Adaptive Management Committee
DRAFT Upper Basin Study – Habitat Synthesis

MEMORANDUM

To: Adaptive Management Committee

From: Gina Morimoto, ENTRIX
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Date: December 11, 2006

Re: Synthesis of Upper Basin Habitat Information of the Santa Ynez River

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Introduction

In the Lower Santa Ynez River Fish Management Plan (FMP) (SYRTAC 2000) the Santa Ynez River Technical Advisory Committee (SYRTAC) considered various ways to utilize the upper Santa Ynez River Basin (upstream of Bradbury Dam) to increase production of steelhead in the Santa Ynez River. Although it was not proposed for immediate implementation, the FMP commits to further consideration and evaluation of opportunities identified in the Upper Basin. Additional information is needed to refine potential proposals for passage alternatives and use of stock with more compatible genetics for stocking operations in Lake Cachuma and in the Upper Santa Ynez River watershed. Further consideration of opportunities requires additional information on the character of the rainbow trout populations in the Upper Basin and the habitat suitable to support rainbow trout/steelhead rearing and spawning.

The Adaptive Management Committee (AMC), for the Cachuma Project, has been tasked with analyzing and evaluating opportunities that would provide access for Southern California steelhead (*Oncorhynchus mykiss*) from the Lower Santa Ynez Basin (below Bradbury Dam) to the Upper Santa Ynez Basin (above Bradbury Dam) to increase production of steelhead in the Santa Ynez River watershed (SYRTAC 2000). This memorandum consists of assessing the status of steelhead/rainbow trout habitat in the Upper Basin of the Santa Ynez River

(Upper Basin), which is a continuation of the Upper Basin Study Plan[1] set forth by the AMC. This assessment is based on a review and synthesis of available data from the United States Forest Service (USFS) and more recent data from the Cachuma Conservation Release Board (CCRB) and summarizes and compiles the available information on steelhead/rainbow trout habitat in the Upper Basin.

Based on this assessment, the streams that are recommended for further investigation of spawning and rearing habitat are:

- Cachuma Reach – Santa Ynez River (Cachuma Reach), Santa Cruz, Coche, Peach Tree, and Devil's Canyon creeks
- Gibraltar Reach - Gidney, Mono, Indian, Buckhorn, Blue Canyon, Escondido Canyon, and Alder creeks
- Jameson Reach - North Fork Juncal Creek

Study Area

For the purpose of this memorandum, the Upper Basin is defined as the portion of the Santa Ynez River watershed upstream of Bradbury Dam (Figure 1). Currently, the Upper Basin of the Santa Ynez River is divided into three sub-basins by three dams. Gibraltar Dam was completed in 1920 and is owned by the City of Santa Barbara. Juncal Dam was completed in 1930 and is owned by the Montecito Water District. Bradbury Dam was completed in 1953 and is owned by the U.S. Bureau of Reclamation (Reclamation). The three sub-basins are:

- **Lower sub-basin (Cachuma Reach)** – Mainstem Santa Ynez River from Bradbury Dam to Gibraltar Dam, including Lake Cachuma. Major tributaries include Cachuma, Santa Cruz, Oso, Tequepis, Los Laureles, and Devil's Canyon creeks.
- **Middle sub-basin (Gibraltar Reach)** – Mainstem Santa Ynez River from Gibraltar Dam (including the reservoir) to Juncal Dam. The major tributaries include Blue Canyon, Mono, Indian, Gidney, Camuesa, Agua Caliente Canyon, Fox, and Alder creeks.
- **Upper sub-basin (Jameson Reach)** – Mainstem Santa Ynez River from Juncal Dam eastward into the headwaters of the Santa Ynez River. The major tributaries include Juncal and North Fork Juncal creeks.

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[1] The Upper Basin Study Plan consists of three components: a historical stocking investigation (ENTRIX 2004), a genetics data synthesis (Toline et al. 2006), and an assessment of habitat in the Upper Basin (this memo).

Methods

An exerted effort was made to obtain all of the readily available existing information on steelhead/rainbow trout habitat in the Upper Basin during the summer of 2003. The USFS has conducted numerous studies in the Santa Ynez River watershed. Additionally, the United States Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (CDFG) have collected rainbow trout tissue samples within the Upper Basin for genetic analysis. Furthermore, a recent habitat assessment of the Santa Cruz drainage was conducted in May, June, and November of 2004 (Engblom and Volan 2004a; Engblom and Volan 2004b; Engblom and Volan 2004c; Engblom and Volan 2004d).

The majority of steelhead/rainbow trout habitat in the Upper Basin occurs within the boundaries of the Los Padres National Forest (LPNF). To a large extent, therefore, information collected by the USFS was relied upon for this analysis. Biologists at three LPNF offices indicated that information collected from fish habitat studies conducted within the Upper Basin were stored at the USFS Headquarters in Goleta, the Santa Lucia Ranger District in Santa Maria, and the Santa Barbara Ranger District located within the Santa Ynez River Watershed in Santa Barbara. The majority of information collected was stored in the Santa Lucia Ranger District office. Geographic Information System (GIS) databases and study method descriptions were stored in the USFS Headquarters. No recent information was available from the USFS offices in 2003. The information collected ranged from the 1930s to 1997. Lake Cachuma was omitted from this analysis because the USFS does not have jurisdiction in this area and therefore little to no information was found at USFS offices.

Information typically collected by the USFS included quantitative habitat studies (habitat typing), qualitative habitat studies, fish presence/absence surveys, quantitative fish population studies, water quality monitoring, fish passage inventories, water quality monitoring, and instream flow studies. Copies of data sheets, summary reports, and maps were obtained from the USFS and organized by stream. For the purposes of this effort, the USFS information was compiled according to flow, water temperature, spawning habitat, rearing habitat, and barriers. Steelhead/rainbow trout presence was recorded by life stage and population. Relevant results of a recent migration barrier inventory conducted in 2003 (Stoecker 2004) also are summarized in this document (see Attachment A).

Discrepancies were encountered within some of the data sets, such as differing dates of sampling and various degrees of effort associated with data collection or sampling. In order to resolve discrepancies, the data were rated based on its overall reliability. For example, data that were collected more recently or streams that had multiple sources of confirmed data were considered strongly reliable. In certain cases, data were inadequate, or were collected before 1995, and thus received a fair reliability rating. A weak rating indicated that the data were largely qualitative observations and/or were recorded before 1985. After the data were compiled and synthesized, informational gaps were identified. Although abundant quantitative information may have been available before 1985, the reliability was considered weak because many factors may have changed the habitat since then (i.e., banks may have eroded causing changes in spawning habitat). Where data were found only before 1985, this was considered an informational gap, as current conditions may be vastly different. The data gaps are identified in this memorandum.

The intent of this assessment was to attempt to identify favorable habitat for steelhead/rainbow trout. Streams that received high habitat ratings ("3") for both spawning and rearing habitats were considered potentially of high benefit for steelhead/rainbow trout (Tables 1 to 3). Historical documents containing qualitative information were also included in the assessment to gain an overall perspective of available steelhead/rainbow trout habitat in the Upper Basin. Tables 1 to 3 summarize the data collected from the USFS files and historical documents.

Although every effort was made to rate the categories in Tables 1 to 3 based on quantitative data, sometimes only qualitative information was available and therefore professional opinion was utilized. The ratings were done to provide a general description of the categories, and should not be used as the sole source of information when making management decisions.

