

ISSUE 20: WATERSHED MANAGEMENT (WATER QUALITY)

Changes from the Draft to the Final EIS

Several modifications were made to this section from what was presented in the DEIS. Alternative 7 of the DEIS was replaced with Alternative 7-M in this FEIS and the discussion below was adjusted accordingly. This required remodeling of a number of the sediment tables and alternative summaries. A number of minor sediment calculation errors were corrected as well as adjusting a number of the TPA sediment totals based on more refined mileages that were available for the FEIS. After the Draft EIS was released the Montana DEQ refined the TMDL planning schedule for a number of the watersheds in or around the Gallatin NF. The TMDL information and appropriate website links were updated. The Cumulative Effects section was extensively upgraded to include more specific disclosure of cumulative effects of roads and trail activities (travel planning related) to timber harvest/silviculture, grazing, mining and mine reclamation, weeds, recreation, and several other minor program cumulative effects. A section was added on the effects of the updated Forest goals, standards, and guidelines to water resources. Sediment standards and roads and trails management and decommissioning standards were updated.

Introduction

This section addresses the potential sedimentation effects of the Travel Plan alternatives on streams and water quality. Road and trail use, particularly motorized use, can adversely affect watershed integrity, particularly sediment levels. Watershed condition, stream habitat characteristics, stream channel and form, and effects on watershed conditions are detailed in Issue 7: Fisheries.

Affected Environment

The Gallatin National Forest has an extensive network of high quality stream habitat as described in the Issue 7: Fisheries section in Chapter 3. Gallatin National Forest lands function as recharge areas for the Gallatin Valley Aquifer system and the City of Bozeman water supply. Sediment monitoring and modeling during the last 20 years has demonstrated that the Gallatin National Forest road system is the main source of human-caused sediment increases on the Forest. Forest Service and other research literature has consistently documented that up to 90% of the sediment produced from timber sale areas comes from roads (Cafferata and Spittler 1998, Swanson and Dyrness 1975, Rice and Lewis 1992). Road sediment occurs from erosion of the road surface, cut slopes, fill slopes, and ditches, is transported through drainages (often ephemeral), and then discharged to streams, lakes or wetlands. McCashion and Rice (1983) found in a study of northwestern California logging roads that 40% of the total eroded material was derived from road systems. The process includes soil detachment, and either direct transport to a stream, lake, or wetland, or temporary storage in drainages. The sediment is then mobilized when sufficient sediment transport energy is available. Significant variables in road system sediment include intensity and amount of rainfall, road surface (native, gravel, paved), soil texture, slope, cover protection of cut and fill slopes, road design, road width and gradient, and width and condition of streamside buffering for sediment filtration. Motorized trails (ATVs and motorcycles) generally contribute less sediment than roads,

due to narrower prisms and reduced cut and fill slopes. Non-motorized trails normally contribute less sediment than motorized trails, due to narrower prisms, less braiding, and typically more natural drainage (Meyer 2002).

The potential effects of roads on sediment are most pronounced at stream crossings. In general, lower slope position roads have much greater impact on stream channels and water quality than mid and upper slope position roads. Culverts can cause large amounts of sediment when hydraulic capacity is exceeded, or the culvert inlet is plugged and road fills are overtopped. When road fills are breached, sediment loadings can be greatly increased. Interception of interflow by cut slopes can generate substantial amounts of runoff, converting subsurface flows to surface flows (Furniss et al. 2000). Where surface flows are continuous between road and streams, as when ditches convey road runoff to stream channels, the road generating or receiving the runoff is considered hydrologically connected to the stream network (Furniss et al. 2000). Where there is hydraulic connectivity, rapid runoff, sediments and road-associated channels generated on the road surface provide an efficient sediment route into the natural channel network.

Montana Water Quality Standards

Most streams on the Gallatin National Forest are classified by the State of Montana as B-1. Waters classified as B-1 are suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply. A description of Montana surface water quality standards and procedures, including B-1 designated streams can be found at <http://www.deq.state.mt.us/dir/legal/Chapters/CH30-06.pdf>.

For waters classified as B-1, no increases are allowed above naturally-occurring concentrations of sediment, settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife. ‘Naturally-occurring’ means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been applied. ‘Reasonable land, soil, and water conservation practices’ are methods, measures or practices that protect present and reasonably anticipated beneficial uses. These practices include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during or after pollution-producing activities.

The Absaroka Beartooth Wilderness, Lee Metcalf Wilderness and Hyalite Creek waters are classified as A-1. The Bozeman Creek Watershed is classified as A-1 closed. Waters classified as A-1 or A-1 closed are to be maintained suitable for drinking, culinary, and food processing after conventional treatment for removal of naturally-present impurities. Water quality must be maintained suitable for bathing, swimming and recreation, growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers, and agricultural and industrial water supply. No increases are allowed above naturally-occurring concentrations of sediment or suspended sediment, except as permitted in 75-5-318, Montana Code Annotated (MCA): “*settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the*

waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.”

General prohibitions also state that pollution resulting from storm drainage, storm sewer discharges and non-point sources including irrigation practices, road building, construction, logging practices, over-grazing and other practices must be eliminated or minimized as ordered by the Montana Department of Environmental Quality (DEQ).

Water Quality Limited Segments and Total Maximum Daily Loads (TMDLs)

The Federal Clean Water Act and the Environmental Protection Agency Water Quality Planning regulations require states to identify watercourses that contain water quality-limited segments. A water quality-limited segment is a water body that does not fully meet water quality standards or has beneficial uses that are being threatened. The State of Montana DEQ has listed several Gallatin National Forest streams on the 2004 Montana Water Quality Integrated Report (<http://nris.state.mt.us/wis/environet/2004Home.html>) that are also on the 2002 303(d) list. Streams on the Gallatin Forest listed for silviculture or road sources or siltation/suspended solids as a probable cause of impairment include Squaw Creek, Taylor Fork, Cache Creek, Sixmile Creek, Shields River and Red Canyon Creek. Streams listed for other impairment causes include Soda Butte Creek, Clarks Fork Yellowstone River, Fisher Creek (mining), South Fork Madison (arsenic) and Mol Heron Creek (flow alteration). The West Fork of the Gallatin River and two tributaries on private land (Middle Fork of the West Fork, South Fork of the West Fork) are listed for construction, silviculture, and logging roads for suspended sediment and/or siltation. Upper Mill Creek, Cherry Creek, Upper Lower Deer Creek, Upper Deer Creek, and Bear Creek (near Gardiner) are streams partially on the Forest that are on the 1996 list, but not on the 2002 or 2004 list, as they did not pass the state's sufficient and credible data determination, but have been identified as needing further study.

Montana is using a watershed approach to facilitate development of water quality restoration plans. DEQ has divided the state into 91 watershed planning areas and scheduled completion of restoration plans for all areas by May, 2007. The Cooke City TMDL plan was approved in 2002. Other scheduled TMDL completion dates for watersheds in or immediately downstream from the Forest include: Upper Madison (2008-2012), Upper Gallatin (2008-2012), East Gallatin (2007), Shields (2006), Paradise (2005), Boulder River (2005) and Clarks Fork Yellowstone (2006). The schedule can be found at: <http://deq.mt.gov/wqinfo/TMDL/2005Schedual1218.pdf>. The Forest is participating in the development of these TMDLs.

Pending completion of a TMDL on a water body listed pursuant to MCA 75-5-702: new or expanded nonpoint source activities affecting a listed water body may commence and continue provided those activities are conducted in accordance with reasonable land, soil, and water conservation practices; for existing nonpoint source activities, the department shall continue to use educational nonpoint source control programs and voluntary measures.

The Direct and Indirect Effects and Cumulative Effects sections below estimate sediment levels for each Travel Plan Area (TPA), by alternative, for non-motorized trail use, motorized trail use, roads, timber harvest and fire.

