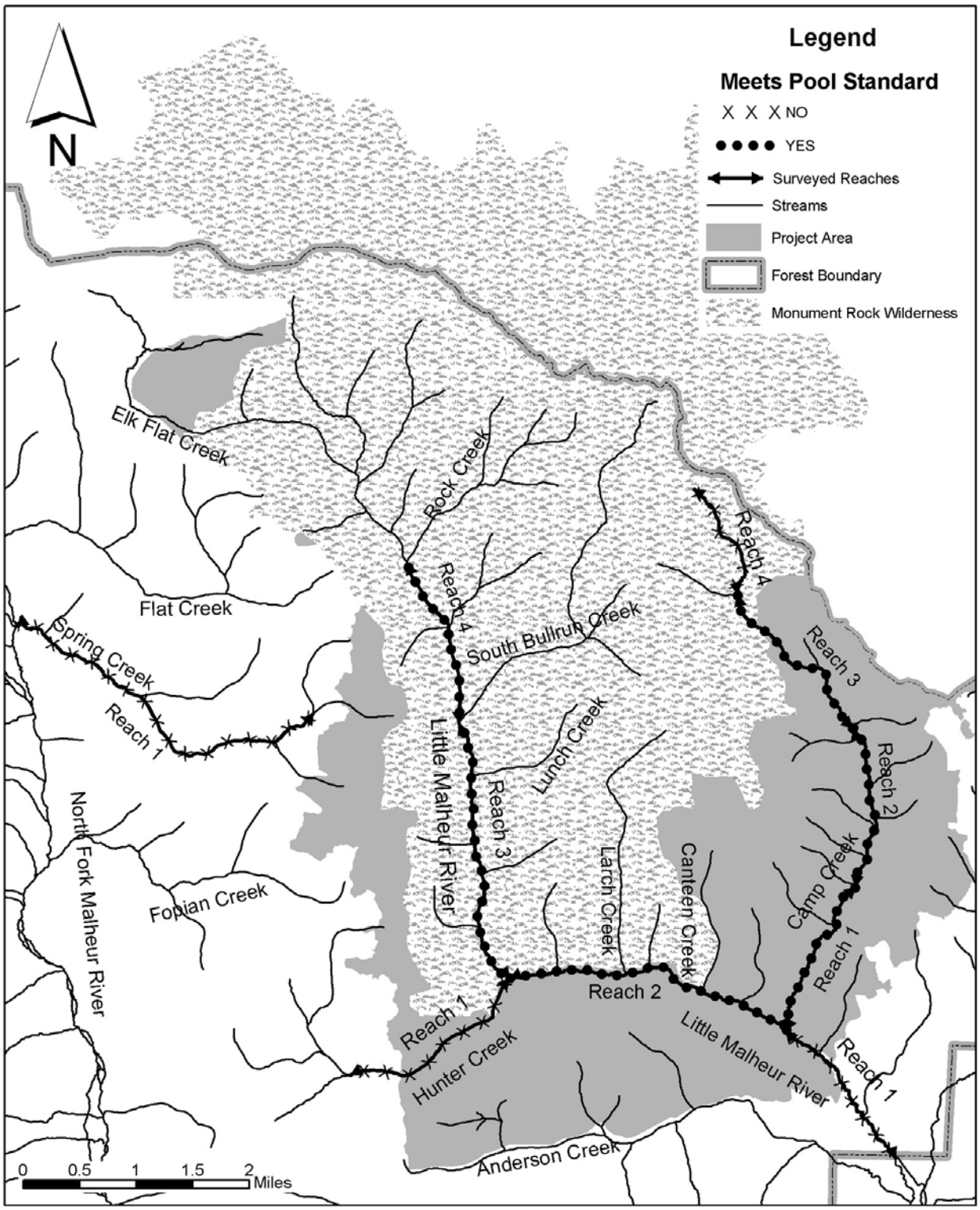
BE Map 1. Distribution of redband trout in the analysis area.



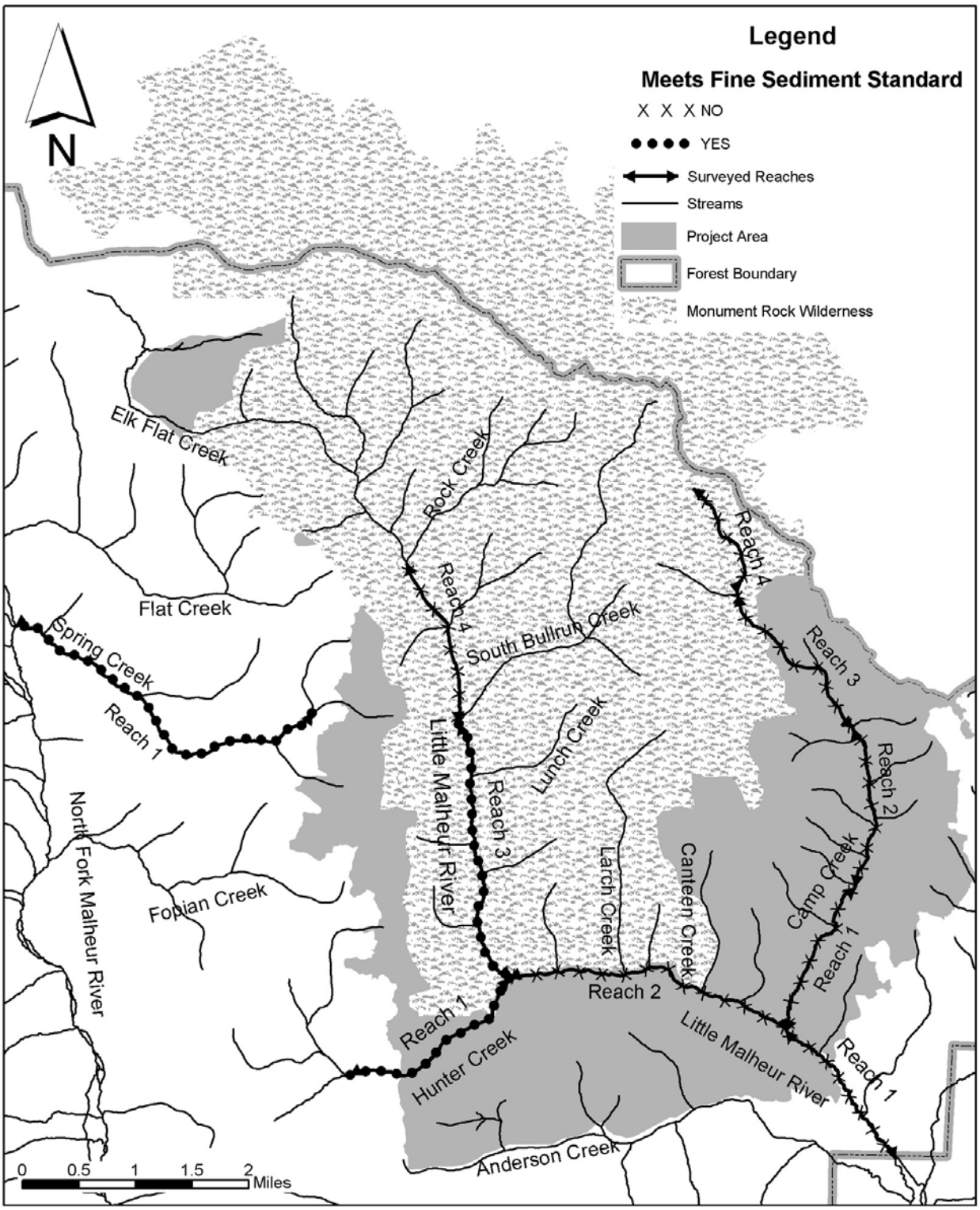
BE Map 2. Location of surveyed