APPENDIX E – STREAMBANK EROSION SOURCE ASSESSMENT – ROCK CREEK TPA

TABLE OF CONTENTS

LIST OF TABLES

E1.0 EXISTING BANK EROSION SEDIMENT LOADS

In order to determine sediment loads from bank erosion, results from the field study (results are presented in **Appendix C**) were used to develop reasonable estimates to represent the total sediment loads from bank erosion for each watershed.

In the Rock Creek TPA, the sediment load for each eroding bank in a sampled reach was calculated, and then the total sediment load for that reach was summed (**Table E-1**). Monitoring site sediment loads were extrapolated to the stream reach, stream segment and sub-watershed scales based on aerial assessment reach type analysis and field verified reach types for assessment sites. Streambank erosion data were extrapolated using the following procedure:

1. Monitoring site sediment loads were extrapolated directly to the stream reach in which the monitoring site was located, based on total loading per 1000/ft.

2. Existing streambank erosion sediment loads were extrapolated to un-assessed reaches based on the average sediment loading/1000ft from assessed sites for each reach type grouping. Some reach types were grouped together in order to have a larger number of sampled reaches to average; based on similarities with stream slope, stream order, and best professional judgment. This produced five groupings with average loads ranging from 8 to 22 tons per year per 1000 feet. In the MR-0-3-U/MR-0-4-U grouping, the load from reach WFRK 14-03 was excluded from the average because it contained one unique bank that was contributing a very large load and was unrepresentative of the rest of that stream segment and other streams in the watershed. Un-assessed reach types were assigned loads from the most applicable and appropriate assessed reach type grouping (**Table E-2**).

Table E-1. Reach Total Sediment Load per 1000 feet

Reach ID	Reach Type	Total Sediment Load per 1000 feet (Tons/Year)
ANTE 21-01	MR-0-3-U	35.2
BREW 06-01	MR-0-3-U	19.5
UWIL 11-05	MR-0-3-U	6.7
WFRK 14-03	MR-0-3-U	110.1
WFRK 27-02	MR-0-3-U	24.1
WFRK 30-02	MR-0-3-U	24.4
EFRK 03-03	MR-0-4-U	16.6
UWIL 15-01	MR-0-4-U	29.9
SCOT 08-01	MR-2-1-U	27.3
SLUI 14-01	MR-2-2-C	18.0
MINE 14-02	MR-2-2-U	3.4
SLUI 18-02	MR-2-2-U	3.9
BREW 05-01	MR-2-3-U	3.4
EFRK 01-02	MR-2-3-U	11.9
QUTZ 09-01	MR-4-1-C	61.1
FLAT 12-01	MR-4-1-U	31.1
MINE 10-02	MR-4-1-U	2.2
SCOT 16-02	MR-4-1-U	4.4
SFAN 06-01	MR-4-2-C	7.2
ANTE 07-01	MR-4-2-U	15.2

Table E-1. Reach Total Sediment Load per 1000 feet

Reach ID	Reach Type	Total Sediment Load per 1000 feet (Tons/Year)
SFAN 13-01	MR-4-2-U	2.7
FLAT 13-01	MR-10-1-U	1.9

Table E-2. Existing Load Reach Groupings and Load Estimates

Reach Type Grouping	Number of Sampled Reaches	Sampled Reaches	Average Existing Bank Erosion Sediment Load per 1000 feet (Tons/Year)
MR-0-1-U	0	applied MR-2-2-U/MR-2-2-C rate	8
MR-0-2-U	0	applied MR-2-2-U/MR-2-2-C rate	8
MR-0-3-C	0	applied MR-0-3-U/MR-0-4-U rate	22
MR-0-3-U/MR-0-4-U	8	ANTE 21-01, BREW 06-01, UWIL 11-05, WFRK 14-03, WFRK 27-02, WFRK 30-02, EFRK 03-03, UWIL 15-01	22
MR-2-1-C	0	applied MR-2-1-U/MR-4-1-U/MR-4-1-C/MR-10-1-U	21
MR-2-1-U/MR-4-1-U/ MR-4-1-C/MR-10-1-U	6	SCOT 08-01, QUTZ 09-01, FLAT 12-01, MINE 10-02, SCOT 16-02, FLAT 13-01	21
MR-2-2-U/MR-2-2-C	3	SLUI 14-01, MINE 14-02, SLUI 18-02	8
MR-2-3-C	0	applied MR-2-3-U	12
MR-2-3-U	2	BREW 05-01, EFRK 01-02	12
MR-4-2-U/MR-4-2-C	3	SFAN 06-01, ANTE 07-01, SFAN 13-01	8
MR-4-3-C	0	applied MR-2-3-U	12
MR-4-3-U	0	applied MR-2-3-U	12
MR-10-1-C	0	applied MR-2-1-U/MR-4-1-U/MR-4-1-C/MR-10-1-U	21
MR-10-2-C	0	applied MR-2-2-U/MR-2-2-C	8

Reach Type values = Level 3 Ecoregion - valley gradient – stream order – valley confinement

E2.0 ESTABLISHING THE TOTAL ALLOWABLE LOAD

Once the existing bank erosion sediment load was derived, a desired load was established to determine the target conditions and allocation of sediment reductions.