The different categories in Tables 1 to 3 were rated as follows. Flow was directly translated from data sheets. For example, if the data sheet noted flow as *very low*, then very low was entered into Tables 1 to 3. This process prevented the potential error of classifying a very low flow stream as intermittent. Water temperature information was generally inadequate. Most streams only had one temperature reading per reach. Moreover, the time of the temperature reading was usually not recorded. The temperatures were rated conservatively, according to temperature ranges provided in the *Lower Santa Ynez River Fish Management Plan* (SYRTAC 2000), and were rated as tolerable (≤ 20°C), questionable (21 - 22°C), or not tolerable (≥ 23°C).

From a habitat perspective, spawning habitat was rated according to the abundance of riffles and spawning gravels. In some cases, spawning habitat was noted by the USFS as poor (qualitative). Where possible, quantitative measurements were used to rate spawning habitat. Rearing habitat was rated according to cover present. Cover included instream complexity and riparian vegetation. Barriers were recorded on data sheets. In some cases, it was unclear as to whether a barrier would completely block upstream migration. For example, a barrier to upstream migration at low flows may not block upstream migration at intermediate or high flows, in which case the barrier would not block access to upstream spawning and rearing habitat in years that sufficient flow occurs during the rainy (spawning) season. Therefore, an effort was made to identify whether a barrier would be a complete barrier at all flows, or a partial barrier only at low flows. Barriers were not rated in Tables 1 to 3, but were summarized in detail in Attachment A.

Steelhead/rainbow trout abundance was generally assessed based on the number of steelhead/rainbow trout observed at a given location. In some instances, many steelhead/rainbow trout were observed throughout a reach, which was interpreted as an abundant steelhead/rainbow trout population. While this assessment was largely qualitative, it can be used to indicate the relative numbers of steelhead/rainbow trout historically found in a stream. Steelhead/rainbow trout life stages have been interpreted according to length. Juveniles were defined as smaller than six inches. Adults were defined as being six inches or greater.

Results

A total of 13 streams in the Upper Basin were rated as good potential high benefit, based only on spawning and rearing habitat ratings (Tables 1 to 3 and Figure 1). Of these, two had perennial flows and 11 had intermittent flows. Four of the streams had strongly reliable habitat data, although these streams ranged in reliability of fish population data. Seven of the streams had fairly reliable habitat data. Two of the streams had weak habitat and fish population data. Barriers that may potentially block fish passage at all flows were identified on nine of these streams.

Cachuma Reach

In the Cachuma reach, five streams were considered as providing potentially good habitat for steelhead/rainbow trout. These streams were the Santa Ynez River mainstem, Santa Cruz, Coche, Devil's Canyon, and Peach Tree creeks. All streams were intermittent and had tolerable water temperatures. Barriers that may potentially block upstream migration at all flows were identified on the Santa Ynez River (Bradbury Dam), Santa Cruz (West Fork and East Fork), Coche and Devil's Canyon creeks (Attachment A).

Table 1. Habitat and fish production data synthesis from USFS files and historical documents for the Cachuma Reach.

	Habitat					*O. mykiss* Presence			
Stream	**Flow**	**Water Temperature**	**Spawning Habitat**	**Rearing Habitat**	**Reliability of Habitat Data**	***O. mykiss* Population**	**Life Stages Present**	**Reliability of Population Data**	**References**
Santa Ynez River	Intermittent / Perennial	2	3	3	Strong	3	Adults	Fair	Chubb 1997; USFS 1995d; USFS 1995e; USFS 1980f
Cachuma Creek	Intermittent	3	3	1	Weak	3	Adults	Fair	Chubb 1997; CDFG 1954a
Lazaro Canyon	Perennial								USGS ____
Lion Canyon	Perennial								USGS ____
Tequepis Canyon Creek	Perennial								USGS ____
Santa Cruz Creek	Intermittent	3	3	3	Fair	3	Adults & Juveniles	Fair	Engblom & Volan 2004a; Chubb 1997; CDFG 1954b
Peach Tree Creek	Intermittent	3	3	3	Fair	2	Questionable	Weak	Chubb 1997; USFS 1993e; CDFG 1944
Mine Canyon	Questionable	0	2	3	Weak	2	Questionable	Weak	USFS 1993d
Black Canyon	Very low	1	1	2	Weak	0	None	Fair	USFS ____
East Fork Santa Cruz Creek	Perennial	2	2	3	Strong	2	Adults & Juveniles	Strong	Engblom & Volan 2004c; Engblom & Volan 2004d; USFS 1980k
Grapevine Creek	Intermittent	3	2	3	Strong	1	Adults & Juveniles	Strong	Engblom & Volan 2004c; Engblom & Volan 2004d; Chubb 1997
West Fork Santa Cruz Creek	Perennial / Low	3	2	3	Strong	2	Adults & Juveniles	Strong	Engblom & Volan 2004a; Engblom & Volan 2004b; Chubb 1997; USFS 1997a
Coche Creek	Intermittent	2-3	3	3	Strong	3	Adults & Juveniles	Strong	Engblom & Volan 2004b
Horse Canyon	Perennial								
Hot Spring Canyon Creek	Perennial								

Table 1. ***(Continued)***

	Habitat					*O. mykiss* Presence			
Stream	**Flow**	**Water Temperature**	**Spawning Habitat**	**Rearing Habitat**	**Reliability of Habitat Data**	***O. mykiss* Population**	**Life Stages Present**	**Reliability of Population Data**	**References**
Los Laureles Canyon Creek	Perennial								
Red Rock Canyon Creek	Perennial								
Lewis Canyon	Perennial								
Oso Canyon	Seasonal / Very low	3	2	3	Fair	0	None	Fair	Chubb 1997; USFS 1994e
Devil's Canyon	Intermittent	3	3	3	Strong	1	Questionable	Weak	Chubb 1997; USFS 1995a; USFS 1995b; USFS 1995c

Shading = No available data

Factor	Score Rating
Water Temperature	3 = tolerable, 2 = questionable, 1 = not tolerable, 0 = no data found
Spawning Habitat	3 = existent, 2 = questionable, 1 = poor , 0 =non existent
Rearing Habitat	3 = existent, 2 = questionable, 1 = poor , 0 =non existent
O. mykiss Population	3 = abundant, 2 = common, 1 = few, 0 = non-existent

Gibraltar Reach

In the Gibraltar reach, seven streams received high spawning and rearing habitat ratings. These streams included Gidney, Mono, Indian, Buckhorn, Blue Canyon, Escondido, and Alder creeks. Of these steams, only Buckhorn and Escondido creeks were perennial. All other streams were intermittent, according to the data analyzed. All streams had tolerable water temperatures for steelhead/rainbow trout. Potential complete fish passage barriers (at all flows) were identified on Gidney, Mono, Indian, Escondido, Blue Canyon, Agua Caliente, Fox, and Alder creeks (Attachment A).

Table 2. Habitat and fish production data synthesis from USFS files and historical documents for the Gibraltar Reach.