stream reaches in the analysis area.



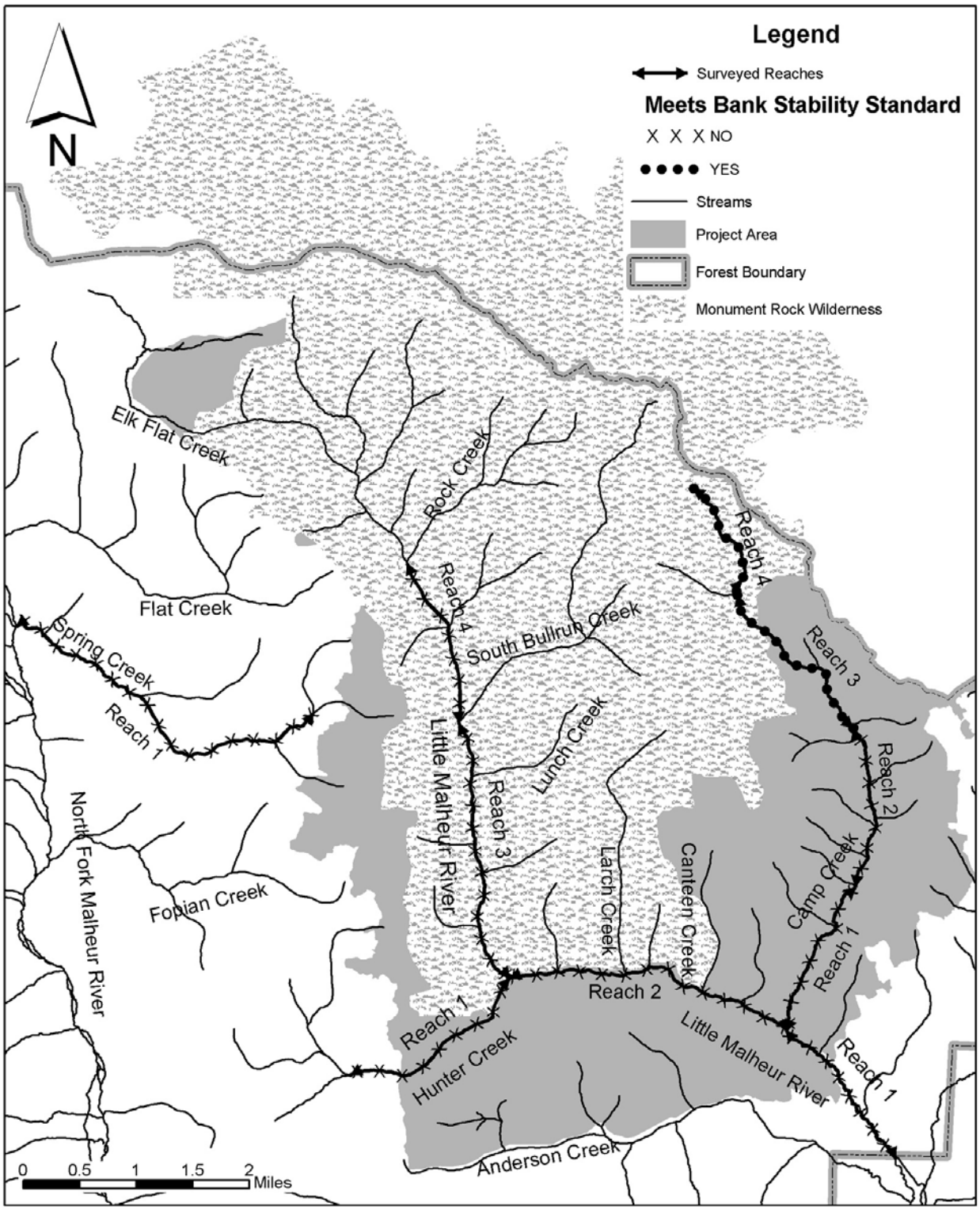
BE Map 3. Locations of surveyed stream reaches that currently meet the Forest Plan standard for LWD.