It is difficult to precisely quantify total sediment loads from bank erosion without assessing the entire length of streambanks. However, quantitative data coupled with qualitative information from the sample reaches provides a good basis to estimate the total load and potential for sediment load reduction.

As described in the section above, all streams were delineated into reaches defined by a particular reach type. Each individual reach was also reviewed and human influences on bank erosion were presumed and assigned to that reach based on nearby land use and land management. Reaches that occurred in areas with land management practices conducive to bank stability and streamside vegetative health (such as riparian fencing or healthy wetland/riparian buffers) or areas of little human influence were designated as naturally influenced (70% or more of the reach is attributed to natural influence). Conversely, reaches that were predominantly influenced by the effects of land or stream management

that often result in bank instability (no riparian vegetation, channel straightening, road encroachment) were designated as human influenced (70% or more of the reach is attributed to human influence).

Sampled reaches were sorted by their influence category (natural or human), mean BEHI rating, reach type, and the average sediment loads (tons/1000'). In past TMDL bank erosion assessments, efforts to define a reference condition to differentiate between existing conditions and the potential conditions given reasonable land, soil, and water conservation practices relied on comparisons between identified external or internal reference reaches; relationships between the percentages of slowly eroding banks and actively eroding banks; or ratios of load contribution from human influenced and naturally eroding banks.

In the Rock Creek TPA, it was often difficult to distinguish natural vs. human influence because of historical mining, grazing, and logging that has occurred in the watershed. Many reaches were categorized as being predominately natural because they were in a state of recovery, however this potentially neglected past human influence on the stream, making it difficult to determine a reference condition. Because there is high confidence in the BEHI measurements that were performed in the field in 2011, to estimate a potential decrease in sediment loading due to improved streambank stability, mean BEHI rating values (**Table E-3**) in the existing dataset for each reach type that exceeded the "moderate" category were taken out and total loads were again averaged within reach type groupings. These reduced average loads were then extrapolated to reach types that were considered to be human influenced throughout the watershed, based on the extrapolation groupings used for existing loads (**Table E-4**). Reaches that were designated to be naturally influenced were given a desired load matching the existing load. Extrapolated loads by watershed are presented in **Table E-5** (Extrapolated loads by Reach ID are located in **Table E1-1** in **Attachment E-1**).

Table E-3. Mean BEHI rating and Total Sediment Load by Sampled Reach

Reach ID	Reach Type	Mean BEHI Rating
ANTE 21-01	MR-0-3-U	high
WFRK 14-03	MR-0-3-U	high
BREW 06-01	MR-0-3-U	moderate
WFRK 27-02	MR-0-3-U	moderate
UWIL 11-05	MR-0-3-U	low
WFRK 30-02	MR-0-3-U	moderate
UWIL 15-01	MR-0-4-U	moderate
EFRK 03-03	MR-0-4-U	moderate
FLAT 13-01	MR-10-1-U	moderate
SCOT 08-01	MR-2-1-U	moderate
SLUI 14-01	MR-2-2-C	high
SLUI 18-02	MR-2-2-U	low
MINE 14-02	MR-2-2-U	low
EFRK 01-02	MR-2-3-U	moderate
BREW 05-01	MR-2-3-U	low
QUTZ 09-01	MR-4-1-C	high
FLAT 12-01	MR-4-1-U	high
MINE 10-02	MR-4-1-U	low
SCOT 16-02	MR-4-1-U	low
SFAN 06-01	MR-4-2-C	moderate
ANTE 07-01	MR-4-2-U	high
SFAN 13-01	MR-4-2-U	low

Table E-4. Desired Load Reach Groupings and Load Estimates

Reach Type Grouping	Number of Sampled Reaches	Sampled Reaches	Average Desired Bank Erosion Sediment Load per 1000 feet (Tons/Year)
MR-0-1-U	0	applied MR-2-2-U/MR-2-2-C rate	4
MR-0-2-U	0	applied MR-2-2-U/MR-2-2-C rate	4
MR-0-3-C	0	applied MR-0-3-U/MR-0-4-U rate	20
MR-0-3-U/MR-0-4-U	8	ANTE 21-01, BREW 06-01, UWIL 11-05, WFRK 14-03, WFRK 27-02, WFRK 30-02, EFRK 03-03, UWIL 15-01	20
MR-2-1-C	0	applied MR-2-1-U/MR-4-1-U/MR-4-1-C/MR-10-1-U	9
MR-2-1-U/MR-4-1-U/ MR-4-1-C/MR-10-1-U	6	SCOT 08-01, QUTZ 09-01, FLAT 12-01, MINE 10-02, SCOT 16-02, FLAT 13-01	9
MR-2-2-U/MR-2-2-C	3	SLUI 14-01, MINE 14-02, SLUI 18-02	4
MR-2-3-C	0	applied MR-2-3-U	8
MR-2-3-U	2	BREW 05-01, EFRK 01-02	8
MR-4-2-U/MR-4-2-C	3	SFAN 06-01, ANTE 07-01, SFAN 13-01	5
MR-4-3-C	0	applied MR-2-3-U	8
MR-4-3-U	0	applied MR-2-3-U	8
MR-10-1-C	0	applied MR-2-1-U/MR-4-1-U/MR-4-1-C/MR-10-1-U	9
MR-10-2-C	0	applied MR-2-2-U/MR-2-2-C	4

