Klamath National Forest

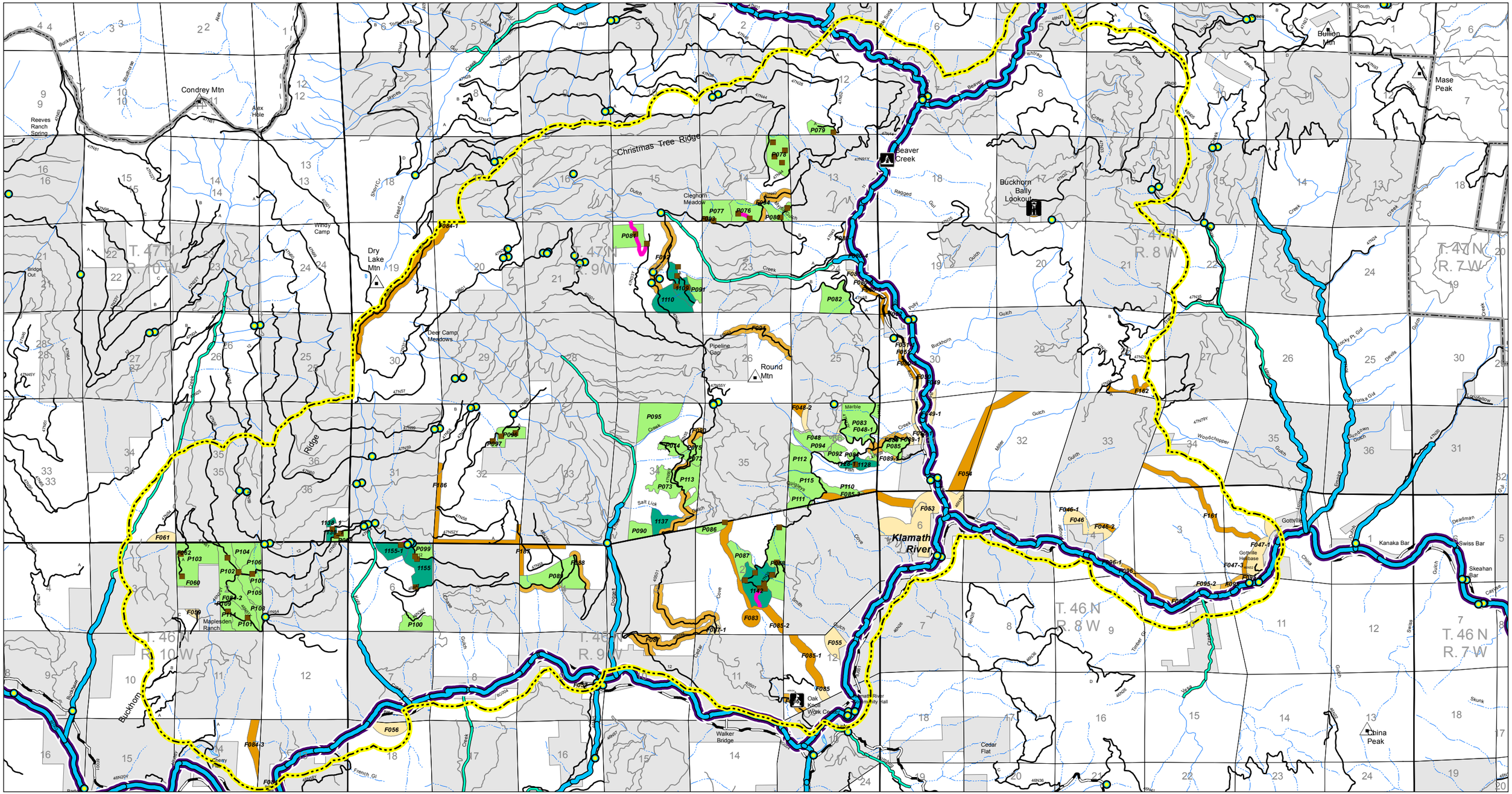
Westside Fire Recovery Project

Fisheries Biological Assessment

Appendices

Appendix A. Project maps – 7 total, 6 maps of fire areas with proposed actions and 1 map of proposed legacy sediment site repair in Elk Creek Watershed.
Appendix B Detailed tables of proposed activities and CWE model outputs
Appendix C. KNF Table of Population and Habitat Indicators
Appendix D. Environmental Baseline and Effects Checklists, 5th and 7th field watersheds
Appendix E. Project Design Features, Best Management Practices and Wet Weather Operation Standards
Appendix F. Life history and biological requirements of Pacific Salmonids
Appendix G. Summary of Project Element Effects to Coho Salmon, and Critical Habitat, by 2014 Fire Area

For more information contact:
Bobbie DiMonte Miller
Program Manager, Fisheries/Botany/Invasives
Klamath National Forest
bdimontemiller@fs.fed.us
1711 S. Main St. Yreka, CA 96097
Desk phone 530-841-4418



USDA

Westside Fire Recovery
Beaver
Project Boundary
Consultation Action

Data as of 3/31/2015

Legend

Landing Type

- Ground Based
- Water Source
- Coho Critical Habitat
- Chinook Fall
- Rainbow Trout Resident
- Westside Fire Recovery Boundary
- Temporary Road On Existing Roadbed
- NFTS System Road
- Salvage Harvest Treatments with Site Preparation, Plant and Release
- Site Preparation, Plant and Release Treatment Only
- Fuels Management Zone Treatment
- Roadside Fuels Treatment
- Wildland Urban Interface Treatment
- Campground
- Administrative Site
- Lookout
- State or US Highway County Road
- Private/Other Road
- Ranger District Boundary
- Private Land Within the Forest Boundary
- Intermittent Stream
- Perennial Stream

0 1 2 Miles

N W E S

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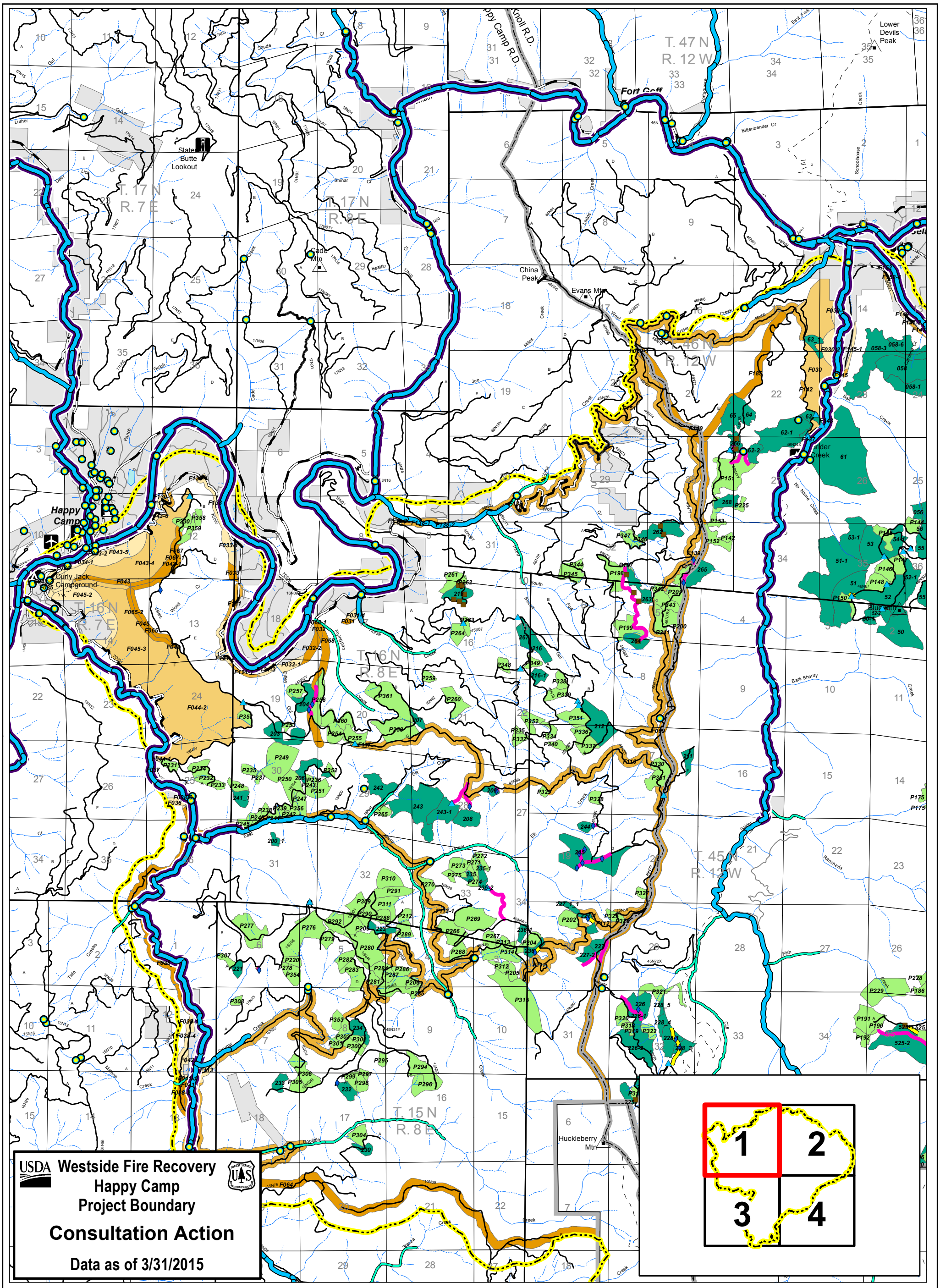
Date: 4/2/2015

Roadside hazard treatment is proposed up to 250 feet either side of all NFTS sytem roads within the project area and temporary roads used to access treatment units.



Legend

Landing Type
- Ground Based
- Helicopter
- Skyline
- Water Source
- Coho Critical Habitat
- Chinook Fall
- Rainbow Trout Resident
- Westside Fire Recovery Boundary

- Temporary Road On Existing Roadbed
- New Temporary Road
- NFTS System Road
- Salvage Harvest Treatments with Site Preparation, Plant and Release
- Site Preparation, Plant and Release Treatment Only
- Fuels Management Zone Treatment
- Roadside Fuels Treatment
- Prescribed Burn Treatment
- Wildland Urban Interface Treatment

- Mountain Peak
- Campground
- Administrative Site
- Helibase
- Lookout

- State or US Highway
- County Road
- Private/Other Road
- Trail

- Ranger District Boundary
- Wilderness
- Private Land Within the Forest Boundary
- Intermittent Stream
- Perennial Stream

Date: 4/1/2015

Roadside hazard treatment is proposed up to 250 feet either side of all NFTS sytem roads within the project area and temporary roads used to access treatment units.

N W E S

0 1 2 Miles

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USDA Westside Fire Recovery
Happy Camp
Project Boundary

Consultation Action

Data as of 3/31/2015

Legend

- Landing Ground Based
- Landing Helicopter
- Landing Skyline
- Water Source
- Coho Critical Habitat
- Chinook Fall
- Rainbow Trout Resident
- Westside Fire Recovery Boundary
- Temporary Road On Existing Roadbed
- New Temporary Road
- NFTS System Road
- Salvage Harvest Treatments with Site Preparation, Plant and Release
- Site Preparation, Plant and Release Treatment Only
- Fuels Management Zone Treatment
- Roadside Fuels Treatment
- Prescribed Burn Treatment
- Wildland Urban Interface Treatment
- Mountain Peak
- Campground
- Administrative Site
- Lookout
- State or US Highway
- County Road
- Private/Other Road
- Trail
- Ranger District Boundary
- Wilderness
- Private Land Within the Forest Boundary
- Intermittent Stream
- Perennial Stream

Date: 4/13/2015

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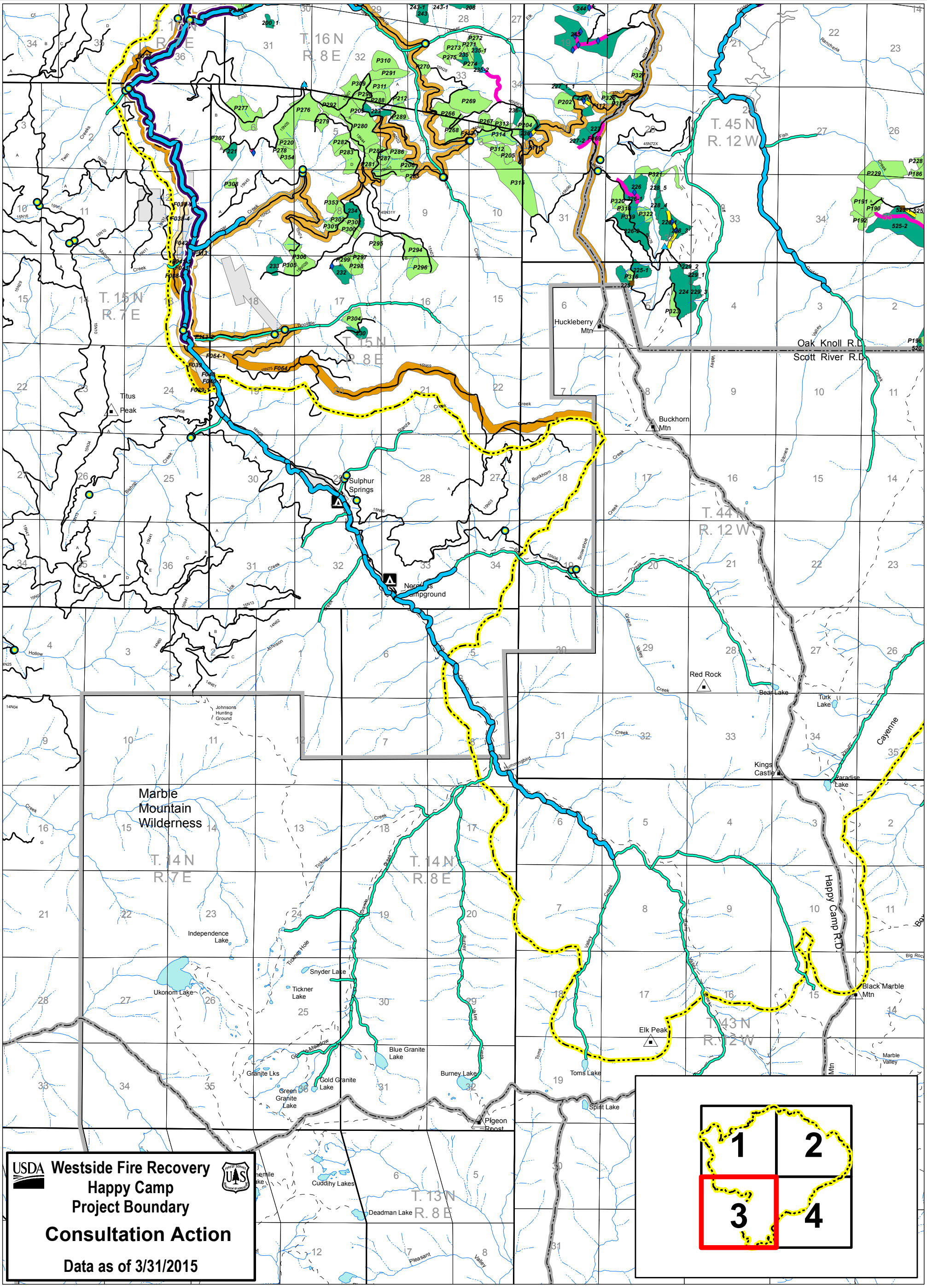
Roadside hazard treatment is proposed up to 250 feet either side of all NFTS sytem roads within the project area and temporary roads used to access treatment units.



Legend

Landing Type
- Ground Based
- Helicopter
- Skyline
- Water Source
- Coho Critical Habitat
- Chinook Fall
- Rainbow Trout Resident
- Westside Fire Recovery Boundary

- Temporary Road On Existing Roadbed
- New Temporary Road
- NFTS System Road
- Salvage Harvest Treatments with Site Preparation, Plant and Release
- Site Preparation, Plant and Release Treatment Only
- Fuels Management Zone Treatment
- Roadside Fuels Treatment
- Wildland Urban Interface Treatment

Roadside hazard treatment is proposed up to 250 feet either side of all NFTS sytem roads within the project area and temporary roads used to access treatment units.

- Mountain Peak
- Campground
- State or US Highway
- County Road
- Private/Other Road
- Trail
- Ranger District Boundary
- Wilderness
- Private Land Within the Forest Boundary
- Intermittent Stream
- Perennial Stream

Date: 4/1/2015

N W E S

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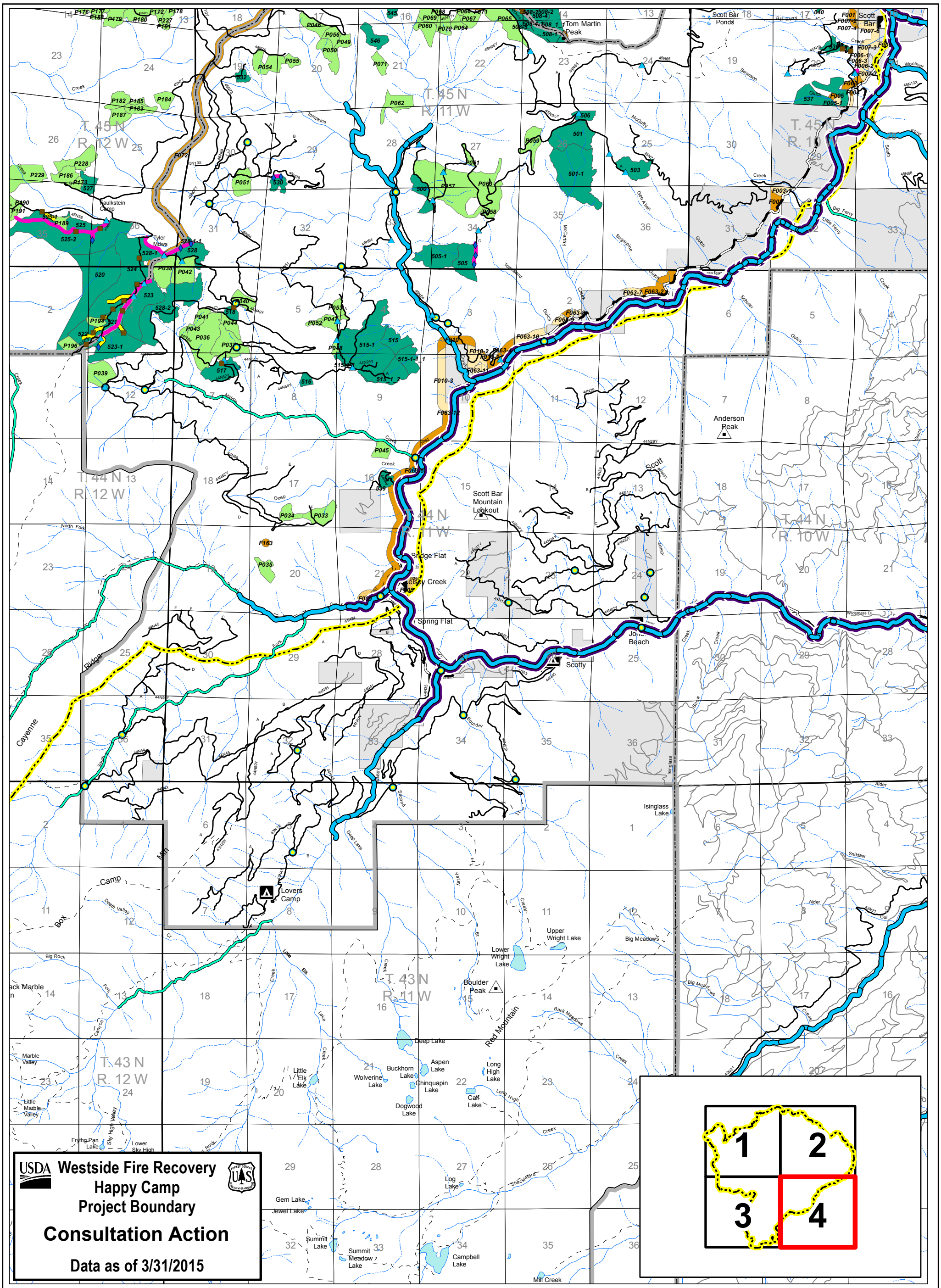
USDA
Westside Fire Recovery
Happy Camp
Project Boundary
Consultation Action
Data as of 3/31/2015
T. 45 N
R. 12 W
T. 45 N
R. 11 W
T. 45 N
R. 10 W
T. 44 N
R. 12 W
T. 44 N
R. 11 W
T. 44 N
R. 10 W
T. 43 N
R. 12 W
T. 43 N
R. 11 W
Tom Martin Peak
Scott Bar Ponds
Scott Bar
Anderson Peak
Scott Bar Mountain Lookout
Bridge Flat
Helsey Creek
Spring Flat
Scotty
Boulder
Isinglass Lake
Lovers Camp
Upper Wright Lake
Lower Wright Lake
Big Meadows
Boulder Peak
Deep Lake
Aspen Lake
Buckhorn Lake
Wolverine Lake
Chinquapin Lake
Long High Lake
Dogwood Lake
Little Elk Lake
Log Lake
Campbell Lake
Gem Lake
Jewel Lake
Summit Lake
Summit Meadow Lake
Miff Creek
Red Mountain
Cayenne Mtn
Box Camp
Tyler Meadows
Faulkstein Camp
Legend
Landing Type
Ground Based
Helicopter
Skyline
Water Source
Coho Critical Habitat
Chinook Fall
Rainbow Trout Resident
Westside Fire Recovery Boundary
Temporary Road On Existing Roadbed
New Temporary Road
NFTS System Road
Salvage Harvest Treatments with Site Preparation, Plant and Release
Site Preparation, Plant and Release Treatment Only
Fuels Management Zone Treatment
Prescribed Burn Treatment
Wildland Urban Interface Treatment
Roadside hazard treatment is proposed up to 250 feet either side of all NFTS sytem roads within the project area and temporary roads used to access treatment units.
Mountain Peak
Campground
Administrative Site
Picnic Site
State or US Highway
County Road
Private/Other Road
Trail
Ranger District Boundary
Wilderness
Private Land Within the Forest Boundary
Intermittent Stream
Perennial Stream
Date: 4/1/2015
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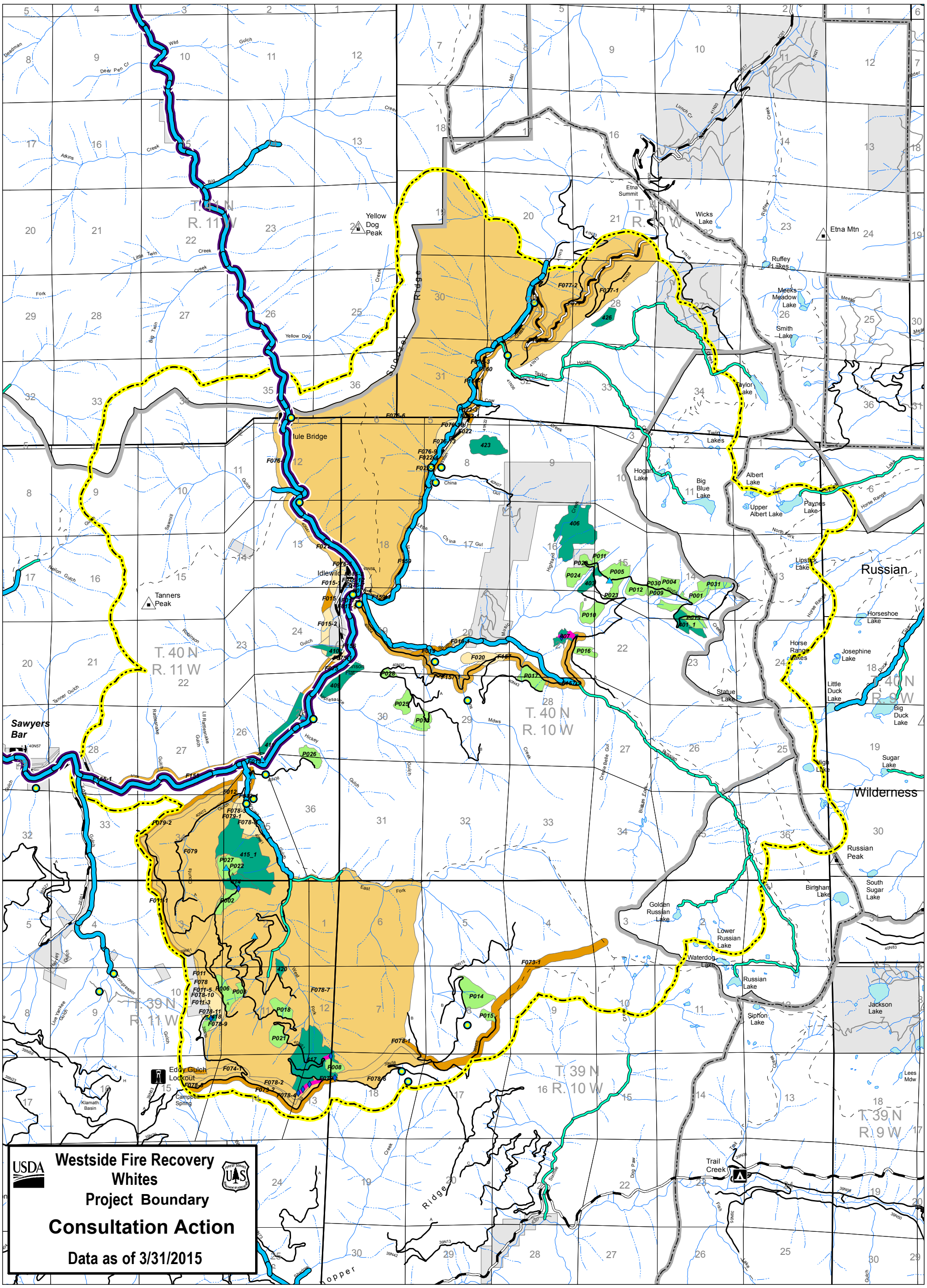
Westside Fire Recovery
Whites
Project Boundary
Consultation Action
Data as of 3/31/2015
USDA
Yellow Dog Peak
Etna Mtn
Etna Summit
Wicks Lake
Ruffey Lakes
Meeks Meadow Lake
Smith Lake
Taylor Lake
Twin Lakes
Hogan Lake
Big Blue Lake
Albert Lake
Upper Albert Lake
Paynes Lake
Lipstick Lake
Russian
Horseshoe Lake
Horse Range Lakes
Josephine Lake
Little Duck Lake
Big Duck Lake
Statue Lake
Sugar Lake
High Lake
Wilderness
Russian Peak
Bingham Lake
South Sugar Lake
Golden Russian Lake
Lower Russian Lake
Waterdog Lake
Russian Lake
Siphon Lake
Jackson Lake
Lees Mdw
Trail Creek
Tanners Peak
Idlewild
Iule Bridge
Sawyers Bar
Eddy Gulch Lookout
Campbell Spring
Compressor
T. 41 N R. 11 W
T. 41 N R. 10 W
T. 40 N R. 11 W
T. 40 N R. 10 W
T. 40 N R. 9 W
T. 39 N R. 11 W
T. 39 N R. 10 W
T. 39 N R. 9 W
Legend
Landing Type
Helicopter
Skyline
Water Source
Coho Critical Habitat
Chinook Fall
Rainbow Trout Resident
Westside Fire Recovery Boundary
Temporary Road On Existing Roadbed
New Temporary Road
NFTS System Road
Salvage Harvest Treatments with Site Preparation, Plant and Release
Site Preparation, Plant and Release Treatment Only
Fuels Management Zone Treatment
Roadside Fuels Treatment
Prescribed Burn Treatment
Wildland Urban Interface Treatment
Mountain Peak
Campground
Administrative Site
Lookout
State or US Highway
County Road
Private/Other Road
Trail
Ranger District Boundary
Wilderness
Private Land Within the Forest Boundary
Intermittent Stream
Perennial Stream
Roadside hazard treatment is proposed up to 250 feet either side of all NFTS sytem roads within the project area and temporary roads used to access treatment units.
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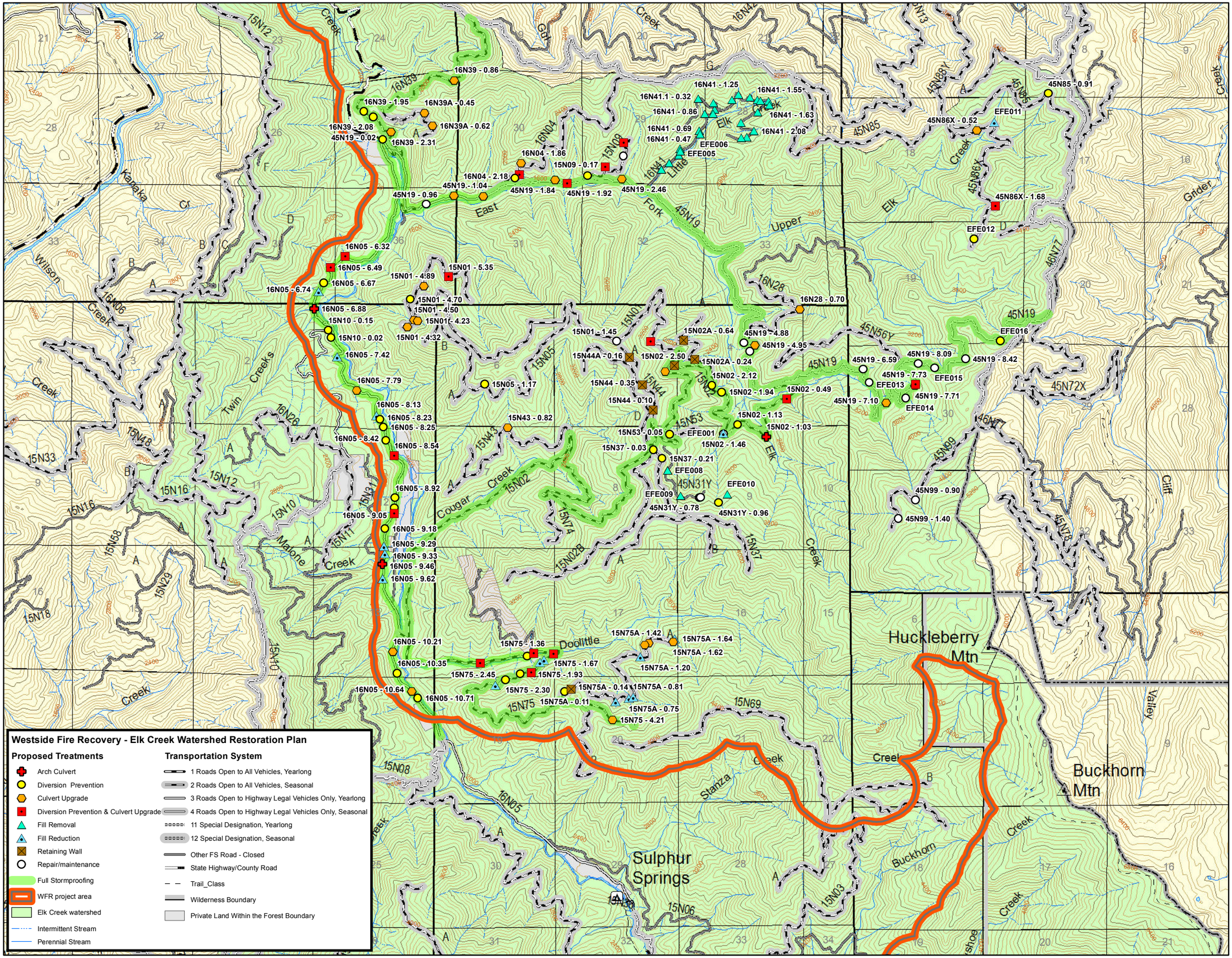
Date: 4/13/2015


Westside Fire Recovery - Elk Creek Watershed Restoration Plan
Proposed Treatments
Arch Culvert
Diversion Prevention
Culvert Upgrade
Diversion Prevention & Culvert Upgrade
Fill Removal
Fill Reduction
Retaining Wall
Repair/maintenance
Full Stormproofing
WFR project area
Elk Creek watershed
Intermittent Stream
Perennial Stream
Transportation System
1 Roads Open to All Vehicles, Yearlong
2 Roads Open to All Vehicles, Seasonal
3 Roads Open to Highway Legal Vehicles Only, Yearlong
4 Roads Open to Highway Legal Vehicles Only, Seasonal
11 Special Designation, Yearlong
12 Special Designation, Seasonal
Other FS Road - Closed
State Highway/County Road
Trail_Class
Wilderness Boundary
Private Land Within the Forest Boundary
Huckleberry Mtn
Buckhorn Mtn
Sulphur Springs
Wilson Creek
Kanaka Cr
Twin Creeks
Cougar Creek
Malone Creek
Doolittle
East Fork Elk Creek
Upper Elk Creek
Little Elk Creek
Gulch
Stanza Creek
Buckhorn Creek
Cliff Creek
Grider Creek
Valley Creek
16N39 - 0.86
16N39 - 1.95
16N39A - 0.45
16N39 - 2.08
45N19 - 0.02
16N39A - 0.62
16N39 - 2.31
16N41.1 - 0.32
16N41 - 1.25
16N41 - 1.55
16N41 - 0.86
16N41 - 1.63
16N41 - 0.69
16N41 - 2.08
16N41 - 0.47
EFE006
EFE005
16N04 - 1.86
15N09 - 0.17
16N04 - 2.18
45N19 - 1.04
45N19 - 1.84
45N19 - 1.92
45N19 - 2.46
45N19 - 0.96
45N85 - 0.91
EFE011
45N86X - 0.52
45N86X - 1.68
EFE012
16N05 - 6.32
16N05 - 6.49
16N05 - 6.67
16N05 - 6.74
15N01 - 5.35
15N01 - 4.89
15N01 - 4.70
15N01 - 4.50
15N01 - 4.23
15N01 - 4.32
16N05 - 6.88
15N10 - 0.15
15N10 - 0.02
16N05 - 7.42
16N05 - 7.79
16N05 - 8.13
16N05 - 8.23
16N05 - 8.25
16N05 - 8.42
16N05 - 8.54
16N05 - 8.92
16N05 - 9.05
16N05 - 9.18
16N05 - 9.29
16N05 - 9.33
16N05 - 9.46
16N05 - 9.62
16N05 - 10.21
16N05 - 10.35
16N05 - 10.64
16N05 - 10.71
16N28 - 0.70
15N01 - 1.45
15N02A - 0.64
45N19 - 4.88
45N19 - 4.95
15N44A - 0.16
15N02 - 2.50
15N02A - 0.24
15N02 - 2.12
15N05 - 1.17
15N44 - 0.35
15N44 - 0.10
15N02 - 1.94
15N02 - 0.49
15N02 - 1.13
15N02 - 1.03
15N43 - 0.82
15N53 - 0.05
EFE001
15N02 - 1.46
15N37 - 0.03
15N37 - 0.21
EFE008
EFE009
45N31Y
EFE010
45N31Y - 0.78
45N31Y - 0.96
45N19 - 6.59
45N19 - 8.09
45N19 - 8.42
45N19 - 7.73
EFE015
EFE013
45N19 - 7.71
45N19 - 7.10
EFE014
EFE016
45N99 - 0.90
45N99 - 1.40
15N75A - 1.42
15N75A - 1.64
15N75A - 1.62
15N75A - 1.20
15N75 - 1.36
15N75 - 1.67
15N75 - 2.45
15N75 - 1.93
15N75 - 2.30
15N75A - 0.14
15N75A - 0.81
15N75A - 0.11
15N75A - 0.75
15N75 - 4.21

Appendix B: Detailed Project Tables

Table 1. Temporary road construction by 7th field watershed (all are outside of RR).

7th Field Watershed	Miles of New Temporary Road
Caroline Creek-Klamath River	0.12
Cliff Valley Creek	0.48
Cougar Creek-Elk Creek	0.04
Lower Grider Creek	0.09
Middle Creek	0.24
O'Neil Creek	0.43
Schutts Gulch-Klamath River	0.18
Shadow Creek	0.04
Tom Martin Creek-Klamath River	0.29
Upper East Fork Elk Creek	0.08
Upper Elk Creek	0.06
Upper Grider Creek	0.85
Walker Creek	0.46
Whites Gulch	0.06
Grand Total	**3.43**

Table 2. Acres of Happy Camp fire area with proposed RR site preparation hand treatments by 7th field watershed (none proposed in Beaver Fire).

7th Field Watersheds	**Acres of RR within site prep and plant units**
China Creek	57.54
Cliff Valley Creek	39.72
Cougar Creek-Elk Creek	78.53
Deep Creek-Scott Creek	10.48
Doolittle Creek	24.76
Fryingpan Creek-Klamath River	37.12
Hoop&Devil-Elk Creek	23.51
Horse Creek	56.22
Lower East Fork Elk Creek	149.85
Lower Grider Creek	62.85
McCarthy Creek-Scott River	24.61
Middle Creek	106.99
North Fork Kelsey Creek	0.99
O'Neil Creek	11.57
Rancheria Creek	23.61
Schutts Gulch-Klamath River	2.92

South Fork Kelsey Creek	1.68
Tom Martin Creek-Klamath River	8.40
Tompkins Creek	133.10
Upper East Fork Elk Creek	192.32
Upper Elk Creek	20.93
Upper Grider Creek	15.85
Walker Creek	33.93
Total	1112.5

Table 3. Acres of Whites Fire with proposed hand treatments in RR by 7th field watershed (none proposed in Beaver Fire).

7th Field Watersheds	Acres of RR within site prep and plant units
Music Creek	48.48
Robinson Gulch-North Fork Salmon River	10.71
Upper South Russian Creek	12.97
Whites Gulch	55.01
Total	127.17

Table 4. CWE model outputs reflecting effects of Consultation Action by 5th field watershed.

5th Field Watershed	2014 Fire	Drainage Area (acres)	ERA Risk Ratio	USLE Risk Ratio	GEO Risk Ratio
Humbug Creek-Klamath River	Beaver	68023	0.31	0.58	0.85
Beaver Creek	Beaver	69610	1.02	1.11	1.01
Horse Creek-Klamath River	Beaver	98625	0.73	0.81	0.92
Seiad Creek-Klamath River	Happy Camp Complex	81706	0.56	0.32	0.70
Indian Creek-Scott River	Happy Camp Complex	76548	0.60	0.76	0.78
Lower Scott River	Happy Camp Complex	98016	0.55	0.41	0.64
Thompson Creek-Klamath River	Happy Camp Complex	67301	0.43	0.24	0.56
Elk Creek	Happy Camp Complex	60829	0.51	0.52	0.53
Ukonom Creek-Klamath River	Happy Camp Complex	87884	0.39	0.22	0.53
South Fork Salmon River	Whites	185597	0.31	0.27	0.47
North Fork Salmon River	Whites	130545	0.34	0.30	0.68

Table 5. ERA model outputs showing current condition and effects of Consultation Action by 7th field watershed.

7th Field Watershed	2014 Fire	Drainage Area (acres)	Current ERA Risk Ratio	ERAs Fire, Salvage, Site Prep	ERA temp roads	ERA legacy Sites	ERA Risk Ratio	Change in ERA from Action
Bear Creek	Beaver	4219	0.76	0.0			0.76	0.00
Buckhorn Creek	Beaver	9118	0.95	12.3			0.97	0.02
Buckhorn Gulch-Beaver Creek	Beaver	8234	1.11	27.1			1.14	0.03
Collins Creek-Klamath River	Beaver	7845	0.41	7.5			0.42	0.01
Doggett Creek	Beaver	7701	2.36	17.6			2.39	0.03
Dona Creek-Klamath River	Beaver	4380	0.89	5.9			0.90	0.01
Dutch Creek	Beaver	6386	0.70	0.0	0.4		0.70	0.00
Dutch Creek	Beaver	3827	1.46	25.3			1.54	0.08
Jaynes Canyon	Beaver	7009	1.16	1.1			1.17	0.00
Kohl Creek	Beaver	3537	1.57	10.1	0.1		1.61	0.03
Little Humbug Creek	Beaver	6188	0.20	0.0			0.20	0.00
Lower West Fork Beaver Creek	Beaver	4044	1.31	1.3			1.31	0.00
Lumgrey Creek	Beaver	5496	0.44	1.0			0.44	0.00
McKinney Creek	Beaver	7275	0.80	0.0			0.80	0.00
Miller Gulch-Klamath River	Beaver	6557	0.30	12.6			0.31	0.02
Quigleys Cove-Klamath River	Beaver	6162	0.37	40.9	0.1		0.42	0.06
Soda Creek-Beaver Creek	Beaver	7370	1.08	2.3			1.08	0.00
Vesa Creek	Beaver	3141	0.10	0.0			0.10	0.00
Bear Creek	Happy Camp Complex	6698	0.66	1.3			0.66	0.00
Benjamin Creek-Klamath River	Happy Camp Complex	9998	0.41	7.8			0.42	0.01
Big Ferry-Swanson	Happy Camp Complex	7612	1.14	15.9	0.0		1.16	0.02

7th Field Watershed	2014 Fire	Drainage Area (acres)	Current ERA Risk Ratio	ERAs Fire, Salvage, Site Prep	ERA temp roads	ERA legacy Sites	ERA Risk Ratio	Change in ERA from Action
Bishop Creek-Elk Creek	Happy Camp Complex	9253	0.57	6.0		-4.1	0.58	0.00
Caroline Creek-Klamath River	Happy Camp Complex	1801	0.54	9.6	0.6		0.60	0.06
China Creek	Happy Camp Complex	6189	0.86	37.9	1.3		0.94	0.08
Cliff Valley Creek	Happy Camp Complex	3952	0.35	16.4	1.2		0.41	0.06
Cougar Creek-Elk Creek	Happy Camp Complex	6918	0.39	10.2	0.1	-19.2	0.37	-0.02
Deep Creek-Scott River	Happy Camp Complex	3798	0.44	3.7			0.45	0.01
Doolittle Creek	Happy Camp Complex	4050	0.56	10.1		-8.5	0.57	0.01
Franklin Gulch-Scott River	Happy Camp Complex	6450	0.37	6.4			0.38	0.01
Granite Creek	Happy Camp Complex	7541	0.59	0.0			0.59	0.00
Headwaters Elk Creek	Happy Camp Complex	2688	0.32	0.0			0.32	0.00
Hoop&Devil-Elk Creek	Happy Camp Complex	3075	0.39	54.0		-8.7	0.53	0.15
Horse Creek	Happy Camp	2537	0.74	21.8	0.0		0.83	0.09

7th Field Watershed	2014 Fire	Drainage Area (acres)	Current ERA Risk Ratio	ERAs Fire, Salvage, Site Prep	ERA temp roads	ERA legacy Sites	ERA Risk Ratio	Change in ERA from Action
	Complex							
Lower East Fork Elk Creek	Happy Camp Complex	3430	0.43	7.9	0.3	-15.7	0.41	-0.02
Lower Grider Creek	Happy Camp Complex	10768	0.71	47.5	0.6		0.77	0.06
Lower Seiad Creek	Happy Camp Complex	3844	0.31	0.0			0.31	0.00
McCarthy Creek-Scott River	Happy Camp Complex	11611	0.51	18.9	0.2		0.52	0.02
Middle Creek	Happy Camp Complex	4496	0.69	41.0	0.6		0.80	0.11
Middle Elk Creek	Happy Camp Complex	2727	1.40	0.0			1.40	0.00
Negro Creek	Happy Camp Complex	2111	0.48	0.0			0.48	0.00
North Fork Kelsey Creek	Happy Camp Complex	5177	0.28	0.3			0.28	0.00
O'Neil Creek	Happy Camp Complex	2429	0.82	15.5	0.8		0.91	0.08
Rainy Valley Creek	Happy Camp Complex	2985	0.11	0.0			0.11	0.00
Rancheria Creek	Happy Camp Complex	4374	0.88	8.4			0.90	0.03

7th Field Watershed	2014 Fire	Drainage Area (acres)	Current ERA Risk Ratio	ERAs Fire, Salvage, Site Prep	ERA temp roads	ERA legacy Sites	ERA Risk Ratio	Change in ERA from Action
Sambo Gulch-Klamath River	Happy Camp Complex	6393	0.29	0.1			0.29	0.00
Schutts Gulch-Klamath River	Happy Camp Complex	6692	0.59	6.0	0.3		0.60	0.01
South Fork Kelsey Creek	Happy Camp Complex	6199	0.21	0.7			0.21	0.00
Tom Martin Creek-Klamath River	Happy Camp Complex	10690	0.53	42.3	0.2		0.58	0.04
Tompkins Creek	Happy Camp Complex	9327	0.53	48.7	0.1		0.60	0.07
Toms Valley Creek-Elk Creek	Happy Camp Complex	4564	0.23	0.0			0.23	0.00
Upper Canyon Creek	Happy Camp Complex	5179	0.08	0.0			0.08	0.00
Upper East Fork Elk Creek	Happy Camp Complex	3873	0.58	12.9	0.2	-13.7	0.58	0.00
Upper Elk Creek	Happy Camp Complex	3025	0.54	24.1	1.4	-5.0	0.63	0.09
Upper Grider Creek	Happy Camp Complex	8467	0.42	28.9	2.7		0.47	0.05
Walker Creek	Happy Camp Complex	7635	1.06	27.1	2.5		1.12	0.06
West Grider Creek-Klamath River	Happy Camp	4026	0.41	6.1			0.42	0.02

7th Field Watershed	2014 Fire	Drainage Area (acres)	Current ERA Risk Ratio	ERAs Fire, Salvage, Site Prep	ERA temp roads	ERA legacy Sites	ERA Risk Ratio	Change in ERA from Action
	Complex							
Big Creek	Whites	2735	0.00	0.4			0.00	0.00
Eddy Gulch	Whites	4425	0.49	4.5			0.50	0.01
Jackass Gulch	Whites	2807	0.26	0.0			0.26	0.00
Jessups Gulch-North Fork Salmon River	Whites	4546	0.45	0.0			0.45	0.00
Lower North Russian Creek	Whites	4501	0.76	79.3			0.98	0.22
Lower South Russian Creek	Whites	2138	0.88	2.9			0.90	0.02
Music Creek	Whites	3286	1.03	4.7	0.0		1.05	0.02
Robinson Gulch-North Fork Salmon River	Whites	5202	0.74	10.1			0.76	0.02
Shadow Creek	Whites	5690	0.55	25.1	0.1		0.60	0.04
Sixmile Creek	Whites	4049	0.18	3.9			0.19	0.01
Specimen Creek	Whites	5009	0.30	0.0			0.30	0.00
Sugar Creek	Whites	8760	0.21	0.0			0.21	0.00
Taylor Creek	Whites	4016	0.54	3.2			0.55	0.01
Upper French Creek	Whites	8721	0.58	0.0			0.58	0.00
Upper North Russian Creek	Whites	3130	0.39	72.9			0.70	0.31
Upper South Russian Creek	Whites	6396	0.38	2.7	0.2		0.39	0.01
Whites Gulch	Whites	8576	0.64	223.8	0.3		0.97	0.33
Yellow Dog Creek-North Fork Salmon River	Whites	9239	0.20	72.2			0.28	0.08

Table 6. USLE model outputs reflecting current condition and effects of Consultation Action by 7th field watershed.

7th Field Watershed	2014 Fire	Current Risk Ratio	USLE Fire, Salvage, Site Prep (yd3/year)	USLE temp roads (yd3/year)	USLE legacy Sites (yd3/year)	USLE Risk Ratio	Changes in USLE from Action
Bear Creek	Beaver	0.85	0.0			0.85	0.00
Buckhorn Creek	Beaver	0.85	2.8			0.85	0.00
Buckhorn Gulch-Beaver Creek	Beaver	1.34	2.1			1.35	0.01
Collins Creek-Klamath River	Beaver	0.89	1.0			0.89	0.00
Doggett Creek	Beaver	1.52	1.9			1.53	0.00
Dona Creek-Klamath River	Beaver	1.13	1.8			1.14	0.01
Dutch Creek	Beaver	1.67	4.4			1.70	0.03
Jaynes Canyon	Beaver	1.68	0.0			1.68	0.00
Kohl Creek	Beaver	1.53	4.7	0.1		1.55	0.01
Little Humbug Creek	Beaver	0.25	0.0			0.25	0.00
Lower West Fork Beaver Creek	Beaver	1.65	0.0			1.65	0.00
Lumgrey Creek	Beaver	1.38	0.0			1.38	0.00
McKinney Creek	Beaver	1.00	0.0			1.00	0.00
Miller Gulch-Klamath River	Beaver	0.48	0.0			0.48	0.00
Quigleys Cove-Klamath River	Beaver	0.73	0.8	0.03		0.74	0.01
Sambo Gulch-Klamath River	Beaver	0.39	0.0			0.39	0.00
Soda Creek-Beaver Creek	Beaver	1.60	0.0			1.60	0.00
Vesa Creek	Beaver	0.25	0.0			0.25	0.00
Bear Creek	Happy Camp Complex	0.28	0.0			0.28	0.00
Benjamin Creek-Klamath River	Happy Camp Complex	0.33	0.0			0.33	0.00
Big Ferry-Swanson	Happy Camp	0.73	2.1	0.01		0.73	0.01

7th Field Watershed	2014 Fire	Current Risk Ratio	USLE Fire, Salvage, Site Prep (yd3/year)	USLE temp roads (yd3/year)	USLE legacy Sites (yd3/year)	USLE Risk Ratio	Changes in USLE from Action
	Complex						
Bishop Creek-Elk Creek	Happy Camp Complex	0.10	0.0		-2.8	0.09	0.00
Caroline Creek-Klamath River	Happy Camp Complex	0.60	6.0	2		0.64	0.04
China Creek	Happy Camp Complex	0.79	5.6	2.9		0.81	0.02
Cliff Valley Creek	Happy Camp Complex	0.63	5.8	3.5		0.65	0.02
Cougar Creek-Elk Creek	Happy Camp Complex	0.50	0.4	0.1	-24.1	0.45	-0.05
Deep Creek-Scott River	Happy Camp Complex	0.52	0.7			0.53	0.00
Doolittle Creek	Happy Camp Complex	0.42	1.0		-8.3	0.41	-0.02
Franklin Gulch-Scott River	Happy Camp Complex	0.39	0.0			0.39	0.00
Fryingpan Creek-Klamath River	Happy Camp Complex	1.07	2.5	0.2		1.08	0.01
Granite Creek	Happy Camp Complex	0.00	0.0			0.00	0.00
Headwaters Elk Creek	Happy Camp	0.42	0.0			0.42	0.00

7th Field Watershed	2014 Fire	Current Risk Ratio	USLE Fire, Salvage, Site Prep (yd3/year)	USLE temp roads (yd3/year)	USLE legacy Sites (yd3/year)	USLE Risk Ratio	Changes in USLE from Action
	Complex						
Hoop&Devil-Elk Creek	Happy Camp Complex	0.63	0.4		-12.1	0.57	-0.06
Horse Creek	Happy Camp Complex	1.00	6.3	0.01		1.03	0.03
Lower East Fork Elk Creek	Happy Camp Complex	1.00	1.2	0.4	-25.7	0.91	-0.09
Lower Grider Creek	Happy Camp Complex	0.77	26.9	0.7		0.79	0.02
Lower Seiad Creek	Happy Camp Complex	0.16	0.0			0.16	0.00
McCarthy Creek-Scott River	Happy Camp Complex	0.49	4.8	0.2		0.50	0.01
Middle Creek	Happy Camp Complex	0.87	8.7	1		0.89	0.02
Middle Elk Creek	Happy Camp Complex	0.12	0.0			0.12	0.00
Negro Creek	Happy Camp Complex	0.91	0.0			0.91	0.00
North Fork Kelsey Creek	Happy Camp Complex	0.50	0.0			0.50	0.00
O'Neil Creek	Happy Camp	1.58	4.8	2.2		1.60	0.02

7th Field Watershed	2014 Fire	Current Risk Ratio	USLE Fire, Salvage, Site Prep (yd3/year)	USLE temp roads (yd3/year)	USLE legacy Sites (yd3/year)	USLE Risk Ratio	Changes in USLE from Action
	Complex						
Rainy Valley Creek	Happy Camp Complex	0.17	0.0			0.17	0.00
Rancheria Creek	Happy Camp Complex	1.14	0.0			1.14	0.00
Schutts Gulch-Klamath River	Happy Camp Complex	0.74	0.5	1		0.75	0.00
South Fork Kelsey Creek	Happy Camp Complex	0.18	0.0			0.18	0.00
Tom Martin Creek-Klamath River	Happy Camp Complex	0.78	9.6	0.4		0.79	0.01
Tompkins Creek	Happy Camp Complex	0.82	11.2	0.1		0.83	0.01
Toms Valley Creek-Elk Creek	Happy Camp Complex	0.32	0.0			0.32	0.00
Upper Canyon Creek	Happy Camp Complex	0.01	0.0			0.01	0.00
Upper East Fork Elk Creek	Happy Camp Complex	0.81	1.4	0.2	-34.1	0.74	-0.08
Upper Elk Creek	Happy Camp Complex	0.93	19.2	3.1	-9.8	0.96	0.03
Upper Grider Creek	Happy Camp	0.55	12.6	5.5		0.57	0.02

7th Field Watershed	2014 Fire	Current Risk Ratio	USLE Fire, Salvage, Site Prep (yd3/year)	USLE temp roads (yd3/year)	USLE legacy Sites (yd3/year)	USLE Risk Ratio	Changes in USLE from Action
	Complex						
Walker Creek	Happy Camp Complex	0.98	15.0	9.4		1.00	0.02
West Grider Creek-Klamath River	Happy Camp Complex	0.88	0.0			0.88	0.00
Big Creek	Whites	0.00	0.6			0.00	0.00
Eddy Gulch	Whites	0.97	0.1			0.97	0.00
Jackass Gulch	Whites	0.27	0.0			0.27	0.00
Jessups Gulch-North Fork Salmon River	Whites	0.40	0.0			0.40	0.00
Lower North Russian Creek	Whites	0.79	4.7			0.81	0.01
Lower South Russian Creek	Whites	0.81	0.0			0.81	0.00
Music Creek	Whites	0.82	1.2	0.1		0.83	0.00
Robinson Gulch-North Fork Salmon River	Whites	0.85	1.0			0.85	0.00
Shadow Creek	Whites	0.96	7.3	0.2		0.98	0.01
Sixmile Creek	Whites	0.56	0.0			0.56	0.00
Specimen Creek	Whites	0.09	0.0			0.09	0.00
Sugar Creek	Whites	0.25	0.0			0.25	0.00
Taylor Creek	Whites	0.55	0.2			0.55	0.00
Upper French Creek	Whites	0.33	0.0			0.33	0.00
Upper North Russian Creek	Whites	0.40	29.9			0.47	0.07
Upper South Russian Creek	Whites	0.46	3.2	0.9		0.47	0.00
Whites Gulch	Whites	0.83	41.1	1.1		0.86	0.03
Yellow Dog Creek-North Fork Salmon River	Whites	0.30	2.7			0.31	0.00

Table 7. GEO model outputs reflecting current condition and effects of Consultation Action by 7th field watershed.