Direct and Indirect and Effects

Ground disturbance associated with roads and trails can result in localized erosion and displacement of soil (sediment) and associated delivery to stream channels (Meyer 2002, Furniss et al. 2000). Erosion and sediment effects were evaluated by land type for each alternative using the R1/R4 sediment model (Cline et al. 1981) and adjusting sediment coefficients based on existing road and timber harvest unit conditions within each TPA. The R1/R4 model used is designed to address the cumulative effects of timber harvest operations, road construction, and fire. The model does not attempt to analyze the effects of grazing and mining activities (other than vegetation removal and road construction) or individual episodic storm events. The model is designed to compare relative differences among alternatives rather than to predict precise sediment yields that are likely to occur upon project implementation. Because the R1/R4 model relies on climatic conditions averaged over long periods, the model's accuracy is best when averaged over several years. The model is less reflective of individual drought or flood years. The R1/R4 Sediment model focuses on slope processes and estimates the water and sediment delivered to the main channel by forest management within the watershed, including the headwater stream channels. However, the routing of sediment and water through the main channel is limited to broadly based regional curves as no main channel hydrologic or hydraulic processes are modeled directly. Sediment levels for this FEIS were calculated using sediment coefficients from R1/R4 model runs. Sediment coefficients were developed for five primary geological types on the Gallatin: hard crystalline, Tertiary volcanic, Livingston volcanic, hard sedimentary and Cretaceous sedimentary. These are shown in Table 3.20. 1.

Table 3.20. 1 Travel management sediment modeling coefficients.

	Hard Crystalline	Tertiary Volcanic	Livingston Volcanic	Hard Sedimentary	Cretaceous Sedimentary
Code	C	V	L	H	S
Erosion (tons/mile ² /year)	15	20	40	25	75
Geological Erosion Coefficient	0.6	0.8	1.6	1.0	3
Natural Sediment (tons/mile ² /year)	7.5	10	20	12.5	37.5
Timber Sediment (tons/mile ² /year)	5.34	6.53	15.86	8.34	26.67
Fire Sediment (tons/mile ² /year)	4.45	5.44	13.22	6.95	22.23
Road Sediment (tons/mile ² /year)	0.35	0.46	0.93	0.58	1.74
Motorized Trail (ATV/motorcycle) Sediment (tons/mile ² /year)	0.09	0.12	0.46	0.14	0.43
Non-motorized Trail Sediment (tons/mile ² /year)	0.02	0.03	0.12	0.04	0.11

The modeling coefficients were then multiplied by the size of each TPA for natural sediment and the square miles of timber harvest less than five years old. Road and trail sediment was calculated by miles of road and trail in each TPA. Road and trail sediment coefficients were calculated for roads and two trail categories (motorized - ATV/motorcycle trails, and non-motorized trails). Road sediment per mile of road is greater than for trails, due to wider prism width and larger cut and fill slopes. Motorized trail sediment, on the average, is greater than non-motorized trail sediment due to greater trail width and generally greater sediment delivery efficiency at stream crossings. Localized horse trail crossings can have as much or more localized sediment impact as motorized trail crossings. Sediment was calculated for all roads, trails, timber harvest units, and fires within the TPA boundaries on Forest Service and private land. The sediment calculations were run for 2006 sediment yields, assuming each Travel Plan alternative was implemented.

Total sediment loading for Alternative 1, which approximates existing condition, was calculated for each for each TPA, as shown in Table 3.20.2.

Total sediment is a summation of natural sediment, motorized and non-motorized trail sediment (added for the trail sediment column), road sediment, timber sediment and fire sediment. The percent over natural is the total sediment divided by natural sediment.

Sediment levels in Alternative 1 (Table 3.20.2) indicate that motorized trail sediment is generally higher than non-motorized trail sediment due to higher per mile sediment yields for motorized trails and frequently more miles of motorized trails than non-motorized trails. A major exception is in the Absaroka-Beartooth and Lee Metcalf Wilderness TPAs, where all trails are non-motorized. In almost all TPAs, road sediment is considerably higher than trail sediment. The road sediment coefficients assume that road sediment increases are most frequent in the first two years after road construction but continue at about one-third of new road construction levels, since the road surface and to varying degrees cut and fill slopes can continue to function as sediment sources until the roads are obliterated, recontoured, or sufficiently drained to be disconnected from stream systems (Furniss et al. 2000). The AB Wilderness, LM Wilderness, Gallatin Crest, Porcupine Buffalo Horn, and Sawtooth TPAs have more trail sediment than road sediment. Timber sediment is relatively low since only timber harvest units newer than five years old were included. Timber sediment declines substantially after 2 years as ground vegetation becomes re-established. Fire sediment potential is substantial in areas that have had recent large fires, including the Absaroka Beartooth Wilderness (multiple fires since 2000), Cabin Creek (Beaver Creek fire in 2000), Gallatin Roded (Purdy fire in 2001), Mission Creek (Rough Draw fire in 2003) and Bear Canyon, Gallatin Crest and Yellowstone (Fridley fire in 2001). Fire sediment increases are most frequent in the first three years after a fire and decline quickly with re-vegetation. The Taylor Fork travel planning area contains extensive areas of natural erosive Cretaceous sediments, particular in the upper end of the drainage (Cache Creek and Deadhorse Creek). Many of the most erosive roads in the Taylor Fork TPA have been decommissioned in recent years which reduces sediment delivery.

Table 3.20. 2 Alternative 1 - estimated sediment yields, by TPA

		Alternative 1 – Sediment Analysis								
		Sediment Type/Source – Tons/Year								
Travel Planning Area	Area (mi sq)	Natural	Motorized Trail	Non-Motorized Trail	Trail	Road	Timber	Fire	Total	Percent Over Natural
AB Beartooth Plateau	102.7	770	0	0.87	0.87	0	0	0	771	0.11
AB Wilderness	809.3	7082	0	14.13	14.13	0	0	58.78	7154	1.03
Bangtails	27.8	556	4.14	3.27	7.41	121.27	4.91	0.04	689	24.05
Bear Canyon	17.5	219	2.1	0.33	2.43	44.66	2.75	41.2	310	41.66
Big Sky	27.8	694	5.26	3.23	5.26	325.96	52.12	0	1077	55.24
Bozeman Creek	33.7	422	0.14	1.10	1.24	20.3	0	0.05	443	5.12
Bridger Canyon	13.4	201	0.6	0.83	1.43	27.8	0	0	230	14.53
Cabin Creek	85.4	2136	11.89	2.44	14.33	23.2	0	253	2426	13.60
Cherry Creek	41.7	834	0.92	5.17	6.09	14.88	0	0	855	2.51
Cooke City	40.8	357	0	0.53	0.53	17.41	0	0	375	5.03
Deer Creeks	104.6	2092	37.26	1.54	38.80	65.1	0	0	2196	4.97
East Boulder	63.1	789	4.62	0.47	5.09	20.3	2.58	0.03	817	3.55
East Crazies	163.4	3268	9.66	4.44	14.10	63.24	0	30.5	3,376	3.30
Fairy Lake	36.1	451	0.98	0.53	1.51	53.94	0	0	507	12.29
Gallatin Crest	175.5	1,755	12.84	2.39	15.23	10.58	4.1	1.7	1767	1.75
Gallatin River Canyon	55.5	555	1.15	0.70	1.85	10.69	0	0.03	568	2.27
Gallatin Roded	95.5	955	7.44	0.77	8.21	134.78	12.37	31.45	1142	19.56
Gardiner Basin	39.9	399	1.68	0.24	1.92	28.98	0	0.02	429	7.76
Hebgen Lake Basin	90.3	903	1.44	0.01	1.45	92.92	0	0.33	998	10.48
Hyalite	32.4	324	2.88	0.33	3.21	37.26	0	0.044	365	12.49
Ibex	30.6	612	17.02	0.61	17.63	47.43	0	0	677	10.64
Lionhead	89.0	890	6.24	0.58	6.82	25.3	0	0.03	922	3.61
LM Wilderness Hilgards	52.1	391	0	0.60	0.60	0	0	0	391	0.15
LM Wilderness Monument	50.5	632	0	1.17	1.17	0	0	0	633	0.19
LM Wilderness Spanish Peaks	106.4	798	0	2.14	2.14	0	0	0	800	0.27
Main Boulder	32.3	242	0.54	0.33	0.87	3.5	0.37	0	247	1.96
Mill Creek	116.5	1310	11.02	0.64	11.66	68.12	0.44	0.1	1391	6.13
Mission	18.3	229	0.56	0.31	0.87	6.96	0	11.2	248	8.30
North Bridgers	52.8	660	3.78	0.29	4.07	46.4	0	0	710	7.65
Porcupine Buffalo Horn	93.8	938	8.04	0.74	8.78	0.92	0	1.04	949	1.14
Sawtooth	30.6	306	0	0.27	0.27	0.92	0	0	308	0.39
Shields	60.8	608	4.14	1.44	5.58	146.01	2.53	0	1370	12.67
South Plateau	62.1	621	1.92	0.44	2.36	73.6	0.78	0.02	697	12.37
Taylor Fork	120.3	3006	17.11	4.71	21.82	107.88	1.17	1.22	3138	4.39
Tom Miner Rock	36.3	363	1.2	0.30	1.50	46.92	0	0.04	412	13.34
West Bridgers North	36.3	454	2.94	0.14	3.08	5.22	0	0	462	1.83
West Bridgers South	21.2	265	3.36	0.17	3.53	0	13	0	282	6.23
Yankee Jim Canyon	77.5	775	0.48	0.55	1.03	38.18	0	1.11	815	5.20
Yellowstone	47.5	475	2.28	0.55	2.83	46	9.86	44.3	578	21.81
Total	32,42.5	38,337	182	59	250	1777	107	476	41,547	

