Forest Road Monitoring
2006-2008

USDA Forest Service
Lake Tahoe Basin Management Unit

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Executive Summary

This report summarizes a three-year monitoring program (2006 thru 2008) which evaluated the effectiveness of the LTBMU's Forest Road BMP Retrofit Program and up-dates the previous roads report covering the period between 2003 and 2005 (Breibart, 2007). This report evaluated the effectiveness of 4.21 miles of upgrades that occurred during this period. Relatively few upgrades have occurred in this period, compared to the 154 mile of upgrades evaluated in the 2007 report.

The monitoring program goals include:

- Evaluating BMP effectiveness at stream crossings utilizing Forest Service Region-5's Best Management Practices Evaluation Program (BMPEP) protocols.
- Assessing the change in risk of sediment transport as a result of BMP implementation using Water Quality Risk Assessment Protocols (WQRAP).

BMPEP

All four road surface, drainage and slope protection evaluations for implemented BMP upgrades were rated effective. Stream crossing evaluations determined that all sites with a stream crossing were rated effective at preventing plugging and reducing diversion potential. Sidecast Material evaluations were also rated effective at all sites.

WQRAP

A total of 4.21 miles of road were evaluated of which 2.08 miles were located outside an SEZ, had no risk of sediment delivery to a water body and therefore were not rated. The remaining 2.13 miles consisted of 0.54 miles of low risk and 1.59 miles of moderate risk road (Table 4.1). All 1.59 miles of moderate risk road segments were located on Slaughterhouse Canyon road (18E22.5).

Conclusions/Recommendations

Monitoring results indicate that BMP retrofits overall have been effective at reducing the risk of road-borne sediment migration to water bodies in the Lake Tahoe Basin. WQRAP scores are low with the exception of road 18E22.5, Slaughterhouse Canyon Road (a trail to road conversion), which received predominately moderate ratings due to the surface type and gradient. This road was upgraded because logging vehicles will use this road during proposed vegetation management activities. After vegetation management activities are completed the Forest plans to maintain this road as a level II road, closed to the public, but available for administrative use by the USFS. It is recommended to increase the coverage of gravel surfacing of the road from currently covering the area of the stream crossings, to include the length of the road segments (with gradients >5%) connected to the stream crossing. This would increase the total length of gravel surfacing from 44 feet to 364 feet, and would result in reducing the rating from moderate to low risk for this road. This report and roads monitoring reports from previous years can be found at http://www.fs.fed.us/r5/ltbmu/publications/.

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INTRODUCTION

This report summarizes a three-year monitoring program to evaluate the effectiveness of LTBMU's Forest Road Projects implemented between 2006 and 2008 and up-dates the findings of a previous report entitled *Forest Road BMP Upgrade Monitoring Report 2003-2005*, *Breibart, Harris and Norman*, which evaluated BMP upgrades implemented on a total of 154 miles of roads. In comparison, road upgrades identified during the period between 2006 and 2008 totaled only 4.21 miles road upgrades. All road projects evaluated in this report underwent at least one winter season before they were evaluated in November of 2008.
The monitoring program goals are:

- Evaluating BMP effectiveness at stream crossings utilizing Forest Service Region-5's Best Management Practices Evaluation Program (BMPEP) protocols.
- Assessing the change in risk of sediment transport as a result of BMP implementation using Water Quality Risk Assessment Protocols (WQRAP).

2.0 ROADS EVALUATED BETWEEN 2006 & 2008

Five evaluated road projects were implemented in the southern end of the Lake Tahoe Basin. The Slaughterhouse Canyon road project was implemented on the East Shore.

The following are brief descriptions of these projects:

- Road 18E22.5 is located west of Highway 28 and provides vehicle access into Slaughterhouse Canyon. Two miles of road were converted from a non-system trail to a system road to prepare the road for logging vehicle use. The trail was widened from 8 feet to 12 feet for a planned fuels reduction project. Gravel was placed on the road surface at all water crossings and water bars were installed. The project includes 3 separate stream crossings, totaling 0.37 miles of connected length, on Slaughterhouse Creek.

