Scott River and Shasta River Study Reaches

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The purpose of this document is to establish stream reaches in the Scott River and Shasta River basins based on the best current information. Reaches are segments of stream with geographically similar flow and channel structure (Bovee et al. 1998). Stream reach breaks are based on physical (i.e. gradient, channel type, substrate) and natural hydrological (i.e. stream flow, accretion) characteristics. Previous studies have divided both basins into reaches (e.g. CDFG 2009, McBain & Trush 2009 and 2012, and SVRCD and McBain & Trush 2013). Those reports were reviewed as part of this process and many of the reach breaks are at the same or similar locations established in the previous studies.

METHODS

Initial reach breaks were established at locations of natural accretion, such as tributary and spring inflows. Streamflow and accretion in both basins may be influenced in the summer and fall due to the existence of both surface water diversion and groundwater extraction. Because these water sources are interconnected there can be localized affects during the irrigation season with one section of a reach having flowing water while another is dry.

Additional reach breaks were established based on gradient changes. Aquatic microhabitat variables are heavily influenced by gradient. Both the Scott and Shasta exhibit similar gradient patterns with steeper gradient upstream of the mouth, a low gradient middle valley, and steeper gradient headwaters. In both basins, most of the tributaries flow through the low gradient middle valley prior to entering the main channels creating three gradient reaches: low, transition, and steep.

Channel morphology and substrate were also considered for additional reaches and/or adjustment of breaks established based on gradient. Both variables are influenced by the streamflow and gradient resulting in similar reach breaks. For example sinuosity is associated with the low gradient reaches and gravel is present at the gradient transition zones.

Consideration was also given to impassable barriers (e.g. Dwinnell Dam), access locations such as bridges, and reach breaks from previous studies and on-going monitoring for establishment or adjustment of reach break locations.

SCOTT RIVER

GENERAL WATERSHED INFORMATION

The Scott River basin can be divided into six eco-regions based on climate (primarily rainfall), channel geomorphology, topography and hydrology (NCRWB 2005, SRWC 2006, Harter and Hines 2008):

- **Canyon** – from mouth to Meamber Creek (or USGS gage) on the mainstem and includes all tributaries to this section.
- **Valley** – mainstem Scott River from Shackleford Creek to South Fork/East Fork confluence. Includes the lower section of major tributaries (Shackleford/Mill, Kidder/Patterson, Moffett, Etna and French) and eastern gulches (McConaughy, Hartstrand, Shell and Hamlin).
- **Westside Tributaries** – Shackleford/Mill, Kidder/Patterson, Etna, French, Sugar, Wildcat.
- **Eastside Tributaries** – Moffett, McAdams and Indian. Also includes a number of ephemeral streams.
- **West Headwater** – South Fork Scott.
- **East Headwater** – East Fork Scott.

The mainstem contains two dissimilar sections; a relatively steep gradient bedrock-dominated canyon segment and a low gradient alluvium-dominated valley segment. Westside tributaries and headwaters experience high annual precipitation with snowmelt contributing to late spring and early summer flows. In contrast, Eastside tributaries receive less precipitation and are generally dry in late summer. Westside streams originate in the granitic-dominated Salmon and Marble Mountains while Eastside streams are largely dominated by sedimentary and metamorphic bedrock.

Chinook spawning typically occurs in the mainstem, though they may also utilize the lower portions of tributaries if conditions are suitable. Most Chinook juveniles migrate out of the system as age 0+ prior to June. A limited number of Chinook rear in the system to age 1+ and outmigration occurs by mid-April (Daniels et al. 2011).

Coho primarily utilize Westside tributaries and the South Fork and East Fork for spawning, though some mainstem spawning occurs. Coho salmon in the Scott River appear to have one strong brood year lineage (CDFG-EIR 2009) with a three year cycle (2001, 2004, 2007 and most recently 2010). This would suggest that instream conditions that exist in 2013/2014 may have a significant effect on future runs. Most Coho outmigrate as 1+, though a significant number of 0+

fish are also known to leave the system in late spring (Chesney et al. 2007). Steelhead spawn and rear in the same areas as coho but also utilize Eastside streams (e.g. Moffett Creek). The majority of outmigrants are 1+ and 2+ smolts.

SCOTT RIVER MAINSTEM REACHES

The mainstem Scott River is broken into reaches based primarily on changes in substrate (Sommarstrom 1990, Cramer Fish Sciences 2010), channel morphology and hydrology: Generally reach breaks are specified where tributary inflow occurs that can alter the flow regime or produce channel changes (e.g. channel may widen downstream of large tributary)or other physical features such as changes in gradient. The mainstem Scott has some unique characteristics, both physical and hydraulic. In addition, there are localized sampling points that have been used over the years for sediment, water quality, fisheries and groundwater studies (Sommarstrom et al. 1990, Quigley et al. 2001, Maurer 2002, NCRWB 2011 and S.S. Papadopulos & Associates 2012). These points, generally bridges that allow access to the river, are included as sub reaches between Moffett Creek and Etna Creek and upstream of Etna Creek. Reaches are identified in Table 1 and Figures 1 and 2.

- **Mouth to Shackleford Creek (or USGS gage)**. Confined channel composed of primarily bedrock. Includes all tributaries to this reach.
- **Shackleford Creek to Oro Fino Creek**. Unconfined low gradient channel composed primarily of sand.
- **Oro Fino Creek to Moffett Creek**. Unconfined low gradient channel composed primarily of sand.
- **Moffett Creek to Etna Creek**. Unconfined low gradient channel, substrate primarily sand and gravel.
- Sub Reaches:
    - 4a. Moffett Creek to Island Bridge
    - 4b. Island Bridge to Eller Lane Bridge
    - 4c. Eller lane Bridge to Etna Creek
- **Etna Creek to French Creek**. Unconfined low gradient channel, substrate primarily gravel and sand. Major diversion (SVID) mid-reach at RM 46.
- Sub Reach:
    - 5a. Etna Creek to Horn Lane Bridge

  - 5b. Horn Lane Bridge to French Creek

- **French Creek to Lower Mine Tailings.** Unconfined low gradient channel, substrate primarily gravel and cobble.

- Sub Reach:

  - 6a. French Creek to Fay Lane

  - 6b. Fay Lane to Lower Mine Tailings

- **Lower Mine Tailings to South Fork/East Fork confluence**. Moderately confined low gradient channel, substrate primarily cobble and gravel. Major diversion (Farmers Ditch) just upstream of Sugar Creek confluence at RM 53.

SCOTT RIVER TRIBUTARY REACHES

Tributaries were broken into reaches based on the same hydrological and physical characteristics as the main channel. Reaches are presented in Table 2 and Figures 2 and 3.

- **Westside Tributaries** – The lower portions of Shackleford/Mill, Kidder/Patterson and Etna Creek consist of low gradient channels that course through the valley. Substrate is dominated by sand and gravel. The lower reaches of these creeks are often dry in late summer and early fall as flow goes sub-surface. These lower reaches are used by coho for spawning but have little rearing potential. The lower portion of French Creek can also become disconnected during dry years. The upper portions of all Westside tributaries are dominated by confined steep gradient channels.

  Shackleford/Mill Creek, Etna Creek and French Creek are divided into lower and upper reaches which separate the valley sections from the upper watersheds. The reach break for upper Shackleford Creek occurs at a barrier falls. Flows in the lower sections of Shackleford and Mill creeks may become subsurface in late summer.