	Habitat					*O. mykiss* Presence			
Stream	**Flow**	**Water Temperature**	**Spawning Habitat**	**Rearing Habitat**	**Reliability of Habitat Data**	***O. mykiss* Population**	**Life Stages Present**	**Reliability of Population Data**	**References**
Gibraltar Reservoir	N/A	2	1	2	Weak	3	Adults & Juveniles	Fair	CDFG 1933; USFS 1980b
Santa Ynez River	Intermittent	1-2	2	3	Weak	2	Adults & Juveniles	Fair	USFS 1980a
Gidney Creek	Intermittent	3	3	3	Weak	2	Adults & Juveniles	Fair	USFS 1980d
Camuesa Creek	Intermittent	0	1	1	Weak	Questionable	Questionable	Weak	Chubb 1997
Mono Creek	Intermittent	1-3	3	3	Fair	2	Adults & Juveniles	Fair	Chubb 1997; USFS 1993f; USFS 1980l
Indian Creek	Intermittent	3	3	3	Fair	2	Adults & Juveniles	Fair	Chubb 1997; USFS 1994f; USFS 1980g; CDFG 1933
Buckhorn Creek	Perennial	3	3	3	Weak	3	Adults & Juveniles	Fair	Chubb 1997; USFS 1980e
Alamar Creek									
Blue Canyon Creek	Intermittent	3	3	3	Fair	3	Adults & Juveniles	Fair	Chubb 1997; USFS 1994b
Escondido Canyon	Perennial	3	3	3	Fair	3	Adults & Juveniles	Fair	USFS 1994a
Agua Caliente Canyon	Questionable	1-3	2	2	Fair	0	None	Fair	Chubb 1997; USFS 1997b; USFS 1994g; USFS 1993c
Diablo Canyon		1			Fair				USFS 1994h
Fox Creek	Perennial	3	2	3	Strong	2	Adults & Juveniles	Fair	Chubb 1997; USFS 1996a; USFS 1993a

Table 2. ***(Continued)***

	Habitat					*O. mykiss* Presence			
Stream	**Flow**	**Water Temperature**	**Spawning Habitat**	**Rearing Habitat**	**Reliability of Habitat Data**	***O. mykiss* Population**	**Life Stages Present**	**Reliability of Population Data**	**References**
Alder Creek	Intermittent	1-3	3	3	Strong	1	Adults & Juveniles	Fair	Chubb 1997; USFS 1996a; USFS 1994i; USFS 1993b

Shading = No available data

Factor	Score Rating
Water Temperature	3 = tolerable, 2 = questionable, 1 = not tolerable, 0 = no data found
Spawning Habitat	3 = existent, 2 = questionable, 1 = poor , 0 =non existent
Rearing Habitat	3 = existent, 2 = questionable, 1 = poor , 0 =non existent
O. mykiss Population	3 = abundant, 2 = common, 1 = few, 0 = non-existent

Jameson Reach

North Fork Juncal Creek comprised the streams in the Jameson reach with high spawning and rearing habitat potential. The data classified the stream as intermittent, with tolerable water temperatures. A waterfall in the upper portion of the creek forms a natural, complete barrier to upstream migration, but trout habitat is available in downstream reaches.

Table 3. Habitat and fish production data synthesis from USFS files and historical documents for the Jameson Reach.

	Habitat					*O. mykiss* Presence			
Stream	**Flow**	**Water Temperature**	**Spawning Habitat**	**Rearing Habitat**	**Reliability of Habitat Data**	***O. mykiss* Population**	**Life Stages Present**	**Reliability of Population Data**	**References**
Jameson Lake	N/A	3	2	2	Weak	2	Adults	Weak	Chubb 1997; CDFG 1934
Santa Ynez River	Intermittent	3	2	3	Weak	2	Adults & Juveniles	Fair	USFS 1980c
North Fork Juncal Creek	Intermittent	2-3	3	3	Fair	3	Adults & Juveniles	Fair	USFS 1994c
Juncal Creek (SYR)	Intermittent	2-3	2	2	Fair	1	Adults & Juveniles	Fair	USFS 1994d

Factor	Score Rating
Water Temperature	3 = tolerable, 2 = questionable, 1 = not tolerable, 0 = no data found
Spawning Habitat	3 = existent, 2 = questionable, 1 = poor , 0 =non existent
Rearing Habitat	3 = existent, 2 = questionable, 1 = poor , 0 =non existent
O. mykiss Population	3 = abundant, 2 = common, 1 = few, 0 = non-existent

Discussion

To date, Chubb's (1997) synthesis of the LPNF habitat and steelhead/rainbow trout potential in the Upper Basin is one of the most comprehensive overviews of habitat available for steelhead/rainbow trout in the Upper Basin. Streams are discussed based on spawning and rearing habitat quality and fish production potential.

Spawning Habitat

According to results presented in Tables 1 to 3, streams that contain or have contained spawning habitat are:

- Cachuma Reach - Santa Ynez River (Cachuma Reach), Cachuma, Santa Cruz, Peach Tree, Coche, and Devil's Canyon creeks
- Gibraltar Reach - Gidney, Mono, Indian, Buckhorn, Blue Canyon, Escondido Canyon, and Alder creeks
- Jameson Reach - North Fork Juncal Creek

Chubb (1997) attempted to estimate the amount of habitat available on USFS land and the "current" and potential young-of-the-year or smolt production. Table 4 has been reproduced from Chubb (1997) for informational purposes. Although the habitat and trout density estimates can be used to broadly assess the areas where potentially good spawning habitat may be found, the assumptions made to calculate habitat and trout densities should be more closely looked at for their applicability to the Upper Basin if more clearly defined estimates are desired. Therefore, while Table 4 provides the most comprehensive estimates of spawning habitat and trout density, there are limitations to the uses of the data that should be recognized. Additionally, discrepancies may exist in the way miles were calculated in Table 4. Engblom and Volan (2004c) measured Grapevine Creek as 2.8 miles, while Chubb (1997) reports a total of 2.0 miles.

Based on the analysis by Chubb (1997), Alder and Blue Canyon creeks had some of the highest proportions of riffle habitat and thus may provide more spawning habitat. In addition, these creeks provided good spawning habitat, which is defined by Chubb (1997) as having a high percentage of gravels (>20%), no more than 15% fine sediments, and channel morphology (width/depth ± 15) that offers good oxygen and silt carrying capacities. However, streamflow 40-m below the diversion on Alder Creek was observed to go subsurface (ENTRIX 1995). Therefore, steelhead may have difficulty in reaching spawning habitat during drier years. Other streams that Chubb (1997) identified that may support spawning habitat are Juncal, Fox, and Devil's Canyon creeks.

Table 4. Habitat capability and estimates of potential steelhead production in the upper Santa Ynez River basin (based upon USFS stream surveys 1982-1997). Reproduced from Chubb (1997).

Drainage	Reach	Chan Type	Flow Type[1]	Miles	Avg Width (m)	% Riffle	% Gravel	% Fine	Spawning Habitat[2] (m^2)	YOY Trout Densities (No./100m)	Total No. YOY	
											From Habitat[3]	From Densities[4]
ABOVE CACHUMA RESERVOIR												
Santa Ynez River	1	C3	S	2.0	6.0	10	20	20	40	30	400	1,940
	2	C2	SI	3.0	10.0	30	5	20	724	30	7,240	2,896
	3	C2	PI	3.0	10.0	20	5	20	483	70	4,830	6,760
Cachuma Cr.	1	B3?	PI	4.0	1.5	10?	10?	10?	193	25	1,930	320
	2	B3?	PI	4.0	1.5	10?	10?	10?	193	25		
EF Santa Cruz Cr.	1	B3?	P	3.0	1.5	10	5	0	36	30	720	2,880
	2	B1	P	3.5	2.0	20	10	0	225	45	4,500	5,320
	3	B2	P	3.0	1.0	20	15	5	90	130	3,600	12,540
Santa Cruz Cr.			I	13.4								
Grapevine Cr.[5]	1	C2?	P	0.7	2.0	40	10	10	90	130	1,800	2,900
	2	B3?	P	1.3	1.5	40	10	5	318	50	12,720	2,100
WF Santa Cruz Cr.	1	B2?	P	2.5	1.5	20	10	10	121	30	2,420	2,400
Coche Cr.[6]	1	B3?	P	1.3	1.5	20	20	5	126	25	5,040	1,040
	2	B3?	P	1.0	1.5	20	20	5	242	65	4,840	2,100
Black Canyon	1	B2?	S	2.0	1.5	20?	10	10	97	0	-	-
Peachtree Cr.	1	B3	SI	1.0	1.5	20?	30	30	24	60	240	1,920
Oso Cr.	1	B3	S	1.0	1.5					0		
	2	B2	S	1.0	1.0					0		
Devil's Canyon	1	D3	S	0.1	4.0	4.0	10	10		0		
	2	B3a	SI	0.1	3.5	3.5	20	0	68	20	2,720	60
	3	B2a	P	1.5	2.0	2.0	20	5	290	20	11,600	60
	4	B2a	P	1.0	2.0	2.0	20	5?	193	0	-	-
Total above Lake Cachuma:				32							66,532	117,016
Total steelhead potential				23							56,261	25,456