Table E-5. Extrapolated Existing and Desired Loads by Watershed

Sub-watershed	Existing Bank Erosion Load	Desired Bank Erosion Load	Percent Reduction
Antelope Creek (includes SF Antelope Creek)	691	416	40%
Basin Gulch	161	69	57%
Brewster Creek	246	195	21%
East Fork Rock Creek	984	896	9%
Eureka Gulch (includes Basin and Quartz gulches)	712	407	43%
Flat Gulch	280	116	58%
Miners Gulch	473	439	7%
Quartz Gulch	526	324	38%
Scotchman Gulch	683	470	31%
South Fork Antelope Creek	158	87	45%
Sluice Gulch	398	213	46%
Upper Willow Creek (includes Scotchman and Miners gulches)	3548	3019	15%
West Fork Rock Creek	2880	1897	34%

E3.0 ALLOCATIONS AND ACHIEVEMENT

The desired sediment load is a gross estimate based on limited data. As such, the quantified load is not as significant for management and TMDL achievement purposes as the potential percent reduction. Since the desired load is based on the average of BEHI ratings with the "high" category excluded, it is assumed that this is a reasonable estimate for what is achievable in bank stabilization. The percent reduction allocation encompasses all adjacent land use categories and land management practices, and expects land owners to manage their properties with all applicable and reasonable land, water, and soil conservation practices to protect, improve, and restore stable and healthy streambanks and riparian corridors. Reasonable land, water, and conservation practices in this context may include limiting riparian livestock grazing durations to reduce effect on riparian vegetation, directing livestock to designed water gaps or off-site watering locations, establishing a specific riparian corridor with free from human-related activity, or re-establishment of key riparian vegetation. It is acknowledged that recovery of stable banks and improvement of riparian vegetation communities may take many decades to achieve. It is encouraged that, in addition to managing current activities with all reasonable land, soil, and water conservation practices, management decisions to promote floodplain functionality and native vegetation establishment throughout the riparian corridor will be reviewed and implemented wherever and whenever possible.

Although it is difficult to discern between bank erosion influenced from current or historic human practices and bank erosion as a result of natural processes using aerial imagery and GIS methodology, it is possible to identify potential present-day influencing factors with these methods. Through the stratification process used during the assessment method, adjacent land use and potential current influences on bank erosion was noted for each reach. Simple breakouts of the apparent percent influence on major land use types allows a general, but useful, overview of those activities that may be affecting bank erosion. This data can be used to help assist land managers with prioritizing areas to expedite sediment load reductions and eventually achieve the TMDL. Rough estimates of potential influence at the watershed scale are presented in **Table E-6** below.

Table E-6. Natural and Human Influences on Bank Erosion

Watershed	Natural	Transport	Grazing	Cropland	Mining	Forestry	Irrig.	Other
Antelope Creek	10%	4%	67%	12%	0%	1%	6%	0%
Basin Gulch	30%	38%	23%	4%	5%	0%	0%	0%
Brewster Creek	42%	30%	10%	0%	0%	11%	0%	7%
East Fork Rock Creek	26%	12%	26%	4%	0%	0%	29%	3%
Eureka Gulch	0%	20%	4%	0%	76%	0%	0%	0%
Flat Gulch	30%	2%	64%	0%	0%	4%	0%	1%
Miners Gulch	88%	3%	3%	0%	2%	3%	0%	0%
Quartz Gulch	72%	0%	4%	0%	3%	0%	0%	21%
Scotchman Gulch	56%	10%	33%	0%	0%	0%	0%	1%
South Fork Antelope Creek	2%	1%	61%	0%	0%	36%	0%	0%
Sluice Gulch	29%	10%	41%	0%	5%	11%	2%	2%
Upper Willow Creek	37%	4%	36%	4%	0%	0%	19%	0%
West Fork Rock Creek	52%	18%	13%	2%	0%	1%	0%	14%

It is acknowledged that the developed sediment loads and the method by which to attribute human and historic influence are estimates based on aerial photography, best professional judgment, and limited access to on-the-ground reaches. The assignment of bank erosion loads to the various land uses is not definitive; however it does provide helpful guidance for directing focus and efforts at reducing the loads from those causes which are likely having the biggest impacts on the investigated streams. Ultimately, it is the responsibility of local land owners and managers to identify the causes of bank erosion, and adopt practices to reduce bank erosion where ever practicable and possible. Complete TMDLs and allocations are presented in **Section 5-7**.