  Kidder and Patterson Creeks join in the Scott River valley. This section is designated as the lower reach and the channel is slough-like with sand substrate. Kidder and Patterson are divided into lower and upper reaches similar to other Westside streams (designated as middle and upper in table). The lower portion of Patterson Creek is often referred to as Big Slough and the reference is sometimes used for the section of Kidder Creek between Patterson and the confluence with the Scott. No known spawning occurs in these lower reaches.

  The upper reaches of all these streams are known coho and steelhead spawning areas. Sugar Creek is used by coho and steelhead for spawning and rearing in the middle and upper portions of the watershed. Coho and steelhead spawning also occurs in the lower portion of Wildcat Creek. No separate reaches were designated for these two streams.

- **Eastside Tributaries** – The major eastside tributary is Moffett Creek. Moffett is divided into lower, middle and upper reaches. The lower reach is similar to Westside streams in that the channel is alluvial, composed of primarily sand and gravel and flow can go sub-surface in late summer and early fall. The middle and upper reaches are separated primarily based on hydrology and overall stream length. There is little information on lower and upper Moffett due to lack of access. Steelhead are known to spawn in middle Moffett and are assumed to use the other reaches. McAdam and Indian Creeks could be considered separate reaches but are not divided out here. The Eastside also includes a number of ephemeral gulches that feed the mainstem Scott.

  The potential exists for spawning in the Moffett Creek drainage (NMFS 2012) and there have been sporadic reports of adult coho in the lower sections of Moffett and McAdams Creek. Three redds identified in 2002 in middle Moffett may have been produced by coho, but also could have been the result of steelhead spawning (Maurer 2002).

- **West Headwaters** – Consist of the South Fork Scott River. No reach breaks were defined for the South Fork. Coho and steelhead use the South Fork for spawning and rearing.

- **East Headwater** – The East Fork Scott is divided into a lower and upper reach based on channel type and hydrology. Beginning at the mouth, the East Fork travels through a relatively confined channel up to Grouse Creek. This lower section also includes Noyes Valley Creek which is moderately confined and could be considered a separate reach. However, there is little information on this creek concerning fish use. The upper portion of the East Fork flows through a moderately confined valley. Tributaries to the upper East Fork are steep gradient with the lower sections used by coho and steelhead.

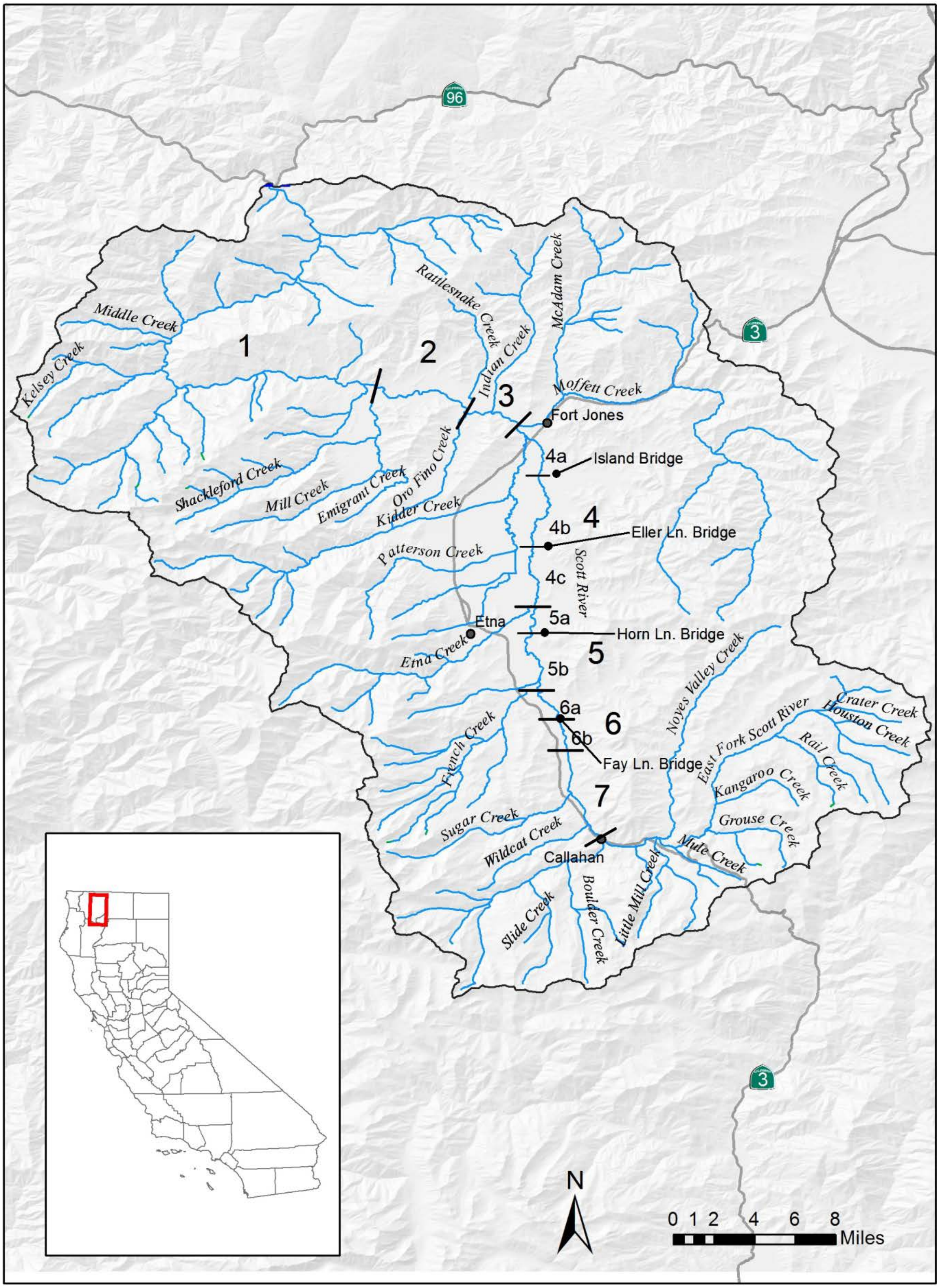


Figure 1. Scott River Mainstem Reaches.