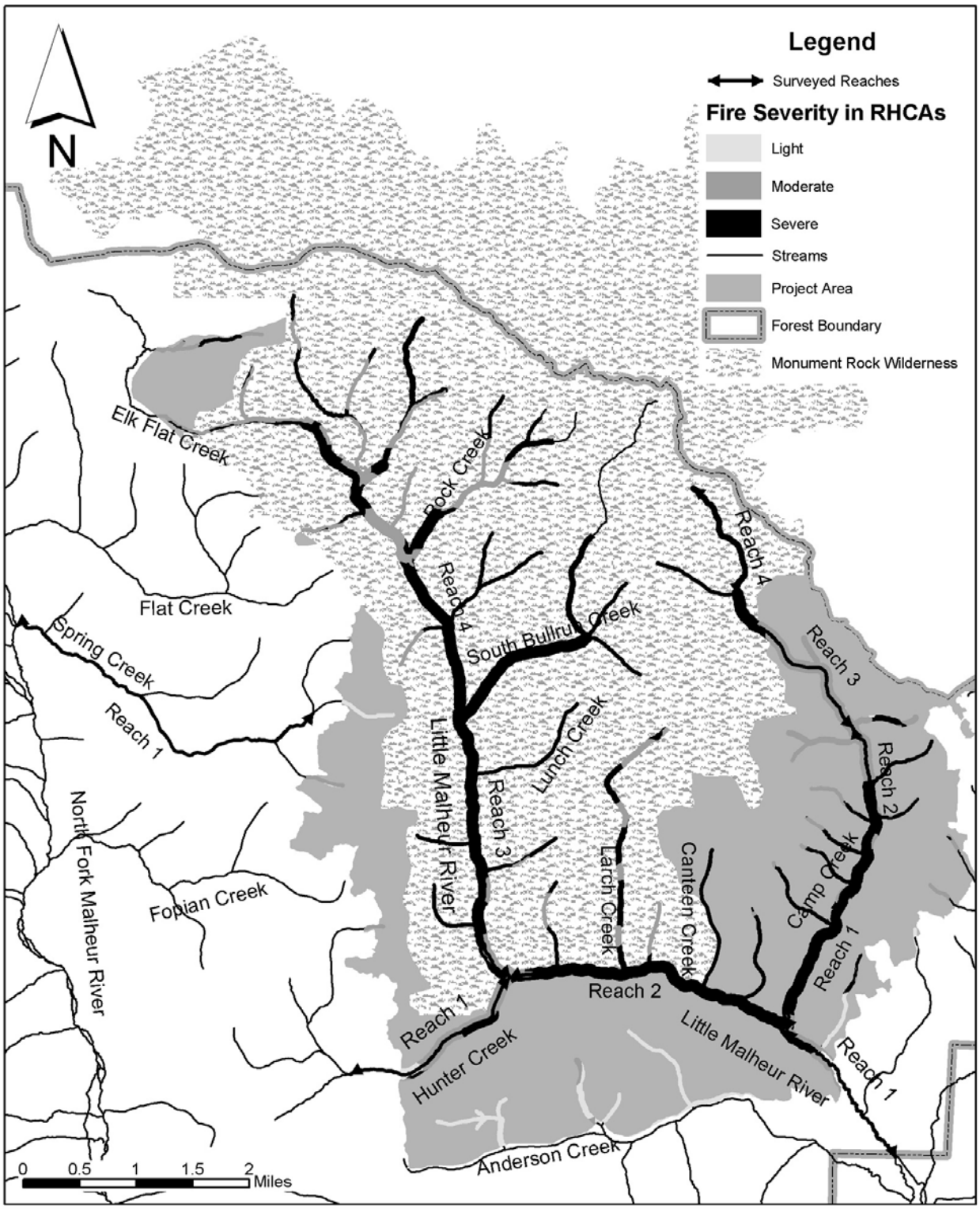
BE Map 4. Locations of surveyed stream reaches that currently meet the Forest Plan standard for pools.



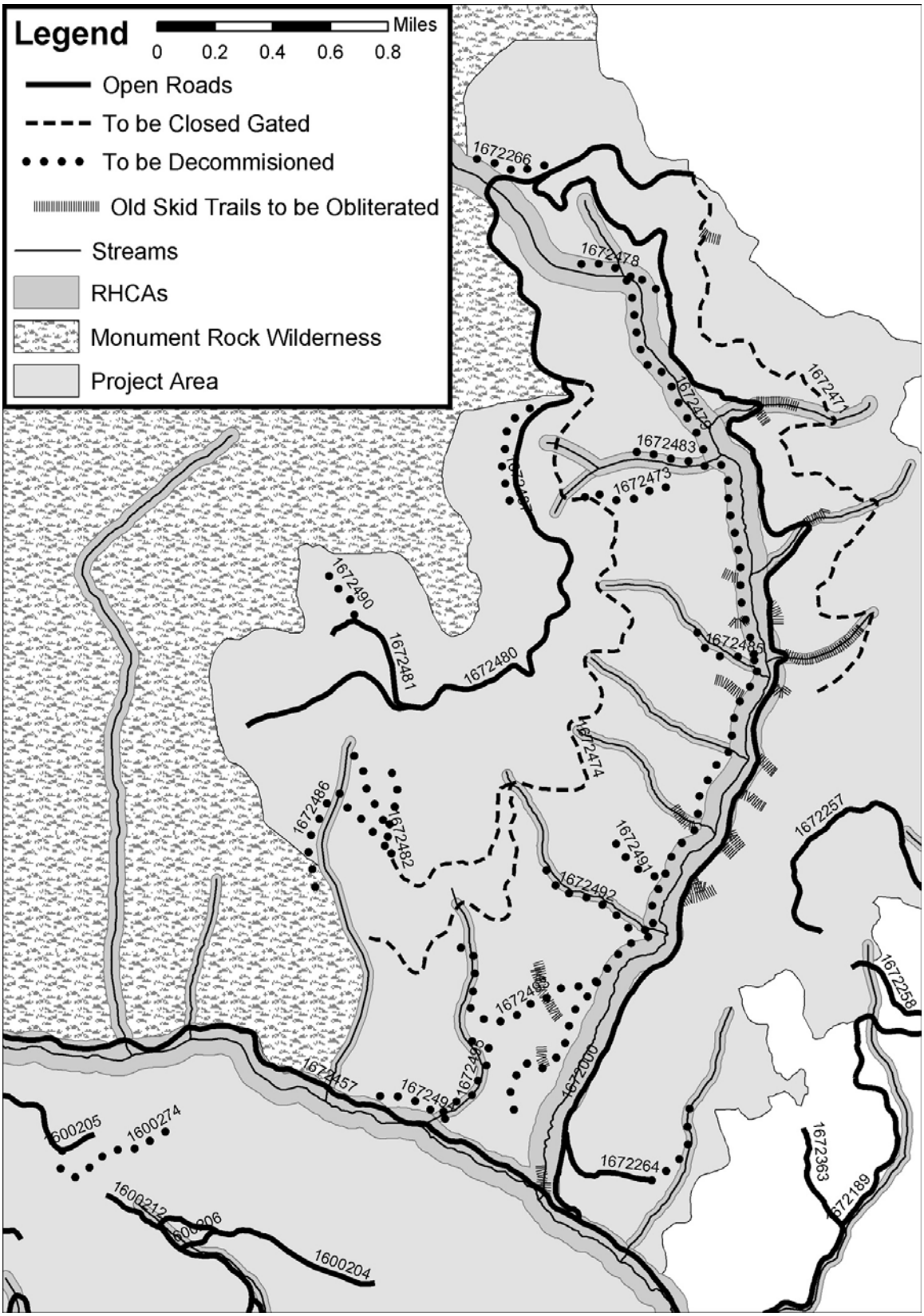
BE Map 5. Locations of surveyed stream