APPENDIX E
STREAMBANK EROSION ASSESSMENT

MIDDLE AND LOWER BIG HOLE RIVER WATER QUALITY RESTORATION PLANNING AREAS

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January 2007

Project No. B15532.09

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1.0 INTRODUCTION

This report presents an assessment of sediment loading due to streambank erosion along stream segments listed as impaired due to sediment in the Middle and Lower Big Hole TMDL Planning Areas (TPA). Sediment loads due to streambank erosion were calculated based on field data collected in 2005 and 2006. Data collected in the field was extrapolated to the listed stream segments based on the Aerial Assessment Database compiled prior to field data collection. This data was also used to estimate sediment loading at the watershed scale and to assess the potential to decrease sediment inputs due to streambank erosion. The following reports provide further background information for this assessment:

> *Middle and Lower Big Hole TMDL Planning Area Sediment Monitoring Quality Assurance Project Plan* (MDEQ 2005)
>
> *Aerial Assessment of Selected Stream Segments in the Middle and Lower Big Hole TMDL Planning Area* (MDEQ 2006)
>
> A*erial Assessment of the Middle and Lower Big Hole TMDL Planning Area: Pintlar Creek to the Beaverhead River* (Applied Geomorphology/DTM Consulting 2005)
>
> *Water Quality Status Report and Sampling and Analysis Plan: Middle and Lower Big Hole River Water Quality Restoration Planning Areas* (MDEQ 2005)

1.1 Sediment Impairments

Sediment loading due to streambank erosion was assessed in the field on 20 of the 23 sediment listings on the 2006 303(d) List including upper Birch, California, Camp, Corral, Deep, Delano, Divide, Elkhorn, Fishtrap, Gold, Grose, Lost, Oregon, Pattengail, Rochester, Sawlog, Sevenmile, Sixmile, Soap, and Trapper creeks. Additional assessments were performed on 9 stream segments with 2006 303(d) pollution listings that were potentially related to sediment such as low flow or habitat alterations. Those assessments were performed on the middle and lower segments of the Big Hole River, Wise River, lower Birch, Canyon, French, Moose, Jerry, and Willow creeks. Based on the 303(d) listing status when sampling was conducted, no assessments were performed on Charcoal, Twelvemile, or Wickiup Creek.

2.0 DATA COLLECTION AND EXTRAPOLATION

Streambank erosion assessments were performed on 222 streambanks along 49 monitoring sections covering 29 stream segments within the Middle and Lower Big Hole TPA. In general, two monitoring sections were assessed in each stream segment. Eroding streambank assessments were typically performed along a 900-foot monitoring section, though lengths varied from 600 feet on the smallest streams to approximately 3,500 feet on the Big Hole River. A total of 10.1 miles (53,125 feet) of stream were assessed. Monitoring section locations are presented in **Figure 2-1**.

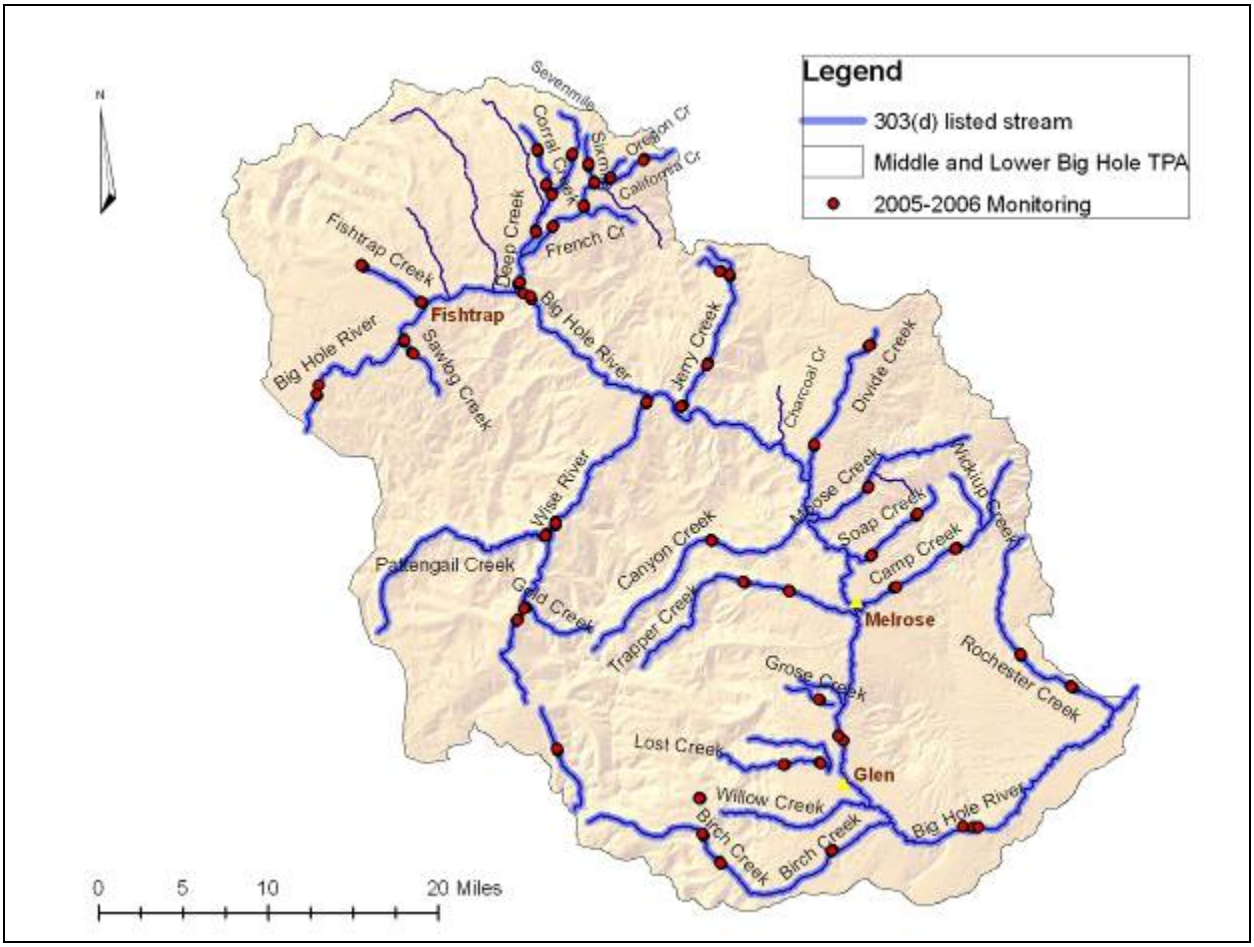

Figure 2-1. Monitoring Sections.

2.1 Field Data Collection

Streambank erosion was assessed by performing Bank Erosion Hazard Index (BEHI) measurements and evaluating the Near Bank Stress (NBS) (Rosgen 1996, 2004). The BEHI score was determined at each eroding streambank based on the following parameters: bank height, bankfull height, root depth, root density, bank angle and surface protection. BEHI categories range from “very low” to “extreme”. At each eroding streambank, the NBS was determined by performing a channel cross-section measurement. The NBS is the ratio of the

near-bank maximum bankfull depth (measured as the deepest point in the 1/3 of the channel closest to the bank) to the bankfull mean depth (Rosgen 2004). NBS categories range from "very low" to "extreme". The length, height, and composition of each eroding streambank were noted and the source of streambank instability was identified based on the following near-stream source categories:

- Transportation
- Riparian Grazing
- Cropland
- Mining
- Silviculture
- Irrigation-shifts in stream energy
- Natural Sources
- Other

The source of streambank erosion was evaluated based on observed anthropogenic disturbances and the surrounding land-use practices. For example, an eroding streambank in a heavily grazed area in which all the willows had been removed was assigned a source of "100% riparian grazing", while an eroding streambank due to road encroachment upstream was assigned a source of "100% transportation". Naturally eroding streambanks were considered the result of "natural sources". The "other" category was chosen when streambank erosion resulted from a source not described in the list. If multiple sources were observed, then a percent was noted for each source.

2.2 Estimating Sediment Loads from Field Data

The length of eroding streambank, mean height, and the annual retreat rate were used to determine the annual sediment input from eroding streambanks (in cubic feet). The length and mean height were measured in the field, while the annual retreat rate was determined based on the relationship between BEHI and NBS scores. Streambank retreat rates measured in the Lamar River in Yellowstone National Park (Rosgen 1996) were applied to streambanks in the Middle and Lower Big Hole TPA (**Table 2-1**). The annual sediment input in cubic feet was then converted into cubic yards (divided by 27 cubic feet per yard) and finally converted into tons per year based on the bulk density of the streambank to provide an annual sediment load.

Table 2-1. Annual Streambank Retreat Rates (Feet/Year) (adapted from Rosgen 1996).

		Near Bank Stress				
		Very Low	**Low**	**Moderate**	**High**	**Very High**
BEHI	Low	0.019	0.042	0.089	0.19	
	Moderate	0.082	0.17	0.33	0.62	1.3
	High - Very High	0.29	0.44	0.7	1.1	1.7
	Extreme	0.6	0.83	1.3	1.7	2.3

2.3 Streambank Composition

Bulk density of streambanks in the Middle and Lower Big Hole TPA was determined based on streambank composition data collected in the field and standard soil weights compiled by the U.S Department of the Interior (USDI 1998). Soil weights in the "well-graded" category were selected to most accurately reflect streambank composition, since "well-graded" suggests a wide

array of size classes, which is likely what is found in nature. Based on data collected in the 49 monitoring sections, the average streambank composition was 70% "silt/sand" and 30% "gravel/cobbles". This composition most closely resembles the soil group described as "well-graded sand". Based on the minimum value of the USDI dry unit weight for "well-graded sand", a value of 107 pounds/foot³ (1.44 tons/yard³) was estimated as the average bulk density of streambank material (USDI 1998) (**Table 2-2**). The minimum value was selected to account for plant roots within the streambank that would decrease the overall soil density.

Streambanks along the mainstem of the Big Hole River in the Lower Big Hole TPA were determined to have a composition differing from the entire watershed, where many of the assessed sections were on smaller tributary streams. Based on the 13 eroding streambanks assessed along the lower Big Hole River, an average composition of 43% "silt/sand" and 57% "gravel/cobbles" was observed. This composition most closely resembles the soil group described as "well-graded gravel with silt". Based on the minimum value of the USDI dry unit weight for "well-graded gravel with silt", a value of 89 pounds/foot³ (1.20 tons/yard³) was estimated as the average weight of the streambank material (USDI 1998).

Table 2-2. Streambank Bulk Density (adapted from USDI 1998).

Sample Area	Sample Size	Mean Composition		Soil Group	Minimum Dry Unit Weight (Pounds/Foot³)	Minimum Dry Unit Weight (Tons/Yard³)
		Sand / Silt (%)	Gravel / Cobbles (%)			
Entire Watershed	225	70	30	Well-graded sand	107	1.44
Lower Big Hole	13	43	57	Well-graded gravel with silt	89	1.20

2.4 Data Extrapolation

Streambank erosion, measured along 49 monitoring sections, was extrapolated to the stream reach and stream segment scales based on the Aerial Assessment Database. In the field, **monitoring sections** were selected in areas that were representative of the overall stream condition at the stream reach scale. Sediment loads, derived from the monitoring sections, were extrapolated to the stream reach scale. **Stream reaches** were defined in the Aerial Assessment Database prior to field work through the use of GIS data layers and aerial imagery (Applied Geomorphology/DTM Consulting 2005, MDEQ 2005). Sediment loads extrapolated to the stream reach scale were then summed to achieve an estimate of sediment input due to streambank erosion to each 303(d) listed **stream segment**. Sediment loading at the watershed scale and the potential to decrease streambank erosion were also estimated. The extrapolation process was outlined in the *Middle and Lower Big Hole TMDL Planning Area Sediment Monitoring Quality Assurance Project Plan* (MDEQ 2005), which presented the following definitions:

Definitions: *Stream Segment – 303(d) listed segment*
Stream Reach – Aerial or field verified subdivision of the stream segment with like land cover and Rosgen level 1 stream type

Monitoring Section – A 900 foot or 20xbankfull width (whichever is longer) section of a reach where detailed monitoring occurs that represents conditions along a stream reach

3.0 SEDIMENT LOADING DUE TO STREAMBANK EROSION

3.1 Monitoring Section Sediment Loads

Eroding streambank assessments were performed along a total of 10.1 miles of stream in the Middle and Lower Big Hole TPA. A total sediment load of 551.8 tons/year was attributed to eroding streambanks within the monitoring sections. Sediment loads due to streambank erosion from these individual monitoring sections ranged from 0.0 tons/year in monitoring section "Delano 1" to 147.5 tons/year in monitoring section "Lower Big Hole 2". A summary of eroding streambank conditions and sediment loading is presented in **Table 3-1**. Sediment loads calculated for each monitoring section were normalized to a length of 1000 feet for the purpose of comparison and extrapolation. Mean BEHI scores, length of eroding bank, percent of eroding bank, stream type at the laser level cross-section, and the potential stream type are also presented for each monitoring section in **Table 3-1**.

