Lime Complex Interagency BAER TEAM
Hydrologist Report
Shasta-Trinity National Forest

I. OBJECTIVES

The objective of this report is to provide a rapid assessment of the area affected by the Lime Fire Complex. High severity wildfires and suppression efforts can increase runoff and erosion rates by orders of magnitude, possibly threatening life, property, roads and trails as well as severely degrading water quality and aquatic ecosystems. This report provides a brief overview of the hydrologic resource issues of the Lime, Miners and Slide Fires of the Lime complex including burn severity, watershed response, values at risk, focused inventory of high risk watersheds, changes in runoff and suggested treatments and recommendations.

II. ISSUES/ VALUES AT RISK

The limiting factors for values at risk below the burned area are water quality in relation to fish habitat and road stability.

a. Water Quality and Fish Habitat

The South Fork of the Trinity River watershed basin (SFTR) 4th Field Hydrologic Code (HUC) has historically been recognized as a major producer of Chinook and Coho salmon (a listed species), and steelhead trout (PWA, 1994). The (SFTR) currently is included in the California's Clean Water Act (CWA) 303(d) as water quality limited due to sediment. The level of sedimentation in the SFTR was judged to exceed the existing water quality standards (WQS) necessary to support the beneficial uses of the basin, particularly the cold water fisheries. Accelerated erosion from the high burn severity and suppression of the Lime, Miners and Slide fires could adversely affect the ability of the stream system to support cold water fish such as Chinook salmon and steelhead trout (EPA, 1998).

b. Road Stability

High severity burns and fire suppression efforts can increase water yield, runoff and erosion rates by several orders of magnitude. These increased water yields and erosion rates increase the risk of culvert plugging, stream diversion, and road washouts and failures. Several of the roads below severely burned areas are likely at risk because of increased runoff and sediment yield.

III. OBSERVATIONS

a. Affected Environment

The Lime, Slide and Miners Fires, of the Lime Complex, burned approximately 25,181, 1157, and 24,782 acres of the Shasta Trinity National Forest and adjacent lands (burn area perimeter). The Miners fire was dominantly located in the headwater tributaries of Lower Hayfork Creek (5th field HUC), the Lime Fire in the headwater tributaries of the Middle South Fork of the Trinity River (5th field HUC) and the Slide Fire in the headwaters of the Lower South Fork of the Trinity River (5th field HUC). The vegetation types consumed by the fire were mixed coniferous forest lesser area extents of brush and oak. The terrain is steep

with elevational ranges from approximately 1200 to 4400 feet above mean sea level (i.e. 3200 foot difference).

The average annual precipitation ranges from 50 to 60 inches per year with 90 percent falling during the winter months. A snow pack (i.e. 2 to 4 feet) is common above 3500 feet. Rain is common below 2500 feet. Rain on snow events are common down to 1500 feet. The majority of the severely burned area is below 4400 feet. Hydrologic features found within the fire area include perennial, intermittent and ephemeral streams as well as number of smaller ponds.

b. Reconnaissance Method

Reconnaissance of the burned area was conducted using a rapid approach described as a burned area emergency assessment. The burned area emergency assessment is an immediate and rapid assessment of the burned area that is conducted in order to identify post-fire threats, critical values at risk, and need for emergency stabilization measures. The burned area emergency assessment is not a comprehensive evaluation of all fire damages or long-term rehabilitation or restoration needs (FSM 2500, 2004).

Reconnaissance of the burned area was conducted by helicopter overviews, driving roads, and hiking on trails and cross-country through the burn. Specialists included soil scientists, fisheries biologists, geologists, botanists, archaeologists, and road engineers.

c. Watershed Conditions

Peak flows within the fire area are predicted to increase as a result of the fire. However, due to the limited hydrophobic soils (approximately 2% of the fire area with moderate hydrophobicity of 2-5 cm depth); increases in runoff are assumed to be strictly due to loss of vegetation and ground cover (i.e. interception, evapotranspiration, ground cover storage). Elevated stream flows can be expected to occur in the burned watersheds, with greater flow increases in those drainages having higher percentages of high burn severity and the limited areas with the hydrophobic soils. Table 1 displays the acres of burn severity by 6^{th} and 7^{th} – Field Hydrologic Codes (HUC). All 6^{th} fields have less than 12% burned in high and moderate severities. Analysis of all 7^{th} fields shows increased burn percentages in the high and moderate severities with the Little Creek-Hayfork Creek the highest at 33%.