- Road 13N81, which joins Fallen Leaf Lake Road, was rebuilt to improve 0.25 miles of road used for vehicle access to a new water storage tank. Work included widening, re-grading, rip rap retaining walls, placement of gravel and installation of water bars at grade dependent intervals.

- Roads 12N19 and 12N19A were rebuilt after the 2007 Angora Fire, to facilitate access for mitigation of fire damage. Work included installation of water bars at grade dependent intervals and placement of rip rap to stabilize slopes at drainages. Road improvements total over one mile.

- Road 1112 provides administrative vehicle access to the Hawksworth Pack Station at Celio Ranch. This 0.13 mile section of road previously had a concave cross-sectional profile. This section of road was upgraded by adding 3 to 6 inches of gravel over the existing road which established an erosion resistant road profile.

- Road 17E78, joins Tahoe Mountain Road. After the Angora Fire, approximately 0.8 miles of the upper road section were regraded, outsloped and water barred. Water bars were installed at grade dependent intervals but no water bars were installed in the 1/10 mile section of the road where it crosses private property. Twenty feet of the roadway near the upper terminus was decommissioned by blocking access with logs and covering the road with branches and woody debris. This road is used for administrative use only.

3.0 MONITORING METHODS

Post-project monitoring consists of the following two methods of data collection and analysis:

- Evaluation of BMP effectiveness at stream crossings utilizing Forest Service, Region 5 Best Management Practices Evaluation Program (BMPEP), protocols.
- Assessing change in risk of erosion and sediment transport which resulted from maintained or newly implemented BMPs using Water Quality Risk Assessment Protocols (WQRAP).

Note: Sediment loads can be estimated before and after BMP implementation utilizing the Water Erosion Prediction Project (WEPP) erosion and prediction model. WEPP has been used to evaluate roads in past reports, however it was not used in this report due to a lack of roads which qualified as high risk (no significant erosion potential was observed). Monitoring protocols are documented in the Roads Monitoring Plan (Norman, 2004).

3.1 BMPEP Ratings

BMPEP protocols were developed by the USDA, Forest Service, Region 5, in agreement with the California State Water Quality Control Board (USDA, FS, 2002). These protocols are generally applied to timber, roads, recreation, fuels reduction, construction and range. Selected protocols which focus on qualitative assessment of BMP's implemented near stream crossings include:

- E08, Road surface, drainage and slope protection
- E09, Stream crossings
- E11, Control of side cast material

Evaluations were conducted at four perennial stream crossings. Road surface, drainage, and slope protection protocol (E08) was used to evaluate erosion control, stability of road slope surfaces and spoil disposal areas on road segments draining directly to the stream crossing. Stream crossing protocol (E09) was used to evaluate the degree to which the general guidelines for location and design of roads were followed and also evaluates stability of road slope surfaces and spoil disposal areas. The side-cast material protocol (E11) was used to evaluate fill or other material along the road at stream crossings.

During BMP implementation, a variety of questions are asked which determine if the BMP was constructed according to project plans and specifications. To determine the effectiveness of BMP's, an additional dataset was collected to determine if beneficial uses were impaired, and if

so, to what extent, duration and degree. Protocol E08, for example, addresses the degree of surface erosion present using the following classifications:

- Little or no evidence of rilling.
- Some rills present on <10% of the road segment or were present but do not leave road surface.
- >10% of surface length has rills 2" deep and 20' in length, which continue off the road surface.

Scores are given for each dataset and summarized for both implementation and effectiveness. Evaluations are scored using an algorithmic rule set embedded in the database.

3.2 Water Quality Risk Assessment Protocol (WQRAP) Ratings

Pre-project WQRAP ratings were used to qualitatively assess the risk of sediment transport and water quality impairment in 1988. However, none of the roads evaluated in 2008 had pre-project data available. Post-project WQRAP ratings were conducted to determine current water quality risk.

Post-project monitoring used a field form developed by *Derrig, 1999*. The following three types of road segments are evaluated:

1) Road segments at stream crossings.
2) Road segments within stream environmental zones (SEZ) (<450 feet from a channel).
3) Road segments not within stream environmental zones (Non-SEZ) but are hydrologically connected to SEZs (>450 feet from a channel).