7th Field Watershed	2014 Fire	Current Risk Ratio	GEO Fire, Salvage, Site Prep (yd3/decade)	GEO temp roads (yd3/decade)	GEO legacy Sites (yd3/decade)	Risk Ratio	Changes to Risk Ratio from Action
Bear Creek	Beaver	0.73	0			0.73	0.00
Buckhorn Creek	Beaver	0.68	531			0.69	0.01
Buckhorn Gulch-Beaver Creek	Beaver	1.18	1193			1.21	0.03
Collins Creek-Klamath River	Beaver	0.78	163			0.79	0.01
Doggett Creek	Beaver	1.11	572			1.13	0.01
Dona Creek-Klamath River	Beaver	1.17	395			1.19	0.02
Dutch Creek	Beaver	0.93	1408	53		0.99	0.06
Jaynes Canyon	Beaver	0.85	0			0.85	0.00
Kohl Creek	Beaver	1.19	698	13		1.22	0.04
Little Humbug Creek	Beaver	0.65	0			0.65	0.00
Lower West Fork Beaver Creek	Beaver	1.05	0			1.05	0.00
Lumgrey Creek	Beaver	1.04	0			1.04	0.00
McKinney Creek	Beaver	1.97	0			1.97	0.00
Miller Gulch-Klamath River	Beaver	0.75	0			0.75	0.00
Quigleys Cove-Klamath River	Beaver	0.72	986	12		0.77	0.05
Soda Creek-Beaver Creek	Beaver	1.46	0			1.46	0.00
Vesa Creek	Beaver	0.67	0			0.67	0.00
Bear Creek	Happy Camp Complex	1.01	0			1.01	0.00
Benjamin Creek-Klamath River	Happy Camp Complex	0.63	0			0.63	0.00
Big Ferry-Swanson	Happy Camp Complex	0.62	35	0		0.62	0.00
Bishop Creek-Elk Creek	Happy Camp Complex	1.76	0		-149	1.76	0.00

7th Field Watershed	2014 Fire	Current Risk Ratio	GEO Fire, Salvage, Site Prep (yd3/decade)	GEO temp roads (yd3/decade)	GEO legacy Sites (yd3/decade)	Risk Ratio	Changes to Risk Ratio from Action
Caroline Creek-Klamath River	Happy Camp Complex	1.64	156	61		1.66	0.02
China Creek	Happy Camp Complex	0.76	590	134		0.78	0.02
Cliff Valley Creek	Happy Camp Complex	0.32	365	57		0.35	0.03
Cougar Creek-Elk Creek	Happy Camp Complex	0.64	16	1	-1080	0.60	-0.04
Deep Creek-Scott River	Happy Camp Complex	1.39	36			1.39	0.00
Doolittle Creek	Happy Camp Complex	0.46	17		-309	0.44	-0.02
Franklin Gulch-Scott River	Happy Camp Complex	0.39	0			0.39	0.00
Fryingpan Creek-Klamath River	Happy Camp Complex	0.76	87	5		0.76	0.00
Granite Creek	Happy Camp Complex	1.52	0			1.52	0.00
Headwaters Elk Creek	Happy Camp Complex	0.15	0			0.15	0.00
Hoop&Devil-Elk Creek	Happy Camp Complex	0.60	9		-311	0.57	-0.03
Horse Creek	Happy Camp Complex	0.81	919	0		0.91	0.10
Lower East Fork Elk Creek	Happy Camp Complex	0.49	42	11	-680	0.42	-0.07
Lower Grider Creek	Happy Camp Complex	1.09	1921	70		1.12	0.04
Lower Seiad Creek	Happy Camp Complex	0.16	0			0.16	0.00
McCarthy Creek-Scott River	Happy Camp Complex	0.43	275	4		0.43	0.01

7th Field Watershed	2014 Fire	Current Risk Ratio	GEO Fire, Salvage, Site Prep (yd3/decade)	GEO temp roads (yd3/decade)	GEO legacy Sites (yd3/decade)	Risk Ratio	Changes to Risk Ratio from Action
Middle Creek	Happy Camp Complex	1.09	1919	75		1.19	0.11
Middle Elk Creek	Happy Camp Complex	2.85	0			2.85	0.00
Negro Creek	Happy Camp Complex	0.24	0			0.24	0.00
North Fork Kelsey Creek	Happy Camp Complex	0.46	0			0.46	0.00
O'Neil Creek	Happy Camp Complex	1.53	90	14		1.54	0.01
Rainy Valley Creek	Happy Camp Complex	0.02	0			0.02	0.00
Rancheria Creek	Happy Camp Complex	0.68	0			0.68	0.00
Sambo Gulch-Klamath River	Happy Camp Complex	0.69	0			0.69	0.00
Schutts Gulch-Klamath River	Happy Camp Complex	1.16	8	11		1.16	0.00
South Fork Kelsey Creek	Happy Camp Complex	0.35	0			0.35	0.00
Tom Martin Creek-Klamath River	Happy Camp Complex	0.44	645	20		0.46	0.02
Tompkins Creek	Happy Camp Complex	0.82	1272	8		0.85	0.03
Toms Valley Creek-Elk Creek	Happy Camp Complex	0.60	0			0.60	0.00
Upper Canyon Creek	Happy Camp Complex	0.07	0			0.07	0.00
Upper East Fork Elk Creek	Happy Camp Complex	0.54	98	5	-591	0.50	-0.04
Upper Elk Creek	Happy Camp Complex	0.44	248	40	-238	0.45	0.01

7th Field Watershed	2014 Fire	Current Risk Ratio	GEO Fire, Salvage, Site Prep (yd3/decade)	GEO temp roads (yd3/decade)	GEO legacy Sites (yd3/decade)	Risk Ratio	Changes to Risk Ratio from Action
Upper Grider Creek	Happy Camp Complex	0.32	1569	224		0.37	0.05
Walker Creek	Happy Camp Complex	1.92	817	715		1.96	0.04
West Grider Creek-Klamath River	Happy Camp Complex	0.59	0			0.59	0.00
Big Creek	Whites	0.00	0			0.00	0.00
Eddy Gulch	Whites	0.76	0			0.76	0.00
Jackass Gulch	Whites	0.19	0			0.19	0.00
Jessups Gulch-North Fork Salmon River	Whites	0.59	0			0.59	0.00
Lower North Russian Creek	Whites	0.84	162			0.85	0.01
Lower South Russian Creek	Whites	0.63	0			0.63	0.00
Music Creek	Whites	1.17	33	1		1.17	0.00
Robinson Gulch-North Fork Salmon River	Whites	0.79	37			0.80	0.00
Shadow Creek	Whites	0.45	62	1		0.45	0.00
Sixmile Creek	Whites	0.38	0			0.38	0.00
Specimen Creek	Whites	0.65	0			0.65	0.00
Sugar Creek	Whites	0.45	0			0.45	0.00
Taylor Creek	Whites	0.54	0			0.54	0.00
Upper French Creek	Whites	0.78	0			0.78	0.00
Upper North Russian Creek	Whites	0.98	0			0.98	0.00
Upper South Russian Creek	Whites	0.77	16	5		0.77	0.00
Whites Gulch	Whites	0.61	218	6		0.62	0.01
Yellow Dog Creek-North Fork Salmon River	Whites	0.28	0			0.28	0.00

Appendix C: Klamath National Forest Matrix: Table of Population and Habitat Indicators for Use on the Klamath National Forest in the Northwest Forest Plan Area

Aquatic Habitat Conditions Analysis Guidelines

AP = Analytical Process for Developing Biological Assessments for Federal Actions Affecting Fish within the Northwest Forest Plan Area (USDI, USDA, and NOAA 2004).
Available at www.blm.gov/or/esa/reports/**Analytical_Process**_110504.doc.

The table(s) within this Appendix show criteria used to determine baseline conditions in 7th-and **5th-field** watersheds within the KNF boundaries **that contain anadromous fish habitat**. The criteria in the Table and footnotes are used to describe the current condition of Klamath Mountains watersheds, and to determine if projects are likely to affect anadromous salmonids via effects on salmonid habitat components. Current conditions of watershed(s) are assessed and documented in the Table of Habitat Indicators; and effects to Indicators from proposed actions are discussed in the narrative within the BA/BE and summarized in the Table of Habitat Indicators.

The initial KNF-NMFS Level 1 review of the Table criteria was completed by Perrochet, Thomas, and Flickinger in April 2007. Edits to LWD were made in March 2009 to reflect LRMP EIS values. The Table was updated in 2004 as part of the Analytical Process for ESA consultation with NMFS. In May 2012 Grunbaum and Meneks provided updates/edits to this document and the Table of Habitat Indicators.

The Table, as designed in the 2004 Analytical Process, and in earlier versions (1997 NMFS BO for the LRMP), suggests values to determine a level of functioning for anadromous fish bearing streams. A note about rigid values to assess level of functioning: in addition to fixed habitat parameters not allowing for natural variability, fixed habitat parameters set standards that may be geomorphically inappropriate (Bisson et al. 1997). Variability is an inherent property of aquatic ecosystems in the Pacific Northwest and habitats at any given location will change from year to year, decade to decade, and century to century (Bisson et al. 1997). Healthy lotic ecosystems require different parts of the channel system to exhibit very different in-channel conditions and that those conditions change through time (Reid and Furniss 1998). Also, data may not be available for the stream being assessed. Therefore, a conclusion of function must be evaluated with professional judgment recognizing the streams capability to perform within rigid values. In some cases, a stream's morphology, aspect or size may not support "Properly Functioning" criteria values for one or more habitat Indicators. If an Indicator for a particular stream is determined to be functioning at its capability (due to morphology, aspect, or size), it is rated as Properly Functioning even if it doesn't meet Table criteria values. In the absence of available data, table and associated footnotes suggest factors that should be considered when evaluating indicators.

Klamath National Forest Tributaries Table of Pathways and Indicators

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
Habitat: Non Watershed Condition Indicators				
Water Quality:	Temperature [(1)]			
	1st - 3rd Order Streams [instantaneous]	69 F degrees (~ 20.5 C) or less	> 69 to 70.5 degrees F	70.5 F degrees (~ 21.3 C) or more
	4th-5th Order Streams [Maximum Weekly Maximum Temperature]	70.5 F degrees (~ 21.4 C) or less	> 70.5 to 73.5 degrees F	73.5 F degrees (~ 23.0 C) or more
	Suspended Sediment/Turbidity	Little to no quantitative turbidity data exists for streams on the Klamath National Forest. Use the following criteria to infer condition of turbidity Indicator: (1) professional judgment from years of direct observation of tributary streams; (2) amount of fines in substrate from stream survey data, (3) CWE modeled level of watershed surface erosion and mass wasting, and (4) condition of stream buffer RR and channel (particularly if there has been recent debris flows that altered the channel). Professional judgment of turbidity is based on observations of water clarity after peak flows in tributaries to the mainstems of the Klamath, Scott, and Salmon Rivers that have watersheds with varying degrees of disturbance from nearly pristine to highly disturbed. Properly Functioning: Water clarity returns quickly (within three days) following peak flows.	Water clarity slow (four to six days) to return following peak flows, moderate to high fines in substrate, moderate modeled surface erosion and mass wasting, and RRs are not fully functioning.	Water clarity poor for long periods of time (one week or more) following peak flows. Some suspended sediments occur even at low flows or base flow. High fines in substrate, stream buffers in poor condition, high modeled surface erosion and mass wasting, and riparian reserves are in poor condition.
	Chemical/Nutrient Contamination [(2)]	Scott, Salmon, and Klamath River mainstems: Low levels of contamination from agriculture, industrial, and other sources; no excess nutrients. No CWA 303d designated reaches. Scott, Salmon, and Klamath River tributaries: None or low levels of chemical and/or nutrient contamination from agriculture, industrial, and other sources; no excess nutrients.	Scott, Salmon, and Klamath River mainstems: Moderate levels of contamination from agriculture, industrial, and other sources; some excess nutrients. One or more CWA 303d designated reaches Scott, Salmon, and Klamath River tributaries: Moderate levels of contamination from agriculture, industrial, and other sources and/or moderate excess nutrients.	Scott, Salmon, and Klamath Rivers: mainstems: High levels of contamination from agriculture, industrial, and other sources; high levels of nutrients. One or more CWA 303d designated reaches Scott, Salmon, and Klamath River tributaries: High levels of contamination from agriculture, industrial, and other sources and/or moderate to high excess nutrients.
Habitat Access:	Physical Barriers (AP)	Any man-made barriers present in watershed allow upstream and downstream passage at all flows.	One or more human -made barriers present in watershed do not allow upstream and/or downstream passage at base/low flows.	Human-made barriers present in watershed do not allow upstream and/or downstream passage at a range of flows for at least one life history stage.
	Substrate character [(3)]	Use stream survey data for determining substrate character. In addition, use USLE and GEO models to determine functioning level of Indicator and potential effects of sediment delivery to streams that may affect anadromous fish and their habitat. Can also infer substrate character functioning level from other factors such as high road density and hydrologic connection, recent large intense wildfires, and recent (last 20 years) altered channel.		

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
Habitat Elements:		Less than 15% fines (<2 mm) in spawning habitat (pool tail-outs, low gradient riffles, and glides) and cobble embeddedness less than 20%. Additional desired conditions, as per TMDL/NCRWB water quality compliance, include: *Pool sediment vol (V*): ≤21% *Subsurface, <0.85 mm: ≤14% *Subsurface, <6.4 mm: ≤30%	15% or greater fines (<2 mm) in spawning habitat (pool tail-outs, low gradient riffles, and glides) and/or cobble embeddedness is 20% or greater.	Greater than 20% fines (<2 mm) in spawning habitat (pool tail-outs, low gradient riffles, and glides) and cobble embeddedness greater than 25%.
	Large Woody Debris **(4)**	See KNF LRMP EIS Chapter 3, text and tables on Pages 68-69. For stream reaches on the Westside of the Forest, manage for an average of 20 pieces of large wood per 1,000 ft in 3-5th order streams (LRMP Page 4-143). Large wood is defined as a minimum length of 50 feet and diameter of 24 inches on the Westside. However, site potential and channel width must be considered rather than using strict numbers. Also consider the potential for future LWD recruitment in both the short- and long-term.	Current levels are being maintained at minimum levels desired for "properly functioning" but potential sources for long term woody debris recruitment are lacking to maintain these minimum values.	Current levels are not at those desired levels for "properly functioning" and potential sources of woody debris for short and/or long term recruitment are lacking.
	Pool Quality and Frequency **(5)**	At least one primary pool every three to seven bankfull channel widths. In 1st through 3rd order streams, a primary pool must have a maximum depth of two feet or greater. In 4th and 5th order streams, a primary pool must have a maximum depth of three feet or greater. In 6th order and larger streams, a primary pool must have a maximum depth of four feet or greater.	At least one pool every three to seven bankfull channel widths. At least half of the pools are primary pools. At least half the pools have a maximum depth of at least 24 inches (1st- 3rd order streams) or 36 inches (4th order and greater).	There is less than one pool every three to seven bankfull channel widths and/or less than half the pools have maximum depth of at least 24 inches (1st-3rd order streams) or 36 inches (4th order and greater).
	Off-Channel Habitat	Fish have unrestricted access to off-channel habitats (such as oxbows, off-channel ponds, backwaters, and areas of low flow velocity and cover) in unconstrained reaches during high flows and flooding events in winter. And these off-channel areas are relatively undisturbed by dikes, levees, dredge tailings, roads, excavations, fills, flow diversions, development, vegetation clearing, wood removal, poor water quality, etc.	Fish access to off-channel habitats, and the quantity and quality of off-channel habitats, in unconstrained reaches, is diminished due to dikes, levees, dredge tailings, roads, excavations, fills, flow diversions, development, vegetation clearing, wood removal, poor water quality, etc.	Fish access to off-channel habitats in unconstrained reaches is severely restricted or impossible due to dikes, levees, dredge tailings, roads, excavations, fills, flow diversions, development, etc., and/or the quality of the off-channel habitats is poor due to vegetation clearing, wood removal, poor water quality, and the other factors listed above. .

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
Habitat Elements:	Refugia (important remnant habitat for sensitive aquatic species)	CHs necessary for successful completion of all anadromous salmonid life history phases (spawning, incubation, emergence, freshwater rearing, and migration) are functioning, accessible, and well-distributed. Critical summer refugia in Klamath Mountain streams include: (1) thermal refugia and (2) anadromous stream reaches with intact RRs, cool clean water, pools that are not filled-in or partially filled-in with excess sediment, adequate stream flows, and good water quality. Critical winter habitat for anadromous salmonids includes side channels, off-channel habitats, and floodplain habitats.	Not all CHs necessary for successful completion of all anadromous salmonid life history phases are functioning and/or accessible for salmonids and/or well-distributed. Habitat quality and/or accessibility is diminished due to dikes, levees, dredge tailings, other fills, roads, excavations, flow diversions, development, vegetation clearing, wood removal, poor water quality, etc.	Many of the CHs necessary for successful completion of all anadromous salmonid life history phases are not functioning and/or not accessible for salmonids, and are thus are poorly distributed across the stream network and not providing adequate biological connectivity.
Channel Condition and Dynamics:	Width/Depth Ratio [6]	Width-to-Depth ratio < 12 on all reaches that could otherwise best be described as 'A', 'G', and 'E' channel types. Width-to-Depth ratio > 12 on all reaches that could otherwise best be described as 'B', 'F', and 'C' channel types. No braided streams formed due to excessive sediment loads. Lacking data, width-to-depth ratio should be evaluated considering the following factors: (1) recent (last 20 years) history of debris flows that have scoured channel and resulted in aggradation or degradation of the stream bed, (2) recent history of mass wasting that delivered large volumes of sediment to the stream that may have filled in pools, (3) pool frequency and depth information from stream surveys, (4) watershed disturbance as estimated with CWE modeling for mass wasting (GEO) and peak flows (ERA/TOC), and (5) frequency of large woody debris in the stream channel. For properly functioning, stream crossing density is low, there have been few mass wasting events caused by management actions, there are numerous deep pools, modeled mass wasting and surface erosion is low, and there is adequate LWD. If there is no or little management disturbance legacy in a watershed, then width-to-depth ratio is assumed to be properly functioning.	More than 10% of the reaches are outside of the ranges given for Width/Depth ratios for the channel types specified in "Properly Functioning" block. Braiding has occurred in some alluvial reaches as a result of excessive aggradation due to high sediment loads. For at-risk, stream crossing density is moderate to high, there have been some mass wasting events caused by management actions, pool frequency and quality is at-risk, modeled mass wasting and surface erosion is moderate to high, and there is inadequate LWD.	More than 25% of the reaches are outside of the ranges given for Width/Depth ratios for the channel types specified in "Properly Functioning" block. Braiding has occurred in many alluvial reaches as a result of excessive aggradation due to high sediment loads. For not properly functioning, stream crossing density is high, there have been some large mass wasting events caused by management actions, pool frequency and quality is poor, modeled mass wasting and surface erosion is moderate to high, and there is inadequate LWD.

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
	Streambank Condition (AP)	> 80% of any stream reach has ≥ 90% stability. Most watersheds have no bank stability surveys data so the level of streambank stability should be evaluated by considering: (1) density of road-stream crossings per stream or stream reach, (2) amount of inner gorge road, (3) other clearing and/or compaction directly adjacent to the stream, (4) artificial banks created by pushing up berms, and (5) recent (since 1996) channel altering debris flows. For properly functioning: Stream crossing density is low to moderate, there is little to no inner gorge road, there is no or only minor disturbance next to the stream channel, there are few or no berms, dikes, or levees constraining the channel, and/or there has been no or minor channel alteration/filling due to debris flows/landslides related to past management actions.	50-80% of any stream reach has ≥ 90% stability. For at-risk: Stream crossing density is moderate to high, there is some inner gorge road, there is some disturbance next to the stream channel, there are some berms, dikes, or levees constraining the channel, and/or there has been some channel alteration/filling due to debris flows/landslides related to past management actions.	< 50% of any stream reach has ≥90% stability For not properly functioning: Stream crossing density is high, there is over a mile of inner gorge road, there is significant disturbance next to the stream channel, berms, dikes, or levees constrain over a mile of channel; and/or there has been significant channel alteration/filling due to debris flows/landslides related to past management actions.
	Floodplain Connectivity (AP)	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation, and succession.	Reduced linkage of wetland, floodplains, and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession.	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain, and riparian areas; wetland area drastically reduced and riparian vegetation/succession altered significantly.
Flow / Hydrology:	Change in Peak/Base Flows [7]	Properly functioning watersheds for peak flow have low modeled ERA/TOC, low road density, few large clearings in the rain-snow transition zone, and vegetation close to reference condition. Properly functioning watersheds for base flow have low modeled ERA/TOC, low road density and hydrologic connectivity, and vegetation close to reference condition.	Watersheds at-risk for change in peak flow have moderately high to high modeled ERA/TOC, moderate to high road density, and/or some large recent clearings in the rain-snow transition zone. Watersheds at-risk for change in base flow have denser vegetation compared to reference conditions, several water diversions, and moderate density of roads that have hydrologic connectivity.	Watersheds not properly functioning or change in peak flow have high modeled ERA/TOC, high road density, and may have large recent clearings in the rain-snow transition zone. Watersheds not properly functioning for change in base flow have much denser vegetation compared to reference conditions, numerous or large water diversions, and high density of roads that have hydrologic connectivity.
	Increase in Drainage Network (AP)	Zero or minimum increases in active channel length correlated with human caused disturbance (e.g., trails, ditches, compaction, impervious surface, etc.). The primary cause of drainage network increase in Klamath Mountain watersheds is hydrologic connectivity between the road system and the stream network.	Low to Moderate increases in active channel length correlated with human caused disturbance (e.g., trails ditches, compaction, impervious surface, etc.).	Greater than moderate increase in active channel length correlated with human caused disturbance (e.g., trails ditches, compaction, impervious surface, etc.).

Klamath National Forest Tributaries Table of Pathways and Indicators:				
Pathways	***Indicators***	***Properly Functioning***	***At Risk***	***Not Properly Functioning***
Watershed Condition <u>Indicators</u>				
Watershed Conditions:	Road Density and Location (AP)	Less than 2 miles per square mile.	Two to three miles per square mile.	Over 3 miles per square mile.
	RRs – NW Forest Plan (AP) **(8)**	The RR system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (> 80% intact), and/or for grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition > 50%.	Moderate loss of connectivity or function (shade, LWD recruitment, etc.) of RR system, or incomplete protection of habitat and refugia for sensitive aquatic species (approx. 70-80% intact), and/or for grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better. Some past stand-replacement timber harvest or intense fire in RR, moderate road and landing density in RR, minor to moderate level of mining in RR, vegetation/fuels moderately departed from historic fuels conditions, species diversity and vegetation structure in stream buffers moderately altered from reference condition due to fire suppression and past timber harvest, and moderate modeled CWE values.	RR system is fragmented, poorly connected, or provides inadequate protection of habitat and refugia for sensitive aquatic species (approx. less than 70% intact), and/or for grazing impacts; percent similarity of riparian vegetation to the potential natural community/composition is 25% or less. Extensive past stand-replacement timber harvest or intense fire in RR, high road and landing density in RR, moderate to high intensity of mining in RR, vegetation/fuels greatly departed from historic fuels conditions, species diversity and vegetation structure in stream buffers significantly altered from reference condition due to fire suppression and past timber harvest, and high modeled CWE values.
	Disturbance History/Regime	Frequency, duration, and magnitude of stochastic disturbance events are close to reference condition. The following factors should be considered in rating the Watershed Disturbance/Regime indicators: (1) overall watershed disturbance as determined through CWE modeling, (2) road density and location, (3) current impacts from past stand-replacing forestry, mining, and intense fires, (4) departure from historic fire regime, (5) departure from historic vegetation structure and composition, and (6) character of development on private property. For properly functioning, a watershed should have low CWE and road density (all models under "1" threshold), few impacts from past stand-replacement forestry or intense fire, are not significantly departed from historic vegetation/fuels condition and fire regime, and/or have low disturbance on private property.	In at-risk watersheds, frequency, duration, and magnitude of stochastic disturbance events are moderately departed from reference condition. At-risk watersheds have moderate to high CWE and road density (one or two models over "1" threshold), some significant impacts from past stand-replacement forestry or intense fire, are moderately departed from historic vegetation/fuels condition and fire regime, and/or have moderate disturbance on private property.	In not properly functioning watersheds, frequency, duration, and magnitude of stochastic disturbance event is significantly departed from reference condition. Not properly functioning watersheds have high CWE and road density (all models over "1" threshold), significant impacts from past stand-replacement forestry or intense fire, are significantly departed from historic vegetation/fuels condition and fire regime, and/or have significant disturbance on private properties.
Summary Integration of all species and habitat indicators effects	How do the effects to indicators affect each fish species and their habitat? Describe by species and by 7th and 5th-field watersheds. See AP guidance. In addition to the narrative summary, use Summary Table in Tables required for BA/BE.			

Footnotes to Table Above: *Table of Population and Habitat Indicators For Use on the Klamath National Forest in the Northwest Forest Plan Area, as adjusted from Appendix A in the Analytical Process*.

1) (Temperature) Proper Functioning criteria for 4th -5th Order streams is derived from temperature monitoring near the mouth of streams of relatively undisturbed watersheds (Clear, Dillon, and Wooley Creeks). –Maximum Weekly Maximum Temperatures (MWMT) as high as 70.5 degrees F have been recorded on these streams (EA Engineering, 1998 Salmon River and Dillon Creek Watershed Fish Habitat and Channel Type Analysis, Appendix 2). At-Risk criteria for 4th/5th order streams is derived from monitoring in streams that support populations of anadromous fish, although temperatures in this range (70.5 to 73.5 degrees F) are considered sub-optimal. The Not Properly Functioning criterion is sustained temperatures above 73.5 degrees F - that causes cessation of growth and approach lethal temperatures for salmon and steelhead. Properly Functioning criteria for 1st - 3rd order streams is derived from Desired Future Conditions (DFC) values given in the LRMP EIS p 3-68. At Risk and Not Properly Functioning criteria for 1st – 3rd order streams are assigned on a temperature continuum with values given for 4th/5th order streams, with the maximum instantaneous temperature of At Risk 1st - 3rd order streams coinciding with the minimum MWMT of 4th/5th order At Risk streams. [Stream Order according to Strahler (1957).]

(2) (Chemical/Nutrient Contamination) For projects within the river corridors of the mainstem Scott, Salmon, and Klamath Rivers the criteria is unchanged from AP Table. For tributaries to the Scott, Salmon, and Klamath Rivers use the criteria from the AP table. Although these tributaries have CWA 303d designation, Klamath National Forest tributaries are typically properly functioning for dissolved oxygen, nutrients, and microcystin, and because temperature and sediment is assessed in the Temperature and Substrate Character Indicators. Chemical contamination and nutrients should be assessed for Scott, Salmon, and Klamath River tributaries.

(3) (Substrate Character) Use recent stream survey data where available. Properly Functioning criteria for % fines in gravel is from the LRMP EIS p 3-68. Additional Forest-wide desired conditions for sediment (pool sediment, subsurface sediment) are described by Laurie and Elder (2012) in relation to monitoring for TMDL and NCRWB water quality standards. When location-specific information is unavailable, use the following as best appropriate: use USLE and GEO models to determine functioning level of Indicator and potential effects of sediment delivery to streams that may affect anadromous fish and their habitat, infer substrate character functioning level from other factors such as high road density and degree of hydrologic connection, recent large intense wildfires, and recent (last 20 years) debris flows that altered channels, and lastly use professional judgment to describe existing conditions and to estimate effects based upon model output interpretation, research results, or other information. The KNF CWE modeling procedure describes the risk (probability) of project-caused sediment production (see 2004 CWE process paper, by Elder and Reichert, in fisheries sufficiency guides). For existing condition and effects of the action:

1. Properly Functioning: USLE and GEO values are less than 1.0
2. At Risk: USLE and GEO values are between 1.0-1.20
3. Not Properly Functioning: USLE and GEO values are greater than 1.20

(4) (Large Woody Debris) See KNF LRMP EIS Chapter 3, text and tables on Pages 68-69. For

stream reaches on the Westside of the Forest, manage for an average of 20 pieces of large wood per 1,000 ft in 3-5th order streams (LRMP Page 4-143). Large wood is defined as a minimum length of 50 feet and diameter of 24 inches on the Westside. However, site potential and channel width must be considered rather than using strict numbers. Also consider the potential for future LWD recruitment in both the short- and long-term.

Criteria for length of LWD for larger streams may be based on average bankfull channel width of the reach: in streams larger than 3rd order a piece of woody debris may qualify as large woody debris in a stream reach if its length is 1.5 times the average bankfull channel width, or if it has a rootwad attached and its length is 1¼ times the average bankfull channel width. Stable pieces of woody debris remain stationary during normal to high flows. Channel width and depth largely determines whether large woody debris recruited into a stream reach will be stable, and largely determines the average size of wood retained in streams (Bilby and Ward 1989, 1991; Robison and Beschta 1990). As channels become wider and deeper, the average size of a stable piece of wood increases. Pieces shorter than bankfull width and with a diameter less than bankfull depth are more likely to be transported out of a reach by streamflow (Bilby 1984, Braudrick et al. 1997). Length of woody debris appears to be most important to its stability where stream discharge is sufficient to float large diameter stems (Bilby 1985, Swanson and others 1984). Branches and/or rootwads, if still attached, add to the stability of woody debris. Therefore, criteria for length of LWD for larger streams may be based on average bankfull channel width of the reach: in streams larger than 3rd order a piece of woody debris may qualify as large woody debris in a stream reach if its length is 1.5 times the average bankfull channel width, or if it has a rootwad attached and its length is 1¼ times the average bankfull channel width.

(5) (Pool Quality and Frequency) A measurable pool is an area of channel which (1) shows clear signs that the pool was created by scour at high flows and/or that the pool is the result of the channel being dammed at the downstream end; (2) has a significant residual depth - the deepest part of the pool must be at least twice as deep as the water flowing out of the pool at the riffle crest; (3) has an essentially flat water surface during low flow - water surface slope <0.05 percent; and (4) includes most of the channel - it must include the thalweg and occupy at least half of the width of the low-flow channel. "Primary" pools are defined by their maximum depth in relationship to size or stream order. As the order or size of the stream increases the required minimum depth for a primary pool increases. In 1st through 3rd order streams, a primary pool must have a minimum depth of two feet or greater. In 4th and 5th order streams, a primary pool must have a minimum depth of three feet. In 6th order and larger streams, a primary pool must have a minimum depth of four feet.

(6) (Width/Depth Ratio) The Width-to-Depth ratio for various channel types is based on delineative criteria of Rosgen (1996). Properly Functioning means that Width-to-Depth ratio falls within expected channel type as determined by the other four delineative factors (entrenchment, sinuosity, slope, and substrate). Aggradation on alluvial flats causing braiding is well known phenomenon that often accompanies changes in Width-to-Depth ratio as watershed condition deteriorates. Stream width is a function of streamflow occurrence and magnitude, size and type of transported sediment, and the bed and bank materials of the channel (Rosgen 1996). Channel widths generally increase with flow volume downstream. Channel widths can be modified by changes in riparian vegetation, landslides particularly debris flows, changes in streamflow regimes, and changes in sediment supply. The AP Table indicates that confined or

entrenched channel types (such as A, G, and E types) are Properly Functioning when Width-to-Depth ratios are <12, and wider channel types (such as B, C, and F types) are Properly Functioning when Width-to-Depth ratios are >12. To meet the Properly Functioning criteria channels must also have no or minimal braiding due to excessive sediment.

(7) (Peak/Base Flows) In most cases, sufficient hydrograph data is not available to determine comparative changes in peak flows as suggested in the AP. Infer changes in **peak flows** when no hydrograph data is available by considering the following factors: (1) CWE runoff model (ERA/TOC) outputs, (2) road density and the degree of hydrologic connectivity between the road system and the stream network, and (3) number, size, and vintage of openings in the forest canopy resulting from past stand-replacement forestry in the snow-rain transition zone where increased openings can result in elevated runoff from rain-on-snow events. The potential for decreased **base flows** in the Project HUC7 watersheds should be evaluated by considering the following factors: (1) increased/decreased evapotranspiration due to denser/sparser vegetation than reference condition that has resulted from stand-replacement forestry and/or fire suppression, (2) number and size of water diversions, and (3) degree of hydrologic connectivity between the road system and the stream network (watersheds with high road density likely have reduced base flows due to impervious surfaces and groundwater interception in road cuts).

(8) (RRs) The following factors should be considered in determining the condition of stream buffer (hydrologic) RR: (1) amount and age of past stand-replacement forestry or intense fire in stream buffers, (2) road and landing density in stream buffers, (3) mining in stream buffers, (4) departure from historic fire regime, (5) condition of riparian vegetation for providing shade, large woody debris, sediment-filtering, and nutrient cycling, and (6) the amount of overall disturbance in the watershed particularly as estimated by the peak flow (ERA) and mass wasting (GEO) models. The following two factors should be considered in determining the condition of geologic RR: (1) amount and age of past stand-replacement timber harvest and/or recent intense wildfire on geologic RR and (2) road and landing density on geologic RR.

Appendix D: Environmental Baseline Checklists – 5th Fields

Table of Pathway and Indicators
Beaver Creek 5th field watershed

Pathways: INDICATORS	ENVIRONMENTAL BASELINE Beaver Creek 5th Field watershed			EFFECTS OF THE ACTION(S) Beaver Creek 5th Field watershed		
	PROPERLY FUNCT	AT RISK	NOT ROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature		**TEMP**				
Sediment-Turbidity			**SED KNF CWE PO/PJ**			
Chemical Contamination	**ND/PO/PJ**					
Habitat Access Physical Barrier	**FPI**					
Habitat Elements Substrate Character			**SED KNF CWE PO/PJ**			
Large Woody Debris			**SS89 KNF GIS PO/PJ**			
Pool Frequency/Quality			**KNF GIS SS06 PO/PJ**			
Off-channel Habitat		**PO/PJ**				
Refugia		**TEMP SS89 PO PJ**				
Channel Cond & Dyn Width-to-Depth Ratio			**SS89 Flood PO/PJ**			
Streambank Condition			**KNF GIS Flood PO PJ**			
Floodplain Condition		**PO/PJ**				
Flow /Hydrology Change in Peak/Base			**KNF GIS RSS**			
Drainage Network Increase			**KNF GIS RSS**			
Watershed Cond. Road Density/Location			**KNF GIS RSS**			
Disturbance History/Regime			**KNF GIS Flood RSS**			
Riparian Reserves			**KNF GIS RSS PO/PJ**			

TEMP = Water temperature monitoring at RM 0.8 and RM 5.8 of mainstem Beaver Creek from 2010 to 2014, and water temperature monitoring of West Fork Beaver Creek at RM 0.8 from 2010 to 2014;
SS89 = 1989 KNF stream survey of mainstem Beaver Creek from mouth to Grouse Creek Confluence (9 miles);
SED = 2009, 2010, 2013 sediment assessment survey; **RSS =** KNF Road Sediment Source Inventory and Risk Assessment;
FPI = KNF Forest-Wide Fish Passage Barrier Inventory; **Flood** = KNF analysis of the 1997 New Year Flood; **ND** = No Data;
PJ = Professional Judgement; **PO** = Personal Observation based on 20+ years observing; **NA** = Not Applicable;
KNF GIS = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015);
Environmental Baseline and Checklist last updated by Jon Grunbaum on April 3, 2015.

The Beaver Creek 5th-field (HUC10) watershed is a true watershed with an area of 69,610 acres. The Beaver Creek watershed is 64% National Forest land and the rest is mostly private industrial timberland. About 2% of the watershed is private residential. There is a 300-acre parcel of BLM land. The mainstem of Beaver Creek from the mouth to the confluence of West Fork Beaver Creek at RM 5.7 is a 5th-order (Strahler 1957) stream. This entire length of mainstem provides spawning and rearing habitat for Coho and Chinook salmon, and steelhead trout. The lower reaches of mainstem Beaver Creek provides thermal refugia for juvenile salmonids as does the creeks cold water plume at the confluence with the Klamath River. Based on recent annual spawning surveys: (1) Chinook salmon spawn in the lower two miles of mainstem Beaver Creek upstream of the West Fork confluence, and Coho salmon spawn in the lower half mile of mainstem Beaver Creek upstream of West Fork; (2) Chinook and Coho salmon spawn in the lower 2.5 miles of West Fork Beaver Creek; and (3) none of the other tributaries to mainstem Beaver Creek or mainstem WF Beaver Creek are known to support salmon. Steelhead utilize and mainstem habitats as well as these tributaries: Jaynes Canyon Creek, Bear Creek, Hungry Creek, Grouse Creek, and Cow Creek. The only current stream survey in the Beaver watershed was a physical and biological assessment of the lower few miles of Hungry Creek in 2010. Otherwise, the most recent surveys were 1989 stream surveys of mainstem Beaver Creek and West Fork Beaver Creek. Stream surveys prior to the 1997 Flood are not very reliable for portraying current condition because the 1997 Flood altered many of the stream channels and stream buffer, and altered substrate composition (but still useful for describing trend). Channel sediment metrics were assessed in 2009, 2010, and 2013 but those metrics are less reliable now for describing current condition because excess sediment has already been delivered to the channel as a result of the 2014 Beaver Fire (but still useful for describing trend).

Beaver Creek 5th-Field (HUC10) Watershed Environmental Baseline Elements:

WATER QUALITY

Water Temperature: From 2010 to 2014, summer water temperature of mainstem Beaver Creek was monitored just upstream from the mouth and at RM 5.8 (just above the West Fork Beaver Creek confluence); and summer water temperature of mainstem West Fork Beaver Creek was monitored just upstream from the mouth at about RM 0.8. The results of this monitoring is shown in the three tables below.

Recent Water Temperature Monitoring Results for Mainstem Beaver Creek Near Mouth						
Start	**End**	**Max Daily Max Temp C**	**Max Average Daily Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp C (MWMT)**
10/8/2009	10/26/2010	19.5	17.1	5.2	16.9	18.9
6/10/2011	10/5/2011	18.0	15.9	4.3	15.7	17.7
6/15/2012	11/1/2012	20.3	18.0	4.7	17.4	19.6
6/11/2013	10/31/2013	21.7	19.1	5.1	18.5	20.7
6/3/2014	9/23/2014	23.2	20.3	6.3	19.6	22.4

Recent Water Temperature Monitoring Results for Mainstem Beaver Creek at RM 5.8						
Start	**End**	**Max Daily Max Temp C**	**Max Average Daily Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp C (MWMT)**
6/27/2010	10/3/2010	17.9	16.4	4.8	16.1	17.5
6/22/2011	10/3/2011	16.6	15.1	5.5	14.9	16.1
6/15/2012	10/31/2012	18.2	17.0	4.5	16.4	17.7
6/11/2013	10/15/2013	19.1	17.8	4.1	17.2	18.4
6/3/2014	10/6/2014	20.3	18.8	4.1	18.3	19.8

Recent Water Temperature Monitoring Results for WF Beaver Creek at RM 0.8						
Start	**End**	**Max Daily Max Temp C**	**Max Average Daily Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp C (MWMT)**
6/28/2010	10/2/2010	15.2	16.7	4.2	15.0	16.3
6/23/2011	10/2/2011	15.3	14.2	4.7	14.0	15.0
6/16/2012	10/31/2012	17.2	16.1	4.1	15.6	16.8
6/11/2013	10/15/2013	18.3	16.8	3.9	16.1	17.5
6/3/2014	10/6/2014	18.9	17.4	4.2	16.9	18.5

As shown in the tables above: (1) water temperature in mainstem Beaver Creek at RM 5.8 and mainstem WF Beaver Creek at RM 0.8 was within the properly functioning range from 2010 to 2014 and (2) water temperature in mainstem Beaver Creek at RM 0.9 was within the properly functioning range from 2010 to 2013 but was in the At-Risk range in 2014. Near record low base flows in summer 2014 may have been a primary factor in high water temperatures and large diurnal temperature variation. It is likely that the rate and magnitude of stream heating and cooling will increase due the 2014 Beaver Fire because: (1) the wildfire burned large swaths of riparian vegetation that had provided shade to stream channels, (2) pools are likely to infill or partially infill with excess sediment which will increase surface area to volume ratio, and (3) the

wildfire is likely to significantly increase the frequency of in-channel debris flows and upslope landslides that can remove riparian vegetation and widen-and-shallow stream channels. **At-Risk**.

Sediment - Turbidity: From annual snorkel fish census surveys through the years it is well documented that mainstem Beaver Creek is turbid with fine suspended sediment even after long periods of low flow – underwater visibility is low with a range of about five or six feet during the most optimal conditions. High watershed disturbance from past vegetation management projects (particularly clearcutting on private timberlands) and the extensive road system are likely the cause of persistent turbidity but no point sorces are known.

The results of 2009, 2010, and 2013 intensive monitoring and evaluation of sediment in mainstem Beaver Creek and mainstem West Fork Beaver Creek that included the metrics: percent surface fines < 2mm, percent sub-surface sediment < 0.85mm, percent sub-surface sedient < 6.38mm, and percent residual pool volume filled with fine sediment (V*), are shown in the three tables in the Substrate Character section below. Substrate quality impairment is evaluated, in part, by comparing the four sediment indicators in mainstems of Beaver Creek and West Fork Beaver Creek to the 85th percentile value of four indicators for reference streams that have minor to negligble management-related watershed disturbance. Watersheds exceeding the 85% percentile of reference streams are considered impaired. One to two sediment indices exceeded reference values in all the sites/survey years that were assessed.

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2010 and 2013 Beaver Creek response reach (beav1) compared to KNF Stream Sediment Monitoring reference conditions (85th percentile). (beav1) metrics over threshold values are bolded.

Sediment Index	2010 beav1 reach average %	2013 beav1 reach average %	Reference Condition (%)
Surface Fines < 2mm	3.0	2.4	6.4
Sub-surface fines < 0.85mm	**18.2**	**18.2**	16.2
Sub-surface fines < 6.38mm	44.2	**47.4**	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	0.053	0.056	0.108

Post 2014 Beaver Fire water quality and sediment conditions in lower mainstem Beaver Creek and lower West Fork Beaver Creek were observed and photographed in the winter after several light to moderate precipitation events: the observations and photographs revealed that (1) turbidity was very high during and long- after precipitation events and (2) large quantities of fine sediment had been delivered to the mainstem which had partially smothered the pre-Fire streambed and salmonid spawning gravels. The 2014 Fire increased the actual rate of surface erosion as well as the modeled rate of surface erosion to well over threshold (USLE = 1.16). Increase in the frequency, magnitude and duration of turbidity due to increased surface erosion due to the 2014 Beaver Fire is likely last for a few years to a decade or more until vegetation gets re-established and ground cover is largely recovered in burned areas. Modeled mass-wasting is over threshold (GEO = 1.07). The rate of mass wasting that can cause bouts of acute turbidity will likely be increased for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots. **Not Properly Functioning**.

Chemical Contamination: No significant source of chemical contamination is known to exist on National Forest lands. No known significant source of chemical contamination is suspected from private lands. **Properly Functioning**.

HABITAT ACCESS

Physical Barriers: There are no barriers to fish passage. **Properly Functioning**.

HABITAT ELEMENTS

Substrate Character: Substrate character was determined: (1)intensive evaluation of substrate composition in 2009, 2010, and 2013; (2) from CWE modeling; and (3) from personal observation of surface substrate composition after the 2014 Beaver Fire and a few light to moderate rainstorms.

Sediment composition was intensely evaluated at three sites within the Beaver Creek HUC10 watershed since 2009. The metrics evaluated were: percent surface fines < 2mm (medial axis), percent sub-surface sediment < 0.85mm, percent sub-surface sediment < 6.38mm, and percent residual pool volume filled with fine sediment (V*). The results of these evaluations are shown in the tables below. Substrate quality is judged in part by comparing the value of the four sediment indicators in Beaver Creek (a managed watershed) to the 85th percentile value of the indicators for reference streams that have minor to negligble management-related watershed disturbance. Stream reaches exceeding the 85% percentile of reference streams may be impaired. One to two sediment indices exceeded reference values in all the sites/survey years that were assessed.

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the lower Beaver Creek response reach (beav1) in 2010 and 2013 compared to KNF stream sediment monitoring reference conditions (@85 percentile). beav1 metrics over reference values are bolded.

Sediment Index	2010 beav1 reach average (%)	2013 beav1 reach average (%)	Reference Condition (%)
Surface Fines < 2mm	3	2.4	6.4
Sub-surface fines < 0.85mm	**18.2**	**18.2**	16.2
Sub-surface fines < 6.38mm	44.2	**47.4**	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	0.053	0.056	0.11

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the upper Beaver Creek response reach (beav2) in 2010 and 2013 compared to KNF stream sediment monitoring reference conditions (@85 percentile). beav2 metrics over reference values are bolded.

Sediment Index	2010 beav2 reach average (%)	2013 beav2 reach average (%)	Reference Condition (%)
Surface Fines < 2mm	3.6	6.3	6.4
Sub-surface fines < 0.85mm	16.0	**19.3**	16.2
Sub-surface fines < 6.38mm	44.0	44.4	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	0.076	0.074	0.11

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the mainstem West Fork Beaver Creek response reach (wfbea1) in 2009 and 2013 compared to KNF stream sediment monitoring reference conditions (@85 percentile). wfbea1 metrics over reference values are bolded.

Sediment Index	2009 wfbea1 reach average (%)	2013 wfbea1 reach average (%)	Reference Condition (%)
Surface Fines < 2mm	3.1	6.1	6.4
Sub-surface fines < 0.85mm	**16.9**	**20.1**	16.2
Sub-surface fines < 6.38mm	45.6	45.5	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	**0.143**	0.124	0.11

Post 2014 Beaver Fire water quality and sediment conditions in lower mainstem Beaver Creek and lower West Fork Beaver Creek were observed and photographed in the winter after several light to moderate precipitation events: the observations and photographs revealed that (1) turbidity was very high during and long- after precipitation events and (2) large quantities of fine sediment had been delivered to the mainstem which had partially smothered the pre-Fire streambed and salmonid spawning gravels. The 2014 Fire increased the actual rate of surface erosion as well as the modeled rate of surface erosion to well over threshold (USLE = 1.16). Increase in the frequency, magnitude and duration of turbidity due to increased surface erosion due to the 2014 Beaver Fire is likely last for a few years to a decade or more until vegetation gets re-established and ground cover is largely recovered in burned areas. Modeled mass-wasting is over threshold (GEO = 1.07). The rate of mass wasting that can cause bouts of acute turbidity will likely be increased for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots. **Not Properly Functioning**.

Large Woody Debris: There is no current quantitative information on LWD and potential for future LWD recruitment to the stream, however, according to a 1989 stream survey there was 1.5 pieces of LWD per 1000 lineal feet on the mainstem between the mouth and Grouse Creek. That is well below the 20 pieces/1000 feet that is desired condition in the Forest Plan or the 20 pieces/mile that is the bare minimum for Properly Functioning is the Table of Habitat Indicators. Late in the 1980s it was recognized that there was a lack of sufficient LWD in fish-bearing

reaches in the Beaver Creek watershed. By 1996 over 340 LWD structures were installed in the mainstem Beaver, West Fork, and Cow Creeks in an attempt to make up for lack of LWD but these structures have almost entirely been blown out by high water, floods, and debris flows.

Currently and qualitatively, there is very little effective LWD in the mainstem channel and little potential for future LWD recruitment (personal observation made during numerous salmon and steelhead census surveys of mainstem Beaver Creek). The density of LWD in West Fork is greater than that of the mainstem but still well below desired condition.

Existing down LWD and standing large green conifer trees or snags are likely reduced in the stream channel and stream buffer due: (1) a "stream cleaning" program that removed LWD from stream channels after the 1964 Flood, (2) easy access to standing live and dead trees at the very high density of stream crossings, (3) easy access to standing live and dead trees along stretches of valley bottom and inner gorge road within stream buffer RRs, (4) past (Forest Service and private) and current (private) clear cutting close to a stream channel, (5) clearing in the Beaver Creek streamside campground, and (6) clearing and disturbance on private property (about half of the land adjacent to mainstem Beaver Creek is private).

Based on these factors, it is my professional opinion that the LWD indicator is **Not Properly Functioning**.