The TPAs with the highest percent above natural (%>N) include Bangtails, Bear Canyon, Big Sky, Gallatin Roaded and Yellowstone. The Bangtail TPA encompasses all of the Bangtail range and the private lands on the west side of the range that have a high localized road density. The Bangtail range includes Bangtail Creek and Willow Creek which are Yellowstone cutthroat trout fisheries. Planned rehabilitation of approximately 46 miles of road in the Bangtails in 2006 and 2007 will reduce the estimated sediment in the Bangtails from the 35.37% over natural shown in the DEIS for Alternative 1 to 25.04% over natural for Alternative 1 in this FEIS. The Bear Canyon TPA (which includes Bear Creek and parts of the Trail Creek drainage) has significant road sediment in Trail Creek and motorized trail sediment in Bear Creek. Trail Creek also had a large amount of the Fridley fire and subsequent salvage harvesting on private land. In a cooperative water quality monitoring project in Bear Canyon, (Story 2004) found that Bear Creek sediment loading is naturally high due to erosive soils and stream banks but is accelerated by motorized trail use to the Forest boundary. Below the Forest boundary, the Bear Canyon trail is close to Bear Creek with several direct snowmelt and storm flow discharge points directly into Bear Creek. Downstream from the Bear Canyon trailhead road, residential developments and agricultural use increased Bear Creek sediment about 5.5 times above the measured amounts in tons/mile sq/year at the Forest boundary. The Big Sky TPA, which is primarily private land, has the highest calculated sediment level increase (55.2% >N) of all of the TPAs. Substantial commercial and residential development in the West Fork of the Gallatin River watershed has greatly increased sediment potential. The Gallatin Roaded TPA has a high road density, the Purdy fire in 2001, and a relatively high % >N sediment level (19.6%). The Fridley fire significantly affected the Yellowstone TPA in 2001, which greatly increased sediment potential in Miller Creek, Fridley Creek, Eightmile Creek, West Pine Creek and Trail Creek. West Pine Creek was particularly impacted by post-fire localized rainstorm events in 2002. Sediment levels in the Yellowstone TPA were calculated at 21.8%>N.

Other TPAs with moderate levels of percent over natural sediment due primarily to roads and trails include Bridger Canyon (14.5%), Fairy lake (12.3%), Shields (12.7%), South Plateau (12.4%) and Tom Miner Rock (13.3%).

Sediment levels were then calculated for each TPA, by alternative, and are shown in Table 3.20.3 through Table 3.20.9. Table 3.20.10 is a tabulation of total sediment for all TPAs, by alternative.

Table 3.20. 3 Alternative 1: trail, road and total sediment levels

Travel Planning Area	Sediment Levels – Alternative 1				
	Sediment Type/Source – Tons/Year				Percent Over Natural
	Non-motorized Trail	Motorized Trail	Road	Total	
AB Beartooth Plateau	0.87	0	0	771	0.11
AB Wilderness	14.13	0	0	7,154	1.03
Bangtails	3.27	4.14	121.27	689	24.05
Bear Canyon	0.33	2.1	44.66	310	41.66
Big Sky	3.23	5.26	325.96	1,077	55.24
Bozeman Creek	1.10	0.14	20.3	443	5.10
Bridger Canyon	0.83	0.6	27.8	230	14.30
Cabin Creek	2.44	11.89	23.2	2,426	13.46
Cherry Creek	5.17	0.92	14.88	855	2.51
Cooke City	0.53	0	17.42	375	5.03

Travel Planning Area	Sediment Levels – Alternative 1				
	Sediment Type/Source – Tons/Year				Percent Over Natural
	Non-motorized Trail	Motorized Trail	Road	Total	
Deer Creeks	1.54	37.26	65.1	2,196	4.06
East Boulder	0.47	4.62	20.3	817	3.23
East Crazies	4.44	9.66	63.24	3,376	3.20
Fairy Lake	0.53	0.98	53.94	507	12.28
Gallatin Crest	2.39	12.84	10.58	1767	1.75
Gallatin River Canyon	0.70	1.15	10.695	568	1.72
Gallatin Roded	0.77	7.44	134.78	1142	18.80
Gardiner Basin	0.24	1.68	28.98	429	7.17
Hebgen Lake Basin	0.01	1.44	92.92	998	10.64
Hyalite	0.33	2.88	37.26	365	11.82
Ibex	0.61	17.02	47.43	677	10.64
Lionhead	0.58	6.24	25.3	922	3.16
LM Wilderness Hilgards	0.60	0	0	391	0.15
LM Wilderness Monument	1.17	0	0	633	0.19
LM Wilderness Spanish Peaks	2.14	0	0	800	0.27
Main Boulder	0.33	0.54	3.5	247	1.89
Mill Creek	0.64	11.02	68.12	1391	5.44
Mission	0.31	0.56	6.96	248	8.13
North Bridgers	0.29	3.78	46.4	710	7.24
Porcupine Buffalo Horn	0.74	8.04	0.92	949	1.14
Sawtooth	0.27	0	0.92	308	0.39
Shields	1.44	4.14	146.01	1370	12.67
South Plateau	0.44	1.92	73.6	697	11.89
Taylor Fork	4.71	17.11	107.88	3138	4.31
Tom Miner Rock	0.30	1.2	46.92	412	13.19
West Bridgers North	0.14	2.94	5.22	462	1.89
West Bridgers South	0.17	3.36	0	282	5.70
Yankee Jim Canyon	0.55	0.48	38.18	815	5.10
Yellowstone	0.55	2.28	46	578	21.49
Total	59	182	1777	41,547	

Table 3.20. 4 Alternative 2: trail, road and total sediment levels.