Table 4. *(Continued)*

Drainage	Reach	Chan Type	Flow Type[1]	Miles	Avg Width (m)	% Riffle	% Gravel	% Fine	Spawning Habitat[2] (m^2)	YOY Trout Densities (No./100m)	Total No. YOY	
											From Habitat[3]	From Densities[4]
ABOVE GIBRALTAR RESERVOIR												
Santa Ynez River	4	C2	S	8.0	5.0	20	15	10	1545	30	30,900	7,720
Gidney Cr.	1	B2?	S	0.6	1.0	20	10	5	193	80	7,720	1,540
	2	B3	P	1.4	1.5							
	3	A2	P	1.0	1.0							
Camuesa Cr.	1	B3	I	6.0						0	-	-
Indian Cr.	1	B2	S	1.0	3.5	20	15	20	169	30	1,690	960
	2	B3a	SI	1.5	3.0	20	10	30	145	10	1,450	480
	3	B3?	P	2.0	2.0	20	10	5	129	10	5,160	640
	4	B2?	P	3.0	2.0	20?	10	5	193	60	7,720	5,800
	5	B3?	PI	5.0	2.0	20?	15	5	483	30	19,320	4,820
Buckhorn Cr.	1	B3?	PI	2.0	2.0	20	15	5	193	65	7,720	4,180
	2	A2	PI	2.5	1.5	40	10	15	241	130	4,820	10,460
Mono Cr.	1	C1	S	1.0	3.0	30	5	20	72	0	-	-
	2	C2?	SI	2.5	2.0	20	20	20	322	15	3,220	1,200
	3	B2?	SI	6.0	1.5	20	10	10	290	45	5,800	8,680
	4	B3?	PI	6.5	1.0	10	15	10	157	15	3,140	3,120
Agua Caliente Cr.	1	D1	S	1.0	3.0					0	-	-
	2	B1	PI	3.5	1.5	50	20	10	845	0	-	-
Blue Canyon Cr.	1	B4c	SI	1.2	3.0	50	50	15	1,448	450	28,960	1,720
	2	B4	SI	1.6	2.0	40	35	20	901	?	7,200	?
	3	B3	SI	0.8	1.5	30	45	20	435	?	2,300	?
Escondido Cr.	1	B3a	P	0.2	4.0	35	30	15	135	100	2,700	640
	2	A2	P	0.6	2.0	?	5	20	29	?	290	
	3	A2a+	P	0.7	1.2	?	30	10	20	0		
Fox Cr.	1	B3a	P	0.5	2.5	40	10	20	80	110	1,600	1,760
	2	A2	P	1.0	1.5	30	10	5	72	0	2,880	
Alder Cr.	1	B3	SI	1.6	3.0	40	30	15	927	250	9,270	12,880
	2	A2a	PI	0.8	2.0	40	20	15	206	100	2,060	2,560
	3	A2	P	0.2	1.5	10	5	30	2	?		
	4	A2a	P	0.2	1.0	20	5	15	3	0		

Table 4. *(Continued)*

Drainage	Reach	Chan Type	Flow Type[1]	Miles	Avg Width (m)	% Riffle	% Gravel	% Fine	Spawning Habitat[2] (m^2)	YOY Trout Densities (No./100m)	Total No. YOY From Habitat[3]	Total No. YOY From Densities[4]
Total above Gibraltar:				64							133,720	69,160
Total steelhead potential:				40							130,210	63,140
ABOVE JAMESON RESERVOIR												
Santa Ynez River	5	B2a	SI	0.9	2.0	25	25	0	188	40	7,520	1,160
	6	A2a+	P	0.9	1.5	30	20	5	143	20	5,720	580
NF Juncal Cr.	1	C3b	SI	1.0	2.5	40	5	30	80	?	1,600	
	2	B2a	P	0.5	1.5	40	10	10	48	110	960	1,760
	3	A2	P	0.8	2.0	10	5	20	13	20	130	500
	4	B2a	P	1.0	2.0	10	15	15	48	0	960	
Total above Jameson Reservoir:				2.5							16,890	4,000
Total steelhead potential:				3							15,800	3,500
Total Overall:				**101**							**217,142**	**118,716**
Total Steelhead Potential:				**69**							**202,271**	**92,096**

[1] P = perennial, S = seasonal, I = intermittent
[2] Spawning habitat available = reach length x width x % riffles x % gravels
[3] Estimated potential YOY or smolt production derived from available gravel spawning habitat, multiplied by 0.20 redds/m^2 (Reiser and White 1981), 2000 eggs/redd (Bulkley 1967), and 0.50 survival of eggs to fry (Bley and Moring 1988). Estimate further reduced by 0.50 if fine sediments 10-20% and 0.25 if fines >20%.
[4] Estimated current [1997] YOY production derived from observed salmonid fry densities projected over total reach length and multipliled by 0.20 for mortality to smolting.
[5] Total miles of creek = 2.8 miles (Engblom and Volan (2004c)
[6] Total miles of creek = 2.5 miles (Engblom and Volan 2004b)

Rearing Habitat

The primary rearing habitat that supports steelhead/rainbow trout fry into the early summer are low gradient riffles, runs, and glides (Chubb 1997). Rearing habitat quality is largely determined by the duration of water flow, moderate water temperatures, and the availability of cobble and small woody debris for use as cover (Chubb 1997). Streams that contain rearing habitat include the Santa Ynez River in all three reaches and:

- Cachuma Reach - Santa Cruz, West Fork Santa Cruz, East Fork Santa Cruz, Coche, Mine Canyon, Peach Tree, Grapevine, Oso, and Devil's Canyon creeks
- Gibraltar Reach - Gidney, Mono, Indian, Buckhorn, Blue Canyon, Escondido Canyon, Fox, and Alder creeks
- Jameson Reach - North Fork Juncal Creek

Chubb (1997) indicated that Juncal, Alder, and Fox creeks appear to have sufficient rearing habitat to support fry produced in spawning beds (Chubb 1997). Blue Canyon and Devil's creeks have relatively good spawning habitat, however, sufficient rearing habitat may not be available to support fry. Other streams that may provide good rearing habitat, but not necessarily prime spawning habitat include portions of the Santa Cruz, Mono, and Indian drainages (Chubb 1997). More recent data suggest that the upper portion of Santa Cruz Creek contained some of the best pool habitat surveyed in the drainage and also contained abundant numbers of steelhead/rainbow trout of multiple age classes (Engblom and Volan 2004a).

From a water temperature and cool water refugia perspective, reaches with denser canopy cover and cool water springs/seeps are likely to retain the coolest water temperatures through the late summer (Chubb 1997). Streams that are thought to provide such refugia are reaches of Juncal, upper Alder, Escondido, Fox, Indian, Devil's Canyon, and Santa Cruz creeks. Limited areas of the mainstem Santa Ynez River above Jameson and below Gibraltar reservoirs have any appreciable shading (Chubb 1997).