Pool Frequency and Quality: There were 26 pools in the 6.2 miles of mainstem Beaver Creek within the Buckhorn-Beaver composite watershed that was surveyed in 1989 with an average maximum pool depth of 3.6 feet. Assuming the average bankfull width was 36 feet there was one pool every 35 bankfull widths, however, the frequency of deep pools (over three feet maximum depth) would be less. Pool frequency was low most likely due to lack of LWD, infilling with excessive sediment from a highly disturbed watershed, and/or extirpation of Beaver (Lanman et.al., 2013) . These factors still exist today. There is still very little LWD in stream channels and low potential for LWD in the near future. Pool filling from excessive sedimentation is expected to increase over the next ten years or more due to elevated surface erosion and increased mass wasting associated with the 2014 Beaver Fire that burned large swaths of vegetation at moderate to high intensity. Modeled surface erosion and mass wasting risk are over threshold (USLE = 1.28; GEO = 1.16). Sedimentation into Beaver Creek has already significantly increased due to the 2014 Beaver Fire.

Aquatic habitat in Beaver Creek was likely much different before fur trapping and European settlement due to beaver activity. Beaver Creek likely had numerous beaver dams which created pools and prime habitat for salmonids. Pool frequency and quality was likely much higher before trapping and settlement. There are still some beaver left in (or migrated back into) Beaver Creek but the population is slow to rebound probably because of continued trapping but also because of streamside disturbance, lack of in-stream key pieces of LWD, and lack of large recruit-able streamside trees greatly diminishes beaver habitat suitablity. **Not Properly Functioning**.

Off-Channel Habitat: Much of the channel of mainstem Beaver Creek is constrained with little potential for floodplain and off-channel habitat development. Most of the unconstrained reaches are on private land where the floodplain is cut-off and the potential for off-channel habitat is restricted by existing roads, berms, and current human activities. There are a few areas where there is functioning off-channel habitat. **At-Risk**.

Refugia: Cold water and cover are the primary elements of salmonid refugia in this watershed. Prior to 2013 summer water temperature was suitable to optimal at all monitoring locations on the mainstem and West Fork. Water temperature was slightly high at the mouth in 2013 and 2014 but still suitable for rearing and for thermal refugia from the Klamath River. Cover is sparse in the lower reaches mainstem Beaver Creek where it is needed most to increase the carrying capacity of the cold thermal refugia. Cover is sparse in these reaches because: (1) the channel has been simplified in order to keep it aligned with the Highway 96 bridge; (2) there are few pools or slack-water areas, and (3) there are few streamside conifer and very little LWD. **At-Risk**.

CHANNEL CONDITION AND DYNAMICS

Width to Depth Ratio: (same discussion as the Pool Frequency/Quality indicator above).
Not Properly Functioning.

Stream Bank Condition: Streambanks are degraded at: (1) numerous stream crossings, (2) where roads and berms are constructed within the stream buffer and inner gorge, (3) adjacent to mainstem Beaver Creek where residences have cleared, compacted, or otherwise modified the streambank, and (4) at the campground where the streambank is a berm and where large conifers on the streambank are removed as hazard trees before they have a chance to be recruited to the stream by streamside residents. There are long stretches of road next to mainstem Beaver Creek, West Fork Beaver Creek, and Hungry Creek where the road fill constitutes on bank of the stream. The 2014 Beaver Fire burned 1,977 acres of vegetation in stream buffer RRs at moderate to high intensity. **Not Properly Functioning**.

Floodplain Connectivity: Much of the channel of mainstem Beaver Creek is constrained with little potential for floodplain and off-channel habitat development. Most of the unconstrained reaches are on private land where the floodplain is cut-off and the potential for off-channel habitat is restricted by existing roads, berms, and current human activities. There are a few areas where there is functioning off-channel habitat. **At-Risk**.

FLOW/HYDROLOGY

Change in Peak/Base flow: Modeled runoff risk is just over threshold (ERA/TOC = 1.01) primarily due to vegetation management, roads, and wildfires (in that order). The firelines are mostly not hydrologically-connected. Increased peak flow due to all these factors combined is likely significant. Base flows are reduced in summer due to State-authorized and riparian water diversions. **Not Properly Functioning**.

Increase in Drainage Network: Road density is very high and hydrologic connectivity of the road system to the stream network ranges from 2% to 54% in the eleven HUC14s (see table below) with an average of 18% across all HUC14s in the HUC10. Therefore, there is likely significant increase in drainage network density due to roads. Fire-lines constructed in attempting to suppress the 2008 and 2014 fires have no or minor hydrologic connectivity with the stream network. **Not Properly Functioning.**

Percent of road system hydrologically-connected to stream network by HUC14 watershed	
HUC14 Name	**Hydrologically Connected Road**

Buckhorn-Beaver	21%
Deer Creek-Beaver Creek	54%
Dutch Creek	36%
Grouse Creek	10%
Hungry Creek	2%
Jaynes Canyon	16%
Lower Cow Creek	11%
Lower West Fork Beaver Creek	22%
Soda Creek-Beaver Creek	10%
Upper Cow Creek	12%
Upper West Fork Beaver Creek	14%

WATERSHED CONDITION

Road Density/Location: Road density is very high at four miles road per square mile watershed. There are over 10 miles of valley-bottom road in the watershed and many additional miles within inner gorge. **Not Properly Functioning**.

Disturbance History/Regime: Much of the northeast quadrant of the watershed was clearcut logged between 1909 and 1931 using railroads to transport logs out of the drainage. There was a period of intense logging from 1955 to 1995 during which 11, 480 acres were clearcut and much of the present road system was constructed. The forest that has regenerated or was planted has developed into over-dense nearly even-aged conifer stands with low vegetative diversity. Fire suppression likely contributed to the low diversity in these regenerated stands. Much of this even-age stand is industrial timberland and the timber owners have been and are still in the process of clearcutting it. The even-age stands on National Forest are very dense and starting to self-thin and the Forest Service has been thinning and reducing fuels in some of the stands.

The last major fire before the 2014 Beaver Fire was the 1955 Dutch Fire (a.k.a. the Haystack Fire) that burned about 1,000 acres along the lower reach of mainstem Beaver Creek. Mining and grazing impacts were intense in the early- to mid-1900s and had major impacts on erosional processes and aquatic habitat. The primary effect of historic railroad logging and intense grazing and mining on watershed processes is slow (or no) vegetative regeneration in highly disturbed areas, but the current magnitude of this effect is small and likely has minor impact on the quality of aquatic habitats beyond the site or stream reach scale.

Approximately 21 miles of stream channel was altered by high water and debris flows during the 1997 Flood which is about 10% of all channels in the watershed. The 1997 Flood triggered 67 major road failures in the Beaver Creek watershed some of which caused or contributed to the channel-altering debris flows, and all of which contributed to excessive sediment delivery to stream channels. 1997 Flood-altered channels are likely slow to recover because watershed disturbance is still very high. The 2014 Beaver Fire disturbance has setback recovery of the stream channel and aquatic habitats by increasing the rate of chronic sediment delivery. The 2014 Fire is likely to increase the rate of channel-altering debris flows for the next ten years or longer.

Currently, watershed disturbance is high primarily due to: (1) vegetation management (clear-cutting on private lands and thinning and fuels reduction on National Forest); (2) the high density road system; and (3) the 2014 Beaver Fire that burned approximately 7,407 acres at moderate to high intensity. Several miles of fire-lines were constructed or re-constructed in attempts to suppress the fire. Modeled watershed disturbance is over threshold in all three models at the HUC10 scale: surface erosion risk (USLE = 1.16); mass wasting risk (GEO = 1.07); and runoff risk (ERA/TOC = 1.01). The source of disturbance in the mass wasting model and runoff models is first and foremost from vegetation management projects followed closely by roads with wildfires a not so distant third source. The source of disturbance in the surface erosion model is primarily the road system with wildfire and vegetation management having minor influence. Firelines were a very minor source of disturbance in the surface erosion and runoff models and accounted for less than 4% of the disturbance in the mass wasting model. **Not Properly Functioning**.

Riparian Reserve: Stream buffer RRs are degraded at: (1) numerous upslope stream crossings and numerous valley bottom and/or inner gorge roads – road density in stream buffer RRs is over 4 miles road per square mile stream buffer RR; (2) the campground (streamside on the mainstem), (3) on private property (about half of the land adjacent to mainstem Beaver Creek downstream from West Fork is private), and (4) on industrial timberlands (nearly half of the Beaver Creek HUC10 is industrial timberland where stream buffers are narrow).

The 2014 Beaver Fire burned 1,977 acres of stream buffer RR at moderate-to-high severity and these areas are in initial or early stage of recovery depending on site condition and site potential. This much moderate and high intensity fire in hydrologic RRs, coupled with a high-density road system, is expected to significantly: (1) decrease hydrologic retention, (2) decrease the sediment filtering and nutrient spiraling function of riparian vegetation compromising the potential of hydrologic RRs to buffer the stream from upslope ground disturbances and landslides, and (3) increase streamside landsliding.

The 2014 Beaver Fire burned 934 acres of geologic RR as follows: 38 acres active landslide; 192 acres toe-zone; and 704 acres inner gorge. Many of the acres of moderate to high severity burned inner gorge are within the 1,977 acres of stream buffer RR that burned at moderate-to-high severity. **Not Properly Functioning**.

Table of Pathway and Indicators
Elk Creek 5th field watershed

Pathways: INDICATORS	ENVIRONMENTAL BASELINE Elk Creek 5th Field watershed			EFFECTS OF THE ACTION(S) Elk Creek 5th Field watershed		
	PROPERLY FUNCT	AT RISK	NOT ROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature		**TEMP**				
Sediment-Turbidity		**SED KNF CWE PO/PJ**				
Chemical Contamination	**ND/PO/PJ**					
Habitat Access Physical Barrier	**FPI**					
Habitat Elements Substrate Character		**SED KNF CWE PO/PJ**				
Large Woody Debris		**SS06 KNF GIS PO/PJ**				
Pool Frequency/Quality		**KNF GIS SS06 PO/PJ**				
Off-channel Habitat	**NA**					
Refugia		**TEMP SS06 PO PJ**				
Channel Cond & Dyn Width-to-Depth Ratio		**SS06 Flood PO PJ**				
Streambank Condition			**KNF GIS Flood PO PJ**			
Floodplain Condition	**NA**					
Flow /Hydrology Change in Peak/Base		**KNF GIS RSS**				
Drainage Network Increase		**KNF GIS RSS**				
Watershed Cond. Road Density/Location		**KNF GIS RSS**				
Disturbance History/Regime		**KNF GIS Flood RSS**				
Riparian Reserves			**KNF GIS RSS PO PJ**			

TEMP = Water temperature monitoring at RM 0.5 and RM 4.5 of mainstem Elk Creek from 1990 to 2014;
SS06 = 2006 KNF stream survey of mainstem Elk Creek from mouth to Bear Creek Confluence (13 miles);

The Elk Creek 5th-field (HUC10) watershed is a true watershed with an area of 60,829 acres. The Elk Creek watershed is over 97% National Forest land and about 3% private or local government. The national forest land has been used for timber production or is in wilderness. The private land is mostly residential with low ground disturbance, however: one large upslope parcel has a several-acre auto wrecking yard complete with hundreds of old cars and noxious weeds; one streamside several acre parcel is the intake facility and water treatment plant for the town of Happy Camp; and one large (10-20 acres) streamside parcel is a commercial campground. The mainstem of Elk Creek is a 5th-order (Strahler 1957) stream from the mouth to East Fork Elk Creek and a 4th-order stream from East Fork Elk Creek to Granite Creek. Mainstem Elk Creek provides approximately 13 miles of habitat for Coho salmon; 12 miles for fall Chinook salmon; 14 miles for spring Chinook salmon; and steelhead throughout the entire mainstem. Several tributaries to mainstem Elk Creek are fish-bearing: East Fork Elk Creek is 4th-order stream that provides 0.4 miles of habitat for Coho salmon and about 2.5 miles of habitat for steelhead/rainbow trout; Twins Creek (1st-order) provides a couple tenths of a mile of habitat for steelhead/rainbow trout; Cougar Creek (2nd-order) provides a few tenths of a mile of habitat for Coho salmon and steelhead/rainbow trout; Bear Creek provides about 0.5 mile of habitat for steelhead trout and several miles of habitat for rainbow trout (some brook trout higher up in the reaches downstream from Bear Lake); Granite and Rainey Valley Creeks are 2nd-order streams that each provide several tenths of a mile of habitat for steelhead trout and a little more for rainbow trout. The other named tributaries to the mainstem (Stanza, Malone, Doolittle, Johnson, Lick) provide a few tenths or less of habitat for steelhead/rainbow trout. None of the un-named tributaries to the mainstem are fish-bearing. The last stream survey of mainstem Elk Creek was in 2006 and went from the mouth to Bear Creek (13.9 miles). The last stream survey of East Fork Elk was in 1990. Bear, Granite, and Burney Creeks were surveyed in 1994 and 1995. Stream surveys prior to the 1997 Flood are not very reliable for portraying current condition because the 1997 Flood altered many of the stream channels and stream buffer, and altered substrate composition. Channel sediment metrics were assessed in 2009, 2011, and 2012 but those metrics are less reliable now for describing current condition because excess sediment has already been delivered to the channel as a result of the 2014 Fire (but still useful for describing trend).

Elk Creek 5th-field (HUC10) Watershed Environmental Baseline Elements:

WATER QUALITY

Water Temperature: Summer (and some winter) water temperature of mainstem Elk Creek was monitored within the Hoop&Devil HUC14 at approximately RM 4.5 nearly every year since 1990 (no data for 1996). Summer water temperature of the mainstem within the HUC14 was monitored near the mouth at RM 0.5 since 2011. The 1997 flood greatly altered the mainstem channel of Elk Creek – resulting in widening and shallowing of the channel, and loss of streamside vegetation. Much of mainstem Elk and several tributaries to mainstem Elk Creek

experienced large debris flows that scoured and altered their channels and ripped out riparian vegetation. Excess sediment from numerous natural debris torrents, and from over 200 road failures, resulted in excessive bedload which overwhelmed and altered the channel of mainstem Elk Creek. The loss of riparian vegetation and narrowing/widening of the stream channel increased the range and magnitude of daily heating and cooling – as described in the assessment: *The Flood of 1997- Klamath National* Forest (USDA KNF, November 1998). Riparian and channel recovery was still taking place when the 2014 Fire hit. Before the 1997 Flood: from 1990 to 1995, the 7-day maximum water maximum temperature (MWMT) 18.7 ^{o}C to 21.8 ^{o}C, with six-year average of 20.8^{o}C. After the 1997 Flood: from 1997 to 2004, the MWMT ranged from 20.1 ^{o}C to 23.7 ^{o}C, with eight-year average of 22.9^{o}C. Since then, the 2008 Panther Fire burned riparian vegetation and increased water temperatures in tributary watersheds upstream from the Hoop-n-Devil watershed. Much higher than average water temperatures in Klamath River tributaries in 2014, including Elk Creek, was likely the result of record or near record low streamflows. As shown in the table below, in the last five years of monitoring, the maximum instantaneous water temperature at RM 4.5 ranged from 20.2^{o}C to 24.8 ^{o}C; the maximum weekly average temperature (MWAT) ranged from 17.5 ^{o}C to 21.1^{o}C; and the MWMT ranged from 19.6 ^{o}C to 23.8^{o}C, with a five-year average of 21.8 ^{o}C.

Recent Water Temperature Monitoring Results for Mainstem Elk Creek at RM 4.5							
Start	**End**	**Max Daily Average Temp C**	**Max Daily Max Temp C**	**Min Daily Min Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp (MWMT)**
7/1/2010	10/21/2010	19.7	22	8.3	5.3	19.0	21.4
7/14/2011	10/11/2011	17.8	20.2	5.3	4.9	17.5	19.6
6/22/2012	10/23/2012	19.5	22.0	7.4	5.2	18.8	21.0
6/8/2013	11/3/2013	21.5	24.4	5.9	6.2	20.5	23.0
5/28/2014	9/24/2014	21.8	24.8	10.3	6	21.1	23.8

As shown in the table below, in the last four years of monitoring, the maximum instantaneous water temperature at RM 0.5 ranged from 20.4^{o}C to 25.3 ^{o}C; the maximum weekly average temperature (MWAT) ranged from 18.0 ^{o}C to 22.1^{o}C; and the MWMT ranged from 19.8 ^{o}C to 24.3^{o}C, with a five-year average of 21.8 ^{o}C.

Recent Water Temperature Monitoring Results for Mainstem Elk Creek at RM 0.5							
Start	**End**	**Max Daily Average Temp C**	**Max Daily Max Temp C**	**Min Daily Min Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp (MWMT)**
6/11/2011	10/4/2011	18.5	20.4	7.3	4.7	18.0	19.8
6/8/2012	10/23/2012	20.1	21.8	7.8	4.9	19.5	20.9
6/6/2013	9/25/2013	22.3	24.4	11.4	5.2	21.3	23.2
5/23/2014	9/30/2014	**22.8**	**25.3**	**10.9**	**5.5**	**22.1**	**24.3**

Therefore, the condition of the Water Temperature indicator is **At-Risk** bordering on Not Properly Functioning.

Sediment - Turbidity: The 2008 Panther Fire significantly elevated the magnitude and duration of turbidity in mainstem Elk Creek (personal observation). This increase in turbidity was generally subsiding when the 2014 Fire hit. The 2014 Fire again significantly elevated the magnitude and duration of turbidity in mainstem Elk Creek during peak runoff events (personal observation). Chronic turbidity is likely to remain elevated for several more years until vegetation and duff recovers ground cover again. Acute fire-related turbidity in mainstem Elk Creek is expected to be elevated for up to ten years or longer because mass wasting/debris flows are expected to significantly increase in 2014 wildfire burned areas in that period of time. Modeled surface erosion is slightly elevated (USLE = 0.30) in the Elk Creek HUC10 and moderately to highly elevated in the three East Fork Elk Creek HUC14s that drain into the the mainstem. Modeled wasting is at threshold (GEO = 0.98). **At-Risk**.

Chemical Contamination: No significant source of chemical contamination is known to exist other than an auto wrecking yard on private property (which is not known to be point source of water contamination). **Properly Functioning**.

HABITAT ACCESS

Physical Barriers: No barriers to fish passage were found in the KNF Fish Passage Inventory (KNF 2003). **Properly Functioning**.

HABITAT ELEMENTS

Substrate Character: Substrate character was determined from a 2006 stream survey, intensive evaluation of streambed sediment composition, existing watershed disturbance levels as described under the *Disturbance History/Regime Indicator* below; and personal observation and judgment.

During the 2006 stream survey, in the mainstem reach from the mouth to EF Elk Creek: (1) surface fines in pebble counts averaged 6.9%; (2) surface fines in pool tail-outs averaged 8.1%, and (3) embeddedness averaged 26.4%. The values of surface fines were within desired range for properly functioning streams but embeddedness slightly exceeded desired range.

During the 2006 stream survey, in the mainstem reach from EF Elk Creek to Bear Creek: (1) surface fines in pebble counts averaged 9.0%; (2) surface fines in pool tail-outs also averaged 9.0%, and (3) embeddedness averaged 27.5%. The values of surface fines were within desired range for properly functioning streams but embeddedness slightly exceeded desired range.

Sediment composition was intensely evaluated at three sites within the Elk Creek HUC10 watershed since 2009. The metrics evaluated were: percent surface fines < 2mm (medial axis), percent sub-surface sediment < 0.85mm, percent sub-surface sediment < 6.38mm, and percent residual pool volume filled with fine sediment (V*). The results of these evaluations are shown in the table below. Substrate quality is judged in part by comparing the value of the four sediment indicators in Elk Creek (a managed watershed) to the 85th percentile value of the indicators for reference streams that have negligble management-related watershed disturbance. Stream reaches exceeding the 85% percentile of reference streams may be impaired.

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2011 East Fork Elk Creek response reach (efelk1) compared to KNF Stream Sediment Monitoring reference conditions (@85 percentile). efelk1 metrics over reference values are bolded.

Sediment Index	efelk1 reach average (%)	Reference Condition (%)
Surface Fines < 2mm	**9.0**	6.4
Sub-surface fines < 0.85mm	15.2	16.2
Sub-surface fines < 6.38mm	45.6	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	0.065	0.11

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2011 Elk Creek response reach (elk2) compared to KNF Stream Sediment Monitoring reference conditions (@85 percentile). elk2 metrics over reference values are bolded.

Sediment Index	elk2 reach average (%)	Reference Condition (%)
Surface Fines < 2mm	**6.7**	6.4
Sub-surface fines < 0.85mm	**18.9**	16.2
Sub-surface fines < 6.38mm	36.6	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	0.05	0.11

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2009 and 2012 Elk Creek response reach (elk4) that is just upstream of Bear Creek confluence compared to KNF Stream Sediment Monitoring reference conditions (@85 percentile). Elk4 metrics over reference values are bolded.

Sediment Index	2009 elk4 reach average (%)	2011 elk4 reach average (%)	Reference Condition (%)
Surface Fines < 2mm	4.2	3.8	6.4
Sub-surface fines < 0.85mm	**20.8**	**17.7**	16.2
Sub-surface fines < 6.38mm	**61.6**	**56.2**	46.1
Fraction of pools filled with fine sediment < 2mm (V *)	**0.121**	0.043	0.11

The area of streambed covered by sand, and the size of sandbars, in mainstem Elk Creek has been noticeably increasing since the 2008 Panther Fire and more recently the 2014 Happy Camp Complex (personal observation from frequent fish/stream surveys and kayak trips down mainstem Elk Creek over the last 20 years). Surface erosion and chronic sedimentation into streams that drain 2014 wildfire burned watersheds is likely to be elevated for several years until vegetation and duff recovers ground cover in areas that burned at moderate-to-high intensity. The rate of mass wasting and debris flows is expected to increase for up to ten years or longer until ground cover increases and the roots of recovering vegetation regain the capacity to bind soil in areas that burned at moderate-to-high intensity. Modeled surface erosion is slightly elevated (USLE = 0.30) in the Elk Creek HUC10 and moderately to highly elevated in the three East Fork Elk Creek HUC14s that drain into the the mainstem. Modeled wasting is at threshold (GEO = 0.98). **At-Risk**.

Large Woody Debris: During the 2006 stream survey of mainstem Elk Creek from the mouth to Bear Creek (about 13.5 stream miles) there were only eight pieces of LWD. However, the

potential for future LWD recruitment was near site potential between RM 0.7 and RM 3.8; and between RM 4.3 to RM 13.6. In fact, many large trees along these reaches did fall into mainstem Elk Creek during heavy snowfall in winter 2012-13. Along mainstem Elk Creek from the mouth to EF Elk Creek there was an estimated 107 recruitable (over 24" dbh) trees per miles; along mainstem Elk Creek from EF Elk to Bear Creek there was an estimated 126 recruitable trees per mile. The potential for future LWD recruitment and for recruited LWD to be left in the stream is greatly diminished along the lower 0.7 mile of Elk Creek mainstem due to the existence of the Happy Camp community water treatment plant, a campground, private residences, roads and a bridge, and an off-road ATV play area in the stream buffer. The potential for future LWD recruitment and for recruited LWD to be left in the stream is greatly diminished from RM 3.8 to RM 4.3 of Elk Creek mainstem due to private residences, roads, and a bridge in the stream buffer. The potential for future LWD recruitment and for recruited LWD to be left in the stream buffers of tributaries to mainstem Elk Creek is moderate to high because most tributary watersheds have low-moderate disturbance in the stream buffers. Many trees within one site potential tree height distance from a channel that were killed or damaged by the 2008 and/or 2014 wildfires are likely to be recruited into the stream over the next ten years or so. **At-Risk**.

Pool Frequency/Quality: In the 2006 stream survey of mainstem Elk Creek from the mouth to EF Elk Creek there was one deep (over three feet maximum depth) pool every 5.6 bankfull widths with an average maximum depth of 6.6 feet; and maximum pool depth ranged from 3.5 to 13.9 feet. In the 2006 stream survey of mainstem Elk Creek from EF Elk Creek to Bear Creek there was one deep (over three feet maximum depth) pool every 7.5 bankfull widths with an average maximum depth of 5.8 feet; and maximum pool depth ranged from 2.7 to 11.4 feet. Excessive fines that are being delivered to mainstem Elk Creek as a result of the 2008 Panther Fire and 2014 Happy Camp Complex fire have significantly increased the size of sandbars in pools reducing residual pool volume (last personal observation made in middle of January 2015). It is likely that pools will continue to fill over the next few to ten years due to increased rate of surface erosion and mass wasting from areas of the watershed that burned at moderate to high severity. **At-Risk**.

Off-Channel Habitat: Generally NA to the Rosgen C-, G-, and F-Channel types in mainstem Elk Creek. Off-channel habitats are not characteristic of these channel types. There are few unconstrained areas – all unconstrained areas are private land. **NA**

Refugia: Cold water and cover are the primary elements of fish refugia in this watershed. Water temperature is slightly high due to channel-widening and loss of vegetation during the 1997 Flood and from loss of stream-shading vegetation in the 2008 Panther Fire. The 2014 Happy Camp Complex fire burned many acres of stream buffer RR which will likely lead to further increases in peak high temperatures. LWD is below desired condition in the lower 0.7 mile of mainstem Elk Creek where rufugia cover is most needed for fish trying to escape high water temperatures in the Klamath River. There are frequent deep pools that provide good cover. **At-Risk**.

CHANNEL CONDITION AND DYNAMICS

Width to Depth Ratio: Approximately 28% of stream channels in the Elk Creek watershed were altered by high water and debris flows during the 1997 Flood. Most of mainstem Elk Creek was scoured and overwhelmed with excess sediment and pools were completely or partially filled with sediment. Most of the channel of mainstem Elk Creek is constrained and excessive sediment from the 1997 Flood has largely been transported out based on the 2006 pool frequency/quality data and personal observation. Many of the flood-altered channel reaches were in tributaries where debris flows altered channel cross-section from V-shape to U-shape. 1997 Flood altered tributary reaches were well on the way to recovery when the 2008 Panther Fire and then the 2014 Happy Camp Complex wildfires hit. Currently, excessive delivery of fines due to the 2008 and 2014 wildfires is filling pools thereby reducing pool volume and mean pool depth. The 2008 and 2014 fires are likely to increase the rate of landsliding and mass wasting which in turn could lead to more altered channel and pool infilling with course sediment. **At-Risk**.

Stream Bank Condition: Much of the streambank of mainstem Elk Creek was scoured and altered during the 1997 Flood event, however, most (over 90%) of the mainstem reaches are constrained with bedrock banks that have largely recovered to site potential from the flood. Streamside vegetation was largely ripped out and the streambanks were altered in the few unconstrained reaches. Recovery of vegetation and streambanks in unconstrained reaches is well underway and most streamside alder trees are still small having only sprouted or germinated in 1998 and have limited ability to stabilize the streambank. The 2014 wildfire burned 1,743 acres of stream buffer RR at moderate to high severity which is approximately 15.2% of the stream buffer in the Elk Creek watershed. Vegetation was killed or burned off streambanks in these areas and will take years to decades to recover. **Not Properly Functioning**.

Floodplain Connectivity: Generally NA to the Rosgen C-, G-, and F-Channel types in mainstem Elk Creek. Floodplains are not characteristic of these channel types. There are few unconstrained areas – all unconstrained areas are private land. **NA**.

FLOW/HYDROLOGY

Change in Peak/Base flow: Modeled runoff risk is moderately elevated (ERA/TOC = 0.51) primarily due to past wildfires, roads, vegetation management, and firelines (in that order). The firelines are mostly not hydrologically-connected. Increased peak flow due to all these factors combined is likely minor. Base flows are reduced in summer due to riparian water rights and municipal water diversion from mainstem Elk Creek. Municipal demand can divert as much as 1.5 million gallons of water per day – this water is diverted at about RM 0.6. **At-Risk**.

Increase in Drainage Network: Road density is moderate to high in 8 of the 12 HUC14s within the Elk Creek HUC10; and very low or zero in the other five HUC14s. Hydrologic connectivity of the road system to the stream network ranges from 10% to 47% in the eight roaded HUC14s. Therefore, there is low to moderate increase in drainage network density due to roads. Fire-lines constructed in attempting to suppress the 2008 and 2014 fires have no or minor hydrologic connectivity with the stream network. **At-Risk**.

WATERSHED CONDITION

Road Density/Location: Road density is low to moderate at one mile road per square mile watershed. There are over 13 miles of valley-bottom road in the watershed. **At-Risk**.

Disturbance History/Regime: The entire length of the stream channel of mainstem Elk Creek was altered by debris flows from road failures and/or natural landslides during the 1997 Flood, and is still recovering. The 1997 Flood triggered 135 major road failures in the Elk Creek watershed some of which caused or contributed to channel-altering debris flows. 1997 Flood-altered channels were well on the way to recovery when the 2008 Panther Fire and 2014 Happy Camp Complex Fires hit.

Currently, watershed disturbance is high primarily because of the 2008 Panther Fire that burned approximately 18,000 acres mostly at moderate to high intensity, and the 2014 Happy Camp Complex which burned 7,762 acres (12.8% of the watershed) at moderate to high intensity. Several miles of fire-lines were constructed or re-constructed in attempts to suppress these fires. Modeled surface erosion is slightly elevated (USLE = 0.30); modeled wasting is at threshold (GEO = 0.98); and modeled runoff risk is moderately elevated (ERA/TOC = 0.51). Disturbance in the models is primarily due to wildfire and roads (in that order). Firelines account for a small fraction (less than 5%) of the modeled disturbance. **At-Risk**.

Riparian Reserve: The stream buffer RR of mainstem Elk Creek is largely intact between RM 0.7 and RM 3.8 because there are no valley bottom roads, stream crossings, or development along this section of mainstem. The stream buffer RR of mainstem Elk Creek is largely intact between RM 4.3 and RM 13.9 because there are few valley-bottom roads, stream-crossings, or development along these reaches. The stream buffer of mainstem Elk Creek is significantly impacted along the lower 0.7 mile of Elk Creek mainstem due to the existence of the Happy Camp community water treatment plant, a campground, private residences, valley-bottom roads, a bridge, and an off-road ATV play area at the mouth. The stream buffer of mainstem Elk Creek is slightly impacted from RM 3.8 to RM 4.3 due to private residences, roads, and a bridge in the stream buffer.

Road density is low at the HUC10 scale because four of the 13 HUC14s are in wilderness where there are no roads. Several of the HUC14s outside of wilderness have moderate to high road density though.

The 2014 Happy Camp Complex fire burned 1,521 acres of stream buffer RR (15.2% all of stream buffer RR in the HUC10) at moderate-to-high severity and these areas are still in initial or early stage of recovery depending on site condition and site potential. Many acres of stream course RRs burned at moderate to high intensity during the 2008 Panther Fire and these areas are still in early to late stages of recovery depending on site condition.

The 2014 Happy Camp Complex fire burned 790 acres of geologic RR as follows: 18 acres active landslide; 5 acres toe-zone; and 767 acres inner gorge. Many of the acres of moderate to high severity burned inner gorge are within the 1,521 acres of stream buffer RR that burned at moderate-to-high severity. **Not Properly Functioning**.

Table of Pathway and Indicators
North Fork Salmon River 5th field watershed

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature		Coho 2014; SRCA 1998; WA 1995			X	
Suspended Sediment - Intergravel DO/Turbidity	CWE 2015; WA 1995				X	
Chemical Contamination/ Nutrients	CA-EPA				X	
Habitat Access Physical Barriers	CDFW 2015; Coho 2014; Siskiyou 2002; FishPass 2001				X	
Habitat Elements Substrate Character and Embeddedness		SRCA 1998; WA 1995			X	
Large Woody Debris			Coho 2014; SRCA 1998; WA 1995		X	
Pool Frequency and Quality		SRCA 1998; WA 1995			X	
Large Pools					X	
Off-channel Habitat		PJ; Coho 2014			X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	PJ; CWE 2015				X	
Streambank Condition	ND - likely Properly Functioning (PJ)				X	
Floodplain Connectivity	PJ, Coho 2014				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE 2015; Coho 2014				X	
Increase in Drainage Network	PJ; CWE 2015				X	
Watershed Conditions Road Density & Location	CWE 2015; SRSS 2002				X	
Disturbance History & Regime	PJ; CWE 2015; WA 1995				X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho 2014; WA 1995			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

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Table of Pathway and Indicators
South Fork Salmon River 5th field watershed

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature[1]			Coho-Sal 2014; SRCA 1998; WA 1997, 1994		X	
Suspended Sediment - Intergravel DO/Turbidity	CWE 2015; WA 1997, 1994				X	
Chemical Contamination/ Nutrients	CA-EPA				X	
Habitat Access Physical Barriers	CDFW 2015; Coho-Sal 2014; Siskiyou 2002; FishPass 2001[2]				X	
Habitat Elements Substrate Character and Embeddedness		SRCA 1998; WA 1997, 1994			X	
Large Woody Debris			Coho-Sal 2014; SRCA 1998; WA 1997, 1994		X	
Pool Frequency and Quality		SRCA 1998; WA 1997, 1994			X	
Large Pools					X	
Off-channel Habitat		PJ; Coho-Sal 2014			X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	PJ; CWE 2015				X	
Streambank Condition	ND - likely Properly Functioning (PJ)				X	
Floodplain Connectivity	PJ, Coho-Sal 2014				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE 2015; Coho-Sal 2014				X	
Increase in Drainage Network	PJ; CWE 2015				X	
Watershed Conditions Road Density & Location	CWE 2015; SRSS 2002				X	
Disturbance History & Regime		PJ; Coho-Sal 2014; WA 1997, 1994			X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sal 2014; WA 1997, 1994			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

[1]Mainstem temperatures considered to be Not Properly Functioning. EF Salmon River, the largest tributary, is Functioning-At-Risk; and smaller tributaries generally Functioning Properly.
[2]Barriers within range of anadromy in EF Salmon River have been remediated or are scheduled for remediation.

Table of Pathway and Indicators
Lower Scott River 5th field watershed

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature			Temps-Scott		X	
Suspended Sediment - Intergravel DO/Turbidity		PJ			X	
Chemical Contamination/ Nutrients			CA-EPA		X	
Habitat Access Physical Barriers	CDFW 2015; Coho-Sct 2014				X	
Habitat Elements Substrate Character and Embeddedness			PJ[1,2]; Coho-Sct 2014		X	
Large Woody Debris			Coho-Sct 2014; WA 2000		X	
Pool Frequency and Quality	ND - likely altered due to historic mining practices				X	
Large Pools					X	
Off-channel Habitat		PJ[1]; Coho-Sct 2014			X	
Refugia		PJ[1]			X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	ND - likely altered due to historic mining practices				X	
Streambank Condition			PJ[1,2]		X	
Floodplain Connectivity		PJ[1]; Coho-Sct 2014			X	
Flow/Hydrology Change in Peak/Base Flows			PJ[1]; Coho-Sct 2014		X	
Increase in Drainage Network		PJ[1]			X	
Watershed Conditions Road Density & Location		WA 2000			X	
Disturbance History & Regime		PJ[1]; Coho-Sct 2014; WA 2000			X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sct 2014; WA 2000			X	
SPECIES AND HABITAT:						
Species and Habitat:		X			X	

Summary/Integration of all Species and Habitat Indicators	Due to lack of data, specific trend for anadromous fish in this drainage is unknown. However, some sources are available to examine the general Scott River condition. (1) Screw trap data since 2000 suggests a steady to upward trend for Chinook smolts and steady to slightly down for steelhead smolts (CDFW 2011). (2) Run size estimate for spawning Chinook since 1978 is steady to slightly down (CDFW 2013). Recent trends for coho are unclear, but overall the run is considered to be depressed. See Life History section for additional information	See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.

[1]This 5th-field watershed includes extensive private property within/without the Forest boundary. Historic resource use throughout the drainage, including dredging, has impacted the watershed, and agriculture and timber extraction continue on private. Therefore, while Forest Service, or inholdings within the boundary, may show properly functioning condition - for instance, all CWE models under "1" threshold (CWE 2015) - the consideration of the *whole* 5th-field watershed suggest lower ratings. Data is largely lacking for private properties.

[2]Due to size of lower Scott River and extreme difficulty to survey, comprehensive datasets for physical attributes are not available.

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Appendix D: Environmental Baseline Checklists – 7th Fields

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # **Westside Fire Recovery**

Big Creek 7th field watershed

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WA 1995				X	
Suspended Sediment - Intergravel DO/Turbidity	CWE 2015				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	CDFW 2015				X	
Habitat Elements Substrate Character and Embeddedness	PJ; CWE 2015				X	
Large Woody Debris	N/A for streams less than 3rd order				X	
Pool Frequency and Quality	No data available				X	
Large Pools					X	
Off-channel Habitat	ND - Due to size and gradient of creek, and constriction of valley, extensive side channel development not expected.				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	ND - Wilderness locales usually considered to be Properly Functioning (PJ)				X	
Streambank Condition	ND - Wilderness locales usually considered to be Properly Functioning (PJ)				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE 2015				X	
Increase in Drainage Network	PJ				X	
Watershed Conditions Road Density & Location	SRSS 2002; GIS				X	

Disturbance History & Regime	PJ; CWE 2015				X	
Riparian Reserves - Northwest Forest Plan	PJ				X	
SPECIES AND HABITAT:						
<u>Species and Habitat</u>: Summary/Integration of all Species and Habitat Indicators		X			X	
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

Buckhorn-Beaver 7th Field Checklist

Pathways: INDICATORS	ENVIRONMENTAL BASELINE Buckhorn-Beaver 7th - field watershed PROPERLY FUNCT	AT RISK	NOT PROP FUNCT	EFFECTS OF THE ACTION(S) Buckhorn-Beaver 7th - field watershed RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature		**TEMP**			**X**	
Sediment - Turbidity			**SS89 KNF GIS PO PJ**		**X**	
Chemical Contamination	**ND/PO/PJ**				**X**	
Habitat Access Physical Barrier	**FPI**				**X**	
Habitat Elements Substrate Character			**SS89 SED PO KNF GIS**		**X**	
Large Woody Debris			**ND/PJ**		**X**	
Pool Frequency/Quality			**SS89 KNF GIS**		**X**	
Off-channel Habitat		**PO PJ**			**X**	
Refugia		**TEMP SS89 / PJ**			**X**	
Channel Cond & Dyn Width/Depth Ratio			**KNF GIS PO PJ**		**X**	
Streambank Condition			**KNF GIS PO PJ**		**X**	
Floodplain Condition		**PO PJ**			**X**	
Flow /Hydrology Change in Peak/Base Flow			**KNF-GIS RSS**		**X**	
Drainage Network Increase			**KNF GIS RSS**		**X**	
Watershed Condition Road Density/Location			**KNF-GIS**		**X**	
Disturbance History/Regime			**KNF GIS**		**X**	
Riparian Reserves			**KNF GIS**		**X**	

TEMP = Last five years of temperature monitoring near the mouth of Beaver Creek;
FPI = KNF Forest-Wide Fish Passage Barrier Inventory (KNF 2003);
SS89 = 1989 KNF stream survey of mainstem Beaver Creek from mouth to WF Beaver Ck;
SED = 2011 sediment assessment survey;
RSS = 1999 KNF Road Sediment Source Inventory and Risk Assessment;
ND = No Data; **PO** = Personal Observation; **PJ** = Professional Judgment; **NA** = Not Applicable;
KNF GIS = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015);
Environmental Baseline completed by Jon Grunbaum on February 11, 2015.

The **Buckhorn-Beaver** 7th-field watershed is a 8,265 acre composite watershed that includes about five miles of lower mainstem Beaver Creek from the mouth upstream to WF Beaver Creek. Mainstem Beaver Creek is a 5th-order stream (Strahler, 1957) within the Buckhorn-

Beaver watershed. Mainstem Beaver Creek supports steelhead and resident rainbow trout, coho and Chinook salmon. Within the Buckhorn-Beaver 7th-field watershed there is (are): one 3rd-order tributary to mainstem Beaver Creek named Buckhorn Gulch; three named 2nd-order tributaries (Fish Gulch, Marble Gulch, and Myrtle Gulch); one unnamed 2nd-order tributary; two named 1st-order tributaries (Ragged Creek and Polly Gulch); over 15 unnamed 1st-order tributaries; and several zero-order draws. These tributaries have very low summer flows or are intermittent. None of the tributaries to mainstem Beaver Creek within the Buckhorn-Beaver HUC14 are fish-bearing. The last stream surveys of mainstem Beaver Creek within the Buckhorn-Beaver watershed were in 1989 and 1991. There are no stream surveys for any of the tributaries to mainstem Beaver Creek in this composite watershed. The Buckhorn-Beaver watershed is 60% National Forest land and the rest is private industrial timberland and smaller private home/small ranch parcels.

Buckhorn-Beaver 7th-Field Watershed Environmental Baseline:

Temperature: Summer water temperature was monitored near the mouth for most years from 1997 to 2014 – monitoring results for the last five years is given in the table below. In the five year period of record the maximum instantaneous water temperature ranged from 18.0°C to 23.2°C; the maximum weekly average temperature (MWAT) ranged from 15.7 °C to 19.6°C; and the maximum weekly maximum temperature ranged from 17.7°C to 22.4°C. Water temperature in mainstem Beaver Creek was within the properly functioning range from 2010 to 2013 (and in previous years of record) but was in the At-Risk range in 2014. Near record low base flows in summer 2014 may have been a primary factor in high water temperatures and large diurnal temperature variation. It is likely that the rate and magnitude of stream heating and cooling will increase due the 2014 Beaver Fire because: (1) the wildfire burned large swaths of riparian vegetation that had provided shade to stream channels, (2) pools are likely to infill or partially infill with excess sediment which will increase surface area to volume ratio, and (3) the wildfire is likely to significantly increase the frequency of in-channel debris flows and upslope landslides that can remove riparian vegetation and widen-and-shallow stream channels. **At-Risk**.

Recent Water Temperature Monitoring Results for Mainstem Beaver Creek Near Mouth

Start	End	Max Daily Max Temp C	Max Average Daily Temp C	Max Diurnal Variation Temp C	Maximum Weekly Average Temp C (MWAT)	Maximum Weekly Maximum Temp C (MWMT)
10/8/2009	10/26/2010	19.5	17.1	5.2	16.9	18.9
6/10/2011	10/5/2011	18.0	15.9	4.3	15.7	17.7
6/15/2012	11/1/2012	20.3	18.0	4.7	17.4	19.6
6/11/2013	10/31/2013	21.7	19.1	5.1	18.5	20.7
6/3/2014	9/23/2014	23.2	20.3	6.3	19.6	22.4

Sediment - Turbidity: In the 1989 stream survey of mainstem Beaver Creek within the Buckhorn-Beaver composite watershed the percent fines in pebble counts was 11% and embeddedness was 21%. From annual snorkel fish census surveys through the years it is well documented that mainstem Beaver Creek is turbid with fine suspended sediment even after long periods of low flow – underwater visibility is low with a range of about five or six feet during the most optimal conditions. The Beaver Creek 5th-field watershed has a high level of disturbance from roads and past logging (particularly the private timberlands).

Post 2014 Beaver Fire water quality and sediment conditions in lower mainstem Beaver Creek and lower West Fork Beaver Creek were observed and photographed in the winter after several light to moderate precipitation events: the observations and photographs revealed that (1) turbidity was very high during and long- after precipitation events and (2) large quantities of fine sediment had been delivered to the mainstem which had partially smothered the pre-Fire streambed and salmonid spawning gravels. The 2014 Fire increased the actual rate of surface erosion as well as the modeled rate of surface erosion to well over threshold (USLE = 1.28). Increase in the frequency, magnitude and duration of turbidity due to increased surface erosion due to the 2014 Beaver Fire is likely last for a few years to a decade or more until vegetation gets re-established and ground cover is largely recovered in burned areas. Modeled mass-wasting is over threshold (GEO = 1.16). The rate of mass wasting that can cause bouts of acute turbidity will likely be increased for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots. **Not Properly Functioning**.

Chemical Contamination: No data. There are no known sources of chemical contamination on National Forest land within the Buckhorn-Beaver watershed. **Properly Functioning**.

Habitat Access

Physical Barriers: An inventory of fish/aquatic organism barriers related to roads was completed in 2003 for the Buckhorn-Beaver area (on National Forest lands/roads) and no barriers to fish or aquatic organisms were found. **Properly Functioning.**

Habitat Elements

Substrate: In the 1989 stream survey of mainstem Beaver Creek within the Buckhorn-Beaver composite watershed: percent fines (11%) and embeddedness (21%) were elevated but within the properly functioning range. From recent annual snorkel fish census surveys it is known that mainstem Beaver Creek still has a large percentage of fines in the channel substrate. **At-Risk.**

Large Woody Debris: There is no reliable quantitative information on LWD and potential for future LWD recruitment to the stream. Qualitatively, there is very little effective LWD in the channel and little potential for future LWD recruitment (personal observation made during numerous salmon/steelhead census surveys of mainstem Beaver Creek). In the late 1980s and early 1990s hundreds of log structures were cabled into the Beaver Creek stream channel to enhance fish habitat and because LWD levels were determined to be very low. Many of these structures have since washed away during peak flows and new recruitment has not replenished the channel.

Existing down LWD and standing large green trees or snags are likely reduced in the stream channel and stream buffer of the mainstem due to easy access and disturbance in stream buffers at: (1) numerous upslope stream crossings (throughout the Beaver HUC10 watershed), (2) numerous valley bottom roads (including unauthorized and ghost roads on the valley floor), (3) the campground (streamside on the mainstem), (4) on private property (about half of the land adjacent to mainstem Beaver Creek is private), and (5) on industrial timberlands (nearly half of this HUC14 and the Beaver Creek HUC10 is industrial timberland). Past timber harvest and associated road construction has reduced the number of large upslope conifers that could be delivered to a stream channel via falling or landsliding.

Based on these factors, it is my professional opinion that the LWD indicator is **Not Properly Functioning**.

Pool Frequency and Quality: There were 26 pools in the 6.2 miles of mainstem Beaver Creek within the Buckhorn-Beaver composite watershed that was surveyed in 1989 with an average maximum pool depth of 3.6 feet. Assuming the average bankfull width was 36 feet there was one pool every 35 bankfull widths, however, the frequency of deep pools (over three feet maximum depth) would be less. Pools in this composite watershed were likely partially filled with excessive sediment - modeled surface erosion risk and mass wasting risk were At-Risk at the 5th-field watershed scale. Pool filling from excessive sedimentation is expected to increase over the next ten years or more due to elevated erosion and increased mass wasting associated with the 2014 Beaver Fire that burned large swaths of forest at moderate to high intensity. Modeled surface erosion and mass wasting risk are over threshold (USLE = 1.28; GEO = 1.16). Sedimentation into Beaver Creek has already significantly increased due to the 2014 Beaver Fire.
Beaver were nearly extirpated in Beaver Creek and other streams in Northern California (Lanman et.al. 2013). Aquatic habitat in Beaver Creek was likely much different before fur trapping and European settlement due to beaver activity. Beaver Creek likely had numerous beaver dams which created pools and prime habitat for salmonids. Pool frequency and quality was likely much higher before trapping and settlement. There are still some beaver left in Beaver Creek but the population is slow to rebound probably because of continued trapping but also because streamside disturbance, lack of in-stream key pieces of LWD, and lack of large recruit-able streamside trees greatly diminishes beaver habitat suitability. **Not Properly Functioning**.

Off-Channel Habitat: Much of the channel of mainstem Beaver Creek is constrained with little potential for floodplain and off-channel habitat development. Most of the unconstrained reaches are on private land where the floodplain is cut-off and the potential for off-channel habitat is restricted by existing roads, berms, and current human activities. There are a few areas where there is functioning off-channel habitat. **At-Risk**.

Refugia: Cold water and cover are the primary elements of fish refugia in this watershed. The water temperature is cool and usually within suitable to optimum range for anadromous salmonids. Water temperature was in the properly functioning range for every year of record except 2014 when it was in the at-risk range. There is little specific quantitative information on cover, however, from stream survey data it is known that cover in the form of deep pools is lacking. LWD levels are low (see LWD indicator above). **At-Risk**.

CHANNEL CONDITION AND DYNAMICS

Width to Depth Ratio: (same discussion as the Pool Frequency/Quality indicator above). **Not Properly Functioning**

Stream Bank Condition: Streambanks are degraded at: (1) numerous stream crossings, (2) where roads and berms are constructed within the stream buffer and inner gorge, (3) adjacent to mainstem Beaver Creek where residences have cleared, compacted, or otherwise modified the streambank, and (4) at the campground where the streambank is a berm and where large conifers on the streambank are removed as hazard trees before they have a chance to be recruited to the stream by streamside residents. The 2014 Beaver Fire burned 1,454 acres of vegetation in

stream buffer RRs (52% of the total stream buffer in the composite watershed) at moderate to high intensity. **Not Properly Functioning**.

Floodplain Connectivity: Much of the channel of mainstem Beaver Creek is constrained with little potential for floodplain and off-channel habitat development. Most of the unconstrained reaches are on private land where the floodplain is cut-off and the potential for off-channel habitat is restricted by existing roads, berms, and current human activities. There are a few areas where there is functioning off-channel habitat. **At-Risk**.

FLOW/HYDROLOGY

Change in Peak/Base flow: Road density is high and 21% of the road system is hydrologically connected to the stream network in the Beaver-Buckhorn HUC14. Peak flows in mainstem Beaver Creek within the Buckhorn-Beaver composite watershed is determined at the 5th-field watershed scale of Beaver Creek because all water drains though this lowest subwatershed. Road density and hydrologic connectivity is high in most of the HUC14s upstream of the Beaver-Buckhorn HUC14 as well. Modeled runoff risk is slightly over threshold at the in the Buckhorn-Beaver HUC14 (ERA/TOC = 1.01) and in the entire Beaver Creek HUC10 (USLE = 1.01). There are several water diversions from lower Beaver Creek – at least one of them takes a significant volume of water out of the summer base flow. The exact volume is unknown, but it is likely that several cfs are diverted from lower Beaver Creek during summer low-flow periods. **Not Properly Functioning**.

Increase in Drainage Network: Road density is high and 21% of the road system is hydrologically connected to the stream network in the Beaver-Buckhorn HUC14. **Not Properly Functioning**

WATERSHED CONDITION

Road Density/Location: Road density is high at 3.9 miles of road per square mile of watershed. There is a valley bottom and/or inner gorge road on at least on one side of mainstem Beaver Creek for most of its' length through this HUC14 watershed. **Not Properly Functioning**.

Disturbance History/Regime: Road density is high and 21% of the road system is hydrologically connected to the stream network. There has been extensive stand-replacement forestry in this composite watershed - particularly on private timberland (some areas of private timberland were and are being salvaged after the 2014 Beaver Fire). Ground disturbance and compaction is at fairly high levels streamside and on the valley floor due to: (1) roads and berms constructed within the stream buffer and inner gorge, (2) existence and maintenance of residences and grounds, and (3) existence and maintenance of the campground.