Travel Planning Area	Sediment Levels – Alternative 2				
	Sediment Type/Source – Tons/Year				Percent Over Natural
	Non-motorized Trail	Motorized Trail	Road	Total	
AB Beartooth Plateau	0.87	0	0	771	0.11
AB Wilderness	14.13	0	0	7154	1.03
Bangtails	2.14	4.14	121.27	689	24.05
Bear Canyon	0.33	1.68	44.66	309	41.46
Big Sky	3.23	1.74	325.96	1,077	55.20
Bozeman Creek	1.10	0.14	20.3	443	5.12
Bridger Canyon	0.84	0.6	27.8	230	14.53
Cabin Creek	0.33	11.89	23.2	2,426	13.60
Cherry Creek	1.10	0.92	14.88	855	2.51
Cooke City	0.53	0	17.42	375	5.03
Deer Creeks	0.53	27.6	63.24	2,184	4.42
East Boulder	1.17	2.8	19.72	815	3.24
East Crazyes	0.31	9.66	63.24	3,376	3.30
Fairy Lake	0.29	0.42	53.94	506	12.16
Gallatin Crest	0.14	11.88	10.58	1786	1.75
Gallatin River Canyon	0.17	1.15	8.37	565	1.85
Gallatin Roded	3.27	2.64	130.18	1,132	18.58
Gardiner Basin	5.17	0.96	28.06	428	7.35
Hebgen Lake Basin	1.54	0.12	92	996	10.24
Hyalite	4.44	1.68	36.34	363	11.84
Ibex	0.61	14.26	44.64	671	9.73
Lionhead	1.44	3	24.84	919	3.20
LM Wilderness Hilgards	0.83	0	0	391	0.15
LM Wilderness Monument	3.23	0	0	633	0.19
LM Wilderness Spanish Peaks	2.44	0	0	800	0.27
Main Boulder	4.71	0.45	3.5	247	1.92
Mill Creek	2.39	6.09	67.08	1,385	5.67
Mission	0.77	0.56	6.96	248	8.30
North Bridgers	0.24	2.94	45.24	708	7.35
Porcupine Buffalo Horn	0.01	8.04	0.92	949	1.14
Sawtooth	0.33	0	0.92	308	0.39
Shields	1.44	4.14	146.01	1,370	12.67
South Plateau	0.74	0.36	72.22	694	11.89
Taylor Fork	0.27	17.11	106.72	3137	4.36
Tom Miner Rock	0.44	0.12	46.92	411	13.04
West Bridgers North	0.30	2.94	5.22	462	1.83
West Bridgers South	0.55	3.36	0	282	6.23
Yankee Jim Canyon	0.55	0.48	38.18	815	5.20
Yellowstone	0.64	2.28	46	578	21.69
Total	59	146	1757	41,490	

Table 3.20. 5 Alternative 3: trail, road and total sediment levels.

Travel Planning Area	Sediment Levels – Alternative 3				
	Sediment Type/Source – Tons/Year				Percent Over Natural
	Non-motorized Trail	Motorized Trail	Road	Total	
AB Beartooth Plateau	0.87	0	0	771	0.11
AB Wilderness	14.13	0	0	7,154	1.03
Bangtails	2.67	6.44	121.27	691	24.36
Bear Canyon	0.29	1.82	44.66	309	41.51
Big Sky	2.03	6.38	325.96	1,080	55.57
Bozeman Creek	1.14	0	20.3	443	5.10
Bridger Canyon	0.98	0	27.8	230	14.30
Cabin Creek	3.49	7.83	23.2	2,423	13.60
Cherry Creek	5.17	0.92	14.88	855	2.51
Cooke City	0.68	0.42	17.42	375	5.19
Deer Creeks	4.18	17.48	63.24	2,177	4.06
East Boulder	0.51	2.66	19.72	814	3.23
East Crazies	5.64	5.06	63.24	3,372	3.20
Fairy Lake	0.33	1.12	53.94	507	12.28
Gallatin Crest	3.41	7.8	10.58	1783	1.57
Gallatin River Canyon	0.94	0.23	8.37	565	1.72
Gallatin Roaded	0.68	3	132.02	1,135	18.80
Gardiner Basin	0.48	0	28.06	427	7.17
Hebgen Lake Basin	0.01	0.12	95.68	999	10.64
Hyalite	0.66	0.36	37.26	363	11.82
Ibex	0.73	13.8	44.64	671	9.68
Lionhead	0.70	2.52	24.84	918.17	3.16
LM Wilderness Hilgards	0.60	0	0	391	0.15
LM Wilderness Monument	1.17	0	0	633	0.19
LM Wilderness Spanish Peaks	2.14	0	0	800	0.27
Main Boulder	0.35	0.36	3.5	247	1.89
Mill Creek	0.99	3.19	66.56	1,382	5.44
Mission	0.47	0	6.96	248	8.13
North Bridgers	0.57	1.96	45.24	708	7.24
Porcupine Buffalo Horn	0.74	8.04	0.92	949	1.14
Sawtooth	0.27	0	0.92	308	0.39
Shields	0.12	9.2	146.01	1374	12.98
South Plateau	0.44	0.36	72.22	694	11.89
Taylor Fork	5.23	15.08	106.72	3,136	4.31
Tom Miner Rock	0.12	0.84	46.92	411	13.19
West Bridgers North	0.02	3.36	5.22	463	1.89
West Bridgers South	0.73	1.4	0	280	5.70
Yankee Jim Canyon	0.67	0	37.72	814	5.10
Yellowstone	0.88	0.96	46	577	21.50
Total	65	123	1762	41,447	

Table 3.20. 6 Alternative 4: trail, road and total sediment levels.

Travel Planning Area	Sediment Levels – Alternative 4				
	Sediment Type/Source – Tons/Year				Percent Over Natural
	Non-motorized Trail	Motorized Trail	Road	Total	
AB Beartooth Plateau	0.87	0	0	771	0.11
AB Wilderness	14.13	0	0	7,154	1.03
Bangtails	3.03	5.06	121.27	690	24.18
Bear Canyon	0.29	1.82	44.66	309	41.51
Big Sky	2.33	5.22	325.96	1,080	55.57
Bozeman Creek	1.14	0	20.3	443	5.10
Bridger Canyon	0.98	0	27.8	230	14.30
Cabin Creek	3.79	6.67	23.2	2,422	13.42
Cherry Creek	5.41	0	14.88	854	2.43
Cooke City	0.43	0.42	17.42	375	5.12
Deer Creeks	4.66	15.64	63.24	2,175	3.99
East Boulder	1.27	0	19.72	813	2.99
East Crazyes	6.96	0	63.24	3,369	3.08
Fairy Lake	0.41	0.84	53.94	506	12.23
Gallatin Crest	4.10	5.04	10.58	1781	1.45
Gallatin River Canyon	0.94	0.23	8.37	565	1.72
Gallatin Roaded	0.68	3	132.02	1,135	18.80
Gardiner Basin	0.48	0	28.06	427	7.17
Hebgen Lake Basin	0.04	0	95.68	999	10.63
Hyalite	0.66	0.36	37.26	363	11.82
Ibex	1.57	10.58	44.64	668	9.15
Lionhead	0.76	2.28	24.84	918	3.14
LM Wilderness Hilgards	0.60	0	0	391	0.15
LM Wilderness Monument	1.17	0	0	633	0.19
LM Wilderness Spanish Peaks	2.14	0	0	800	0.27
Main Boulder	0.43	0	3.5	247	1.78
Mill Creek	1.27	0.87	66.56	1380	5.28
Mission	0.47	0	6.96	248	8.13
North Bridgers	1.13	0	45.24	706	7.03
Porcupine Buffalo Horn	0.83	7.68	0.92	949	1.12
Sawtooth	0.27	0	0.92	308	0.39
Shields	0.83	6.44	146.01	1,372	12.81
South Plateau	0.44	0.36	72.22	694	11.89
Taylor Fork	5.61	13.63	106.72	3,135	4.27
Tom Miner Rock	0.30	0.12	46.92	411	13.04
West Bridgers North	0.54	1.54	5.22	461	1.61
West Bridgers South	1.13	0	0	279	5.33
Yankee Jim Canyon	0.67	0	37.72	814	5.10
Yellowstone	1.12	0	46	576	21.33
Total	74	88	1762	41,451	

Table 3.20. 7 Alternative 5: trail, road and total sediment levels.