Assumptions and Considerations:

- The annual streambank erosion rates used to develop the sediment loading numbers were based on Rosgen BEHI studies developed using USDA Forest Service (in Colorado) data for streams found in sedimentary and/or metamorphic geology. While the geologies between the Rosgen research sites and the Rock Creek TPA are not identical, they are similar enough in character to warrant their application.
- The bank erosion data collected during the 2011 field effort is representative of conditions throughout the Rock Creek watershed.
- The assignment of influence to the eroding banks, and distinction between natural and human caused bank erosion is based on best professional judgment by qualified and experienced field personnel.
- The present day erosion has been, and continues to be affected by historic mining, grazing, logging, and other disturbances to the riparian corridor (both anthropogenic and natural, in the case of fires).
- The application of a bank erosion load reductions based on reducing BEHI values assumes that improved management practices will lead to improved streambank stability. The percent reduction is considered reasonable given the amount of human influence throughout the Rock Creek watershed.
- Specific quantification of the load reductions estimated here is not as significant as the complete application of best management practices in each of the watersheds of interest. With application of all reasonable land, soil, water conservation practices it is expected that the allocation will be achieved.

The land use percentages identified in **Table E-6** are general and may not be entirely accurate. They are intended to provide a starting point for further investigation and activity to address bank erosion by land use planners and watershed managers.

ATTACHMENT E-1

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
ANTE 01-01	MR-10-1-U	388	40	60	21	9	8.1	3.5	
ANTE 02-01	MR-4-1-U	433	40	60	21	9	9.1	3.9	
ANTE 03-01	MR-10-1-U	370	40	60	21	9	7.8	3.3	
ANTE 04-01	MR-4-1-U	2583	40	60	21	9	54.2	23.2	
ANTE 05-01	MR-4-1-C	1437	20	80	21	9	30.2	12.9	
ANTE 06-01	MR-2-2-C	2193	20	80	8	4	17.5	8.8	
ANTE 07-01	MR-4-2-U	1041	0	100	15	5	15.6	5.2	
ANTE 08-01	MR-2-2-U	1886	0	100	8	4	15.1	7.5	
ANTE 09-01	MR-2-2-C	1869	0	100	8	4	15.0	7.5	
ANTE 10-01	MR-2-2-U	1513	0	100	8	4	12.1	6.1	
ANTE 11-01	MR-0-2-U	827	0	100	8	4	6.6	3.3	
ANTE 11-02	MR-0-2-U	4376	0	100	8	4	35.0	17.5	
ANTE 12-01	MR-2-2-C	1064	0	100	8	4	8.5	4.3	
ANTE 13-01	MR-4-2-C	745	0	100	8	5	6.0	3.7	
ANTE 14-01	MR-2-2-C	1285	0	100	8	4	10.3	5.1	
ANTE 15-01	MR-4-2-U	452	0	100	8	5	3.6	2.3	
ANTE 16-01	MR-4-3-U	734	0	100	12	8	8.8	5.9	
ANTE 17-01	MR-4-3-U	1085	0	100	12	8	13.0	8.7	
ANTE 18-01	MR-2-3-C	2122	0	100	12	8	25.5	17.0	
ANTE 19-01	MR-4-3-C	722	0	100	12	8	8.7	5.8	
ANTE 20-01	MR-2-3-U	941	0	100	12	8	11.3	7.5	
ANTE 20-02	MR-2-3-U	2698	0	100	12	8	32.4	21.6	
ANTE 21-01	MR-0-3-U	1555	0	100	35	20	54.4	31.1	
ANTE 21-02	MR-0-3-U	497	10	90	22	20	10.9	9.9	
ANTE 21-03	MR-0-3-U	3697	10	90	22	20	81.3	73.9	
ANTE 21-04	MR-0-3-U	1457	10	90	22	20	32.1	29.1	
Antelope Creek Totals							**533.1**	**328.7**	**38%**

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
BASN 01-01	MR-10-1-U	336	20	80	21	9	7.1	3.0	
BASN 02-01	MR-4-1-U	190	20	80	21	9	4.0	1.7	
BASN 02-02	MR-4-1-U	82	0	100	21	9	1.7	0.7	
BASN 02-03	MR-4-1-U	590	10	90	21	9	12.4	5.3	
BASN 03-01	MR-10-1-U	384	40	60	21	9	8.1	3.5	
BASN 04-01	MR-4-1-U	581	30	70	21	9	12.2	5.2	
BASN 05-01	MR-10-1-U	304	30	70	21	9	6.4	2.7	
BASN 06-01	MR-4-1-U	588	40	60	21	9	12.3	5.3	
BASN 07-01	MR-10-1-C	2054	30	70	21	9	43.1	18.5	
BASN 08-01	MR-4-1-C	1151	40	60	21	9	24.2	10.4	
BASN 09-01	MR-10-1-C	1412	30	70	21	9	29.7	12.7	
Basin Gulch Totals							**161.1**	**69.0**	**57%**
BREW 01-01	MR-4-2-C	3640	80	20	8	8	29.1	29.1	
BREW 02-01	MR-2-2-U	1473	40	60	8	4	11.8	5.9	
BREW 03-01	MR-2-3-U	481	40	60	12	8	5.8	3.8	
BREW 04-01	MR-2-3-C	2959	30	70	12	8	35.5	23.7	
BREW 05-01	MR-2-3-U	5563	97	3	3	3	16.7	16.7	
BREW 05-02	MR-2-3-U	7107	20	80	12	8	85.3	56.9	
BREW 06-01	MR-0-3-U	1316	66	34	20	20	26.3	26.3	
BREW 06-02	MR-0-3-U	1614	30	70	22	20	35.5	32.3	
Brewster Creek Totals							**246.0**	**194.7**	**21%**
EFRK 01-01	MR-2-3-U	1901	20	80	12	8	22.8	15.2	
EFRK 01-02	MR-2-3-U	4688	82	18	12	12	56.3	56.3	
EFRK 01-03	MR-2-3-U	3775	10	90	12	8	45.3	30.2	
EFRK 02-01	MR-0-3-U	2665	10	90	22	20	58.6	53.3	
EFRK 02-02	MR-0-3-U	3930	10	90	22	20	86.5	78.6	
EFRK 02-03	MR-0-3-U	5638	20	80	22	20	124.0	112.8	
EFRK 03-01	MR-0-4-U	2519	20	80	22	20	55.4	50.4	
EFRK 03-02	MR-0-4-U	12030	10	90	22	20	264.7	240.6	
EFRK 03-03	MR-0-4-U	8740	70	30	17	17	148.6	148.6	
EFRK 03-04	MR-0-4-U	2569	10	90	22	20	56.5	51.4	
EFRK 03-05	MR-0-4-U	2951	20	80	22	20	64.9	59.0	
East Fork Rock Creek Totals							**983.6**	**896.3**	**9%**