At the monitoring section scale, 2.8% of the bank erosion was attributed to transportation, 51.1% was attributed to riparian grazing, 2.1% was attributed to mining, 0.2% was attributed to silviculture, 3.3% was attributed to irrigation, 33.6% was attributed to natural sources and 6.9 % was attributed to "other", which includes the impact of historic dam failures that affected three of the stream segments (upper Birch Creek, Pattengail Creek and the Wise River) in the Middle and Lower Big Hole TPA. Other sources of bank erosion identified within the monitoring sections include recreation and inadequate stream restoration projects. An overall sediment load from eroding streambanks of 366.6 tons/year (66.4%) was attributed to anthropogenic sources, while 185.2 tons/year (33.6%) was attributed to natural sources. Eighty percent (294.6 tons/year) of the anthropogenically induced sediment load is due to streambank erosion in 16 of the monitoring sections (33%), while the remaining 33 monitoring sections account for only 20% of the anthropogenically induced streambank sediment load. The 16 monitoring sections contributing 80% of the anthropogenically derived sediment load include: Birch 3, California 2, Camp 1, Camp 2, Deep 2, Elkhorn 1, French 1, Grose 1, Lower Big Hole 1, Lower Big Hole 2, Sawlog 1, Sixmile 2, Soap 1, Trapper 1, Willow 1, and Wise 1. Sediment loads, due to streambank erosion for each monitoring section, are provided for each source in **Table 3-2**.

Table 3-1. Monitoring Section Sediment Loads due to Streambank Erosion.

Monitoring Section	Mean BEHI Score	Length of Eroding Bank (Feet)	Reach Length (Feet)	Percent of Reach with Eroding Bank	Sediment Loading from Monitoring Section (Tons/Year)	Sediment Loading per 1000' of Stream (Tons/Year)	Stream Type at Laser Level Cross-section	Potential Stream Type
Birch 1	27.0	146	900	8.1	4.8	5.4	B3a	B3a/B3
Birch 2	28.5	122	900	6.8	8.3	9.2	C3b	B3
Birch 3	32.9	190	900	10.6	8.8	9.8	B3c	C3
California 1	30.9	95	900	5.3	3.3	3.7	E4	E4
California 2	29.4	236	900	13.1	12.0	13.3	E4	E4
Camp 1	32.5	207	900	11.5	18.0	20.0	B4c	C4
Camp 2	31.5	195	900	10.8	10.5	11.7	C4	B4c
Canyon 1	25.0	250	900	13.9	6.3	7.0	C4	C4
Corral 1	39.3	31	900	1.7	1.6	1.8	E4a	A4
Corral 2	29.0	205	900	11.4	5.0	5.6	E4	E4
Deep 1	27.0	346	900	19.2	13.2	14.7	C4	E4
Deep 2	36.2	460	1000	23.0	42.6	42.6	C4	C4
Delano 1	15.6	0	900	0.0	0.0	0.0	A4	A3
Delano 2	22.8	166	900	9.2	1.9	2.1	E4b	E3b
Divide 1	23.0	288	900	16.0	4.8	5.4	B4c	E4
Divide 2	25.6	91	900	5.1	2.0	2.2	F4	C4
Elkhorn 1	42.0	249	900	13.8	14.6	16.3	B4c	B4c
Fishtrap 1	27.3	109	900	6.1	2.8	3.1	B4	B3
Fishtrap 2	20.9	94	900	5.2	1.4	1.5	C4	C3
French 1	35.6	428	900	23.8	28.0	31.1	C4	C4
Gold 1	32.8	164	900	9.1	4.5	5.0	C4	E4
Grose 1	37.7	185	600	15.4	18.2	30.3	B5a	E3a
Jerry 1	20.8	245	900	13.6	6.2	6.9	B4c	B3
Jerry 2	23.9	127	900	7.1	1.8	2.0	C4	B3c
Lost 1	29.0	43	700	3.1	1.0	1.4	E4b	E3b
Lost 2	30.2	52	600	4.3	2.1	3.4	E5b	E3b
Lower Big Hole 1	19.7	1000	3245	15.4	42.1	13.0	C4	C4
Lower Big Hole 2	34.3	1139	3530	16.1	147.5	41.8	C4	C4
Middle Big Hole 1	24.0	233	3400	3.4	3.3	1.0	C4	C4
Middle Big Hole 2	20.0	323	3450	4.7	6.3	1.8	C4	C4
Moose 1	14.9	120	900	6.7	2.5	2.8	B4	B3
Oregon 1	22.6	29	600	2.4	1.1	1.8	E4b	E3b
Pattengail 1	19.2	17	900	0.9	1.4	1.5	B3c	B3c
Rochester 1	31.8	73	900	4.1	3.1	3.4	C5b	E4b
Rochester 2	38.1	85	900	4.7	5.1	5.6	E4	E4
Sawlog 1	30.7	145	900	8.1	7.6	8.5	C4	E4
Sawlog 2	29.2	10	600	0.6	0.2	0.4	E5	E4
Sevenmile 1	32.4	142	900	7.9	7.5	8.3	E4b	E4b
Sevenmile 2	27.7	118	900	6.6	2.8	3.1	E4	E4
Sixmile 1	28.1	79	900	4.4	3.2	3.6	B4	B4
Sixmile 2	35.9	538	900	29.9	23.9	26.6	G4	E3b
Soap 1	27.6	940	900	52.2	14.1	15.6	E4a	E3a
Soap 2	37.4	15	600	1.3	1.9	3.1	E5b	E4b
Trapper 1	33.3	237	900	13.2	8.3	9.2	E4	E4
Trapper 2	24.4	91	900	5.1	0.7	0.7	C4	E4
Willow 1	35.4	153	1000	7.7	14.3	14.3	C4	E4
Wise 1	34.7	462	900	25.7	28.9	32.1	B4c	C4
Wise 2	13.9	95	1200	4.0	0.7	0.5	C3	C3
Wise 3	13.5	90	1100	4.1	1.5	1.4	C3	C3

Table 3-2. Monitoring Section Sediment Loads from Individual Sources due to Streambank Erosion.

Stream Segment	Sediment Load	Sources								Total Load
		Transportation	Riparian Grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural Sources	Other	
Birch 1	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.00	1.22	3.62	**4.8**
	Percent	0%	0%	0%	0%	0%	0%	25%	75%	
Birch 2	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.00	8.32	0.00	**8.3**
	Percent	0%	0%	0%	0%	0%	0%	100%	0%	
Birch 3	**Tons/Year**	0.00	8.79	0.00	0.00	0.00	0.00	0.00	0.00	**8.8**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
California 1	**Tons/Year**	0.00	0.00	0.00	3.29	0.00	0.00	0.00	0.00	**3.3**
	Percent	0%	0%	0%	100%	0%	0%	0%	0%	
California 2	**Tons/Year**	0.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	**12.0**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Camp 1	**Tons/Year**	0.00	5.19	0.00	0.00	0.00	3.97	4.24	4.56	**18.0**
	Percent	0%	29%	0%	0%	0%	22%	24%	25%	
Camp 2	**Tons/Year**	0.00	10.54	0.00	0.00	0.00	0.00	0.00	0.00	**10.5**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Canyon 1	**Tons/Year**	0.38	2.01	0.00	0.00	0.00	0.00	3.91	0.00	**6.3**
	Percent	6%	32%	0%	0%	0%	0%	62%	0%	
Corral 1	**Tons/Year**	0.00	0.00	0.00	0.00	0.81	0.00	0.81	0.00	**1.6**
	Percent	0%	0%	0%	0%	50%	0%	50%	0%	
Corral 2	**Tons/Year**	0.00	5.01	0.00	0.00	0.00	0.00	0.00	0.00	**5.0**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Deep 1	**Tons/Year**	0.00	1.62	0.00	0.00	0.00	0.00	11.63	0.00	**13.2**
	Percent	0%	12%	0%	0%	0%	0%	88%	0%	
Deep 2	**Tons/Year**	3.48	35.60	0.00	0.00	0.00	0.00	3.56	0.00	**42.6**
	Percent	8%	83%	0%	0%	0%	0%	8%	0%	
Delano 1	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.0**
	Percent	0%	0%	0%	0%	0%	0%	0%	0%	
Delano 2	**Tons/Year**	0.00	1.92	0.00	0.00	0.00	0.00	0.00	0.00	**1.9**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Divide 1	**Tons/Year**	2.94	0.53	0.00	0.00	0.00	1.37	0.00	0.00	**4.8**
	Percent	61%	11%	0%	0%	0%	28%	0%	0%	
Divide 2	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.99	0.99	0.00	**2.0**
	Percent	0%	0%	0%	0%	0%	50%	50%	0%	
Elkhorn 1	**Tons/Year**	0.00	0.00	0.00	7.32	0.00	0.00	0.00	7.32	**14.6**
	Percent	0%	0%	0%	50%	0%	0%	0%	50%	
Fishtrap 1	**Tons/Year**	0.00	1.75	0.00	0.00	0.00	1.01	0.00	0.00	**2.8**
	Percent	0%	63%	0%	0%	0%	37%	0%	0%	
Fishtrap 2	**Tons/Year**	0.09	0.69	0.00	0.00	0.00	0.00	0.60	0.00	**1.4**
	Percent	7%	50%	0%	0%	0%	0%	43%	0%	
French 1	**Tons/Year**	0.00	24.80	0.00	0.00	0.00	0.00	0.00	3.20	**28.0**
	Percent	0%	89%	0%	0%	0%	0%	0%	11%	
Gold 1	**Tons/Year**	3.59	0.88	0.00	0.00	0.00	0.00	0.00	0.04	**4.5**
	Percent	80%	20%	0%	0%	0%	0%	0%	1%	
Grose 1	**Tons/Year**	0.00	6.39	0.00	0.00	0.00	0.00	0.00	11.79	**18.2**
	Percent	0%	35%	0%	0%	0%	0%	0%	65%	
Jerry 1	**Tons/Year**	0.00	6.10	0.00	0.00	0.00	0.00	0.15	0.00	**6.2**
	Percent	0%	98%	0%	0%	0%	0%	2%	0%	
Jerry 2	**Tons/Year**	0.00	1.84	0.00	0.00	0.00	0.00	0.00	0.00	**1.8**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Lost 1	**Tons/Year**	0.48	0.52	0.00	0.00	0.00	0.00	0.00	0.00	**1.0**
	Percent	48%	52%	0%	0%	0%	0%	0%	0%	