Another major stressor that is adversely affecting watershed processes now, and that will continue to affect watershed processes/conditions and set the stage for future disturbance regimes in the next decades or longer, was the 2014 Beaver Fire that burned large swaths of forest at moderate and high intensity in upslope and riparian areas. The 2014 Beaver Fire burned 1,454 acres of vegetation in stream buffer RRs (52% of the total stream buffer in the composite watershed) at moderate to high intensity. This much moderate and high intensity fire in hydrologic RRs, coupled with a high-density road system, is expected to significantly: (1) decrease hydrologic retention, (2) decrease the sediment filtering and nutrient spiraling function of riparian vegetation compromising the potential of hydrologic RRs to buffer the stream from upslope ground disturbances and landslides, and (3) increase streamside landsliding. The 2014 Fire caused 25% or greater basal area mortality on 635 acres of unstable ground RR as follows: 4 acres of active landslide; 157 acres of toe-zone; and 534 acres of inner gorge. [note: most or all

of the 534 acres of inner gorge are within hydrologic RR so these acres should not be double-counted]. This much moderate and high intensity fire on geologic RRs is expected to significantly increase the risk, rate, and adverse cumulative effects of excess sediment delivery, transport, and deposition in stream channels.
CWEs are over threshold in all three CWE model runs as follows: (USLE = 1.28; GEO = 1.16; ERA/TOC = 1.10). **Not Properly Functioning**.

Riparian Reserves: Stream buffer RRs are degraded at: (1) numerous upslope stream crossings, (2) numerous valley bottom and/or inner gorge roads (including unauthorized and ghost roads), (3) the campground (streamside on the mainstem), (4) on private property (about half of the land adjacent to mainstem Beaver Creek is private), and (5) on industrial timberlands (nearly half of this HUC14 and the Beaver Creek HUC10 is industrial timberland). In addition, the 2014 Beaver Fire burned 1,454 acres of vegetation in stream buffer RRs (52% of the total stream buffer in the composite watershed) at moderate to high intensity. This much moderate and high intensity fire in hydrologic RRs, coupled with a high-density road system, is expected to significantly: (1) decrease hydrologic retention, (2) decrease the sediment filtering and nutrient spiraling function of riparian vegetation compromising the potential of hydrologic RRs to buffer the stream from upslope ground disturbances and landslides, and (3) increase streamside landsliding. The 2014 Fire caused 25% or greater basal area mortality on 635 acres of unstable ground RR as follows: 4 acres of active landslide; 157 acres of toe-zone; and 534 acres of inner gorge. [note: most or all of the 534 acres of inner gorge are within hydrologic RR so these acres should not be double-counted]. This much moderate and high intensity fire on geologic RRs is expected to significantly increase the risk, rate, and adverse cumulative effects of excess sediment delivery, transport, and deposition in stream channels. **Not Properly Functioning**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # **Westside Fire Recovery**

China Creek 7th Field Checklist

Pathways: INDICATORS	ENVIRONMENTAL BASELINE China Creek 7th Field Watershed			EFFECTS OF THE ACTION(S) China Creek 7th Field Watershed		
	PROPERLY FUNCT	AT RISK	NOT PROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature	**TEMP**				**X**	
Sediment-Turbidity		**SS98 SED KNF GIS**			**X**	
Chemical Contamination	**ND/PO/PJ**				**X**	
Habitat Access Physical Barrier	**FPI**				**X**	
Habitat Elements Substrate Character		**SS98 SED KNF GIS**			**X**	
Large Woody Debris		**SS98**			**X**	
Pool Frequency/Quality		**SS98 Flood**			**X**	
Off-channel Habitat		**PO/PJ**			**X**	
Refugia	**TEMP**	**SS98 PO/PJ**			**X**	
Channel Cond & Dyn Width-to-Depth Ratio		**SS98 Flood PO/PJ**			**X**	
Streambank Condition		**SS98 Flood PO/PJ**			**X**	
Floodplain Condition		**PO/PJ**			**X**	
Flow /Hydrology Change in Peak/Base Flow		**KNF GIS RSS**			**X**	
Drainage Network Increase		**KNF GIS RSS**			**X**	
Watershed Cond. Road Density/Location			**KNF GIS**		**X**	
Disturbance History/Regime		**KNF GIS RSS**			**X**	
Riparian Reserves		**KNF GIS RSS**			**X**	

TEMP = Water temperature monitoring of mainstem Elk Creek upstream of Bear Creek confluence from 2010 to 2014; **FPI** = KNF Forest-Wide Fish Passage Barrier Inventory; **ND** = No Data; **PJ** = Professional Judgment; **PO** = Personal observation based on 20+ years observing; **NA** = Not Applicable; **SED =** 2011 KNF Sediment Assessment Survey (KNF 2013); **Flood** = 1997 Flood Assessment (KNF 1998); **SS98** = 1998 KNF (contracted) stream survey of mainstem China Creek; **RSS =** KNF Road Sediment Source Inventory and Risk Assessment (USDA 2012);

The **Klamath/China Creek** 7th-field (HUC14) watershed is a true watershed with an area of 6,189 acres. Approximately 9% of the watershed is private property and the rest in National Forest. Mainstem China Creek is the primary stream in the watershed and is a 3rd-order (Strahler 1957) stream. South Fork China Creek, Three Biscuit Gulch, and Wolf Creek are the only named tributaries to China Creek. South Fork China Creek provides habitat for rainbow trout but the other tributaries to China Creek are not fish-bearing. Mainstem China Creek and South Fork China Creek combined provide approximately 3.4 miles of habitat for resident rainbow trout. Mainstem China Creek provides approximately 1.8 miles of habitat for steelhead trout; 0.8 mile of habitat for Coho salmon; and 0.5 miles for Chinook salmon. The last stream survey of mainstem China Creek was in 1998.

Klamath-China Creek 7th-field watershed Environmental Baseline Elements:

Water Temperature: Summer water temperature in mainstem China Creek about 0.8 mile upstream of the mouth was monitored from 2010 to 2014 – see table below for a summary of monitoring results. In this five year period of record the maximum instantaneous water temperature ranged from 17.6°C to 20.3°C; the maximum weekly average temperature (MWAT) ranged from 15.7°C to 18.4°C; and the maximum weekly maximum temperature ranged from 17.1°C to 19.6°C. Near record low base flows may have been a primary factor in the much higher than average water temperatures in 2014. It is possible that rate and magnitude of stream heating and cooling will slightly increase due the 2014 Happy Camp Complex Fire because: (1) the wildfire burned areas of riparian vegetation that had provided stream shade and thermal buffering to stream channels, (2) pools may partially infill with excess sediment which will increase surface area to volume ratio, and (3) the wildfire may increase the frequency of in-channel debris flows and upslope landslides that can remove riparian vegetation and widen-and-shallow stream channels. The condition of the water temperature indicator is just barely in the **Properly Functioning** range in 2014.

Recent Water Temperature Monitoring Results for mainstem China Creek at RM 0.8

Start	End	Max Daily Max Temp C	Max Average Daily Temp C	Max Diurnal Variation Temp C	Maximum Weekly Average Temp C (MWAT)	Maximum Weekly Maximum Temp C (MWMT)
6/6/2010	10/11/2010	19.0	17.5	3.8	17.0	18.6
6/10/2011	10/13/2011	17.6	16.1	3.5	15.7	17.1
6/8/2012	10/9/2012	18.3	17.2	3.6	16.6	17.8
5/18/2013	10/1/2013	19.7	18.5	3.6	17.7	18.9
5/28/2014	10/1/2014	20.3	19.0	3.8	18.4	19.6

Sediment - Turbidity: See discussion for Substrate Character indicator below At-Risk**.**

Chemical Contamination: No significant source of chemical contamination is known to exist. **Properly Functioning**.

HABITAT ACCESS

Physical Barriers: No barriers to fish passage are known to exist. **Properly Functioning**.

Substrate Character: The results of 2011 intensive monitoring and evaluation of sediment in mainstem China Creek that included the metrics: percent surface fines < 2mm, percent sub-surface sediment < 0.85mm, percent sub-surface sedient < 6.38mm, and percent residual pool volume filled with fine sediment (V*), is shown in the table below. Substrate quality was evaluated by comparing the four sediment indicators in mainstem China Creek (a managed watershed) to the 85th percentile value of the four indicators for pooled reference streams that have minor to negligble management-related watershed disturbance. Watersheds exceeding the 85% percentile of reference streams may have impaired sediment regime. In 2011 three of the four sediment indices exceeded reference values.

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2011 China Creek response reach (china1) compared to KNF Stream Sediment Monitoring reference conditions (85th percentile). (china1) metrics over reference values are bolded.

Sediment Index	2011 China1 reach average %	Reference Condition (%)
Surface Fines < 2mm	**8.6**	6.4
Sub-surface fines < 0.85mm	**23.2**	16.2
Sub-surface fines < 6.38mm	**47.4**	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	0.088	0.108

Average percent surface fines observed during the 1998 stream survey of China Creek were as follows: 8.9% on riffles; 12.8% on pool tail-outs; and 12.3% in runs. This survey was conducted the summer after the 1997 New Years Flood which caused numerous debris flows that delivered a large pulse of sediment into the mainstem.

The 2014 Happy Camp Complex Fire increased the rate of erosion and sediment delivery to China Creek. The frequency, magnitude and duration of turbidity and fine sediment delivery due to surface erosion is likely to be elevated for a few years until vegetation gets re-established and ground cover is largely recovered in burned areas. The volume of fine and coarse sediment delivery to streams due to mass wasting is likely to increase for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots.

Modeled surface erosion risk (USLE = 0.75); modeled mass wasting risk (GEO = 0.75); and modeled runoff risk (ERA/TOC = 0.84) are moderately to highly elevated due to roads, past wildfires, and past vegetation management; in that order. **At-Risk**.

Large Woody Debris: Course Woody Material (CWM) was tallied in the lower three miles of China Creek during the 1998 stream survey. The majority of CWM was in the 4- to 18-inch diameter class and were less than 36 feet in length. Several dozen pieces occurrred in the 24-inch diameter class but were less than 50 feet in length. Eighteen pieces of CWM were over 24-inches in diameter and over 50 feet in length, or an average of 6 pieces of LWD per mile. There

is a high density of stream crossings where green trees, snags and LWD can be accessed, and past timber harvest and road building/mainteance has reduced the amount of LWD that could be transported to the stream channel via trees falling or landsliding. The was a moderate to large number of green trees adjacent to lower China Creek that were large enough to provide large woody debris should they fall into China Creek. **At-Risk**.

Pool Frequency and Quality: In the 1998 stream survey of China Creek there were 81 pools in the lower three miles of China Creek that ranged in maximum depth from 1.2 to 5.8 feet, with a mean maximum depth of 2.4 feet. Seventeen pools had a maximum depth of three feet or greater. There was one pool every 9.7 bankfull channel widths (assuming bankfull width was 20 feet). There was one deep pool approximately every 47 bankfull widths. Pools may be reduced in number and/or depth due to low levels of in-channel LWD and/or excess sediment (from high levels of watershed disturbance) in-filling pools. **At-Risk**.

Off-Channel Habitat: Generally not applicable in the China Creek watershed where most channels are Rosgen A-, and B-Channel types that are too constrained and entrenched to have floodplains that allow off-channel habitat development. There is a few tenths of a mile of slightly unconstrained channel in the lower mainstem reach that could be flooded and become off-channel habitat, however, the County road crossing just upstream from this reach may be preventing floodplain interaction. **At-Risk**.

Refugia: Cold water and cover are the primary elements of fish refugia in this watershed. China Creek water temperatures are believed to remain cool and within the suitable range for anadromous salmonids throughout the year. In the 1998 stream survey there was good cover provided by CWM and large boulders but deep pools were sparse. The one unconstrained reach that could provide winter refugia may not be functioning due to way the channel is constricted at the County Road stream crossing. **At-Risk**.

CHANNEL CONDITION AND DYNAMICS

Width-to-Depth Ratio: There were 11 landslides and 32 major road failures in the China Creek drainage during the 1997 flood event resulting in numerous debris flows that altered about 24% of the channels in the China Creek watershed. The Width-to-depth ratio was appreciably altered by the 1997 Flood, and that the channel of China Creek is shallower and wider as a result. Flood-altered channels are recovering but probably slowly due to high levels of watershed disturbance. **At-Risk**.

Streambank Condition: About 24% of the channels in the China Creek watershed were altered in the 1997 Flood and areas of streambank were reset, however, vegetation on streambanks has largely recovered. Invasive blackberries have taken over some of the streambanks adjacent to the lower 0.5 mile of mainstem. There is a high density of stream crossings. **At-Risk**.

Floodplain Connectivity: Generally not applicable in the China Creek watershed where most channels are Rosgen A-, and B-Channel types that are too constrained and entrenched to have floodplains that allow off-channel habitat development. There is a few tenths of a mile of slightly unconstrained channel in the lower mainstem reach that could be flooded and become

off-channel habitat, however, the County road crossing just upstream from this reach may be preventing floodplain interaction. **At-Risk**.

FLOW/HYDROLOGY

Change in Peak/Base Flow: Road and stream crossing density is very high and 5% of the road system is hydrologically-connected to the stream network. Peak flows are likely being affected (increased) by increased drainage network due to roads. Runoff will be increased from areas that burned at moderate to high intensity in the 2014 Fire. Modeled runoff risk is highly elevated (ERA/TOC = 0.84) but still under threshold. **At-Risk.**

Increase in Drainage Network: Road and stream crossing density is very high and 5% of the road system is hydrologically-connected to the stream network. In the short term (10 years) runoff will be increased from areas that burned at moderate to high intensity in the 2014 Fire which will increase effective drainage density. **At-Risk.**

WATERSHED CONDITION

Road Density/Location: Road density is very high with 5.6 miles of road per square mile of watershed, and there is over a mile of valley bottom road. **Not Properly Functioning.**

Disturbance History/Regime: Watershed disturbance is high primarily due to the very high density road system and the high density of stream crossings. Many of the streams in the watershed have multiple stream crossings stacked on them.

There has been considerable past stand-replacement forestry but none within the last 25 years on National Forest land. The current effect of past stand-replacement forestry on watershed processes is likely small.

The 2014 Happy Camp Complex Fire burned 502 acres or 8.1% of the watershed at moderate to high severity including 100 acres of stream buffer RR and 36 acres of geologic RRs (some of the hydrologic and geologic RRs are the same acres).

Approximately 9% of the watershed is private property that has residences, roads, and clearings but no other major ground disturbing or industrial grade disturbances are known to occur there.

Modeled surface erosion risk (USLE = 0.75); modeled mass wasting risk (GEO = 0.75); and modeled runoff risk (ERA/TOC = 0.84) are moderately to highly elevated due to roads, past wildfires, and past vegetation management; in that order. **At-Risk**.

Riparian Reserves: There has been past timber harvest/salvage and road building in areas that would now qualify as riparian reserve, although none of this disturbance has been recent (within the last 25 years) and recovery is taking place. There are numerous stream crossings and roads within stream buffers (hydrologic RR). There is high road density and many road segments are constructed on unstable ground (geologic RR).

The 2014 Fire burned 100 acres of stream buffer RRs at moderate to high intensity, which is 7% of the total stream buffer in the HUC14 watershed. This much moderate and high intensity fire in hydrologic RRs, coupled with a high-density road system, is expected to: (1) decrease hydrologic retention time, (2) decrease the sediment filtering and nutrient spiraling function of riparian vegetation thereby compromising the potential of hydrologic RRs to buffer the stream

from upslope ground disturbances and landslides, and (3) increase streamside landsliding. The 2014 Fire caused 25% or greater basal area mortality on 36 acres of unstable ground RR as follows: 2 acres of active landslide and 34 acres of inner gorge. [note: most or all of the 36 acres of inner gorge are within hydrologic RR]. This much moderate and high intensity fire on geologic RRs is expected to slightly increase the risk, rate, and adverse cumulative effects of excess sediment delivery, transport, and deposition in stream channels. **At-Risk**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # Westside **Fire Recovery**
Cougar Creek 7th Field Checklist

Pathways: **INDICATORS**	**ENVIRONMENTAL BASELINE** CougarCk-ElkCk 7th Field watershed			**EFFECTS OF THE ACTION(S)** CougarCk-ElkCk 7th Field watershed		
	PROPERLY FUNCT	AT RISK	NOT ROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature		**TEMP**			**X**	
Sediment-Turbidity		**KNF GIS PO**		**X**		
Chemical Contamination		**ND/PO/PJ**			**X**	
Habitat Access Physical Barrier		**FPI**			**X**	
Habitat Elements Substrate Character		**SS2006 SED KNF GIS PO/PJ**		**X**		
Large Woody Debris		**SS2006 PO**		**X**		
Pool Frequency/Quality		**SS2006 PO**		**X**		
Off-channel Habitat	**NA**					
Refugia		**TEMP SS2006 PO**		**X**		
Channel Cond & Dyn Width-to-Depth Ratio		**Flood PO**			**X**	
Streambank Condition		**Flood PO/PJ**			**X**	
Floodplain Condition	**NA**			**X**		
Flow /Hydrology Change in Peak/Base Flow		**KNF GIS RSS**			**X**	
Drainage Network Increase			**KNF GIS RSS**	**X**		
Watershed Cond. Road Density/Location			**KNF GIS RSS**	**X**		
Disturbance History/Regime		**KNF GIS Flood RSS PJ**		**X**		
Riparian Reserves		**KNF GIS Flood RSS PJ**			**X**	

TEMP = Last five years of temperature monitoring at RM 4.5 of mainstem Elk Creek;

FPI = KNF Forest-Wide Fish Passage Barrier Inventory (KNF 2003);

SS06 = 2006 KNF stream survey of mainstem Elk Ck; **Flood** = KNF flood analysis of the 1997 New Years Flood

SED = 2011 sediment assessment survey (USFS 2014);

RSS = KNF Road Sediment Source Inventory and Risk Assessment (USFS 2012);

ND = No Data; **PO** = Personal Observation; **PJ** = Professional Judgment; **NA** = Not Applicable;

KNF GIS = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015);

Environmental Baseline completed by Jon Grunbaum on February 25, 2015.

The Cougar Creek-Elk Creek 7th-field watershed is a composite watershed with an area of 6,918 acres. Mainstem Elk Creek is a fourth-order stream (Strahler 1957) and the principle stream in the composite watershed. Main tributaries to mainstem Elk Creek in this composite watershed include Cougar, Malone, and Twins Creeks. The (approximate) 4.7 miles of mainstem Elk Creek within the Cougar-Malone watershed provides habitat for winter- and summer-run steelhead, spring- and summer-run Chinook salmon, coho salmon, and rainbow trout. Cougar Creek has 1.3 miles of habitat for resident rainbow and steelhead trout and a few hundred feet of coho habitat. Twins Creek has 0.3 miles of resident rainbow trout habitat. Malone Creek is non fish-bearing. None of the other tributaries to mainstem Elk Creek in this composite watershed are known to support fish populations. The last stream survey of mainstem Elk Creek was summer 2006.

Cougar Creek-Elk Creek 7th-Field (HUC14) Watershed Environmental Baseline Elements:

WATER QUALITY

Water Temperature: There has been no consistent water temperature monitoring within the Cougar Creek-Elk Creek HUC14, however, summer (and some winter) water temperature of mainstem Elk Creek was monitored 0.2 miles downstream of the Cougar Creek-Elk Creek HUC14 every year since 1990 (no data for 1996). The 1997 flood greatly altered the mainstem channel of Elk Creek – resulting in widening and shallowing of the channel, and loss of streamside vegetation. Much of mainstem Elk and several tributaries to mainstem Elk Creek experienced large debris flows that scoured and altered their channels and ripped out riparian vegetation. Excess sediment from numerous natural debris torrents, and from over 200 road failures, resulted in excessive bedload which overwhelmed and altered the channel of mainstem Elk Creek. The loss of riparian vegetation and narrowing/widening of the stream channel increased the range and magnitude of daily heating and cooling – as described in the assessment: *The Flood of 1997- Klamath National* Forest (USDA KNF, November 1998). Riparian and channel recovery was still taking place when the 2014 Fire hit. Before the 1997 Flood: from 1990 to 1995, the 7-day maximum water maximum temperature (MWMT) 18.7 °C to 21.8 °C, with six-year average of 20.8°C. After the 1997 Flood: from 1997 to 2004, the MWMT ranged from 20.1 °C to 23.7 °C, with eight-year average of 22.9°C. Since then, the 2008 Panther Fire burned riparian vegetation and increased water temperatures in tributary watersheds upstream from the Cougar Creek-Elk Creek HUC14. As shown in the table below, in the last five years of monitoring, the maximum instantaneous water temperature ranged from 20.2°C to 24.8 °C; the maximum weekly average temperature (MWAT) ranged from 17.5 °C to 21.1°C; and the MWMT ranged from 19.6 °C to 23.8°C, with a five-year average of 21.8 °C. High water temperatures in Klamath River tributaries, including Elk Creek, in summer 2014 was likely the result of record or near record low streamflows. **At-Risk**.

Recent Water Temperature Monitoring Results for Mainstem Elk Creek at RM 4.5							
Start	End	Max Daily Average Temp C	Max Daily Max Temp C	Min Daily Min Temp C	Max Diurnal Variation Temp C	Maximum Weekly Average Temp C (MWAT)	Maximum Weekly Maximum Temp (MWMT)
7/1/2010	10/21/2010	19.7	22	8.3	5.3	19.0	21.4
7/14/2011	10/11/2011	17.8	20.2	5.3	4.9	17.5	19.6
6/22/2012	10/23/2012	19.5	22.0	7.4	5.2	18.8	21.0
6/8/2013	11/3/2013	21.5	24.4	5.9	6.2	20.5	23.0
5/28/2014	9/24/2014	21.8	24.8	10.3	6	21.1	23.8

Sediment - Turbidity: Turbidity was noticeably high during and after peak flows for several years following the 1997 Flood. The 2008 Panther Fire significantly elevated the magnitude and duration of turbidity in mainstem Elk Creek (personal observation). The increase in turbidity from the 2008 Panther Fire was generally subsiding when the 2014 Fire hit. The 2014 Fire again significantly elevated the magnitude and duration of turbidity in mainstem Elk Creek during peak runoff events (personal observation). Chronic turbidity is likely to remain elevated for several more years until vegetation and duff recovers ground cover again. Acute fire-related turbidity in mainstem Elk Creek is expected to be elevated for up to ten years or longer because the rate of mass wasting/debris flows is expected to increase in the Cougar Creek-Elk Creek HUC14 for this period of time as well as in many of the HUC14s that drain into the Cougar Creek-Elk Creek HUC14. Modeled surface erosion is moderately elevated (USLE = 0.50); modeled wasting is moderately elevated (GEO = 0.64); and modeled runoff risk is slightly elevated (ERA/TOC = 0.39). **At-Risk**.

Chemical Contamination: No significant source of chemical contamination is known to exist on National Forest lands. An auto wrecking yard on private property is *suspected* of minimally contaminating surface and ground water with petroleum products and other automotive pollutants but tests have not been conducted. **At-Risk**.

HABITAT ACCESS

Physical Barriers: Two road related barriers to fish passage are known to exist from the KNF 2003 Fish Passage Inventory (sites #180 and #183). These two barriers likely exclude steelhead from a few tenths of a mile of suitable habitat in Twins and Malone Creeks, however, there is little to no suitable salmon habitat in these streams. **At-Risk**.

HABITAT ELEMENTS

Substrate Character: Substrate character was determined from a 2006 stream survey, 2011 intensive sediment monitoring and evaluation in the mainstem 0.2 miles downstream of the HUC14 boundary, existing watershed disturbance levels as described under the *Disturbance History/Regime Indicator* below; and personal observation. During the 2006 stream survey: (1) surface fines in pebble counts averaged 6.9%; (2) surface fines in pool tail-outs averaged 8.1%, and (3) embeddedness averaged 26.4%.

The values of surface fines were within desired range for properly functioning streams but embeddedness slightly exceeded desired range.

The results of 2011 intensive monitoring and evaluation of sediment in mainstem Elk Creek that included the metrics: percent surface fines < 2mm, percent sub-surface sediment < 0.85mm, percent sub-surface sedient < 6.38mm, and percent residual pool volume filled with fine sediment (V*), is shown in the table below. Substrate quality impairment was evaluated in mainstem Elk Creek by comparing the four sediment indicators in Elk Creek (a managed watershed) to the 85th percentile value of four indicators for reference streams that have negligble management-related watershed disturbance. Watersheds exceeding the 85% percentile of reference streams are considered impaired. In the 2011 sediment monitoring, two of the four sediment indices (surface fines < 2mm and subsurface fines < 0.85mm) in Elk Creek were determined to very slightly exceed reference watershed values as shown in the table below.

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2011 Elk Creek response reach (elk2) compared to KNF Stream Sediment Monitoring reference conditions (@85 percentile). Elk2 metrics over threshold values are bolded.

Sediment Index	Elk2 reach average (%)	Reference Condition (%)
Surface Fines < 2mm	**6.7**	6.4
Sub-surface fines < 0.85mm	**18.9**	16.2
Sub-surface fines < 6.38mm	36.6	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	0.05	0.11

The area of streambed covered by sand and the volume of sandbars in mainsten Elk Creek has been noticeably increasing since the 2008 Panther Fire and rapidly increasing after the 2014 Happy Camp Complex Fire (personal observation from frequent fish/stream surveys and/or kayak trips down mainstem Elk Creek over the last 20 years – made by myself and FS River Ranger David Payne). Fines are increasing in volume and decreasing residual pool volume. Fines are infiltrating or covering spawning areas. Surface erosion and chronic sedimentation into streams is likely to be elevated for several years until vegetation and duff recovers ground cover in areas that burned at moderate-to-high intensity. The rate of mass wasting and debris flows is expected to increase for up to ten years or longer until ground cover increases and the roots of recovering vegetation regain the capacity to bind soil in areas that burned at moderate-to-high intensity. Modeled surface erosion is moderately elevated (USLE = 0.50); modeled wasting is moderately elevated (GEO = 0.64); and modeled runoff risk is slightly elevated (ERA/TOC = 0.39). **At-Risk.**

Large Woody Debris: During the 2006 stream survey of mainstem Elk Creek within the Cougar Creek-Elk Creek HUC14 composite watershed (total of 4.9 miles surveyed) there was only one piece of Key LWD, several logs jams composed of woody debris smaller than Key LWD, a fish habitat enhancement structure composed of LWD smaller than Key LWD, and five logs that were cut up that may have qualified to be Key LWD before being cut. A total of 135 standing trees large enough to qualify as LWD were counted during the stream survey, which is an average of 27.5 per mile. There has been little management on National Forest land on the North side of mainstem Elk Creek in this composite watershed that would reduce LWD or potential recruitment of LWD, however, LWD and potential future LWD recruitment is reduced within the stream buffer on several private parcels on the north banks of Elk Creek. LWD delivery, and development of future potential LWD recruits on the south side of mainstem Elk Creek is diminished due to the Elk Creek County/Forest Service road which is constructed in the inner gorge or on lower slopes within the RR stream buffer of Elk Creek, and several other creek

access roads/mining camps in the stream buffer RR. The County/Forest Service road intercepts logs that may otherwise be delivered to mainstem Elk Creek and reduces potential for growth of trees that could become LWD in the future. Creek accesses provide public access to standing and down trees in the stream buffer RR of mainstem Elk Creek.

Based on: (1) the lack of sufficient LWD within the stream channel of mainstem Elk Creek, and (2) the poor to fair number of potential recruit trees observed in the stream buffer RRs of mainstem Elk Creek - it is my professional opinion that the LWD indicator is **At-Risk**.

Pool Frequency/Quality: Many pools in mainstem Elk Creek were filled in with excessive sediment during the 1997 flood event. The flood filled in half the pools so that they were no longer classified as pools in the 1997 stream survey versus the 1989 stream survey. The remaining half of pools that existed prior to the 1997 flood were greatly reduced in depth. Pool frequency in the 1998 stream survey of mainstem Elk Creek was one pool every 9.4 bankfull channel widths. Deep pool (three feet deep or greater) frequency in the 1998 stream survey of mainstem Elk Creek was one deep pool every 24 bankfull channel widths. Streamflows since the 1997 Flood have moved much of the excessive sediment out of the system and excavated pools but recovery is likely incomplete. In the 2006 stream survey, there were 49 pools with an average depth of 5.6 feet, and 47 of the pools were deep pools (greater than 3 feet deep). In the 2006 stream survey there was one deep pool every nine bankfull channel widths. In my professional opinion, pool frequency/quality is still not quite fully recovered fully. The area of streambed covered by sand and the volume of sandbars in mainstem Elk Creek has been noticeably increasing since the 2008 Panther Fire and rapidly increasing after the 2014 Happy Camp Complex Fire (personal observation from frequent fish/stream surveys and/or kayak trips down mainstem Elk Creek over the last 20 years – made by myself and FS River Ranger David Payne). Fines are increasing in volume and decreasing residual pool volume. **At-Risk**.

Off-Channel Habitat: Generally NA to the Rosgen C-, G-, and F-Channel types in mainstem Elk Creek between the confluences of East Fork Elk Creek and Doolittle Creek. However, there is one large braid with pools that can serve as critical high-water refugia for juvenile coho salmon – the braid is on Private land but has not been modified in a way that degrades its' value as winter refugia. **NA**.

Refugia: Cold water and cover are the primary elements of fish refugia in this watershed. Water temperature is still slightly high due to channel-widening and loss of vegetation during the 1997 Flood, and from loss of stream-shading vegetation in the 2008 Panther Fire and 2014 Happy Camp Complex fire. LWD is below desired condition in mainstem Elk Creek due to past and current human disturbance in the stream buffer (roads; private property). There are frequent deep pools that provide good cover. **At-Risk**.

CHANNEL CONDITION AND DYNAMICS

Width to Depth Ratio: Depositional reaches were scoured and/or overwhelmed with sediment from the 1997 Flood. Pools were lost or partially filled with sediment. The stream channel was widened and/or shallowed in many locations, and/or entrenched under a deep lens of sediment after the flood resided. Mainstem Elk Creek has been getting deeper and narrower since the 1997 Flood but channel recovery (channel deepening and narrowing) is still incomplete.

Constrained reaches are largely recovered. Recovery of the few unconstrained reaches is progressing well but alder trees are still small and have limited ability to stabilize the streambanks. Excess fine sediment is being delivered to mainstem Elk Creek as a result of the 2008 and 2014 wildfires. Sandbars are beginning to diminish residual pool volume which is slightly increasing the channel width-to-depth ratio. **At-Risk**.

Stream Bank Condition: Much of the streambanks of mainstem Elk Creek were scoured and eroded during the 1997 Flood event, however, many reaches are constrained transport reaches with bedrock banks that showed little to no disturbance from the flood. Recovery of the few unconstrained reaches is progressing well but alder trees are still small and have limited ability to stabilize the streambanks. **At-Risk**.

Floodplain Connectivity: Generally NA to the Rosgen C-, G-, and F-Channel types in mainstem Elk Creek between the confluences of East Fork Elk Creek and Doolittle Creek. However, there is one "floodplain" with a large high-water braid with pools that can serve as critical high-water refugia for juvenile coho salmon – the floodplain is on Private land but has not been modified in a way that degrades its' value as winter refugia. **NA.**

FLOW/HYDROLOGY

Change in Peak/Base flow: Road density is high at 4.1 miles of road per square mile of watershed and 33% of the road system is hydrologically connected to the stream network. Modeled runoff risk is slightly elevated (ERA/TOC = 0.39) due to past timber harvest/salvage and road building. **At-Risk**.

Increase in Drainage Network: Road density is high at 4.1 miles of road per square mile of watershed and 33% of the road system is hydrologically connected to the stream network.**Not Properly Functioning**.

WATERSHED CONDITION

Road Density/Location: Road density is high at 4.1 miles of road per square mile of watershed. There are many miles of valley bottom road adjacent to mainstem Elk Creek and Cougar Creek – several miles are within inner gorge. **Not Properly Functioning**.

Disturbance History/Regime: The entire length of the stream channel of mainstem Elk Creek was altered by debris flows from road failures and/or natural landslides during the 1997 Flood, and is still recovering. Several roads have been decommissioned or storm proofed since the 1997 Flood but the (non-decommissioned) road density is still high at 4.1 miles per square mile and 33% of the road system is still hydrologically connected to the stream network. There are many miles of road within the stream buffer including several miles of inner gorge road. Roads are likely increasing peak flows, elevating sediment delivery to stream channels, and diminishing the potential for LWD to be left in channels and the potential for new LWD to grow and be recruited into channels.

The 1987 Fire burned the SE quarter of the watershed. The 2007 Titus-Wingate Fire caused minor disturbance when 83 acres burned including two acres that burned at moderate intensity within stream buffer RRs. The 2014 Happy Camp Complex fire burned 100 acres of stream

buffer RR at moderate-to-high severity which is about 6% of the hydrologic RRs in the HUC14. The 2014 Happy Camp Complex fire burned 56 acres of geologic RR at moderate-to-high intensity which is about 9% of the geologic RRs in the HUC14 – 55 acres of that was in inner gorge (which is both hydrologic and geologic RR). From a watershed perspective, the 2014 Fire in the Cougar Creek-Elk Creek HUC14 was generally a beneficial disturbance since it cleaned up excess dead and live fuels, did some natural thinning, and had minimal torching into the crowns of large live trees. However, this disturbance is likely to elevate peak flows and increase sediment delivery in the short-term. **At-Risk**.

Riparian Reserves: The 1997 flood greatly altered the mainstem channel of Elk Creek, and some of the tributaries to the mainstem – resulting in widening and shallowing of the channel, and loss of streamside vegetation. Excess sediment from numerous natural debris torrents, and from over 200 road failures, resulted in excessive bedload which overwhelmed and altered the channel of mainstem Elk Creek and removed or buried riparian vegetation. Recovery is taking place as riparian vegetation grows back and the channel deepens and narrows, but recovery is incomplete. The 2014 Happy Camp Complex fire burned 56 acres of geologic RR at moderate-to-high intensity which is about 9% of the geologic RRs in the HUC14 – 55 acres of that was in inner gorge (which is both hydrologic and geologic RR). There are many miles of road within the stream buffer including several miles of inner gorge road. **At-Risk**.

Table of Pathway and Indicators for 7th Field Watershed:

Eddy Gulch (for Eddy Gulch)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; WA 1995; Temps-Eddy				X	
Suspended Sediment - Intergravel DO/Turbidity	CWE 2015; Sed 2013; WA 1995				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ; CDFW 2015; Siskiyou 2002; FishPass 2001				X	
Habitat Elements Substrate Character and Embeddedness		Sed 2013; Eddy 2006			X	
Large Woody Debris			Eddy 2006; WA 1995		X	
Pool Frequency and Quality			Eddy 2006		X	
Large Pools					X	
Off-channel Habitat	N/A - Not present					
Refugia		PJ			X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth			PJ; Eddy 2006; Eddy 1993		X	
Streambank Condition	ND - likely Functioning-At-Risk (PJ)				X	
Floodplain Connectivity		PJ			X	
Flow/Hydrology Change in Peak/Base Flows		PJ			X	
Increase in Drainage Network	CWE 2015				X	
Watershed Conditions Road Density & Location			Coho-Sal 2014; Sed 2013; SRSS 2002; WA 1995; GIS		X	
Disturbance History & Regime		PJ; WA 1995			X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sal 2014; WA 1995			X	
SPECIES AND HABITAT:						

<u>Species and Habitat</u>: Summary/Integration of all Species and Habitat Indicators		X			X	
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. For a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # **Westside Fire Recovery**

Horse Creek 7th Field Checklist

Pathways: **INDICATORS**	**ENVIRONMENTAL BASELINE** Horse Creek 7th Field Watershed			**EFFECTS OF THE ACTION(S)** Horse Creek 7th Field Watershed		
	PROPERLY FUNCT	AT RISK	NOT PROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature	**TEMP**				**X**	
Sediment - Turbidity		**KNF GIS RSS ND/PO/PJ**			**X**	
Chemical Contamination	**PJ/ND**				**X**	
Habitat Access Physical Barrier	**FPI**				**X**	
Habitat Elements Substrate Character		**KNF GIS RSS ND/PO/PJ**			**X**	
Large Woody Debris	**ND/PO/PJ**				**X**	
Pool Frequency/Quality		**ND/PJ Flood**			**X**	
Off-channel Habitat	**NA**					
Refugia	**TEMP**	**PO/PJ**			**X**	
Channel Cond & Dyn Width-to-Depth Ratio		**ND/PJ Flood**			**X**	
Streambank Condition		**KNF GIS**			**X**	
Floodplain Condition	**NA**					
Flow /Hydrology Change in Peak/Base Flow		**KNF GIS RSS PO/PJ**			**X**	
Drainage Network Increase		**KNF GIS RSS**			**X**	
Watershed Cond. Road Density/Location			**KNF GIS**		**X**	
Disturbance History/Regime		**KNF GIS Flood RSS**			**X**	
Riparian Reserves		**KNF GIS RSS**			**X**	

TEMP = 2004 Karuk DNR Horse Creek water temperature monitoring in KNF database;

FPI = KNF Forest-Wide Fish Passage Barrier Inventory; **ND** = No Data; **PJ** = Professional Judgment; **PO** = Personal observation based on 20+ years observing; **NA** = Not Applicable; **Flood** = 1997 Flood Assessment (KNF 1998); **KNF GIS** = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015); **RSS =** KNF Road Sediment Source Inventory and Risk Assessment (USDA 2012);

Environmental Baseline and Checklist last updated by Jon Grunbaum on March 4, 2015.

The (Little) Horse Creek 7th field watershed (HUC14) is a true watershed of 2,537 acres. Approximately 2% of the watershed is private property and the rest in National Forest. Horse Creek is a 3rd-order stream (Strahler 1957) and the primary stream in the watershed. Horse Creek is known to provide about 1.4 miles of habitat for resident rainbow trout, a few tenths of a mile of habitat for Coho salmon and winter steelhead trout. (Little) Horse Creek is not known to support Chinook salmon or summer-run steelhead. There are several zero and 1st-order tributaries to mainstem Horse Creek but none are named and none are fish-bearing. There are no recent surveys of (Little) Horse Creek other than presence/absence surveys to determine fish distribution.

(Little) Horse Creek 7th-Field watershed Environmental Baseline Elements:

Water Quality

Water temperature: Water temperature in lower Horse Creek stayed below 66°F from July 10 through to the end of September, 2004 (Karuk Tribe Temperature monitoring record in KNF temperature database). **Properly Functioning**.

Sediment-Turbidity: No Data. Turbidity likely slightly elevated due to high road density and moderate to high watershed disturbance. The 2014 Happy Camp Complex that burned 15% of the stream buffer RR s in the watershed and 45 acres within inner gorge will increase the duration and magnitude of turbidity associated with peak flows for the short term until vegetation and ground cover recover. **At-Risk**.

Chemical Contamination: No significant source of chemical contamination is known to exist. **Properly Functioning**.

Habitat Access

Physical Barriers: The are no barriers to fish passage in the Horse Creek watershed. P**properly Functioning.**

Habitat Elements

Substrate Character: No data. Rate of sediment delivery and fines in substrate likely elevated due to high road density and moderate to high levels of watershed disturbance (USLE = 0.86; GEO = 0.76). The 2014 Happy Camp Complex that burned 15% of the stream buffer RR s in the watershed and 45 acres within inner gorge will increase sediment delivery rate for the short term until vegetation and ground cover recover. **At-Risk**.

Large Woody Debris: The in-channel quantity of LWD and the number of large conifers that could recruit into a stream channel is likely near site potential in and adjacent to most channels because there is not much access to the stream buffer (i.e. there is not much private property or valley bottom road, there is a low density of stream crossings, and not much stand-replacement forestry has occurred adjacent to perennial streams). **Properly Functioning**.

Pool Frequency and Quality: Much of the mainstem of Horse Creek was altered during the 1997 Flood and pools were likely lost or diminished due to aggradation and/or channel scour. Recovery from the flood (the scouring of sediment out of pools in this instance) is likely occurring. **At-Risk**.

Off-channel Habitat: Not applicable in the Horse Creek watershed where channels are Rosgen A-, and B-channel types that are too constrained and entrenched to have floodplains that allow off-channel habitat development. There is no off-channel habitat. **NA**.

Refugia: Coho salmon and other salmonids use the lower few tenths of a mile of Horse Creek for summer thermal refugia nearly every year. Cold clear water and cover are the primary element of refugia. Water temperature is believed to be suitable to optimum for Coho salmon and other salmonids but cover is lacking. Each summer, the local watershed council ensures passage into the creek from the Klamath River and installs branch bundles for fish cover. **At-Risk**.

Channel Conditions and Dynamics

Width-to-Depth Ratio: No data. The Rosgen A- and B-channel types of the Fort Goff watershed are generally not susceptible to channel type change unless a major debris flow has scours and/or aggrades the channel. Much of the stream channel of (Little) Horse Creek was altered during the 1997 Flood. Recovery of the altered channel is probably proceeding slowly because sediment delivery rate is still elevated above threshold (GEO = 1.01). **At-Risk**.

Streambank Condition: Much of the mainstem of Horse Creek was altered during the 1997 Flood and pools were likely lost or diminished due to aggradation and/or channel scour. Recovery from the flood (the scouring of sediment out of pools in this instance) is likely occurring. **At-Risk**.

Floodplain Connectivity: Not applicable in the Horse Creek watershed where channels are Rosgen A-, and B-channel types that are too constrained and entrenched to have floodplains. There are no floodplains. **NA**

Flow/Hydrology

Change in Peak/Base Flow: Peak flows may be slightly increased because road density is high and 12% of the road system is hydrologically connected to the stream network. Road-related increase in peak flow will continue until the road system is disconnected from the stream network through storm proofing and/or decommissioning. In addition, peak flows may be increased in the short term due to decreased hydrologic retention capacity on the 22% of the watershed that burned at moderate to high severity. Increase in peak flows related to the 2014

Fire will diminish as vegetation and ground cover recovers. Modeled runoff risk is moderately high (ERA/TOC = 0.70). The residences at the mouth of Horse Creek have domestic water rights that reduce base flow. **At-Risk.**

Drainage Net Increase: The drainage density is slightly increased due to high road density coupled with 12% hydrologic connectivity between the road system and the stream network. **At-Risk**.

Watershed Conditions

Road Density/Location: Road density is high at 4.8 miles of road per square mile of watershed and 12% of the road system is hydrologically connected to the stream network. There is about a half-mile of valley bottom road within the watershed. **Not Properly Functioning**.

Disturbance History/Regime: There is moderate to high disturbance from the high density road system. There has been no recent (last 25 years) stand-replacement forestry so there is very little disturbance of watershed processes still present from past vegetation management projects. The 2014 Happy Camp Complex Fire burned 567 acres (22% of the HUC14) at moderate to high intensity and the rest not burned or low intensity. This mix of unburned, low intensity burn, and moderate to high intensity burn is likely not too far outside the range of historical natural variability for wildfires in the western Klamath Mountains. Past fire suppression and stand-replacement forestry over the last 80 years or so may have contributed to higher percentage of moderate to high severity burn than would have occurred if fires had not been suppressed since the early 1900s, and stand-replacement forestry had not occurred.

There are two residences and a residential lot adjacent to the lower .3 mile of mainstem Horse Creek which have minor localized impact on the riparian zone and channel.

Modeled surface erosion risk (USLE = 0.86) is moderately high; modeled mass wasting risk (GEO = 0.76) is moderately high; and modeled runoff risk (ERA/TOC = 0.70) is moderately high primarily due to high road density with the 2014 Fire a distant second source of disturbance. Disturbance from past vegetation management is negligible (at least in the CWE models). **At-Risk**.

Riparian Reserves: Although road density is high the density of stream crossings and roads within stream buffer RRs is relatively low. The stream buffer is modified at the mouth of Horse Creek due to the County Road and clearings, compacted areas, and structures on three private parcels, however, streambanks and a narrow buffer are largely undisturbed. The 2014 Happy Camp Complex burned 15% of the stream buffer in the HUC14 at moderate to high severity; and burned at moderate to high severity on 2 acres of active landslide and on 45 acres of inner gorge (which is 12% of the geologic RRs in the watershed). **At-Risk**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # Westside **Fire Recovery**

Hoop & Devil 7th Field Checklist

Pathways: **INDICATORS**	**ENVIRONMENTAL BASELINE** Hoop & Devil 7th Field watershed			**EFFECTS OF THE ACTION(S)** Hoop & Devil 7th Field watershed		
	PROPERLY FUNCT	AT RISK	NOT ROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature		**TEMP**			**X**	
Sediment-Turbidity		**PO KNF CWE**			**X**	
Chemical Contamination	**ND/PO/PJ**				**X**	
Habitat Access Physical Barrier	**FPI**				**X**	
Habitat Elements Substrate		**SED KNF CWE PO**			**X**	
LWD		**SS06 PO**			**X**	
Pool Frequency/Quality	**SS06 PO**				**X**	
Off-channel Habitat	**NA**					
Refugia		**TEMP SS06 PO PJ**			**X**	
Channel Cond & Dyn W/D Ratio		**SS06 Flood PO PJ**			**X**	
Streambank Condition		**Flood PO PJ**			**X**	
Floodplain Condition	**NA**					
Flow /Hydrology Peak/Base Flow		**KNF GIS RSS**			**X**	
Drainage Network Increase		**KNF GIS RSS**			**X**	
Watershed Cond. Road Density/Location			**KNF GIS RSS**		**X**	
Disturbance History/Regime		**KNF GIS Flood RSS**			**X**	
Riparian Reserves		**KNF GIS Flood PO PJ**			**X**	

TEMP = Water temperature monitoring at RM 4.5 of mainstem Elk Creek from 1990 to 2014;

SS06 = 2006 KNF stream survey of mainstem Elk Creek from mouth to EF Elk Confluence (3.8 miles);

RSS = 1999 KNF Road Sediment Source Inventory and Risk Assessment; **FPI** = KNF Forest-Wide Fish Passage Barrier Inventory; Flood = KNF analysis of the 1997 New Years Flood; ND = No Data; PJ = Professional Judgment; **PO** = Personal Observation based on 20+ years observing; NA = Not Applicable;

KNF GIS = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015);

Environmental Baseline and Checklist completed by Jon Grunbaum on February 9, 2015.

The Hoop and Devil 7th-field watershed is a composite watershed with an area of 3,070 acres. The Hoop&Devil composite watershed is 92% National Forest land, and 8% private land. The private land is mostly residential with low ground disturbance, however, one upslope large parcel has a several-acre auto wrecking yard complete with hundreds of old cars and noxious weeds; one streamside several acre parcel is the intake facility and water treatment plant for the town of Happy Camp; and one large (10-20 acres) streamside parcel is a commercial campground. Mainstem Elk Creek is a fourth-order stream (Strahler 1957) and the principle stream in the composite watershed. The channel and riparian vegetation along the lower 0.7 mile of Elk Creek mainstem is moderately impacted by the water treatment plant, the campground, private residences, roads and a bridge, and an off-road ATV play area at the mouth. The (approximate) 4.3 miles of mainstem Elk Creek within the Hoop&Devil watershed provide habitat for winter- and summer-run steelhead, spring- and summer-run Chinook salmon, and winter coho salmon. There is one 2nd-order tributary, several 1st-order tributaries, and several intermittent and ephemeral tributaries to mainstem Elk Creek within the Hoop&Devil composite watershed but none are named and none are fish-bearing. The last stream survey of mainstem Elk Creek was summer 2006. Channel sediment metrics were assessed in 2009 and 2013 but those metrics are no longer valid for describing current condition because excess sediment has already been delivered to the channel as a result of the 2014 Fire. Channel sediment metrics in mainstem Elk Creek were assessed in 2011.

Hoop & Devil 7th-Field Watershed Environmental Baseline Elements:

WATER QUALITY

Water Temperature: Summer (and some winter) water temperature of mainstem Elk Creek was monitored within the Hoop&Devil 7th-field watershed at approximately RM 4.5 nearly every year since 1990 (no data for 1996). The 1997 flood greatly altered the mainstem channel of Elk Creek – resulting in widening and shallowing of the channel, and loss of streamside vegetation. Much of mainstem Elk and several tributaries to mainstem Elk Creek experienced large debris flows that scoured and altered their channels and ripped out riparian vegetation. Excess sediment from numerous natural debris torrents, and from over 200 road failures, resulted in excessive bedload which overwhelmed and altered the channel of mainstem Elk Creek. The loss of riparian vegetation and narrowing/widening of the stream channel increased the range and magnitude of daily heating and cooling – as described in the assessment: *The Flood of 1997-Klamath National* Forest (USDA KNF, November 1998). Riparian and channel recovery was still taking place when the 2014 Fire hit. Before the 1997 Flood: from 1990 to 1995, the 7-day maximum water maximum temperature (MWMT) 18.7 ^{o}C to 21.8 ^{o}C, with six-year average of 20.8^{o}C. After the 1997 Flood: from 1997 to 2004, the MWMT ranged from 20.1 ^{o}C to 23.7 ^{o}C, with eight-year average of 22.9^{o}C. Since then, the 2008 Panther Fire burned riparian vegetation and increased water temperatures in tributary watersheds upstream from the Hoop-n-Devil

watershed. High water temperatures in Klamath River tributaries including Elk Creek in summer 2014 was likely the result of record or near record low streamflows. As shown in the table below, in the last five years of monitoring, the maximum instantaneous water temperature ranged from 20.2°C to 24.8 °C; the maximum weekly average temperature (MWAT) ranged from 17.5 °C to 21.1°C; and the MWMT ranged from 19.6 °C to 23.8°C, with a five-year average of 21.8 °C. **At-Risk**.

Recent Water Temperature Monitoring Results for Mainstem Elk Creek at RM 4.5							
Start	**End**	**Max Daily Average Temp C**	**Max Daily Max Temp C**	**Min Daily Min Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp (MWMT)**
7/1/2010	10/21/2010	19.7	22	8.3	5.3	19.0	21.4
7/14/2011	10/11/2011	17.8	20.2	5.3	4.9	17.5	19.6
6/22/2012	10/23/2012	19.5	22.0	7.4	5.2	18.8	21.0
6/8/2013	11/3/2013	21.5	24.4	5.9	6.2	20.5	23.0
5/28/2014	9/24/2014	21.8	24.8	10.3	6	21.1	23.8

Turbidity: The 2008 Panther Fire significantly elevated the magnitude and duration of turbidity in mainstem Elk Creek (personal observation). This increase in turbidity was generally subsiding when the 2014 Fire hit. The 2014 Fire again significantly elevated the magnitude and duration of turbidity in mainstem Elk Creek during peak runoff events (personal observation). Chronic turbidity is likely to remain elevated for several more years until vegetation and duff recovers ground cover again. Acute fire-related turbidity in mainstem Elk Creek is expected to be elevated for up to ten years or longer because mass wasting/debris flows are expected to significantly increase in the Hoop'n'Devil HUC14 watershed for this period of time as well as in many of the HUC14 watersheds upstream of the Hoop'n'Devil HUC14. Modeled surface erosion is moderately elevated (USLE = 0.63) in the Hoop'n'Devil HUC14 and moderately to highly elevated in the three East Fork Elk Creek HUC14s that drain into the Hoop'n'Devil HUC14. Modeled wasting is moderately elevated (GEO = 0.60) in the Hoop'n'Devil HUC14 and moderate to way-over threshold in most of the HUC14s that drain into the Hoop'n'Devil HUC14. **At-Risk**.

Chemical Contamination: No significant source of chemical contamination is known to exist other than an auto wrecking yard on private property (which is not known to be point source of water contamination). **Properly Functioning**.

HABITAT ACCESS

Physical Barriers: No barriers to fish passage were found in the KNF Fish Passage Inventory (KNF 2003). **Properly Functioning**.

HABITAT ELEMENTS

Substrate Character: Substrate character was determined from a 2006 stream survey, 2011 intensive sediment monitoring and evaluation, existing watershed disturbance levels as described under the *Disturbance History/Regime Indicator* below; and personal observation. During the 2006 stream survey: (1) surface fines in pebble counts averaged 6.9%; (2) surface fines in pool tail-outs averaged 8.1%, and (3) embeddedness averaged 26.4%. The values of surface fines were within desired range for properly functioning streams but embeddedness slightly exceeded desired range.