Fire	HUC 7 no	6th Field HUC Subwatershed	7th Field HUC Subwatershed	Wshed Area (ac)	Area Burned (ac)	% High	% Mod	% Low	% Burned by BI
	18010212000000	South Fork Trinity River (HUC 4)		596164	86,071	0%	1%	3%	4.5%
Lime	18010212020000	Middle Fork Trinity River (HUC 5)		118626	22,722	0%	3%	7%	10.1%
Lime	18010212020200	Cave Creek-Miller Springs		26327	2,082	0%	2%	6%	7.9%
Lime	18010212020202	Cave Creek-Miller Springs	Little Bear Wallow Creek-Hidden Valley	9794	278	0%	1%	3%	3.5%
Lime	18010212020203	Cave Creek-Miller Springs	Miller Springs	6994	1,804	1%	5%	17%	22.8%
Lime	18010212020300	Plummer Creek		16223	5,832	1%	11%	24%	36.0%
Lime	18010212020301	Plummer Creek	Upper Plummer Creek	7954	985	0%	2%	10%	12.4%
Lime	18010212020302	Plummer Creek	Lower Plummer Creek	8269	4,847	3%	19%	37%	58.6%
Lime	18010212020400	Butter Creek		23459	1,698	0%	3%	4%	7.2%
Lime	18010212020402	Butter Creek	Lower Indian Valley	5926	1,540	0%	11%	15%	26.0%
Lime	18010212020403	Butter Creek	Butter Creek Meadows	9854	158	0%	0%	1%	1.6%
Lime	18010212020500	Sulphur Glade Creek-Waldorf Flat		22781	2,325	0%	2%	8%	10.2%
Lime	18010212020501	Sulphur Glade Creek-Waldorf Flat	McClellen-South Fork Trinity River	6955	2,325	0%	7%	27%	33.4%
Lime	18010212020502	Sulphur Glade Creek-Waldorf Flat	Hitchcock Creek-Oak Flat	11793	1,920	0%	3%	13%	24%
Miners	18010212040000	Lower Hayfork River (HUC 5)		142015	14,037	1%	3%	6%	9.9%
Miners	18010212040300	Rusch Creek-Little Creek		32139	4,586	1%	6%	7%	14.4%
Miners	18010212040302	Rusch Creek-Little Creek	Hayfork Valley	8087	418	0%	3%	1%	5.2%
Miners	18010212040303	Rusch Creek-Little Creek	Little Creek-Hayfork Creek	5818	3,750	7%	26%	32%	64.5%
Miners	18010212040304	Rusch Creek-Little Creek	Rusch Creek	8404	417.7	0%	3%	1%	5.2%
Miners	18010212040404	Corral Creek		23120	942	0%	1%	3%	4.1%
Miners	18010212040401	Corral Creek	Upper Corral Creek	8634	119	0%	1%	1%	1.4%
Miners	18010212040403	Corral Creek	Lower Corral Creek	5976	823	0%	3%	10%	13.8%
Miners	18010212040500	Grassy Flat-Miners Creek		34935	8,509	1%	7%	16%	24.4%
Miners	18010212040501	Grassy Flat-Miners Creek	Bear Creek	4882	2,938	3%	20%	38%	60.2%
Miners	18010212040502	Grassy Flat-Miners Creek	Miners Creek	8296	4,305	3%	12%	38%	51.9%
Miners	18010212040503	Grassy Flat-Miners Creek	Upper Hayfork Creek Canyon	8565	1,267	0.5%	0.054	0.089	14.8%
Slide	18010212050000	Lower South Fork Trinity River (HUC 5)		129183.4	754.2	0.0	0.0	0.0	0.0
Slide	18010212050200	Hyampom		36657.7	754.2	0.0	0.0	0.0	0.0
Slide	18010212050203	Hyampom	Big Creek-Hyampom	5292.0	145.0	0.0	0.0	0.0	0.0
Slide	18010212050204	Hyampom	Big Slide Creek-South Fork Trinity River	10173.5	609.2	0.0	0.0	0.0	0.0

Table 1: Approximate burn severity by 6th and 7th field Hydrologic Unit Code (HUC) subwatersheds and fires.

Present management direction states that culverts should be designed to accommodate the 100-yr stream flow event. Table 2 presents the peak flow analyses pre and post fire for the Lime, Miners and Slide fires by 6th and 7th field HUC. Pre-fire and post-fire flow estimates were derived using Waananen and Crippen (1977) regional stream flow equations modified using the gauge verses ungaged relationship for neighboring stream gauges and fire severity. Table 3 presents additional peak flow analyses for 8th field HUC or smaller subwatersheds in higher severity burn areas of concern.

The risk of degrading water quality and road stability is dependant on the nature, timing, and duration of winter storms. Post-burn rainfall/runoff patterns will likely alter the hydrologic regime of the severely burned subwatersheds and increase the risk of storm generated debris flows in stream channels.

Lime Fire

Aerial and ground reconnaissance showed that overall the majority of the Lime fire burned in a low severity mosaic that should not have major negative impacts to the watershed. However, two main areas within the Lime fire that were of concern are listed below.

- Cold Camp Creek
  - Burned extensively (~ 55% moderate to severe burn severity).
  - Cold Camp creek (8th field HUC) is a transport headwater stream to Butter Creek (6th filed HUC) an important Coho salmon and steelhead trout stream.
  - Modeling estimates show that Cold Camp Creek stream flows post-fire may increases by a magnitude 2.5x the current flows. These estimates will

increase the likelihood of debris flows and sediment transport in drainages and increase the potential for culvert plugging and road washouts on the 2N54 road (Table 3).

- Limedyke Lookout Area
  - The headwaters of an old debris flow that drains directly into a small steep tributary of the South Fork of the Trinity River. See Geology Resource Report for additional information.

Miners Fire

Aerial and ground reconnaissance showed that the Miners fire burned in higher severity than the Lime fire in several subwatersheds (Table 2). Subwatersheds of more concern are listed below.

- Miners and Bear Creek
  - Concentrated pockets of high and moderate burn severity are present in the headwaters reaches of the East and West Forks of Miners Creek and Bear Creek.
  - The headwaters of the East and West Miners Creek forks (8^{th} field HUC) and Bear Creek are transport streams to Miners and Bear Creeks (7^{th} field HUC), important Steelhead and resident trout streams.
  - Modeling estimates show that Miners Creek and Bear Creek stream flows post-fire may increase by magnitudes of 1.8x and 2.0x the current flows increasing the likelihood of debris flows and sediment transport in drainages of erosive soils and rain-on-snow regimes.
- Little Creek
  - Concentrated pockets of high and moderate burn severity in the headwater reaches of Little Creek and immediately below Hayfork Bally.
  - The headwaters immediately below Hayfork Bally are transport streams to Little Creek and Hayfork Creek (8^{th}-7^{th} field HUC), important Steelhead and Coho streams.
  - Modeling estimates show that Little Creek stream flows post-fire may increase by a magnitude of 2.5x the present flows. These estimates will increase the likelihood of water generated debris flows and sediment transport in drainages with erosive soils and increase the potential for culvert plugging and road washouts on the 4N08 road (Table 3).
  - Field reconnaissance already revealed rilling and sediment transport in the highly erosive dioritic soil regimes along the dozer lines and in the high severity burn pockets in the headwaters of Little Creek.
  - There may be private land residences and water resources at risk above Hayfork Creek and county road 301 (SE1/4, SW1/4 Sec. 30, T3N, R12W and NE1/4, NE1/4, Sec. 31, T3N, R12W) due to estimated increased flows and sediment delivery, and runoff drainage modification caused by uphill dozer lines and cleared safety zones above DP 21. Further evaluation and monitoring may be necessary.