Travel Planning Area	Sediment Levels – Alternative 5				
	Sediment Type/Source – Tons/Year				Percent Over Natural
	Non-motorized Trail	Motorized Trail	Road	Total	
AB Beartooth Plateau	0.87	0	0	771	0.11
AB Wilderness	14.13	0	0	7154	1.03
Bangtails	3.03	5.06	121.27	690	24.18
Bear Canyon	0.49	1.12	44.66	309	41.28
Big Sky	2.33	5.22	325.96	1,080	55.57
Bozeman Creek	1.14	0	20.3	443	5.10
Bridger Canyon	0.98	0	27.8	230	14.30
Cabin Creek	3.79	6.67	23.2	2,422	13.42
Cherry Creek	5.41	0	14.88	854	2.43
Cooke City	0.50	0.105	17.82	375	5.16
Deer Creeks	7.66	4.14	63.24	2,167	3.59
East Boulder	1.27	0	19.72	813	2.99
East Crazyes	6.96	0	63.24	3,369	3.08
Fairy Lake	0.41	0.84	53.94	506	12.23
Gallatin Crest	4.52	3.36	10.58	1780	1.38
Gallatin River Canyon	1.00	0	8.37	564	1.69
Gallatin Roaded	0.71	2.88	132.02	1,134	18.79
Gardiner Basin	0.48	0	28.06	427	7.17
Hebgen Lake Basin	0.04	0	95.68	999	10.63
Hyalite	0.66	0.36	36.8	362	11.67
Ibex	2.65	6.44	44.64	665	8.79
Lionhead	1.06	1.08	25.3	918	3.09
LM Wilderness Hilgards	0.60	0	0	391	0.15
LM Wilderness Monument	1.17	0	0	633	0.19
LM Wilderness Spanish Peaks	2.14	0	0	800	0.27
Main Boulder	0.43	0	3.5	247	1.78
Mill Creek	1.30	0.58	66.56	1379	5.26
Mission	0.47	0	6.96	248	8.13
North Bridgers	1.13	0	45.24	706	7.03
Porcupine Buffalo Horn	1.79	3.84	0.92	946	0.81
Sawtooth	0.27	0	0.92	308	0.39
Shields	2.03	1.84	146.01	1369	12.53
South Plateau	0.44	0.36	72.22	694	11.89
Taylor Fork	5.98	12.18	106.72	3,134	4.23
Tom Miner Rock	0.30	0.12	46.92	411	13.04
West Bridgers North	0.98	0	5.22	460	1.37
West Bridgers South	1.13	0	0	279	5.33
Yankee Jim Canyon	0.67	0	37.72	814	5.10
Yellowstone	1.12	0	46	576	21.33
Total	82	56	1762	41,428	

Table 3.20. 8 Alternative 6: trail, road and total sediment levels.

Travel Planning Area	Sediment Levels – Alternative 6				
	Sediment Type/Source – Tons/Year				Percent Over Natural
	Non-motorized Trail	Motorized Trail	Road	Total	
AB Beartooth Plateau	0.87	0	0	771	0.11
AB Wilderness	14.13	0	0	7,163	1.03
Bangtails	3.51	3.22	121.27	689	23.93
Bear Canyon	0.49	1.12	44.66	309	41.28
Big Sky	3.68	0	325.96	1,076	55.01
Bozeman Creek	1.14	0	20.3	443	5.10
Bridger Canyon	0.98	0	27.8	230	14.30
Cabin Creek	5.51	0	23.2	2417	13.19
Cherry Creek	2.70	0	14.88	851	2.11
Cooke City	0.50	0	17.82	375	5.14
Deer Creeks	8.74	0	63.24	2,164	3.44
East Boulder	1.27	0	19.72	813	2.99
East Crazyes	6.96	0	63.24	3,369	3.08
Fairy Lake	0.65	0	53.94	506	12.10
Gallatin Crest	5.36	0	10.58	1717	1.24
Gallatin River Canyon	1.00	0	8.37	564	1.69
Gallatin Roded	0.83	2.4	131.56	1,134	18.70
Gardiner Basin	0.48	0	28.06	427	7.17
Hebgen Lake Basin	0.00	0.24	95.68	1,000	10.66
Hyalite	0.66	0.36	37.26	363	11.82
Ibex	4.33	0	44.64	661	8.01
Lionhead	1.33	0	25.3	917	3.00
LM Wilderness Hilgards	0.60	0	0	391	0.15
LM Wilderness Monument	1.17	0	0	633	0.19
LM Wilderness Spanish Peaks	2.14	0	0	800	0.27
Main Boulder	0.43	0	3.5	247	1.78
Mill Creek	1.30	0.58	66.56	1,379	5.26
Mission	0.47	0	6.96	248	8.13
North Bridgers	1.13	0	45.24	706	7.03
Porcupine Buffalo Horn	2.75	0	0.92	943	0.50
Sawtooth	0.27	0	0.92	308	0.39
Shields	2.51	0	146.01	1,367	12.42
South Plateau	0.53	0	72.22	694	11.85
Taylor Fork	9.13	0	106.72	3,124	3.93
Tom Miner Rock	0.33	0	46.92	411	13.02
West Bridgers North	0.98	0	5.22	460	1.37
West Bridgers South	1.13	0	0	279	5.33
Yankee Jim Canyon	0.67	0	37.72	814	5.10
Yellowstone	1.12	0	46	576	21.33
Total	92	8	1762	41,390	

Table 3.20. 9 Alternative 7-M: trail, road and total sediment levels.

Travel Planning Area	Sediment Levels – Alternative 7-M				
	Sediment Type/Source – Tons/Year				Percent Over Natural
	Non-motorized Trail	Motorized Trail	Road	Total	
AB Beartooth Plateau	0.87	0	0	771	0.11
AB Wilderness	14.13	0	0	7,154	1.03
Bangtails	1.44	11.04	122.20	695	25.13
Bear Canyon	.4	1.4	45.24	310	41.63
Big Sky	2.33	5.22	325.96	1,080	55.57
Bozeman Creek	1.14	0	20.3	443	5.1
Bridger Canyon	0.98	0	26.41	229	13.61
Cabin Creek	3.9	6.09	23.2	2,422	13.4
Cherry Creek	5.16	0.92	13.95	854	2.4
Cooke City	0.50	0.105	16.2	374	4.71
Deer Creeks	3.24	21.16	60.45	2,177	4.06
East Boulder	0.52	2.66	19.14	814	3.16
East Crazyes	6.36	2.3	62.31	3,370	3.13
Fairy Lake	0.41	0.84	53.36	506	12.1
Gallatin Crest	4.05	5.28	10.58	1781	1.46
Gallatin River Canyon	0.99	0	7.91	564	1.61
Gallatin Roded	0.63	3.24	126.04	1,129	18.19
Gardiner Basin	0.48	0	28.52	428	7.28
Hebgen Lake Basin	0.04	0	91.54	995	10.18
Hyalite	0.66	0.36	36.34	362	11.53
Ibex	3.00	5.06	44.64	664	8.62
Lionhead	1.06	1.08	25.76	918	3.14
LM Wilderness Hilgards	0.6	0	0	391	0.15
LM Wilderness Monument	1.16	0	0	633	0.18
LM Wilderness Spanish Peaks	2.14	00	0	800	0.27
Main Boulder	0	0.43	3.5	247	1.78
Mill Creek	1.33	0.29	64.48	1,377	5.09
Mission	0.47	0	6.38	247	7.88
North Bridgers	1.13	0	45.82	707	7.12
Porcupine Buffalo Horn	1.74	4.08	0.92	946	0.83
Sawtooth	0.27	0	0.92	308	0.39
Shields	1.44	4.14	143.22	1,368	12.44
South Plateau	0.44	0.36	72.68	695	11.97
Taylor Fork	6.00	12.18	99.76	3,127	4.00
Tom Miner Rock	0.3	0.12	46.92	411	13.04
West Bridgers North	0.36	2.1	5.22	462	1.69
West Bridgers South	0.72	1.4	0	280	5.7
Yankee Jim Canyon	0.67	0	37.72	814	5.1
Yellowstone	1.12	0	46	576	21.33
Total	73	92	1,740	41,432	

Table 3.20. 10 Total sediment for all TPAs, by alternative.