The results of 2011 intensive monitoring and evaluation of sediment in mainstem Elk Creek that included the metrics: V*, percent surface fines < 2mm, percent sub-surface sediment < 0.6.35mm, and percent sub-surface sedient < 0.85mm. Substrate quality impairment was evaluated in mainstem Elk Creek by comparing the four sediment indicators in Elk Creek (a managed watershed) to the 85th percentile value of four indicators for reference streams that have negligble management-related watershed disturbance. Watersheds exceeding the 85% percentile of reference streams are considered impaired. In the 2011 sediment monitoring, two of the four sediment indices (surface fines < 2mm and subsurface fines < 0.85mm) in Elk Creek were determined to very slightly exceed reference watershed values as shown in he table below.

Average surface, sub-surface and volume of fine sediment filling pools (v-star) from the 2011 Elk Creek response reach (elk2) compared to KNF Stream Sediment Monitoring reference conditions (@85 percentile). Elk2 metrics over threshold values are bolded.

Sediment Index	Elk2 reach average (%)	Reference Condition (%)	Reference Condition ratio
Surface Fines < 2mm	**6.7**	**6.4**	**1.05**
Sub-surface fines < 0.85mm	**18.9**	**16.2**	**1.17**
Sub-surface fines < 6.38mm	36.6	46.1	0.79
Fraction of pools filled with fine sediment < 2mm (V star)	0.05	0.11	0.45

The area of streambed covered by sand, and the size of sandbars, in mainsten Elk Creek has been noticeably increasing since the 2008 Panther Fire and more recently the 2014 Happy Camp Complex (personal observation from frequent fish/stream surveys and kayak trips down mainstem Elk Creek over the last 20 years). Surface erosion and chronic sedimentation into streams is likely to be elevated for several years until vegetation and duff recovers ground cover in areas that burned at moderate-to-high intensity. The rate of mass wasting and debris flows is expected to increase for up to ten years or longer until ground cover increases and the roots of recovering vegetation regain the capacity to bind soil in areas that burned at moderate-to-high intensity. Modeled surface erosion is moderately elevated (USLE = 0.63) in the Hoop'n'Devil HUC14 and moderately to highly elevated in the three East Fork Elk Creek HUC14s that drain into the Hoop'n'Devil HUC14. Modeled wasting is moderately elevated (GEO = 0.60) in the Hoop'n'Devil HUC14 and moderately to way-over threshold in most of the HUC14s that drain into the Hoop'n'Devil HUC14. **At-Risk.**

Large Woody Debris: During the 2006 stream survey of mainstem Elk Creek within the Hoop&Devil composite watershed there were only four pieces of LWD in 3.8 miles of mainstem that was surveyed. However, the potential for future LWD recruitment is near site potential between RM 0.7 and RM 3; and many large trees along this reach did fall into mainstem Elk Creek during heavy snowfall in winter 2012-13. The potential for future LWD recruitment and for recruited LWD to be left in the stream is greatly

diminished along the lower 0.7 mile of Elk Creek mainstem due to the existence of the Happy Camp community water treatment plant, a campground, private residences, roads and a bridge, and an off-road ATV play area in the stream buffer. The potential for future LWD recruitment and for recruited LWD to be left in the stream is greatly diminished from RM 3.8 to RM 4.3 of Elk Creek mainstem due to private residences, roads, and a bridge in the stream buffer. The potential for future LWD recruitment and for recruited LWD to be left in the stream buffers of tributaries to mainstem Elk Creek is moderate to high because most tributary watersheds have low disturbance in the stream buffers. **At-Risk**.

Pool Frequency/Quality: In the 2006 stream survey of mainstem Elk Creek there was one deep (over three feet maximum depth) pool every 5.6 bankfull widths with an average maximum depth of 6.6 feet. Maximum pool depth ranged from 3.5 to 13.9 feet. Excessive fines that are being delivered to mainstem Elk Creek as a result of the 2008 Panther Fire and 2014 Happy Camp Complex fire has increased the size of sandbars in pools but has only slightly decreased residual pool depth and volume (as of last personal observation made in middle of January 2015). **Properly Functioning**.

Off-Channel Habitat: Generally NA to the Rosgen C-, G-, and F-Channel types in mainstem Elk Creek. Off-channel habitats are not characteristic of these channel types. **NA**

Refugia: Cold water and cover are the primary elements of fish refugia in this watershed. Water temperature is still slightly high due to channel-widening and loss of vegetation during the 1997 Flood, and from loss of stream-shading vegetation in the 2008 Panther Fire and 2014 Happy Camp Complex fire. LWD is below desired condition in the top 0.6 mile and lower 0.7 mile of mainstem Elk Creek due to past and current human disturbance in the stream buffer (roads; private property). There are frequent deep pools that provide good cover. **At-Risk**.

CHANNEL CONDITION AND DYNAMICS

Width to Depth Ratio: Mainstem Elk Creek was scoured and/or overwhelmed with excess sediment delivered to the channel from the 1997 Flood. Pools were completely or partially filled with sediment. Constrained gorge reaches of mainstem Elk Creek were least altered by the flood and first to be able to transport out the excessive sediment. Most of the channel of mainstem Elk Creek within the Hoop&Devil composite watershed is tightly constrained gorge and excessive sediment from the 1997 Flood has largely been transported out based on based on the 2006 pool frequency/quality data and personal observation. Recovery of the few unconstrained reaches is progressing well but alder trees are still small and have limited ability to stabilize the streambanks. **At-Risk**.

Stream Bank Condition: Much of the streambank of mainstem Elk Creek was scoured and eroded during the 1997 Flood event, however, most of the reaches are constrained sediment transport reaches with bedrock banks that sustained little to no disturbance from the flood. Streamside vegetation was largely ripped out and the streambanks were altered in the few unconstrained reaches. Recovery of vegetation and streambanks in unconstrained reaches is well underway and most streamside alder trees are still small having only sprouted or germinated in 1998 and have limited ability to stabilize the streambank. **At-Risk**.

Floodplain Connectivity: Generally NA to the Rosgen C-, G-, and F-Channel types in mainstem Elk Creek. Floodplains are not characteristic of these channel types. **NA**.

FLOW/HYDROLOGY

Change in Peak/Base flow: Modeled runoff risk is slightly elevated (ERA/TOC = 0.39) primarily due to roads, past wildfires, vegetation management, and fire lines (in that order). Road density is high but only 10% of the road system is hydrologically-connected to the stream network. The fire lines are mostly not hydrologically-connected. Increased peak flows due to all these factors combined is likely minor. Base flows are reduced in summer due to riparian water rights and municipal water diversion from mainstem Elk Creek. Municipal demand can divert as much as 1.5 million gallons of water per day – this water is diverted at about RM 0.6. **At-Risk**.

Increase in Drainage Network: Road density is high but only about 10% of the road system is hydrologically-connected to the stream network. **Properly Functioning**.

WATERSHED CONDITION

Road Density/Location: Road density is high at 3.4 miles of road per square mile of watershed. There are several hundred meters of valley bottom road. There is over a mile of (County) road constructed within the inner gorge of lower mainstem Elk Creek but this road is paved, full-bench in bedrock and has not had few stability problems over at least the last 20 years. **Not Properly Functioning**.

Disturbance History/Regime: Watershed disturbance in the Hoop&Devil composite watershed is moderately high, primarily from high road density but also from the 1987 Fire (which burned the SE quarter of the watershed) and the 2014 Happy Camp Complex fire and from past harvest/salvage: modeled surface erosion risk is moderately high (USLE = 0.63), modeled mass wasting risk is moderately elevated (GEO = 0.60, and modeled runoff risk is slightly elevated (ERA/TOC = 0.39). The entire length of the stream channel of mainstem Elk Creek was altered by debris flows from road failures and/or natural landslides during the 1997 Flood, and is still recovering. The 1997 Flood triggered hundreds of road failures in the Elk Creek watershed that caused many debris flows and intensified mainstem channel alteration from natural debris flows that were occurring. There was only one major road damage site within the Hoop&Devil composite watershed resulting the 1997 Flood. The 2014 Happy Camp Complex fire burned 653 acres of stream buffer RR but only 27 acres burned at moderate-to-high severity. The 2014 Happy Camp Complex fire burned only 13 acres of geologic RR at moderate-to-high intensity. From a watershed perspective, the 2014 Fire in the Hoop&Devil HUC14 was generally a beneficial disturbance since it cleaned up excess dead and live fuels, did some natural thinning, and had minimal torching into the crowns of large live trees. **At-Risk**.

Riparian Reserve: The stream buffer RR of mainstem Elk Creek is largely intact between RM 0.7 and RM 3.8 because there are no roads or development along this section of mainstem. The stream buffer of mainstem Elk Creek is significantly impacted along the lower 0.7 mile of Elk Creek mainstem due to the existence of the Happy Camp community water treatment plant, a campground, private residences, roads and a bridge, and an off-road ATV play area in the stream buffer. The stream buffer of mainstem Elk Creek is slightly impacted from RM 3.8 to RM 4.3 due to private residences, roads, and a bridge in the stream buffer. Upslope road density is high

but the density of stream crossings is moderate. The 2014 Happy Camp Complex fire burned 653 acres of stream buffer RR but only 27 acres burned at moderate-to-high severity. The 2014 Happy Camp Complex fire burned only 13 acres of geologic RR at moderate-to-high intensity. **At-Risk**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # Westside Fire Recovery

Lower East Fork Elk Creek 7th Field Checklist

Pathways:	ENVIRONMENTAL BASELINE LowerEastForkElkCreek HUC14			EFFECTS OF THE ACTION(S) LowerEastForkElkCreek HUC14		
	PROPERLY		NOT PROP			
Water Quality		**TEMP**			**X**	
Sediment-Turbidity		**SED** **KNF GIS**		**X**		
Chemical Contamination	**ND/PO/PJ**				**X**	
Habitat Access	**FPI**				**X**	
Habitat Elements Substrate Character		**SED** **KNF CWE**		**X**		
Large Woody Debris		**SS90** **PO PJ**		**X**		
Pool Frequency/Quality	**SS90** **PO**			**X**		
Off-channel Habitat	**NA**					
Refugia		**TEMP** **SS90**		**X**		
Channel Cond & Dyn Width-to-Depth Ratio		**SS90** **PO PJ**			**X**	
Streambank Condition		**PO PJ**			**X**	
Floodplain Condition	**NA**					
Flow /Hydrology Change in Peak/Base Flow		**KNF GIS** **RSS**			**X**	
Drainage Network Increase		**KNF GIS** **RSS**		**X**		
Watershed Cond. Road Density/Location			**KNF GIS** **RSS PO**	**X**		
Disturbance History/Regime		**KNF GIS** **RSS**		**X**		
Riparian Reserves		**KNF GIS**			**X**	

TEMP = Water temperature monitoring at RM 4.5 of mainstem Elk Creek from 1990 to 2014;

SS90 = 1990 KNF stream survey of mainstem East Fork Elk Creek; **SED =** 2011 sediment assessment survey; **RSS =** 1999 KNF Road Sediment Source Inventory and Risk Assessment; **FPI** = KNF Forest-Wide Fish Passage Barrier Inventory; ND = No Data; PJ = Professional Judgment; **PO** = Personal Observation based on 20+ years observing; NA = Not Applicable;

KNF GIS = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015);

Environmental Baseline and Checklist last updated by Jon Grunbaum on February 27, 2015.

Lower East Fork Elk Creek is a 7th-field (HUC14) composite watershed of 3,430 acres that includes the lower three miles of mainstem EF Elk Creek which is a 3rd-order stream (Strahler 1957) and several zero- to second-order (Strahler 1957) tributaries to the mainstem. In summer 2014 juvenile Coho salmon were documented in the lower 0.18 mile of East Fork Elk Creek below a suspected barrier. The KNF GIS fish distribution layer shows Coho range extending up to 0.5 miles but documentation is poor. Chinook salmon were observed in the lower 0.15 miles of EF Elk Creek during the 1990 stream survey. Mainstem EF Elk supports resident rainbow and steelhead trout for the entire reach within this composite watershed. Little Elk Creek is the largest (3rd-order) and only named tributary to EF Elk Creek within this HUC14 and supports resident rainbow trout in the lower few tenths of a mile (and maybe steelhead but no adult steelhead have been documented). None of the other tributaries to mainstem EF Elk Creek within this HUC14 are fish-bearing. The last survey of mainstem East Fork Elk Creek was in 1990.

Lower East Fork Elk 7th Field (HUC14) Watershed Environmental Baseline Elements:

WATER QUALITY

Water Temperature: Summer water temperature in mainstem EF Elk Creek was monitored near the mouth of the creek from 2010 to 2014 – see table below for a summary of monitoring results. In this five year period of record the maximum instantaneous water temperature ranged from 18.1°C to 22.1°C; the maximum weekly average temperature (MWAT) ranged from 16.0 °C to 19.0°C; and the maximum weekly maximum temperature ranged from 17.6°C to 21.2°C. Water temperature in mainstem EF Elk Creek was within the properly functioning range from 2010 to 2012 but was in the at-risk range in 2013 and 2014. Near record low base flows may have been a primary factor in the much higher than average water temperatures and large diurnal temperature variation in 2014. It is likely that the rate and magnitude of stream heating and cooling will increase due the 2014 Happy Camp Complex Fire because: (1) the wildfire burned large swaths of riparian vegetation that had provided shade and thermal buffering to stream channels, (2) pools are likely to infill or partially infill with excess sediment which will increase surface area to volume ratio, and (3) the wildfire is likely to significantly increase the frequency of in-channel debris flows and upslope landslides that can remove riparian vegetation and widen-and-shallow stream channels. **At-Risk**.

Recent Water Temperature Monitoring Results for East Fork Elk Creek Near Mouth						
Start	**End**	**Max Daily Max Temp C**	**Max Average Daily Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp C (MWMT)**
7/1/2010	10/10/2010	19.5	17.8	4.2	17.3	18.9
6/11/2011	10/4/2011	18.1	16.5	3.9	16.0	17.6
6/8/2012	10/23/2012	19.3	17.8	4.1	17.1	18.5
6/7/2013	9/29/2013	21.0	19.1	4.4	18.3	20.0
5/28/2014	9/24/2014	22.1	19.9	5.1	19.0	21.2

Sediment – Turbidity: The 2014 Happy Camp Complex Fire burned 200 acres of stream buffer hydrologic RR (20% of the total stream buffer RR in the HUC14) at moderate to high intensity – half of which was within inner gorge geologic RR. In addition, the 2014 Fire burned four acres of active landslide geologic RR at moderate to high intensity. The magnitude and duration of turbidity in East Fork Elk Creek has increased significantly since the 2014 Fire (personal observation). Surface erosion and chronic sedimentation into streams is likely to be elevated for several years until vegetation and duff recovers ground cover in areas that burned at moderate-to-high intensity. The rate of mass wasting and debris flows is expected to increase in moderate to high severity burned areas for up to ten years or longer until ground cover recovers and the roots of regenerating vegetation regain the capacity to bind soil. Therefore, the magnitude and duration of turbidity during and after peak flow events is likely to remain significantly elevated for at least more several years. Modeled surface erosion risk is high (USLE = 0.88); and modeled mass wasting risk is moderately elevated (GEO = 0.48). Modeled disturbance in the two HUC14s that drain into Lower East Fork Elk Creek mainstem is about the same as in Lower East Fork Elk Creek HUC14.

Chemical/Nutrient Contamination: No chemical or nutrient contamination is known to exist.

HABITAT ACCESS

Physical Barriers: There are no man-made barriers restricting or preventing salmon migration. The road-stream crossing over Little Elk Creek may be a barrier to rainbow/steelhead trout but there is only a few tenths of a mile of suitable habitat.

HABITAT ELEMENTS

Substrate Character: The results of 2011 intensive monitoring and evaluation of sediment in mainstem East Fork Elk Creek that included the metrics: percent surface fines < 2mm, percent sub-surface sediment < 0.85mm, percent sub-surface sedient < 6.38mm, and percent residual pool volume filled with fine sediment (V*), are shown in the table below. Substrate quality impairment was evaluated by comparing the four sediment indicators in East Fork Elk Creek (a managed watershed) to the 85th percentile value of four indicators for reference streams that have negligble management-related watershed disturbance. Watersheds exceeding the 85% percentile of reference streams *may* have impaired watershed function. In the 2011 sediment monitoring, one of the four sediment indices (surface

fines < 2mm) in East Fork Elk Creek was determined to slightly exceed reference watershed values as shown in the table below.

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2011 East Fork Elk Creek response reach (efelk1) compared to KNF Stream Sediment Monitoring reference conditions (@85 percentile). East Fork Elk Creek metrics exceeding 85th percentile reference values are bolded.

Sediment Index	efelk1 reach average (%)	Reference Condition (%)
Surface Fines < 2mm	**9.0**	6.4
Sub-surface fines < 0.85mm	15.2	16.2
Sub-surface fines < 6.38mm	45.6	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	0.065	0.11

The 2014 Happy Camp Complex Fire burned 200 acres of stream buffer hydrologic RR (20% of the total stream buffer RR in the HUC14) at moderate to high intensity – half of which was within inner gorge geologic RR. In addition, the 2014 Fire burned four acres of active landslide geologic RR at moderate to high intensity. Surface erosion and chronic sedimentation into streams is likely to be elevated for several years until vegetation and duff recovers ground cover in areas that burned at moderate-to-high intensity. The rate of mass wasting and debris flows is expected to increase in moderate to high severity burned areas for up to ten years or longer until ground cover recovers and the roots of regenerating vegetation regain the capacity to bind soil. Modeled surface erosion risk is high (USLE = 0.88); and modeled mass wasting risk is moderately elevated (GEO = 0.48). Modeled disturbance in the two HUC14s that drain into Lower East Fork Elk Creek mainstem is about the same as in Lower East Fork Elk Creek HUC14. **At-Risk.**

Large Woody Debris: During the 1990 stream survey there was only five pieces of LWD per mile. The availablity of LWD to be recruited to the stream channel has been significantly reduced in all HUC14s of East Fork Indian Creek due to past wildfires, and extensive road building (and maintenance) and stand-replacement timber harvest. **At-Risk**.

Pool Frequency/Quality: Pool frequency was one pool every 19 bankfull channel widths during the 1990 stream survey. **At-Risk**.

Off-Channel Habitat: NA to most of the stream channels in the East Fork Elk Creek HUC14 which are Rosgen A-, B-, and G-channel types. Off-channel habitat is not characteristic of these constrained and entrenched channel types. **NA**.

Refugia: Cold water and cover are the primary elements of refugia that East Fork Elk Creek could potentially provide. Water temperature in EF Elk Creek is at or near properly functioning condition and still optimal to suitable for salmonids. There is likely insufficient cover in the form of LWD and deep pools. **At-Risk.**

CHANNEL CONDITION AND DYNAMICS

Width to Depth Ratio: Based on low pool frequency (lack of deep spots) it is assumed that width-to-depth ratio is increased. **At-Risk**.

Streambank Condition: Prior to the 2014 Happy Camp Complex Fire streambanks were in relatively undisturbed condition except: (1) at stream crossing of which there is a low density and (2) in Little Elk Creek where a road impacts the streambank at several locations. A few tenths of a mile of streambanks along Little Elk Creek was destroyed or degraded during the 2014 Fire when fire crews attempted to reconstruct the lower section of the road to gain access to manage the fire. The 2014 Happy Camp Complex Fire burned 200 acres of stream buffer hydrologic RR (20% of the total stream buffer RR in the HUC14) at moderate to high intensity – half of which was within inner gorge geologic RR. **At-Risk.**

Floodplain Connectivity: NA to most of the stream channels in the East Fork Elk Creek HUC14 which are Rosgen A-, B-, and G-channel types. There is negligible potential for floodplain in these constrained and entrenched channel types. **NA**.

FLOW/HYDROLOGY

Change in Peak/Base Flow: Road density is high and 15% of the road system is hydrologically-connected to the stream network. Modeled runoff risk is moderately elevated (ERA/TOC = 0.41) primarily due to past wildfires and roads. 2014 fire lines are mostly not hydrologically-connected. **At-Risk**.

Drainage Network Increase: Road density is high and 15% of the road system is hydrologically-connected to the stream network. 2014 fire lines are mostly not hydrologically-connected. **At-Risk**.

Road Density and Location: Road density is high at 4.0 miles road per square mile watershed and 15% of the road system is hydrologically connected to the stream network. There is a valley-bottom road in the stream buffer RR that runs the entire length of the mainstem (about three miles). There is a road all the way up the gut of Little Elk Creek that is within the stream buffer RRs and directly impacts that channel in some places. The lower 1000 feet or so of this road was re-opened during the 2014 Fire and much sediment was pushed into the creek. **Not Properly Functioning**.

Disturbance History/Regime: The primary disturbances currently adversely affecting watershed processes are: (1) the high density road system with 15% hydrologic connectivity and with a large percentage of the road length within hydrologic and/or geologic RRs and (2) the 2014 Happy Camp Complex Fire that burned 200 acres of stream buffer hydrologic RR (20% of the total stream buffer RR in the HUC14) at moderate to high intensity (half of which was within inner gorge geologic RR), and that burned four acres of vegetation at moderate to high intensity on four acres of active landslide. Surface erosion and chronic sedimentation into streams is likely to be elevated for several years until vegetation and duff recovers ground cover in areas that burned at moderate-to-high intensity. The rate of mass wasting and debris flows is expected to increase in moderate to high severity burned areas for up to ten years or longer until ground cover recovers and the roots of regenerating vegetation regain the capacity to bind soil. Modeled surface erosion risk is high (USLE = 0.88); modeled mass wasting risk is moderately elevated (GEO = 0.48); and modeled runoff risk is moderate (ERA/TOC = 0.41). The 2014 Fire helped restore the fire regime by reducing the Fire Return Interval Departure (FRID). **At-Risk**.

Riparian Reserves: The primary disturbances currently adversely affecting the condition of riparian reserves are: (1) the high density road system with a large percentage of the road length within hydrologic and/or geologic RRs and (2) the 2014 Happy Camp Complex Fire that burned 200 acres of

stream buffer hydrologic RR (20% of the total stream buffer RR in the HUC14) at moderate to high intensity (half of which was within inner gorge geologic RR), and that burned four acres of vegetation at moderate to high intensity on four acres of active landslide. **At-Risk**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # **Westside Fire Recovery**

Lower Grider Creek 7th Field Checklist

Pathways: **INDICATORS**	**ENVIRONMENTAL BASELINE** Lower Grider Creek 7th -field watershed			**EFFECTS OF THE ACTION(S)** Lower Grider Creek 7th -field watershed		
	PROP FUNCT	AT RISK	NOT PROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature		TEMP			X	
Sediment-Turbidity			SS1998 2014Recon		X	
Chemical Contamination	ND/PJ				X	
Habitat Access Physical Barrier	FPI				X	
Habitat Elements Substrate			SS1998 2014Recon		X	
LWD		SS1998 2014 Recon PJ			X	
Pool Frequency/Quality		SS1998			X	
Off-channel Habitat		KNF GIS PJ			X	
Refugia		TEMP PJ			X	
Channel Cond & Dyn Width/Depth Ratio		2014Recon			X	
Streambank Condition		Flood 2014 Fire			X	
Floodplain Condition		PJ			X	
Flow /Hydrology Peak/Base Flow		KNF-GIS RSS			X	
Drainage Network Increase		KNF-GIS RSS			X	
Watershed Condition Road Density/Location		KNF-GIS Flood			X	
Disturbance History/Regime			KNF-GIS Flood 2014 Fire		X	
Riparian Reserves			KNF-GIS Flood 2014 Fire		X	

ND = No Data; **NA** = Not Applicable; **PJ** = Professional Judgment;

2014 Recon = Observations/photos of channel, riparian, LWD recruitment, and substrate condition made in Fall 2014;

TEMP = USFS Water temperature monitoring data from 2010 to 2014;

FPI = Fish Passage Inventory (KNF, 2003); RSS **=** 1999 KNF Road Sediment Source Inventory and Risk Assessment;

SS1998 = 1998 KNF stream survey of mainstem Grider Creek; **Flood** = 1997 KNF Flood Assessment

KNF GIS = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015);

Environmental Baseline completed by Jon Grunbaum on February 9, 2015.

The Lower Grider Creek 7th-field watershed is a composite watershed of 10,768 acres of which approximately 95% is National Forest land. The lower mainstem of Grider Creek is a 4th-order (Strahler 1957) stream and is the primary stream in the composite watershed. Approximately eight miles of lower mainstem Grider Creek is within the composite watershed. There are numerous un-named zero-order draws and first-order tributaries to lower mainstem Grider Creek, and three named 2nd-order tributaries: Salt Creek, No Mans Creek, and Bark Shanty Creek. Mainstem Grider Creek within the lower Grider Creek HUC 7 composite watershed provides habitat for rainbow/steelhead trout along its' entire length, and provides habitat for Coho and Chinook salmon in the lower seven miles. Salt Creek supports salmon and steelhead/rainbow trout in the lower few hundred feet of stream that flows out on the floodplain of mainstem Grider Creek, but No Mans and Bark Shanty Creeks are not fish-bearing. The most current quantitative and qualitative stream survey of mainstem Grider Creek was in summer 1998. Channel sediment metrics were assessed in 2009 and 2013 but those metrics are no longer valid for describing current condition because excess sediment has already been delivered to the channel as a result of the 2014 Fire.

Lower Grider Creek 7th-Field Watershed Environmental Baseline Elements:

Water Quality:

Temperature: Summer water temperature was monitored 1.60 miles above the mouth (at the Forest Service property boundary) most years from 1996 to 2014 – monitoring results for the last five years is given in the table below. In the five year period of record the maximum instantaneous water temperature ranged from 17.4 °C to 20.4 °C; the maximum weekly average temperature (MWAT) ranged from 15.2 °C to 17.7°C; and the maximum weekly maximum temperature ranged from 17.1 °C to 19.6°C. Although water temperature in mainstem Grider Creek has been within the properly functioning range in the last five years it is likely that the rate and magnitude of stream heating and cooling will significantly increase due the 2014 Fire because: (1) the wildfire burned large swaths of riparian vegetation that had provided shade to stream channels, (2) pools are likely to infill or partially infill with excess sediment, and (3) the wildfire is likely to significantly increase the frequency of in-channel debris flows and upslope landslides that can remove riparian vegetation and widen-and-shallow stream channels. **At-Risk**.

Recent Water Temperature Monitoring Results for Mainstem Grider Creek at RM 1.6							
Start	**End**	**Daily Average Temp C**	**Daily Max Temp C**	**Daily Min Temp C**	**Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp (MWMT)**
7/2/2010	10/25/2010	17.2	19.4	8.0	4.6	16.6	18.9
6/9/2011	10/11/2011	15.5	17.4	14.0	4.1	15.2	17.1
6/7/2012	10/10/2012	16.8	18.5	7.7	4.1	16.3	18.0
5/17/2013	10/1/2013	18.0	19.8	7.2	4.0	17.3	19.1
5/23/2014	9/24/2014	18.3	20.4	9.0	4.5	17.7	19.6

Sediment/Turbidity: Fines and embeddedness were slightly elevated during the 1998 stream survey. The 2014 Happy Camp Complex Fire burned large areas of the Grider watershed at high to moderate intensity which has greatly increased sediment delivery into Grider Creek stream channels. Post 2014 Fire water quality and sediment conditions in lower mainstem Grider Creek were observed and photographed in the fall after several light to moderate precipitation events: the observations and photographs revealed that (1) turbidity was very high during and long- after precipitation events and (2) large quantities of fine sediment and silt had been delivered to mainstem Grider Creek which had partially filled in pools and has partially smothered the pre-Fire streambed and salmonid spawning gravels. The frequency, magnitude and duration of turbidity is likely to be significantly elevated for at least the next the next few years until vegetation gets re-established and ground cover increases, and excess fines are winnowed out of the system. Risk of landslides that can cause bouts of acute turbidity will likely be increased for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots. Modeled surface erosion is moderately elevated to over threshold in the four Grider HUC14 subwatersheds. Modeled mass-wasting is over threshold in the Lower Grider HUC14 watershed. **Not Properly Functioning**.

Chemical Contamination: No significant source of chemical contamination is known to exist on National Forest land in the Grider Creek watershed. **Properly Functioning**.

Habitat Access

Physical Barriers: Fish passage barriers were inventoried on the Westside of the KNF (USDA, 2003) – no fish passage barriers at road-stream crossings were found in the Lower Grider Creek composite watershed. **Properly Functioning**.

Habitat Elements

Substrate: During the 1998 stream survey there was 12% fines in pool tail-outs and embeddedness was 30%, and fines composed 45% of surface substrate in pebble counts. Post-2014 Fire water quality and sediment conditions in lower mainstem Grider Creek were observed and photographed in the fall after several light to moderate precipitation events: the observations and photographs revealed large quantities (excess) of fine sediment and silt had been delivered to mainstem Grider Creek which had partially filled in pools and smothered the pre-Fire streambed and salmonid spawning gravels. Excess sediment delivery to lower mainstem Grider Creek from the 2014 Fire is expected to persist for up to ten years or longer until vegetation and ground cover recovers and until trees start growing large enough for their roots to provide soil cohesion. Modeled surface erosion is moderately elevated to over threshold in the four Grider HUC14 subwatersheds. Modeled mass-wasting is over threshold in the Lower Grider HUC14 watershed. **Not Properly Functioning**.

Large Woody Debris: There were very few pieces of LWD in the active channel during the 1998 stream survey - after the floods and debris flows of the 1997 New Years Flood. Additional wood has recruited into the stream since 1998 and LWD levels have improved on National Forest land. Recruitment potential for future LWD is near site potential above the Grider Creek campground because there are few roads and little access to timber along the upper reaches of mainstem Grider Creek. Recruitment potential for future LWD is low downstream of the 46N66 Bridge because there is easy creek access from private properties and the potential for growing large conifers that would be allowed to fall into Grider Creek from the broad privately-owned valley floor is low. Upstream of the 46N66 Bridge, the 2014 Fire killed and damaged many trees in the riparian zone that has greatly increased large woody debris loading into mainstem Grider Creek so that LWD loading is high side upstream of the 46N66 Bridge. The LWD indicator is **At-Risk** because downstream of the 46N66 Bridge on private property there is little LWD in the channel and few potential recruitment trees adjacent to the channel.

Pool Frequency and Quality: In the last stream survey of Grider Creek in 1998 there was one pool every about every 13 bankfull channel widths, and one deep pool every 82 bankfull channel widths. In 1998 the average maximum pool depth was 1.2 meters. This related to a rating of "Not Properly Functioning". However, it is my professional opinion that the mainstem of Grider Creek had largely recovered before the 2014 Fire hit (based on annual visits to the creek for salmon and steelhead surveying since 1996; and based on the fact there had been no major disturbances in the watershed since 1997). Currently, excess sediment from severely and moderately burned forest is being delivered to mainstem Grider Creek and this elevated sediment delivery rate is expected to continue or increase over the several years. Pools are partially filling with sediment now and that trend is likely to increase

over the next several years or longer. Pools are likely to decrease in frequency, depth, area, and volume over the next several years or longer. **At-Risk**.

Off-channel Habitat: Not applicable in the Rosgen A-, B-, and G-Channel types of most of mainstem Grider Creek upstream of the 46N66 bridge. There off-channel habitat and unhindered potential for off-channel habitat development upstream of the 46N66 bridge in a few stream reaches where the valley floor is wide enough to allow off-channel habitat development. Below the 46N66 bridge (private land; lower 1.6 miles of mainstem Grider Creek) there is a broad valley floor (actually a large alluvial fan) that could support significant off-channel habitat but much of the creek through this area has been channelized to keep the creek from flooding, braiding or meandering onto grazing lands or other developed property, and to keep the creek in the right alignment for the existing bridge near the mouth. Therefore, it is unlikely that the lower 1.6 mile of Grider Creek, where there is significant potential for off-channel habitat, will be allowed to develop off-channel habitat in the foreseeable future. **At-Risk**.

Refugia: Cool water and cover are the primary elements of fish refugia in this watershed. Water temperature was within the suitable to optimum range for salmonid growth and survival prior to the 2014 Fire. Water temperature is likely to significantly increase due to the 2014 Fire and may drop into the non-suitable or less than optimal range. Cover provided by LWD and channel complexity is near site potential in mainstem Grider Creek upstream of the campground (because there has been nearly no roads or harvest within the riparian zone). Cover complexity is below site potential downstream of the campground (lower two miles of mainstem) due to manual removal of woody debris from the riparian zone by campers, road/campground maintenance crews and private property owners, and due to channelization on private lands. **At-Risk**.

Width/Depth Ratio: The New Years Flood of 1997 and associated debris flows altered the channel of Rancheria Creek (tributary to mainstem Grider Creek) and the mainstem of Grider Creek from Rancheria Creek to the mouth: over 50% of stream channels in the Lower Grider Creek HUC14 watershed were altered. The altered channel/streambank/riparian zone is still recovering. Upstream of the 46N66 bridge, stream channel width-to-depth ratio was largely recovered by the time the 2014 Fire hit. The pre-2014 Fire recovery trajectory of the lower two miles of mainstem Grider Creek downstream from the 46N66 bridge has been slower and limited due to channelization, grazing, and other activities on that private property. The 2014 Fire is already starting to increase the width-to-depth ratio of pools in mainstem Grider Creek due to infilling with excessive fine sediment (silt, sand, gravels) generated by increased surface runoff and erosion and small debris flows from large swaths of forest that burned at moderate to high intensity. Although not observed yet, the 2014 Fire is likely to trigger excessive sediment to be delivered to stream channels for a decade or more because the rate of landsliding is expected to increase in large swaths of forested areas that burned at moderate to high intensity. Increased runoff and landsliding from burned areas is likely to increase the frequency of channel-altering debris flows. Excessive sediment delivery and increased channel-altering debris flows are likely to persist for up to ten years or longer. **At-Risk**.

Streambank Condition: The New Years Flood of 1997 and associated debris flows altered the channel of Rancheria Creek (tributary to mainstem Grider Creek) and the mainstem of Grider Creek from Rancheria Creek to the mouth: over 50% of stream channels in the Lower Grider Creek HUC14 watershed were altered. The altered channel/streambank/riparian zone is still recovering. Upstream of the 46N66 bridge, streambanks were largely recovered by the time the 2014 Fire hit although many of the streamside alders are still young having sprouted after the 1997 Flood. The pre-2014 Fire recovery

trajectory of the streambank adjacent to the lower two miles of mainstem Grider Creek downstream from the 46N66 bridge has been slower and limited due to channelization, grazing, and other activities on that private property. **At-Risk**.

Floodplain Connectivity: Not applicable in the Rosgen A-, B-, and G-Channel types of most of mainstem Grider Creek upstream of the 46N66 bridge. There off-channel habitat and unhindered potential for off-channel habitat development upstream of the 46N66 bridge in a few stream reaches where the valley floor is wide enough to allow off-channel habitat development. Below the 46N66 bridge (private land; lower 1.6 miles of mainstem Grider Creek) there is a broad valley floor (actually a large alluvial fan) that could support significant off-channel habitat but much of the creek through this area has been channelized to keep the creek from flooding, braiding or meandering onto grazing lands or other developed property, and to keep the creek in the right alignment for the existing bridge near the mouth. Therefore, it is likely that the lower 1.6 mile of Grider Creek, where there is significant potential for floodplain connectivity, will not be allowed to flood if the property owners can prevent it from occurring. **At-Risk**.

Flow/Hydrology

Change in Peak/Base Flow: Road density is low to moderate and only 18% of the road system is not hydrologically-connected to the stream network. Drainage net increase due to roads is low. The 2014 Fire that burned large swaths of forested ground at moderate to high intensity is expected to increase surface runoff and peak flows during runoff periods, and expected to slightly elevate base flows due to less evapotranspiration. Modeled runoff risk is high but still below threshold (ERA/TOC = 0.88). Lower in the watershed, base flows may be adversely affected by water diversions. The Grider Ranch alone has a large capacity intake. It is unknown how much water is actually drafted out of Grider Creek. **At-Risk**.

Drainage Net Increase: There is minor potential for significant drainage net increase due to roads because: (1) road density is low, (2) a 1999 road sediment source survey conducted by the KNF determined that only 18% of the road system was hydrologically-connected to the stream network, (3) only 11% of hydrologically-connected road has not been storm proofed, and (4) other than the two miles of valley bottom road, much of the road system is on upper slopes or ridges with not much drainage area or other roads upslope of them. Overland flow will increase on large swaths of previously forested ground that was burned at moderate to high intensity during the 2014 Fire and is likely to increase drainage network density. **At-Risk.**

Watershed Conditions

Road Density/Location: Road density is low to moderate at 1.6 miles road per square mile watershed (slightly higher if all roads on private lands were included). Several roads with the highest watershed risk were decommissioned or storm proofed in 2002 and 2003. There is valley bottom road in the lower two miles of the Grider Creek valley. **At-Risk.**

Disturbance History/Regime: Watershed risk and adverse watershed effects due to roads is low because road density is low, roads with the highest watershed risk have been decommissioned or storm proofed, and drainage network increase due to roads is minor. The New Year Flood of 1997 and associated debris flows altered over 50% of all stream channels in the Lower Grider Creek watershed. Approximately seven miles of lower mainstem Grider Creek was altered by a massive debris flow that

originated several miles up the mainstem of Rancheria Creek. There were 28 landslides and nine major road failures in the Lower Grider Creek composite watershed during the flood; some of the landslides and debris flows appeared to be related to road drainage failure or road-stream crossing failure (including the massive debris flow that originated up Rancheria Creek). Stream channels, streambanks, and riparian vegetation were still recovering from the flood when the 2014 Fire hit.

Currently, the major disturbance event that is affecting watershed processes now and that will continue to affect watershed conditions in the next ten years or more was the 2014 Fire that burned large swaths of forest at moderate and high intensity in upslope and riparian areas. Prior to the 2014 Fire, fire regimes had been significantly altered due to fire suppression with the Fire Return Interval Departure (FRID) severely departed from the pre-fire-suppression regime. The severely departed FRID was likely a significant factor in the large size and high severity of the 2014 Fire in the Grider Creek watershed. Dead fuel loading is now very high in many of the fire-suppressed stands that burned at moderate to high intensity in 2014. The 2014 Fire helped restore the fire regime in some areas but more cycles of fire (either prescribed fire or managed unplanned ignitions) will be needed in the near future to clean up fire-killed vegetation and restore a fire regime that benefits ecosystems – and to avoid a truly catastrophic fire decades from now across large swaths of landscape where dense fire-suppressed stands of trees were killed in the 2014 Fire.

Fire severity exceeding 25% basal area mortality can significantly increase the risk of landsliding on unstable ground. The 2014 Fire caused 25% or greater basal area mortality on 3,587 acres (or 33% of the total watershed area!) of unstable ground geologic RR as follows: 39 acres on active landslide; 1,081 acres within inner gorge; and 2,467 acres on highly dissected granitic terrain. Post-2014 Fire modeled cumulative watershed effects for the Lower Grider Creek HUC14 watershed are moderately elevated to over threshold with most of the disturbance attributed to the 2014 Fire: (USLE = 0.74; GEO = 1.09; ERA/TOC = 70). The GEO model for mass wasting is over-threshold. **Not Properly Functioning.**

Riparian Reserves: The New Years Flood of 1997 and associated debris flows severely scoured the channel of mainstem Grider Creek and removed much of the riparian vegetation - over 50% of stream channel in the Lower Grider Creek watershed was altered, including much of the mainstem of Grider Creek from Rancheria Creek down. The altered channel/streambank/riparian zone was still recovering when the 2014 Fire hit. Upstream of the campground the channel and streambanks were well on the way to recovery before the 2014 Fire but riparian vegetation was still recovering from the loss of streamside large alders. The post-flood recovery trajectory of stream channels and riparian vegetation was slower and less clear in the lower 2.0 miles of the Grider Creek watershed below the campground because: (1) most of the broad valley floor adjacent to Lower Grider Creek is private land with various levels of disturbance in stream buffer and upslope areas from grazing, roads, and other activities which limits the development of mature riparian vegetation in some places and times and (2) two miles of road and one campground is within hydrologic riparian reserve.

Currently, the major factor affecting condition of hydrologic RRs was the 2014 Fire which burned 3,418 acres of hydrologic RRs at moderate to high intensity, which is 47% of all hydrologic RR in the HUC14 watershed. This much moderate and high intensity fire in hydrologic RRs is expected to significantly decrease the nutrient spiraling and sediment buffering function of stream course RRs and will significantly compromise the potential of hydrologic RRs to buffer the stream from upslope ground disturbances and landslides. The 2014 Fire caused 25% or greater basal area mortality on 3,587 acres

(or 33% of the total watershed area!) of unstable ground geologic RR. This much moderate and high intensity fire on geologic RRs is expected to significantly increase the rate and risk of landsliding. **Not Properly Functioning**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # **Westside Fire Recovery**
Lower Horse Creek 7th Field Watershed Checklist

Pathways:	ENVIRONMENTAL BASELINE Lower Horse Ck 7th Field watershed			EFFECTS OF THE ACTION(S) Lower Horse Ck 7th Field watershed		
INDICATORS	PROP FUNCT	AT RISK	NOT PROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature	TEMP				X	
Sediment-Turbidity			SED RSS SS2002 KNF GIS PO PJ		X	
Chemical/Nutrient Contamination		PO PJ			X	
Habitat Access Physical Barriers	FPI				X	
Habitat Elements Substrate			SED RSS SS2002 KNF GIS PO PJ		X	
Large Woody Debris			SS2002 PO PJ		X	
Pool Frequency/Quality			SS2002 SED PO PJ		X	
Off-channel Habitat			Horse WA PO PJ		X	
Refugia	TEMP	PO PJ			X	
Channel Cond & Dyn Width/Depth Ratio			SS2002 SED PO PJ		X	
Streambank Condition			Horse WA PJ		X	
Floodplain Condition			Horse WA PO PJ		X	
Flow /Hydrology Change in Peak/Base Flow			KNF GIS RSS		X	
Drainage Network Increase			KNF GIS RSS		X	
Watershed Cond. Road Density/Location			KNF GIS PO PJ		X	
Disturbance History/Regime			SED RSS KNF GIS Horse WA		X	
Riparian Reserves			RSS KNF GIS Horse WA		X	

TEMP = Last five years of temperature monitoring of mainstem Horse Creek at RM 2.4;
FPI = KNF Forest-Wide Fish Passage Barrier Inventory (KNF 2003);
SS2002 = KNF stream survey of the upper 1.15 miles of mainstem Horse Creek within the Lower Horse Creek HUC14;
SED = 2010/2013 sediment assessment survey (USFS 2014);
RSS = Road Sediment Source Inventory and Risk Assessment (KNF 2012);

The Lower Horse Creek 7th-field (HUC14) watershed is a composite watershed of 7,983 acres. Approximately 74% of the HUC14 is National Forest and the rest is private residential and ranching property, and industrial timberland. Approximately 6.2 miles of mainstem Horse Creek is within this composite watershed: from the mouth upstream to the confluence with Salt Gulch. Lower mainstem Horse Creek is a 4th-order (Strahler 1957) stream in this composite watershed. Measuring from the mouth: the entire 6.2 miles of mainstem Horse Creek provides habitat for coho salmon, winter steelhead trout, and resident rainbow trout; and the lower five miles provides habitat for Chinook salmon. There are five 2nd-order tributaries to mainstem Horse Creek in this HUC14 named: Crawfish Gulch, Fish Gulch, Hamburg Gulch, Maple Gulch, and Robinson Gulch. Robinson Gulch provides a few tenths of a mile of habitat for winter steelhead/rainbow trout. Fish Gulch provides a few tenths of a mile of habitat for winter steelhead/rainbow trout and coho salmon. Maple Gulch and all other un-named tributaries to lower mainstem Horse Creek are not fish-bearing. There are also several zero- and first-order tributaries to mainstem Horse Creek in the composite watershed that are not named and not fish-bearing, and often not running with surface flow in summer. Buckhorn and Middle Creeks are major tributaries to lower mainstem Horse Creek but are their own HUC14 true watersheds (that support steelhead/rainbow trout and possibly Coho salmon (the land is private and has not been surveyed by FS). The most current comprehensive stream survey in the Lower Horse Creek HUC14 watershed was conducted in 2002 and surveyed the upper 1.15 mile section of mainstem Horse Creek that is on National Forest land. An earlier stream survey of the entire mainstem of Horse Creek and some tributaries was conducted in 1989-90 as reported in the Horse Creek Watershed Analysis (KNF 2002). Streambed sediment and stream shading was monitored in 2010 and 2013. Water temperature of mainstem Horse Creek within the Horse Creek HUC14 was monitored for five years between 2010 and 2013. Summer streamflow volume is measured annually a short distance upstream from the mainstems' confluence with the Klamath River.

Lower Horse Creek 7th-Field Watershed Environmental Baseline Elements:

Water Quality:

Temperature: Summer water temperature was monitored in mainstem Horse Creek at RM 2.4 from 2010 to 2014 and those monitoring results are given in the table below. In the five year period of record the maximum instantaneous water temperature ranged from 15.1^{o}C to 18.2^{o}C; the maximum weekly average temperature (MWAT) ranged from 14.8^{o}C to 16.7^{o}C; and the maximum weekly maximum temperature ranged from 15.8^{o}C to 17.7^{o}C. **Properly Functioning**.

Recent Water Temperature Monitoring Results for Mainstem Horse Creek at RM 2.4						
Start	**End**	**Max Daily Max Temp C**	**Max Average Daily Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp C (MWMT)**
7/8/2010	10/25/2010	17.1	16.1	3.5	15.8	16.8
6/9/2011	10/14/2011	15.1	16.1	3.9	14.8	15.8
6/16/2012	10/31/2012	17.0	16.2	3.8	15.7	16.6
6/6/2013	10/31/2013	18.2	17.1	3.3	16.5	17.6
5/29/2014	10/1/2014	18.2	17.2	3.3	16.7	17.7

Sediment –Turbidity: Turbidity discussion included with Substrate Character indicator discussion - see below. **At-Risk**.

Chemical/Nutrient Contamination: No significant source of chemical contamination is known to exist in Horse Creek. Range cattle utilizing allotments throughout the watershed and intensive grazing in the lower Horse Creek Valley contributes an unknown amount of nutrients to Horse Creek streams and the Klamath River. The Horse Creek Ecosystem Analysis states that EPA thresholds are not exceeded using existing stocking rates coupled with data from a study conducted in Oregon. The Ecosystem analysis goes on to state that "there is the possibility of a significant effect on the aquatic resources, however the true affects are unknown because nutrient loading of the aquatic environment has not been investigated on the Klamath National Forest." **At-Risk**.

Habitat Access

Physical Barriers: There are no high or medium priority fish passage barriers in the Horse Creek watershed. There is only one remaining low-priority fish barrier on National Forest lands in the Horse Creek watershed – this is a barrier to resident fish but not salmon or steelhead. Push-up dams created by private landowners annually or semi-annually by use of heavy equipment often prevents or makes fish passage difficult in lower mainstem Horse Creek. **At-Risk**.

Habitat Elements

Substrate Character and **Sediment-Turbidity:** It is theorized that turbidity and rate of sediment delivery to mainstem Horse Creek is significantly elevated over pre-European settlement conditions or reference conditions. This theory is based on the following results and observations:

(1) Road density is high and about 15% of the road system is hydrologically connected to the stream network.
(2) Road density is high to very high in all the HUC14 watersheds that drain into the Lower Horse HUC14 watershed. Road density is high at the scale of the Horse Creek HUC12

true watershed.

(3) There are few pools in the lower mainstem and existing pools are generally very shallow. Poor pool frequency and quality was documented during the 1989 and 2002 stream surveys and is observed each year during annual salmon spawning surveys. It is suspected that excessive sediment from extensive watershed disturbance throughout the HUC12 is being delivered to mainstem Horse Creek and that the excess sediment is filling pools in the lower gradient reaches. [The dearth of LWD and restricted channel sinuosity, and lack of beaver, in the lower mainstem channel are also major contributing factors for low pool frequency and quality].

(4) Results of intensive sediment monitoring (see discussion and results below) suggests that excessive sediment is being delivered to lower mainstem Horse Creek and that this excessive sediment is impacting sediment condition and in-filling pools.

(5) Modeled CWEs are moderately high in the Lower Horse Creek HUC14: (USLE = 0.54; GEO = 0.59; ERA/TOC = 0.79). Modeled CWEs are moderately high or high in all the HUC14 watersheds that drain into the Lower Horse HUC14 watershed.

The results of 2010 and 2013 intensive monitoring and evaluation of sediment in mainstem Horse Creek that included the metrics: percent surface fines < 2mm, percent sub-surface sediment < 0.85mm, percent sub-surface sedient < 6.38mm, and percent residual pool volume filled with fine sediment (V*), is shown in the table below. Substrate quality impairment was evaluated in mainstem Horse Creek by comparing the four sediment indicators in mainstem Horse Creek (a managed watershed) to the 85th percentile value of four indicators for reference streams that have minor to negligble management-related watershed disturbance. Watersheds exceeding the 85% percentile of reference streams are considered impaired. In 2010 and 2013 three of the four sediment indices exceeded reference values.

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2010 and 2013 Horse Creek response reach (horse1) compared to KNF Stream Sediment Monitoring reference conditions (85th percentile). [horse1] metrics over threshold values are bolded.

Sediment Index	2010 horse1 reach average %	2013 horse1 reach average %	Reference Condition (%)
Surface Fines < 2mm	4.3	**11**	6.4
Sub-surface fines < 0.85mm	**20**	**16.4**	16.2
Sub-surface fines < 6.38mm	**46.6**	45.2	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	**0.237**	**0.220**	0.108

Based on the preceding discussion, it is my professional opinion that the functioning condition of the Sediment-Turbidity indicator is **At-Risk**; and the functioning condition of the Substrate Character indicator is **Not Properly Functioning.**

Large Woody Debris: The 1989-90 stream surveys showed there was a lack of LWD along most of mainstem Horse Creek (Horse Creek WA). In the last stream survey of lower mainstem Horse Creek in July 2002, there was zero pieces of LWD in the 1.2 mile section of stream that was surveyed, however, there were over 57 trees growing adjacent to that reach that were big enough to qualify as LWD: this survey was on National Forest lands at the upper end of the Lower Horse Creek HUC14 mainstem segment. From personal observations made during recent annual fish censuses: (1) there are very few pieces of in-channel LWD in the lower five mile

segment of mainstem Horse Creek; (2) there are very few large conifers or conifers at all in the riparian zone on the east side of the mainstem to provide for future LWD recruitment, and (3) there is little potential for growing large conifers on the east side of the mainstem because the riparian buffer is narrow and confined by a berm and road. **Not Properly Functioning**.

Pool Frequency and Quality: Pool frequency was very low during the 1989-90 stream survey (Horse Creek WA). In the last stream survey of lower mainstem Horse Creek, in July 2002, there were only two pools in the 1.15 miles of stream that was surveyed: this survey was on National Forest land at the upper end of the segment of lower mainstem Horse Creek that is within the Lower Horse Creek HUC14 watershed. From personal observations made during recent annual fish censuses: pool frequency is low and pools are generally very shallow in the lower five mile segment of mainstem Horse Creek. Factors suspected for low pool frequency and depth are: (1) pool in-filling due to excessive sediment delivery from excessive watershed disturbance, (2) dearth of in-channel LWD to create lateral scour and plunge pools, and (3) restricted channel sinuosity due to berm diminishes potential for meander scour/point bar formation. It is likely that beaver were plentiful in Northern California streams including Horse Creek prior to fur trapping and settlement (Lanman et.al. 2013). If so, aquatic and riparian habitat in the broad lower Horse Creek valley was probably profoundly different than today with numerous beaver dams creating pools and prime habitat for salmonids. Beaver are nearly extirpated in Horse Creek and beaver habitat is severely degraded or lost due to berms, roads, and conversion to pasture. **Not Properly Functioning**.