Table 3-2. *Continued*

Stream Segment	Sediment Load	Sources								Total Load
		Transportation	Riparian Grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural Sources	Other	
Lost 2	**Tons/Year**	0.00	2.05	0.00	0.00	0.00	0.00	0.00	0.00	**2.1**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Lower Big Hole 1	**Tons/Year**	0.00	11.57	0.00	0.00	0.00	0.00	30.55	0.00	**42.1**
	Percent	0%	27%	0%	0%	0%	0%	73%	0%	
Lower Big Hole 2	**Tons/Year**	0.00	49.88	0.00	0.00	0.00	6.43	91.16	0.00	**147.5**
	Percent	0%	34%	0%	0%	0%	4%	62%	0%	
Middle Big Hole 1	**Tons/Year**	0.00	2.46	0.00	0.00	0.00	0.00	0.87	0.00	**3.3**
	Percent	0%	74%	0%	0%	0%	0%	26%	0%	
Middle Big Hole 2	**Tons/Year**	3.02	0.00	0.00	0.00	0.00	1.43	1.90	0.00	**6.3**
	Percent	48%	0%	0%	0%	0%	22%	30%	0%	
Moose 1	**Tons/Year**	0.41	0.00	0.00	0.00	0.00	0.00	2.08	0.00	**2.5**
	Percent	16%	0%	0%	0%	0%	0%	84%	0%	
Oregon 1	**Tons/Year**	0.00	0.01	0.00	0.61	0.00	0.00	0.47	0.00	**1.1**
	Percent	0%	1%	0%	56%	0%	0%	43%	0%	
Pattengail 1	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.38	**1.4**
	Percent	0%	0%	0%	0%	0%	0%	0%	100%	
Rochester 1	**Tons/Year**	0.00	3.07	0.00	0.00	0.00	0.00	0.00	0.00	**3.1**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Rochester 2	**Tons/Year**	0.00	2.74	0.00	0.00	0.00	2.33	0.00	0.00	**5.1**
	Percent	0%	54%	0%	0%	0%	46%	0%	0%	
Sawlog 1	**Tons/Year**	0.00	7.63	0.00	0.00	0.00	0.00	0.00	0.00	**7.6**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Sawlog 2	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	**0.2**
	Percent	0%	0%	0%	0%	0%	0%	100%	0%	
Sevenmile 1	**Tons/Year**	0.00	1.40	0.00	0.00	0.00	0.00	6.05	0.00	**7.5**
	Percent	0%	19%	0%	0%	0%	0%	81%	0%	
Sevenmile 2	**Tons/Year**	0.00	2.82	0.00	0.00	0.00	0.00	0.00	0.00	**2.8**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Sixmile 1	**Tons/Year**	0.00	2.28	0.00	0.00	0.00	0.00	0.95	0.00	**3.2**
	Percent	0%	71%	0%	0%	0%	0%	29%	0%	
Sixmile 2	**Tons/Year**	0.00	23.90	0.00	0.00	0.00	0.00	0.00	0.00	**23.9**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Soap 1	**Tons/Year**	0.00	14.06	0.00	0.00	0.00	0.00	0.00	0.00	**14.1**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Soap 2	**Tons/Year**	0.00	1.86	0.00	0.00	0.00	0.00	0.00	0.00	**1.9**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Trapper 1	**Tons/Year**	0.00	7.53	0.00	0.00	0.00	0.00	0.00	0.76	**8.3**
	Percent	0%	91%	0%	0%	0%	0%	0%	9%	
Trapper 2	**Tons/Year**	0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.00	**0.7**
	Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Willow 1	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.00	6.91	7.36	**14.3**
	Percent	0%	0%	0%	0%	0%	0%	48%	52%	
Wise 1	**Tons/Year**	0.00	19.55	0.00	0.00	0.00	0.00	8.45	0.91	**28.9**
	Percent	0%	68%	0%	0%	0%	0%	29%	3%	
Wise 2	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.54	**0.7**
	Percent	0%	0%	0%	0%	0%	0%	17%	83%	
Wise 3	**Tons/Year**	0.75	0.00	0.00	0.00	0.00	0.75	0.00	0.00	**1.5**
	Percent	50%	0%	0%	0%	0%	50%	0%	0%	

3.2 Stream Reach Sediment Loads

Sediment loads calculated at the monitoring section scale were extrapolated to the aerial assessment stream reach and stream segment scales. The monitoring section sediment load was extrapolated directly to the stream reach in which it was located. Stream reaches in which no monitoring section was located were assigned a sediment load due to streambank erosion based on the most similar monitoring section. This decision was based on several factors including the existing and potential stream type, valley type, the surrounding landscape, land-use practices, information in the Aerial Assessment Database, a review of 2005 color aerial imagery in GIS, and best professional judgment based on site-specific knowledge acquired during the monitoring section assessment process.

Sources of sediment due to streambank erosion at the stream reach and stream segment scales were determined based on monitoring section data and the Aerial Assessment Database. Sources of streambank erosion at the monitoring section scale were assigned directly to the aerial assessment reach in which they occurred. Sources of sediment to stream reaches in which no monitoring section was located were evaluated using the Aerial Assessment Database, which included information for "prominent land use", "indictors of potential degradation", and "potential sources of potential degradation". Additional information regarding these parameters can be found in the *Middle and Lower Big Hole TMDL Planning Area Sediment Monitoring Quality Assurance Project Plan* (MDEQ 2005). A review of color aerial imagery from 2005 and on-the-ground knowledge gained during the assessment process were used as supporting information when assigning sediment sources.

For aerial assessment stream reaches in which no monitoring section was located, 34% of the sediment load was considered to be the result of natural background erosion. This is based on the percent of natural sediment load attributed to streambank erosion in the monitoring sections (**see Section 2.1**). Anthropogenic sediment loads in these stream reaches was estimated to be 66% of the total sediment load. Sediment loading due to streambank erosion was assigned to the anthropogenic sources of sediment observed within each stream reach on an equal basis. For example, if "grazing" and "silviculture" were both observed within a stream reach, then both were assigned 33% of the total sediment load (50% of the anthropogenic sediment load). This process was performed individually for each reach, with sediment loads assigned to each observed source based on the overall estimated reach load. Thus, sources of sediment in reaches with low overall sediment loads accounted for less of the total sediment load at the reach scale than sources of sediment in reaches with high sediment loads. When no anthropogenic sources were indicated in the aerial assessment database, 100% of the estimated sediment load was considered natural. Data extrapolated to the stream reach scale is presented in the Streambank Erosion Database in **Attachment A**. This database is an extension of the Aerial Assessment Database prepared prior to field data collection.

3.3 Stream Segment Sediment Loads

Sediment loads were extrapolated to 386.3 miles of listed stream segments based on stream reaches defined in the Aerial Assessment Database. Sediment loads extrapolated from the monitoring sections scale to the stream reaches scale were summed to obtain a sediment load for

each stream segment (**Attachment A**). A total estimated sediment load of 15,167.8 tons/year was attributed to eroding streambanks on the assessed stream segments. Estimated sediment loads for 303(d) listed stream segments ranged from 8.8 tons/year for Delano Creek to 6030.1 tons/year for the lower segment of the Big Hole River. At the stream segment scale, 5.4% of the bank erosion was attributed to transportation, 34.1% was attributed to riparian grazing, 5.2% was attributed to cropland, 0.6% was attributed to mining, 1.2% was attributed to silviculture, 0.9% was attributed to irrigation, 50.2% was attributed to natural sources and 2.3% was attributed to "other". An overall sediment load of 7,554.3 tons/year (49.8%) from eroding banks was attributed to anthropogenic sources, while 7,613.5 tons/year (50.2%) were attributed to natural sources. Sediment loads due to streambank erosion for each stream segment are provided for each source in **Table 3-3**.

Table 3-3. Stream Segment Sediment Loads from Individual Sources due to Streambank Erosion.

Stream Segment	Stream Segment Length (Miles)	Sediment Load	Sources								Total Load
			Transportation	Riparian Grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural Sources	Other	
Big Hole River, middle	45.9	Tons/Year	106.68	67.71	60.45	0.00	0.00	4.44	119.90	0.00	359.2
		Percent	30%	19%	17%	0%	0%	1%	33%	0%	
Big Hole River, lower	48.6	Tons/Year	226.07	1216.37	491.93	0.00	0.00	27.99	4067.76	0.00	6030.1
		Percent	4%	20%	8%	0%	0%	0%	67%	0%	
Birch Creek, upper	13.8	Tons/Year	0.00	0.00	0.00	0.00	0.00	0.00	352.56	75.77	428.3
		Percent	0%	0%	0%	0%	0%	0%	82%	18%	
Birch Creek, lower	10.7	Tons/Year	0.00	369.77	27.10	0.00	0.00	0.00	156.82	0.00	553.7
		Percent	0%	67%	5%	0%	0%	0%	28%	0%	
California Creek	7.9	Tons/Year	0.00	215.75	0.00	31.32	4.12	0.00	31.95	0.00	283.1
		Percent	0%	76%	0%	11%	1%	0%	11%	0%	
Camp Creek	15.5	Tons/Year	14.10	502.81	46.91	0.00	0.00	34.72	92.76	23.71	715.0
		Percent	2%	70%	7%	0%	0%	5%	13%	3%	
Canyon Creek	18.4	Tons/Year	160.65	31.16	0.00	0.00	0.00	0.00	211.15	0.00	403.0
		Percent	40%	8%	0%	0%	0%	0%	52%	0%	
Corral Creek	5.1	Tons/Year	0.00	58.12	0.00	0.00	13.31	0.00	25.87	0.00	97.3
		Percent	0%	60%	0%	0%	14%	0%	27%	0%	
Deep Creek	9.2	Tons/Year	76.27	462.50	0.00	0.00	0.00	0.00	331.63	0.00	870.4
		Percent	9%	53%	0%	0%	0%	0%	38%	0%	
Delano Creek	2.3	Tons/Year	0.00	8.77	0.00	0.00	0.00	0.00	0.00	0.00	8.8
		Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Divide Creek	14.0	Tons/Year	51.21	56.45	16.82	0.00	0.00	25.14	54.25	0.00	203.9
		Percent	25%	28%	8%	0%	0%	12%	27%	0%	
Elkhorn Creek	7.2	Tons/Year	16.85	0.00	0.00	31.62	11.81	0.00	35.08	23.63	119.0
		Percent	14%	0%	0%	27%	10%	0%	29%	20%	
Fishtrap Creek	5.8	Tons/Year	1.13	36.52	0.00	0.00	0.00	9.51	13.33	0.00	60.5
		Percent	2%	60%	0%	0%	0%	16%	22%	0%	
French Creek	10.6	Tons/Year	26.39	455.75	0.00	7.17	36.25	0.00	202.93	17.01	745.5
		Percent	4%	61%	0%	1%	5%	0%	27%	2%	
Gold Creek	4.9	Tons/Year	19.42	4.78	0.00	0.00	0.00	0.00	24.00	0.22	48.4
		Percent	40%	10%	0%	0%	0%	0%	50%	0%	
Grose Creek	3.4	Tons/Year	0.00	69.73	0.00	0.00	0.00	0.00	11.98	86.29	168.0
		Percent	0%	42%	0%	0%	0%	0%	7%	51%	
Jerry Creek	12.7	Tons/Year	0.00	173.29	27.93	0.00	29.14	0.00	58.29	0.00	288.6
		Percent	0%	60%	10%	0%	10%	0%	20%	0%	
Lost Creek	7.8	Tons/Year	3.84	45.28	0.00	0.00	0.00	0.00	6.91	0.00	56.0
		Percent	7%	81%	0%	0%	0%	0%	12%	0%	
Moose Creek	17.0	Tons/Year	39.67	54.77	3.04	0.00	24.88	0.00	100.61	0.00	223.0
		Percent	18%	25%	1%	0%	11%	0%	45%	0%	

Table 3-3. ***Continued***

Stream Segment	Stream Segment Length (Miles)	Sediment Load	Sources								Total Load
			Transportation	Riparian Grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural Sources	Other	
Oregon Creek	1.7	**Tons/Year**	4.04	0.03	0.00	6.51	0.00	0.00	6.06	0.00	16.6
		Percent	24%	0%	0%	39%	0%	0%	36%	0%	
Pattengail Creek	18.7	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.00	458.62	10.19	468.8
		Percent	0%	0%	0%	0%	0%	0%	98%	2%	
Rochester Creek	15.7	**Tons/Year**	22.82	126.90	16.87	16.22	0.00	32.36	66.01	0.00	281.2
		Percent	8%	45%	6%	6%	0%	12%	23%	0%	
Sawlog Creek	4.6	**Tons/Year**	0.00	33.72	0.00	0.00	0.00	0.00	43.43	0.00	77.1
		Percent	0%	44%	0%	0%	0%	0%	56%	0%	
Sevenmile Creek	6.3	**Tons/Year**	0.00	45.90	0.00	0.00	0.00	0.00	86.11	0.00	132.0
		Percent	0%	35%	0%	0%	0%	0%	65%	0%	
Sixmile Creek	4.3	**Tons/Year**	0.00	99.38	0.00	0.00	0.00	0.00	33.88	0.00	133.3
		Percent	0%	75%	0%	0%	0%	0%	25%	0%	
Soap Creek	8.3	**Tons/Year**	4.90	220.64	15.40	0.00	0.00	0.00	18.64	0.00	259.6
		Percent	2%	85%	6%	0%	0%	0%	7%	0%	
Trapper Creek	17.4	**Tons/Year**	3.05	137.82	3.05	0.00	0.00	0.00	68.63	13.14	225.7
		Percent	1%	61%	1%	0%	0%	0%	30%	6%	
Willow Creek	21.6	**Tons/Year**	28.48	81.71	65.22	0.00	62.64	0.00	272.90	77.44	588.4
		Percent	5%	14%	11%	0%	11%	0%	46%	13%	
Wise River	27.1	**Tons/Year**	14.00	602.10	14.44	0.00	0.00	7.66	661.46	23.64	1323.3
		Percent	1%	45%	1%	0%	0%	1%	50%	2%	

3.4 Watershed Sediment Loads

Sediment loads due to streambank erosion at the watershed scale were estimated based on data collected throughout the Middle and Lower Big Hole TPA. A total of 10.1 miles of stream were assessed in 2005 and 2006. Results from monitoring sites along these 10.1 miles were extrapolated to the 386.3 miles of listed stream segments. Based on a modified version of the USGS National Hydrography Dataset (NHD), in which irrigation ditches were removed, there are a total 2,346.4 miles of stream in the Middle and Lower Big Hole TPA (**Table 3-4**). Thus, sediment loads from a total of 1,960.1 miles of stream remain unaccounted for at the watershed scale.