reaches that currently meet the Forest Plan standard for fine sediment.



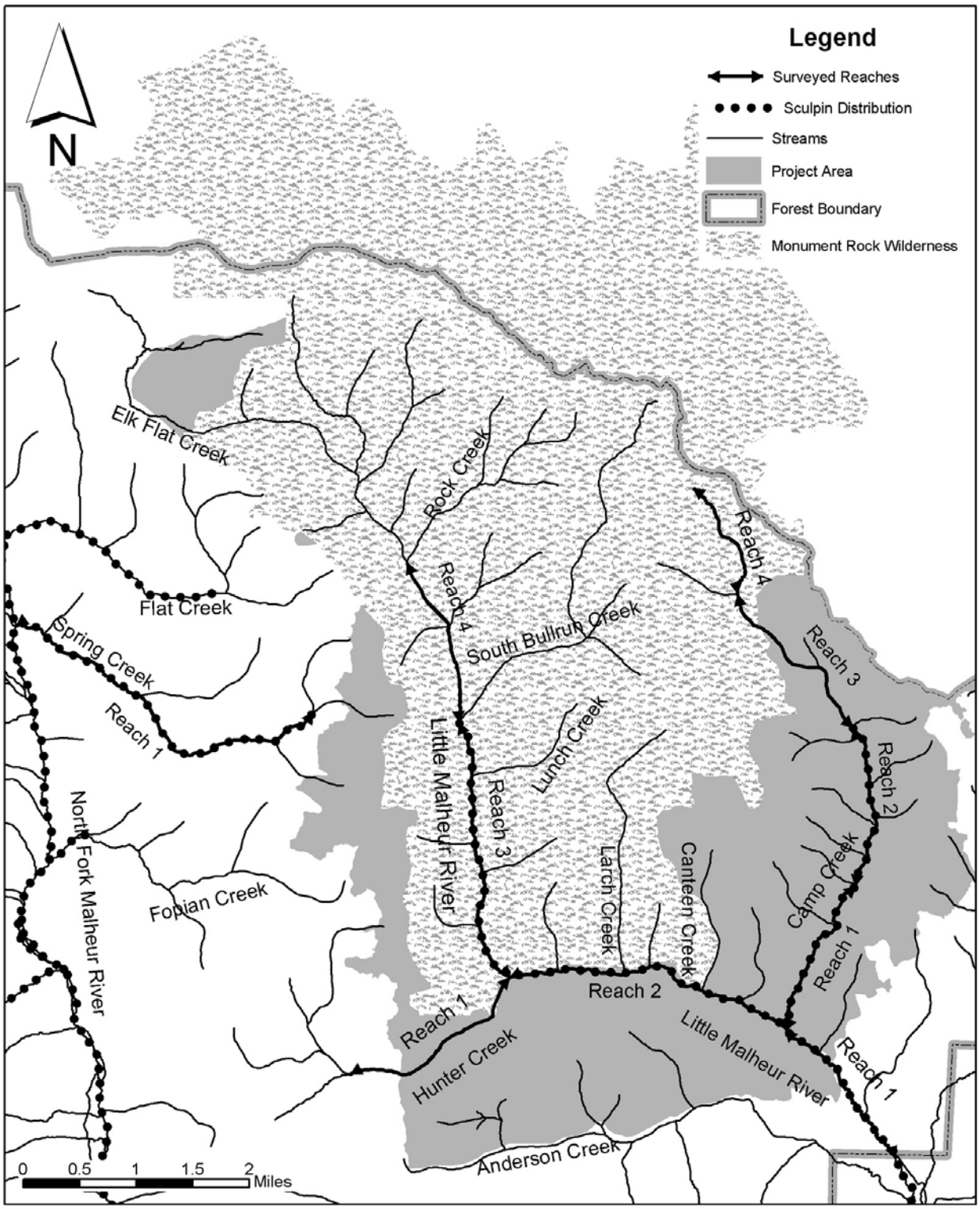
BE Map 6. Locations of surveyed stream reaches that currently meet the Forest Plan standard for stream bank stability.