During recent habitat assessments of the Santa Cruz drainage (Engblom and Volan 2004a; Engblom and Volan 2004b; Engblom and Volan 2004c; Engblom and Volan 2004d), steelhead/rainbow trout were observed in nearly every reach of the streams sampled within the drainage. Generally, where water was present of adequate depth and favorable conditions existed for rearing or spawning habitat, steelhead/rainbow trout were observed. The West and East Forks of Santa Cruz Creek were surveyed, along with upper Santa Cruz, Coche and Grapevine creeks.

Contrary to Chubb (1997), Engblom and Volan (2004b) found more water flowing, better habitat conditions, and significantly more fish in West Fork Santa Cruz Creek than in East Fork Santa Cruz Creek. The upper reach of West Fork Santa Cruz Creek appeared to offer excellent rearing conditions (i.e., cooler water temperatures, many pools available, and abundant overhanging trees and riparian vegetation). However, overall numbers of steelhead/rainbow trout were lower in West Fork Santa Cruz Creek than in Coche or Grapevine creeks, primarily due to summer drying conditions (Engblom and Volan 2004b). Additionally, Engblom and Volan (2004b) were uncertain where the 30-foot waterfall was located in East Fork Santa Cruz Creek that Chubb (1997) mentions. Engblom and Volan (2004b) and Stoecker (2004) observed a significant passage barrier (but not 30-ft high) that may have been the waterfall that Chubb (1997) mentions near the headwaters of West Fork that completely blocks fish migration.

Multiple age classes of steelhead/rainbow trout were present in Coche Creek (Engblom and Volan 2004b). Although the pools tended to be more shallow, an abundant canopy and cool water temperatures created favorable rearing conditions in June 2004 (Engblom and Volan 2004b). Coche Creek had some of the best rearing habitat observed in the entire Santa Cruz watershed (Engblom and Volan 2004b). The lower portions of Coche Creek were dry/intermittent, but the mid to upper reaches were flowing after three years of average to below average rainfall (Engblom and Volan 2004b).

The upper portion of East Fork Santa Cruz Creek (upstream of Grapevine Creek) contained few pools and offered marginal summer rearing conditions (Engblom and Volan 2004c). The lower section of East Fork Santa Cruz Creek also held low numbers of steelhead/rainbow trout, which were usually observed downstream of pools and within pools (Engblom and Volan 2004d). However, the lower section of East Fork Santa Cruz Creek contained numerous large, deep pools that contained steelhead/rainbow trout during the November survey (Engblom and Volan 2004d). Steelhead/rainbow trout were not found in abundant numbers overall in the lower reach.

Lower Grapevine Creek had similar conditions to the upper portion of East Fork Santa Cruz Creek with multiple age classes of steelhead/rainbow trout present (Engblom and Volan 2004c). Engblom and Volan (2004c) found that there was a ¼-mile in the upper reach of the creek that was wetted and held a small residual population of trout. The remaining portion of the creek was completely dry except for the ½-mile portion that flows into East Fork Santa Cruz Creek (Engblom and Volan 2004c).

Barriers

Stream surveyors often reported barriers in the data sheets. A summary of barriers that are thought to block fish passage is provided in Attachment A. There were sometimes differences in opinion regarding the height of the barrier, or even the location of the barrier, in the various studies. The most recent and comprehensive survey for barriers to fish migration was conducted in 2003 (Stoecker 2004). However, lack of access to some private land resulted in some data gaps.

In the Cachuma Reach, barriers that may potentially block upstream migration at all flows were identified on the Santa Ynez River (Bradbury Dam), Santa Cruz (West Fork and East Fork), Coche and Devil's Canyon creeks (Attachment A). There was a 6-ft nearly vertical bedrock chute (complete passage barrier) that emptied into a shallow bedrock pool, located several hundred yards upstream of Coche Creek Campground in Coche Creek (Engblom and Volan 2004b, Stoecker 2004). No fish observed upstream of barrier, despite suitable habitat present (Engblom and Volan 2004b). On Devil's Canyon Creek, two tributaries form a confluence approximately 1/3 mile upstream from the last observed surface flow (Stoecker 2004). This area may represent the natural upstream limit to salmonid migration due to the steepness of the boulder gradient, lack of summer flow, multiple drops associated with boulder cascades, and higher quality habitat downstream (Stoecker 2004). In the middle section of East Fork Santa Cruz Creek, there is a lower waterfall that presents a 10 to 12-ft drop into a large bedrock pool (Stoecker 2004). The upper waterfall drops 12 to 15-ft into a large pool, which is likely to present a complete barrier to upstream migrants (Stoecker 2004).

Potential complete fish passage barriers (at all flows) in the Gibraltar Reach were identified on Gidney, Mono, Indian, Escondido, Blue Canyon, Agua Caliente, Fox, and Alder creeks (Attachment A). Three boulders in the lower section of Gidney Creek were impassable (USFS 1980d). There is a debris dam located on Mono Creek. The height of the dam from the downstream pool surface to the top of the spillway measures approximately 18 feet (Stoecker 2004). This dam is a complete barrier to migration (Stoecker 2004). A two-stage bedrock waterfall drops 16-ft into a 9-foot deep pool that spills water down an additional 27-foot drop on Indian Creek, which would serve as a complete barrier to steelhead/rainbow trout (Stoecker 2004). A 12.5-ft almost vertical bedrock chute/waterfall located 0.25 mile upstream of Blue Canyon Creek forms a complete barrier to upstream fish migration at all flows on Escondido Creek (USFS 1994a; Stoecker 2004). A boulder-debris jam 7-ft high with no downstream pool may serve as a complete barrier on Blue Canyon Creek (Stoecker 2004). Several complete passage barriers were noted on Agua Caliente Creek. Most notable is a concrete arch debris dam measured 58.5-ft tall from the surface of the downstream pool to the top of the main notch, which blocks fish passage (Stoecker 2004). A bedrock waterfall located approximately 750 feet upstream of the diversion measures approximately 30 tall on Fox Creek (Stoecker 2004). A 5-foot deep pool occurs downstream of the falls, which is complete barrier at all flows (Stoecker 2004). Above the diversion dam, an approximately 30-ft high bedrock waterfall flowing into a 5-ft deep forms a complete barrier on Alder Creek (Stoecker 2004).

In the Jameson Reach, a waterfall in the upper portion of North Fork Juncal Creek forms a natural, complete barrier to upstream migration, but trout habitat is available in downstream reaches.

Data Gaps

There were a few streams where habitat data were not available. These included Tequepis Canyon, Lazaro Canyon, Lion Canyon, Horse Canyon, Hot Spring Canyon, Los Laureles Canyon, Red Rock Canyon, Lewis Canyon, and Alamar creeks. Based off of a U.S. Geological Survey (USGS) topographic map, it appears that all of these streams, with the exception of Alamar Creek, may be perennial.

Many streams had weak habitat and/or weak population data. These include Cachuma, Peach Tree, Mine Canyon, Black Canyon, Gidney, Camuesa, and Buckhorn creeks, Santa Ynez River (Gibraltar and Jameson reaches), Gibraltar Reservoir, and Jameson Lake. Therefore, it may be conducive to investigate the potential of these streams for spawning and rearing habitat capacities, especially for streams where older information indicated favorable habitat may exist. Such streams that may contain favorable spawning and rearing habitat include Peach Tree, Gidney, and Buckhorn creeks and the Santa Ynez River (Gibraltar Reach).