Sediment input along the 1,960.1 miles of un-assessed streams was evaluated using the 25th percentile of sediment loading from the entire dataset of assessed streams. Based on the 25th percentile of the entire dataset at the stream segment scale, which includes both assessed reaches and reaches to which data was extrapolated, an annual sediment load of 13.1 tons/mile was estimated to be the natural background rate of streambank erosion within the Middle and Lower Big Hole TPA. This value is equivalent to 2.5 tons/year of sediment input from every 1000 feet of stream. In an attempt to refine this value, the 25th percentile for streambank erosion at the monitoring section scale, which includes only assessed reaches, was also reviewed, resulting in a value of 2.04 tons/year. Thus, an annual background erosion rate of approximately 2-2.5 tons per 1000 feet of stream is thought to be appropriate for streams in the Middle and Lower Big Hole TPA.

Based on an estimated background sediment load of 13.1 tons/mile (2.5 tons/1000 feet) a total estimated sediment load of 40,845 tons/year was attributed to eroding streambanks within the Middle and Lower Big Hole TPA. Streambank erosion sediment loads and sources at the watershed scale for assessed stream segments are presented in **Table 3-5**.

Table 3-4. Summary of Sediment Loads due to Streambank Erosion at the Watershed Scale.

TMDL Planning Area	Stream Length (Miles)	Length of Stream Assessed using Aerial Imagery (Miles)	Length of Stream Unassessed (Miles)	Estimated Sediment Load for Assessed Streams	Estimated Sediment Load for Unassessed Streams based on Stream Segment Extrapolation (13.1 Tons/Mile/Year)	Total Sediment Load
Middle Big Hole	977.0	174.2	802.8	5032.0	10516.3	15548.3
Lower Big Hole	1369.4	212.1	1157.3	10135.8	15160.9	25296.7
Total	**2346.4**	**386.3**	**1960.1**	**15167.8**	**25677.2**	**40845.0**

Table 3-5. Watershed Sediment Loads from Individual Sources due to Streambank Erosion.

Stream Segment	Total Stream Length within Watershed based on NHD (Miles)	Sediment Load	Sources								Total Load
			Transportation	Riparian Grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural Sources	Other	
Big Hole River, middle	977.0	Tons/Year	4617.99	2931.13	2616.68	0.00	0.00	192.29	5190.20	0.00	15548.3
		Percent	30%	19%	17%	0%	0%	1%	33%	0%	
Big Hole River, lower	1369.4	Tons/Year	948.40	5102.75	2063.66	0.00	0.00	117.40	17064.47	0.00	25296.7
		Percent	4%	20%	8%	0%	0%	0%	67%	0%	
Birch Creek, upper	37.3	Tons/Year	0.00	0.00	0.00	0.00	0.00	0.00	605.87	130.22	736.1
		Percent	0%	0%	0%	0%	0%	0%	82%	18%	
Birch Creek, lower	30.2	Tons/Year	0.00	540.16	39.59	0.00	0.00	0.00	229.09	0.00	808.8
		Percent	0%	67%	5%	0%	0%	0%	28%	0%	
California Creek	40.3	Tons/Year	0.00	535.08	0.00	77.67	10.21	0.00	79.23	0.00	702.2
		Percent	0%	76%	0%	11%	1%	0%	11%	0%	
Camp Creek	86.2	Tons/Year	32.34	1153.57	107.63	0.00	0.00	79.66	212.82	54.40	1640.4
		Percent	2%	70%	7%	0%	0%	5%	13%	3%	
Canyon Creek	54.6	Tons/Year	349.76	67.83	0.00	0.00	0.00	0.00	459.70	0.00	877.3
		Percent	40%	8%	0%	0%	0%	0%	52%	0%	
Corral Creek	9.5	Tons/Year	0.00	92.32	0.00	0.00	21.14	0.00	41.09	0.00	154.6
		Percent	0%	60%	0%	0%	14%	0%	27%	0%	
Deep Creek	151.9	Tons/Year	322.36	1954.86	0.00	0.00	0.00	0.00	1401.72	0.00	3678.9
		Percent	9%	53%	0%	0%	0%	0%	38%	0%	
Delano Creek	2.3	Tons/Year	0.00	8.77	0.00	0.00	0.00	0.00	0.00	0.00	8.8
		Percent	0%	100%	0%	0%	0%	0%	0%	0%	
Divide Creek	181.8	Tons/Year	603.60	665.29	198.19	0.00	0.00	296.25	639.36	0.00	2402.7
		Percent	25%	28%	8%	0%	0%	12%	27%	0%	
Elkhorn Creek	10.4	Tons/Year	22.82	0.00	0.00	42.82	16.00	0.00	47.51	32.01	161.2
		Percent	14%	0%	0%	27%	10%	0%	29%	20%	
Fishtrap Creek	54.2	Tons/Year	12.92	419.24	0.00	0.00	0.00	109.20	153.08	0.00	694.4
		Percent	2%	60%	0%	0%	0%	16%	22%	0%	
French Creek	68.1	Tons/Year	62.01	1070.82	0.00	16.85	85.18	0.00	476.81	39.96	1751.6
		Percent	4%	61%	0%	1%	5%	0%	27%	2%	
Gold Creek	7.0	Tons/Year	30.14	7.42	0.00	0.00	0.00	0.00	37.24	0.34	75.1
		Percent	40%	10%	0%	0%	0%	0%	50%	0%	
Grose Creek	3.4	Tons/Year	0.00	69.71	0.00	0.00	0.00	0.00	11.98	86.27	168.0
		Percent	0%	42%	0%	0%	0%	0%	7%	51%	
Jerry Creek	61.3	Tons/Year	0.00	542.92	87.49	0.00	91.29	0.00	182.62	0.00	904.3
		Percent	0%	60%	10%	0%	10%	0%	20%	0%	
Lost Creek	12.0	Tons/Year	7.62	89.80	0.00	0.00	0.00	0.00	13.70	0.00	111.1
		Percent	7%	81%	0%	0%	0%	0%	12%	0%	
Moose Creek	78.9	Tons/Year	183.91	253.93	14.10	0.00	115.38	0.00	466.49	0.00	1033.8
		Percent	18%	25%	1%	0%	11%	0%	45%	0%	

Table 3-5. *Continued*

Stream Segment	Total Stream Length within Watershed based on NHD (Miles)	Sediment Load	Sources								Total Load
			Transportation	Riparian Grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural Sources	Other	
Oregon Creek	3.0	**Tons/Year**	8.05	0.06	0.00	12.99	0.00	0.00	12.08	0.00	33.2
		Percent	24%	0%	0%	39%	0%	0%	36%	0%	
Pattengail Creek	74.0	**Tons/Year**	0.00	0.00	0.00	0.00	0.00	0.00	1166.90	25.94	1192.8
		Percent	0%	0%	0%	0%	0%	0%	98%	2%	
Rochester Creek	74.2	**Tons/Year**	85.09	473.24	62.92	60.49	0.00	120.69	246.18	0.00	1048.6
		Percent	8%	45%	6%	6%	0%	12%	23%	0%	
Sawlog Creek	7.0	**Tons/Year**	0.00	47.60	0.00	0.00	0.00	0.00	61.29	0.00	108.9
		Percent	0%	44%	0%	0%	0%	0%	56%	0%	
Sevenmile Creek	6.3	**Tons/Year**	0.00	45.90	0.00	0.00	0.00	0.00	86.11	0.00	132.0
		Percent	0%	35%	0%	0%	0%	0%	65%	0%	
Sixmile Creek	5.2	**Tons/Year**	0.00	108.71	0.00	0.00	0.00	0.00	37.06	0.00	145.8
		Percent	0%	75%	0%	0%	0%	0%	25%	0%	
Soap Creek	17.7	**Tons/Year**	7.22	325.19	22.70	0.00	0.00	0.00	27.47	0.00	382.6
		Percent	2%	85%	6%	0%	0%	0%	7%	0%	
Trapper Creek	53.3	**Tons/Year**	9.40	425.13	9.40	0.00	0.00	0.00	211.70	40.54	696.2
		Percent	1%	61%	1%	0%	0%	0%	30%	6%	
Willow Creek	84.1	**Tons/Year**	68.14	195.46	156.01	0.00	149.85	0.00	652.82	185.25	1407.5
		Percent	5%	14%	11%	0%	11%	0%	46%	13%	
Wise River	270.6	**Tons/Year**	48.01	2064.94	49.53	0.00	0.00	26.26	2268.53	81.09	4538.4
		Percent	1%	45%	1%	0%	0%	1%	50%	2%	

4.0 POTENTIAL SEDIMENT LOAD REDUCTION

This section is provided for technical guidance in determining sediment allocations to human influenced activities that cause streambank erosion. The results are only one of a number of components that will be considered during the TMDL sediment allocation process. The results are provided to determine a reasonable amount of sediment reduction to sources that influence streambank erosion. The allocation process will also consider economic feasibility of restoration from each significant source and regional BMP effectiveness studies. Determining a potential overall load reduction from streambank erosion also will help define how much sediment production from streambank erosion is likely derived from natural conditions.

4.1 Reference Condition and Best Management Practices

The Beaverhead-Deerlodge National Forest (BDNF) reference dataset indicates that a "moderate" BEHI score (20-29.5) can be expected on reference streams with the following stream types: A, C, (C3, C4) and E (E3, E4, E5, Ea) (**Table 4-1**) (Bengeyfield 2004). Streams classified as B stream types are on the border of the "moderate" and "high" (30.0-39.5) BEHI categories, with B3 streams falling in "moderate" category and B4 streams falling in the "high" category. A "moderate" BEHI score indicates that a streambank is eroding, but that the erosion is limited by such factors as vegetation along the top of the bank, a deep binding root mass, low bank height, and large substrate along the toe of the bank.

Based on the BDNF reference dataset, it was determined that functioning streams in the Middle and Lower Big Hole TPA would tend to have a "moderate" BEHI score. In situations where a loss of riparian vegetation along the channel margin has lead to BEHI scores greater than "moderate", applying Best Management Practices (BMPs) that promote the growth of woody vegetation along the streambank is the primary way to decrease the BEHI score to "moderate". More extreme cases of bank erosion may require manual re-vegetation and/or active channel restoration.

Table 4-1. Expected BEHI Values for Various Stream Types based on the BDNF Reference Dataset.