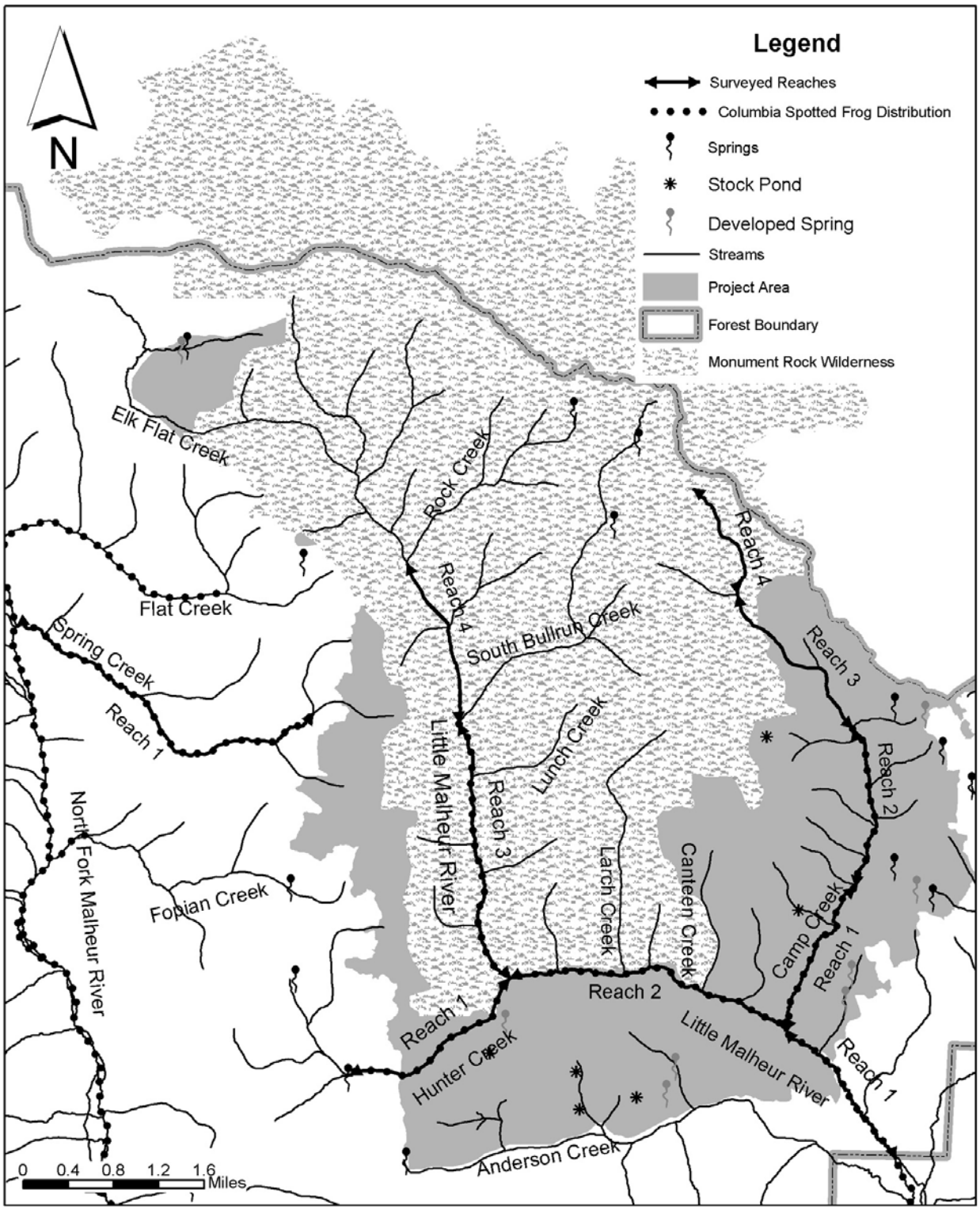
BE Map 7. Fire severity in RHCAs in the Monument Fire area.



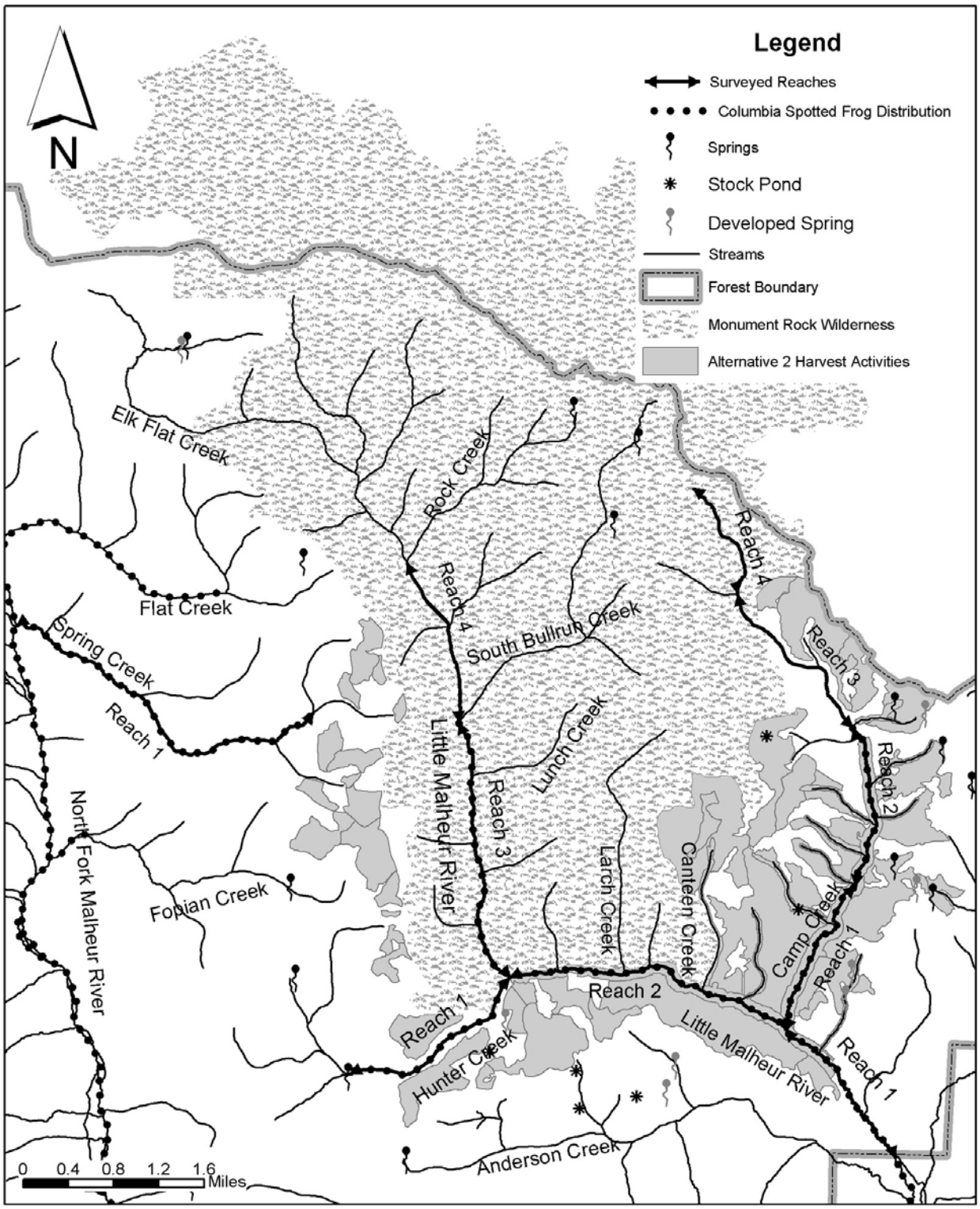
BE Map 8. Locations of road and skid trails in the Camp Creek drainage proposed to be closed, decommissioned, or obliterated.