Off-channel Habitat: Before channelization, the lower four miles of mainstem Horse Creek was unconstrained as it flowed through its' broad very gently sloping valley - so that the stream could interact with its' floodplain and off-channel habitats could develop. Currently, lower mainstem Horse Creek is tightly constrained to the west hillside by a berm to protect ranch land and roads; therefore, there is little potential for off-channel habitat development along this section. A small unconstrained mainstem reach just upstream from Fish Gulch is partially impacted by a stream crossing. Other unconstrained channel areas along the mainstem are not significantly restricted due to human disturbance. There are no unconstrained reaches in the tributaries to lower mainstem Horse Creek (*within the Lower Horse Creek HUC14* watershed). **Not Properly Functioning**.

Refugia: Cool water and cover in lower mainstem Horse Creek are the primary elements of fish refugia in this HUC 14 composite watershed. Water temperature is within optimum to suitable range for salmonids, however, there is very little cover or quality cover due to near lack of pools, lack of deep pools, and dearth of LWD. Prior to near extirpation of beaver and severe degradation of beaver habitat, beaver likely constructed numerous dams that would have provided excellent habitat for salmonids. **At-Risk**.

Width-to-Depth Ratio: There are very few pools in lower mainstem Horse Creek within this HUC14 which suggests that sediment delivery rate in the Horse Creek watershed is excessive and beyond the ability of the stream to transport it. Excessive sediment delivery beyond the capability of the Horse Creek to transport the sediment is likely because the Lower Horse Creek HUC 14 and most of the HUC14s that drain into lower Horse Creek have moderate to high levels of watershed disturbance. It is likely that W/D ratio of the mainstem is increased due to channel shallowing from the sediment infilling.

The lower several miles of mainstem Horse Creek is prevented from moving laterally due to a berm, therefore, potential for channel recovery/restoration is very low. The berm transformed lower mainstem Horse Creek from an unconstrained flood-prone channel to constrained channel with a narrow riparian stream buffer. Restricted channel sinuosity due to berm diminishes potential for meander scour/point bar formation that likely existed before the channel was constrained. **Not Properly Functioning.**

Streambank Condition: Streambanks adjacent to lower mainstem Horse Creek are likely quite different than they were prior to when the channel was constrained against the west hillside via a berm. Streambanks are altered or in a disturbed state at several locations adjacent to the mainstem where the main road is constructed within inner gorge which has subsequently required rip-rapping of the streambank to stabilize/buttress some sections of road. Streambanks are altered at road-stream crossings which are numerous throughout the HUC14. **Not Properly Functioning**.

Floodplain Connectivity: Historically, lower mainstem Horse Creek was unconstrained as it flowed through a (relatively) wide flat valley, and high flows could spill out onto a wide floodplain. Today, lower mainstem Horse Creek is tightly constrained by a berm and is disconnected from its' floodplain. **Not Properly Functioning**.

Flow/Hydrology

Changes in Peak/Base Flow: Road density is high in the Lower Horse Creek HUC 14 composite watershed and about 15% of the road system is hydrologically connected to the stream network. In addition, road density is high in the HUC14s that drain into the Lower Horse Creek HUC14. Modeled ERA/TOC is moderately high (ERA/TOC = 0.79) in the Lower Horse Creek HUC14; and is high in the Buckhorn HUC14 watershed, and well over threshold in the Middle Creek and Middle Horse HUC14 watersheds, that drain into the Lower Horse Creek HUC 14 watershed. Therefore, peak flows are likely significantly elevated in lower mainstem Horse Creek. Numerous large diversions from mainstem Horse Creek diminish base flows (Horse Creek WA, KNF 2002) which can reduce carrying capacity for salmonids. Excessive water diversion in late summer 2014 severely diminished base flow in the lowest reaches of Horse Creek threatening the survival of juvenile salmonids including coho salmon (personal observation): the California Department of Fish and Wildlife had to intervene to reduce diversion and restore adequate flow to the creek for the fish. **Not Properly Functioning**.

Drainage Net Increase: Road density is high and 21% of the road system is hydrologically connected to the stream network. **Not Properly Functioning**.

Watershed Conditions

Road Density/Location: The road density is high at 3.8 miles of road per square mile of watershed. There is valley bottom road adjacent to the entire length of mainstem lower Horse Creek on the east side of the channel, including over two miles of inner gorge road (the highest risk sections have been recently storm proofed). **Not Properly Functioning.**

Disturbance History/Regime: Road density is high and 15% of the road system is hydrologically connected to the stream network. There has been extensive stand-replacement forestry in this composite watershed - particularly on private timberland. Ground disturbance,

compaction, and removal of riparian vegetation is prevalent streamside and on the valley floor due to: (1) roads and berms constructed within the stream buffer and inner gorge, (2) construction and maintenance of residences and ranches, and (3) grazing and pasture maintenance.

The most significant and longest-lasting degradation of aquatic and riparian habitats and ecosystems in the Lower Horse Creek HUC14 resulted from industrial mining. In the late 1930s much of the Horse Creek valley floor from the confluence with the Klamath River up to Fish Gulch was industrially dredged. The mining proponent had the foresight to remove and store much of the topsoil before the valley was over-turned with the house-sized dredge. After dredging, Horse Creek was tightly and permanently confined against the west hillside with a berm so that the stream could no longer interact with its' floodplain and so the pastures that were created with the saved topsoil would be protected. Currently, aquatic and riparian ecosystems are kept in an altered and largely un-recovered condition by the berm, berm and road maintenance and reconstruction, land clearing, and occasional use of heavy equipment in the stream buffer and channel (on private land). Constraining mainstem Horse Creek has significantly reduced the quantity and quality of aquatic and riparian habitats and the potential for recovery towards pre-European settlement conditions.

The fire return interval departure (FRID) and vegetative attributes in the Horse Creek watershed and surrounding landscape are moderately to significantly departed from historical range due to fire suppression which has successfully interrupted fire cycles in many areas of the watershed. Increasing fire return intervals can result in moderate to dramatic changes to one or more of the following: fire size, intensity and severity and landscape patterns. Stand-replacement forestry in the watershed is also likely to have altered the fire regime.

Modeled CWEs are moderately high in the Lower Horse Creek HUC14: (USLE = 0.54; GEO = 0.59; ERA/TOC = 0.79).

Based on the above discussion, it is my professional opinion that the condition of the watershed Disturbance History/Regime indicator is **Not Properly Functioning**.

Riparian Reserves: Road density and stream crossing density is high, and cumulatively, there are many miles road on the valley floor, within stream buffer RRs, and within inner gorge. Much of the stream buffer of lower mainstem Horse Creek is altered by berm construction and inner gorge road on the east side of the stream. The lower two miles of the Horse Creek valley was converted from an unconstrained stream with a wide riparian zone to pasture protected by a berm to keep the stream tightly constrained against the west hillside. As a result there is reduced stream shading, reduced sediment buffering and nutrient cycling, reduced potential to grow large conifers, reduced large wood recruitment, and significant overall loss of habitat for aquatic and riparian species. Range cattle that utilize allotments throughout the watershed impact riparian vegetation and trample streambanks. **Not Properly Functioning**.

Table of Pathway and Indicators for 7th Field Watershed:
Westside Fire Recovery Project:
Lower North Russian / Upper North Russian (for North Russian Creek) 7th Field Checklists

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline					
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
Habitat Quality Temperature	WQ 2012; WA 1995; Temps-NRussian				X	
Suspended Sediment - Intergravel DO/Turbidity[1]	PO-Fire, CWE 2015; Sed 2013				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ; CDFW 2015; FishPass 2001				X	
Habitat Elements Substrate Character and Embeddedness[1]	CWE 2015; Sed 2013; NRussian 2004				X	
Large Woody Debris			NRussian 2004; WA 1995		X	
Pool Frequency and Quality			NRussian 2004; WA 1995		X	
Large Pools					X	
Off-channel Habitat	PJ				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth		PJ; NRussian 2004			X	
Streambank Condition	ND - likely Properly Functioning (PJ)				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows[1]	PJ; CWE 2015; Coho 2014 (long-term)	PJ, BAER (short-term)			X	
Increase in Drainage Network		PJ			X	
Watershed Conditions Road Density & Location		SRSS 2002; GIS			X	
Disturbance History & Regime	PJ; CWE 2015				X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho 2014; WA 1995			X	
Species and Habitat:		X			x	

Summary/Integration of all Species and Habitat Indicators	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.	

Table of Pathway and Indicators for 7th Field Watershed:

Lower South Russian / Upper South Russian (for South Russian Creek)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; WA 1995; Temps-SRussian				X	
Suspended Sediment - Intergravel DO/Turbidity[1]	PJ, CWE 2015; Sed 2013 (long-term)	PO-Fire (short-term)			X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers[2]		PJ; CDFW 2015; FishPass 2001; SRussian1980			X	
Habitat Elements Substrate Character and Embeddedness[1]	CWE 2015; Sed 2013 (long-term)	PO-Fire (short-term)			X	
Large Woody Debris			WA 1995		X	
Pool Frequency and Quality		PJ; SRussian 1994			X	
Large Pools					X	
Off-channel Habitat	PJ				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth		PJ; SRussian 1994			X	
Streambank Condition	ND - likely Functioning-At-Risk (PJ)				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows[1]	PJ; CWE 2015; Coho 2014 (long-term)	PJ, BAER (short-term)			X	
Increase in Drainage Network		PJ			X	
Watershed Conditions Road Density & Location[3]	GIS (Upper S. Rus)		SRSS 2002; WA 1995; GIS (Lower S. Rus.)		X	
Disturbance History & Regime	PJ; CWE 2015 (Upper S. Rus.)	PJ; Coho 2014; WA 1995 (Lower S. Rus.)			X	

Riparian Reserves - Northwest Forest Plan		PO-Fire; PJ; BAER; Coho 2014; WA 1995			X	
SPECIES AND HABITAT:						
<u>Species and Habitat</u>: Summary/Integration of all Species and Habitat Indicators		X			X	
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

[1]Short-term, post-fire degradation in current condition may occur for several Indicators - turbidity, substrate character, change in peak/base flows. These Indicators are expected to return to more typical and expected condition within a season or two. Other fire-affected Indicators, such as Riparian Reserves, will take longer to recover, and the new "current condition" will likely persist for many years.

[2]Although various databases do not identify any passage barriers, a potential barrier is present on private property downstream of Music Creek in the form of an historic dam atop a bedrock fall/chute which used to divert water to a small hydropower plant (Pers. Obs. - M. Meneks; SRussian 1980). Degree of passage restriction unknown.

[3]Focus is on Lower South Russian watershed as Wilderness dominates Upper South Russian; and most Project activities will be occurring in association with the former 7th-field HUC. This watershed also identified as having concerns due to disturbance at least in part from roads.

Table of Pathway and Indicators for 7th Field Watershed:

North Fork Kelsey Creek (for NF Kelsey Creek)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; Temps-Kelsey				X	
Suspended Sediment - Intergravel DO/Turbidity	CWE 2015				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ; CDFW 2015				X	
Habitat Elements Substrate Character and Embeddedness	CWE 2015				X	
Large Woody Debris			WA 2000		X	
Pool Frequency and Quality	No data available				X	
Large Pools					X	
Off-channel Habitat	ND - Due to size and gradient of creek, and constriction of valley, extensive side channel development not expected.				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	ND - Wilderness locales usually considered to be Properly Functioning (PJ)				X	
Streambank Condition	ND - While Wilderness locales usually considered to be Properly Functioning, likely Functioning-At-Risk due to past flood impact (PJ)				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE 2015 (long-term)	BAER-Sct (short-term)			X	
Increase in Drainage Network	PJ; CWE 2015				X	
Watershed Conditions Road Density & Location	WA 2000; GIS				X	
Disturbance History & Regime	PJ; CWE 2015				X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sct 2014; WA 2000			X	
SPECIES AND HABITAT:						

Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	Due to lack of data, specific trend for anadromous fish in this drainage is unknown. However, some sources are available to examine the general Scott River condition. (1) Screw trap data since 2000 suggests a steady to upward trend for Chinook smolts and steady to slightly down for steelhead smolts (CDFW 2011). (2) Run size estimate for spawning Chinook since 1978 is steady to slightly down (CDFW 2013). Recent trends for coho are unclear, but overall the run is considered to be depressed. See Life History section for additional information			See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

Table of Pathway and Indicators for 7th Field Watershed:

Shadow Creek (for Shadow Creek / WF Shadow Creek)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; WA 1995; Temps-Shadow				X	
Suspended Sediment - Intergravel DO/Turbidity	CWE 2015; WA 1994				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ[1]; CDFW 2015				X	
Habitat Elements Substrate Character and Embeddedness		PJ; Sed 2013			X	
Large Woody Debris	ND - Given general lack of LWD in SF Salmon drainage (SRCA 1998; WA 1997, 1994), Indicator likely to be Not Properly Functioning (PJ)				X	
Pool Frequency and Quality	No data available				X	
Large Pools					X	
Off-channel Habitat	ND - Due to size and gradient of creek, and constriction of valley, extensive side channel development not expected.				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	No data available				X	
Streambank Condition	No data available				X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE 2015				X	
Increase in Drainage Network		PJ			X	
Watershed Conditions Road Density & Location		Sed 2013; SRSS 2002; GIS			X	
Disturbance History & Regime	PJ; CWE 2015				X	
Riparian Reserves - Northwest Forest Plan	PJ				X	
SPECIES AND HABITAT:						

Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

[1]Possible seasonal diversion concern identified by Salmon River Restoration Council during Salmon River Working Group meetings (2015); status unknown.

Table of Pathway and Indicators for 7th Field Watershed:

South Fork Kelsey Creek (for mainstem Kelsey Creek)

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; Temps-Kelsey				X	
Suspended Sediment - Intergravel DO/Turbidity	CWE 2015; Sed 2013				X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ; CDFW 2015; FishPass 2001[1]				X	
Habitat Elements Substrate Character and Embeddedness	CWE 2015; Sed 2013; WA 2000; Kelsey2005, 1997				X	
Large Woody Debris			WA 2000; Kelsey 1997		X	
Pool Frequency and Quality		WA 2000; Kelsey 1997, 1989			X	
Large Pools					X	
Off-channel Habitat	PJ				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	PJ; Kelsey 1997				X	
Streambank Condition		PJ			X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows	PJ; CWE 2015 (long-term)	BAER-Sct (short-term)			X	
Increase in Drainage Network		PJ			X	
Watershed Conditions Road Density & Location		WA 2000; GIS			X	
Disturbance History & Regime	PJ; CWE 2015				X	
Riparian Reserves - Northwest Forest Plan		PJ; Coho-Sct 2014; WA 2000			X	
SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species		X			X	

and Habitat Indicators	Due to lack of data, specific trend for anadromous fish in this drainage is unknown. However, some sources are available to examine the general Scott River condition. (1) Screw trap data since 2000 suggests a steady to upward trend for Chinook smolts and steady to slightly down for steelhead smolts (CDFW 2011). (2) Run size estimate for spawning Chinook since 1978 is steady to slightly down (CDFW 2013). Recent trends for coho are unclear, but overall the run is considered to be depressed. See Life History section for additional information	See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.

[1]Barriers in Kelsey Ck drainage are on SF Kelsey Creek, outside range of anadromy

Table of Pathway and Indicators for 7th Field Watershed:

Tompkins Creek

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; Temps-Tompkins				X	
Suspended Sediment - Intergravel DO/Turbidity[1]		Sed 2013; WA 2000; CWE 2015; PJ			X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers	PJ; CDFW 2015				X	
Habitat Elements Substrate Character and Embeddedness[1]		Sed 2013; CWE 2015; PJ			X	
Large Woody Debris			PJ; Coho-Sct 2014; WA 2000		X	
Pool Frequency and Quality		USFS 2013; PJ			X	
Large Pools					X	
Off-channel Habitat	PJ				X	
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth	WA 2000				X	
Streambank Condition		PJ			X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows[1,2]		BAER-HC (short-term [peak])			X	
		PJ (long-term [base])			X	
Increase in Drainage Network		PJ			X	
Watershed Conditions Road Density & Location		Sed 2013; WA 2000; GIS			X	
Disturbance History & Regime		PJ; WA 2000			X	
Riparian Reserves - Northwest Forest Plan[1]		PJ; Coho-Sct 2014; WA 2000			X	

SPECIES AND HABITAT:						
Species and Habitat: Summary/Integration of all Species and Habitat Indicators		X			X	
	Due to lack of data, specific trend for anadromous fish in this drainage is unknown. However, some sources are available to examine the general Scott River condition. (1) Screw trap data since 2000 suggests a steady to upward trend for Chinook smolts and steady to slightly down for steelhead smolts (CDFW 2011). (2) Run size estimate for spawning Chinook since 1978 is steady to slightly down (CDFW 2013). Recent trends for coho are unclear, but overall the run is considered to be depressed. See Life History section for additional information			See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

[1]Short-term, post-fire degradation in current condition may occur for several Indicators - turbidity, substrate character, change in peak/base flows. These Indicators are expected to return to more typical and expected condition within a season or two. Other fire-affected Indicators, such as Riparian Reserves, will take longer to recover, and the new "current condition" will likely persist for many years.

[2]In the short-term, there may be a noticable change in (peak) flows due to fire impacts. Long-term, a diversion to private property affects base flows.

Table of Pathway and Indicators for 7th Field Watershed:

Whites Gulch

DIAGNOSTIC OR PATHWAY and INDICATOR	Environmental Baseline			Effects of the Action		
	PROPERLY FUNCTIONING	FUNCTIONING - AT RISK	NOT PROP. FUNCT.	RESTORE	MAINTAIN	DEGRADE
HABITAT:						
Habitat Quality Temperature	WQ 2012; WA 1995; Temps-Whites				X	
Suspended Sediment - Intergravel DO/Turbidity[1]	PJ, CWE 2015; Sed 2013; Whites 2006 (long-term)	PO-Fire (short-term)			X	
Chemical Contamination/ Nutrients	PJ				X	
Habitat Access Physical Barriers[2]	PJ, CDFW 2015; Siskiyou 2002; FishPass 2001				X	
Habitat Elements Substrate Character and Embeddedness[1]	CWE 2015; Sed 2013; Eddy 2006	PO-Fire (short-term)			X	
Large Woody Debris			Whites 2006; WA 1995		X	
Pool Frequency and Quality	Whites 2006				X	
Large Pools					X	
Off-channel Habitat	N/A - Not present					
Refugia	PJ				X	
Channel Cond & Dyn Average Wetted Width/Maximum Depth		PJ, Whites 2006			X	
Streambank Condition		PJ			X	
Floodplain Connectivity	PJ				X	
Flow/Hydrology Change in Peak/Base Flows[1]	PJ; CWE 2015; Coho 2014 (long-term)	PJ, BAER (short-term)			X	
Increase in Drainage Network		PJ			X	
Watershed Conditions Road Density & Location		SRSS 2002; GIS			X	
Disturbance History & Regime		PJ; Coho 2014; WA 1995			X	
Riparian Reserves - Northwest Forest Plan		PO-Fire; PJ; BAER; Coho			X	

		2014; WA 1995				
SPECIES AND HABITAT:						
<u>Species and Habitat</u>: Summary/Integration of all Species and Habitat Indicators		X			X	
	For the Salmon River drainage, long-term trends for most anadromous species/runs are unclear (Quiñones 2011). The exceptions include spring Chinook (increasing) and summer steelhead (decreasing), but these trends also show a signal of hatchery influence (Quiñones 2011). See Life History section for additional information.			See Env. Conseq. for a Indicator effects summary. The Env. Conseq. section also describes effects to fish and their habitat.		

[1]Short-term, post-fire degradation in current condition may occur for several Indicators - turbidity, substrate character, change in peak/base flows. These Indicators are expected to return to more typical and expected condition within a season or two. Other fire-affected Indicators, such as Riparian Reserves, will take longer to recover, and the new "current condition" will likely persist for many years.

[2]Barriers in identified in anadromous reach have been remediated. Some partial (culvert) barriers to resident fish may be present WF Whites Gulch.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # **Westside Fire Recovery**

Lower West Fork Beaver Creek 7th Field Checklist

Pathways: INDICATORS	ENVIRONMENTAL BASELINE Lower WF Beaver Ck 7th field			EFFECTS OF THE ACTION(S) Lower WF Beaver Ck 7th field		
	PROP FUNCT	AT RISK	NOT PROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature	TEMP				X	
Sediment-Turbidity		SED KNF GIS Beaver WA			X	
Chemical Contamination	ND/PJ				X	
Habitat Access Physical Barriers	FPI				X	
Habitat Elements Substrate Character			SED KNF GIS Beaver WA		X	
Large Woody Debris			Beaver WA RSS PO PJ		X	
Pool Frequency/Quality		SED KNF GIS Flood			X	
Off-channel Habitat	NA					
Refugia	TEMP	PO PJ			X	
Channel Cond & Dyn Width-to-Depth Ratio		SED KNF GIS Flood			X	
Streambank Condition		KNF GIS RSS			X	
Floodplain Condition	NA					
Flow /Hydrology Change in Peak/Base Flow			KNF GIS RSS		X	
Drainage Network Increase			KNF GIS RSS		X	
Watershed Cond. Road Density/Location			KNF GIS RSS		X	
Disturbance History/Regime			KNF GIS RSS Flood		X	
Riparian Reserves		KNF GIS RSS			X	

TEMP = Last five years of temperature monitoring of mainstem WF Beaver Creek at RM 0.8;

FPI = Fish Passage Inventory (KNF, 2003); **Beaver WA** = 1996 Beaver Creek Ecosystem (Watershed) Analysis;

SS89 = 1989 KNF stream survey of the lower 2.5 miles of WF Beaver Creek;

SED = 2010/2013 sediment assessment survey (USFS 2014); **Flood** = 1997 KNF Flood Assessment;

RSS = Road Sediment Source Inventory and Risk Assessment (KNF 2012);

NA = Not Applicable; **PO** = Personal Observation; **PJ** = Professional Judgment; **ND** = No Data;

KNF GIS = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015);

Environmental Baseline completed by Jon Grunbaum on February 17, 2015.

The Lower WF Beaver Creek 7th-field (HUC14) watershed is a composite watershed of 4,044 acres. Approximately 44% of the area is National Forest and the rest is primarily private industrial timberland. About 3.3 miles of lower mainstem WF Beaver Creek flows through the Lower WF Beaver HUC14 composite watershed. Lower mainstem WF Beaver Creek is a 4th-order (Strahler 1957) stream and the primary stream in the composite watershed. The entire 3.3 miles of Lower WF Beaver Creek provides habitat for rainbow/steelhead trout. Lower mainstem WF Beaver Creek provides about 1.7 miles of habitat for Chinook and Coho salmon. There is one 3rd-order tributary to Lower WF Beaver Creek named Bear Creek but this drainage is its' own 7th-field watershed. The Lower WF Beaver Creek 7th-field composite watershed has one 2nd-order tributary to Lower WF Beaver Creek named Little Soda Creek, and has numerous unnamed 1st-order tributaries and zero-order draws or intermittent streams. None of the tributaries to Lower WF Beaver Creek within the Lower WF Beaver Creek HUC14 is fish-bearing. The last stream survey of Lower WF Beaver Creek was in 1989.

Lower WF Beaver Creek 7th-Field watershed Environmental Baseline Elements:

Water Quality:

Temperature: Summer water temperature was monitored in mainstem WF Beaver Creek at RM 0.8 from 2010 to 2014 and those monitoring results are given in the table below. In the five year period of record the maximum instantaneous water temperature ranged from 15.2°C to 18.9°C; the maximum weekly average temperature (MWAT) ranged from 14.0°C to 16.9°C; and the maximum weekly maximum temperature ranged from 15.0°C to 18.5°C. **Properly Functioning**.

Recent Water Temperature Monitoring Results for Mainstem WF Beaver Creek at RM 0.8						
Start	**End**	**Max Daily Max Temp C**	**Max Average Daily Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp C (MWMT)**
6/28/2010	10/2/2010	15.2	16.7	4.2	15.0	16.3
6/23/2011	10/2/2011	15.3	14.2	4.7	14.0	15.0
6/16/2012	10/31/2012	17.2	16.1	4.1	15.6	16.8
6/11/2013	10/15/2013	18.3	16.8	3.9	16.1	17.5
6/3/2014	10/6/2014	18.9	17.4	4.2	16.9	18.5

Sediment/Turbidity: See discussion for the Substrate Condition indicator below. **At-Risk**.

Chemical Contamination: No significant source of chemical contamination is known to exist in streams in the Lower WF Beaver HUC 7 watershed. **Properly Functioning**.

Habitat Access

Physical Barriers: A fish passage inventory was completed in 2001 (KNF, 2003). No fish passage barriers were found in the Lower WF Beaver HUC 7 composite watershed. **Properly Functioning**.

Habitat Elements

Substrate Character and **Sediment-Turbidity:** It is theorized that turbidity and rate of sediment delivery to mainstem WF Beaver Creek is significantly elevated over pre-European settlement conditions or reference conditions. This theory is based on the following results and observations:

(6) Road density is very high and about 22% of the road system is hydrologically connected to the stream network.
(7) Results of intensive sediment monitoring (see discussion and results below) suggests that excessive sediment is being delivered to mainstem WF Beaver Creek and that this excessive sediment is impacting sediment condition and in-filling pools.
(8) Modeled surface erosion risk (USLE = 1.65) and runoff risk is (ERA/TOC = 1.31) are well over threshold, and modeled mass wasting is at threshold (GEO = 1.05).
(9) Excess fines were already being delivered to mainstem WF Beaver Creek after just light to moderate rains on the 2014 Beaver Fire burned areas (personal observation and photos, January 2015). The frequency, magnitude and duration of turbidity is likely to be significantly elevated for at least the next the next few years until vegetation gets re-established in burned areas and ground cover increases, and excess fines are winnowed out of the system.

The results of 2009 and 2013 intensive monitoring and evaluation of sediment in mainstem WF Beaver Creek that included the metrics: percent surface fines < 2mm, percent sub-surface sediment < 0.85mm, percent sub-surface sedient < 6.38mm, and percent residual pool volume filled with fine sediment (V*), are shown in the table below. Substrate quality impairment was evaluated in mainstem by comparing the four sediment indicators in WF Beaver Creek (a managed watershed) to the 85th percentile value of four indicators for reference streams that have minor to negligble management-related watershed disturbance. Watersheds exceeding the 85% percentile of reference streams may be impaired. In 2009 and 2013 two of the four sediment indices exceeded reference values.

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2009 and 2013 West Fork Beaver Creek response reach (wfbea1) compared to KNF Stream Sediment Monitoring reference conditions (85th percentile). [wfbea1] metrics over threshold values are bolded.

Sediment Index	2009 horse1 reach average %	2013 horse1 reach average %	Reference Condition (%)
Surface Fines < 2mm	3.1	6.1	6.4
Sub-surface fines < 0.85mm	**16.9**	**20.3**	16.2
Sub-surface fines < 6.38mm	45.5	45.5	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	**0.143**	**0.124**	0.108

Based on the preceding discussion, it is my professional opinion that the functioning condition of the Sediment-Turbidity indicator is **At-Risk**; and the functioning condition of the Substrate Character indicator is **Not Properly Functioning.**

Large Woody Debris: Current LWD levels are likely low in WF Beaver Creek streams because: (1) there was extensive upslope stand-replacement timber harvest that has not recovered long enough to provide LWD-sized trees for recruitment, (2) there is a very high density of road-stream crossings where vegetation is kept cleared, where large hazard trees are felled, and where people have access to and remove standing trees and LWD, (3) the inner gorge road on the north bank of mainstem WF Beaver Creek is a major factor in limiting the amount of LWD that can grow, fall into, or be left in the mainstem, and (4) fish habitat surveys have identified a lack of LWD in Beaver Creek watershed streams (1996 Beaver WA). **Not Properly Functioning**.

Pool Frequency and Quality: The 1997 New Year Flood triggered 19 major road failures, activated or caused five landslides, and altered three miles of stream channel or about 20% of the stream channels in the Lower WF Beaver Creek composite watershed. In addition, there were numerous major road failures and landslides in the HUC14 watersheds upstream of Lower WF Beaver Creek that likely delivered excess sediment to the lower mainstem. There were few pools during a stream survey in 1989-90 (Horse WA) suggesting that pools may have been partially or completely filled in with excessive sediment. The 1996 Beaver Creek Watershed Analysis stated that all surveyed streams [in the Beaver Creek watershed] are severely lacking pools; probably a result of excessive sediment inputs. Altered channels appear to be recovering but likely very slowly due to continuing high CWEs from the road system. Width-to-depth ratio may still be slightly increased, and pool depth might still be slightly decreased, compared to reference conditions. Results of 2009 and 2013 sediment monitoring suggest that excess sediment is still being delivered to mainstem WF Beaver Creek. **At-Risk**.

Off-channel Habitat: Not applicable in the Rosgen A-, B-, C-, and G-channel types of lower WF Beaver Creek and tributaries. Off-Channel habitat development is not characteristic of these channel types. **NA**

Refugia: Cool water and cover are the primary elements of fish refugia in this watershed. Summer water temperature is within the optimum to suitable range for salmonids but fish cover is inadequate due to low frequency of deep pools and deficiency of LWD. **At-Risk**.

Width-to-Depth Ratio: See discussion for Pool Frequency and Quality indicator above. **At-Risk**.

Streambank Condition: The 1997 Flood altered about 20% of the channels in the Lower WF Beaver Creek watershed and recovery is still taking place. Road-stream crossing density is extremely high and there is disturbance of the streambank at each stream crossing from clearing vegetation, grading, compacting, and removing hazard trees. The numerous disturbances could be cumulative particularly when there are multiple stream crossings on the same streams as there are on several tributaries to lower WF Beaver Creek. The entire length of lower WF Beaver Creek mainstem has a road constructed within the inner gorge (NFTS 47N01) on the north side of the stream. Segments of that road prism actually comprise the streambank where rip-rapping has been placed to prevent the road from washing out. The riparian zone on the south side of mainstem WF Beaver Creek is relatively undisturbed. About 336 acres of stream course RR burned in the 2014 Beaver Fire but only eight acres burned at moderate to high severity. **At-Risk**.

Floodplain Connectivity: Not applicable in the Rosgen A-, B-, C-, and G-channel types of Lower WF Beaver Creek and tributaries. Floodplains are not characteristic of these channel types. **NA**

Flow/Hydrology

Change in Peak and Base Flow: Road density is very high, stream crossing density is extremely high, and there has been little maintenance or storm proofing on these roads except for repairing major road failures after the 1997 Flood, therefore, potential for hydrologic connectivity of the road system to the stream network is high. The main road running up Lower WF Beaver Creek is constructed within a tight inner gorge and there is no way that this road can be hydrologically disconnected from the stream network. Modeled runoff risk is ratio is well over threshold (ERA/TOC = 1.31). **Not Properly Functioning**.

Increase in Drainage Network: Road density is very high at 5.9 miles of road per square mile of watershed and 22% of the road system is hydrologically connected to the stream network. **Not Properly Functioning**.

Watershed Conditions

Road Density/Location: Road density is very high at 5.9 miles of road per square mile of watershed and 22% of the road system is hydrologically connected to the stream network. Road-stream crossing density is extremely high (about half the tributaries to Lower WF Beaver Creek have three or more road-stream crossings). The entire length of WF Beaver Creek Road (NFTS Road 47N01) is constructed within stream buffer RRs and much of the road prism is near the streambank within a tight inner gorge. The inner gorge road is rip-rapped in several locations to prevent the road from washing out. The inner gorge road on the north bank precludes development of riparian vegetation and delivery of LWD to the channel from that side of the stream. **Not Properly Functioning**.

Disturbance History/Regime:

The 1997 New Year Flood triggered 15 major road failures, activated or caused nine landslides, and altered three miles of stream channel or about 20% of the stream channels in the Lower WF Beaver Creek composite watershed. The channel is still recovering but likely very slowly due to continuing high CWEs from the road system.

The largest disturbance factor in the Lower WF Beaver Creek watershed is by far the high density and poorly located road system. Past stand-replacement forestry is a distant second source of watershed disturbance and 2014 Beaver Fire effects is a lagging third source of disturbance.

Modeled surface erosion risk is not properly functioning (USLE = 1.65) and is well over threshold, modeled mass wasting risk is just at threshold (GEO = 1.05), and runoff risk is at-risk (ERA/TOC = 1.31) and at threshold. **Not Properly Functioning**.

Riparian Reserves: The 1997 Flood altered about 20% of the channels in the Lower WF Beaver Creek HUC14 watershed adversely affecting streambanks and removing riparian vegetation. Riparian vegetation is largely recovered from the flood.

Road-stream crossing density is extremely high and there is disturbance of the streambank and stream buffer at each stream crossing from clearing vegetation, grading, compacting, and removing hazard trees – the numerous disturbances add up to a significant impact especially when there are multiple stream crossings on the same streams as there are on several tributaries to lower WF Beaver Creek. The entire length of WF Beaver Creek Road (NFTS Road 47N01) is constructed within stream buffer RRs and much of the road prism is near the streambank within a tight inner gorge. This inner gorge road precludes development of riparian vegetation on that side of the creek, destabilizes the inner gorge, and chronically and acutely (during storms) delivers sediment directly into WF Beaver Creek. There are also short road segments that are located on toe zone in the HUC14. There has been past (over 15 years ago) stand-replacement timber harvest and road building on National Forest lands that would now be protected within stream buffer RRs or geologic RRs, and there has been past and current timber harvest on private lands in riparian and upslope areas that would be considered stream buffer RR or geologic RR if the land was National Forest.

The 2014 Fire caused 25% or greater basal area mortality on only five acres of unstable ground RR and eight acres of hydrologic RR. **At-Risk**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # Westside **Fire Recovery**

Middle Elk Creek 7th Field Watershed Checklist

Pathways: INDICATORS	ENVIRONMENTAL BASELINE Middle Elk 7th Field Watershed			EFFECTS OF THE ACTION(S) Middle Elk 7th Field Watershed		
	PROPERLY FUNCT	AT RISK	NOT ROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature	**TEMP**				**X**	
Sediment-Turbidity	**SED KNF GIS PO/ PJ**				**X**	
Chemical Contamination	**ND/PO/PJ**				**X**	
Habitat Access Physical Barrier	**FPI**				**X**	
Habitat Elements Substrate Character	**SED KNF GIS PO/ PJ**				**X**	
Large Woody Debris	**PO / PJ**				**X**	
Pool Frequency/Quality	**PO/ PJ**				**X**	
Off-channel Habitat	**NA**					
Refugia	**TEMP PO / PJ**				**X**	
Channel Cond & Dyn Width-to-Depth Ratio	**KNF GIS PO/ PJ**				**X**	
Streambank Condition		**KNF GIS PO / PJ**			**X**	
Floodplain Condition	**NA**					
Flow /Hydrology Change in Peak/Base Flow			**KNF GIS**		**X**	
Drainage Network Increase		**KNF GIS PJ**			**X**	
Watershed Cond. Road Density/Location	**KNF GIS RSS**				**X**	
Disturbance History/Regime		**KNF GIS PO / PJ**			**X**	
Riparian Reserves			**KNF GIS PO / PJ**		**X**	

TEMP = Water temperature monitoring of mainstem Elk Creek upstream of Bear Creek confluence from 2010 to 2014;

FPI = KNF Forest-Wide Fish Passage Barrier Inventory; **ND** = No Data; **PJ** = Professional Judgment; **PO** = Personal Observation based on 20+ years observing; NA = Not Applicable; **SED =** 2009 and 2012 KNF Sediment Assessment Survey; **RSS =** KNF Road Sediment Source Inventory and Risk Assessment (USDA 2012);

KNF GIS = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015);

Environmental Baseline and Checklist last updated by Jon Grunbaum on March 2, 2015.

The Middle Elk 7th-field watershed (HUC14) is a composite watershed with an area of 2,727 acres. The composite watershed is 100% National Forest land, and a small fraction of the composite watershed is within the Marble Mountain Wilderness. Mainstem Elk Creek is a fourth-order stream (Strahler 1957) and the principle stream in the composite watershed. There are two 2nd-order, several 1st-order, and several intermittent and emphemeral tributaries to mainstem Elk Creek in the composite watershed but none are named and none are fish-bearing. The (approximate) 2.4 miles of mainstem Elk Creek within the Middle Elk composite watershed provides habitat for winter steelhead and resident rainbow trout, and is suspected coho salmon habitat, although few coho have been seen as high as Bear Creek (which is just downstream from the Middle Elk watershed boundary) in annual surveys conducted over the last 20 years. A few summer steelhead and spring Chinook have been seen in mainstem Elk Creek in the Middle Elk composite watershed in surveys over the past 20 years. Fall Chinook generally do not spawn or rear as far upstream as the Middle Elk composite watershed. The last survey of mainstem Elk Creek within the Middle Elk composite watershed was summer 1997 but this survey is no longer current because the 1997 Flood altered the channel of mainstem Elk Creek. Lower mainstem Elk Creek just downstream of the Middle Elk composite watershed was surveyed in 1997/98 and 2006. The 1997/98 stream survey of mainstem Elk Creek is no longer valid because the channel and aquatic habitats have greatly recovered from the 1997 Flood (but the survey is useful for demonstrating recovery). In developing the Environmental Baseline for the Middle Elk composite watershed, the 2006 stream survey of lower mainstem Elk Creek just downstream from the Middle Elk composite watershed was used as surrogate for estimating aquatic habitat conditions in mainstem Elk Creek within the Middle Elk composite watershed.

Middle Elk 7th-Field (HUC14) Watershed Environmental Baseline Elements:

WATER QUALITY

Water temperature: Summer water temperature in mainstem Elk Creek within the Middle Elk Creek HUC14 just upstream of the Bear Creek confluence was monitored from 2010 to 2014 – see table below for a summary of monitoring results. In this five year period of record the maximum instantaneous water temperature ranged from 18.1°C to 22.2°C; the maximum weekly average temperature (MWAT) ranged from 15.3 °C to 18.3°C; and the maximum weekly maximum temperature ranged from 17.8°C to 21.4°C. Near record low base flows may have been a primary factor in the much higher than average water temperatures and large diurnal temperature variation in 2014. It is likely that the rate and magnitude of stream heating and cooling will increase due the 2014 Happy Camp Complex Fire because: (1) the wildfire burned large swaths of riparian vegetation that had provided shade and thermal buffering to stream channels, (2) pools are likely to infill or partially infill with excess sediment which will increase surface area to volume ratio, and (3) the wildfire is likely to significantly increase the frequency of in-channel debris flows and upslope landslides that can remove riparian vegetation and widen-and-shallow stream channels. The condition of the water temperature indicator is just barely in the **Properly Functioning** range.

Recent Water Temperature Monitoring Results for mainstem Elk Creek Upstream of Bear Creek Confluence						
Start	**End**	**Max Daily Max Temp C**	**Max Average Daily Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp C (MWMT)**
7/7/2010	10/1/2010	19.7	17.2	5.0	16.5	19.1
6/10/2011	10/5/2011	18.1	15.5	5.0	15.3	17.8
6/7/2012	9/27/2012	20.1	17.1	5.3	16.6	19.3
6/5/2013	9/29/2013	21.6	18.6	5.7	17.7	20.5
5/23/2014	9/30/2014	22.2	19.0	6.2	18.3	21.4

Sediment - Turbidity: See discussion for Substrate Character indicator below At-Risk**.**

Chemical Contamination: No significant source of chemical contamination is known to exist. **Properly Functioning**.

HABITAT ACCESS

Physical Barriers: There are no roads or stream crossings. No barriers to fish or aquatic organism passage are known to exist. **Properly Functioning**.

HABITAT ELEMENTS

Substrate Character: The results of 2009 and 2012 intensive monitoring and evaluation of sediment in mainstem Elk Creek in the Middle Elk HUC14 that included the metrics: percent surface fines < 2mm, percent sub-surface sediment < 0.85mm, percent sub-surface sedient < 6.38mm, and percent residual pool volume filled with fine sediment (V*), is shown in the table below. Substrate quality in the Middle Elk HUC14 was evaluated by comparing the four sediment indicators in mainstem Elk Creek to the 85th percentile value of the four indicators for pooled reference streams that have minor to negligble management-related watershed disturbance. Watersheds exceeding the 85% percentile of reference streams may have impaired sediment regime. In 2009 three of the four sediment indices exceeded reference values; and in 2012 two of the four sediment indices exceeded reference values.

Average surface fines, average sub-surface fines, and average volume of fine sediment filling pools (V*) from the 2009 and 2012 Elk Creek response reach (elk4) compared to KNF Stream Sediment Monitoring reference conditions (85th percentile). (elk4) metrics over reference values are bolded.

Sediment Index	2009 Elk4 reach average %	2012 Elk4 reach average %	Reference Condition (%)
Surface Fines < 2mm	4.2	3.8	6.4
Sub-surface fines < 0.85mm	**20.8**	**17.7**	16.2
Sub-surface fines < 6.38mm	**61.6**	**56.2**	46.1
Fraction of pools filled with fine sediment < 2mm (V star)	**0.121**	0.043	0.108

The Elk4 site monitors a HUC12 reference watershed : the 2007 Elk Fire and 2008 Panther Fire likely contributed to the sediment indices being over reference values in this reference watershed – particularly the 2008 Panther Fire that severely burned much of this HUC14 resulting in debris flows in most of the tributaries that was delivered to mainstem Elk Creek.

The 1987 Fire, the 2007 Elk Fire, the 2008 Panther Fire, and the 2014 Happy Camp Complex Fire have likely significantly increased the rate of erosion and sediment delivery to streams. The frequency, magnitude and duration of turbidity and fine sediment delivery due to surface erosion is likely to be elevated for a few years until vegetation gets re-established and ground cover is largely recovered in burned areas. The volume of fine and coarse sediment delivery to streams due to mass wasting is likely to be excessive for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots.

No recent surveys or observations have been made of mainstem channel condition in the Middle Elk HUC14 since the 2014 Fire, however, sand is notably decreasing the volume of pools in the lower mainstem (personal observation of myself and River Ranger David Payne in February 2015) and I suspect that excess sand is accumulating in the mainstem within the Middle Elk HUC14 as well.

Modeled surface erosion risk is low (USLE = 0.12) because ground cover has largely recovered from the 2008 Panther Fire that was far more severe and widespread that the 2014 Fire that largely burned at low severity. Modeled mass wasting is way over threshold (GEO = 2.85); and modeled runoff risk is well over threshold (ERA/TOC = 1.40). Therefore, sediment delivery rate to mainstem Elk Creek is likely to remain excessive for at least the short-term (10 years). A**t-Risk**.

Large Woody Debris: The only past and current management actions that could affect the growth of large streamside trees, the recruitment of large trees into the stream channel, and the residence time of LWD in channels within the Middle Elk HUC14 is: (1) construction and maintenance of a foot-trail on one side of the creek and (2) fire suppression actions. Neither of these actions independently or combined has been of great enough magnitude to significantly affect the process of LWD recruitment and retention. Therefore, the condition of the large woody debris indicator is **Properly Functioning**. Much LWD is being recruited to the stream channel due to the 2008 Panther Fire that killed a lot of streamside conifers that are now falling.

Pool Frequency/Quality: Past and current management actions that could affect the Pool Frequency/Quality and Width-to Depth Ratio indicators are: (1) construction and maintenance of a foot-trail on one side of the creek and (2) fire suppression actions. These types of actions could affect pool frequency/quality and width-to depth ratio by cutting down large streamside trees and/or bucking up LWD that is lying in the channel so that the scour, sediment sorting, and cover functions of LWD is diminished. However, neither of these actions independently or combined has been of great enough magnitude to significantly affect the process of LWD recruitment and retention. **Properly Functioning**. However, increased erosion from the 2008 Panther Fire that burned large areas of the Middle Elk HUC14 at moderate to high severity has increased sediment delivery to the mainstem and may be reducing pool volume. Increase in sedimentation of mainstem Elk Creek has also increased due to the 2014 Happy Camp Complex fire that burned 512 acres of stream buffer RR at moderate to high intensity in the Middle Elk HUC14 and in contributing HUC14s. Therefore, the pool frequency/quality and width-to depth ratio indicators could become at-risk in the near future. No recent surveys or observations have

been made of channel condition in the Middle Elk HUC14 since the 2014 Fire, however, sand is notably decreasing the volume of pools in the lower mainstem (personal observation of myself and River Ranger David Payne in February 2015) and is likely decreasing the volume of pools and the quality of spawning gravels in the Middle Elk HUC14.

Off-Channel Habitat: There is no potential for development of off-channel habitats in the Rosgen A-, B-, and G-channel types of mainstem Elk Creek or the A- and B-channel types of Middle Elk HUC14 tributaries. Off-channel habitat development is not characteristic of these channel types. **NA**.

Refugia: Cold water and cover are the primary elements of fish refugia in this watershed. Water temperature is Properly Functioning in Middle Elk Creek and there is good cover provided by boulders and LWD (that is actively recruiting to the channel due to the 2008 Panther Fire that killed large trees along extensive segments of the mainstem). **Properly Functioning**.

CHANNEL CONDITION AND DYNAMICS

Width to Depth Ratio: See discussion for Pool Frequency/Quality indicator above. **Properly Functioning**.

Streambank Condition: Much of the streambank of mainstem Elk Creek was scoured during the 1997 Flood, however, many reaches are constrained transport reaches with bedrock banks that changed little during the flood. High water and debris flows during the flood did remove riparian vegetation (mainly alder and willow) in places which is re-growing. The channel alteration from the flood is considered natural since there was negligible management disturbance in or upstream from the Middle Elk HUC14 prior to the flood. Recovery of flood-altered channels was progressing well until the 2008 Panther Fire hit which burned large swaths of stream buffer RR along the mainstem and tributaries at moderate to high severity – which later resulted in debris flows down most of the tributaries which altered those tributary channels and streambanks. The 2014 Happy Camp Complex burned 8% of the stream buffer RRs at moderate to high intensity. So, vegetation on streambanks is in early stages of recovery along miles of stream. Construction and maintenance of a trail on one side of the mainstem causes minor isolated streambank disturbances at stream crossings. **At-Risk**.

Floodplain Connectivity: Floodplain is not characteristic of the constrained Rosgen A-, B-, and G-channel types in the Middle Elk HUC14 composite watershed. There are no floodplains. **NA**.

FLOW/HYDROLOGY

Change in Peak/Base Flow: There is no road, landings, stand-replacement forestry or other significant management disturbance in the Middle Elk HUC14 or any of the HUC14s upstream of Middle Elk. It could be argued that fire suppression was a management action that contributed to the large area of moderate to high severity burn that occurred in the 2008 Panther Fire and 2014 Happy Camp Complex Fire. Modeled runoff risk is way over threshold (ERA/TOC = 1.40) due almost entirely to the 2008 and 2014 fires. **Not Properly Functioning**.

Increase in Drainage Network: There is negligible road mileage so there is negligible potential for road-related hydrologic connectivity that could increase drainage network. There is a trail system in the composite watershed but this disturbance to too minor to have any significant effect on the extent of

drainage network. Overland flow and the extent of the drainage network will be increased in watershed areas that burned at moderate to high intensity until vegetation and ground cover is well on the way to recovery. **At-Risk**.

WATERSHED CONDITION

Road Density/Location: Road density is extremely low (0.05 mile per square mile of watershed) within the Middle Elk composite watershed, and there are no valley bottom roads. **Properly Functioning**.

Disturbance History/Regime: There is little road (0.05 mile) in the composite watershed and there has been minor past timber harvest and salvage.

The 1997 New Year Flood altered about half the channels in the composite watershed, including the entire length of mainstem Elk Creek, and many tributaries on the south side of the watershed that drain the 1987 Fire area. The debris torrents that altered mainstem Elk Creek in the Middle Elk Creek composite watershed appeared to derive from natural sources such as landslides originating on un-managed ground in wilderness upstream from the Middle Elk Creek composite watershed and from sensitive ground (granitic plutons) within the Middle Elk Creek composite watershed where the 1987 Fires burned at moderate to high intensity. Therefore, much of the 1997 channel alteration of mainstem Elk Creek within the Middle Elk composite watershed was within the range of natural variability. Stream channels that were altered in the 1997 Flood are mostly recovered; vegetation on streambanks is still recovering.

Existing disturbance affecting watershed function is almost entirely from wildfires in 1987, 2007, 2008, and 2014 – particularly the 2008 Panther Fire that burned much of the Middle Elk HUC14 at moderate to high severity resulting in debris flows that altered most of the tributary channels and that delivered large volumes of sediment to mainstem Elk Creek. It could be argued (but not proven) that fire suppression was a primary factor that contributed to the large areas of moderate to high severity burn that is outside of the range of natural variability. Modeled surface erosion risk is low (USLE = 0.12) because ground cover has largely recovered from the 2008 Panther Fire that was far more severe and widespread that the 2014 Fire that largely burned at low severity. Modeled mass wasting is way over threshold (GEO = 2.85); and modeled runoff risk is well over threshold (ERA/TOC = 1.40). Therefore, sediment delivery rate to mainstem Elk Creek is likely to remain excessive for at least the short-term (10 years). **At-Risk.**

Riparian Reserves: There is hardly any road (0.05 mile) and no stream crossings in the Middle Elk Creek composite watershed, and there is minor disturbance from past timber harvest/salvage. The 1987 Fires damaged some stream buffers but these were largely recovered to the point that tributary channels were well-shaded prior to the 2008 Panther Fire. The 2007 Elk Fire burned intensely in some stream buffers but most stream buffers were un-affected and only a total of 28 acres of stream buffer burned at moderate to high intensity. The 2008 Panther Fire burned the stream buffer along most of the length of mainstem Elk Creek in the Middle Elk HUC14 at moderate to high severity killing most of the large conifers that dominated the riparian zone, and burned large swaths of riparian vegetation along the tributaries which later experienced debris flows that reset the channel and streambanks. The 2014 Happy Camp Complex burned 8% of the stream buffer in the HUC14 at moderate to high severity; and burned at moderate to high severity on 27 acres of active landslide, 7 acres of toe zone, and 42 acres of inner gorge. **Not Properly Functioning**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # **Westside Fire Recovery**

O'Neill Creek 7th Field Watershed Checklist

Pathways: INDICATORS	ENVIRONMENTAL BASELINE O'Neil Creek 7th-Field Watershed			EFFECTS OF THE ACTION(S) O'Neil Creek 7th-Field Watershed		
	PROPERLY FUNCT	AT RISK	NOT PROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature	**TEMP**				**X**	
Sediment-Turbidity			**KNF GIS ND/PO/PJ**		**X**	
Chemical Contamination	**ND/PJ**				**X**	
Habitat Access Physical Barrier	**FPI**				**X**	
Habitat Elements Substrate Character			**KNF GIS ND/PO/PJ**		**X**	
Large Woody Debris	**KNF GIS PJ**				**X**	
Pool Frequency/Quality		**KNF GIS ND/PO/PJ**			**X**	
Off-channel Habitat	**NA**					
Refugia	**TEMP PJ**				**X**	
Channel Cond & Dyn Width-to-Depth Ratio		**KNF GIS Flood ND/PO/PJ**			**X**	
Streambank Condition		**KNF GIS Flood ND/PO/PJ**			**X**	
Floodplain Condition	**NA**					
Flow /Hydrology Change Peak/Base Flow		**KNF GIS RSS ND/PJ**			**X**	
Drainage Network Increase			**KNF GIS RSS ND/PJ**		**X**	
Watershed Cond. Road Density/Location			**KNF GIS**		**X**	
Disturbance History/Regime			**KNF GIS RSS Flood ND/PO/PJ**		**X**	
Riparian Reserves			**KNF GIS ND/PO/PJ**		**X**	

TEMP = Water temperature monitoring of O'Neil Creek near mouth from 2010 to 2014;

FPI = Fish Passage Inventory (KNF, 2003);

ND = No data; **NA** = Not Applicable; **PO** = Personal Observation; **PJ** = Professional Judgment;

O'Neil Creek 7th field (HUC14) watershed is a true watershed with an area of 2,429 acres. Mainstem O'Neil Creek is a 2rd-order (Strahler 1957) stream and the primary stream in the watershed. There are several 1st- and zero-order tributaries to the mainstem but none are named and none are fish-bearing. Mainstem O'Neil Creek provides 0.8 miles of habitat for steelhead/rainbow trout and about a tenth of a mile of habitat for Coho salmon. There is a constructed off-channel pond on the Klamath River floodplain that is connected to O'Neil Creek that is used by Coho salmon and other salmonids. O'Neil Creek is not known to be used by Chinook salmon. Juvenile salmon and steelhead use the cool water at the mouth of O'Neil Creek for thermal refugia when the river gets too warm. There are no recent stream surveys of O'Neil Creek.