Road segments at stream crossings are defined as culverts, pipe arches, bridges or fords, which have a discernible stream channel above and below the crossing, and those that cross wet meadow areas even if they do not necessarily have a discernible channel upstream. Stream crossings were evaluated based on the following characteristics:

- Connected length, which is the length of road segment hydrologically connected to a surface water body through rills, gullies, overland flow or drainage ditches.
- Crossing condition (structure crushed, dented, or blocked, evidence of erosion or ponding around crossing).
- Diversion potential and diversion distance (defined as the road distance that diverted runoff would travel).
- Road surface type and grade.

SEZ segments are defined as segments of road that pass within 450 feet of a meadow, stream or lake, or segments of road that pass through an SEZ but have no distinct crossing. Non-SEZ segments are defined as segments of road that are greater than 450 feet from a meadow, stream, or lake, and/or segments of road having a chronic erosion feature such as rill or gully that connects to an SEZ *(Derrig, 1999)*. SEZ and Non-SEZ segments are evaluated for the following characteristics:

- SEZ or Non-SEZ.
- Connected length.
- Road surface type and grade.
- Presence/absence of chronic erosion features.

These road segments are assigned a risk score as designated in Table A1 and Table A2, in Appendix-A

4.0 RESULTS

4.1 BMPEP Ratings

BMPEP evaluations were conducted on four stream crossings. All four evaluations for Road surface, Drainage and Slope Protection (E08), Stream Crossings (E09) and Control of Sidecast Material (E11) were rated effective. Three crossings were located on road 118E22.5 and one on road 1112.

4.2 WQRAP Ratings

A summary of water quality risk for each road is outlined in Table 1. A total of 4.21 miles of road were evaluated of which 2.08 miles were located outside an SEZ, had no risk of sediment delivery to a water body and therefore received no risk rating. This includes the following four roads, 13N81, 12N19, 12N19A, and 17E78. The remaining 2.13 miles consisted of 0.54 miles of low risk and 1.59 miles of moderate risk respectively for road 18E22.5 and road 1112. Table A3 in Appendix A, presents WQRAP rating for each road segment.

Table 1. Results of Water Quality Risk Analysis. Mileage is the total connected length of roads within each watershed.

		Pre-project				**Post-project**				**Change**			
Road Location	**Road #**	**L**	**M**	**H**	**T**	**L**	**M**	**H**	**T**	**L**	**M**	**H**	**T**
		Miles				**Miles**				**Miles**			
Slaughter House Canyon	18E22.5	0	0	0	0	**0.41**	**1.59**	0	**2.0**	0	0	0	0
Fallen Leaf	13N81	0	0	0	0	0	0	0	0	0	0	0	0
Fallen Leaf	12N19	0	0	0	0	0	0	0	0	0	0	0	0
Garner Mountain Road	12N19A	0	0	0	0	0	0	0	0	0	0	0	0
South Upper Truckee	1112	0	0	0	0	**0.13**	0	0	**0.13**	0	0	0	0
Tahoe Mountain Road	17E78	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total		**0**	**0.0**	**0**	0.0	**0.54**	**1.59**	**0**	**2.13**	**0**	**0.0**	**0**	**0.0**

L=Low water quality risk, M=Moderate Water Quality Risk, H=High Water Quality Risk T= Total
Roads that do not show L, M, or H scores are roads without risk.

5.0 CONCLUSIONS/ RECOMMENDATIONS

Monitoring results indicate that BMP retrofits overall have been effective at reducing the risk of road-borne sediment migration to water bodies in the Lake Tahoe Basin. WQRAP scores are low with the exception of road 18E22.5, Slaughterhouse Canyon Road (a trail to road conversion), which received predominately moderate ratings due to the surface type and gradient. This road was upgraded because logging vehicles will use this road during proposed vegetation management activities. After vegetation management activities are completed the Forest plans to maintain this road as a level II road, closed to the public, but available for administrative use by the USFS. It is recommended to increase the coverage of gravel surfacing of the road from currenlty covering the area of the stream crossings, to include the length of the road segments (with gradients >5%) connected to each of the three stream crossing. This would increase the total length of gravel surfacing from 44 feet to 364 feet, and would result in reducing the rating from moderate to low risk for this road.