Fire	HUC no	6th Field HUC Subwatershed	7th Field HUC Subwatershed	Wshed Area (ac)	% High	% Mod	% Low	Stream Gage for calcs	Pre '2-yr Qp (cfs)	Pre 5-yr Q (cfs)	Pre '10-yr Qp (cfs)	Pre '25-yr Qp (cfs)	Pre '50-yr Qp (cfs)	Pre 100-yr Qp (cfs)	Post 2-yr Qp (cfs)	Post '10-yr Qp (cfs)	Post '2-yr Peak Increase x normal	Post '10-yr Peak Increase x normal
	18010212	South Fork Trinity River (HUC 4)		596164	0%	1%	3%	147	25151	42416	54,949	71,877	85,498	99,747	26,906	58,305	1.1	1.1
Lime	1801021202	Middle Fork Trinity River (HUC 5)		118626	0%	3%	7%	147	5882	10080	13,271	17,642	20,986	24,483	6,762	15,034	1.1	1.1
Lime	180102120202	Cave Creek-Miller Springs		26327	0%	2%	6%	146	1211	2070	2,667	3,459	4,162	4,919	1,349	2,939	1.1	1.1
Lime	18010212020202	Cave Creek-Miller Springs	Little Bear Wallow Creek-Hidden Valley	9794	0%	1%	3%	146	497	859	1,117	1,464	1,761	2,081	521	1,166	1.0	1.0
Lime	18010212020203	Cave Creek-Miller Springs	Miller Springs	6994	1%	5%	17%	146	367	636	831	1,092	1,314	1,553	489	1,078	1.3	1.3
Lime	180102120203	Plummer Creek		16223	1%	11%	24%	146	783	1345	1,742	2,270	2,731	3,228	1,214	2,584	1.5	1.5
Lime	18010212020301	Plummer Creek	Upper Plummer Creek	7954	0%	2%	10%	146	412	713	930	1,221	1,469	1,736	479	1,070	1.2	1.2
Lime	18010212020302	Plummer Creek	Lower Plummer Creek	8269	3%	19%	37%	146	427	738	962	1,263	1,520	1,796	822	1,737	1.9	1.8
Lime	180102120204	Butter Creek		23459	0%	3%	4%	146	1092	1868	2,409	3,129	3,765	4,449	1,219	2,650	1.1	1.1
Lime	18010212020402	Butter Creek	Lower Indian Valley	5926	0%	11%	15%	146	316	549	718	945	1,137	1,344	450	978	1.4	1.4
Lime	18010212020403	Butter Creek	Butter Creek Meadows	9854	0%	0%	1%	146	500	863	1,123	1,471	1,770	2,092	511	1,146	1.0	1.0
Lime	180102120205	Sulphur Glade Creek-Waldorf Flat		22781	0%	2%	8%	146	1063	1820	2,348	3,050	3,670	4,337	1,209	2,644	1.1	1.1
Lime	18010212020501	Sulphur Glade Creek-Waldorf Flat	McClellen-South Fork Trinity River	6955	0%	7%	27%	146	366	633	826	1,087	1,307	1,545	529	1,167	1.4	1.4
Lime	18010212020502	Sulphur Glade Creek-Waldorf Flat	Hitchcock Creek-Oak Flat	11793	0%	3%	13%	146	588	1013	1,315	1,720	2,070	2,446	718	1,582	1.2	1.2
Miners	1801021204	Lower Hayfork River (HUC 5)		142015	1%	3%	6%	146	5520	9277	11,751	14,989	18,034	21,313	6,409	13,384	1.2	1.1
Miners	180102120403	Rusch Creek-Little Creek		32139	1%	6%	7%	146	1449	2472	3,178	4,115	4,951	5,851	1,830	3,874	1.3	1.2
Miners	18010212040302	Rusch Creek-Little Creek	Hayfork Valley	8087	0%	3%	1%	146	419	724	944	1,239	1,491	1,762	462	1,022	1.1	1.1
Miners	18010212040303	Rusch Creek-Little Creek	Little Creek-Hayfork Creek	5818	7%	26%	32%	146	311	540	706	930	1,119	1,323	674	1,396	2.2	2.0
Miners	18010212040304	Rusch Creek-Little Creek	Rusch Creek	8404	0%	3%	1%	146	433	749	976	1,281	1,541	1,822	478	1,058	1.1	1.1
Miners	180102120404	Corral Creek		23120	0%	1%	3%	146	1078	1844	2,379	3,090	3,717	4,393	1,142	2,505	1.1	1.1
Miners	18010212040401	Corral Creek	Upper Corral Creek	8634	0%	1%	1%	146	444	767	1,000	1,312	1,578	1,865	454	1,019	1.0	1.0
Miners	18010212040403	Corral Creek	Lower Corral Creek	5976	0%	3%	10%	146	319	553	723	952	1,146	1,354	382	851	1.2	1.2
Miners	180102120405	Grassy Flat-Miners Creek		34935	1%	7%	16%	146	1562	2663	3,421	4,425	5,324	6,291	2,145	4,544	1.4	1.3
Miners	18010212040501	Grassy Flat-Miners Creek	Bear Creek	4882	3%	20%	38%	146	266	462	605	799	961	1,135	519	1,107	2.0	1.8
Miners	18010212040502	Grassy Flat-Miners Creek	Miners Creek	8296	3%	12%	38%	146	428	741	965	1,267	1,524	1,801	756	1,625	1.8	1.7
Miners	18010212040503	Grassy Flat-Miners Creek	Upper Hayfork Creek Canyon	8565	0.5%	0.054	0.089	146	441	762	993	1,302	1,567	1,852	546	1,196	1.2	1.2
Slide	1801021205	Lower South Fork Trinity River (HUC 5)		129183.4	0.0	0.0	0.0	146.0	5069.3	8526.7	10811.4	13803.9	16607.9	19627.5	5107.9	10888.0	1.0	1.0
Slide	180102120502	Hyampom		36657.7	0.0	0.0	0.0	146.0	1631.6	2779.2	3568.5	4614.0	5551.2	6560.5	1675.4	3657.6	1.0	1.0
Slide	18010212050203	Hyampom	Big Creek-Hyampom	5292.0	0.0	0.0	0.0	146.0	285.8	496.4	649.8	856.6	1030.7	1218.0	295.8	671.1	1.0	1.0
Slide	18010212050204	Hyampom	Big Slide Creek-South Fork Trinity River	10173.5	0.0	0.0	0.0	146.0	514.7	888.1	1155.0	1512.7	1820.0	2150.9	555.2	1239.3	1.1	1.1