Conclusion

The purpose of this memo was to summarize and compile available information on steelhead/rainbow trout habitat in the Upper Basin. The compiled information was then analyzed to determine where potential spawning and rearing habitat may exist for steelhead/rainbow trout. This assessment should be used as a tool to consider where additional studies may be needed in the Upper Basin for the study of steelhead/rainbow trout habitat. Based on the results of this analysis, the following streams may potentially provide favorable spawning and rearing habitat:

- Cachuma Reach – Santa Ynez River (Cachuma Reach), Santa Cruz, Coche, Peach Tree, and Devil's Canyon creeks
- Gibraltar Reach - Gidney, Mono, Indian, Buckhorn, Blue Canyon, Escondido Canyon, and Alder creeks
- Jameson Reach - North Fork Juncal Creek

Of these streams, complete passage barriers have been reported on: the Santa Ynez River (Bradbury Dam in Cachuma Reach), Coche, Devil's Canyon, Gidney, Mono, Indian, Blue Canyon, Escondido, and Alder creeks. However, in some cases, habitat was available downstream of the first barrier to upstream migration. In addition, the analysis for determining favorable spawning and rearing habitat was based primarily on older data for Peach Tree, Gidney, and Buckhorn creeks.

According to Chubb (1997), the streams that appear to provide the best spawning and rearing habitats are Alder and Blue Canyon creeks. Flow has been observed to go subsurface below the diversion in Alder Creek (ENTRIX 1995). Therefore, this should be considered for future management actions. Other streams that appear to provide both habitats, but of a lesser, good quality, are Juncal, Fox, and Devil's Canyon creeks (Chubb 1997). Santa Cruz, Mono, and Indian drainages may provide good rearing habitat, but prime spawning habitat does not appear to be available (although spawning habitat is present) (Chubb 1997). Additionally, other streams in the Upper Basin may offer good steelhead/rainbow trout habitat, such as (but not limited to) Gidney, Buckhorn, Escondido, and North Fork Juncal creeks, and possibly the Santa Ynez River mainstem. It would be beneficial to evaluate the potential of these streams identified in this analysis and Chubb's (1997) analysis for spawning and rearing habitat in future studies.

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Summary of Migration Barriers

An exerted effort was made to obtain all of the readily available existing information on steelhead/rainbow trout habitat in the Upper Basin. The USFS has conducted numerous studies in the Santa Ynez River watershed. A recent habitat assessment of the Santa Cruz drainage was conducted in May, June, and November of 2004 (Engblom and Volan 2004a; Engblom and Volan 2004b; Engblom and Volan 2004c; Engblom and Volan 2004d). Much of the information fish on migration barriers in the upper Santa Ynez River Basin was summarized from a passage barrier assessment conducted in 2003 (Stoecker 2004). Although the information collected by Stoecker (2004) is extensive, lack of written permission limited on-the-ground surveys on some private lands. Information regarding the type of barriers that partially or completely block upstream migration is summarized in Table A-1.

Table A-1 includes barriers identified as complete or partial, but not potential barriers for which insufficient information was available. Stoecker (2004, p. 9)) classified potential barriers into four categories as follows:

> "Complete Barrier
>
> Structures that exceed the upstream migration capabilities of steelhead were given a barrier status of complete.
>
> Partial Barrier
>
> Structures that would limit upstream migration to some degree, during various flows, were given this status. Due to the limited snapshot observation of barriers, high severity barriers that may be "complete" barriers were given partial status if conditions could not be accurately estimated during migration flows or only limited surveying access occurred. The cumulative impact of multiple partial barriers with variable flow passage windows can prevent upstream passage on that stream.
>
> Not a barrier
>
> These structures were observed to present no significant impediment to steelhead and/or smaller rainbow trout in their =current state. Stream conditions change and these structures may become impediments to fish passage in the future.
>
> Unknown
>
> Limited information about these structures was obtained and additional assessment is needed to determine impacts to fish passage."

Table A-1. Additional information regarding type of barriers that potentially block migration.

Streams with Barriers that Block Migration	Type of Barrier	Description of Barrier	References
		CACHUMA REACH	
Santa Ynez River, Cachuma Reach	Dam	Cachuma Dam blocks the upper 2/3 of the best spawning grounds in the Santa Ynez River system.	Evans 1950, Stoecker 2004
	Low Flows	Low flows during summer months isolate steelhead in deep pools between very shallow water.	Evans 1950
Santa Ynez River	Low Flow road crossing	Road crossing to Lower Oso day use area forms a partial barrier to migration, with shallow water depth during low flows.	Stoecker 2004
Santa Ynez River	Low Flow crossing	Paradise Road crossing upstream of Falls Day Use Area forms a partial barrier. Insufficient depth at moderate to low flows. Scour height and required jump to migrate onto the crossing presents a moderate to high degree of difficulty during moderate and high flows, respectively.	Stoecker 2004
Santa Ynez River	Low Flow crossing	Paradise Road crossing downstream of Live Oak Day Use Area forms a partial barrier to migration, with insufficient depth at low flows.	Stoecker 2004
Santa Ynez River	Low Flow crossing	Paradise Road crossing upstream of Live Oak Day Use Area forms a partial barrier to migration, with insufficient depth at low flows.	Stoecker 2004
Santa Ynez River	Low Flow road crossing	Paradise Road crossing upstream from Red Rock Day Use Area forms a partial barrier to migration, with insufficient depth at low flows.	Stoecker 2004
Santa Ynez River	Low Flow road crossing	Paradise Road crossing adjacent to Redrock Trailhead parking area forms a partial barrier to migration, with insufficient depth at low flows.	Stoecker 2004
Harvey's Creek	Culvert that may form a partial barrier	Long (175 ft), concrete arch culvert extending from Harvey's Cove to Highway 154 crossing was almost filled in with substrate and was classified as a partial barrier to migration. When Cachuma Reservoir is at maximum capacity, the culvert may be completely submerged.	Stoecker 2004
Cachuma Creek	Low Flows	Low flows during summer months isolate steelhead in pools between very shallow water.	CDFG 1954a

Table A-1. Continued.

Streams with Barriers that Block Migration	Type of Barrier	Description of Barrier	References
Cachuma Creek	Low Flow road crossing	Happy Canyon Road crossing may form a partial barrier to migration, with insufficient depth at low flows.	Stoecker 2004
Cachuma Creek	Steep gradient, Insufficient flow	Cachuma Creek upstream of the uppermost eastern tributary was dry. A 12-foot-long, natural, bedrock chute immediately upstream on the eastern tributary was classified as a partial barrier to migration, due to low summer flow and steep gradient.	Stoecker 2004
Lazaro Creek	Waterfall	A three-part bedrock waterfall forms a complete natural barrier to upstream migration.	Stoecker 2004
Soldier Home Creek (unnamed western tributary to Cachuma Creek)	Low Flow road crossing	Happy Canyon Road crossing upstream from Cachuma Camp was classified as a partial barrier at low flows due to streambed grade of the crossing and shallow depth in V on river-left. It was noted that a steep-gradient reach immediately upstream forms a complete, natural barrier.	Stoecker 2004
Lion Creek	Waterfall	A 13-ft-high waterfall with a shallow pool located approximately 1 mile upstream of the confluence with Cachuma Creek forms a natural, complete barrier to upstream migration.	Stoecker 2004
Tequepis Creek	Low Flow, Culvert crossing	A concrete box culvert was classified as a partial barrier, with insufficient water depth across the culvert during low flows.	Stoecker 2004
Santa Cruz Creek	Sediment deposit	A sediment deposit at the mouth of the creek at Cachuma Reservoir where flows were observed to go subsurface, and the lower 0.25 mile of creek was dry. During below-average water years, there may not be connectivity between reservoir and creek may not occur.	Stoecker 2004
East Fork Santa Cruz Creek	Waterfall	Three complete barriers have been observed in the middle section of the East Fork Santa Cruz Creek. Information is limited on the type of barrier. One is known to be a 30 ft waterfall 300 yards above the next confluence.	USFS 1980k (see Stoecker 2004 summary in the following).
East Fork Santa Cruz Creek	Waterfall	A 13-ft-high waterfall with a 9-ft vertical drop at the time of survey, was classified as a partial barrier. A 5-ft depth increase in lower pool during wet years may allow some adult steelhead to ascend.	Stoecker 2004

Table A-1. Continued.