O'Neil Creek 7th-field (HUC14) Watershed Environmental Baseline Elements:

WATER QUALITY

Temperature: Summer water temperature in mainstem O'Neil Creek just upstream from the mouth was monitored from 2010 to 2014 – see table below for a summary of monitoring results. In this four year period of record the maximum instantaneous water temperature ranged from 16.7°C to 19.1°C; the maximum weekly average temperature (MWAT) ranged from 15.4°C to 17.4°C; and the maximum weekly maximum temperature ranged from 16.4°C to 18.6°C. Near record low base flows may have been a primary factor in the much higher than average water temperature in 2014. It is possible that rate and magnitude of stream heating and cooling will slightly increase due the 2014 Happy Camp Complex Fire because: (1) the wildfire burned areas of riparian vegetation that had provided stream shade and thermal buffering to stream channels, (2) pools may partially infill with excess sediment which will increase surface area to volume ratio, and (3) the wildfire may increase the frequency of in-channel debris flows and upslope landslides that can remove riparian vegetation and widen-and-shallow stream channels. **Properly Functioning**.

Recent Water Temperature Monitoring Results for Mainstem O'Neil Creek Near Mouth						
Start	**End**	**Max Daily Max Temp C**	**Max Average Daily Temp C**	**Max Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp C (MWMT)**
6/28/2011	10/4/2011	16.7	15.6	2.7	15.4	16.4
6/14/2012	9/24/2012	17.8	16.9	2.9	16.4	17.4
6/7/2013	10/16/2013	18.6	17.5	2.6	16.9	17.9
5/29/2014	9/23/2014	19.1	18.0	3.0	17.4	18.6

Sediment - Turbidity: No data. Before the 2014 Happy Camp Complex burned much of the watershed it was assumed that turbidity was low and that sediment delivery, storage, and transport was near equilibrium because: (1) there is low density of stream crossings and road in stream buffers, (2) there have been no recent [25 + years] wildfires of any significance, and (3) there has been little recent stand-replacement forestry.

The 2014 Fire significantly increased rate of erosion, sedimentation, and turbidity as witnessed at the mouth of O'Neil Creek where it crosses under the Klamath River Highway. The 2014 Fire burned about 166 acres of stream buffer RRs at moderate to high intensity which is 28% of the total stream buffer in the HUC14 watershed. This much moderate and high severity fire in hydrologic RRs is expected to significantly increase streamside mass wasting and decrease the nutrient spiraling and sediment buffering function of stream course RRs. The frequency, magnitude and duration of turbidity is likely to be elevated for at least the next the next few years until vegetation gets re-established and ground cover increases, and excess fines are winnowed out of the system. The 2014 Fire caused 25% or greater basal area mortality on 789 acres of unstable ground RR as follows: 135 acres of inner gorge [note: much of the acres of inner gorge are within hydrologic RR so these acres should not be double-counted] and 654 acres of highly dissected granitics. This much moderate and high intensity fire on geologic RRs is expected to significantly increase the rate of mass wasting and excess sediment delivery to the stream network. Excessive delivery of fine and coarse sediment to streams due to mass wasting is likely to be excessive for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots.

Modeled surface erosion risk (USLE = 1.37) and modeled mass-wasting risk (GEO = 1.50) are way over threshold; and modeled runoff risk is moderately high (ERA/TOC = 0.80). **Not Properly Functioning**.

Chemical Contamination: No significant source of chemical contamination is known to exist in the O'Neil Creek watershed. **Properly Functioning**

HABITAT ACCESS

Physical Barriers: No man-made barriers to fish passage exists in the O'Neil Creek watershed. P**roperly Functioning.**

HABITAT ELEMENTS

Substrate Character: See discussion for the Sediment–Turbidity indicator above. **Not Properly Functioning**.

Large Woody Debris: No data. It is assumed that LWD and potential for future LWD recruitment is near site-potential because there has been little timber harvest in the watershed near a stream course, there is little access to perennial streams via roads. There is very limited access to the stream so that the potential for removal of LWD and/or potential future recruitment tree from the riparian zone is small – the only access to the stream network occurs at the mouth where there is a campground and the Klamath River Highway, at one powerline crossing of the mainstem, and at several stream crossings in the headwaters. The 2014 Happy Camp Complex Fire may have burned up some streamside trees that could have become future LWD but it is more likely that the fire killed trees will recruit to the stream earlier than if they had not been killed in the fire. **Properly Functioning**.

Pool Frequency/Quality: No data. Prior to the 2014 Happy Camp Complex Fire it was assumed that the Pool Frequency/Quality indicator was properly functioning because there was very little disturbance in the watershed particularly near a stream course. The 2014 Fire caused 25% or greater basal area mortality on 789 acres of unstable ground RR. This much moderate and high intensity fire on geologic RRs is expected to significantly increase the rate of mass wasting and excess sediment delivery to the stream network that could fill or partially infill pools. Excessive delivery of fine and coarse sediment to streams due to surface erosion and mass wasting is likely to be excessive for a decade or more. **At-Risk.**

Off-Channel Habitat: Not applicable in the Rosgen A- and B-channel types that characterize channels in the O'Neil Creek watershed. There is negligible potential for off-channel habitat development. **NA**.

Refugia: Cold water delivered to the lower mainstem, the off-channel pond on the Klamath River floodplain, and the Klamath River is the primary element of anadromous fish refugia associated with O'Neil Creek. Water temperature is believed to be within suitable to optimal range for salmonids. **Properly Functioning**.

Channel Condition and Dynamics

Width-to-Depth Ratio: No data. The rate of debris flows is likely to increase due to large area of severe burn on 789 acres of geologic RR. Debris flows are likely to alter width-to-depth ratio by scouring V-shaped channels to U-shaped channels. Debris flows may deposit excess sediment into channels which could fill or partially fill deep spots (pools). **At-Risk**.

Streambank Condition: Prior to the 2014 Happy Camp Complex Fire streambanks were assumed to be in good condition because there has been little past timber harvest, road construction, or moderate to high severity wildfire in stream buffers.

The 2014 Fire burned about 166 acres of vegetation on streambanks at moderate to high severity. Streambanks are likely to be degraded from accelerated rate of debris flows from 789 acres of geologic RR that burned at moderate to high severity in the 2014 Fire. **At-Risk**.

Floodplain Connectivity: Not applicable in the Rosgen A- and B-channel types in the O'Neil Creek watershed. There are no floodplains. **NA**.

Flow/Hydrology

Change in Peak/Base Flow: Road density is high but only 4% of the road system is hydrologically connected to the stream network so there is little potential for drainage network increase due to roads. Overland flow and the extent of the drainage network is likely to be significantly increased in the tributary watersheds that burned in the 2014 Happy Camp Complex Fire because large areas of the watershed burned at moderate to high intensity in upslope and riparian areas. Modeled runoff risk for the entire composite watershed is moderately high (ERA/TOC = 0.80).

There is one water diversion that has a domestic use limit of 4,200 gallons per day. The campground is planning to re-build its' water system and will once again draw from O'Neil Creek (probably much less than 4,200 gallons/day). These diversions will slightly reduce base flow. **At-Risk**.

Drainage Network Increase: The road density is high at 3.3 miles of road per square mile of watershed and 4% of the road system is hydrologically connected to the stream network. Overland flow and the extent of the drainage network is likely to be significantly increased in the short term because large areas of these watersheds burned at moderate to high intensity in upslope and riparian areas. **Not Properly Functioning**.

Watershed Conditions

Road Density/Location: The road density is high at 3.3 miles of road per square mile of watershed and 4% of the road system is hydrologically connected to the stream network. There is very little valley bottom road (except for the Klamath River Highway and a short section of the campground road). **Not Properly Functioning**.

Disturbance History/Regime: There is high road density but roads are generally on ridges or upper mid-slopes and stream crossing density is low. Only about 4% of the road system is hydrologically connected to the stream network.

There were three landslides and five major road failures in the O'Neil Creek watershed during the 1997 Flood which altered about 36% of the stream channels. The channel was well into recovery when the 2014 Fire hit.

The 2014 Happy Camp Complex Fire is the primary disturbance currently affecting watershed processes. It could be argued (but not proven) that fire suppression was a primary factor that contributed to the large areas of moderate to high severity burn that is outside of the range of natural variability. About 166 acres of stream buffer RRs was burned at moderate to high intensity, which is 28% of the total stream buffer in the HUC14 watershed. This much moderate and high intensity fire in hydrologic RRs is expected to significantly increase streamside mass wasting and decrease the nutrient spiraling and sediment buffering function of stream course RRs. The 2014 Fire caused 25% or greater basal area mortality on 789 acres of unstable ground RR as follows: 135 acres of inner gorge [note: much of the 588 acres of inner gorge are within hydrologic RR so these acres may be double-counted] and 654 acres of highly dissected granitics. This much moderate and high intensity fire on geologic RRs is expected to significantly increase the rate landsliding.

Modeled surface erosion risk (USLE = 1.37) and modeled mass-wasting risk (GEO = 1.50) are way over threshold; and modeled runoff risk is moderately high (ERA/TOC = 0.80). Roads are the primary disturbance factor in the USLE model with wildfire a close secondary factor. Wildfire is the primary disturbance factor in the mass wasting risk and runoff risk models with roads as a distant second factor. Past vegetation management and fire lines are negligible components of the total disturbance. **Not Properly Functioning**.

Riparian Reserves: Road density is high but only 4% of the road system is hydrologically connected to the stream network. Stream crossing density is low.

The function of stream buffers was adversely affected by the 1997 Flood when 36% of the channels in the watershed were altered. The channels were largely recovered when the 2014 Fire hit.

The 2014 Happy Camp Complex Fire burned about 166 acres of stream buffer RRs at moderate to high intensity (which is 28% of the total stream buffer in the HUC14 watershed) and caused 25% or greater basal area mortality on 789 acres of unstable ground RR as follows: 135 acres of inner gorge [note: much of the 588 acres of inner gorge are within hydrologic RR so these acres may be double-counted] and 654 acres of highly dissected granitics. **Not Properly Functioning**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # **Westside Fire Recovery**

Tom Martin Creek-Klamath River 7th Field Checklist

Pathways: INDICATORS	ENVIRONMENTAL BASELINE TomMartinCk KlamathR HUC14			EFFECTS OF THE ACTION(S) TomMartinCk KlamathR HUC14		
	PROPERLY FUNCT	AT RISK	NOT PROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature	**TEMP**				**X**	
Sediment-Turbidity		**KNF GIS ND/PO/PJ**			**X**	
Chemical Contamination	**ND/PJ**				**X**	
Habitat Access Physical Barrier	**FPI**				**X**	
Habitat Elements Substrate Character		**KNF GIS ND/PO/PJ**			**X**	
Large Woody Debris	**KNF GIS PJ**				**X**	
Pool Frequency/Quality		**KNF GIS ND/PO/PJ**			**X**	
Off-channel Habitat	**NA**					
Refugia	**TEMP PJ**				**X**	
Channel Cond & Dyn Width-to-Depth Ratio		**KNF GIS Flood ND/PO/PJ**			**X**	
Streambank Condition			**KNF GIS Flood ND/PO/PJ**		**X**	
Floodplain Condition	**NA**					
Flow /Hydrology Change Peak/Base Flow		**KNF GIS RSS ND/PJ**			**X**	
Drainage Network Increase		**KNF GIS RSS ND/PJ**			**X**	
Watershed Cond. Road Density/Location	**KNF GIS**				**X**	
Disturbance History/Regime			**KNF GIS RSS Flood ND/PO/PJ**		**X**	
Riparian Reserves			**KNF GIS Flood ND/PO/PJ**		**X**	

TEMP = Karuk Tribe water temperature monitoring data from 2004, 2005, and 2006; **FPI** = Fish Passage Inventory (KNF, 2003);

ND = No data; **NA** = Not Applicable; **PO** = Personal Observation; **PJ** = Professional Judgment;

Flood = 1997 KNF Flood Assessment; **RSS =** KNF Road Sediment Source Inventory and Risk Assessment (USDA 2012);

KNF GIS = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015)

Environmental Baseline and Checklist completed by Jon Grunbaum, March 6, 2015.

This environmental baseline primarily covers conditions in main tributary watersheds to the Klamath River in this composite watershed. See the Mid-Klamath River Corridor Environmental Baseline for watershed, water quality, and aquatic habitat conditions in the Klamath River and in face drainages to the Klamath River.

Tom Martin-Klamath River is a composite 7th-field watershed (HUC14) of 10,690 acres. The composite watershed is 92% National Forest and the rest is mostly private residential and some industrial timberland. The composite watershed includes a 4.8 mile section of the mainstem Klamath River that supports Coho and Chinook salmon, and steelhead trout throughout its' length. There are three named 3rd-order tributaries (Mill, Macks, and Tom Martin Creeks); two named 2nd-order tributaries (Kuntz and Muck-a-Muck Creeks), three named 1st-order tributaries (Mitchell Creek, China Creek, and Hicks Gulch), and several un-named first-order tributaries and zero-order draws to the Klamath River in the composite watershed. None of these tributaries to the Klamath River support salmon except for Tom Martin Creek that provides important thermal refugia for salmon at the mouth of the creek and for several hundred feet up the creek including a constructed off channel pond fed by water from Tom Martin Creek. Tom Martin and Macks Creek support steelhead and resident rainbow trout in their lower segments (about 0.5 mile each). Kuntz, Mill, and Mitchell Creeks support resident rainbow trout in their lower segments (0.8 mile, 1.5 miles, and 0.3 mile, respectively). None of the other tributaries to the Klamath River in this composite watershed are fish-bearing. There are no known stream surveys of any of the tributaries to the Klamath River in this composite watershed.

Tom Martin-Klamath River 7th-field Watershed (HUC14) Environmental Baseline

Water Quality:

Water Temperature: Summer water temperature of Tom Martin Creek at the mouth was monitored in 2004, 2005, and 2006. The instantaneous maximum temperature recorded was 65°F in 2004 and 2005, and 66°F in 2006. There is no data on water temperatures in the other tributary streams to the Klamath River in this composite watershed but it is believed that water temperatures are properly functioning in all or nearly all these small well-shaded streams – particularly the north-facing drainages on the south side of the river. **Properly Functioning**. (Water temperature in the Klamath River is analyzed in the mid-Klamath Corridor environmental baseline and checklist).

Sediment - Turbidity: No data. Before the 2014 Happy Camp Complex burned nearly the entire composite watershed area south of the river it was assumed that turbidity was low and that sediment delivery, storage, and transport was near equilibrium because: (1) road density is low, (2) there is low density of stream crossings and road in stream buffers, (3) no recent [25 + years] wildfires of any significance, and (4) little recent stand-replacement forestry. The 2014 Fire significantly increased rate of runoff, erosion, sedimentation, debris flows, and turbidity as witnessed at the mouth of burned tributaries from where they cross with the Klamath River Highway. The frequency, magnitude and duration of turbidity is likely to be significantly elevated for at least the next the next few years until vegetation gets re-established and ground cover increases, and excess fines are winnowed out of the system. Landslide risk will be increased for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots – and excessive sediment delivery to streams is likely during this period.

Modeled surface erosion risk is moderately high (USLE = 0.78); modeled mass-wasting risk is moderate (GEO = 0.44); and modeled runoff risk is moderate (ERA/TOC = 0.53). **At-Risk**.

Chemical Contamination: No significant source of chemical contamination is known to exist in the tributaries to the Klamath River in this composite watershed. **Properly Functioning**. (Water quality in the Klamath River is analyzed in the mid-Klamath Corridor environmental baseline and checklist).

Habitat Access

Physical Barriers: An inventory of fish passage barriers related to roads was completed in this HUC14 and no man-made barriers were found on National Forest land without easement. The Klamath River Highway degrades habitat and poses passage problems because it crosses the mouths of all the tributaries on the south side of the river, however, there is no or not much suitable steelhead or salmon habitat upstream of the highway. **Properly Functioning**.

Habitat Elements

Substrate Character: See discussion for the Sediment–Turbidity indicator above. **At-Risk**.

Large Woody Debris: No data. It is assumed that LWD and potential for future LWD recruitment is near site-potential because there has been little timber harvest in the watershed near a stream course, there is little access to perennial streams via roads. There is very limited access to the stream so that the potential for removal of LWD and/or potential future recruitment tree from the riparian zone is small – the only access to the stream network occurs: (1) near the mouths of tributaries where there are private parcels and the Klamath River Highway and (2) at one powerline crossing of the tributary watersheds. The potential for growing large trees is significantly diminished on private lands on the south side of the river that were hydraulically mined leaving no topsoil and compacted ground. The 2014 Happy Camp Complex Fire may have burned up some streamside trees that could have become future LWD but it is more likely that the fire killed trees will recruit to the stream earlier than if they had not been killed in the fire. **At-Risk**.

Pool Frequency/Quality: No data. Many of the tributary channels on the south side of the river have already had debris flows that are largely the after-effect of heavy rain on severely burned ground from the 2014 Happy Camp Complex Fire. More 2014 Fire related debris flows are likely to occur over the next decade of longer. Channels of tributaries on the south side of the river are being scoured by debris flows and more is expected. Debris flows in south-side tributaries are likely to reduce pool frequency and depth due to sediment in-filling and loss of channel structure. **At-Risk.**

Off-channel Habitat: Not applicable in the Rosgen A- and B-channel types that characterize the Klamath River tributaries in this watershed. **NA**.

Refugia: Cold water delivered to the Klamath River by the tributaries is the primary element of anadromous fish refugia that is contributed by Klamath River tributaries in this watershed. Water temperatures are believed to be within suitable to optimal range for salmonids in all or nearly all the small well-shaded tributaries to the Klamath River in the composite watershed. **Properly Functioning**.

Channel Condition and Dynamics

Width-to-Depth Ratio: No data. Many of the tributary channels on the south side of the river have already had debris flows that are largely the after-effect of heavy rain on severely burned ground from the 2014 Happy Camp Complex Fire. More 2014 Fire related debris flows are likely to occur over the next decade of longer. Channels of tributaries on the south side of the river are being scoured by debris flows and more is expected. Debris flows are likely to alter width-to-depth ratio by scouring V-shaped channels to U-shaped channels. **At-Risk**.

Streambank Condition: Prior to the 2014 Happy Camp Complex Fire streambanks in tributaries were assumed to be in good condition because there has been little past timber harvest, road construction, or moderate or intense wildfire in stream buffers. Channel alteration that occurred during the 1997 Flood was assumed to be well on the way to recovery because overall watershed disturbance was low.

The 2014 Fire burned much of the ground on the south side of the river – about 4,200 acres. About 951 acres of stream buffer RRs was burned at moderate to high intensity, which is 39% of the total stream buffer in the *entire* HUC14 composite watershed, therefore, *much* of the stream buffer on the south side of the river burned at moderate to high intensity. Many of the tributary channels on the south side of the river have already had debris flows that are largely the after-effect of heavy rain on severely burned ground from the 2014 Fire. More 2014 Fire related debris flows are likely to occur over the next decade of longer. Streambanks of tributaries on the south side of the river are in poor condition due to loss of vegetation and accelerated rate of debris flows. **Not Properly Functioning**.

Floodplain Connectivity: Not applicable in the Rosgen A- and B-channel types that characterize the Klamath River tributaries in this composite watershed. There are no floodplains. **NA**.

Flow/Hydrology

Change in Peak/Base Flow: Road density is low and only 3% of the road system is hydrologically connected to the stream network so there is little potential for drainage network increase due to roads. Overland flow and the extent of the drainage network is likely to be significantly increased in the tributary watersheds that burned in the 2014 Happy Camp Complex Fire because large areas of these watersheds burned at moderate to high intensity in upslope and riparian areas. Modeled runoff risk for the entire composite watershed is moderate (ERA/TOC = 0.53), however, nearly all the disturbance in the model is from the 2014 which burned only on the south side of the river on about 2/3 of the composite watershed. Therefore, modeled runoff risk would be considerably higher, possibly near threshold, if just the burned area (south side of the river) of the composite watershed was modeled.

There are numerous domestic water diversions from tributaries on the south side of the river in this composite watershed that undoubtedly reduce base flow but the details of the diversions are not known. **At-Risk**.

Drainage Network Increase: Road density is low and only 3% of the road system is hydrologically connected to the stream network so there is little potential for drainage network increase due to roads. Overland flow and the extent of the drainage network is likely to be significantly increased in the tributary watersheds that burned in the 2014 Happy Camp Complex Fire because large areas of these

watersheds burned at moderate to high intensity in upslope and riparian areas.

At-Risk.

Watershed Conditions

Road Density/Location: The road density is low at 1.4 miles of road per square mile of watershed and 3% of the road system is hydrologically connected to the stream network. There is very little valley bottom road (except for the Klamath River Highway and roads/compaction on private lands). **Properly Functioning**.

Disturbance History/Regime: There is low disturbance from timber harvest and roads in the composite watershed on National Forest lands. Roads are generally on ridges or upper mid-slopes and stream crossing density is low. Only about 3% of the road system is hydrologically connected to the stream network. Much of the watershed area on the south side of the Klamath River is released roadless area. There is considerable disturbance from past mining, roads, and development on some of the private land along the south side of the river in the Hamburg vicinity.

There were seven major road failures in the Tom Martin-Klamath River composite watershed during the 1997 Flood which altered about 7% of the tributary channels. Short sections of Mill, Macks, and Tom Martin Creeks were altered but there was no obvious link between channel alteration and past management and the channel alteration was likely within the range of natural variability.

There was a small fire (less than 40 acres) in 2007 that burned primarily at low intensity and is not a significant watershed concern.

The 2014 Happy Camp Complex Fire is the primary disturbance currently affecting watershed processes in the portion of the composite watershed south of the Klamath River. It could be argued (but not proven) that fire suppression was a primary factor that contributed to the large areas of moderate to high severity burn that is outside of the range of natural variability. The 2014 Fire burned most of the ground on the south side of the river – about 4,200 acres. About 951 acres of stream buffer RRs was burned at moderate to high intensity, which is 39% of the total stream buffer in the *entire* HUC14 composite watershed, therefore, much of the stream buffer on the south side of the river burned at moderate to high intensity. This much moderate and high intensity fire in hydrologic RRs is expected to significantly increase streamside mass wasting and decrease the nutrient spiraling and sediment buffering function of stream course RRs. The 2014 Fire caused 25% or greater basal area mortality on 630 acres of unstable ground RR as follows: 28 acres of active landslide; 23 acres of toe-zone; and 588 acres of inner gorge [note: much of the 588 acres of inner gorge are within hydrologic RR so these acres should not be double-counted]. This much moderate and high intensity fire on geologic RRs is expected to significantly increase the rate landsliding.

Modeled surface erosion risk is moderately high (USLE = 0.78); modeled mass-wasting risk is moderate (GEO = 0.44); and modeled runoff risk is moderate (ERA/TOC = 0.53). Modeled watershed disturbance is primarily due to the 2014 Fire with roads as a distant second. Past vegetation management and 2014 fire lines are small components of the total disturbance. **Not Properly Functioning**.

Riparian Reserves: Road and stream crossing density is low with stream buffer RRs.

The function of stream buffers were adversely affected by the 1997 Flood when 7% of the channels in the composite watershed were altered, however, this much channel alteration during a major flood was likely within the range of natural variability.

About 951 acres of stream buffer RRs was burned at moderate to high intensity, which is 39% of the total stream buffer in the *entire* HUC14 composite watershed, therefore, much of the stream buffer on

the south side of the river burned at moderate to high intensity. The 2014 Fire caused 25% or greater basal area mortality on 630 acres of unstable ground RR as follows: 28 acres of active landslide; 23 acres of toe-zone; and 588 acres of inner gorge [note: much of the 588 acres of inner gorge are within hydrologic RR so these acres are double-counted]. **Not Properly Functioning**.

CHECKLIST FOR DOCUMENTING ENVIRONMENTAL BASELINE AND EFFECTS OF PROPOSED ACTION(S) ON RELEVANT INDICATORS

PROJECT AND SITE # **Westside Fire Recovery**
Walker Creek 7th Field Watershed Checklist

Pathways: **INDICATORS**	ENVIRONMENTAL BASELINE Walker Creek 7th-field watershed			EFFECTS OF THE ACTION(S) Walker Creek 7th-field watershed		
	PROPERLY FUNCT	AT RISK	NOT PROP FUNCT	RESTORE	MAINTAIN	DEGRADE
Water Quality Temperature		TEMP			X	
Sediment-Turbidity			SS07/08 KNF CWE PO PJ		X	
Chemical Contamination	ND/PJ				X	
Habitat Access Physical Barrier	FPI				X	
Habitat Elements Substrate Character			SS07/08 KNF CWE PO PJ		X	
Large Woody Debris			SS07/08		X	
Pool Frequency/Quality		Flood SS07/08			X	
Off-channel Habitat		PO			X	
Refugia		TEMP SS07/08			X	
Channel Cond & Dyn Width/Depth Ratio			Flood SS07/08		X	
Streambank Condition			SS07/08 Flood KNF GIS		X	
Floodplain Condition		PO			X	
Flow /Hydrology Change in Peak/Base Flow			KNF GIS RSS		X	
Drainage Network Increase		KNF GIS RSS			X	
Watershed Cond. Road Density/Location			KNF GIS		X	
Disturbance History/Regime			KNF GIS Flood		X	
Riparian Reserves			KNF GIS Flood		X	

TEMP = Water temperature monitoring near mouth of Walker Creek from 2010 to 2014; **FPI** = KNF Forest-Wide Fish Passage Barrier Inventory; **SS97/98** =1997 and 1998 KNF stream surveys of the lower mainstem of Walker Creek; **RSS =** 1999 KNF Road Sediment Source Inventory and Risk Assessment; **Flood** = KNF analysis of the 1997 New Years Flood; **ND** = No Data; **PJ** = Professional Judgment; **PO** = Personal Observation based on 20+ years

observing; **NA** = Not Applicable; **KNF GIS** = KNF GIS database query and CWE modeling for WFR Project (Fall 2014 to Winter 2015).

Environmental Baseline completed by Jon Grunbaum on February 10, 2015.

The Walker Creek 7th-field watershed (or HUC14) is a true watershed of 7,635 acres. Walker Creek is 99% National Forest land and 1% private residential land. Walker Creek is a 4rd-order (Strahler 1957) stream and is the primary stream in the watershed. Walker Creek has numerous zero- to 1st-order tributaries, one 2nd-order tributary, and two 3rd-order tributaries. The only named tributary is East Fork Walker Creek (2nd-Order). Walker Creek supports resident rainbow trout in the lowest 6.1 miles of mainstem, steelhead trout in the lower 4.8 miles, and coho salmon in the lower 2.1 miles. Chinook are not documented in Walker Creek. The tributaries to Walker Creek are non fish-bearing. The last stream survey of the entire mainstem of Walker Creek was in summer 1998. Approximately 0.60 mile of mainstem Walker Creek was surveyed in 2007.

Walker Creek 7th-field watershed Environmental Baseline elements:

Temperature: Summer water temperature was monitored near the mouth for most years from 1997 to 2014 – monitoring results for the last five years is given in the table below. In the five year period of record the maximum instantaneous water temperature ranged from 18.2 °C to 20.4 °C; the maximum weekly average temperature (MWAT) ranged from 15.7 °C to 17.5°C; and the maximum weekly maximum temperature ranged from 17.7 °C to 19.9°C. Although water temperature in mainstem Walker Creek has been within the properly functioning range in the last five years it is likely that the rate and magnitude of stream heating and cooling will significantly increase due the 2014 Fire because: (1) the wildfire burned large swaths of riparian vegetation that had provided shade to stream channels, (2) pools are likely to infill or partially infill with excess sediment which will increase surface area to volume ratio, and (3) the wildfire is likely to significantly increase the frequency of in-channel debris flows and upslope landslides that can remove riparian vegetation and widen-and-shallow stream channels. **At-Risk**.

Recent Water Temperature Monitoring Results for Mainstem Walker Creek Near Mouth							
Start	**End**	**Daily Average Temp C**	**Daily Max Temp C**	**Daily Min Temp C**	**Diurnal Variation Temp C**	**Maximum Weekly Average Temp C (MWAT)**	**Maximum Weekly Maximum Temp C (MWMT)**
6/27/2010	10/8/2010	18.2	20.4	9.6	6.6	17.5	19.9
6/7/2011	10/5/2011	16.1	18.2	8	6.1	15.7	17.7
6/13/2012	9/25/2012	17.0	18.5	9.8	5.3	16.5	18.1
4/26/2013	9/30/2013	17.9	19.6	6	5.6	17.2	18.9
5/29/2014	9/23/2014	18.1	19.9	8.8	5	17.4	19.2

Sediment/Turbidity: During the 1997 New Years Flood there were 78 landslides and 51 major road failures, and approximately 81% of the channels in the Walker Creek HUC14 were altered. There was massive aggradation in many reaches of Walker Creek as evidenced by almost complete lack of deep pools in the 1998 stream survey, and lenses of sediment over eight feet deep in the mainstem upstream of the East Fork confluence. Some reaches were still aggraded and recovering just prior to

the 2014 Happy Camp Complex fire. In the 1998 stream survey of mainstem Walker Creek the percent fines in pebble counts ranged from 19% to 21%, fines in pool tail-outs was 4%, and embeddedness averaged 18%. In the 2007 stream survey, average percent fines in pool tail-outs was low at 7% and average percent fines in pebble counts was low averaging 4%. Post 2014 Happy Camp Complex Fire water quality and sediment conditions in lower mainstem Walker Creek were observed and photographed in the winter after several light to moderate precipitation events: the observations and photographs revealed that (1) turbidity was very high during and long- after precipitation events and (2) large quantities of fine sediment had been delivered to the mainstem which had partially filled in pools and has partially smothered the pre-Fire streambed and salmonid spawning gravels. The frequency, magnitude and duration of turbidity is likely to be significantly elevated for at least the next the next few years until vegetation gets re-established and ground cover increases, and excess fines are winnowed out of the system. Risk of landslides that can cause bouts of acute turbidity will likely be increased for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots. Modeled surface erosion is near threshold (USLE = 0.93) and mass-wasting is way over threshold (GEO = 1.89) in the Walker Creek HUC14. **Not Properly Functioning**.

Chemical Contamination: No significant source of chemical contamination is known to exist on National Forerst lands within the Walker Creek watershed. **Properly Functioning**.

HABITAT ACCESS

Physical Barriers: A fish passage assessment and inventory in the Walker Creek watershed found no fish passage barriers. **Properly Functioning.**

HABITAT ELEMENTS

Substrate Character: During the 1997 New Years Flood there were 78 landslides and 51 major road failures, and approximately 81% of the channels in the Walker Creek HUC 7 were altered. There was massive aggradation in many reaches of Walker Creek as evidenced by almost complete lack of deep pools in the 1998 stream survey, and lenses of sediment up to eight feet deep. Some reaches were still aggraded just prior to the 2014 Happy Camp Complex fire, however, partial recovery from the 1997 Flood had occurred: *in the 1998 stream survey of mainstem Walker Creek the percent fines in pebble counts ranged from 19% to 21%, fines in pool tail-outs was 4%, and embeddedness averaged 18%. In the 2007 stream survey, average percent fines in pool tail-outs was low at 7% and average percent fines in pebble counts was low averaging 4%, however, percent embeddedness was high (average = 38%, range = 20% to 50%, mode = 45%, median = 40%) which suggests that there still may be excessive course sediment from the 1997 Flood filling up deep areas of the pre-flood channel.*

Post-2014 Fire water quality and sediment conditions in lower mainstem Walker Creek were observed and photographed in the winter after several light to moderate precipitation events: the observations and photographs revealed large quantities (excess) of fine sediment had been delivered to mainstem Grider Creek which had partially filled in pools and smothered the pre-Fire streambed and salmonid spawning gravels. The frequency, magnitude and duration of turbidity is likely to be significantly elevated for at least the next the next few years until vegetation gets re-established and ground cover increases, and excess fines are winnowed out of the system. Landslide risk will be

increased for a decade or more due to decreased evapotranspiration, decreased ground cover, increased groundwater, increased overland flow, and/or loss of soil cohesion provided by living tree roots. Modeled surface erosion is near threshold (USLE = 0.93) and mass-wasting is way over threshold (GEO = 1.89) in the Walker Creek HUC14. **Not Properly Functioning**.

Large Woody Debris: Down and standing stock of large wood in stream buffers is suspected to have been reduced by past timber harvest and salvage, road construction through RRs, and by virtue of the increased access roads provide to down and standing wood sources within stream buffers. Much LWD was eliminated from mainstem Walker Creek by debris flows during the 1997 Flood. In the 1998 stream survey, there were 14 pieces of wood at least 24 inches in diameter per mile, but many of these were less than 50 feet long. In the 1998 survey, there were only 23 pieces of wood at least 24 inches in diameter in the five miles plus reach of Walker Creek that was surveyed – which equals less than five pieces of LWD per mile. In the 2007 stream survey there was no LWD in the 0.60 mile section of mainstem that was surveyed. It appears that potential for future LWD production and recruitment was lost or setback due to widespread debris flows (many from stream crossing failures) that scoured the channel and streambanks of many Walker Creek tributaries during the 1997 Flood. Potential for LWD to be delivered to Walker Creek is diminished due to past wildfires, salvage, and stand-replacement timber harvest, and due to easy access to the stream buffer via numerous roads and via private property near the mouth.

Streamside trees killed in the 2014 Happy Camp Complex fire are expected to be recruited to the stream channel in high numbers over the next ten years or so. This is likely to bring in-channel LWD levels up to desired condition level within the next few years. However, the 2014 Fire intensifies the problem of having few large conifers left in stream buffer for future LWD recruitment after the 2014 Fire killed trees have mostly all fallen. **Not Properly Functioning**.

Pool Frequency/Quality: Many tributaries and most of mainstem of Walker Creek were scoured and/or aggraded as a result of debris flows triggered by the 1997 flood (see Disturbance History/Regime Indicator). This resulted in simplification of channel structure and filling in of pools. In the 1998 stream survey there was one pool every 8 bankfull widths defined as habitat unit showing distinct scour, or ponding, but there was a distinct lack of deep (greater than three feet depth) pools with only one "deep" pool in six stream miles surveyed. There was considerable recovery from 1998 to 2007. In the 2007 stream survey there were 30 pools in the 0.60 mile surveyed with an average depth of 2.3 feet, including six deep pools, however, primary pool frequency was still low with only one deep pool approximately every 18 bankfull widths. This indicates that much mainstem channel recovery from the flood had occurred.

The 2014 Happy Camp Complex fire greatly increased the rate of sediment delivery into Walker Creek stream. Pools have already partially filled with sediment and that trend is likely to increase over the next several years or longer due to increase rates of surface erosion and mass wasting on moderate to high severity burned ground. Pools are likely to decrease in frequency, depth, area, and volume over the next several years or longer. **At-Risk**.

Off-Channel Habitat: NA to most of the stream channels in the Walker Creek watershed which are Rosgen A-, B-, C-, F-, and G-channel types. Off-channel habitat is not characteristic of these channel types. There is one unconstrained reach along mainstem Walker Creek that is impacted by a main road crossing the valley floor at that point – and by trying to maintain this crossing in this unstable area. Maintaining this crossing impacts

movement of the stream channel across it's' floodplain, therefore, impacts the development of off-channel habitat. **At-Risk**.

Refugia: Cold water and cover are the primary elements of refugia that Walker Creek could potentially provide. Water temperature in Walker Creek is still slightly elevated from channel effects associated with the 1997 flood (channel widening and shallowing, loss of streamside vegetation). On a hot day when fish need to find cooler water - the water temperature in Walker Creek near the mouth may be cooler than the river but is still often sub-optimal. LWD cover is lacking. Overall cover complexity was medium in the 1998 survey and low in the 2007 stream survey. Water diversions and streambank alteration associated with private property and State Highway 96 within the lower 0.5 mile of stream degrades refugia qualities by diverting water, channelizing the stream, modifying the streambanks, and removing riparian vegetation. The 2014 Happy Camp Complex fire burned 35% of the stream buffer riparian vegetation in the Walker Creek watershed at moderate to high severity. This loss of riparian vegetation is expected to significantly increase rate of stream heating/cooling and summer high water temperature. **At-Risk.**

CHANNEL CONDITION AND DYNAMICS

Width to Depth Ratio: During the 1997 New Years Flood there were 78 landslides and 51 major road failures, and approximately 81% of the channels in the Walker Creek HUC 7 were altered including most of the mainstem. Many tributaries and long reaches of mainstem Walker Creek were "blown-out" by debris flows, scour, and aggradation triggered by the 1997 flood. The streambank was scoured and riparian vegetation was ripped out along many reaches of the tributaries. Stream channels are still re-adjusting and recovering. There was massive aggradation in many reaches of mainstem Walker Creek as evidenced by almost complete lack of deep pools in the 1998 stream survey, and lenses of sediment up to eight feet deep. Many mainstem reaches are still aggraded today. Debris flows in tributaries scoured the channel changing their cross-section profile from V-shaped to U-shaped. The altered channels and stream buffers of the Walker Creek watershed are in mid-stage of recovery from the 1997 Flood disturbance. Increased mass wasting and debris flows related to the 2014 Fire is expected to setback channel recovery. **Not Properly Functioning**.

Streambank Condition: Streambanks along much of the mainstem and many tributaries of Walker Creek were scoured or aggraded in 1997 flood, resulting in the loss of riparian vegetation and simplification of channel structure. Channel bank erosion occurred after the flood as flow routed around deposits of course sediment. Stream shading is recovering quickly but some reaches where trees and other vegetation were removed by debris flows or buried are still not recovered. Streambank scour from large debris flows in tributaries could take many more years to fully recover. The 2014 Happy Camp Complex fire burned 35% of the stream buffer riparian vegetation in the Walker Creek watershed at moderate to high severity. This loss of riparian vegetation is expected to significantly setback streambank recovery and likely lead to new impacts to the streambanks such as increased streamside landsliding. **Not Properly Functioning**.

Floodplain Connectivity: NA to most of the stream channels in the Walker Creek watershed which are Rosgen A-, B-, C-, F-, and G-channel types. Floodplain is not characteristic of these channel types. There is one unconstrained reach along mainstem Walker Creek that is impacted by a main road crossing the valley floor at that point – and by trying to maintain this crossing in this unstable area. Maintaining this crossing restricts movement of the stream channel and its' interaction with the floodplain. **At-Risk**.

FLOW/HYDROLOGY

Change in Peak/Base Flow: Road density is high at 3.8 miles of road per square mile of watershed, there are many miles of valley bottom and/or inner gorge road, and a high density of stream crossings. About 4% of the road system is hydrologically connected to the stream network. The 2014 Fire that burned large swaths of forested ground at moderate to high intensity is expected to significantly increase surface runoff and peak flows and slightly elevate base flows due to less evapotranspiration for up to ten years of longer. Modeled runoff risk is slightly over threshold (ERA/TOC = 1.03). Base flows in the lowest reach of mainstem Walker Creek are reduced by an unknown amount by several private water diversions. **Not Properly Functioning**.

Drainage Net Increase: There is low to moderate potential for drainage net increase due to roads because road density is high but only 4% of the road system is hydrologically connected to the stream network. Drainage network increase is expected to significantly increase due to increased overland flow over large swaths of previously forested ground that was burned at moderate to high intensity during the 2014 Fire. **At-Risk.**

Road Density/Location: Road density is high at 3.8 miles of road per square mile of watershed and there are many miles of valley bottom and/or inner gorge road. There is a high density of stream crossings. **Not Properly Functioning.**

Disturbance History/Regime: During the 1997 New Year Flood there were 78 landslides and 51 major (over $2500 to repair) road failures. Approximately 81% of the channels in the Walker Creek watershed were altered by debris flows. Debris flows originated from some natural mass wasting sources, however, road failures, primarily stream crossing failures, appear to have triggered many of the debris flows that made a significant contribution to altering stream channels and depositing excessive sediment in the mainstem. Many of the tributaries were scoured by natural and road failure related debris flows that changed the channel configuration of many Walker Creek tributaries from V-shaped to U-shaped channels. Extensive damage to the road system (and aquatic habitats) occurred because much of the upslope road system that failed was constructed on geologically unstable ground. Several of the most heavily flood damaged roads were decommissioned to reduce future watershed threat.

The 1999 Thom Seider Watershed Analysis determined that the Walker Creek watershed is “impaired”. *Impaired* watersheds are places where levels of natural and human-caused disturbances may have exceeded the ability of the area absorb and/or be resilient to additional disturbances. [note: the definition of “impaired’ in the Thom-Seider WA is no longer used by the Forest; water quality impairment is defined in the Klamath Basin Water Quality Plan (California State Water Board)].

Prior to the 2014 Fire it was determined that the fire regime and vegetative attributes in the Walker Creek watershed and surrounding landscape were moderately to significantly departed from historical range [Fire/Fuels Condition Class 2 and 3] due to fire suppression - which could result in moderate to dramatic changes to one or more of the following: fire size, intensity and severity and landscape patterns. All this did happen in the 2014 Happy Camp Complex fire. Therefore, the major stressor (cumulative with the road system) that is adversely affecting watershed processes now, and that will continue to affect watershed processes/conditions and set the stage for future disturbance regimes in the next decades or longer, was the 2014 Happy Camp Complex Fire that burned large swaths of forest at moderate and high intensity in upslope and riparian areas. The 2014 Fire burned 836 acres of stream buffer RRs at moderate to high intensity, which is 35% of the total stream buffer in the HUC14

watershed. This much moderate and high intensity fire in hydrologic RRs is expected to significantly decrease the nutrient spiraling and sediment buffering function of stream course RRs and will significantly compromise the potential of hydrologic RRs to buffer the stream from upslope ground disturbances and landslides, and will increase streamside landsliding. The 2014 Fire caused 25% or greater basal area mortality on 2,736 acres of unstable ground RR as follows: 7 acres of active landslide; 568 acres of inner gorge; and 2151 acres of highly dissected granitic. [note: most or all of the 568 acres of inner gorge are within hydrologic RR so these acres should not be double-counted]. This much moderate and high intensity fire on geologic RRs is expected to significantly increase the rate, risk, and cumulative watershed effects of landsliding.

Even before the 2014 Happy Camp Complex fire, modeled CWEs in the Walker Creek watershed were moderate to high due to high road density, with past wildfire and logging distant seconds: [USLE = 0.39; GEO = 0.88; ERA/TOC = 0.50]. The 2014 Happy Camp Complex fire increased modeled CWEs to near threshold for surface erosion (USLE = 0.93); way over threshold for mass wasting (GEO = 1.89); and just over threshold for runoff (ERA/TOC = 1.03). **Not Properly Functioning**.

Riparian Reserves: Streambanks along much of the mainstem and many tributaries of Walker Creek were scoured or aggraded during the 1997 flood resulting in the loss of riparian vegetation and simplification of channel structure including increased width-to-depth ratio and infilling of pools. Approximately 81% of the channels in the Walker Creek watershed were altered by debris flows. Lower gradient mainstem reaches were heavily aggraded with a lens of new sediment up to eight feet deep, and streambank erosion occurred as river stage increased over the elevated streambed. Debris flows in tributaries scoured the channel changing their cross-section profile from V-shaped to U-shaped. The altered channels and stream buffers of the Walker Creek watershed are in mid-stage of recovery from the 1997 Flood disturbance. Stream shading was largely recovered from the 1997 Flood debris flows before the 2014 Happy Camp Complex fire hit and burned extensive areas of stream buffer at moderate-to-high severity.

Stream buffers and watershed processes are impacted and at-risk from numerous valley bottom/inner gorge roads and high density of stream crossings. Roads constructed on geologically unstable ground and within stream buffers/inner gorge continue to elevate surface erosion, mass wasting, and peak flows. Easy road access to the riparian zone provided by valley bottom roads and numerous road-stream crossings impedes development of desired condition in stream buffers because of the roads' very existence and maintenance thereof, and because it provides easy access to LWD in the channel and to standing trees that would provide for future LWD recruitment.

The major stressor (cumulative with the road system) that is adversely affecting hydrologic RRs and geologic RRs was the 2014 Happy Camp Complex Fire that burned large areas within stream buffers and on unstable ground. The 2014 Fire burned 836 acres of stream buffer RRs at moderate to high intensity, which is 35% of the total stream buffer in the HUC14 watershed. This much moderate and high intensity fire in hydrologic RRs, coupled with a high-density road system, is expected to significantly: (1) decrease hydrologic retention, (2) decrease the sediment filtering and nutrient spiraling function of riparian vegetation compromising the potential of hydrologic RRs to buffer the stream from upslope ground disturbances and landslides, and (4) increase streamside landsliding. The 2014 Fire caused 25% or greater basal area mortality on 2,736 acres of unstable ground RR as follows: 7 acres of active landslide; 568 acres of inner gorge; and 2151 acres of highly dissected granitic. [note: most or all of the 568 acres of inner gorge are within hydrologic RR so these acres should not be double-counted]. This much

moderate and high intensity fire on geologic RRs is expected to significantly increase the risk, rate, and adverse cumulative effects of excess sediment delivery, transport, and deposition in stream channels. **Not Properly Functioning**.