Table 2: Peak Flow Analyses for 7th Field Subwatersheds in the Lime, Miners and Slide Fires. Watersheds of concern or showing the highest increases in stream flow post-fire are highlighted in yellow, orange and red in increasing risk severity.

Fire	HUC 7 No	HUC 7	HUC 8	HUC 8a	Wshed Area (ac)	Area Burned (ac)	% High	% Mod	% Low	Stream Gage for calcs	Pre '2-yr Qp (cfs)	Pre 5-yr Q (cfs)	Pre '10-yr Qp (cfs)	Pre '25-yr Qp (cfs)	Pre '50-yr Qp (cfs)	Pre 100-yr Qp (cfs)	Post 2-yr Qp (cfs)	Post '10-yr Qp (cfs)	Post '2-yr Peak Increase x normal	Post '10-yr Peak Increase x normal
Lime	18010212020402	Lower Indian Valley	Cold Camp Creek		1005	704	5%	50%	15%	146	64	113	151	202	243	287	158	326	2.5	2.2
Lime	18010212020402	Lower Indian Valley	Cold Camp Creek	2N54 culvert	26	24	5%	80%	10%	146	2	4	6	8	10	12	7	16	3.1	2.6
Lime	18010212020502	Hitchcock Creek-Oak Flat	Limedyke Lookout Slide Creek		2212	1,172	3%	15%	35%	146	130	228	302	401	482	570	238	519	1.8	1.7
Lime	18010212020502	Hitchcock Creek-Oak Flat	Limedyke Lookout Slide Creek	Limedyke Lookout Slide	32	32	30%	65%	5%	146	3	5	7	10	12	14	10	21	3.5	2.9
Miners	18010212040303	Little Creek-Hayfork Creek	Little Creek		2180	1,744	20%	20%	40%	146	129	225	298	396	476	563	327	682	2.5	2.3
Miners	18010212040303	Little Creek-Hayfork Creek	Little Creek	4N08 Culvert	90	85	50%	20%	25%	146	7	13	18	25	30	35	24	52	3.4	2.9
Miners	18010212040502	Miners Creek	East Fork Miners Creek		2127	1,127	3%	12%	38%	146	126	221	291	388	466	551	225	496	1.8	1.7
Miners	18010212040502	Miners Creek	West Fork Miners Creek		6099	3,287	3%	11%	40%	146	325	563	736	969	1,166	1,378	579	1,254	1.8	1.7

Table 3: Areas of Concern (for more detail, see Appendix). Watersheds of concern or showing the highest increases in stream flow post-fire are highlighted in yellow, orange and red in increasing risk severity.

IV. TREATMENT RECOMMENDATIONS

Based on the assessment of subwatershed response, emergency determinations, and values at risk, the following treatment recommendations have been identified. Implementation of the following treatment recommendations should help in protecting the water quality and road stability values at risk.

- Upgrade culvert sizes or build critical dips on the 2N54 road in Cold Camp Creek, the 4N08 road in Little Creek roads to minimize road failure. See Tables 2 and 3 for subwatershed increased flow magnitude estimations.
- Clean all ditches, cross drains, and cross drain inlets, and remove constructed road berms.
- Increase vegetation and soil recovery rates by treating suitable moderate and high severity burned areas with mulching in the Cold Camp Creek (good accessibility), Little Creek, and Miners Creek Subwatersheds.
- Create in-stream sediment storage areas in the Cold Camp Creek subwatershed.
- Ensure that all dozer lines and safety zones established during fire suppression have been waterbarred and mulched, particularly in areas of highly erodable soils, and near drainages and private land.

V. MONITORING RECOMMENDATIONS

Based on the assessment of subwatershed response, emergency determinations, and values at risk, the following recommendations have been identified.

- Monitor effectiveness of road storm proofing, maintenance and culvert upgrades using California's Best Management Practices (USDA, 2000).
- Monitor vegetation and soil recovery rates in the mulched subwatersheds.
- Monitor the effectiveness of the in-stream sediment storage structures in the Cold Camp Creek subwatershed to benefit future BAER assessment and "proven effective" treatment options.
- Monitor the effectiveness of dozer line waterbars and mulching.

VI. REFERENCES

Environmental Protection Agency (USEPA, Region 9), 1998. South Fork Trinity River Sediment Total Maximum Daily Load. 109 p.

Forest Service Manual 2500, Watershed and Air Management, 2004. National Headquarters, Washington, DC. 44 p.

Pacific Watershed Associates (PWA). 1994. Action plan for restoration of the South Fork Trinity River watershed and its fisheries, prepared for US Bureau of Reclamation and the Trinity River Task Force, February.

USDA Forest Service, 2000. Water Quality Management for Forest System Lands in California, Best Management Practices. Pacific Southwest Region.

Waananen, A. & Crippen, J., 1977. Magnitude and Frequency of Floods in California, US Geological Survey, Water- Resources Investigations 77-21. 96 p.