REFERENCES

Derrig, M.J., G. Whitley, K. Cahill and G. Villanueva. 1999. System roads inventory and analysis on the Lake Tahoe Basin Management Units. USDA Forest Service Lake Tahoe Basin Management Unit.

USDA Forest Service. June 2002. Investigating water quality in the Pacific Southwest Region: best management practices evaluation program (BMPEP) user's guide. USDA Forest Service Pacific Southwest Region; Vallejo, California.

Breibart, A., J. Harris and S. Norman. 2007. Forest Roads BMP Upgrade Monitoring Report, 2003-2005. USDA Forest Service Lake Tahoe Basin Management Unit.

APPENDIX A

Table A1: Water Quality Risk Scores for Individual Road Features.

Connected Length	Score
not connected	0
<91 meters (300 ft)	5
91-275 meters (300-900 ft)	15
>275 meters (900 ft)	35
Road Grade	
<5%	0
6-10%	10
>10%	20
Surface Type	
Gravel or paved	0
Native	10
[1]Inlet Condition	
Good	0
Poor	10
[1]Diversion Distance	
No diversion potential	0
<23 meters (75 ft)	5
23-91 meters (75-300 ft)	10
>91 meters (300 ft)	25
[2]SEZ or NON-SEZ	
NON-SEZ	0
SEZ	20
[2]Chronic Erosion Feature	
None	0
Present	15

1. *Applies to crossings only.*
2. *Applies to SEZ's and Non-SEZ's only.*

Table A2: Total Water Quality Risk Score and Associated Risk Category

Risk Category	Total Score (X)
High	X>60
Moderate	X=25-60
Low	X<25

Table A3: WQRAP Summary for Evaluated Road Segments

Road Number	Segment Miles	CONNECT	ROAD GRADE	SURFACE TYPE	[1]INLET CONDITION	[1]DIVERSION DISTANCE	[2]SEZ or Non-SEZ	[2]CHRONIC EROSION FEATURE	RISK SCORE	RATING	Description
1112	0.13	5	0	0	0	5	0	0	10	Low	Crossing
18E22.5	0.13	5	10	0	0	0	0	0	15	Low	Crossing at the bottom section of the road
18E22.5	0.11	5	10	10	0	0	0	0	25	Mod	Crossing at the top section of the road
18E22.5	0.13	0	10	0	0	0	0	0	10	Low	Crossing at spring one, spring did not flow entirely into the pipe
18E22.5	0.02	0	0	10	0	0	20	0	30	Mod	SEZ at the bottom section of the road- right side of crossing
18E22.5	0.11	0	0	10	0	0	20	0	30	Mod	SEZ at the bottom section of the road- left side of crossing
18E22.5	0.13	5	0	10	0	0	20	0	35	Mod	SEZ at the top section of the road
18E22.5	0.12	0	0	10	0	0	20	0	30	Mod	SEZ at the top section of the road
18E22.5	0.15	5	10	10	0	0	20	0	45	Mod	SEZ near the spring
18E22.5	0.13	0	0	10	0	0	20	0	30	Mod	SEZ near the spring
18E22.5	0.11	5	0	0	0	0	20	0	25	Mod	SEZ near spring one (top)
18E22.5	0.14	0	0	10	0	0	20	0	30	Mod	SEZ near spring one (top)
18E22.5	0.15	0	0	0	0	0	20	0	20	Low	SEZ near spring one (top)
18E22.5	0.18	5	0	0	0	0	20	0	25	Mod	SEZ near spring two (mid-turn)
18E22.5	0.12	0	0	10	0	0	20	0	30	Mod	SEZ near spring two (mid-turn)
18E22.5	0.15	5	0	0	0	0	20	0	25	Mod	SEZ near spring three (bottom)
18E22.5	0.12	0	0	10	0	0	20	0	30	Mod	SEZ near spring three (bottom)
13N81	0.25	There is no crossing or SEZ, therefore no risk to water quality.									
12N19	1.00	There is no crossing or SEZ, therefore no risk to water quality.									
12N19A	0.03	There is no crossing or SEZ, therefore no risk to water quality.									
#17E78	0.80	There is no crossing or SEZ, therefore no risk to water quality.									
Total miles	4.21										

1. Applies to crossings only
2. Applies to SEZ's and Non-SEZ's only.