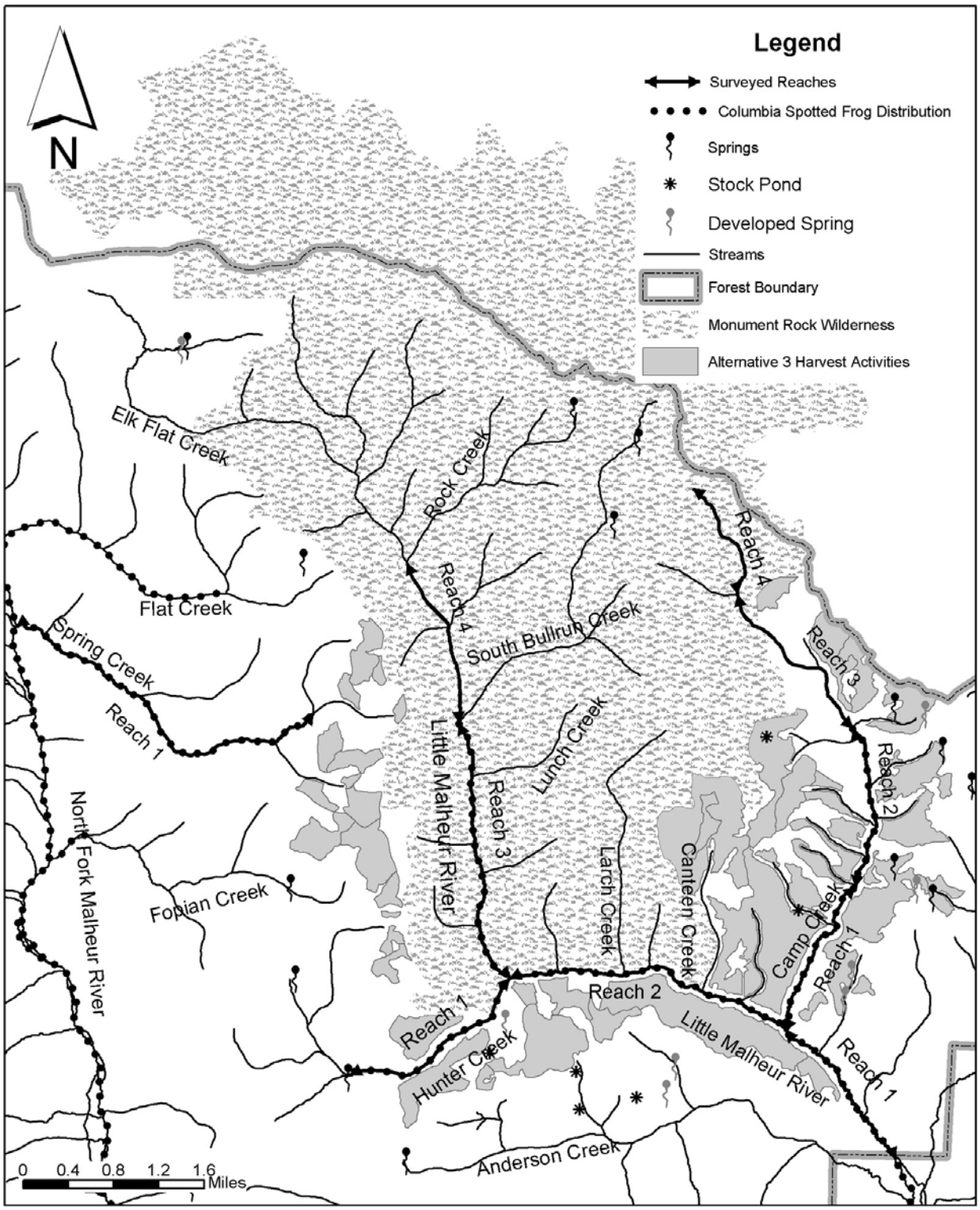
BE Map 9. Distribution of potential habitat for Malheur mottled sculpin in the analysis area.