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
EURK 01-01	MR-4-2-C	1146	0	100	8	5	9.2	5.7	
EURK 02-01	MR-4-2-U	451	0	100	8	5	3.6	2.3	
EURK 03-01	MR-4-2-U	269	0	100	8	5	2.2	1.3	
EURK 04-01	MR-0-2-U	682	0	100	8	4	5.5	2.7	
EURK 04-02	MR-0-2-U	520	0	100	8	4	4.2	2.1	
Eureka Gulch Totals							**24.5**	**14.1**	**42%**
FLAT 01-01	MR-4-1-U	994	40	60	21	9	20.9	8.9	
FLAT 01-02	MR-4-1-U	824	30	70	21	9	17.3	7.4	
FLAT 02-01	MR-2-1-U	1066	30	70	21	9	22.4	9.6	
FLAT 03-01	MR-4-1-U	896	60	40	21	9	18.8	8.1	
FLAT 04-01	MR-2-1-U	1238	50	50	21	9	26.0	11.1	
FLAT 05-01	MR-4-1-U	680	40	60	21	9	14.3	6.1	
FLAT 06-01	MR-2-1-U	1058	40	60	21	9	22.2	9.5	
FLAT 07-01	MR-4-1-U	961	50	50	21	9	20.2	8.6	
FLAT 08-01	MR-10-1-C	396	30	70	21	9	8.3	3.6	
FLAT 09-01	MR-4-1-C	506	30	70	21	9	10.6	4.6	
FLAT 10-01	MR-10-1-C	585	20	80	21	9	12.3	5.3	
FLAT 11-01	MR-10-1-U	1083	0	100	21	9	22.7	9.7	
FLAT 12-01	MR-4-1-U	1838	0	100	31	9	57.0	16.5	
FLAT 13-01	MR-10-1-U	3639	80	20	2	2	7.3	7.3	
Flat Gulch Totals							**280.3**	**116.4**	**58%**

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
MINE 01-01	MR-10-1-U	3839	100	0	21	21	80.6	80.6	
MINE 02-01	MR-10-1-C	1154	100	0	21	21	24.2	24.2	
MINE 03-01	MR-10-1-U	719	100	0	21	21	15.1	15.1	
MINE 04-01	MR-4-1-U	452	100	0	21	21	9.5	9.5	
MINE 05-01	MR-10-1-U	313	100	0	21	21	6.6	6.6	
MINE 06-01	MR-4-1-U	486	100	0	21	21	10.2	10.2	
MINE 07-01	MR-10-1-U	349	100	0	21	21	7.3	7.3	
MINE 08-01	MR-4-1-U	3876	100	0	21	21	81.4	81.4	
MINE 09-01	MR-4-1-C	3941	80	20	21	21	82.8	82.8	
MINE 09-02	MR-4-1-C	1626	50	50	21	9	34.1	14.6	
MINE 10-01	MR-4-1-U	918	90	10	21	21	19.3	19.3	
MINE 10-02	MR-4-1-U	1151	100	0	2	2	2.3	2.3	
MINE 10-03	MR-4-1-U	1922	100	0	21	21	40.4	40.4	
MINE 11-01	MR-4-2-U	997	30	70	8	5	8.0	5.0	
MINE 12-01	MR-2-2-C	2538	90	10	8	8	20.3	20.3	
MINE 13-01	MR-4-2-C	2607	60	40	8	5	20.9	13.0	
MINE 14-01	MR-2-2-U	1022	60	40	8	4	8.2	4.1	
MINE 14-02	MR-2-2-U	730	100	0	3	3	2.2	2.2	
Miners Gulch Totals							**473.3**	**438.9**	**7%**
QUTZ 01-01	MR-10-1-U	983	100	0	21	21	20.6	20.6	
QUTZ 02-01	MR-10-1-C	2714	100	0	21	21	57.0	57.0	
QUTZ 03-01	MR-4-1-C	468	100	0	21	21	9.8	9.8	
QUTZ 04-01	MR-10-1-C	726	100	0	21	21	15.2	15.2	
QUTZ 05-01	MR-4-1-C	1324	100	0	21	21	27.8	27.8	
QUTZ 06-01	MR-10-1-C	719	100	0	21	21	15.1	15.1	
QUTZ 07-01	MR-4-1-C	3471	90	10	21	21	72.9	72.9	
QUTZ 08-01	MR-2-1-C	1062	30	70	21	9	22.3	9.6	
QUTZ 09-01	MR-4-1-C	3633	50	50	61	9	221.6	32.7	
QUTZ 10-01	MR-10-1-C	288	80	20	21	21	6.1	6.1	
QUTZ 11-01	MR-4-1-C	446	80	20	21	21	9.4	9.4	
QUTZ 12-01	MR-10-1-C	2278	80	20	21	21	47.8	47.8	
Quartz Gulch Totals							**525.7**	**324.0**	**38%**