A	B3	B4	B	C3	C4	C	E3	E4	E5	Ea	E
24.2	27.1	31.7	29.7	26.9	26.5	26.5	26.3	24.2	22	22.7	23.6

4.2 Streambank Erosion Sediment Load Reductions

To estimate a potential decrease in sediment loading due to improved streambank stability, BEHI values in the existing dataset that exceeded the "moderate" category were reduced to "moderate" and loads were re-calculated. Applying a "moderate" BEHI score to eroding streambanks assessed along the individual monitoring sections generally leads to a reduction in sediment loads (**Table 4-2**). The exception is when the existing streambank condition was described as "moderate" and no further potential for reduction was identified. Reductions calculated at the monitoring section scale were extrapolated to the stream segment scale using the Aerial Assessment Database (**Table 4-3**). Note that the 0% reduction identified in **Table 4-3** for the middle segment of the Big Hole River, the upper segment of Birch Creek, Delano Creek, and

Pattengail Creek indicates that streambank erosion does not currently exceed a “moderate” BEHI score due to anthropogenic disturbances. The percent reduction identified at the stream segment scale was then extrapolated directly to the watershed scale. Thus, as contributing source areas, streambank erosion on tributaries to listed stream segments should also meet the “moderate” BEHI requirement. This reduction often resulted in a “moderate BEHI/low NBS” combination for an expected retreat rate of 0.17 tons/year. Because there was no streambank erosion within the monitoring sections on the middle segment of the Big Hole River, an estimated reduction at the watershed scale of 33% was used based on the average reduction estimated for the entire Middle and Lower Big Hole TPA. Through BMPs, the actual length and height of eroding banks could also be reduced, which would lead to further reductions in sediment loading.

Table 4-2. Monitoring Section Sediment Loads with BEHI Reduced to "Moderate".

Monitoring Section	Sediment Loading from Monitoring Section (Tons/Year)	Sediment Loading per 1000' of Stream (Tons/Year)	Sediment Loading from Monitoring Section with "Moderate" BEHI (Tons/Year)	Sediment Loading per 1000' of Stream with "Moderate" BEHI
Birch 1	4.84	5.38	4.84	5.38
Birch 2	8.32	9.25	6.74	7.49
Birch 3	8.79	9.77	4.02	4.46
California 1	3.29	3.66	2.57	2.86
California 2	12.00	13.34	5.44	6.04
Camp 1	17.97	19.96	15.31	17.01
Camp 2	10.54	11.72	5.63	6.26
Canyon 1	6.30	7.00	5.22	5.80
Corral 1	1.61	1.79	0.62	0.69
Corral 2	5.01	5.57	3.25	3.61
Deep 1	13.25	14.72	13.25	14.72
Deep 2	42.64	42.64	21.44	21.44
Delano 1	0.00	0.00	0	0.00
Delano 2	1.92	2.13	1.92	2.13
Divide 1	4.84	5.38	4.05	4.50
Divide 2	1.99	2.21	1.99	2.21
Elkhorn 1	14.65	16.28	5.49	6.10
Fishtrap 1	2.77	3.08	1.72	1.92
Fishtrap 2	1.39	1.54	1.39	1.54
French 1	28.00	31.11	12.72	14.13
Gold 1	4.52	5.02	2.31	2.57
Grose 1	18.18	30.29	6.4	10.66
Jerry 1	6.24	6.94	4.52	5.02
Jerry 2	1.84	2.04	1.71	1.90
Lost 1	1.00	1.42	1	1.42
Lost 2	2.05	3.42	0.89	1.48
Lower Big Hole 1	42.12	12.98	42.12	12.98
Lower Big Hole 2	147.47	41.78	68.65	19.45
Middle Big Hole 1	3.34	0.98	3.34	0.98
Middle Big Hole 2	6.35	1.84	6.35	1.84
Moose 1	2.49	2.76	2.49	2.76
Oregon 1	1.09	1.81	0.8	1.33
Pattengail 1	1.38	1.53	1.38	1.53
Rochester 1	3.07	3.41	1.3	1.44
Rochester 2	5.07	5.63	1.79	1.99
Sawlog 1	7.63	8.48	3.28	3.64
Sawlog 2	0.23	0.38	0.23	0.38
Sevenmile 1	7.46	8.29	2.95	3.28
Sevenmile 2	2.82	3.13	1.93	2.15
Sixmile 1	3.24	3.60	2.53	2.81
Sixmile 2	23.90	26.55	11.48	12.76
Soap 1	14.06	15.62	14.06	15.62
Soap 2	1.86	3.09	0.52	0.87
Trapper 1	8.29	9.21	4.96	5.51
Trapper 2	0.67	0.74	0.67	0.74
Willow 1	14.27	14.27	5.9	5.90
Wise 1	28.91	32.12	9.52	10.57
Wise 2	0.66	0.55	0.66	0.55
Wise 3	1.50	1.36	1.5	1.36

Table 4-3. Potential Sediment Load Reduction from Stream Segments with BEHI Reduced to "Moderate".

Stream Segment	Total Load (Tons/Year)	Total Load with "Moderate" BEHI (Tons/Year)	Total Load due to Anthropogenic Sources (Tons/Year)	Total Load with "Moderate" BEHI due to Anthropogenic Sources (Tons/Year)	Potential Reduction in Anthropogenic Sediment Load with "Moderate" BEHI (Tons/Year)	Percent Reduction in Anthropogenic Sediment Load with "Moderate" BEHI
Big Hole River, middle	359.2	359.2	239.3	239.3	0.0	0%
Big Hole River, lower	6030.1	3935.7	1962.4	1270.9	691.4	35%
Birch Creek, upper	428.3	377.9	75.8	75.8	0.0	0%
Birch Creek, lower	553.7	252.8	396.9	181.2	215.7	54%
California Creek	283.1	156.3	251.2	132.2	119.0	47%
Camp Creek	715.0	408.2	622.3	352.8	269.4	43%
Canyon Creek	403.0	341.6	191.8	156.0	35.8	19%
Corral Creek	97.3	56.6	71.4	42.8	28.6	40%
Deep Creek	870.4	752.5	538.8	430.7	108.0	20%
Delano Creek	8.8	8.8	8.8	8.8	0.0	0%
Divide Creek	203.9	192.6	149.6	139.2	10.4	7%
Elkhorn Creek	119.0	71.0	83.9	48.0	35.9	43%
Fishtrap Creek	60.5	50.7	47.2	37.4	9.8	21%
French Creek	745.5	489.8	542.6	346.2	196.3	36%
Gold Creek	48.4	36.5	24.4	12.5	11.9	49%
Grose Creek	168.0	66.4	156.0	59.7	96.3	62%
Jerry Creek	288.6	212.9	230.4	170.6	59.8	26%
Lost Creek	56.0	40.3	49.1	33.4	15.7	32%
Moose Creek	223.0	126.3	122.4	62.1	60.2	49%
Oregon Creek	16.6	12.2	10.6	7.8	2.8	27%
Pattengail Creek	468.8	436.7	10.2	10.2	0.0	0%
Rochester Creek	281.2	128.0	215.2	90.8	124.3	58%
Sawlog Creek	77.1	34.2	33.7	14.5	19.3	57%
Sevenmile Creek	132.0	66.1	45.9	27.9	18.0	39%
Sixmile Creek	133.3	69.1	99.4	51.5	47.9	48%
Soap Creek	259.6	224.3	240.9	213.6	27.4	11%
Trapper Creek	225.7	168.2	157.1	99.6	57.5	37%
Willow Creek	588.4	366.7	315.5	183.7	131.8	42%
Wise River	1323.3	733.5	661.8	257.7	404.2	61%