Streams with Barriers that Block Migration	Type of Barrier	Description of Barrier	References
East Fork Santa Cruz Creek	Waterfalls	Lower waterfall presents a 10-12-ft drop into a large bedrock pool. Upper waterfall drops 12-15-ft into a large pool. Likely to present a complete barrier to upstream migrants.	Stoecker 2004
West Fork Santa Cruz Creek	Steep cascade and boulders	Large boulders form natural, complete barriers to upstream migration. Observed directly downstream of the upper sections of the creek where the two main 1st order branches meet to form WF Santa Cruz Creek.	Engblom and Volan 2004b, Stoecker 2004
Coche Creek	Waterfall, bedrock chutes	6-ft nearly vertical bedrock chute empties into shallow bedrock pool, located several hundred yards upstream of Coche Creek Campground. No fish observed upstream of barrier, despite suitable habitat present. Considered complete passage barrier.	Engblom and Volan 2004b, Stoecker 2004
San Rafael Mountain Creek	Steep boulder gradient	A boulder cascade (9-ft) with a shallow (0.5-ft) pool below is likely to prevent upstream migration.	Stoecker 2004
DeVaul Creek	Culvert crossing	This concrete arch culvert (9-ft wide, 8.5-ft tall, and 190-ft long) was perched upon a concrete apron. The apron itself was perched 18 inches to 3 feet above the creek. Both culvert and apron have a moderately steep gradient and would impede upstream migration.	Stoecker 2004
Hot Springs Creek	Culvert crossing	A 35-ft long box culvert and a 200-ft corrugated metal culvert are seperated by a 25-ft concrete channel. This long section would pose serious problems for upstream migrants due to high water velocities and a lack of resting sites.	Stoecker 2004
Kelly Creek	Low Flow, Concrete channelization	A 70-ft long concrete channel with a 1-ft lip above the downstream pool runs underneath the bridge. Natural scour has created a more natural stream bottom. Would pose an obstacle to upstream migration during lower flows.	Stoecker 2004
Bear Creek	Culvert crossing	A metal culvert 348-ft in length and perched 1.5-ft is likely to be a complete migration barrier due to very high flow velocities during the spawning season.	Stoecker 2004
Cold Springs Creek	Culvert crossing	A box culvert 50-ft in length lies perched nearly 6-feet above the downstream pool. May impede migration.	Stoecker 2004

Table A-1. Continued.

Streams with Barriers that Block Migration	Type of Barrier	Description of Barrier	References
Los Prietos Creek	Culvert crossing	This perched, corrugated metal culvert measured 6 feet in diameter and 50 feet long. The jump height from the downstream pool to the lip of the culvert measured 15 feet and is thus a complete barrier to ascending individuals.	Stoecker 2004
Oso Creek	Low Flow road crossing	This low-flow concrete crossing spans the stream channel and measured 14 feet wide. The crossing is elevated above the natural streambed a maximum of 5 inches and has a mild to flat slope. Would impose a barrier at low flows.	Stoecker 2004
Oso Creek	Waterfall	This bedrock waterfall drops vertically 10 feet into a small 12-inch deep pool downstream. A complete barrier.	Stoecker 2004
Devil's Canyon Creek	Low Flow Culvert crossing	Two 5-foot diameter corrugated metal culvert pipes measured 18 feet long, located 300 feet upstream of the confluence with the Santa Ynez River. A 4-foot drop occurs from the lip of the 30-ft long apron to the downstream substrate. A partial barrier.	Stoecker 2004
Devil's Canyon Creek	Waterfalls	Impassable falls one mile upstream from diversion.	Chubb 1997
Devil's Canyon Creek	Steep gradient / Insufficient flow	Two tributaries form a confluence approximately 1/3 mile upstream from the last observed surface flow. This area may represent the natural upstream limit to salmonid migration due to the steepness of the boulder gradient, lack of summer flow, multiple drops associated with boulder cascades, and higher quality habitat downstream.	Stoecker 2004
		GIBRALTAR REACH	
Santa Ynez River, Gibraltar Dam	Dam	Gibraltar Dam, located approximately 0.25 mile upstream from Devils Canyon Creek forms a complete barrier to upstream migration.	Stoecker 2004
Santa Ynez River	Low Flows road crossing	First LPNF road crossing downstream of Juncal Dam forms a partial barrier to migration, with absent or shallow water depth at low flows. Turbulence over apron at moderate and high flows results in moderate to high difficulty for adult steelhead and may impede passage for small salmonids.	Stoecker 2004
Santa Ynez River	Low Flow road crossing	Romero Camuesa Road crossing at Juncal Campsite forms a partial barrier to migration, with insufficient depth at low flows	Stoecker 2004

Table A-1. Continued.

Streams with Barriers that Block Migration	Type of Barrier	Description of Barrier	References
Gidney Creek	Boulder	Three boulders in the lower section of Gidney Creek were impassable.	USFS 1980d
Mono Creek	Debris Dam (Mono Debris Dam)	The dam was built to catch sediment bound for the downstream reservoir. The height of the dam from the downstream pool surface to the top of the spillway measures approximately 18 feet. The lack of a fish pass makes this dam a complete barrier to migration.	Stoecker 2004
Indian Creek	Low Flow Road crossing	This low-flow Camuesa Road crossing measured 13-ft wide and spanned 125-ft across the stream channel. The surface of the concrete crossing has a mild downstream slope. During the observed dry conditions, a vertical drop of 2 feet was measured from the downstream crossing surface lip to the downstream natural streambed.	Stoecker 2004
Indian Creek	Low Flow Road crossing	This low-flow Canesa Road crossing measured 13 feet wide. The concrete surface of the crossing has a mild downstream slope. An apron extends 3 to 5 feet downstream of the crossing with a total drop of 4 feet from the crossing surface to the downstream natural streambed. The slope of the apron varies from approximately 30 to 45 degrees.	Stoecker 2004
Indian Creek	Low Flow Road crossing	This low-flow Canesa Road crossing measured 13 feet wide. The concrete surface of the crossing has a mild downstream slope. A vertical drop varying between 12 and 18 inches occurs from the crossing surface to the downstream substrate.	Stoecker 2004
Indian Creek	Weir	A Concrete V-shaped weir spans the channel. A vertical drop of 4 feet 6 inches occurs from the low point of the V to the surface of the downstream pool. The downstream pool had a maximum depth of 4 feet 6 inches. May pose a barrier at certain flows.	Stoecker 2004
Indian Creek	Waterfall	A two-stage bedrock waterfall drops 16-ft into a 9-foot deep pool that spills water down an additional 27-foot drop. This feature would be a complete barrier to salmonids.	Stoecker 2004
Indian Creek	Waterfalls	11 complete barriers were observed below narrows camp in the middle section of Indian Creek. Barriers range from 4 ft to 20 ft.	CDFG 1933

Table A-1. Continued.