Appendix E: Project Design Features and Best Management Practices

Project Design Features

Project Design Feature	Description	Applicable Alternatives and Units
Watershed - 1	The project is proposed to take place during the normal operating season (NOS) that is defined as May 1 to October 31. All ground disturbing activities, whether inside or outside of the NOS, will be implemented according to the Forest's Wet Weather Operation Standards (Klamath National Forest, 2002).	All units where applicable
Watershed - 2	Areas where soil has been disturbed by project activities within Riparian Reserves must be stabilized prior to the end of the normal operating season, prior to sunset if the National Weather Service forecast is a "chance" (30%) of rain within the next 24 hours, or at the conclusion of the operations, whichever is sooner. This includes skid trails that cross swales (i.e. linear depressions perpendicular to the slope contour that do not meet definition for designation as a Riparian Reserve). Restoration generally consists of removing excess sediment, reshaping and waterbarring former approaches, and spreading slash on the former crossing.	All units where applicable
Watershed - 3	Project Riparian Reserves are established in the following manner per the Forest Plan (site tree for Salmon and Happy Camp districts is 170 feet, site tree for Scott and Oak Knoll districts is 150 feet): For fish-bearing streams, it is the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream), whichever is greatest. For Salmon and Happy Camp ranger districts, this will be 340 feet (680 feet total). For permanently flowing non-fish-bearing streams, it is the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream), whichever is greatest. For Salmon and Happy Camp ranger districts, this will be 170 feet (340 feet total) and 150 feet for the Oak Knoll and Scott River Ranger District. For intermittent streams, the stream channel and extending to the top of the inner gorge, or extension from the edges of the stream channel to a distance equal to the height of one site potential tree, or 100 feet slope distance, whichever is greatest. For unstable lands, it is the extent of unstable and potentially unstable areas. Consistent with Forest Plan direction, riparian reserves for wetlands and springs will be defined by the edge of the feature out to a distance equal to 1 site potential tree. These riparian reservess will be flagged and avoided during salvage	All units where applicable

Project Design Feature	Description	Applicable Alternatives and Units
	harvest.	
Watershed - 4	Tractors and mechanical harvesters will be excluded from all riparian reserves associated with stream channels, active landslides, inner gorges, and toe zones of dormant landslide deposits. Hazard tree removal units are the exception. In Hazard tree units the equipment will be excluded from the inner 50 feet of the non-fish bearing riparian reserve, one site tree for fish bearing streams and in the perimeter of all active landslides and toe zones of dormant landslides. Equipment will be excluded from wetlands or wet meadows (excluding small springs and seeps). To limit slope disturbance, inner gorge terrain (> 65% slope) that extends beyond riparian reserves will be buffered by 20-foot slope distance and excluded from mechanical equipment activities. In areas where treatments may conflict, a hydrologist will be consulted.	All units where applicable
Watershed - 5	New temporary roads or landings will not be constructed in any riparian reserve associated with stream channels, on toe zones of landslides, active landslides or inner gorges. Exceptions for this project design feature for Alternative 2: Landings # DZ03, DZ10, DZ23, L043, L044, and L090.	All units where applicable
Watershed - 6	There will be no salvage logging on active landslides.	All units where applicable
Watershed - 7	Limit equipment disturbance within 20 feet on either side of swales by minimizing equipment crossings and avoiding running trails up the axis of swales, except at designated crossings.	All units where applicable
Watershed - 8	In salvage units and subsequent site preparation, skidding equipment will be restricted to slopes less than 35 percent. Skid trails that connect benches in dormant landslide terrain can have minor portions of the skid trails on slopes greater than 35 percent. In site preparation units (where no salvage will occur) felling and skidding equipment will be restricted to slopes less than 45% in non-granitic and non-schist soil types (see soils report for locations).	All salvage and site preparation units
Watershed - 9	Ground-based harvest equipment will be limited to 35% slopes, except when moving from one bench to another on dormant landslide terrain. In addition, ground-based equipment can travel up to 100 feet on slopes 35 to 45 percent.	All units where applicable
Watershed - 10	During site preparation, material greater than 8'' inches in diameter would not be removed unless needed to reduce 1,000 hour fuel loading to seven tons per acre, retain as close to seven tons per acre as possible.	All units where applicable
Watershed - 11	Site preparation treatments would be designed to meet soils management direction in the Forest Plan. This may include use of low ground pressure equipment, retaining slash and large woody material and implementing hand treatments instead of mechanical.	All units where applicable
Watershed - 12	All hazard trees cut within 25 feet of a stream channel will be left on site unless it continues to pose a threat to safety or accessibility (see watershed-4 for equipment exclusion	All units where applicable

Project Design Feature	Description	Applicable Alternatives and Units
	restrictions). Along fish-bearing stream reaches, all hazard trees greater than 26 inches in diameter at breast height within the first site tree (150-170 feet) will be left on site unless after felling, it continues to pose a threat to safety, infrastructure, forest road drainage system integrity or accessibility.	
Watershed - 13	Live trees directly rooted into the banks or otherwise integral to the stability of the channel bank will not be felled unless they pose an overhead hazard and, if felled, will be left on site unless this poses a hazard on the ground per Forest Service safety requirements.	All units where applicable
Watershed - 14	Directional felling will be used to protect streambanks where hazard trees need to be mitigated for public or employee safety.	All units where applicable
Watershed - 15	Improvements to existing system roads in the project area will avoid over-steepened road cuts where possible, minimize sidecasting, and maintain ditches, cross drains, and any outsloped road segments.	All units where applicable
Watershed - 16	Roads will be watered as appropriate to maintain road fines on site. Other materials may be used for dust abatement as approved by the Forest Service.	All units where applicable
Watershed - 17	Upgrades or improvements to stream crossings will be built to Forest Plan standards.	All units where applicable
Watershed - 18	Activities which require culvert replacement or removal will occur during the least critical periods for water and aquatic resources: when streams are dry or during low-water conditions; and in compliance with spawning and breeding season restrictions.	All units where applicable
Watershed - 19	Legacy sediment site treatments within or adjacent to streams will have erosion-prevention techniques applied such as silt fences, straw waddles, or mulch to minimize the risk of discharge.	All units where applicable
Watershed - 20	All project-related temporary structures, materials and project-related debris will not be stored for any length of time on active landslides and will be removed from riparian areas and stream channels prior to winter shutdown.	All units where applicable
Watershed - 21	For legacy sediment site repairs, fill materials generated will be reincorporated back into subgrade to the extent possible; all excess fill materials will be spoiled at a site reviewed and approved by Forest Service botanist, watershed, and heritage specialists.	All legacy site repair where applicable
Watershed - 22	Following harvest activities achieve at least 50 percent effective soil cover on new temporary roads and block them after the harvest season (prior to the first winter after use). New temporary roads will also be sub-soiled (or tilled) after use. All temporary roads (new, existing or re-opened decommissioned roads) will have the takeoffs from system road obliterated or blocked to avoid unauthorized use. All temporary roads will be hydrologically stabilized including removal of culverts and fills at stream crossings, out-sloping of road surfaces, and proper construction of water bars. Erosion and sedimentation control structures (water bars) will	New temp roads: 6, 7, 8, 10, 11, 12, 20, 27

Project Design Feature	Description	Applicable Alternatives and Units
	be maintained and repaired per the guidance in the Forest Service Handbook 2409.15 R5 Supplement.	
Watershed - 23	Existing landings will be used to the extent possible. Existing landings in stream-course riparian reserves will not be expanded towards stream channels, or on to active landslides, or where vegetation that provides shade to a stream would need to be cut. Existing landings in riparian reserves will be shaped and treated for erosion control at the end of each season of use, and hydrologically restored at project completion (including subsoiling and covering with slash/mulch as needed). Reused landings in riparian reserves will have site specific erosion control measures to reduce risk of sediment delivery into streams. During opening or construction of any landings, material will not be sidecast into intermittent or perennial stream channels. At project conclusion, landings will be configured for long-term drainage and stability by reestablishing natural runoff patterns. All landings will be covered with at least 50 percent effective soil cover. Use of certified weed free materials including straw, wood chips, or mulch may be used where on-site material is insufficient.	All units where applicable
Watershed - 24	Refueling will not take place within riparian reserves except at designated landings in locations where most disconnected from water resources. A spill containment kit will be in place where refueling and servicing take place.	All units where applicable
Watershed - 25	Skid trail erosion control work will be kept current during implementation. Erosion control and drainage of skid trails will be complete prior to shutting down operations due to wet weather or at project completion.	All units where applicable
Watershed - 26	Use existing skid trails instead of building new skid trails unless using existing skid trails will have greater negative effects. Space skid trails at least 75 feet apart, except near landings and where trails converge. Use no skid trails in areas in which ground-based mechanical equipment is excluded. Designation of new skid trails will be approved by a Timber Sale Administrator. Erosion and sedimentation control structure will be maintained and repaired per the guidance in the Forest Service Handbook 2409.15 R5 Supplement.	All units where applicable
Watershed - 27	No full bench skid trails will be constructed. Full bench skid trails have the entire skid trail cut into the hillslope.	All units where applicable
Watershed - 28	Locations where skid trails intersect roads will be obliterated or effectively blocked to vehicle access.	All units where applicable
Watershed - 29	Skyline corridors will be placed on the landscape as to minimize disturbance to active landslides, inner gorges and toe zones of dormant landslide deposits. All skyline and ground-based yarding will require one-end suspension in corridors and on skid trails. Corridors for skyline yarding that are parallel to the stream channel will be placed outside of the riparian reserve. The corridor may cross the stream channel with full suspension of logs within ten feet from the stream bank. Apply erosion control measures as necessary in cable corridors to control erosion and runoff. This could include hand construction of water bars and /or spreading slash from	All units where applicable

Project Design Feature	Description	Applicable Alternatives and Units
	adjacent areas.	
Watershed - 30	Where skidding occurs through units with less than 50 percent soil cover, mulch skid trails of greater than 15 percent slope, to achieve at least 50 percent effective soil cover on skid trails (approximately 40 acres across the project area may require this). Effective soil cover could include plant litter, woody material in contact with the soil, living vegetation, and rock fragments with a diameter of ½ to 3 inches. Use of certified weed free materials including straw, wood chips, or mulch may be used where on-site material is insufficient. Masticators will cover their tracks/traces with masticated slash upon exiting fuels treatment units/areas.	Based on soil burn severity data, these units are most likely to require this: 225, 264, 402, 525, 528, 540, 1109, 1129, 1136, 1140, 1142, 1151, and 1155.
Watershed - 31	Prescribed fire effects in riparian reserves will mimic a low intensity backing fire, except for handpiles where higher intensity may occur to consume pile material. Ignition of underburns will generally not occur in riparian reserves. Approval by the District Fish Biologist is needed for underburn riparian reserve ignitions.	All units where applicable
Watershed - 32	Handpiles and windrows in riparian reserves will be placed in a checkerboard pattern whenever possible (not piled directly above another). Handpiles will be less than six feet in diameter and will be more than 15 feet away from intermittent streams and 30 feet away from perennial streams.	All units where applicable
Watershed - 33	For underburning, hand-line construction in riparian vegetation shall be avoided and in general should be farther than 25 feet from stream channels. Handlines will be mitigated (waterbarred and covered with organic material) immediately following prescribed burning, when safe to do so.	All units where applicable
Watershed - 34	Draft water only at sites designated by the Forest Service. Decisions related to where water drafting occurs will be coordinated with a Forest Service fisheries biologist so that potential impacts to anadromous fish, and the thermal refugia they rely upon, are sufficiently minimized. Sites that are not likely to have rearing Coho salmon present will be prioritized for use, such as mainstem sites on the Klamath, Scott, and Salmon rivers. Priority will also be given to sites that involve drafting relatively warmer waters in mainstem rivers; drafting from tributaries and colder water sources, especially in their lower reaches, will be avoided particularly during late summer and early fall (when fish survival is dependent upon thermal refugia). Water storage facilities such as foldable tanks are encouraged and will be assessed for sites with moderate flows that simultaneously support rearing SONCC coho salmon, and may be subject to high drafting use (e. g., Walker Creek). Project-related water drafting will be monitored, and shifted away from streams if their baseflows will no longer sustain drafting-related water withdrawal consistent with PDFs. The following creeks will be avoided, due to their small size, small summer base flows, and consistent presence of rearing SONCC Coho salmon - Tom Martin Cr, O'Neil Cr, Little Horse Cr, and China Cr. <u>When drafting from waters designated as coho salmon Critical Habitat:</u> *NOAA Fisheries Water Drafting Specifications (2001) apply* 1. Intakes will be screened with 3/32" mesh for rounded or square openings, or 1/16" mesh for slotted openings. When in	All units where applicable

Project Design Feature	Description	Applicable Alternatives and Units
	habitat potentially occupied by steelhead trout, intakes will be screened with 1/8" mesh size. Wetted surface area of the screen or fish-exclusion device shall be proportional to the pump rate to ensure that water velocity at the screen surface does not exceed 0.33 feet/second. a. Use of a NOAA approved fish screen will ensure the above specifications are met. 2. Fish screen will be placed parallel to flow. 3. Pumping rate will not exceed 350 gallons-per-minute or 10% of the flow of the anadromous stream drafted from. 4. Pumping will be terminated when tank is full. Additional applicable specifications: • There will be no modification/improvement of drafting sites in Coho Critical Habitat. Water drafting by more than one truck shall not occur simultaneously. <u>When drafting from waters that are not Coho Salmon critical habitat, but do contain fish:</u> *Forest Service Best Management Practices (BMP) Handbook direction applies (BMP 2.5)* 1. For fish-bearing streams, the water drafting rate should not exceed 350 gallons per minute for streamflow greater than or equal to 4.0 cubic feet per second (cfs). 2. Below 4.0 cfs, drafting rates should not exceed 20 percent of surface flows. 3. Water drafting should cease when bypass surface flows drop below 1.5 cfs. 4. Intakes, for trucks and tanks, shall be placed parallel to the flow of water and screened, with opening size consistent with the protection of aquatic species of interest. 5.Fish-bearing streams that are temporarily dammed to create a drafting pool shall provide fish passage for all life stages of fish. <u>When drafting from non-fish-bearing waters:</u> *Forest Service BMP Handbook direction applies (BMP 2.5)* • Drafting rate should not exceed 350 gallons per minute for stream flow greater than or equal to 2.0 cubic feet/second. • Drafting rate should not exceed 50 percent of surface flow. • Drafting should cease when bypass surface flow drops below ten gallons per minute. • Drafting by more than one truck shall not occur simultaneously.	
Watershed – 35	Rock and gravel will be applied to drafting sites if it is needed to prevent stream sedimentation. Water drafting sites located in non-fish-bearing waters only may include minor instream modification, such as fine sediment removal and building of board/plastic dams. All boards and plastic will be removed after use. Water drafting sites located within fish-bearing stream segments may not be modified, except rocking the approach to prevent sedimentation.	All units where applicable

Best Management Practices

Best Management Practices (BMPs) were developed to comply with Section 208 of the Clean Water Act. BMPs have been certified by the State Water Quality Resources Control Board and approved by the Environmental Protection Agency (EPA) as the most effective way of protecting water quality from impacts stemming from non-point sources of pollution. These practices have been applied to forest activities and have been found to be effective in protecting water quality within the Klamath National Forest (Forest). Specifically, effective application of the Region 5 Forest Service BMPs has been found to maintain water quality that is in conformance with the Water Quality Objectives in the North Coast Regional Water Quality Control Board's Basin Plan (http://www.waterboards.ca.gov/northcoast/water_issues/programs/basin_plan/).

Region 5 Forest Service BMPs have been monitored and modified since their original implementation in 1979 to make them more effective. Numerous on-site evaluations by the North Coast Region Water Quality Control Board have found the practices to be effective in maintaining water quality and protecting beneficial uses.

The Forest monitors the implementation and effectiveness of BMPs on randomly selected projects each year. From 2000 to 2012, BMP implementation requirement were met on 78-100 percent (91 percent average) of sites sampled, and BMP effectiveness requirements were met on 88-100 percent (94 percent average) of the sites sampled (USDA Forest Service, 2013c). The critical BMP evaluation is *effectiveness* which is a field evaluation to determine how well the BMP worked to prevent sedimentation. The success rate for effectiveness has been in the high 80s and 90s each year since 1993.

Best Management Practices first identified and utilized by the Klamath National Forest are listed in appendix D of the Forest Plan. These basic BMPs have been revised over the years, and are currently similar to those listed in the 2012 Region 5 BMP update in Chapter 10 of the Soil and Water Conservation Handbook, which additionally includes a narrative and objective of each (USDA USFS 2011); and where there are differences, direction is to employ the newer BMP list. The following 'on-the-ground' prescriptions below are incorporated into the project (see chapter 2 of draft EIS).

BMP 1.1 – Timber Sale Planning Process:

Requires the Interdisciplinary Team (interdisciplinary team) to consider methods of reducing water quality impacts during the planning phase of a project. This is accomplished during the planning process of the Timber Sale project.

- An interdisciplinary team review was completed and project design features have been incorporated into the project design (See Chapter 2 of the DEIS).

BMP 1.2 – Timber Harvest Unit Design:

Requires the interdisciplinary team to consider methods of reducing water quality impacts due to changes in unit design. This is accomplished during the planning phase of a project. Examples of design changes are restricting timing of tree removal and utilizing less impacting yarding systems.

- An interdisciplinary team review was completed and project design features have been incorporated into the project design (See Chapter 2 of the DEIS).

BMP 1.3 – Use of Erosion Hazard Rating for Unit Design:

Identifies high or very high erosion hazard areas and adjust management activities to prevent downstream water quality impacts; and to increase soil cover for those areas that have a high risk of contributing sediment into streams. This is done during the planning and layout phase of the project.

- Based on field review and site data (percent slope distribution, soil texture), the Forest Soil Scientist determined the surface erosion hazard rating for each treatment unit and prescribed logging systems and soil cover needs based on the erosion hazard rating.

BMP 1.4 – Use of Sale Area Maps for Designating Water Quality Protection:

Identifies sensitive areas and water uses as part of the Timber Sale contract to assist operators in locating water concerns and applying protection methods. This is accomplished during contract preparation and implemented during layout of the sale.

- The Sale Area Map will include all protected stream-courses, unstable land features, springs, wetlands, meadows, water drafting sites, landings, temporary roads, and logging system for each unit.

BMP 1.5 – Limiting Operating Period of Timber Sale:

To prevent soil compaction and erosion from operations during wet weather; and to ensure placement of erosion control structures prior to the onset of winter to reduce water quality impacts. This is accomplished during the timber sale operations.

- The project is proposed to take place during the normal operating season (NOS) that is defined as May 1 to October 31. All ground disturbing activities, whether inside or outside of the NOS, will be implemented according to the Forest's Wet Weather Operation Standards (Klamath National Forest, 2002).
- Areas where soil has been disturbed by project activities within Riparian Reserves must be stabilized prior to the end of the normal operating season, prior to sunset if the National Weather Service forecast is a "chance" (30 percent) of rain within the next 24 hours, or at the conclusion of the operations, whichever is sooner. This includes skid trails that cross swales (i.e. linear depressions perpendicular to the slope contour that do not meet definition for designation as a Riparian Reserve). Restoration generally consists of removing excess sediment, reshaping and waterbarring former approaches, and spreading slash on the former crossing.

BMP 1.6 – Protection of Unstable Lands:

Provides for special treatment of unstable areas to avoid triggering mass slope failure with resultant erosion and sedimentation.

- Tractors and mechanical harvesters will be excluded from all Riparian Reserves associated with stream channels, active landslides, inner gorges, and toe zones of dormant landslide deposits. Hazard tree removal units are the exception. In Hazard tree units the equipment will be excluded from the inner 50 feet of the non-fish bearing Riparian Reserve, one site tree for fish bearing streams and in the perimeter of all active landslides and toe zones of dormant landslides.
- To limit slope disturbance, inner gorge terrain (greater than 65 percent slope) that extends beyond Riparian Reserves will be buffered by 20-foot slope distance and excluded from mechanical equipment activities. In areas where treatments may conflict, a hydrologist will be consulted.

- There will be no salvage logging on active landslides.
- Limit equipment disturbance within 20 feet on either side of swales by minimizing equipment crossings and avoiding running trails up the axis of swales, except at designated crossings.

BMP 1.8 – Streamside Management Zone Designation:

Designates zones adjacent to water and/or riparian areas as zones of special management. This is accomplished during the planning and layout phase of the project.

- Project Riparian Reserves are established in the following manner per the Forest Plan (site tree for Salmon and Happy Camp districts is 170 feet, site tree for Scott and Oak Knoll districts is 150 feet):
    - For fish-bearing streams, it is the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet total, including both sides of the stream), whichever is greatest. For Salmon and Happy Camp ranger districts, this will be 340 feet (680 feet total).
    - For permanently flowing nonfish-bearing streams, it is the area on each side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet total, including both sides of the stream), whichever is greatest. For Salmon and Happy Camp ranger districts, this will be 170 feet (340 feet total) and 150 feet for the Oak Knoll and Scott River Ranger District.
    - For intermittent streams, , the stream channel and extending to the top of the inner gorge, or extension from the edges of the stream channel to a distance equal to the height of one site potential tree, or 100 feet slope distance, whichever is greatest. For unstable lands, it is the extent of unstable and potentially unstable areas.
    - Consistent with Forest Plan direction, Riparian Reserves for wetlands and springs will be defined by the edge of the feature out to a distance equal to 1 site potential tree. These RRs will be flagged and avoided during salvage harvest.

BMP 1.9 – Determining Tractor Loggable Ground:

Minimize erosion and sedimentation resulting from ground disturbance of tractor logging systems.

- Ground-based harvest equipment will be limited to 35 percent slopes, except when moving from one bench to another on dormant landslide terrain. In addition, ground-based equipment can travel up to 100 feet on slopes 35 to 45 percent.
- Site preparation treatments would be designed to meet soils management direction in the KNF Forest Plan. This may include use of low ground pressure equipment, retaining slash and large woody material and implementing hand treatments instead of mechanical.

BMP 1.10 – Tractor Skidding Design:

Designates a tractor skid pattern over steepened areas, designates tractor crossings, and reduces skid patterns in sensitive areas to reduce erosion and compaction. This is accomplished during the sale layout and operations phase of the project.

- In salvage units and subsequent site preparation, skidding equipment will be restricted to slopes less than 35 percent. Skid trails that connect benches in dormant landslide terrain can have minor portions of the skid trails on slopes greater than 35 percent.
- In site preparation units (where no salvage will occur) felling and skidding equipment will be restricted to slopes less than 45 percent in non-granitic and non-schist soil types (see soils report for locations).
- Use existing skid trails instead of building new skid trails unless using existing skid trails will have greater negative effects. Space skid trails at least 75 feet apart, except near landings and where trails converge. Use no skid trails in areas in which ground-based mechanical equipment is excluded (Designation of new skid trails will be approved by a Timber Sale Administrator. Erosion and sedimentation control structure will be maintained and repaired per the guidance in the Forest Service Handbook 2409.15 R5 Supplement.
- No full bench skid trails will be constructed. Full bench skid trails have the entire skid trail cut into the hillslope.
- Locations where skid trails intersect roads will be obliterated or effectively blocked to vehicle access.

BMP 1.11 – Suspended Log Yarding in Timber Harvesting:

Protect the soil mantle from excessive disturbance; maintain the integrity of the Streamside Management Zone and other sensitive watershed areas, and to control erosion on cable corridors.

- Skyline corridors will be placed on the landscape as to minimize disturbance to active landslides, inner gorges and toe zones of dormant landslide deposits. All skyline and ground-based yarding will require one-end suspension in corridors and on skid trails. Corridors for skyline yarding that are parallel to the stream channel will be placed outside of the Riparian Reserve. The corridor may cross the stream channel with full suspension of logs within ten feet from the stream bank. Apply erosion control measures as necessary in cable corridors to control erosion and runoff. This could include hand construction of water bars and /or spreading slash from adjacent areas.

BMP 1.12 – Log Landing Location:

Locate new landings or reuse existing landings in such a way as to avoid watershed impacts and associated water quality degradation.

- See BMP 2.4
- Existing landings will be used to the extent possible. Existing landings in stream-course Riparian Reserves will not be expanded towards stream channels, or on to active landslides, or where vegetation that provides shade to a stream would need to be cut. Existing landings in Riparian Reserves will be shaped and treated for erosion control at the end of each season of use, and hydrologically restored at project completion (including subsoiling and covering with slash/mulch as needed). Reused landings in Riparian Reserves will have site specific erosion control measures to reduce risk of sediment delivery into streams.

- During opening or construction of any landings, material will not be sidecast into intermittent or perennial stream channels.
- At project conclusion, landings will be configured for long-term drainage and stability by reestablishing natural runoff patterns. All landings will be covered with at least 50 percent effective soil cover. Use of certified weed free materials including straw, wood chips, or mulch may be used where on-site material is insufficient.

BMP 1.13 – Erosion Prevention and Control Measures During Timber Sale Operations:

Ensures that Purchasers operations shall be conducted reasonably to minimize soil erosion. This is accomplished during the pre-operations meeting with the purchaser, and throughout the operations phase of the timber sale.

- Erosion control measures are discussed during the pre-operations meeting with the purchaser and the Forest Service. They are updated throughout the operations phase of the timber sale.
- The Klamath Wet Weather Operation Standards (USDA Forest Service 2002) will be used for all project activities (harvest, hauling, planting).

BMP 1.16 – Log Landing Erosion Prevention and Control:

Works to reduce erosion and subsequent impacts sedimentation from log landings. Timber Sale Contract provide for erosion prevention and control measures on all landings. This is best done by design of landing drainage measures during the planning phase of the project, and implemented during the operations phase.

- See BMP 1.12.

BMP 1.17 – Erosion Control on Skid Trails:

Employs preventive measures such as drainage structures to reduce water concentration and erosion. This is accomplished during the operations phase of the project. Because of the timing of this project, pre-staging of straw bales for timely construction of water bars will be called for.

- Where skidding occurs through units with less than 50 percent soil cover, mulch skid trails of greater than 15 percent slope, to achieve at least 50 percent effective soil cover on skid trails (approximately 40 acres across the project area may require this). Effective soil cover could include plant litter, woody material in contact with the soil, living vegetation, and rock fragments with a diameter of ½ to 3 inches. Use of certified weed free materials including straw, wood chips, or mulch may be used where on-site material is insufficient.

BMP 1.18- Meadow Protection during Timber Harvest:

The objective is to avoid damage to ground cover, soil and hydrologic function of meadows.

- Equipment will be excluded from wetlands or wet meadows (excluding small springs and seeps).

BMP 1.19 – Streamcourse Protection:

Protects the natural flow of streams and reduces the entry of sediment and any other pollutants into streams. The location of stream crossings must be agreed to by the Sale Administrator and the Hydrologist. The accomplishment of the objective of this measure is during the operations phase of the project.

- Tractors and mechanical harvesters will be excluded from all Riparian Reserves associated with stream channels, active landslides, inner gorges, and toe zones of dormant landslide deposits. Hazard tree removal units are the exception. In Hazard tree units the equipment will be excluded from the inner 50 feet of the non-fish bearing Riparian Reserve, one site tree for fish bearing streams and in the perimeter of all active landslides and toe zones of dormant landslides.
- To limit slope disturbance, inner gorge terrain (greater than 65 percent slope) that extends beyond Riparian Reserves will be buffered by 20-foot slope distance and excluded from mechanical equipment activities. In areas where treatments may conflict, a hydrologist will be consulted.
- All hazard trees cut within 25 feet of a stream channel will be left on site unless it continues to pose a threat to safety or accessibility (See watershed-4 for equipment exclusion restrictions). Along fish-bearing stream reaches, all hazard trees greater than 26 inches in diameter at breast height within the first site tree (150-170 feet) will be left on site unless after felling, it continues to pose a threat to safety, infrastructure, forest road drainage system integrity or accessibility.
- Live trees directly rooted into the banks or otherwise integral to the stability of the channel bank will not be felled unless they pose an overhead hazard and, if felled, will be left on site unless this poses a hazard on the ground per Forest Service safety requirements.
- Directional felling will be used to protect streambanks where hazard trees need to be mitigated for public or employee safety.

BMP 1.20 – Erosion Control Structure Maintenance:

Requires periodic inspection of erosion control structures to assess maintenance needs and effectiveness. This is accomplished during the operations and post-operations phase of the project; this ensures the adequacy of erosion control measures.

- Skid trail erosion control work will be kept current during implementation. Erosion control and drainage of skid trails will be complete prior to shutting down operations due to wet weather or at project completion.

BMP 1.21 – Acceptance of Erosion Control Measures Before Timber Sale Closure:

Erosion control measures are inspected for adequacy to ensure erosion control as planned. This is accomplished during the post-operations phase of the project during the contract final inspection.

- At project completion, permanent operating water bars will be installed and/or repaired as necessary on all skid trails, and slash scattered on all skid trails if necessary.
- The Timber Sale Administrator will inspect the Erosion Control Measures for compliance with contract.

BMP 2.4 – Road Maintenance and Operations (Temporary Roads):

The objective is to improve road slope stabilization by applying mechanical and vegetative measures. This is accomplished during the operations phase of the project.

- New temporary roads or landings will not be constructed in any Riparian Reserve associated with stream channels, on toe zones of landslides, active landslides or inner

gorges. Exceptions for this project design feature for Alternative 2: Landings # DZ03, DZ10, DZ23, L043, L044, and L090. Further exceptions may be approved if they meet the criteria described in the hydrology effects analysis.

- Following harvest activities achieve at least 50 percent effective soil cover on new temporary roads and block them after the harvest season (prior to the first winter after use). New temporary roads will also be sub-soiled (or tilled) after use.
- All temporary roads (new, existing or re-opened decommissioned roads) will have the takeoffs from system road obliterated or blocked to avoid unauthorized use. All temporary roads will be hydrologically stabilized including removal of culverts and fills at stream crossings, out-sloping of road surfaces, and proper construction of water bars. Erosion and sedimentation control structures (water bars) will be maintained and repaired per the guidance in the Forest Service Handbook 2409.15 R5 Supplement.

BMP 2.4 – Road Maintenance and Operations (System Roads)

- Improvements to existing system roads in the project area will avoid over-steepened road cuts where possible, minimize sidecasting, and maintain ditches, cross drains, and any outsloped road segments.
- Roads will be watered as appropriate to maintain road fines on site. Other materials may be used for dust abatement as approved by the Forest Service.
- Upgrades or improvements to stream crossings will be built to Forest Plan standards.
- Activities which require culvert replacement or removal will occur during the least critical periods for water and aquatic resources: when streams are dry or during low-water conditions; and in compliance with spawning and breeding season restrictions.
- Legacy sediment site treatments within or adjacent to streams will have erosion-prevention techniques applied such as silt fences, straw waddles, or mulch to minimize the risk of discharge.

All project-related temporary structures, materials and project-related debris will be removed from riparian areas and stream channels prior to winter shutdown.
For legacy sediment site repairs, fill materials generated will be reincorporated back into subgrade to the extent possible; all excess fill materials will be spoiled at a site reviewed and approved by Forest Service botanist, watershed, and heritage specialists.

BMP 2.5 - Water Source Development Consistent with Water Quality Protection:

The objective is to limit and mitigate the effects of water source development through the planning of impoundments and withdrawals.

Draft water only at sites designated by the Forest Service.

- When drafting from waters designated as coho salmon Critical Habitat: NOAA Fisheries Water Drafting Specifications (2001) apply
- Intakes will be screened with 3/32” mesh for rounded or square openings, or 1/16” mesh for slotted openings. When in habitat potentially occupied by steelhead trout, intakes will be screened with 1/8” mesh size. Wetted surface area of the screen or fish-exclusion device shall be proportional to the pump rate to ensure that water velocity at the screen surface does not exceed 0.33 feet/second.

  1. Use of a NOAA approved fish screen will ensure the above specifications are met.
  1. Fish screen will be placed parallel to flow.

2. Pumping rate will not exceed 350 gallons-per-minute or 10 percent of the flow of the anadromous stream drafted from.
3. Pumping will be terminated when tank is full.
4. Additional applicable specifications:
5. There will be no modification/improvement of drafting sites in Coho Critical Habitat.

- Water drafting by more than one truck shall not occur simultaneously.
- When drafting from waters that are not coho salmon Critical Habitat, but do contain fish:

  1. For fish-bearing streams, the water drafting rate should not exceed 350 gallons per minute for streamflow greater than or equal to 4.0 cubic feet per second (cfs).
  2. Below 4.0 cfs, drafting rates should not exceed 20 percent of surface flows.
  3. Water drafting should cease when bypass surface flows drop below 1.5 cfs.
  4. Intakes, for trucks and tanks, shall be placed parallel to the flow of water and screened, with opening size consistent with the protection of aquatic species of interest.
  5. Fish-bearing streams that are temporarily dammed to create a drafting pool shall provide fish passage for all life stages of fish.
  6. When drafting from non-fish-bearing waters:
  7. Drafting rate should not exceed 350 gallons per minute for stream flow greater than or equal to 2.0 cubic feet/second.
  8. Drafting rate should not exceed 50 percent of surface flow.
  9. Drafting should cease when bypass surface flow drops below ten gallons per minute.
  10. Drafting by more than one truck shall not occur simultaneously.

- Rock and gravel will be applied to drafting sites if it is needed to prevent stream sedimentation.
- Water drafting sites located in non-fish-bearing waters only may include minor instream modification, such as fine sediment removal and building of board/plastic dams. All boards and plastic will be removed after use.
- Water drafting sites located within fish-bearing stream segments may not be modified, except rocking the approach to prevent sedimentation.

BMP 2.11 - Servicing and Refueling of Equipment:

Prevent fuels, lubricants, cleaners, and other harmful materials from discharging into nearby surface waters or infiltrating through soils to contaminate groundwater resources.

- Refueling will not take place within Riparian Reserves except at designated landings in locations where most disconnected from water resources. A spill containment kit will be in place where refueling and servicing take place.

BMP 2.13 – Erosion Control Plan:

Effectively limit and mitigate erosion and sedimentation from any ground-disturbing activities, through planning prior to commencement of project activity, and through project management and administration during project implementation.

- An Erosion Control Plan will be completed prior to project implementation.

- The Forest's Wet Weather Operations Standards are included in the Erosion Control Plan.

BMP 5.2 – Slope Limitations for Mechanized Equipment Operations:

The objective is to reduce gully and sheet erosion and associated sediment production by limiting tractor use.

- See BMP 1.9 and 1.10.

BMP 5.5 – Disposal of Organic Debris:

The objective is to prevent gully and surface erosion with associated reduction if sediment production and turbidity during and after treatment.

- During site preparation, material greater than 8’’ inches in diameter would not be removed unless needed to reduce 1,000 hour fuel loading to 7 tons per acre, retain as close to 7 tons per acre as possible.

BMP 5.6 – Soil Moisture Limitations for Mechanical Equipment Operations:

The objective is to prevent soil compaction, rutting, and gulling that may result in increased sedimentation and turbidity.

- All ground based equipment will follow the Wet Weather Operation Standards.

BMP 6.3 Protection of Water Quality from Prescribed Burning Effects:

The objective is to maintain soil productivity; minimize erosion; minimize ash, sediment, nutrients, and debris from entering water bodies.

- Prescribed fire effects in Riparian Reserves will mimic a low intensity backing fire, except for handpiles where higher intensity may occur to consume pile material. Ignition of underburns will generally not occur in Riparian Reserves. Approval by the District Fish Biologist is needed for underburn Riparian Reserve ignitions.
- Handpiles and windrows in Riparian Reserves will be placed in a checkerboard pattern whenever possible (not piled directly above another). Handpiles will be less than 6 feet in diameter and will be more than 15 feet away from intermittent streams and 30 feet away from perennial streams.
- For underburning, hand-line construction in riparian vegetation shall be avoided and in general should be farther than 25 feet from stream channels. Handlines will be mitigated (waterbarred and covered with organic material) immediately following prescribed burning, when safe to do so.

References for Best Management Practices

USDA Forest Service. 2013c. Klamath National Forest Best Management Practices Evaluation Program: Water Quality Monitoring Report 2013. Klamath National Forest, Yreka, CA. Retrieved from http://www.fs.usda.gov/detail/klamath/landmanagement/resourcemanagement/?cid=stelprdb5312713 on June 6, 2014.

USDA Forest Service. 2011. Soil and Water Conservation Handbook. Chapter 10 – Water Quality Management Handbook.

USFS. 2002. Wet Weather Operating Standards. Klamath National Forest, Region 5. US Forest Service.

Appendix F: Life History and Biological Requirements

Coho Salmon

General life history information and biological requirements of Southern Oregon/Northern California Coastal (SONCC) Coho salmon have been described in various documents (Hassler 1987; Sandercock 1991; Weitkamp, *et al*. 1995) as well as NOAA-Fisheries' final rule listing SONCC Coho salmon (May 6, 1997; 62 FR 24588).

Coho salmon enter the mainstem of the Klamath River for spawning typically in their third year, primarily between September and December, with a peak in October (NFMS 2007). Over most of this interval, mainstem flows below Iron Gate Dam often are high (ca. 2500-3000 cfs: NMFS 2001). Thus, standard methods for observing and counting spawning fish are not easily applied, and the size of the spawning population is unknown. Approximations put the entire ESU at about 10,000 spawning Coho salmon of non-hatchery origin per year (Weitkamp, *et al*. 1995), of which only a small portion is associated with the Klamath Basin, where several important tributary runs have been reduced to a handful of individuals (NMFS 2001, 2007). Although a minor amount of spawning and growth may occur in the mainstem, the mainstem serves adults primarily as a migration route (NFMS 2007).

Spawning occurs from November to January (Hassler 1987) in the tributaries to the Klamath River, but occasionally as late as February or March (Weitkamp, *et al*. 1995). Coho salmon eggs incubate for 35-50 days between November and March. Successful incubation depends on several factors including dissolved oxygen levels, temperature, substrate size, amount of fine sediment, and water velocity. Fry start emerging from the gravel two to three weeks after hatching and move into shallow areas with vegetative or other cover. As fry grow larger, they disperse up or downstream. In summer, Coho salmon fry prefer pools or other slower velocity areas such as alcoves, with woody debris or overhanging vegetation. Juvenile Coho salmon over-winter in slow water habitat with cover as well. Juveniles may rear in fresh water for up to 15 months then migrate to the ocean as smolts from March to June (Weitkamp, *et al.* 1995). Coho salmon adults typically spend two years in the ocean before returning to their natal streams to spawn as three-year olds.

Available historical and most recent published Coho salmon abundance information are summarized in the NOAA-Fisheries coast-wide status review (Weitkamp, *et al*. 1995). The rivers and tributaries in the California portion of this ESU were estimated to have average recent runs of 7,080 natural spawners and 17,156 hatchery returns, with 4,480 identified as native fish occurring in tributaries having little history of supplementation with non-native fish. However, limited information exists regarding Coho salmon abundance in the Klamath River basin. What information exists [CDFW unpublished data; U.S. Fish and Wildlife Service (USFWS) unpublished data] suggests adult populations are small to nonexistent in most years. The decline of SONCC Coho salmon across the ESU is not the result of one single factor, but rather a number of natural and anthropogenic factors that include dam construction, instream flow alterations; land use activities coupled with large flood events, fish harvest and hatchery effects.

Garwood, J. 2012. Historic and recent occurrence of Coho salmon (*Oncorhynchus kisutch*) in California streams within the Southern Oregon/Northern California Evolutionarily Significant Unit. Fisheries Branch Administrative Report, 2012-03. California Department Fish and Wildlife, Arcata, CA. 77 p.

Salmon River Restoration Council (SRRC). 2005. Salmon River Coho salmon presence/absence and refugia use assessment summary. Unpub. data.

Chinook Salmon

The following information was excerpted or summarized from NMFS status review of Chinook salmon (Meyers, *et al.* 1998). Chinook salmon mature between 2 and 6+ years of age (Meyers, *et al.* 1998). Fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991). Incubation temperature for eggs is 5.0 to 14.4°C, with below 13.0°C preferred for optimal development in most stocks (McCullough 1999). Emerging fry generally do not develop normally above 12.8°C (McCullough 1999). Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. Once feeding, the optimal growth range for juveniles is 10.0 to 15.6°C, with fingerlings preferring to hold at 12 to 14°C (McCullough 1999). In preparation for their entry into a saline environment, juvenile salmon undergo physiological transformations known as smoltification that adapt them for their transition to salt water. For Chinook salmon, the recommended maximum temperature to maintain migratory response and seaward adaptation is 12.0°C; and at temperatures greater than 13.0°C, some physiological processes of smolting may be delayed, and, in extreme cases, reversed (McCullough 1999). Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Meyers, *et al*. 1998). Chinook salmon addressed in this document exhibit an ocean-type life history, and smolts out-migrate predominantly as subyearlings, generally during April through July. Chinook salmon spend between 2 and 5 years in the ocean (Healey 1991), before returning to freshwater to spawn. Some Chinook salmon return from the ocean to spawn one or more years before full-sized adults return.

The UKT ESU includes fall- and spring-run Chinook salmon in the Klamath and Trinity River Basin upstream of the confluence of the Klamath and Trinity rivers. Historically, spring-run Chinook salmon were probably the predominate run. This ESU still retains several distinct spring-run populations, albeit at much reduced abundance levels. Fish from this ESU exhibit an ocean-type life history; however genetically and physically, these fish are quite distinct from coastal and Central Valley Chinook salmon ESUs. Genetic analysis indicated that this ESU form a unique group that is quite distinctive compared to neighboring ESUs. The majority of spring- and fall-run fish emigrate to the marine environment primarily as subyearlings, but have a significant proportion of yearling smolts. Recoveries of coded wire tags indicate that both runs have a coastal distribution off the California and Oregon coasts. The 2011 fall-run Chinook salmon run into the Klamath River system, as compiled by CDFW, was estimated to be 188,845 fish (103,005 adult and 85,840 grilse) (CDFW 2012). This is 154% of the 1978-2011 mean run total of 122,510 fish. Of the 110,554 basin-wide natural spawners (i.e., not of hatchery origin), 5,493 were from the Salmon River and 5,515 from the Scott River. The Klamath River run in 2013 was projected to be above recent historical average (KRTT 2013).

North Fork Salmon River – Chinook Surveys

Chinook are present in the NF Salmon River, inclusive the Project area (~River Mile 4 to Mile 16).

Spawning surveys targeting Chinook have occurred on the NF Salmon River in the Project area since 1980, with fish and/or redds reported most years. Focus has primarily been on the fall-run, although some surveys have happened early enough (September through early-October) to captured spring-run Chinook. Also, spring Chinook are routinely reported during the annual spring Chinook/summer steelhead dive event (late-July or early-August) since 1990.

A 2005 survey of thermal refugia of the NF Salmon River found Chinook juveniles at the mouth of the following tributaries between Forks of Salmon and Jackass Gulch (downstream to upstream): Big Creek, Olsen Gulch, Jones Gulch, Cronan Gulch, Little North Fork Salmon River, Shiltos Creek, and Jackass Gulch (SRRC 2005).

*Location restricted to general Project area (River Mile 4 to Mile 16)
*Query performed on 2/3/2014

- See project record for expanded datasets referred in summary
- Chinook distribution maps include the NF Salmon River in the Project area

Live/Dead Fish Count

- CalFish records available (8): 91145, 91170, 91518, 91519, 91522, 91523, 91526, 91527
    - Inclusive years (all datasets): 1980-1985, 1988, 1989, 1990-2005
- Summary: Chinook recorded in all years, except 1983 and 1984 (no surveys)

Redd Count

- CalFish records available (1): 91073
    - Inclusive years (all datasets): 1971, 1972, 1978, 1980, 1981, 1983-1994
- Summary: Redds recorded all years

Unpublished data and/or field notes from: 1985-2013

Salmon River Restoration Council (SRRC). 2005. Salmon River Coho salmon presence/absence and refugia use assessment summary. Unpub. data.

Steelhead

Biologically, steelhead can be divided into two basic run-types, based on the state of sexual maturity at the time of river entry and duration of spawning migration (Moyle 2002). The stream-maturing type, or summer steelhead, enters fresh water in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type, or winter steelhead, enters fresh water with well-developed gonads and spawns shortly after river entry (August 9, 1996, 61 FR 41542; Barnhart 1986). South of Cape Blanco, Oregon, summer steelhead are known to occur in the Rogue, Smith, Klamath, Trinity, Mad, and Eel rivers, and in Redwood Creek (Busby, *et al.* 1996).

Winter steelhead in California enter fresh water after rivers rise in response to fall/winter rains, typically from December through March, with a peak in January and February, with spawning soon after reaching the breeding grounds (Moyle 2002). In contrast, summer steelhead enter systems as flows taper off in the spring, then spawn the following winter (Moyle 2002). Steelhead require a minimum depth of 0.18 m and a maximum velocity of 2.44 m/s for active upstream migration (Smith 1973). Spawning and initial rearing of juvenile steelhead generally take place in small, moderate-gradient (generally 3-5%) tributary streams (Nickelson, *et al*. 1992). A minimum depth of 0.18 m, water velocity of 0.30-0.91 m/s, and clean substrate 0.6-10.2 cm (Nickelson, *et al*. 1992) are required for spawning. Steelhead spawn in 3.9-9.4°C water (Bell 1991). Depending on water temperature, steelhead eggs may incubate for 1.5 to 4 months (August 9, 1996, 61 FR 41542) before hatching, generally between February and June (Bell 1991). After two to three weeks, in late spring, and following yolk sac absorption, alevins emerge from the gravel and begin actively feeding. After emerging from the gravel, fry usually inhabit shallow water along banks of perennial streams. Fry occupy stream margins (Nickelson, *et al*. 1992). Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson, *et al*. 1992). Steelhead prefer water temperatures ranging from 12-15°C (Reeves *et al*. 1987). Juveniles live in freshwater from one to four years (usually two years in the California ESUs), then smolt and migrate to the ocean in March and April (Barnhart 1986). Winter steelhead populations generally smolt after two years in fresh water (Busby, *et al*. 1996).

The KMP steelhead ESU occurs in coastal river basins between the Elk River in Oregon and the Klamath River in California, inclusive. The KMP steelhead ESU contains populations of both winter and summer steelhead. The Rogue and Klamath River basins are distinctive in that they are two of the few basins producing “half-pounder” steelhead. In 2001, NOAA-Fisheries reconsidered the status of KMP steelhead under the ESA (66 FR 17845, April 4, 2001) and determined that KMP steelhead do not warrant listing as threatened or endangered at this time.

In California, the largest proportions of naturally spawning hatchery fish are believed to occur in the Trinity River, where estimates from 1990s range from 20-70 percent hatchery. These estimates apply to fall-run fish. Because the hatchery program in the Trinity River basin propagates mostly fall-run fish, natural spawners in this basin that return at other times are believed to be predominantly of natural origin. Counts at Willow Creek weir provide an estimate

of about 2000 natural origin fall-run spawners per year. The Willow Creek weir samples steelhead only over a period of about 3 months during the fall run and thus provides no information about other runs in the basin. CDFW biologists estimated natural escapement in the California portion of the ESU to be approximately 30,000-50,000 adults per year.

CH for Coho Salmon (and) EFH for Coho/Chinook Salmon

Designated CH (CH) for Coho salmon encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive (May 5, 1999, 64 FR 24049). The area described in the final rule represented the current freshwater and estuarine range of Coho salmon. Land ownership patterns within the Coho salmon ESU analyzed in this document and spanning southern Oregon and northern California are 53% private lands; 36% Federal lands; 10% State and local lands; and 1% Tribal lands. The Forest Service manages about 1,680,000 acres (90.6%) of land within the Forest boundaries and about 200,000 acres (9.4%) of land are within the Forest boundaries but in other ownership (LRMP, Page 3-12). EFH (EFH) is considered for both Coho and Chinook salmon, with consultation occurring under 305 (b) (4) (A) of the Magnuson-Stevens Fishery Conservation and Management Act. The definition of Coho/Chinook EFH components and extent is described by Amendment 14 (Appendix A, pages 12-35 [adopted year 2000]) of the 1978 Pacific Fisheries Management Council Salmon Fisheries Management Plan.

Conclusions regarding CH and EFH occurrence are based on field review of habitat suitability, professional judgment, District fish survey records, and California Department of Fish and Wildlife (CDFW) information. In general, the KNF Coho Presence (GIS) layer defines CH, and Coho or Chinook distribution (whichever is of maximal extent) defines EFH. As appropriate, the California state information in Calfish.org may also be utilized. Where information on Coho or Chinook is lacking (e.g., no/few surveys have been completed), else it is the professional judgment of the Fish Biologist that neither KNF nor Calfish.org range maps fully capture CH/EFH extent, the KNF Steelhead Trout Distribution (GIS) layer may be used as a proxy for maximum range of anadromous fishes. This dataset is recognized as a conservative approach for assessment of effects to anadromous fish habitat because Coho and Chinook salmon may not occupy the same waters as steelhead due to differences in jumping abilities. The maximum jumping height (under ideal conditions) for Coho is 2.2 meters; Chinook salmon is 2.4 meters; and steelhead is 3.4 meters (Meehan 1991). Therefore, steelhead trout can access more habitat than Coho or Chinook salmon (i.e., steelhead trout can make a 3-meter jump to migrate up a stream, but Coho and Chinook salmon cannot.). Additionally, differences in spawn timing may also affect actual distribution. As an example, steelhead spawn in the spring, encountering higher discharge conditions than Chinook, which spawn in the fall. In consequence, Chinook may be denied access to streams, or segments thereof, due to the presence of low-water barriers that are passible to steelhead during spring flows.

In all cases, field review and site-specific surveys may refine the location of CH or EFH.

Map A-X shows the distribution of CH and EFH the Action Area and Analysis Area. This map is based on fish distribution with site-specific changes made per professional fisheries biologist

knowledge, stream surveys, or CDFW data. Although Field review, survey history, and CalFish.org generally agree concerning known Coho and Chinook presence in the Project area, lack of survey data means the existing range maps may not fully capture actual extent within the NF Salmon River tributaries.

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Appendix G: Summary of Project Element Effects to Coho Salmon, and Critical Habitat, by 2014 Fire Area

Beaver Fire

Beaver-Project element	Direct Effects to Coho Salmon	Indirect and Cumulative Effects to Coho Salmon and Critical Habitat			
		Sediment	**Water Quality**	**Riparian Function**	**Beneficial Effects**
Salvage and Reforestation 350 acres salvage; 1,782 acres site prep and plant	No effect	Minor effects due to small acreage treated; effects would add to elevated sediment conditions in Beaver, Doggett, and Kohl creeks which are heavily disturbed due to 2014 fires and private timber harvest (green and salvage)	Minor effects due to small acreage treated; insignificant effects due to project design	No effect because none is proposed in RR	Reduction of heavy fuels and planting will allow for quicker recovery of late seral vegetation on acres treated and the likely severity of future fires impacts are reduced, especially when fires occur greater than 5 years into the future
Fuels Reduction	No effect	Minor and insignificant due to low level of ground disturbance involved and project design	Minor and insignificant effects due to project design	Minor and insignificant due to project design	Reducing accumulations of dead and live fuels will mimic and promote the natural role of fire in the ecosystem
Hazard Tree Removal	No effect	Minor and insignificant effects due to project design	Minor and insignificant effects due to project design	Approximately 7 miles along CH would be affected; Minor and insignificant effects due to project design	None
Roads, Landings, and Water Drafting	Roads and Landings: no effect Water Drafting: minor short term effects related to disturbance; project design feature that	Roads: no temporary road stream crossings, only 1.2 miles of road on existing roadbed outside of RR Landings: no new landings in RR Water Drafting: insignificant effects due to project design			None

Beaver-Project element	Direct Effects to Coho Salmon	Indirect and Cumulative Effects to Coho Salmon and Critical Habitat			
		Sediment	**Water Quality**	**Riparian Function**	**Beneficial Effects**
	requires coordination with KNF fisheries biologists when determining where water drafting will occur is critical to avoiding adverse effects to salmonids relying upon thermal refugia during base flows				
Legacy Sediment Sites	No effect (none treated)				

Happy Camp Fire

Happy Camp-Project element	Direct Effects to Coho Salmon	Indirect and Cumulative Effects to Coho Salmon and Critical Habitat			
		Sediment	**Water Quality**	**Riparian Function**	**Beneficial Effects**
Salvage and Reforestation 8,728 acres salvage; 5,437 acres site prep and plant	No effect	Minor and insignificant effects due to project design	Minor and insignificant effects due to project design	No effect because none is proposed in RR	Lop and scatter hand treatments in RR would benefit 1,100 acres; Reduction of heavy fuels and planting will allow for quicker recovery of late seral vegetation on acres treated and the likely severity of future fires impacts are reduced, especially when fires occur greater than 5 years into the future
Fuels Reduction	No effect	Minor and insignificant effects due to low level of ground disturbance involved and project	Minor and insignificant effects due to project design	Minor and insignificant effects due to project design	Reducing accumulations of dead and live fuels will mimic and promote the natural role of fire in the ecosystem

Happy Camp-Project element	Direct Effects to Coho Salmon	Indirect and Cumulative Effects to Coho Salmon and Critical Habitat			
		Sediment	**Water Quality**	**Riparian Function**	**Beneficial Effects**
		design			
Hazard Tree Removal	No effect	Minor and insignificant effects due to project design	Minor and insignificant effects due to project design	Approximately 13 miles along CH would be affected; Minor and insignificant effects due to project design	None
Roads, Landings, and Water Drafting	Roads and Landings: no effect Water Drafting: minor short term effects related to disturbance; project design feature that requires coordination with KNF fisheries biologists when determining where water drafting will occur is critical to avoiding adverse effects to salmonids relying upon thermal refugia during base flows	Roads: temporary road crossings would result in short term site level effects nine sites in tributaries above fish bearing habitat in Grider Creek, Cliff Valley Creek, and China Creek; effects to Critical Habitat would be insignificant; Landings: see riparian function; Water Drafting: insignificant effects due to project design	Minor and insignificant effects due to project design	Minor and insignificant effects due to project design; Landings: six new landings in RR were approved for use because potential risks to nearby aquatic habitat were minimized during project design so that meaningful effects to aquatic habitat are not likely; effects to Critical Habitat would be insignificant	None
Legacy Sediment Sites	No effect due to project design	All together these actions will result in meaningful beneficial effects in terms of aquatic organism passage (outside of Critical Habitat), habitat connectivity at crossings, and significant reduction in potential future sediment-related impacts from roads in Doolittle, Cougar, East Fork Elk, and mainstem Elk creeks. Approximately 17 miles of stream habitat, most within Critical Habitat, would benefit from these actions. The passage of aquatic organisms and watershed products			

Happy Camp-Project element	Direct Effects to Coho Salmon	Indirect and Cumulative Effects to Coho Salmon and Critical Habitat			
		Sediment	**Water Quality**	**Riparian Function**	**Beneficial Effects**
		down to Critical Habitat, would be improved in Malone, Twin, and Upper Elk creeks. Site level beneficial effects would also result from project use, and treatment of legacy sediment sites, on several temporary roads (46N41YA in lower Grider Creek, and temporary roads on existing roadbeds near the bottom of Kuntz and O'Neil creeks). These long term beneficial effects would occur on approximately 1.5 miles of stream habitat, above Critical Habitat, in Grider, Kuntz, and O'Neil creeks.			

Whites Fire

Whites-Project element	Direct Effects to Coho Salmon	Indirect and Cumulative Effects to Coho Salmon and Critical Habitat			
		Sediment	**Water Quality**	**Riparian Function**	**Beneficial Effects**
Salvage and Reforestation 741 acres salvage; 654 acres site prep and plant	No effect	Minor and insignificant effects due to project design	Minor and insignificant effects due to project design	No effect because none is proposed in RR	Lop and scatter hand treatments in RR would benefit about 127 acres; Reduction of heavy fuels and planting will allow for quicker recovery of late seral vegetation on acres treated and the likely severity of future fires impacts are reduced, especially when fires occur greater than 5 years into the future
Fuels Reduction	No effect	Minor and insignificant effects due to low level of ground disturbance involved and project design	Minor and insignificant effects due to project design	Minor and insignificant effects due to project design	Reducing accumulations of dead and live fuels will mimic and promote the natural role of fire in the ecosystem
Hazard Tree Removal	No effect	Minor and insignificant effects due to project design	Minor and insignificant effects due to project design	Approximately 8 miles along CH would be affected; Minor and insignificant effects due to project design	None

Whites-Project element	Direct Effects to Coho Salmon	Indirect and Cumulative Effects to Coho Salmon and Critical Habitat			
		Sediment	**Water Quality**	**Riparian Function**	**Beneficial Effects**
Roads, Landings, and Water Drafting	Roads and Landings: no effect Water Drafting: minor short term effects related to disturbance; project design feature that requires coordination with KNF fisheries biologists when determining where water drafting will occur is critical to avoiding adverse effects to salmonids relying upon thermal refugia during base flows	Roads: no temporary road stream crossings Landings: one new landing in RR was approved for use because potential risks to nearby aquatic habitat were minimized during project design so that meaningful effects to aquatic habitat are not likely; effects to Critical Habitat would be insignificant Water drafting: Minor and insignificant effects due to project design			None
Legacy Sediment Sites	No effect (none treated)				