Sediment Type/Source	Total Sediment, All Travel Planning Areas (tons/year)						
	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7-M
Non-Motorized Trail	59	59	65	74	82	92	73
Motorized Trail	182	146	123	88	56	8	92
Road	1,777	1,757	1,762	1,762	1,762	1,762	1,740
Timber	107	107	107	107	107	107	107
Fire	476	476	476	476	476	476	476
Natural	38,945	38,945	38,945	38,945	38,945	38,945	38,945
Total	41,547	41,490	41,447	41,451	41,428	41,390	41,432

Total sediment levels do not have much variation between alternatives since sediment levels are dominated by natural sediment levels and road sediment, and because timber and fire sediment does not vary between alternatives. The primary variable between alternatives is non-motorized and motorized trail sediment which varies substantially. Average natural Sediment for all TPAs is about 93.6% of natural which means management caused sediment averages 6.4% over natural. For Alternative 1 overall sediment levels are about 6.7% over natural; non-motorized trail sediment about 0.15%, motorized trail about 0.46%, roads about 4.6%, timber about 0.27%, and fire about 1.2%. Sediment levels slightly decrease sequentially from Alternative 1 through Alternative 6, so that by Alternative 6, sediment levels are about 6.3% over natural. For Alternative 6, non-motorized trail sediment about 0.23%, motorized trail about 0.02%, roads about 4.5%, timber about 0.27%, and fire sediment about 1.1%. Overall sediment levels in Alternative 7-M are slightly higher than Alternative 5. The largest change is in non-motorized trail sediment, which increases from an estimated 59 tons/year in Alternative 1, to 73 tons/year in Alternative 7-M, and 92 tons/year in Alternative 6. Motorized trail sediment decreases from Alternative 1 at 182 tons/year to 8 tons/year in Alternative 6. The shift from motorized trail sediment to non-motorized trail sediment is due the reduction in motorized trail miles from Alternative 1 to Alternative 6. Timber, fire, and road sediment remain fairly even among alternatives. In actuality, road sediment in Alternative 5 and 6 would likely decrease more than Table 3.20.7 and Table 3.20.8 indicate, since many road segments not allocated for use would be decommissioned. Table 3.20.3 through Table 3.20.9 also do not reflect the fact that actual motorized use would be less in Alternatives 2 through 7-M than Alternative 1, due to implementation of the OHV decision and restriction of motorized trail use primarily to system trails. These tables do not indicate change among alternatives for winterized uses, since the sediment effects of winterized activity are accounted for in the tabulation of road and trail mileages and associated sediment. Winter use (motorized or non-motorized) has essentially no incremental sediment effects since road and trail prisms are already in place and winter use has very little additional ground disturbance.

The alternatives indicate that the TPAs generally have percent over natural sediment levels that comply with Standard M-1 (sediment delivery standards for annual sediment). Watersheds scheduled for TMDL development that are in TPAs compliant with sediment standards for Category A streams (30% >N) include: Storm Castle (Squaw) Creek (18.9 to 18.7% >N), Taylor Fork and Cache Creek (4.0 to 4.4% >N), Sixmile Creek (6.1 to 5.7% >N), Shields River (12.4 to 12.9 >N) and Red Canyon Creek (13.6 to 13.2% >N). Willow Creek and Bangtail Creek are both Yellowstone Cutthroat trout streams in the Bangtails TPA and are anticipated to be reduced form

45% over natural (Willow Creek) and 44% over natural (Bangtail Creek) to 21% and 23% over natural respectively with the road decommissioning work in 2006 and 2007. The 2006/2007 road decommissioning work and ATV construction/maintenance is expected to reduce the overall Bangtail TPA sediment from 35% over natural to 24-25% over natural and comply with the 30% >N standard. Bear Canyon TPA (41.7 to 41.3% >N) sediment is elevated primarily to high road density and Fridley fire effects in Trail Creek. Bear Canyon TPA sediment is expected to drop to about 23% over natural within five years, as the Fridley fire area becomes revegetated. The Big Sky TPA has the highest sediment levels of all TPAs (55.0 to 55.7% >N), but sediment reductions are not expected since the roaded portions are almost entirely on private land and subject to continued residential and commercial development. The Shields River TPA sediment is projected to decrease from 12.98% >N in Alternative 2 to 12.44% >N in Alternative 7-M.

Cumulative Effects

Net Effects of Past and Present Programs and Activities

Cumulative effects are the combined impacts of past, present, and reasonably foreseeable events on watershed conditions and water quality. The spatial area for cumulative effects for Watershed Management (Water Quality) includes the Gallatin National Forest to the external Forest Boundary, with any inclusive private, or other jurisdictional land. Below the Gallatin NF external forest boundary land use often changes from rural to residential and agricultural which generally has more intense watershed management (water quality) impacts than the forested lands of the Gallatin NF. For several resources cumulative effects were considered to below the Gallatin NF boundary. The temporal scope is generally from 1995 to 2015 although all existing impacts are considered such as roads, ski areas, mining, and other management activities/impacts that may have started before 1995. Most of the road network in the sediment analysis was built before 1995. Temporal cumulative impacts for water quality modeling are considered to 2015 which is the out year limitation for the sediment model used for much of the cumulative effects analysis. Cumulative Effects for sediment are addressed in the Direct and Indirect Effects section above for each alternative. Cumulative effects of sediment delivery decrease from Alternative 1 to Alternative 6. Alternative 7-M sediment effects are less than Alternative 1-4 and slightly greater than Alternatives 5 and 6. Relative changes are small and will remain within existing Forest sediment guidelines with the exception of the Big Sky TPA. The Forest Service cannot mitigate sediment delivery in the Big Sky TPA, as the majority of the sediment impacts are on private land.

The sediment analysis in the Watershed Management (water quality) section (Issue 20) contains an extensive cumulative accounting of all timber harvest and silvicultural activities, roads, motorized and non-motorized trails, wildfires, mining activity, ski areas, and other land disturbing impacts on all land jurisdictions within the external Gallatin NF boundary. This includes primarily National Forest lands but also private, State of Montana, and City of Bozeman lands. The results are shown in Tables 3.20.3 through Table 3.20.9. Program areas which have direct sediment effects include timber harvest and silvicultural activities, fire suppression, mineral exploration and development, prescribed fire, facilities (road, trails, road decommissioning), developed ski areas, and roads not under Gallatin Forest jurisdiction.

For timber harvest/silvicultural activities sediment is currently about 107 tons/year which is about 0.25% of the total sediment production on the Gallatin NF. The cumulative timber sediment level does not change between alternatives. For roads (on all jurisdictions) sediment is currently about 1,777 tons/year which is about 4.3% of the total sediment production on the Gallatin NF. For trails sediment is currently about 215 tons/year which is about 0.6% of the total sediment production. For roads and trails combined sediment is currently about 215 tons/year which is about 4.8% of the total sediment production on the Gallatin NF. Sediment impacts from system roads and trails is heavily dependent on maintenance, particularly water bar drainage. Cumulative road and trail sediment level changes only slightly between alternatives. Mining activities were included in the road, trail, or timber columns of total sediment impacts. The East Boulder mine is the largest active mine (Stillwater Mining Company) on the Gallatin NF. Extensive sediment monitoring above and below the mine in 1997-2003 has not documented any measurable sediment impacts from mine activities or road construction. The most intensive historical mining activity on the Gallatin NF has been in the New World Historical Mining District which is undergoing an extensive rehabilitation program. The GNF also has an active program of Abandoned Mine Lands (AML) assessment and rehabilitation.