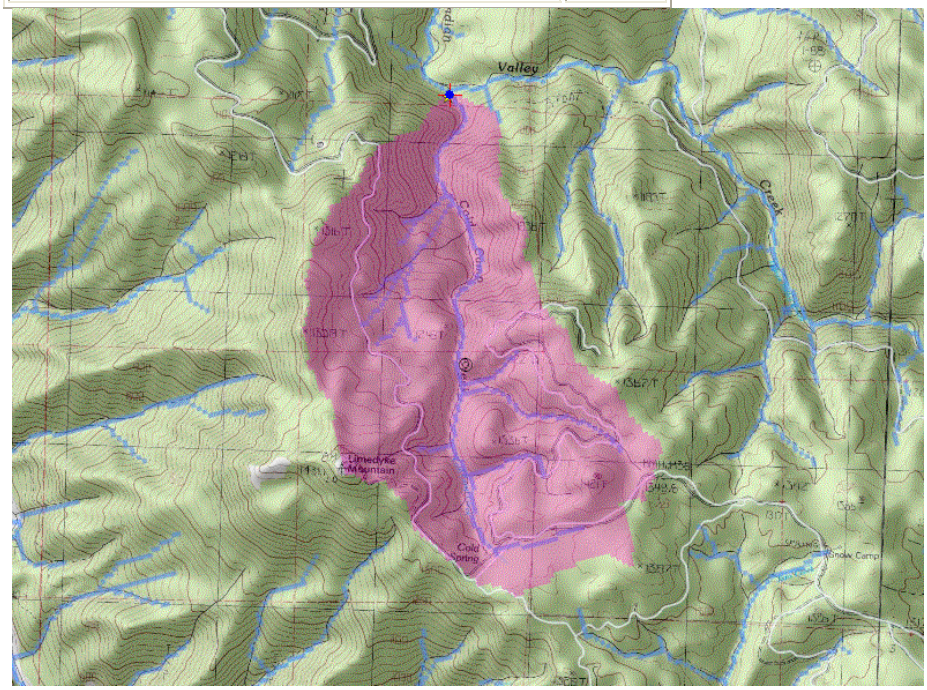
APPENDIX:

Characteristics and maps of Specific Watersheds of Interest

Cold Camp Creek

Date: Wed Aug 20 2008 14:46:58
NAD83 Latitude: 40.5465 (40 32 47)
NAD83 Longitude: -123.4101 (-123 24 36)
NAD27 Latitude: 40.5467 (40 32 48)
NAD27 Longitude: -123.4089 (-123 24 32)

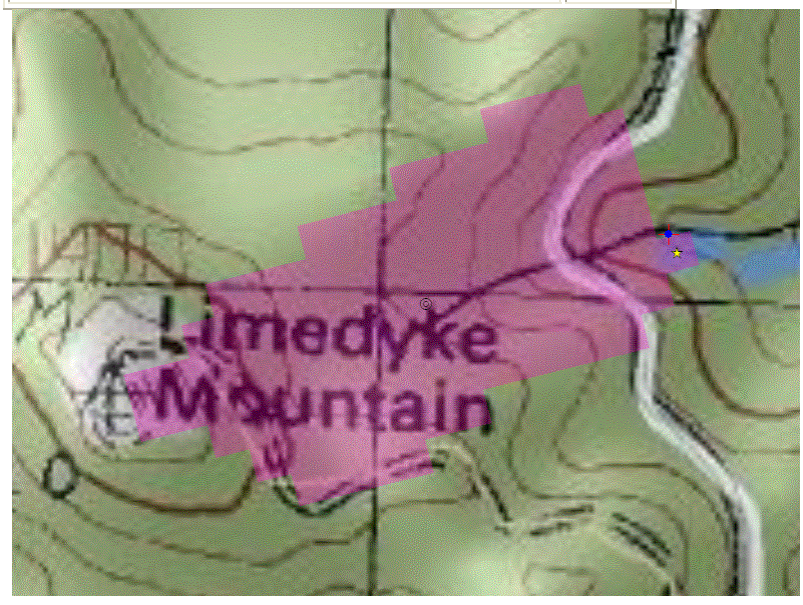
Parameter	Value
Average basin slope, in percent	29.7
Average basin elevation, in feet	4100
Minimum elevation, in feet	2690
X coordinate of the outlet, in map coordinates	-2270070.0
Perimeter, in miles	7.01
Relief, in feet	1990
Maximum elevation, in feet	4680
Average minimum January temperature, in Fahrenheit	31.7
Percentage of basin covered by forest	17.8
Area, in square miles	1.63
Percentage of basin covered by impervious surface	0.11
Distance in miles from basin centroid to the coast	40.9
Elevation at outlet, in feet	2690
Y coordinate of the centroid, in map coordinates	2276162.9
X coordinate of the centroid, in map coordinates	-2270404.8
Relative relief, in feet per mile	284
Percent of area covered by lakes and ponds	0
Average maximum January temperature, in Fahrenheit	48.2
Mean annual precipitation, in inches	69.4
High Elevation Index - Percent of area with elevation > 6000 feet	0
Y coordinate of the outlet, in map coordinates	2277870.0



2N54 Culvert

Date: Wed Aug 20 2008 14:54:30
NAD83 Latitude: 40.5262 (40 31 34)
NAD83 Longitude: -123.4113 (-123 24 40)
NAD27 Latitude: 40.5263 (40 31 34)
NAD27 Longitude: -123.4102 (-123 24 36)