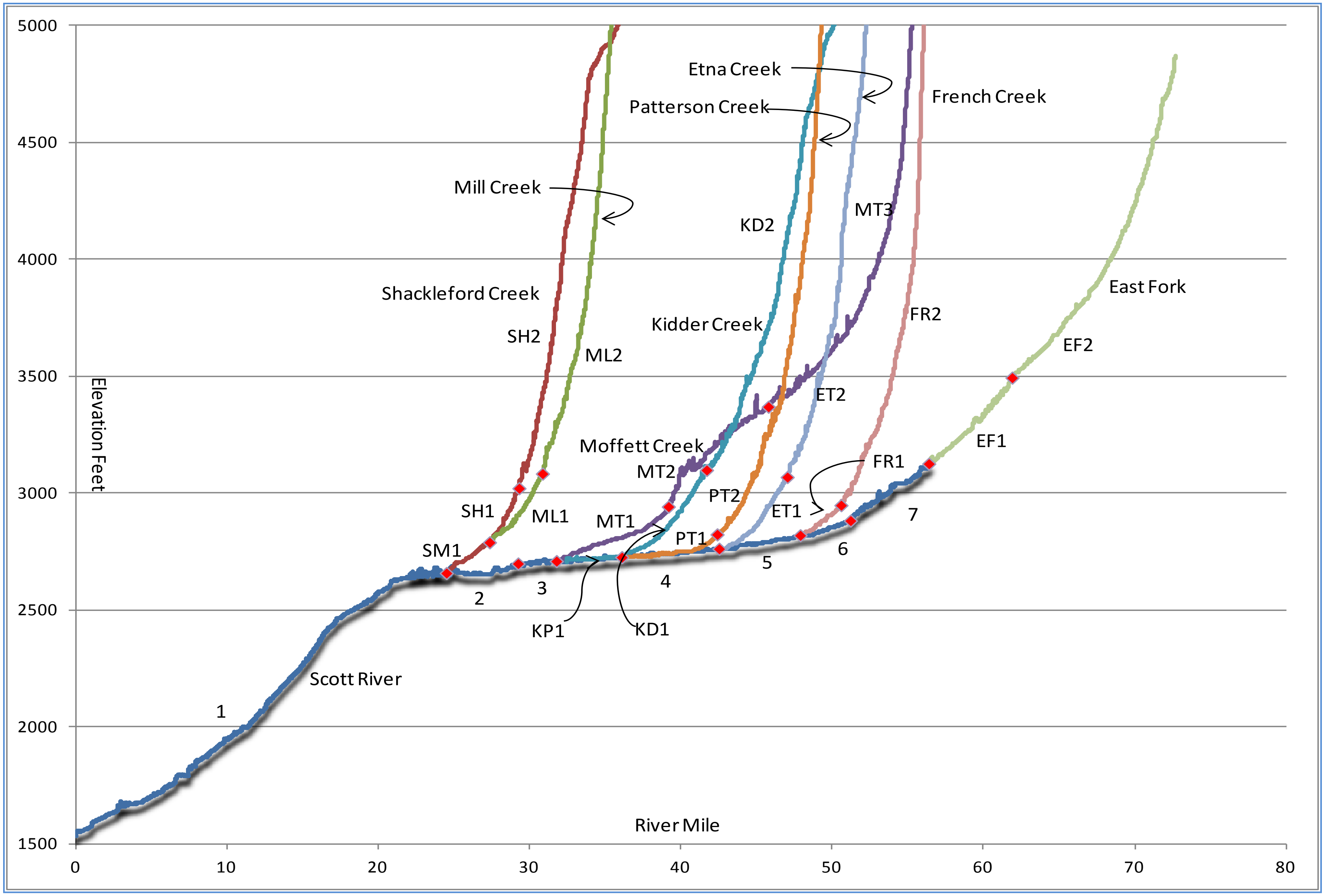


Figure 2. Scott River Basin longitudinal elevation profiles (NED 10m digital data) and reaches.

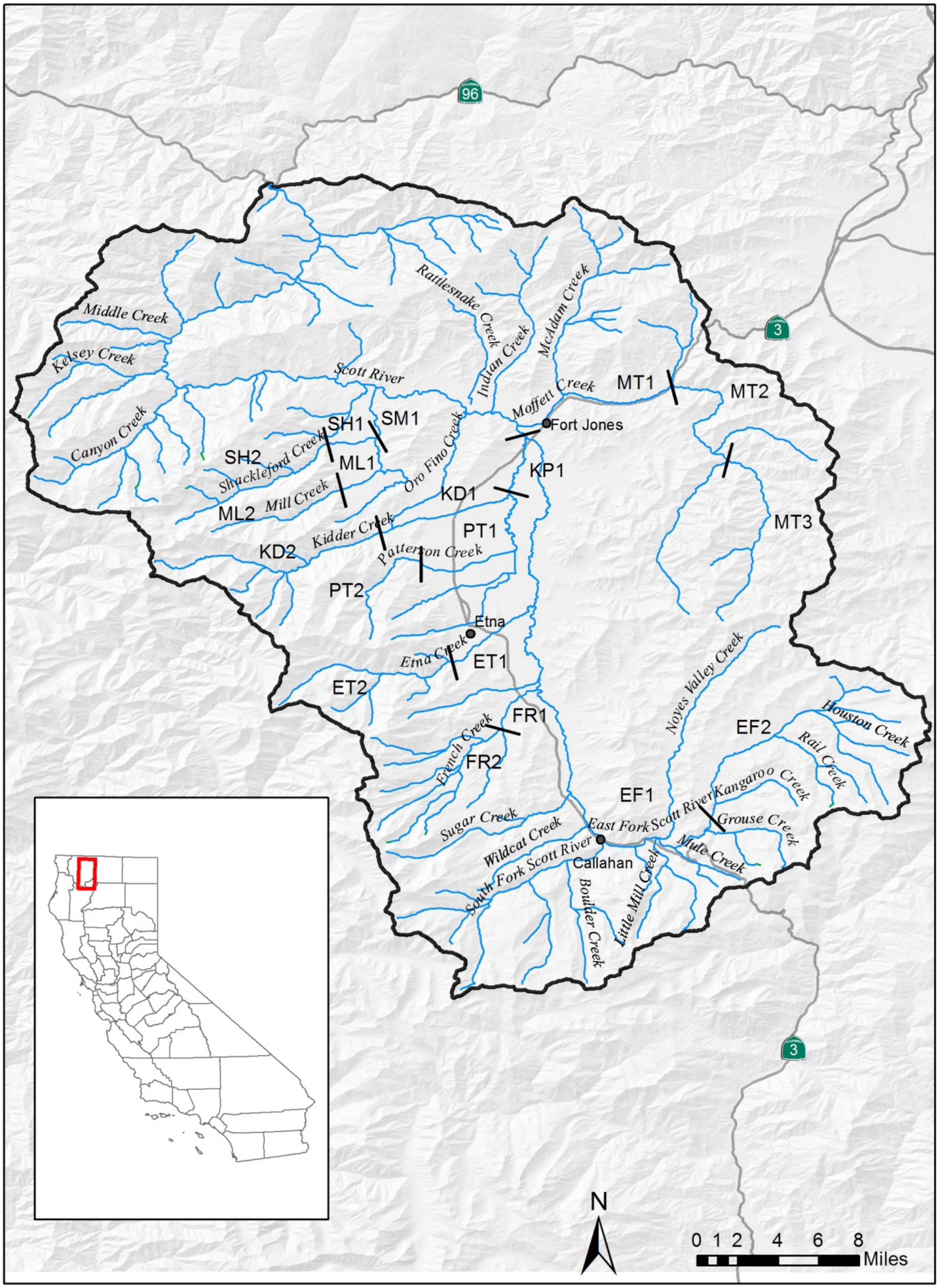


Figure 3. Scott River Tributary Reaches.

Table 1. Scott River Mainstem Reaches.