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ATTACHMENT A

STREAMBANK EROSION DATABASE

MIDDLE AND LOWER BIG HOLE RIVER TMDL PLANNING AREAS

Stream	Reach	Sinuosity	Valley Slope	Channel Slope	Rosgen Classification	Relative Bank Stability	Most Similar Stream Section used for Modeling Sediment Loading (Monitoring Sections in Red)	Sediment Load due to Bank Erosion per 1000 Feet (Tons/Year)	Sediment Load due to Bank Erosion per Mile (Tons/Year)	Aerial Assessment Reach Length (Miles)	Sediment Load due to Bank Erosion for Entire Aerial Assessment Reach (Tons/Year)	Sediment Source (Percent)								Sediment Load by Sediment Source (Tons/Year)							
												Transportation	Riparian grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural sources	Other	Transportation	Riparian grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural sources	Other
Big Hole River	BH 35	1.09	0.13%	0.12%	C	High	Middle Big Hole 1	0.98	5.17	1.98	10.26		66%					34%		0.00	6.77	0.00	0.00	0.00	0.00	3.49	0.00
Big Hole River	BH 36	1.14	0.10%	0.09%	C/Da	Mod	**Middle Big Hole 1**	**0.98**	5.18	3.52	18.22		74%					26%		0.00	13.46	0.00	0.00	0.00	0.00	4.76	0.00
Big Hole River	BH 37	1.14	0.16%	0.14%	C	High	Middle Big Hole 1	0.98	5.17	3.15	16.32	22%	22%	22%				34%		3.59	3.59	3.59	0.00	0.00	0.00	5.55	0.00
Big Hole River	BH 38	1.01	0.06%	0.05%	F	High	Middle Big Hole 1	0.98	5.17	1.39	7.17	33%	33%					34%		2.37	2.37	0.00	0.00	0.00	0.00	2.44	0.00
Big Hole River	BH 39	1.09	0.16%	0.15%	C	Mod	Middle Big Hole 1	0.98	5.17	3.19	16.50	22%	22%	22%				34%		3.63	3.63	3.63	0.00	0.00	0.00	5.61	0.00
Big Hole River	BH 40	1.03	0.27%	0.26%	F	High	Middle Big Hole 1	0.98	5.17	2.77	14.35		33%	33%				34%		0.00	4.74	4.74	0.00	0.00	0.00	4.88	0.00
Big Hole River	BH 41	1.05	0.28%	0.27%	F	High	Middle Big Hole 1	0.98	5.17	3.14	16.22	66%						34%		10.71	0.00	0.00	0.00	0.00	0.00	5.52	0.00
Big Hole River	BH 42	1.10	0.23%	0.21%	C/Da	Mod	**Middle Big Hole 2**	**1.84**	9.71	2.04	19.77	48%					22%	30%		9.40	0.00	0.00	0.00	0.00	4.44	5.93	0.00
Big Hole River	BH 43	1.04	0.28%	0.27%	F	High	Middle Big Hole 2	1.84	9.72	1.89	18.33	33%	33%					34%		6.05	6.05	0.00	0.00	0.00	0.00	6.23	0.00
Big Hole River	BH 44	1.14	0.22%	0.19%	C	Mod	Middle Big Hole 2	1.84	9.72	8.06	78.28	22%	22%	22%				34%		17.22	17.22	17.22	0.00	0.00	0.00	26.62	0.00
Big Hole River	BH 45	1.15	0.45%	0.39%	C/F	High	Middle Big Hole 2	1.84	9.72	6.67	64.78	33%		33%				34%		21.38	0.00	21.38	0.00	0.00	0.00	22.03	0.00
Big Hole River	BH 46	1.05	0.37%	0.35%	F	High	Middle Big Hole 2	1.84	9.72	3.50	34.01	66%						34%		22.45	0.00	0.00	0.00	0.00	0.00	11.56	0.00
Big Hole River	BH 47	1.09	0.28%	0.26%	C/F	High	Middle Big Hole 2	1.84	9.72	4.63	44.96	22%	22%	22%				34%		9.89	9.89	9.89	0.00	0.00	0.00	15.29	0.00
Big Hole River	BH 48	1.10	0.41%	0.37%	F	High	Lower Big Hole 1	12.98	68.53	6.22	426.08	32%						68%		136.35	0.00	0.00	0.00	0.00	0.00	289.73	0.00
Big Hole River	BH 49	1.15	0.32%	0.28%	Da	Low	Lower Big Hole 1	12.98	68.53	6.80	465.84	10%	11%	11%				68%		46.58	51.24	51.24	0.00	0.00	0.00	316.77	0.00
Big Hole River	BH 50	1.44	0.64%	0.45%	C	Mod	Lower Big Hole 1	12.98	68.53	4.87	333.57		32%					68%		0.00	106.74	0.00	0.00	0.00	0.00	226.83	0.00
Big Hole River	BH 51	1.19	0.03%	0.02%	C	Low	**Lower Big Hole 1**	**12.98**	68.53	2.25	154.07		27%					73%		0.00	42.32	0.00	0.00	0.00	0.00	111.76	0.00
Big Hole River	BH 52	1.11	0.35%	0.32%	Da	Low	Lower Big Hole 1	12.98	68.53	4.82	330.29		16%	16%				68%		0.00	52.85	52.85	0.00	0.00	0.00	224.60	0.00
Big Hole River	BH 53	1.16	0.37%	0.32%	C	Low	Lower Big Hole 1	12.98	68.53	2.68	183.84		32%					68%		0.00	58.83	0.00	0.00	0.00	0.00	125.01	0.00
Big Hole River	BH 54	1.17	0.31%	0.26%	Da	Low	Lower Big Hole 1	12.98	68.53	3.18	217.64		16%	16%				68%		0.00	34.82	34.82	0.00	0.00	0.00	148.00	0.00
Big Hole River	BH 55	1.06	0.23%	0.22%	C	Mod	**Lower Big Hole 2**	**41.78**	220.58	2.91	641.85		34%				4%	62%		0.00	217.11	0.00	0.00	0.00	27.99	396.75	0.00
Big Hole River	BH 56	1.23	0.23%	0.18%	C	Low	Lower Big Hole 2	41.78	220.60	3.02	667.09		16%	16%				68%		0.00	106.73	106.73	0.00	0.00	0.00	453.62	0.00
Big Hole River	BH 57	1.27	0.35%	0.27%	C	Low	Lower Big Hole 2	41.78	220.60	1.21	266.59		16%	16%				68%		0.00	42.66	42.66	0.00	0.00	0.00	181.28	0.00
Big Hole River	BH 58	1.38	0.32%	0.23%	C	Low	Lower Big Hole 2	41.78	220.60	2.67	588.02		16%	16%				68%		0.00	94.08	94.08	0.00	0.00	0.00	399.85	0.00
Big Hole River	BH 59	1.37	0.18%	0.13%	Da	Low	Lower Big Hole 2	41.78	220.60	1.96	431.45	10%	11%	11%				68%		43.15	47.46	47.46	0.00	0.00	0.00	293.39	0.00
Big Hole River	BH 60	1.17	0.38%	0.32%	C/Da	Low	Lower Big Hole 2	41.78	220.60	4.24	935.75		32%					68%		0.00	299.44	0.00	0.00	0.00	0.00	636.31	0.00
Big Hole River	BH 61	1.13	0.45%	0.40%	D	Low	Lower Big Hole 2	41.78	220.60	1.76	388.02		16%	16%				68%		0.00	62.08	62.08	0.00	0.00	0.00	263.86	0.00
Birch Creek	Birch 01	1.08			A	Mod	Delano 1	0.00	0.00	2.67	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Birch Creek	Birch 02	1.07	6.5%	6.1%	B	Low	Birch 1	5.38	28.41	2.16	61.38							100%		0.00	0.00	0.00	0.00	0.00	0.00	61.38	0.00
Birch Creek	Birch 03	1.04	2.5%	2.4%	B	Mod	**Birch 1**	**5.38**	28.41	3.57	101.29							25%	75%	0.00	0.00	0.00	0.00	0.00	0.00	25.52	75.77
Birch Creek	Birch 04	1.09	3.7%	3.4%	B	High	**Birch 2**	**9.25**	48.82	5.44	265.66							100%		0.00	0.00	0.00	0.00	0.00	0.00	265.66	0.00
Birch Creek	Birch 05	1.19	2.4%	2.0%	E	Mod	Birch 3	9.77	51.59	1.62	83.49							100%		0.00	0.00	0.00	0.00	0.00	0.00	83.49	0.00
Birch Creek	Birch 06	1.11	2.0%	1.8%	E	Mod	**Birch 3**	**9.77**	51.58	4.93	254.52		100%							0.00	254.52	0.00	0.00	0.00	0.00	0.00	0.00
Birch Creek	Birch 07	1.16	1.5%	1.3%	E	Mod	Birch 3	9.77	51.59	2.59	133.56		66%					34%		0.00	88.15	0.00	0.00	0.00	0.00	45.41	0.00
Birch Creek	Birch 08	1.12	1.9%	1.7%	F	Mod	Birch 3	9.77	51.59	1.59	82.13		33%	33%				34%		0.00	27.10	27.10	0.00	0.00	0.00	27.93	0.00
California	California 01	1.03	19.0%	18.4%	Aa+	High	Corral 1	1.79	9.45	0.66	6.24					66%		34%		0.00	0.00	0.00	0.00	4.12	0.00	2.12	0.00
California	California 02	1.08	2.9%	2.7%	B	High	**California 1**	**3.66**	19.33	1.62	31.32				100%					0.00	0.00	0.00	31.32	0.00	0.00	0.00	0.00
California	California 03	1.17	1.5%	1.3%	E	Mod	California 1	3.66	19.32	0.86	16.62							100%		0.00	0.00	0.00	0.00	0.00	0.00	16.62	0.00
California	California 04	1.15	1.7%	1.5%	C/E	Mod	California 1	3.66	19.32	2.01	38.84		66%					34%		0.00	25.64	0.00	0.00	0.00	0.00	13.21	0.00
California	California 05	1.27	1.7%	1.3%	C/E	Mod	**California 2**	**13.34**	70.41	2.70	190.11		100%							0.00	190.11	0.00	0.00	0.00	0.00	0.00	0.00
Camp Creek	Camp 01	1.05	20.3%	19.4%	A	High	Delano 1	0.00	0.00	2.52	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Camp Creek	Camp 02	1.03	4.8%	4.6%	B	High	Corral 1	1.79	9.45	2.44	23.06		66%					34%		0.00	15.22	0.00	0.00	0.00	0.00	7.84	0.00
Camp Creek	Camp 03	0.90	2.4%	2.7%	B	High	**Camp 2**	**11.72**	61.86	6.69	413.68		100%							0.00	413.68	0.00	0.00	0.00	0.00	0.00	0.00
Camp Creek	Camp 04	1.05	2.5%	2.4%	B/E	High	**Camp 1**	**19.96**	105.41	0.89	93.39		29%				22%	24%	25%	0.00	26.99	0.00	0.00	0.00	20.62	22.06	23.71
Camp Creek	Camp 05	1.08	2.1%	2.0%	E	Mod	Camp 2	11.72	61.88	1.56	96.77		33%	33%				34%		0.00	31.94	31.94	0.00	0.00	0.00	32.90	0.00
Camp Creek	Camp 06	1.09	1.1%	1.0%	E	Mod	Camp 2	11.72	61.88	1.42	88.11	16%	17%	17%			16%	34%		14.10	14.98	14.98	0.00	0.00	14.10	29.96	0.00

Stream	Reach	Sinuosity	Valley Slope	Channel Slope	Rosgen Classification	Relative Bank Stability	Most Similar Stream Section used for Modeling Sediment Loading (Monitoring Sections in Red)	Sediment Load due to Bank Erosion per 1000 Feet (Tons/Year)	Sediment Load due to Bank Erosion per Mile (Tons/Year)	Aerial Assessment Reach Length (Miles)	Sediment Load due to Bank Erosion for Entire Aerial Assessment Reach (Tons/Year)	Sediment Source (Percent)								Sediment Load by Sediment Source (Tons/Year)							
												Transportation	Riparian grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural sources	Other	Transportation	Riparian grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural sources	Other
Canyon Creek	Canyon 01	1.09	6.4%	5.8%	A/B	high	Delano 1	0.00	0.00	2.20	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Canyon Creek	Canyon 02	1.13	3.0%	2.6%	B/C	High	Pattengail 1	1.53	8.08	8.76	70.78							100%		0.00	0.00	0.00	0.00	0.00	0.00	70.78	0.00
Canyon Creek	Canyon 03	1.11	2.9%	2.6%	B/E	High	**Canyon 1**	**7.00**	36.97	2.64	97.72	6%	32%					62%		5.91	31.16	0.00	0.00	0.00	0.00	60.65	0.00
Canyon Creek	Canyon 04	1.02	3.2%	3.1%	B	High	Birch 2	9.25	48.84	4.80	234.47	66%						34%		154.75	0.00	0.00	0.00	0.00	0.00	79.72	0.00
Corral	Corral 01	1.02	15.8%	15.4%	Aa+	High	Corral 1	1.79	9.45	0.64	6.05					66%		34%		0.00	0.00	0.00	0.00	3.99	0.00	2.06	0.00
Corral	Corral 02	1.04	8.4%	8.1%	A	High	**Corral 1**	**1.79**	9.46	1.97	18.63					50%		50%		0.00	0.00	0.00	0.00	9.32	0.00	9.32	0.00
Corral	Corral 03	1.07	4.2%	4.0%	B	High	Corral 2	5.57	29.41	0.81	23.82		66%					34%		0.00	15.72	0.00	0.00	0.00	0.00	8.10	0.00
Corral	Corral 04	1.12	2.7%	2.4%	E	High	Corral 2	5.57	29.41	0.64	18.82		66%					34%		0.00	12.42	0.00	0.00	0.00	0.00	6.40	0.00
Corral	Corral 05	1.03	1.9%	1.9%	E	Mod	**Corral 2**	**5.57**	29.39	1.02	29.98		100%							0.00	29.98	0.00	0.00	0.00	0.00	0.00	0.00
Deep Creek	Deep 01	1.61	1.5%	1.0%	E	High	Deep 1	14.72	77.72	2.08	162.05		66%					34%		0.00	106.95	0.00	0.00	0.00	0.00	55.10	0.00
Deep Creek	Deep 02	1.42	1.2%	0.8%	E	Mod	**Deep 1**	**14.72**	77.72	2.31	179.35		12%					88%		0.00	21.88	0.00	0.00	0.00	0.00	157.47	0.00
Deep Creek	Deep 03	1.25	1.0%	0.8%	E	High	Deep 1	14.72	77.72	1.54	119.46		66%					34%		0.00	78.84	0.00	0.00	0.00	0.00	40.62	0.00
Deep Creek	Deep 04	1.46	0.7%	0.4%	C	Mod	Deep 1	14.72	77.72	2.22	172.46	33%	33%					34%		56.91	56.91	0.00	0.00	0.00	0.00	58.64	0.00
Deep Creek	Deep 05	1.45	0.8%	0.5%	C	Mod	**Deep 2**	**42.64**	225.15	1.05	237.08	8%	83%					8%		19.35	197.91	0.00	0.00	0.00	0.00	19.81	0.00
Delano	Delano 01	1.43	16.7%	11.7%	Aa+	High	Delano 1	0.00	0.00	0.94	0.00					66%		34%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delano	Delano 02	1.04	10.9%	10.5%	A	High	**Delano 1**	**0.00**	0.00	0.61	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delano	Delano 03	1.05	6.6%	6.3%	A	High	**Delano 2**	**2.13**	11.24	0.78	8.77		100%					0%		0.00	8.77	0.00	0.00	0.00	0.00	0.00	0.00
Divide Creek	Div 01	1.09	0.7%	0.6%	F/G	Mod	**Divide 1**	**5.38**	28.39	1.89	53.63	61%	11%				28%			32.54	5.85	0.00	0.00	0.00	15.24	0.00	0.00
Divide Creek	Div 02	1.52	0.5%	0.3%	E	Mod	Divide 2	2.21	11.67	3.26	38.05	22%	22%	22%				34%		8.37	8.37	8.37	0.00	0.00	0.00	12.94	0.00
Divide Creek	Div 03	1.09	0.5%	0.4%	F/G	Mod	Divide 1	5.38	28.41	0.55	15.61	66%						34%		10.30	0.00	0.00	0.00	0.00	0.00	5.31	0.00
Divide Creek	Div 04	2.59	1.5%	0.6%	E	Mod	Divide 2	2.21	11.67	4.39	51.18		66%					34%		0.00	33.78	0.00	0.00	0.00	0.00	17.40	0.00
Divide Creek	Div 05	1.63	0.6%	0.4%	E	Mod	**Divide 2**	**2.21**	11.65	1.70	19.80						50%	50%		0.00	0.00	0.00	0.00	0.00	9.90	9.90	0.00
Divide Creek	Div 06	1.48	0.5%	0.3%	F/G	Mod	Divide 2	2.21	11.67	0.97	11.27		33%	33%				34%		0.00	3.72	3.72	0.00	0.00	0.00	3.83	0.00
Divide Creek	Div 07	1.47	0.5%	0.4%	E		Divide 2	2.21	11.67	1.23	14.32		33%	33%				34%		0.00	4.73	4.73	0.00	0.00	0.00	4.87	0.00
Elkhorn	Elkhorn 01	1.26	11.3%	9.0%	A	High	Delano 1	0.00	0.00	3.38	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Elkhorn	Elkhorn 02	1.02	4.0%	3.9%	B	Mod	Moose 1	2.76	14.57	0.83	12.10				66%			34%		0.00	0.00	0.00	7.98	0.00	0.00	4.11	0.00
Elkhorn	Elkhorn 03	1.08	2.1%	2.0%	B	High	**Elkhorn 1**	**16.28**	85.93	0.55	47.26				50%				50%	0.00	0.00	0.00	23.63	0.00	0.00	0.00	23.63
Elkhorn	Elkhorn 04	1.05	2.0%	1.9%	B/E	Mod	Fishtrap 1	3.08	16.26	1.57	25.53	66%						34%		16.85	0.00	0.00	0.00	0.00	0.00	8.68	0.00
Elkhorn	Elkhorn 05	1.02	5.2%	5.1%	A	High	Birch 1	5.38	28.41	0.63	17.90					66%		34%		0.00	0.00	0.00	0.00	11.81	0.00	6.08	0.00
Elkhorn	Elkhorn 06	1.80	1.9%	1.1%	E	Mod	California 2	13.34	70.44	0.23	16.20							100%		0.00	0.00	0.00	0.00	0.00	0.00	16.20	0.00
Fishtrap Creek	Fish 01	1.13	3.0%	2.7%	B/C	High	**Fishtrap 1**	**3.08**	16.24	1.60	25.95		63%				37%			0.00	16.44	0.00	0.00	0.00	9.51	0.00	0.00
Fishtrap Creek	Fish 02	1.47	1.5%	1.0%	C/E	Mod	Fishtrap 2	1.54	8.13	2.16	17.57		66%					34%		0.00	11.59	0.00	0.00	0.00	0.00	5.97	0.00
Fishtrap Creek	Fish 03	1.30	1.3%	1.0%	C	Mod	**Fishtrap 2**	**1.54**	8.13	2.09	16.97	7%	50%					43%		1.13	8.49	0.00	0.00	0.00	0.00	7.36	0.00
French Creek	French 01	1.04	12.7%	12.2%	A/B	High	Corral 1	1.79	9.45	1.30	12.24					66%		34%		0.00	0.00	0.00	0.00	8.08	0.00	4.16	0.00
French Creek	French 02	1.02	3.7%	3.7%	B	High	Sixmile 1	3.60	19.01	2.25	42.69					66%		34%		0.00	0.00	0.00	0.00	28.17	0.00	14.51	0.00
French Creek	French 03	0.95	1.9%	2.0%	E	Mod	California 1	3.66	19.32	0.56	10.87				66%			34%		0.00	0.00	0.00	7.17	0.00	0.00	3.70	0.00
French Creek	French 04	1.10	1.2%	1.1%	C/F	Mod	California 2	13.34	70.44	1.14	79.97	33%	33%					34%		26.39	26.39	0.00	0.00	0.00	0.00	27.19	0.00
French Creek	French 05	1.13	0.9%	0.8%	C		French 1	31.11	164.26	1.24	204.35		66%					34%		0.00	134.87	0.00	0.00	0.00	0.00	69.48	0.00
French Creek	French 06	1.52	1.1%	0.7%	C	Mod	**French 1**	**31.11**	164.26	0.90	148.64		89%						11%	0.00	131.64	0.00	0.00	0.00	0.00	0.00	17.01
French Creek	French 07	1.42	0.6%	0.4%	C	Mod	Deep 1	14.72	77.72	1.28	99.15		66%					34%		0.00	65.44	0.00	0.00	0.00	0.00	33.71	0.00
French Creek	French 08	1.46	1.1%	0.7%	C/E	Mod	Deep 1	14.72	77.72	1.90	147.60		66%					34%		0.00	97.41	0.00	0.00	0.00	0.00	50.18	0.00
Gold Creek	Gold 01	1.03			C	High	Delano 1	0.00	0.00	1.86	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gold Creek	Gold 02	1.12	4.3%	3.8%	E	High	Delano 2	2.13	11.25	2.13	24.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	24.00	0.00
Gold Creek	Gold 03	1.03	7.3%	7.0%	B		**Gold 1**	**5.02**	26.49	0.92	24.42	80%	20%						1%	19.42	4.78	0.00	0.00	0.00	0.00	0.00	0.22