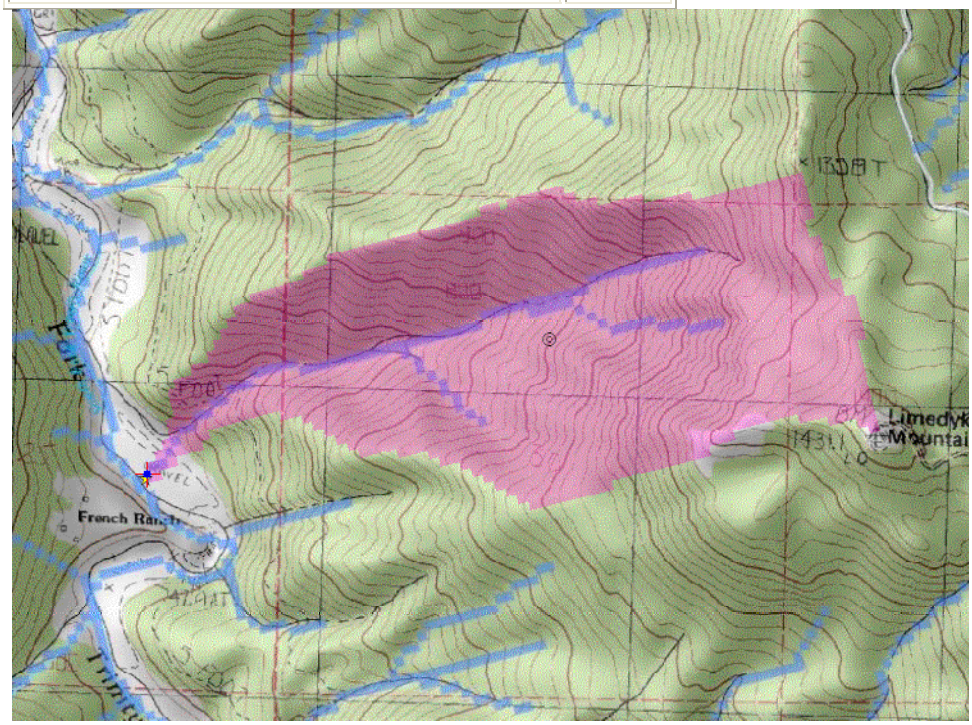
Parameter	Value
Average basin slope, in percent	30.1
Average basin elevation, in feet	4450
Minimum elevation, in feet	4200
X coordinate of the outlet, in map coordinates	-2270820.0
Perimeter, in miles	1.01
Relief, in feet	477
Maximum elevation, in feet	4680
Average minimum January temperature, in Fahrenheit	31.3
Percentage of basin covered by forest	24.6
Area, in square miles	0.0361
Percentage of basin covered by impervious surface	0.21
Distance in miles from basin centroid to the coast	40.8
Elevation at outlet, in feet	4200
Y coordinate of the centroid, in map coordinates	2275719.8
X coordinate of the centroid, in map coordinates	-2271043.8
Relative relief, in feet per mile	474
Percent of area covered by lakes and ponds	0
Average maximum January temperature, in Fahrenheit	47.9
Mean annual precipitation, in inches	68.5
High Elevation Index - Percent of area with elevation > 6000 feet	0
Y coordinate of the outlet, in map coordinates	2275710.0



Limedyke Lookout Slide Basin

Date: Wed Aug 20 2008 15:10:49
NAD83 Latitude: 40.5229 (40 31 22)
NAD83 Longitude: -123.4447 (-123 26 40)
NAD27 Latitude: 40.5231 (40 31 22)
NAD27 Longitude: -123.4435 (-123 26 36)

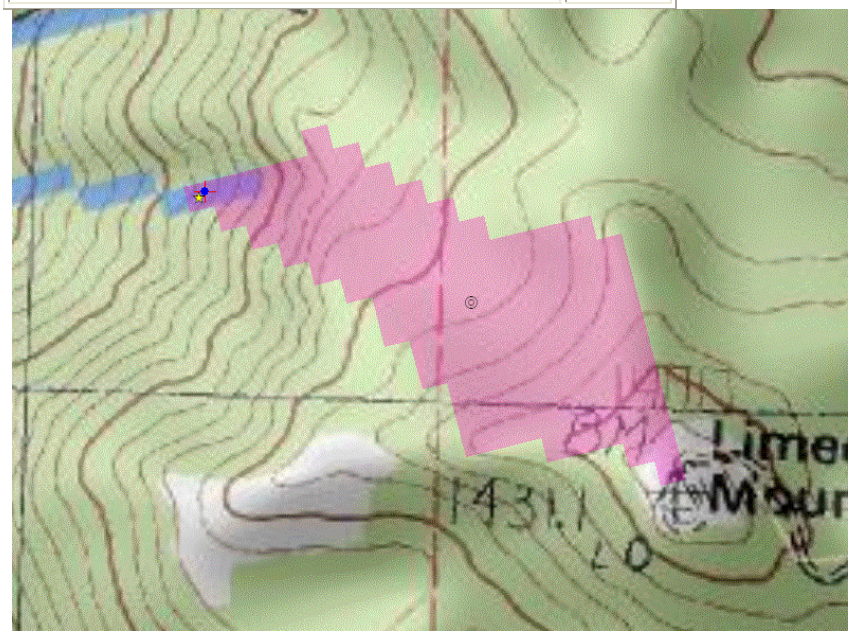
Parameter	Value
Average basin slope, in percent	56
Average basin elevation, in feet	3170
Minimum elevation, in feet	1530
X coordinate of the outlet, in map coordinates	-2273610.0
Perimeter, in miles	4.51
Relief, in feet	3150
Maximum elevation, in feet	4680
Average minimum January temperature, in Fahrenheit	30.3
Percentage of basin covered by forest	58.6
Area, in square miles	0.6
Percentage of basin covered by impervious surface	0
Distance in miles from basin centroid to the coast	40.1
Elevation at outlet, in feet	1530
Y coordinate of the centroid, in map coordinates	2276270.9
X coordinate of the centroid, in map coordinates	-2272258.6
Relative relief, in feet per mile	698
Percent of area covered by lakes and ponds	0
Average maximum January temperature, in Fahrenheit	48.3
Mean annual precipitation, in inches	60
High Elevation Index - Percent of area with elevation > 6000 feet	0
Y coordinate of the outlet, in map coordinates	2276160.0



Limedyke Lookout Slide

Date: Wed Aug 20 2008 15:01:52
NAD83 Latitude: 40.5278 (40 31 40)
NAD83 Longitude: -123.4239 (-123 25 26)
NAD27 Latitude: 40.5280 (40 31 40)
NAD27 Longitude: -123.4228 (-123 25 21)