Scott Mainstem						Fish Use	
Reach (Sub Reach)	**Reach #**	**RM**	**Gradient**	**Channel**	**Substrate [2]**	**Species**	**Note**
Mouth to Shackleford/Mill Creek	1	0-23.8	>1%	Confined	Bedrock/Sand	Chinook	
						Coho	
						Steelhead	
Shackleford/Mill to Oro Fino Creek	2	23.8-31.1	<1%	Unconfined	Sand/Fines	Chinook	USGS Topo RM's are in error - RM 27 to 31 = 1.5 miles
						Coho	
						Steelhead	
Oro Fino Creek to Moffett Creek	3	31.1-33.5	<1%	Unconfined	Sand/Fines	Chinook	
						Coho	
						Steelhead	
Moffett Creek-Etna Creek	4	33.5-42	<1%	Unconfined	Sand/Gravel	Chinook	Flow can go subsurface in summer and dry years; USGS Topo RM's are in error - RM 40 to 41 = 3.0 miles
						Coho	
						Steelhead	
(Moffett Creek to Island Bridge)	(4a)	33.5-36.7	<1%	Unconfined	Sand/Fines	Chinook	Flow can go subsurface in summer and dry years
						Coho	
						Steelhead	
(Island Bridge to Eller Lane Bridge)	(4b)	36.7-41.1	<1%	Unconfined	Sand/Fines	Chinook	USGS Topo RM's are in error - RM 40 to 41 = 3.0 miles
						Coho	
						Steelhead	
(Eller Lane Bridge to Etna Creek)	(4c)	41.1-43.9	<1%	Unconfined	Sand/Gravel	Chinook	
						Coho	
						Steelhead	
Etna Creek to French Creek	5	42-47.8	<1%	Unconfined	Gravel/Sand	Chinook	SVID Diversion Mid-Reach
						Coho	
						Steelhead	
(Etna Creek to Horn Lane Bridge)	(5a)	42-43.9	<1%	Unconfined	Gravel/Sand	Chinook	
						Coho	
						Steelhead	

Scott Mainstem						Fish Use	
Reach (Sub Reach)	Reach #	RM	Gradient	Channel	Substrate [2]	Species	Note
(Horn Lane Bridge to French Creek)	(5b)	43.9-47.8	<1%	Unconfined	Gravel/Sand	Chinook	
						Coho	
						Steelhead	
French Creek to Lower Tailings	6	47.8-51.2	<1%	Unconfined	Coarse Sand	Chinook	
					Gravel/Cobble	Coho	
						Steelhead	
(French Creek to Fay Lane)	(6a)	47.8-49.6	<1%	Unconfined	Gravel/Sand	Chinook	
						Coho	
						Steelhead	
(Fay Lane to Lower Tailings	(6b)	49.6-51.2	<1%	Unconfined	Gravel/Sand	Chinook	
						Coho	
						Steelhead	
Lower Tailings to SF/EF Confluence	7	51.2-55.9	<1%	Mod	Cobble/Gravel	Chinook	Flow - can be subsurface through tailings in summer; Farmers Ditch near Sugar Creek Confluence
				Confined		Coho	
						Steelhead	

Table 2. Scott River Tributary Reaches.

Scott Tributaries						Anadromous Fish Use	
Reach	Reach #	RM	Gradient	Channel	Substrate	Species	Note
Canyon tribs (Tompkins, Canyon, Kelsey, Mill)	na	na	>3%	Confined	Cobble/Gravel/BLD	Chinook	Chinook may spawning in lower sections of tributaries
						Coho	
						Steelhead	
Shackleford/Mill Creek (Lower)	SM1	0-2.8	<1%	Unconfined	Sand/gravel	Chinook	Disconnected in Summer/Low Flow; Chinook may use lower reach for spawning
						Coho	
						Steelhead	
Shackleford Creek (Middle)	SH1	2.8-4.8	<1%	Unconfined	Gravel/Sand	Coho	May become subsurface in summer
						Steelhead	
Shackleford Creek (Upper)	SH2	4.8+	>1%	Confined	Cobble/Gravel/BLD	Coho	Barrier to Fish Access of Upper Shackleford Creek
						Steelhead	
Mill Creek (Lower)	ML1	0-3.5	>1%	Confined	Sand/Gravel	Coho	May become subsurface in summer
						Steelhead	
Mill Creek (Upper)	ML2	3.5+	>1%	Confined	Cobble/Boulder	Coho	
						Steelhead	
Kidder/Patterson (Lower)	KP1	0-3.2	<1%	Unconfined	Sand	Coho	Disconnected in Summer/Low Flow
						Steelhead	
Kidder (Middle)	KD1	3.2-8.8	<1%	Unconfined	Sand/Gravel	Coho	Water diverted from Kidder into Oro Fino Creek
						Steelhead	
Kidder (Upper)	KD2	8.8+	>1%	Confined	Cobble/Gravel	Coho	
						Steelhead	
Patterson (Lower)	PT1	0-6.3	<1%	Unconfined	Sand	Coho	Also known as "Big Slough"
						Steelhead	
Patterson (Upper)	PT2	6.3+	1%-3%	Confined	Gravel/Sand	Coho	
						Steelhead	
Etna Creek (Lower)	ET1	0-4.5	<1%	Unconfined	Sand/Gravel	Chinook	Disconnected in Summer/Low Flow; Chinook may use lower reach for spawning
						Coho	
						Steelhead	

Scott Tributaries						Anadromous Fish Use	
Reach	Reach #	RM	Gradient	Channel	Substrate	Species	Note
Etna Creek (Upper)	ET2	4.5+	>3%	Confined	Cobble/Boulder	Coho	
						Steelhead	
French Creek (Lower)	FR1	0-2.7	<1%	Unconfined	Sand/Gravel	Chinook	Sometimes Disconnected in Summer/Low Flow; Chinook use lower reach for spawning
						Coho	
						Steelhead	
French Creek (Upper)	FR2	2.7+	>3%	Confined	Cobble/Boulder	Coho	Chinook use lower reach for spawning
						Steelhead	
Sugar Creek/Wildcat Creek	na		1%->3%		Cobble/Gravel/BLD	Coho	
						Steelhead	
South Fork	na	na	1%->3%	Mod	Cobble/Gravel/BLD	Chinook	Mine Tailings in lower valley; Chinook may use lower reach for spawning
				Confined		Coho	
						Steelhead	
East Fork (Lower) Includes Noyes Valley Creek	EF1	0-5.5	<3%	Mod	Variable	Coho	
				Confined		Steelhead	
East Fork (Upper)	EF2	5.5+	<3%	Mod	Variable	Coho	
				Confined		Steelhead	
Moffett Creek (Lower) Includes Indian & McAdam Creek	MT1	0-7.4	<1%	Unconfined	Sand	Coho	Disconnected in Summer/Low Flow
						Steelhead	
Moffett Creek (Middle)	MT2	7.4-14	<3%	Mod	Sand/Gravel	Coho	
				Confined		Steelhead	
Moffett Creek (Upper)	MT3	14+	>1%	Mod	?	Coho	Little Data for Upper Moffett
				Confined		Steelhead	
Eastside Tributaries - McConaughy Gulch, Hartstrand Gulch, Shell Gulch and Hamlin Gulch	na		<3%	Mod	Variable	Steelhead	Ephemeral Streams
				Confined			

SHASTA RIVER

GENERAL WATERSHED INFORMATION

Four major tributaries enter the Shasta River: Yreka Creek, Little Shasta River, Big Springs Creek, and Parks Creek.