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
SCOT 01-01	MR-10-1-U	394	100	0	21	21	8.3	8.3	
SCOT 02-01	MR-4-1-U	4959	100	0	21	21	104.1	104.1	
SCOT 03-01	MR-4-1-C	1569	100	0	21	21	32.9	32.9	
SCOT 04-01	MR-4-1-U	1943	100	0	21	21	40.8	40.8	
SCOT 05-01	MR-2-1-U	5642	70	30	21	21	118.5	118.5	
SCOT 06-01	MR-4-1-U	1143	50	50	21	9	24.0	10.3	
SCOT 07-01	MR-0-1-U	4294	20	80	8	4	34.4	17.2	
SCOT 08-01	MR-2-1-U	1662	16	84	27	9	44.9	15.0	
SCOT 08-02	MR-2-1-U	2722	30	70	21	9	57.2	24.5	
SCOT 09-01	MR-4-1-U	419	60	40	21	9	8.8	3.8	
SCOT 10-01	MR-2-1-C	1256	50	50	21	9	26.4	11.3	
SCOT 11-01	MR-4-1-C	890	20	80	21	9	18.7	8.0	
SCOT 12-01	MR-10-1-C	314	20	80	21	9	6.6	2.8	
SCOT 13-01	MR-4-1-C	1414	30	70	21	9	29.7	12.7	
SCOT 14-01	MR-10-1-C	396	40	60	21	9	8.3	3.6	
SCOT 15-01	MR-4-1-C	668	30	70	21	9	14.0	6.0	
SCOT 15-02	MR-4-1-C	1904	30	70	21	9	40.0	17.1	
SCOT 16-01	MR-4-1-U	2761	20	80	21	9	58.0	24.9	
SCOT 16-02	MR-4-1-U	1975	100	0	4	4	7.9	7.9	
Scotchman Gulch Totals							**683.4**	**469.7**	**31%**

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
SFAN 01-01	MR-10-1-U	323	0	100	21	9	6.8	2.9	
SFAN 02-01	MR-4-1-C	1125	0	100	21	9	23.6	10.1	
SFAN 03-01	MR-10-1-C	384	0	100	21	9	8.1	3.5	
SFAN 04-01	MR-4-1-C	433	0	100	21	9	9.1	3.9	
SFAN 05-01	MR-4-1-U	895	0	100	21	9	18.8	8.1	
SFAN 06-01	MR-4-2-C	1365	0	100	7	5	9.6	6.8	
SFAN 06-02	MR-4-2-C	1502	20	80	8	5	12.0	7.5	
SFAN 07-01	MR-10-2-C	354	20	80	8	4	2.8	1.4	
SFAN 08-01	MR-4-2-C	1675	0	100	8	5	13.4	8.4	
SFAN 08-02	MR-4-2-C	2804	0	100	8	5	22.4	14.0	
SFAN 09-01	MR-10-2-C	361	0	100	8	4	2.9	1.4	
SFAN 10-01	MR-4-2-C	1556	0	100	8	5	12.4	7.8	
SFAN 11-01	MR-10-2-C	659	20	80	8	4	5.3	2.6	
SFAN 12-01	MR-4-2-C	1009	40	60	8	5	8.1	5.0	
SFAN 13-01	MR-4-2-U	1025	0	100	3	3	3.1	3.1	
South Fork Antelope Creek							**158.3**	**86.6**	**45%**