Several BMP reviews of prescribed burn projects on the GNF have yet to identify accelerated erosion areas due to prescribed burning. Prescribed burn treatments have had no observed effects on water quality due to lack of new road construction, preponderance of low to moderate intensity broadcast burning, very limited ground disturbance, and frequent robust re-vegetation of spring burns. Developed ski area activities were included within the road, trail, or timber columns of total sediment impacts. Travel plan areas with ski area sediment impacts include Bridger Canyon (Bridger Bowl and Bohart Ranch) and Big Sky (Big Sky, Lone Mountain Ranch, Moonlight Basin, and Pioneer Mountain). Most of these impacts occur on private land but were included in the sediment tables under roads and timber.

Livestock grazing has had a moderate effect on water quality (sediment) in localized areas on the Gallatin NF. Site specific impacted areas are identified and evaluated through the AMP revision process. During the 1990's several allotments were evaluated with formal BMP reviews which was useful in AMP revision. Since 1995 a more intensive geomorphic based inventory system on grazing allotments has been used to evaluate livestock impacts (channel stability ratings, channel typing, pebble counts, fish habitat parameters and more recently bank trampling and stubble height limitations). Livestock effects are considered in AMP analysis but not directly quantified in the sediment modeling since the sediment model does not have a specific grazing impact component. During the 1995 to 2006 period the number of AUM's has decreased on the GNF (about 35% since 1988) due to reduction in sheep allotments, shortened grazing seasons, non-use or vacated allotments, and land exchange out of grazing areas. The Gallatin NF has localized areas of intense livestock impacts which are being actively reduced through the AMP revision process.

Other program areas, including dispersed recreation, outfitter/guide activity, other vegetation projects, lands activities, recreation residences and other developed recreation suites, non-recreation special uses, and wildlife management activities pose cumulative effects to watershed management which are primarily use of the road and trail system included in the sediment analysis in Tables 3.20.3 through Table 3.20.9. The Gallatin NF has had a very active land acquisition program since 1987 acquiring 143,700 acres of lands within the National Forest boundary. Many of the acquired

properties have significant wildlife, wetland, and water quality values and were subject to potential subdivision and development. The net result has been considerably fewer roads and residential development on these parcels than would have occurred otherwise. Another benefit has been the opportunity to decommission about 150 miles of roads in the Taylor Fork, North Gallatin, and Shields drainages. Fisheries management projects have often been coordinated with watershed projects and objectives resulting in a beneficial effect to watershed management. In stream improvement projects typically have short term turbidity increases and sediment mobilization and are permitted by the Montana DFWP and as appropriate the Montana DEQ for short term turbidity exceedance. These effects are generally very localized and short term. Most of the fishery projects have beneficial impacts to stream channel stability.

Projected Combined Effects of Reasonably Foreseeable Programs and Activities

The cumulative effects of reasonably foreseeable programs and activities generally are not anticipated to greatly change sediment levels as displayed in Tables 3.20.3 through Table 3.20.9. Overall road and trail sediment levels are expected to remain similar to present with a slight decline (5% to 20%) in some Travel Planning areas due to decommissioning of project (green) roads. Travel Planning areas with the greatest potential for road decommissioning include Bangtails, Cooke City, Gallatin Roaded, Mill Creek, and Shields. Bear Canyon trail reconstruction and increased maintenance is expected to greatly reduce sediment levels in that Travel Planning Area. A slight expected improvement in trail maintenance will locally reduce sediment potential. Dispersed recreation on the Gallatin National Forest is expected to increase by 5 to 44% depending on the activity. Local watershed management (water quality) impacts are expected to increase accordingly but will remain very low compared to the sediment impacts of the transportation (roads and trails) system.

All of the reasonably foreseeable timber harvest/silvicultural projects are fuel risk reduction, salvage, or insect and disease projects. Sediment and water quality impacts are expected to be minimal and considerably below levels from 1960-2000. Private land timber harvesting activity is also expected to be reduced considerably from the last 2 decades. Livestock effects on water quality (sediment) are expected to continue to decline as the GNF completes revised AMP plans and incorporates more stringent riparian impact standards in AMP's. The reasonably foreseeable revised AMP plans include adaptive management techniques designed to reduce riparian/water quality impacts.

Reasonably foreseeable mineral exploration and development activity is expected to have minimal and very localized effect on watershed management (water quality) on the Gallatin NF. Probability that any unexplored areas would be developed in the next 15 years is low. No large salable minerals are expected to be developed. Leasable mineral development (oil/gas) on the Gallatin to 2015 is expected to be none to minimal.

The Gallatin NF has greatly accelerated fuel reduction projects since 2000 with the initiation of the National Fire Plan. Reasonably foreseeable activities include Hebgen Basin fuels, Main Bounder, Bozeman Municipal watershed, Deer Creeks, Paradise Valley, Long Mountain, Gallatin Canyon North, and multiple smaller fuel reduction projects. These projects have potential to increase

sediment levels if road and commercial harvest activities are included. However, future GNF fuel treatment projects are expected to have limited effect on water quality due to lack of new road construction, preponderance of low to moderate intensity broadcast burning, very limited ground disturbing activity, and frequent robust re-vegetation of spring burns. Project specific potential sediment effects will be disclosed for each project as part of the ongoing NEPA process. Sediment effects of wildfires and wildfire suppression activity in the future are very speculative. A substantial potential exists on the GNF for large wildfires which pose large increases in sediment production if subjected to heavy precipitation within 2 years. Fire suppression can increase watershed disturbance via fire line construction, logistical service areas, helipads, etc. but includes provisions for immediate rehabilitation once the fire is controlled.

Using procedures outlined in the GNF Weeds EIS (2005), contamination of surface water should not occur during Gallatin Forest weed spraying activities, unless a spill occurred directly into a stream. Proposed treatments may still result in small amounts of herbicide entering water. The analysis indicates herbicide applications in all but a few 6th code HUCs on the Forest should remain well below “safe” concentrations and pose little risk to fisheries. This assumes project implementation and mitigation described in the EIS are followed. Results from the analysis indicate treatments proposed for weeds within 17 of the 108 6th code HUCs across the Forest, show some risk for exceeding “safe” concentrations in surface waters. These are constrained in the EIS by pounds of picloram per year to maintain potential concentrations below threshold levels.

Non-recreation special uses, wildlife management activities, heritage resource management activities, Yellowstone National Park and other National Forest travel management plans, and Non-Forest Service wildlife and fisheries management activities have limited cumulative effects other than using the Gallatin NF road and trails system and the effects of that system as previously discussed. No large land acquisition activities like the Gallatin land consolidation are likely in the future but the GNF will continue acquisition and land trade activities on several additional parcels. These acquisitions will continue to provide watershed management benefits primarily through potential development related sediment reduction and acquisition of wetland and riparian habitats.

Foreseeable non-recreation special use activities include hydroelectric development at Hebgen Reservoir dam, and State Highway widening and improvements. These include Cooke City, Grayling Creek Hy 191 bridge, Gallatin Canyon Highway 191 improvements, communication sites, road and utility access to private land, commercial filming, and community facilities such as the Cooke City public waters supply development. These activities generally pose minor and localized impacts on watershed management (sediment) and are disclosed and conditioned in the NEPA and permitting process.

Fish management conservation and restoration actions will continue and projects will likely increase in scale such as the Cherry Creek westslope cutthroat restoration project and the Hebgen Basin Fry Recruitment and Habitat Restoration/Enhancement project. These projects can result in short term turbidity increases depending on the degree of stream channel activity but are permitted through the Montana DFWP, Montana DEQ, and GNF NEPA process. Overall watershed management effects are anticipated to be minor and positive.

Effects of Forest-Wide Goals, Objectives, Standards, and Guidelines

No change in management would occur in Alternative 1. Forest Plan direction that applies to travel management would continue to be followed.