Three distinct longitudinal gradient segments exist in the Shasta River between the confluence with the Klamath River and Dwinnell Dam (Nichols et al. 2010). The 7.8 miles of moderate gradient, confined channel between the confluence with the Klamath River and Yreka Creek is commonly known as the Canyon Reach. Between the confluences of Yreka and Big Springs creeks, the 27.1 mile middle river is mostly low gradient, unconfined sand bed stream channel. Coarser substrate and spring inflow are present at the upper end of the reach at the transition to steeper gradient. Upstream of Parks Creek to Dwinnell Dam, the gradient is steeper in the 5.7 mile stream channel, but flow and gravel input are obstructed by Dwinnell Dam. Dwinnell Dam was built in 1928 and blocks passage to upstream habitat, about 22 percent of the Shasta Basin (Wales 1951 as cited in CDFG 2009)

The tributaries Willow Creek, Parks Creek and the Little Shasta River have low gradient reaches between the foothills and Shasta River whereas Yreka Creek maintains a moderate gradient to the confluence with the Shasta River. The Little Shasta River, Parks Creek, and Willow Creek may be dry in the summer in the valley reach. The 2.2 mile Big Springs Creek and the 0.7 mile Little Springs Creek tributary to Big Springs Creek are spring fed channels to the mainstem Shasta River. Big Springs Creek is the main source of stream flow for the Shasta River below Dwinnell Dam.

Grenada Irrigation District (GID) and Shasta Water Users Association (SWUA) operate diversions at RM 30.6 and RM 17.8 on the Shasta River. GID has a water right of 40 cfs and SWUA has a 42 cfs water right for April to October (Shasta WMSA 2006, Table 2). Big Springs Irrigation District (BSID) has a 30 cfs surface water right to Big Springs Creek, but currently pumps water out of the aquifer to avoid conflicts with senior water rights holders (CDFG 2009).

The geology of the western Shasta Basin is of crystalline formations producing precipitation and snow melt dominated runoff, whereas the eastern side of the basin is mainly porous volcanic formations dominated by spring inflows (Owens and Hecht 1998). Precipitation dominated streams typically have rapid responses to rain events with rapidly descending hydrographs in the summer dry period. Spring and ground water dominated hydrology is moderated by the infiltration of the precipitation and more constant spring outflow.

Chinook and coho spawning primarily occur in the Canyon Reach and the Big Springs Complex (mainstem Shasta RM 34.9 to 36.4, Big Springs Creek, and lower Parks Creek). Steelhead spawning is less defined and more difficult to assess with resident populations potentially contributing to the anadromous population. Steelhead likely spawn in the same areas that coho spawn as well as opportunistically in tributary headwaters.

SHASTA RIVER REACHES

The Shasta River reaches were delineated similarly to previous instream flow studies (CDFG 2009, McBain & Trush 2009 and 2012, SVRDT and McBain & Trush 2013). The anadromous portion of the mainstem Shasta River is bounded by the confluence with the Klamath River and Dwinnell Dam that blocks anadromy to the upstream reach. The mainstem (Figures 4 and 5 and Table 3) and tributaries (Figures 5 and 6 and Table 4) are divided into reaches based on physical and natural hydrological characteristics.

SHASTA RIVER MAINSTEM REACHES

- **Reach 1**, the Canyon Reach, is the lowest of the reaches (RM 0-7.8), extends from the confluence with the Klamath River to the confluence with Yreka Creek, is confined within the canyon with a moderate gradient (0.008), and is a primary spawning location for Chinook and coho (Nichols et al. 2010). Summertime water temperatures can be too warm to support coho rearing. Yreka Creek is a primary input source of coarse spawning substrate to the Canyon Reach (McBain & Trush 2009).
- **Reach 2**, Yreka Creek to the Little Shasta River confluence is the lower portion of the low gradient, unconfined middle valley segment (RM 7.8-16.3) with sand and gravel substrate (McBain & Trush 2009).
- **Reach 3**, the Little Shasta River confluence to the GID diversion (RM16.3-30.6) is the lowest gradient reach. The channel is unconfined and primarily sand. Other smaller diversions and water rights exist in addition to the GID and SWUA diversions. Water temperature in the summer typically rises and the flow diminishes progressing downstream from the spring inflows upstream of this reach.
- **Reach 4**, the GID diversion to Big Springs Creek (RM30.6-33.7) is an area of spring inflow where the water temperature decreases progressing downstream to the GID diversion (McFadin 2005). Big Springs Creek provides the majority of the flow in this reach. The Nature Conservancy (TNC) currently owns the Nelson Ranch (RM 27.5-32.0) and the Big Springs Ranch (an additional 2.5 of river frontage) (Jeffres et al. 2010).
- **Reach 5**, the Big Springs Creek confluence to the Parks Creek confluence (RM 33.7-34.9) is the beginning of the transition to higher gradient. The stream channel is more confined with coarser substrate. Cold water springs (13 to 14.5 degrees C) provide the majority of the flow in reaches 4 and 6.

- **Reach 6** between the Parks Creek confluence and Dwinnell Dam (RM 34.9-40.6) is moderate gradient and heavily influenced by Dwinnell Dam. Only limited water is released from the reservoir to satisfy downstream water rights (CDFG 2009). With low flow and warm summertime water temperatures, this reach is inhospitable for salmonids except at the cold water spring inflows.
- **Reach 7**, an additional headwaters reach upstream of Lake Shastina (RM 40.6 to headwaters ~ RM 52.6), is included in the reach divisions and may be included in the study as circumstances require. Dwinnell Dam blocks anadromous fish passage to this reach as well as gravel inputs to the lower river.

SHASTA RIVER TRIBUTARY REACHES

- **Yreka Creek** (confluence at RM 7.8) is a moderate gradient tributary that drains about seven percent of the Shasta Basin. Unlike other tributaries, Yreka Creek does not flow through the low gradient Shasta Valley prior to entering Shasta River. This enables coarse substrate to be input directly into Shasta River contributing to the spawning gravels in the Canyon Reach (McBain & Trush 2010). Steelhead have spawned in the lower three miles of Yreka Creek (Skinner 1959 in SVRDT and McBain & Trush 2011). Chinook and coho also utilize the lower reach opportunistically when sufficient water is present (CDFG 2009). The lower Yreka Creek Reach (Y1) ends at the Highway 3 crossing due to anthropogenic influence in Yreka. An urban reach (Y2) extends through Yreka from RM 3.4 to the confluence of Greenhorn Creek at RM 5.8. The Headwaters Reach (Y3) extends from the confluence of Greenhorn Creek to the headwaters at approximately RM 12.6.
- **Little Shasta River** is divided into three reaches: Shasta Valley Reach (LS1, RM 0-9.5) from the confluence to the Lower Shasta Road crossing, Foothills Reach (LS2, RM 9.5-20.9) to the confluence with the Cold Bottle Springs tributary, and the Headwaters Reach (LS3, RM 20.9-27.5). Many small diversions are on the Little Shasta River and the stream channel can be dry in the lowest reach during the irrigation season (SVRDT and McBain & Trush 2011). The Valley Reach channel is low gradient and unconfined with small substrate. At RM 9.5, the channel transitions to higher gradient and suitable spawning substrate (McBain & Trush 2009). Potential migration barriers exist at RM 11.8, 12.0, and 13.1 (SVRD and McBain & Trush 2013). The LS2/LS3 reach division location was chosen to include the mapped tributaries and inflows to the north and west of the Little Shasta River (Figure 6). SVRCD and McBain & Trush (2013) reference a natural falls and potential migration barrier at RM 17.4. Field investigations could lead to the relocation of this boundary to that point.
- **Willow Creek**, flowing from the western mountains is not considered a reach and may be dry during the irrigation season (SVRDT and McBain & Trush 2013).