Stream	Reach	Sinuosity	Valley Slope	Channel Slope	Rosgen Classification	Relative Bank Stability	Most Similar Stream Section used for Modeling Sediment Loading (Monitoring Sections in Red)	Sediment Load due to Bank Erosion per 1000 Feet (Tons/Year)	Sediment Load due to Bank Erosion per Mile (Tons/Year)	Aerial Assessment Reach Length (Miles)	Sediment Load due to Bank Erosion for Entire Aerial Assessment Reach (Tons/Year)	Sediment Source (Percent)								Sediment Load by Sediment Source (Tons/Year)							
												Transportation	Riparian grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural sources	Other	Transportation	Riparian grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural sources	Other
Grose	Grose 01	1.07	7.4%	6.9%	A	Mod	Lost 1	1.42	7.50	1.04	7.80		66%					34%		0.00	5.15	0.00	0.00	0.00	0.00	2.65	0.00
Grose	Grose 02	1.18	5.8%	4.9%	A	High	Lost 2	3.42	18.06	1.01	18.24		66%					34%		0.00	12.04	0.00	0.00	0.00	0.00	6.20	0.00
Grose	Grose 03	1.07	5.8%	5.4%	A	High	**Grose 1**	**30.29**	159.95	0.83	132.76		35%						65%	0.00	46.47	0.00	0.00	0.00	0.00	0.00	86.29
Grose	Grose 04	1.02	3.8%	3.7%	G	Mod	Lost 2	3.42	18.06	0.51	9.21		66%					34%		0.00	6.08	0.00	0.00	0.00	0.00	3.13	0.00
Jerry Creek	Jerry 01	1.06	7.8%	7.4%	A	High	Delano 1	0.00	0.00	1.86	0.00					66%		34%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jerry Creek	Jerry 02	1.12	4.8%	4.3%	B	High	Delano 2	2.13	11.25	0.80	9.02					66%		34%		0.00	0.00	0.00	0.00	5.96	0.00	3.07	0.00
Jerry Creek	Jerry 03	1.18	1.9%	1.6%	E	Mod	Sevenmile 2	3.13	16.53	1.74	28.79		33%			33%		34%		0.00	9.50	0.00	0.00	9.50	0.00	9.79	0.00
Jerry Creek	Jerry 04	1.09	4.0%	3.7%	B	High	Fishtrap 1	3.08	16.26	0.57	9.23		33%			33%		34%		0.00	3.05	0.00	0.00	3.05	0.00	3.14	0.00
Jerry Creek	Jerry 05	1.02	1.7%	1.6%	E	Mod	Jerry 1	6.94	36.64	0.88	32.23		33%			33%		34%		0.00	10.64	0.00	0.00	10.64	0.00	10.96	0.00
Jerry Creek	Jerry 06	1.05	4.6%	4.4%	B/C	High	**Jerry 1**	**6.94**	36.64	2.94	107.60		98%					2%		0.00	105.04	0.00	0.00	0.00	0.00	2.56	0.00
Jerry Creek	Jerry 07	1.09	2.3%	2.1%	C/E	Mod	Jerry 1	6.94	36.64	2.31	84.62		33%	33%				34%		0.00	27.93	27.93	0.00	0.00	0.00	28.77	0.00
Jerry Creek	Jerry 08	1.13	2.2%	1.9%	F/G	High	**Jerry 2**	**2.04**	10.77	1.59	17.15		100%							0.00	17.15	0.00	0.00	0.00	0.00	0.00	0.00
Lost	Lost 01	1.29	18.6%	14.4%	Aa+	High	Delano 1	0.00	0.00	2.46	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lost	Lost 02	1.08	7.0%	6.5%	A	High	Lost 1	1.42	7.50	1.65	12.37		66%					34%		0.00	8.16	0.00	0.00	0.00	0.00	4.21	0.00
Lost	Lost 03	1.03	9.5%	9.2%	A	High	**Lost 1**	**1.42**	7.52	1.07	8.05	48%	52%							3.84	4.21	0.00	0.00	0.00	0.00	0.00	0.00
Lost	Lost 04	1.07	6.1%	5.7%	Ea	High	Lost 1	1.42	7.50	1.06	7.95		66%					34%		0.00	5.25	0.00	0.00	0.00	0.00	2.70	0.00
Lost	Lost 05	1.62	5.0%	3.1%	Ea	High	**Lost 2**	**3.42**	18.08	1.53	27.66		100%							0.00	27.66	0.00	0.00	0.00	0.00	0.00	0.00
Moose Creek	Moose 01	1.01			A	High	Delano 1	0.00	0.00	1.62	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Moose Creek	Moose 02	1.06	7.6%	7.2%	B	High	Corral 1	1.79	9.45	1.43	13.54					66%		34%		0.00	0.00	0.00	0.00	8.94	0.00	4.61	0.00
Moose Creek	Moose 03	1.07	3.9%	3.6%	E	Mod	Sevenmile 1	8.29	43.77	1.10	48.32		33%			33%		34%		0.00	15.95	0.00	0.00	15.95	0.00	16.43	0.00
Moose Creek	Moose 04	1.16	2.9%	2.5%	F/G	Mod	Rochester 2	5.63	29.73	0.42	12.49		66%					34%		0.00	8.25	0.00	0.00	0.00	0.00	4.25	0.00
Moose Creek	Moose 05	1.14	1.0%	0.9%	E	Mod	Sawlog 2	0.38	2.01	2.86	5.74							100%		0.00	0.00	0.00	0.00	0.00	0.00	5.74	0.00
Moose Creek	Moose 06	1.03	3.1%	3.0%	B/E	Mod	Sixmile 1	3.60	19.01	0.45	8.47							100%		0.00	0.00	0.00	0.00	0.00	0.00	8.47	0.00
Moose Creek	Moose 07	1.08	1.2%	1.1%	E	Mod	Sawlog 2	0.38	2.01	1.57	3.14							100%		0.00	0.00	0.00	0.00	0.00	0.00	3.14	0.00
Moose Creek	Moose 08	1.04	10.8%	10.4%	A	Mod	Corral 1	1.79	9.45	0.93	8.78							100%		0.00	0.00	0.00	0.00	0.00	0.00	8.78	0.00
Moose Creek	Moose 09	1.10	2.0%	1.8%	E	High	Sawlog 2	0.38	2.01	1.19	2.39							100%		0.00	0.00	0.00	0.00	0.00	0.00	2.39	0.00
Moose Creek	Moose 10	1.08	3.5%	3.2%	B/E	Mod	Moose 1	2.76	14.57	1.06	15.39	66%						34%		10.15	0.00	0.00	0.00	0.00	0.00	5.23	0.00
Moose Creek	Moose 11	1.11	3.1%	2.8%	C/E	Mod	**Moose 1**	**2.76**	14.60	0.83	12.05	16%						84%		1.98	0.00	0.00	0.00	0.00	0.00	10.08	0.00
Moose Creek	Moose 12	1.17	1.5%	1.3%	E	High	Trapper 2	0.74	3.91	2.36	9.21		33%	33%				34%		0.00	3.04	3.04	0.00	0.00	0.00	3.13	0.00
Moose Creek	Moose 13	1.24	1.0%	0.8%	C/E	Mod	California 2	13.34	70.44	1.18	83.44	33%	33%					34%		27.54	27.54	0.00	0.00	0.00	0.00	28.37	0.00
Oregon	Oregon 01	1.08	2.7%	2.5%	B	Mod	Oregon 1	1.81	9.56	1.28	12.23	33%			33%			34%		4.04	0.00	0.00	4.04	0.00	0.00	4.16	0.00
Oregon	Oregon 02	1.02	3.4%	3.3%	G	Mon	**Oregon 1**	**1.81**	9.58	0.46	4.41		1%		56%			43%		0.00	0.03	0.00	2.48	0.00	0.00	1.90	0.00
Pattengail	Pattengail 01	1.13	7.4%	6.5%	A	High	Delano 1	0.00	0.00	3.20	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pattengail	Pattengail 02	1.09	4.5%	4.1%	A	High	Delano 1	0.00	0.00	2.49	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pattengail	Pattengail 03	1.17	2.2%	1.9%	B	High	Fishtrap 1	3.08	16.26	2.53	41.14							100%		0.00	0.00	0.00	0.00	0.00	0.00	41.14	0.00
Pattengail	Pattengail 04	1.18	4.0%	3.4%	B	High	Fishtrap 1	3.08	16.26	2.03	33.01							100%		0.00	0.00	0.00	0.00	0.00	0.00	33.01	0.00
Pattengail	Pattengail 05	2.23	0.9%	0.4%	E	Mod	Deep 1	14.72	77.72	2.09	162.44							100%		0.00	0.00	0.00	0.00	0.00	0.00	162.44	0.00
Pattengail	Pattengail 06	1.43	1.8%	1.3%	Bc	High	Fishtrap 1	3.08	16.26	0.68	11.06							100%		0.00	0.00	0.00	0.00	0.00	0.00	11.06	0.00
Pattengail	Pattengail 07	1.87	0.3%	0.1%	E	Mod	Deep 1	14.72	77.72	2.68	208.29							100%		0.00	0.00	0.00	0.00	0.00	0.00	208.29	0.00
Pattengail	Pattengail 08	2.37	0.2%	0.1%	E	High	Sawlog 2	0.38	2.01	1.86	3.73							34%	66%	0.00	0.00	0.00	0.00	0.00	0.00	1.27	2.46
Pattengail	Pattengail 09	1.24	0.2%	0.2%	F	High	Pattengail 1	1.53	8.08	0.51	4.12							34%	66%	0.00	0.00	0.00	0.00	0.00	0.00	1.40	2.72
Pattengail	Pattengail 10	1.12	1.0%	0.9%	Bc	Mod	**Pattengail 1**	**1.53**	8.09	0.62	5.01								100%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.01