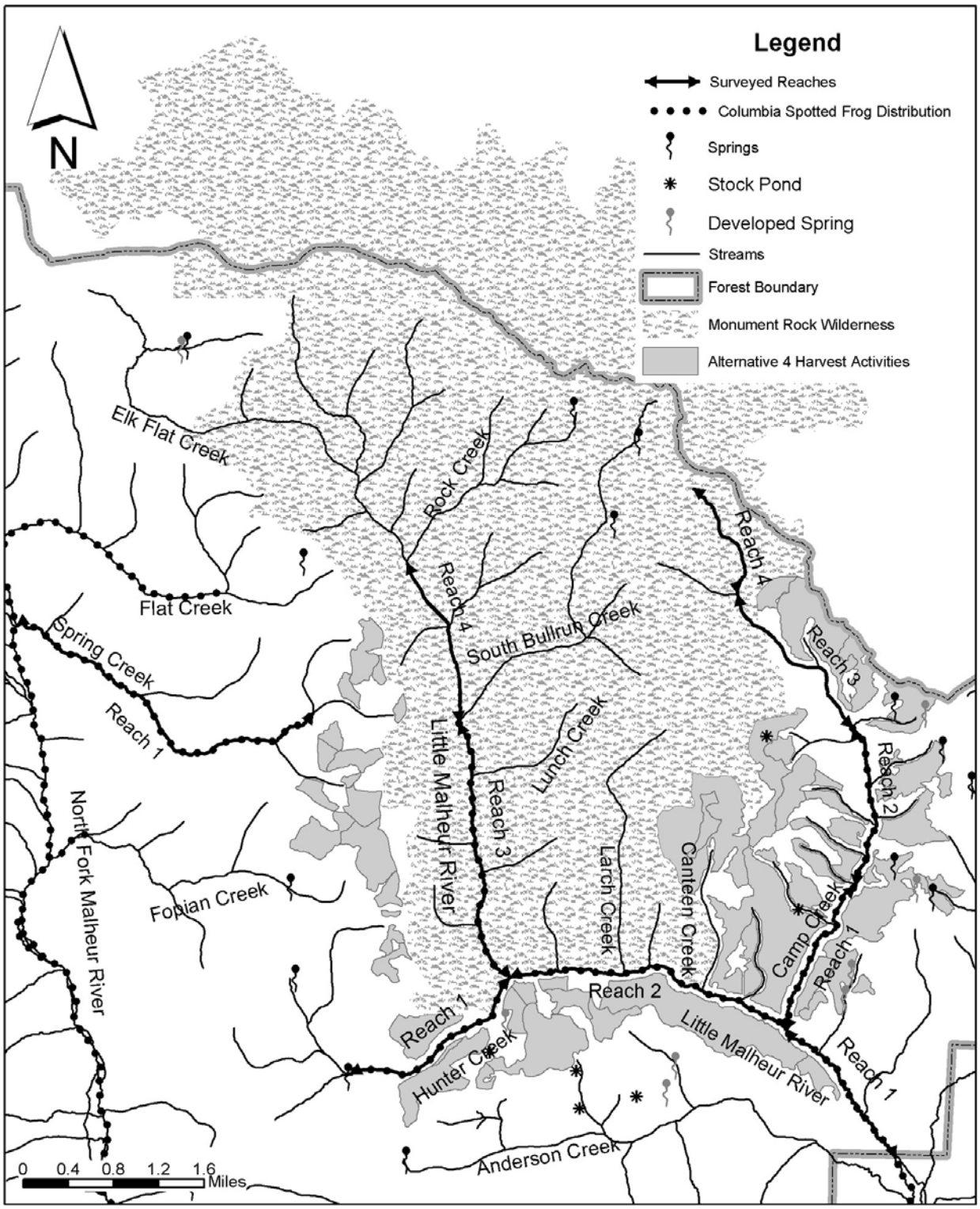
BE Map 10. Distribution of potential habitat for Columbia spotted frogs in the analysis area.



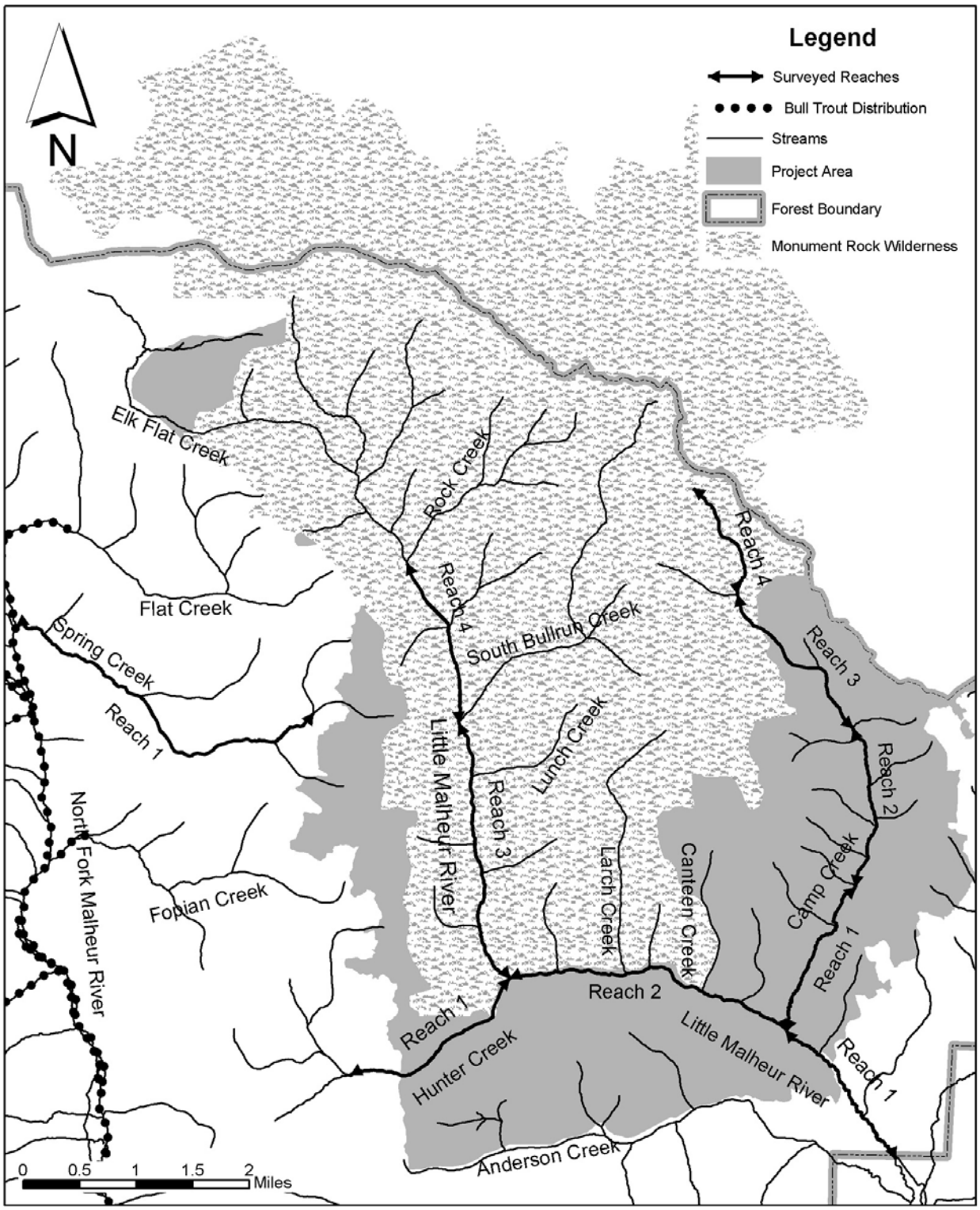
BE Map 11. Location of Columbia spotted frog habitat in the project area in relation to salvage activities proposed under Alternative 2.