- **Big Springs Creek** is a single reach from the springs to the confluence with the Shasta River (RM 0-2.2) and includes the 0.7 mile Little Springs Creek. The Big Springs Ranch is currently owned by TNC which is actively pursuing restoration activities such as riparian fencing (Jeffres et al. 2010). Mean irrigation season flow in Big Springs Creek in 2008 was 50 cfs (Nichol et al. 2010) and is the primary inflow to the Shasta River. Groundwater emerges at 10 to 12 degrees C, but can warm quickly from solar radiation in the wide, shallow Big Springs Creek channel. The Big Springs Irrigation District has a 30 cfs water right from Big Springs Creek during the irrigation season. The Big Springs Creek is an important spawning and rearing area.
- **Parks Creek** is divided into four reaches: the Valley Reach from the confluence to I-5 (P1, RM 0-8.2), I-5 Reach to the impassable barrier (McBain and Trush 2011) at the Montague Water Conservation District (MWCD) diversion (P2, RM 12.2), the Foothills Reach to the East Fork confluence (P3, RM 9.2-15.9), and the Headwaters Reach (P4, RM15.9-21.2). The gradient increases from low, to moderate, to steep. Spawning occurs in the Valley Reach (Chesney and Knechtle 2011). Kettle and Bridgefield Springs provide inflow in the lower reach. The MWCD diversion at RM 12.2 diverts water to the Shasta River upstream of Dwinnell Dam for winter storage.

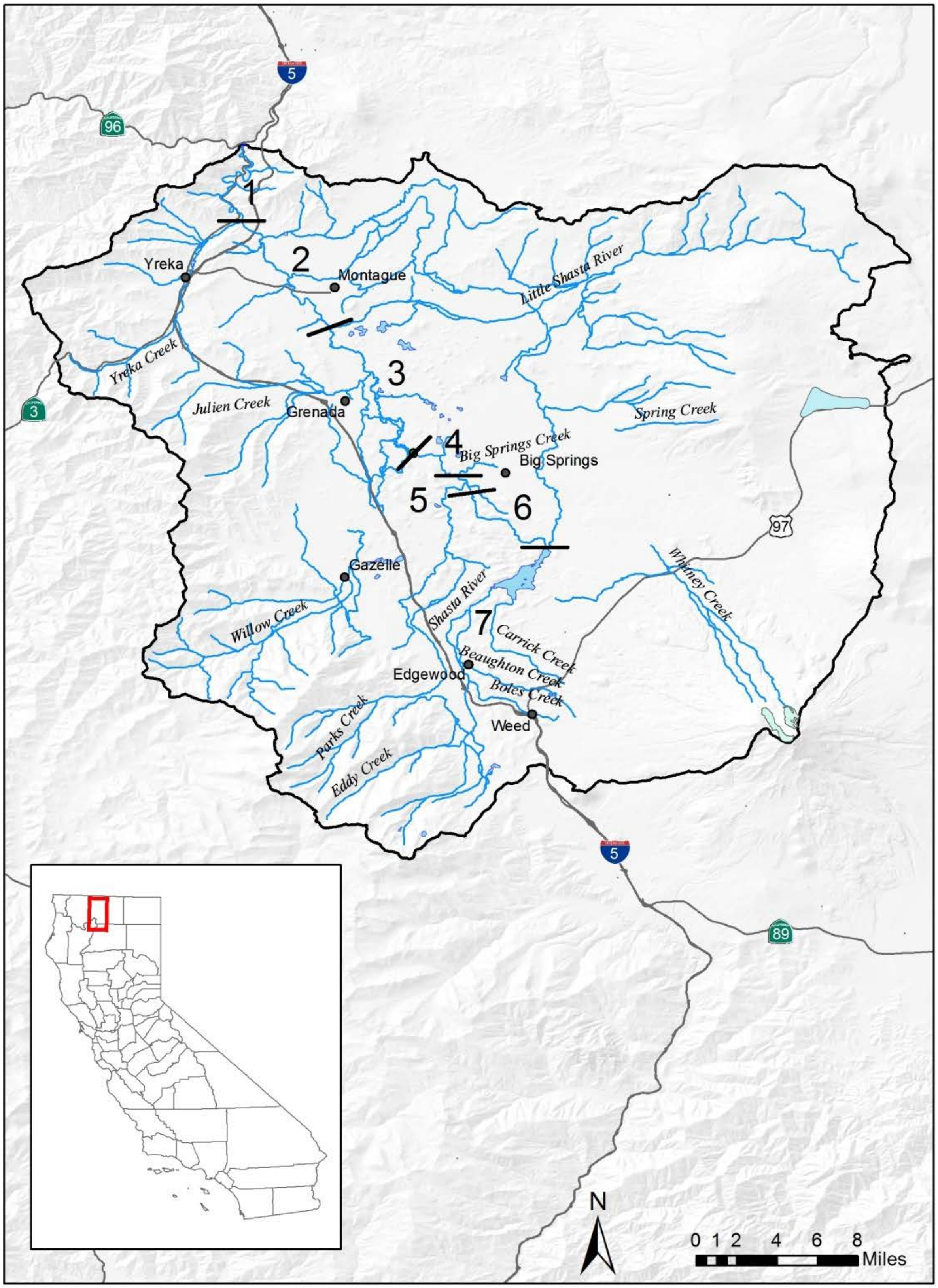


Figure 4. Shasta River Mainstem Reaches.