Stream	Reach	Sinuosity	Valley Slope	Channel Slope	Rosgen Classification	Relative Bank Stability	Most Similar Stream Section used for Modeling Sediment Loading (Monitoring Sections in Red)	Sediment Load due to Bank Erosion per 1000 Feet (Tons/Year)	Sediment Load due to Bank Erosion per Mile (Tons/Year)	Aerial Assessment Reach Length (Miles)	Sediment Load due to Bank Erosion for Entire Aerial Assessment Reach (Tons/Year)	Sediment Source (Percent)								Sediment Load by Sediment Source (Tons/Year)							
												Transportation	Riparian grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural sources	Other	Transportation	Riparian grazing	Cropland	Mining	Silviculture	Irrigation - shifts in stream energy	Natural sources	Other
Rochester	Rochester 01	1.07	18.6%	17.3%	Aa+	High	Lost 1	1.42	7.50	1.57	11.77							100%		0.00	0.00	0.00	0.00	0.00	0.00	11.77	0.00
Rochester	Rochester 02	1.06	5.9%	5.5%	A	High	Lost 1	1.42	7.50	2.09	15.67		66%					34%		0.00	10.34	0.00	0.00	0.00	0.00	5.33	0.00
Rochester	Rochester 03	1.14	3.2%	2.8%	G/F	High	Rochester 1	3.41	18.00	2.73	49.15		33%		33%			34%		0.00	16.22	0.00	16.22	0.00	0.00	16.71	0.00
Rochester	Rochester 04	1.07	2.7%	2.5%	G/F	High	**Rochester 1**	**3.41**	18.00	2.19	39.41		100%							0.00	39.41	0.00	0.00	0.00	0.00	0.00	0.00
Rochester	Rochester 05	1.12	2.6%	2.3%	B	High	Rochester 1	3.41	18.00	3.84	69.14	33%	33%					34%		22.82	22.82	0.00	0.00	0.00	0.00	23.51	0.00
Rochester	Rochester 06	1.18	2.1%	1.8%	C/F	Mod	**Rochester 2**	**5.63**	29.73	2.37	70.46		54%				46%			0.00	38.10	0.00	0.00	0.00	32.36	0.00	0.00
Rochester	Rochester 07	1.12	2.7%	2.4%	C/F	High	Rochester 2	5.63	29.73	0.86	25.56			66%				34%		0.00	0.00	16.87	0.00	0.00	0.00	8.69	0.00
Sawlog Creek	Saw 01	1.02	16.2%	15.9%	A	High	Delano 1	0.00	0.00	0.61	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sawlog Creek	Saw 02	1.07	4.5%	4.2%	B/E	High	Corral 1	1.79	9.45	0.40	3.81							100%		0.00	0.00	0.00	0.00	0.00	0.00	3.81	0.00
Sawlog Creek	Saw 03	1.03	9.0%	8.7%	A	High	Corral 1	1.79	9.45	0.81	7.63							100%		0.00	0.00	0.00	0.00	0.00	0.00	7.63	0.00
Sawlog Creek	Saw 04	1.02	2.8%	2.7%	E	High	Sawlog 1	8.48	44.77	0.65	29.24							100%		0.00	0.00	0.00	0.00	0.00	0.00	29.24	0.00
Sawlog Creek	Saw 05	1.02	2.7%	2.7%	B	High	**Sawlog 1**	**8.48**	44.79	0.75	33.72		100%							0.00	33.72	0.00	0.00	0.00	0.00	0.00	0.00
Sawlog Creek	Saw 06	1.05	1.8%	1.8%	E	Mod	**Sawlog 2**	**0.38**	1.99	1.38	2.74							100%		0.00	0.00	0.00	0.00	0.00	0.00	2.74	0.00
Sevenmile	Sevenmile 01	1.08	11.9%	11.1%	Aa+	High	Corral 1	1.79	9.45	1.16	10.96							100%		0.00	0.00	0.00	0.00	0.00	0.00	10.96	0.00
Sevenmile	Sevenmile 02	1.09	6.0%	5.5%	A	Mod	Corral 1	1.79	9.45	0.73	6.90							100%		0.00	0.00	0.00	0.00	0.00	0.00	6.90	0.00
Sevenmile	Sevenmile 03	1.13	5.5%	4.9%	A	High	**Sevenmile 1**	**8.29**	43.75	1.51	66.06		19%					81%		0.00	12.43	0.00	0.00	0.00	0.00	53.63	0.00
Sevenmile	Sevenmile 04	1.11	2.8%	2.6%	E	High	Sevenmile 2	3.13	16.53	2.60	42.97		66%					34%		0.00	28.36	0.00	0.00	0.00	0.00	14.61	0.00
Sevenmile	Sevenmile 05	1.04	1.9%	1.9%	E	Mod	**Sevenmile 2**	**3.13**	16.52	0.31	5.12		100%							0.00	5.12	0.00	0.00	0.00	0.00	0.00	0.00
Sixmile	Sixmile 01	1.05	8.3%	7.9%	A	High	Corral 1	1.79	9.45	1.15	10.87							100%		0.00	0.00	0.00	0.00	0.00	0.00	10.87	0.00
Sixmile	Sixmile 02	1.07	3.8%	3.6%	E	High	Corral 1	1.79	9.45	1.22	11.53							100%		0.00	0.00	0.00	0.00	0.00	0.00	11.53	0.00
Sixmile	Sixmile 03	1.10	9.3%	8.5%	A	High	Sixmile 1	3.60	19.01	0.33	6.27							100%		0.00	0.00	0.00	0.00	0.00	0.00	6.27	0.00
Sixmile	Sixmile 04	1.05	4.5%	4.3%	A	High	**Sixmile 1**	**3.60**	19.00	0.93	17.67		71%					29%		0.00	12.46	0.00	0.00	0.00	0.00	5.21	0.00
Sixmile	Sixmile 05	1.08	3.9%	3.6%	Bc	Mod	**Sixmile 2**	**26.55**	140.19	0.62	86.92		100%							0.00	86.92	0.00	0.00	0.00	0.00	0.00	0.00
Soap	Soap 01	1.13	14.3%	12.7%	Aa+	High	Lost 1	1.42	7.50	1.00	7.50		66%					34%		0.00	4.95	0.00	0.00	0.00	0.00	2.55	0.00
Soap	Soap 02	1.06	7.6%	7.1%	A	High	**Soap 1**	**15.62**	82.50	2.28	188.10		100%							0.00	188.10	0.00	0.00	0.00	0.00	0.00	0.00
Soap	Soap 03	1.06	5.6%	5.3%	A	High	Lost 1	1.42	7.50	1.98	14.85	33%	33%					34%		4.90	4.90	0.00	0.00	0.00	0.00	5.05	0.00
Soap	Soap 04	1.15	4.9%	4.3%	F/G	Low	**Soap 2**	**3.09**	16.33	1.02	16.66		100%							0.00	16.66	0.00	0.00	0.00	0.00	0.00	0.00
Soap	Soap 05	1.08	3.3%	3.1%	G	Low	Soap 2	3.09	16.32	0.56	9.14		66%					34%		0.00	6.03	0.00	0.00	0.00	0.00	3.11	0.00
Soap	Soap 06	1.45	1.0%	0.7%	E	High	Soap 2	3.09	16.32	1.43	23.33			66%				34%		0.00	0.00	15.40	0.00	0.00	0.00	7.93	0.00
Trapper Creek	Trap 01	1.06	10.1%	9.6%	A	High	Delano 1	0.00	0.00	3.31	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trapper Creek	Trap 02	1.06	5.8%	5.5%	B	High	Delano 1	0.00	0.00	1.96	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Trapper Creek	Trap 03	3.01	7.8%	2.6%	B/E	High	Moose 1	2.76	14.57	1.83	26.63							100%		0.00	0.00	0.00	0.00	0.00	0.00	26.63	0.00
Trapper Creek	Trap 04	1.57	11.2%	7.2%	B	High	Moose 1	2.76	14.57	2.56	37.29							100%		0.00	0.00	0.00	0.00	0.00	0.00	37.29	0.00
Trapper Creek	Trap 05	1.06	3.0%	2.8%	B	Mod	**Trapper 1**	**9.21**	48.63	2.94	143.05		91%						9%	0.00	129.90	0.00	0.00	0.00	0.00	0.00	13.14
Trapper Creek	Trap 06	1.06	1.7%	1.6%	B/E	Mod	**Trapper 2**	**0.74**	3.93	1.24	4.87		100%							0.00	4.87	0.00	0.00	0.00	0.00	0.00	0.00
Trapper Creek	Trap 07	1.16	2.2%	1.9%	E	Mod	Trapper 2	0.74	3.91	3.55	13.86	22%	22%	22%				34%		3.05	3.05	3.05	0.00	0.00	0.00	4.71	0.00
Willow Creek	Willow 01	1.08	8.9%	8.3%	A	High	Delano 1	0.00	0.00	3.56	0.00							100%		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Willow Creek	Willow 02	1.08	5.9%	5.4%	A/B	High	Birch 1	5.38	28.41	3.34	94.91					66%		34%		0.00	0.00	0.00	0.00	62.64	0.00	32.27	0.00
Willow Creek	Willow 03	1.06	3.2%	3.0%	B	High	**Willow 1**	**14.27**	75.36	1.99	150.13							48%	52%	0.00	0.00	0.00	0.00	0.00	0.00	72.69	77.44
Willow Creek	Willow 04	1.07	5.5%	5.2%	F/G	Mod	Moose 1	2.76	14.57	1.71	24.99		66%					34%		0.00	16.49	0.00	0.00	0.00	0.00	8.50	0.00
Willow Creek	Willow 05	1.08	2.5%	2.3%	B	High	Moose 1	2.76	14.57	2.56	37.25							100%		0.00	0.00	0.00	0.00	0.00	0.00	37.25	0.00
Willow Creek	Willow 06	1.09	3.6%	3.3%	B	High	Jerry 2	2.04	10.77	3.74	40.33							100%		0.00	0.00	0.00	0.00	0.00	0.00	40.33	0.00
Willow Creek	Willow 07	1.19	2.2%	1.8%	C	Mod	Birch 3	9.77	51.59	2.51	129.48	22%	22%	22%				34%		28.48	28.48	28.48	0.00	0.00	0.00	44.02	0.00
Willow Creek	Willow 08	1.24	0.6%	0.5%	F	Mod	Birch 3	9.77	51.59	2.16	111.31		33%	33%				34%		0.00	36.73	36.73	0.00	0.00	0.00	37.84	0.00