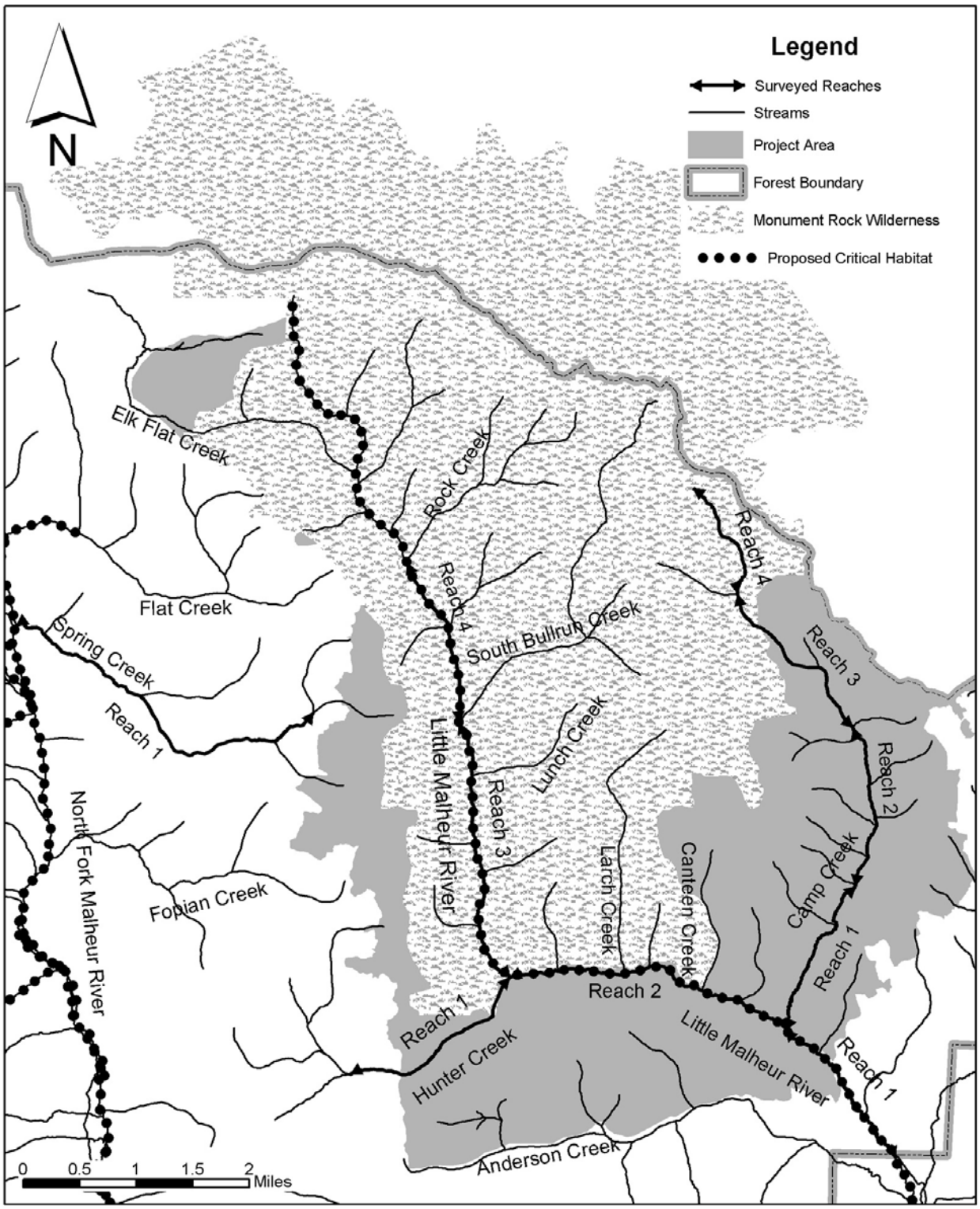
BE Map 12. Location of Columbia spotted frog habitat in the project area in relation to salvage activities proposed under Alternative 3.



BE Map 13. Location of Columbia spotted frog habitat in the project area in relation to salvage activities proposed under Alternative 4.



BE Map 14. Distribution of bull trout in relation to the project area.



BE Map 15. Location of proposed critical habitat for bull trout in the analysis.