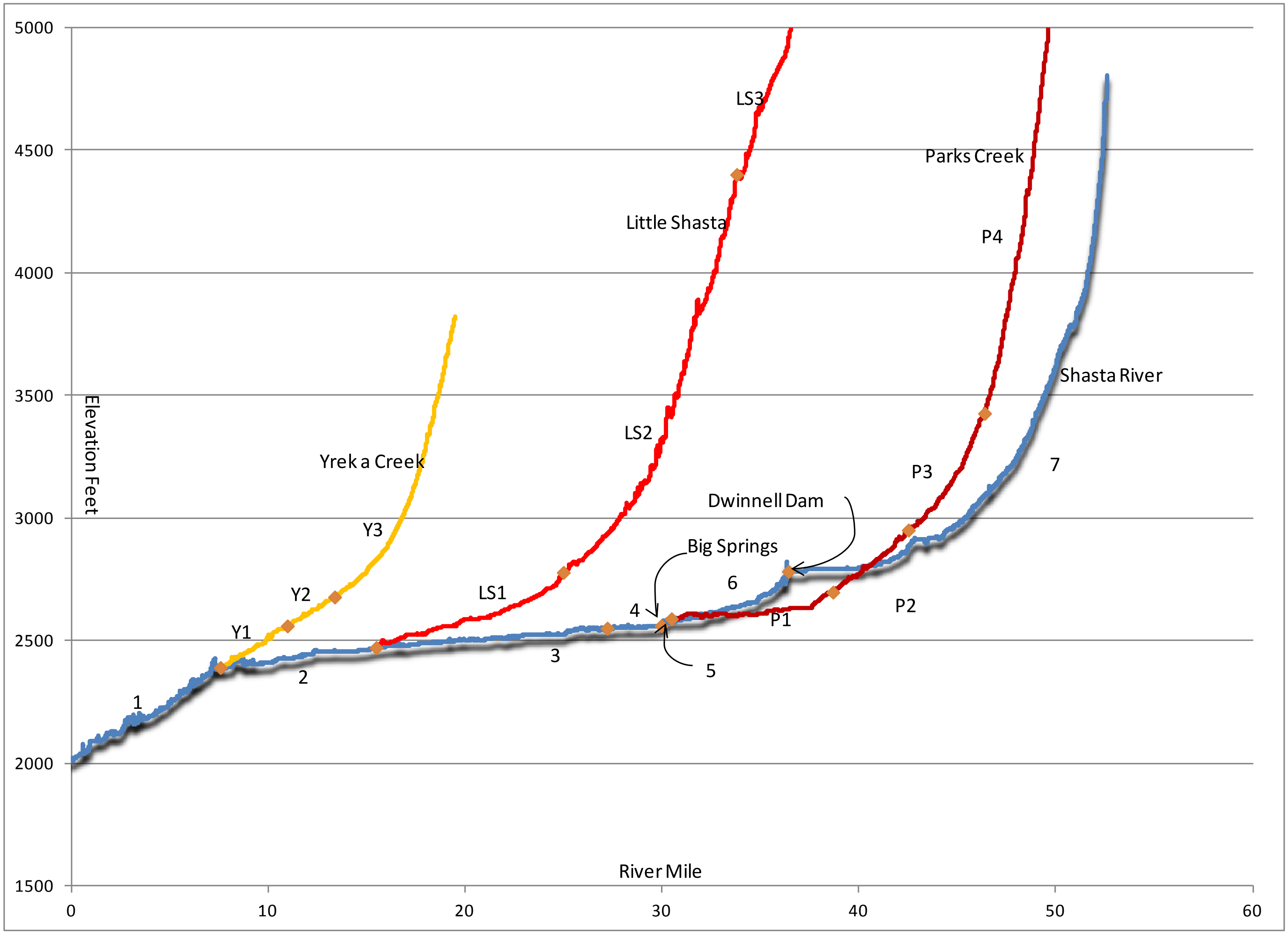


Figure 5. Shasta River Basin longitudinal elevation profiles (NED 10m digital data) and reaches. Big Springs Creek is the same gradient as the main channel and not visible. River mile and elevation from the USGS National Hydrography Dataset.

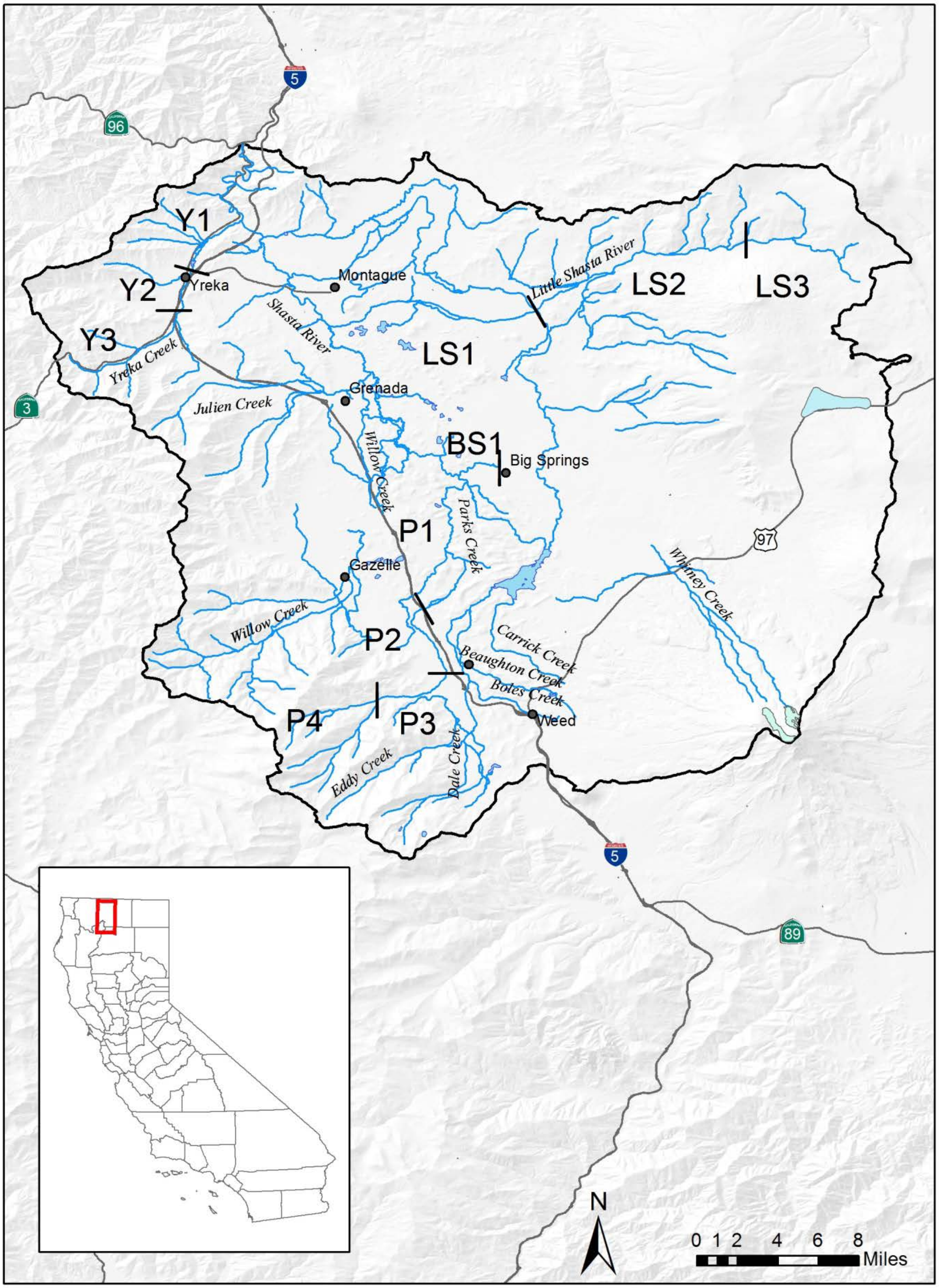


Figure 6. Shasta River Tributary Reaches. Little Springs Creek (Reach BS1a) is a tributary to Big Springs Creek and is not depicted due to its short relative length (0.7 miles).

Table 3. Shasta River Mainstem Reaches.

Shasta Mainstem						Fish use	
Reach (Sub Reach)	Reach #	RM	Gradient	Channel	Substrate [2]	Species	Note
Mouth to Yreka Creek	1	0-7.8	0.5%-1.5%	confined	Coarse	Chinook	No major inflows or diversions in this reach. Water temperatures can exceed 26 degrees C
					Bedrock	Coho	
						Steelhead	
Yreka Creek to Little Shasta River	2	7.8-16.3	<0.5%	unconfined	Coarse	Chinook	High water temperature in summer.
					Fines	Coho	
						Steelhead	
Little Shasta River to GID Diversion	3	16.3-30.6	<0.5%	unconfined	Sand	Chinook	SWUA diversion @ RM 17.85
						Coho	
						Steelhead	
GID Diversion to Big Springs Creek	4	30.6-33.7	<0.5%	mixed	Coarse	Chinook	Spring inflow reduces summertime water temperatures and increases flow progressing downstream
					Fines	Coho	
						Steelhead	
Big Springs to Parks Creek	5	33.7-34.9	0.5%-1.5%	unconfined	Coarse	Chinook	Big Springs inflow provides most of the stream flow downstream
					Fines	Coho	
						Steelhead	
Parks Creek to Dwinnell Dam	6	34.9-40.6	0.5%-1.5%	mixed	Coarse	Chinook	Rearing habitat to about RM 36.9 (Chesney et al. 2011)
					Fines	Coho	
						Steelhead	
Dwinnell Dam to Headwaters	7	40.6-52.6	>1.5%	confined	coarse		No fish passage past Dwinnell Dam

Table 4. Shasta River Tributary Reaches.