Alternatives 2 through 7-M propose a number of goals and objectives to provide for recreation opportunity and access and improve other resource conditions that may have been adversely affected by the Forest's transportation system. Goals and objectives, by themselves, have no environmental effect because they do not constitute final agency decisions. Environmental effects under NEPA are more appropriately addressed at such time that specific actions are proposed to achieve these goals and objectives. The proposed Travel Management Plan does include the final agency decisions for management of public travel and this reflects implementation of the goals and objectives proposed for recreation opportunity. The predicted direct, indirect and cumulative effects of public travel on watershed management/water quality, and hence the implementation of these goals and objectives are addressed earlier in this section.

Alternatives 2 through 6 and Alternative 7-M also propose standards and guidelines to provide for protection of other resources during Travel Plan implementation. Standards and guidelines include protection measures within which future proposals for road and trail construction, reconstruction, maintenance and decommissioning must take place. These are considered final agency decisions because they set limitations within which future actions must take place. The proposed goals, objectives, standards and guidelines that are relevant to the protection and improvement of watershed management/water quality are discussed below.

In Alternative 7-M the Forest-Wide Goals, Objectives, Standards, and Guidelines provide important constraints and guidance to watershed management. The Standard E-5 provides very key constraints to allowable watershed disturbance (roads, harvest units etc.) and is directly tied to the Montana water quality standards and attainment of beneficial uses. During the last several years many proposed Gallatin NF projects have been re-designed to comply with the sediment standards. The proposed standards are more stringent for former stream classes C (fisheries of local importance) and D (non fisheries) as these stream classes change to the management objective of 75% of reference. The Cumulative % of reference standard was dropped since that standard does not have a solid beneficial use foundation and is hard to accurately quantify. The designation of HUC6 watersheds as analysis units for the sediment standard accounting with consideration of HUC7 provides more refined guidance and constraints to potential sediment increases.

Goal D and associated objectives (D1 – Road Rehabilitation, D-2 Trail Rehabilitation, and D-3 Road and Trail Maintenance) give more specific direction to road and trail maintenance with particular emphasis to closing excess roads (decommissioning) and trail maintenance. Guideline D-7 provides additional direction to close and re-vegetate project roads when not needed.

Objective A-6, Backcountry airstrips would require consideration of landing/takeoff locations for airplanes and helicopters which could pose watershed and water quality impacts which would be constrained by water quality standards and other water resource protection related goals and objectives. This objective would apply to Alternative 3 and 7-M. The objective would not

constitute a final agency decision to authorize construction or landings and therefore specific impacts would more appropriately be evaluated once a specific proposal is received.

Generally, the seasonal restrictions proposed from March 30 through either May, June, or July 15 to protect facilities and prevent erosion, would alleviate some of the impacts of the road and trail system to water quality. Roads and trails on the Gallatin NF are especially vulnerable to erosion during snowmelt runoff and the generally high precipitation during May and June.

Cumulative Effects of Past, Present and Reasonably Foreseeable Programs and Activities with the Travel Plan Alternatives

The Cumulative effects of past, present, and reasonably foreseeable programs and activities for sediment are addressed in the Net Effects of Past and Present Programs and Activities, Projected Combined Effects of Reasonably Foreseeable Programs and Activities, and Direct and Indirect Effects section for each alternative. Cumulative effects of sediment delivery decrease from Alternative 1 to Alternative 6. Alternative 7-M sediment effects are less than Alternative 1-4 and slightly greater than Alternatives 5 and 6. Relative changes are very small between alternatives and will remain within existing Forest sediment guidelines with the exception of the Big Sky TPA. The Forest Service cannot mitigate most of the sediment delivery in the Big Sky TPA, as the majority of the sediment impacts are on private land.

Consistency with Laws, Regulations, Policy, and Federal, Regional, State and Local Land Use Plans (including the Forest Plan)

The State of Montana Water Quality Act requires the state to protect, maintain, and improve the quality of water for a variety of beneficial uses. Section 75-5-101, MCA established water quality standards based on beneficial uses. The Montana Department of Environmental Quality has classified all non-Wilderness surface waters on the Gallatin National Forest as B1 except for Bozeman Creek (A-Closed) and Hyalite Creek (A-1). Waters classified as B1 must be suitable for drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply. A 5 NTU (nephelometric turbidity units) turbidity increase above naturally-occurring turbidity is allowed in B1 waters. Surface waters within the Absaroka Beartooth Wilderness are classified as A1, and have similar suitability criteria for beneficial uses, except that no turbidity increase above naturally-occurring turbidity is allowed.

All action alternatives (Alternatives 1 through 7-M) are consistent with the State of Montana Water Quality Act as well as other applicable laws policies, and the Gallatin Forest Plan (USDA 1987). Sediment and TMDL compliance is described in the Direct and Indirect Effects section above. Best Management Practices will be employed under all alternatives to ensure consistency with these protection measures. Specific Montana water quality standards that will be met include Administrative Rules of Montana 17.30.623 (1), which requires that B1 waters ((non-Wilderness streams except for Bozeman Creek (A1 closed) and Hyalite Creek (A1)) after conventional treatment are suitable for growth and propagation of salmonid fishes and associated aquatic life and 17.30.623 (2) (f) that does not allow increases above naturally-occurring concentrations of sediment

that would render the waters harmful to public health, recreation, safety, livestock, fish or other wildlife.

The Gallatin Forest Plan, Forest-wide Standards 10.2 (USDA 1987:II-23) requires that Best Management Practices will be used in all Forest watersheds. Goals and standards that apply include:

STANDARD E-4. Water, Fisheries, and Aquatic Life. “Proposals for road and trail construction, reconstruction, maintenance and other ground disturbing projects (timber sales, fuel treatment projects, mineral activities, etc.) will be designed to not exceed annual sediment delivery levels in excess of those in Table 3.20.11. Sixth-code Hydrologic Unit Codes (HUCs) are the analysis unit for sediment delivery (and other habitat parameters), except where a sixth code HUC artificially bisects a watershed and is therefore inadequate for analysis of impacts to aquatic habitat and aquatic organism metapopulations. In such cases, appropriate larger units will be analyzed (e.g. 5th code HUCs). Within the analysis unit, sediment delivery values in Table 3.20.11 will serve as guidelines; however, sediment delivery values denoted in individual 7th code HUCs may only temporarily exceed sediment delivery rates denoted in Table 3.20.11, in the following circumstances:

1. The 7th code HUC does not contain a fragmented **fish population of special management designation**;
2. The majority of 7th code HUCs in the analysis unit remain within sediment delivery values listed in Table 3.20.11;
3. Other core stream habitat (e.g. pool frequency, pool quality) or biotic (e.g. macroinvertebrates, fish populations) parameters within the 7th code HUC do not indicate impairment as defined by Montana Department of Environmental Quality (MDEQ); and
4. Sediment delivery levels will return to values listed in Table 3.20.11 within 5 years of project completion, and thereby do not lead to stream impairment as defined by Montana Department of Environmental Quality (MDEQ).

Table 3.20.11. Substrate sediment and sediment delivery by Forest stream category. Bold values are provisional pending final analysis of Forest reference data.

Category	Management Objective (% of reference*)	% Fine Substrate Sediment (<6.3mm)	Annual % > Reference* Sediment Delivery
A Sensitive Species and/or Blue Ribbon fisheries	90%	0 – 26 %	30%
B All other streams (formerly Classes B, C, D)	75%	0 – 30 %	50%

*% of reference = % similarity to mean reference condition

STANDARD E-5. Water, Fisheries and Aquatic Life. “Proposed roads and trails shall not be located in the floodplains of rivers and streams or in wetlands except where necessary to cross a stream or wetland with appropriate permits.”

STANDARD E-6. Water, Fisheries and Aquatic Life. “Stream crossing facilities for proposed roads and trails shall allow for passage of aquatic organisms, by avoiding stream channel constriction or alteration of the flow pattern, except where passage restriction is desired to isolate genetically pure cutthroat trout populations from exposure to hybridization or competition by non-native salmonids.”

STANDARD E-7. Water, Fisheries and Aquatic Life. “Road materials should not be side-cast into streams or wetlands.”