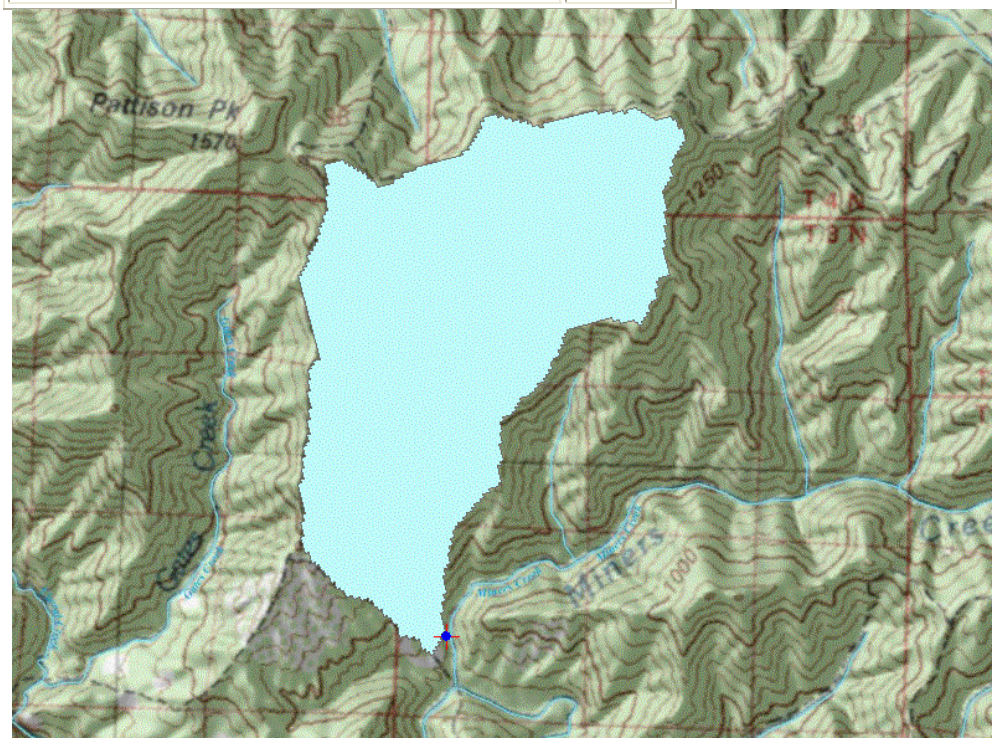
Parameter	Value
Average basin slope, in percent	40.8
Average basin elevation, in feet	4330
Minimum elevation, in feet	3720
X coordinate of the outlet, in map coordinates	-2271780.0
Perimeter, in miles	1.23
Relief, in feet	959
Maximum elevation, in feet	4680
Average minimum January temperature, in Fahrenheit	30.8
Percentage of basin covered by forest	34.2
Area, in square miles	0.0403
Percentage of basin covered by impervious surface	0
Distance in miles from basin centroid to the coast	40.5
Elevation at outlet, in feet	3720
Y coordinate of the centroid, in map coordinates	2275989.8
X coordinate of the centroid, in map coordinates	-2271503.8
Relative relief, in feet per mile	779
Percent of area covered by lakes and ponds	0
Average maximum January temperature, in Fahrenheit	47.9
Mean annual precipitation, in inches	66
High Elevation Index - Percent of area with elevation > 6000 feet	0
Y coordinate of the outlet, in map coordinates	2276190.0



East Fork Miners Creek

Date: Wed Aug 20 2008 16:34:54
NAD83 Latitude: 40.6388 (40 38 19)
NAD83 Longitude: -123.3228 (-123 19 22)
NAD27 Latitude: 40.6390 (40 38 20)
NAD27 Longitude: -123.3216 (-123 19 17)

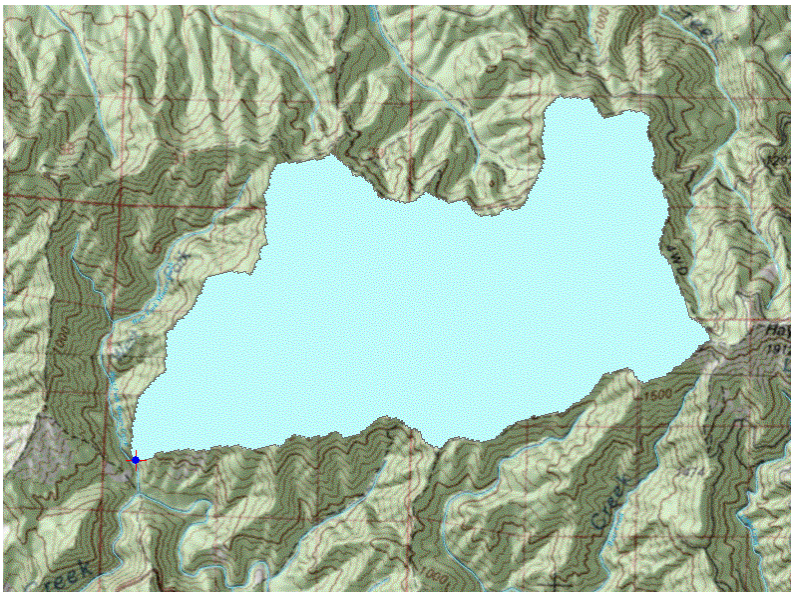
Parameter	Value
Average basin slope, in percent	
Average basin elevation, in feet	
Minimum elevation, in feet	1940
X coordinate of the outlet, in map coordinates	
Perimeter, in miles	11
Relief, in feet	3000
Maximum elevation, in feet	4940
Average minimum January temperature, in Fahrenheit	
Percentage of basin covered by forest	
Area, in square miles	3.36
Percentage of basin covered by impervious surface	
Distance in miles from basin centroid to the coast	
Elevation at outlet, in feet	
Y coordinate of the centroid, in map coordinates	2288212.8
X coordinate of the centroid, in map coordinates	-2259329.3
Relative relief, in feet per mile	272
Percent of area covered by lakes and ponds	0
Average maximum January temperature, in Fahrenheit	
Mean annual precipitation, in inches	
High Elevation Index - Percent of area with elevation > 6000 feet	0
Y coordinate of the outlet, in map coordinates	