Shasta Tributaries						Fish Use	
Reach (*Sub Reach*)	Reach #	RM	Gradient	Channel	Substrate [2]	Species	Note
Yreka Creek							
Confluence to Hwy 3	Y1	0-3.4	0.5%-1.5%	confined	Coarse	Chinook	
						Coho	
						Steelhead	
Hwy 3 to Greenhorn Creek	Y2	3.5-5.8	0.5%-1.5%	confined	Coarse	Coho	Urban area
						Steelhead	
Greenhorn Creek to Headwaters	Y3	5.8-12.6	>1.5%	confined	Coarse	Steelhead	
Oregon Slough		No Reach					
Little Shasta River							
Confluence to Lower Shasta Road	LS1	0-9.5	<0.5%	unconfined	Fines	Chinook	Reach dries in summer
					Sand	Coho	
						Steelhead	
Lower Shasta Road to Cold Bottle Springs Creek	LS2	9.5-18.3	0.5%-1.5% >1.5%	confined	Coarse	Chinook	
						Coho	
						Steelhead	
Cold Bottle Springs Creek to Headwaters	LS3	18.3-27.5	>1.5%	confined			Downstream barriers may preclude anadromous access
Willow Creek		No Reach					
Big Springs Creek	BS1	0-2.2	<0.5%	unconfined	Coarse/ Fines	Chinook	Natural nutrient input
						Coho	
						Steelhead	
Little Springs Creek	BS1a	0-0.7	<0.5%	unconfined	?	Chinook	
						Coho	
						Steelhead	

Shasta Tributaries						Fish Use	
Reach (*Sub Reach*)	Reach #	RM	Gradient	Channel	Substrate [2]	Species	Note
Parks Creek							
Shasta River to I-5	P1	0-8.2	<0.5%	unconfined	Coarse/ Fines	Chinook	Portions can dry in summer
						Coho	
						Steelhead	
I-5 to the MWCD Diversion	P2	8.2-12.2	0.5%-1.5%	unconfined	Coarse	Steelhead	Barrier at RM 12.2
MWCD Diversion to East Fork confluence	P3	12.2-15.9	0.5%-1.5%	unconfined	Coarse		
East Fork Confluence to Headwaters	P4	15.9-21.2	>1.5%	confined	?		

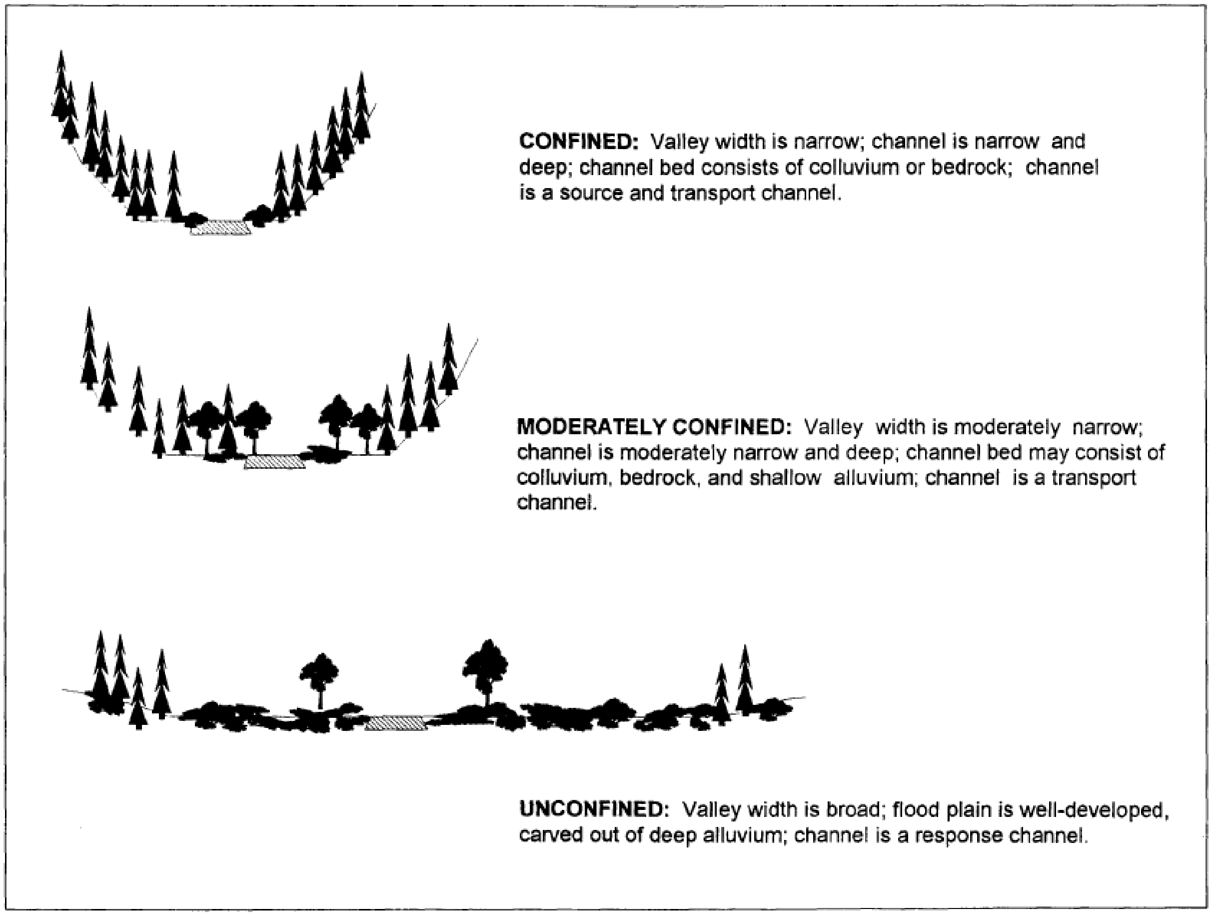
GLOSSARY

SUBSTRATE SIZE CLASSES

Substrate is important for the spawning life stage. Salmonids require the coarse substrate of gravel to small cobble for spawning. Fines can inhibit or preclude successful incubation. The following classification table is taken from Hardin et al. 2005, and has been used as a basis for habitat suitability criteria in the Lower Klamath River.

Classification	Grain Size (Inches)
Organic Debris	
Clay	
Sand and/or Silt	
Coarse Sand	0.1 0.2
Small Gravel	0.2 1
Medium Gravel	1 - 2
Large Gravel	2 - 3
Small Cobble	3 - 6
Medium Cobble	6 - 9
Large Cobble	9 - 12
Small Boulder	12 - 24
Medium Boulder	24 - 48
Large Boulder	48+
Bedrock	

CHANNEL CONFINEMENT



Source: Overton et al. 1997. R1/R4 (Northern/Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures. U.S. Forest Service Tech. Report INT-GTR-346.

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