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
SLUI 01-01	MR-10-1-U	567	40	60	21	9	11.9	5.1	
SLUI 02-01	MR-4-1-U	668	40	60	21	9	14.0	6.0	
SLUI 03-01	MR-4-1-C	1354	30	70	21	9	28.4	12.2	
SLUI 04-01	MR-4-1-U	1434	20	80	21	9	30.1	12.9	
SLUI 04-02	MR-4-1-U	189	20	80	21	9	4.0	1.7	
SLUI 05-01	MR-2-1-C	2271	20	80	21	9	47.7	20.4	
SLUI 06-01	MR-4-1-C	667	20	80	21	9	14.0	6.0	
SLUI 07-01	MR-10-1-C	362	20	80	21	9	7.6	3.3	
SLUI 08-01	MR-4-1-U	894	20	80	21	9	18.8	8.0	
SLUI 08-02	MR-4-1-U	527	20	80	21	9	11.1	4.7	
SLUI 09-01	MR-2-2-U	662	20	80	8	4	5.3	2.6	
SLUI 09-02	MR-2-2-U	2970	20	80	8	4	23.8	11.9	
SLUI 10-01	MR-2-2-C	2751	20	80	8	4	22.0	11.0	
SLUI 11-01	MR-2-2-C	3651	20	80	8	4	29.2	14.6	
SLUI 12-01	MR-2-2-U	1111	40	60	8	4	8.9	4.4	
SLUI 13-01	MR-2-2-U	1262	20	80	8	4	10.1	5.0	
SLUI 14-01	MR-2-2-C	2396	80	20	18	18	43.1	43.1	
SLUI 15-01	MR-4-2-U	509	10	90	8	5	4.1	2.5	
SLUI 15-02	MR-4-2-U	461	10	90	8	5	3.7	2.3	
SLUI 16-01	MR-2-2-U	1787	20	80	8	4	14.3	7.1	
SLUI 16-02	MR-2-2-U	2810	10	90	8	4	22.5	11.2	
SLUI 16-03	MR-2-2-U	1089	0	100	8	4	8.7	4.4	
SLUI 17-01	MR-4-2-U	367	0	100	8	5	2.9	1.8	
SLUI 18-01	MR-2-2-U	191	0	100	8	4	1.5	0.8	
SLUI 18-02	MR-2-2-U	2490	80	20	4	4	10.0	10.0	
Sluice Gulch Totals							**397.6**	**213.3**	**46%**

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
UWIL 01-01	MR-10-1-C	1891	100	0	21	21	39.7	39.7	
UWIL 01-02	MR-10-1-C	1330	50	50	21	9	27.9	12.0	
UWIL 02-01	MR-4-1-C	1033	100	0	21	21	21.7	21.7	
UWIL 03-01	MR-10-1-C	373	90	10	21	21	7.8	7.8	
UWIL 04-01	MR-4-1-C	474	90	10	21	21	10.0	10.0	
UWIL 05-01	MR-10-1-C	779	90	10	21	21	16.4	16.4	
UWIL 06-01	MR-2-1-U	1211	90	10	21	21	25.4	25.4	
UWIL 07-01	MR-4-1-U	1671	90	10	21	21	35.1	35.1	
UWIL 08-01	MR-2-1-U	1301	80	20	21	21	27.3	27.3	
UWIL 09-01	MR-4-1-U	953	80	20	21	21	20.0	20.0	
UWIL 10-01	MR-0-2-U	453	80	20	8	8	3.6	3.6	
UWIL 11-01	MR-0-3-U	2210	70	30	22	22	48.6	48.6	
UWIL 11-02	MR-0-3-U	5939	50	50	22	20	130.7	118.8	
UWIL 11-03	MR-0-3-U	31444	30	70	22	20	691.8	628.9	
UWIL 11-04	MR-0-3-U	1332	20	80	22	20	29.3	26.6	
UWIL 11-05	MR-0-3-U	13490	95	5	7	7	94.4	94.4	
UWIL 11-06	MR-0-3-U	2774	20	80	22	20	61.0	55.5	
UWIL 11-07	MR-0-3-U	1551	20	80	22	20	34.1	31.0	
UWIL 11-08	MR-0-3-U	3166	10	90	22	20	69.6	63.3	
UWIL 11-09	MR-0-3-U	75	20	80	22	20	1.6	1.5	
UWIL 11-10	MR-0-3-U	1487	20	80	22	20	32.7	29.7	
UWIL 12-01	MR-0-3-U	330	20	80	22	20	7.3	6.6	
UWIL 13-01	MR-0-3-U	135	20	80	22	20	3.0	2.7	
UWIL 14-01	MR-0-3-U	8238	20	80	22	20	181.2	164.8	
UWIL 14-02	MR-0-3-U	11023	10	90	22	20	242.5	220.5	
UWIL 14-03	MR-0-3-U	1873	10	90	22	20	41.2	37.5	
UWIL 14-04	MR-0-3-U	5484	10	90	22	20	120.7	109.7	
UWIL 14-05	MR-0-3-U	618	10	90	22	20	13.6	12.4	
UWIL 15-01	MR-0-4-U	11281	53	47	30	20	338.4	225.6	
UWIL 16-01	MR-0-4-U	276	20	80	22	20	6.1	5.5	
UWIL 16-02	MR-0-4-U	391	10	90	22	20	8.6	7.8	
Upper Willow Creek Totals							**2391.5**	**2110.4**	**12%**