West Fork Miners Creek

Date: Wed Aug 20 2008 16:56:30
NAD83 Latitude: 40.6390 (40 38 20)
NAD83 Longitude: -123.3221 (-123 19 19)
NAD27 Latitude: 40.6391 (40 38 20)
NAD27 Longitude: -123.3210 (-123 19 15)

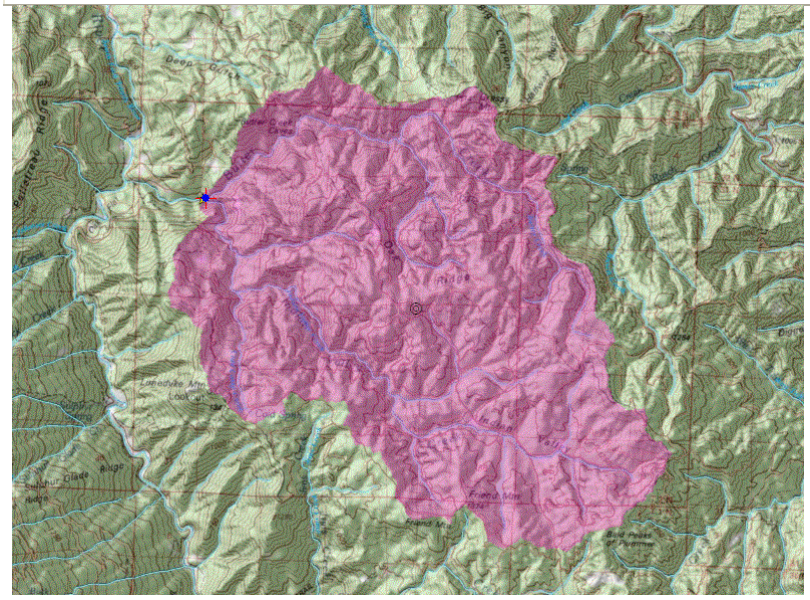
Parameter	Value
Average basin slope, in percent	
Average basin elevation, in feet	
Minimum elevation, in feet	1940
X coordinate of the outlet, in map coordinates	
Perimeter, in miles	19.9
Relief, in feet	3910
Maximum elevation, in feet	5850
Average minimum January temperature, in Fahrenheit	
Percentage of basin covered by forest	
Area, in square miles	9.53
Percentage of basin covered by impervious surface	
Distance in miles from basin centroid to the coast	
Elevation at outlet, in feet	
Y coordinate of the centroid, in map coordinates	2286844.9
X coordinate of the centroid, in map coordinates	-2255474.3
Relative relief, in feet per mile	197
Percent of area covered by lakes and ponds	0
Average maximum January temperature, in Fahrenheit	
Mean annual precipitation, in inches	
High Elevation Index - Percent of area with elevation > 6000 feet	0
Y coordinate of the outlet, in map coordinates	



Indian Creek (into Butter Creek)

NAD83 Latitude: 40.5676 (40 34 03)
NAD83 Longitude: -123.4210 (-123 25 15)
NAD27 Latitude: 40.5677 (40 34 03)
NAD27 Longitude: -123.4199 (-123 25 11)

Parameter	Value
Average basin slope, in percent	27.2
Average basin elevation, in feet	3920
Minimum elevation, in feet	1580
X coordinate of the outlet, in map coordinates	-2270280.0
Perimeter, in miles	36.2
Relief, in feet	3310
Maximum elevation, in feet	4890
Average minimum January temperature, in Fahrenheit	30.8
Percentage of basin covered by forest	46.6
Area, in square miles	34.6
Percentage of basin covered by impervious surface	0.092
Distance in miles from basin centroid to the coast	42.7
Elevation at outlet, in feet	1580
Y coordinate of the centroid, in map coordinates	2276403.2
X coordinate of the centroid, in map coordinates	-2265881.8
Relative relief, in feet per mile	91.5
Percent of area covered by lakes and ponds	0
Average maximum January temperature, in Fahrenheit	48.3
Mean annual precipitation, in inches	67.1
High Elevation Index - Percent of area with elevation > 6000 feet	0
Y coordinate of the outlet, in map coordinates	2280390.0



4N08 Culvert Crossings

Date: Wed Aug 20 2008 15:47:13
NAD83 Latitude: 40.6468 (40 38 48)
NAD83 Longitude: -123.2196 (-123 13 10)
NAD27 Latitude: 40.6470 (40 38 49)
NAD27 Longitude: -123.2185 (-123 13 06)

Parameter	Value
Average basin slope, in percent	51.6
Average basin elevation, in feet	5220
Minimum elevation, in feet	4570
X coordinate of the outlet, in map coordinates	-2251560.0
Perimeter, in miles	1.98
Relief, in feet	1500
Maximum elevation, in feet	6070
Average minimum January temperature, in Fahrenheit	26.3
Percentage of basin covered by forest	38.4
Area, in square miles	0.14
Percentage of basin covered by impervious surface	0
Distance in miles from basin centroid to the coast	46.6
Elevation at outlet, in feet	4570
Y coordinate of the centroid, in map coordinates	2284617.8
X coordinate of the centroid, in map coordinates	-2251497.9
Relative relief, in feet per mile	758
Percent of area covered by lakes and ponds	0
Average maximum January temperature, in Fahrenheit	44.1
Mean annual precipitation, in inches	61.1
High Elevation Index - Percent of area with elevation > 6000 feet	1.8
Y coordinate of the outlet, in map coordinates	2284110.0