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
WFRK 01-01	MR-4-1-U	300	100	0	21	21	6.3	6.3	
WFRK 02-01	MR-10-1-U	612	70	30	21	21	12.8	12.8	
WFRK 03-01	MR-4-1-U	1356	70	30	21	21	28.5	28.5	
WFRK 04-01	MR-2-1-U	1754	50	50	21	9	36.8	15.8	
WFRK 05-01	MR-0-1-U	1618	90	10	8	8	12.9	12.9	
WFRK 06-01	MR-0-2-U	525	90	10	8	8	4.2	4.2	
WFRK 07-01	MR-2-2-U	3154	80	20	8	8	25.2	25.2	
WFRK 08-01	MR-0-2-U	2751	30	70	8	4	22.0	11.0	
WFRK 09-01	MR-2-2-U	702	80	20	8	8	5.6	5.6	
WFRK 09-02	MR-2-2-U	636	80	20	8	8	5.1	5.1	
WFRK 10-01	MR-0-2-U	1175	90	10	8	8	9.4	9.4	
WFRK 10-02	MR-0-2-U	3379	40	60	8	4	27.0	13.5	
WFRK 10-03	MR-0-2-U	3090	20	80	8	4	24.7	12.4	
WFRK 10-04	MR-0-2-U	1828	20	80	8	4	14.6	7.3	
WFRK 11-01	MR-2-2-U	1871	20	80	8	4	15.0	7.5	
WFRK 12-01	MR-4-2-U	552	30	70	8	5	4.4	2.8	
WFRK 13-01	MR-0-2-U	1712	40	60	8	4	13.7	6.8	
WFRK 13-02	MR-0-2-U	2107	30	70	8	4	16.9	8.4	
WFRK 13-03	MR-0-2-U	2147	30	70	8	4	17.2	8.6	
WFRK 13-04	MR-0-2-U	2094	30	70	8	4	16.8	8.4	
WFRK 13-05	MR-0-2-U	3336	30	70	8	4	26.7	13.3	
WFRK 14-01	MR-0-3-U	5699	30	70	22	20	125.4	114.0	
WFRK 14-02	MR-0-3-U	8828	50	50	22	20	194.2	176.6	
WFRK 14-03	MR-0-3-U	7363	58	42	110	20	809.9	147.3	
WFRK 14-04	MR-0-3-U	1164	70	30	22	22	25.6	25.6	
WFRK 14-05	MR-0-3-U	6479	60	40	22	20	142.5	129.6	
WFRK 14-06	MR-0-3-U	3292	40	60	22	20	72.4	65.8	
WFRK 15-01	MR-2-3-U	5791	30	70	12	8	69.5	46.3	
WFRK 16-01	MR-2-3-C	3068	30	70	12	8	36.8	24.5	
WFRK 17-01	MR-0-3-C	2345	40	60	22	20	51.6	46.9	
WFRK 18-01	MR-2-3-C	1129	20	80	12	8	13.5	9.0	
WFRK 19-01	MR-2-3-C	547	30	70	12	8	6.6	4.4	
WFRK 20-01	MR-2-3-U	1435	30	70	12	8	17.2	11.5	

Table E1-1. Sediment Load Reductions by Reach and Subwatershed

REACH_ID	REACH TYPE	LENGTH_FT	% Natural	% Anthro	Existing Rate (ton/1000 ft)	Desired Rate (ton/1000 ft)	Existing Load Estimate	Desired Load Estimate	% Reduction
WFRK 21-01	MR-0-3-U	2207	40	60	22	20	48.5	44.1	
WFRK 22-01	MR-2-3-U	1892	40	60	12	8	22.7	15.1	
WFRK 23-01	MR-0-3-U	2525	50	50	22	20	55.6	50.5	
WFRK 24-01	MR-2-3-U	1639	80	20	12	12	19.7	19.7	
WFRK 25-01	MR-0-3-U	2462	80	20	22	22	54.2	54.2	
WFRK 26-01	MR-2-3-U	2813	60	40	12	8	33.8	22.5	
WFRK 27-01	MR-0-3-U	233	30	70	22	20	5.1	4.7	
WFRK 27-02	MR-0-3-U	919	91	9	24	24	22.1	22.1	
WFRK 27-03	MR-0-3-U	3531	30	70	22	20	77.7	70.6	
WFRK 28-01	MR-2-3-U	4028	50	50	12	8	48.3	32.2	
WFRK 28-02	MR-2-3-U	1600	30	70	12	8	19.2	12.8	
WFRK 29-01	MR-0-3-U	1469	30	70	22	20	32.3	29.4	
WFRK 29-02	MR-0-3-U	3403	40	60	22	20	74.9	68.1	
WFRK 30-01	MR-0-3-U	4451	40	60	22	20	97.9	89.0	
WFRK 30-02	MR-0-3-U	4531	100	0	24	24	108.7	108.7	
WFRK 30-03	MR-0-3-U	1329	60	40	22	20	29.2	26.6	
WFRK 30-04	MR-0-3-U	6540	50	50	22	20	143.9	130.8	
WFRK 30-05	MR-0-3-U	2439	40	60	22	20	53.7	48.8	
WFRK 31-01	MR-0-4-U	957	30	70	22	20	21.0	19.1	
West Fork Rock Creek Totals							**2879.7**	**1896.4**	**34%**