Streams with Barriers that Block Migration	Type of Barrier	Description of Barrier	References
Buckhorn Creek	Insufficient flow	A small 4-foot wide gully with upland grasses growing in the channel and no sign of perennial flow or adequate spawning habitat. Poor habitat upstream and lack of water would imply this is an uppermost barrier.	Stoecker 2004
Roblar Creek	Waterfall	A bedrock waterfall over 20 feet tall was observed. This waterfall is impassable during all flows due to the excessive jump height. Several excellent, deep pools were observed downstream from this waterfall providing good salmonid habitat.	Stoecker 2004
Pine Canyon Creek	Waterfall	A bedrock waterfall approximately 20 feet tall was observed where the canyon becomes confined and turns sharply to the north. This waterfall is impassable during all flows due to the excessive jump height. Several excellent, deep pools were observed downstream from this waterfall providing good salmonid habitat.	Stoecker 2004
Blue Creek	Steep gradient	A Boulder-debris jam 7-ft high with no downstream pool may pose as a complete barrier.	Stoecker 2004
Escondido Creek	Bedrock Chute or waterfall	A 12.5-ft almost vertical bedrock chute/waterfall located 0.25 mile upstream of Blue Canyon Creek forms a complete barrier to upstream fish migration at all flows.	Stoecker 2004, USFS 1994a
Agua Caliente Creek	Debris Dam (Pendola Debris Dam)	A concrete dam 18.5-ft high lacking any fish passage facility completely blocks all upstream movement of fish.	Stoecker 2004
Agua Caliente Creek	Low Flow Road crossing	The 12.5-ft road crossing is perched on an apron over the stream channel. The apron has a 2-ft drop over 6 horizontal feet. A 6-inch drop from the road surface occurs to the top of the concrete apron. Likely to be a partial barrier at most flows and a complete barrier at low flows.	Stoecker 2004
Agua Caliente Creek	Low Flow Road crossing	This 12-ft road crossing is perched on an apron over the stream channel. The steep apron drops vertically 3 feet and projects horizontally 4 feet downstream from the crossing. The downstream pool had a maximum measured depth of 4.5-ft and undercuts the crossing several feet. Likely to be a partial barrier at most flows and a complete barrier at low flows.	Stoecker 2004

Table A-1. Continued.

Streams with Barriers that Block Migration	Type of Barrier	Description of Barrier	References
Agua Caliente Creek	Low Flow Road crossing	This 16-ft road crossing is perched on an apron over the stream channel. The surface of the concrete crossing has a flat to mild slope. The apron drops at a 45-degree angle, but is submerged for the middle 30 feet of the crossing by up to 15 inches of water. Deposited sediment has accumulated to the top of the upstream side of the crossing. Not likely to pose a barrier at low flows but may impede upstream passage of small fish during higher flows.	Stoecker 2004
Agua Caliente Creek	Debris dam	This concrete arch dam measured 58.5-ft tall from the surface of the downstream pool to the top of the main notch. No fish passage facility makes this a complete barrier to migration.	Stoecker 2004
Agua Caliente Creek	Bedrock chute	A series of bedrock chutes and small waterfalls extend for 300-ft making this a complete barrier to migration.	Stoecker 2004
Fox Creek	Waterfall	One complete barrier 5 ft tall in the lower section of Fox Creek.	Chubb 1997, USFS 1980m
Fox Creek	Diversion Dam	This concrete diversion dam presents a 4-ft tall obstacle to upstream migrants. The downstream pool was only 3 inches deep at the time of monitoring. This would present a complete barrier during low flows and may be partial barrier during higher flow times.	Stoecker 2004, Chubb 1997
Fox Creek	Waterfall	A bedrock waterfall located approximately 750 feet upstream of the diversion measures approximately 30 tall. A 5-foot deep pool occurs downstream of the falls. A complete barrier at all flows.	Stoecker 2004, Chubb 1997, USFS 1980m
Alder Creek	Man-made, but passage restored	USFS (1994j) indicated a man-made fish barrier located at the mouth of the creek limited upstream migration of fish during higher winter flows. However, Stoecker (2004) observed that modification of a pipeline crossing formerly protected within a wire-and-stone basket dam, restored fish passage at the mouth of Alder Creek.	USFS 1994j, Stoecker 2004
Alder Creek	Low Flow Flume crossing support structure	Concrete footing structure supporting a flume that carries water from Alder Creek diversion dam to Jameson Reservoir forms a partial barrier to migration, impeding passage at low flows.	Stoecker 2004, USFS 1994j

Table A-1. Continued.

Streams with Barriers that Block Migration	Type of Barrier	Description of Barrier	References
Alder Creek	Diversion dam	The dam measured 10 feet tall from the top to the surface of the 3.5-ft deep downstream pool. If forms a complete barrier to upstream migration except at high flow, when the downstream pool depth may increase significantly to allow fish to leap over the dam. The diversion diverts water to the flume to Jameson Lake through a partially screened flume, and fish may be entrained when flow is diverted.	Stoecker 2004, USFS 1994j
Alder Creek	Waterfall	An approximately 30-ft high bedrock waterfall flowing into a 5-ft deep forms a complete barrier.	Stoecker 2004
Morse Creek	Waterfall	This bedrock and boulder waterfall measured 11-ft tall from the top to the downstream substrate. No pool occurred during the dry conditions encountered. A complete migration barrier.	Stoecker 2004
		JAMESON REACH	
Santa Ynez River Juncal Dam	Dam	Juncal Dam forms a complete barrier to upstream migration	Stoecker 2004, CDFG 1934
Santa Ynez River	Low Flow road crossing	#1 LPNF road crossing upstream of Jameson Reservoir forms a partial barrier to migration, with insufficient depth over road and boulder apron.	Stoecker 2004
Santa Ynez River	Low Flow, Steep gradient, insufficient flow	Approximately 0.25 mile upstream from the confluence with Steelhead Creek, naturally steep boulder gradient reaches, with drops up to 9 feet tall and limited downstream pool formation may form partial barriers to migration at low flows.	Stoecker 2004
Juncal Gate Creek (unnamed northern tributary at #2 Juncal Campsite gate)	Low Flow Road crossing	The crossing measured 14 feet wide and has a flat to mild slope. A boulder and concrete apron extends 6 feet downstream at a moderate gradient and with a maximum drop of 6.5-ft. This presents a complete barrier at low flows and a partial barrier at higher flows.	Stoecker 2004
North Fork Juncal Creek	Waterfall	The total height of this bedrock waterfall measured 21-ft from the top to the surface of the 7-ft deep downstream pool. Impassable during all flows.	Stoecker 2004

Table A-1. Continued.

Streams with Barriers that Block Migration	Type of Barrier	Description of Barrier	References
Steelhead Creek (unnamed northern tributary at Upper Santa Ynez Campsite)	Low Flow Road crossing	The crossing measured 14-ft wide and has a flat to mild slope with significant wear and irregular depressions with up to 4 inches of water depth. A steep, concrete and boulder apron extends for 10 feet downstream, dropping a height of just over 6-ft to the surface of the 3-ft deep downstream pool. This structure significantly impedes upstream migration to excellent salmonid spawning and rearing habitat.	Stoecker 2004
Steelhead Creek (unnamed northern tributary at Upper Santa Ynez Campsite)	Bedrock Chute	This bedrock chute measured 10-ft 4 inches tall and drops at a 45-degree angle to a tiny 6-inch deep pool downstream. A boulder cascade also occurs 300-ft downstream that drops 9-ft into a 4-ft deep pool. This feature likely represents the historic upstream natural limit to steelhead migration on the Santa Ynez.	Stoecker 2004

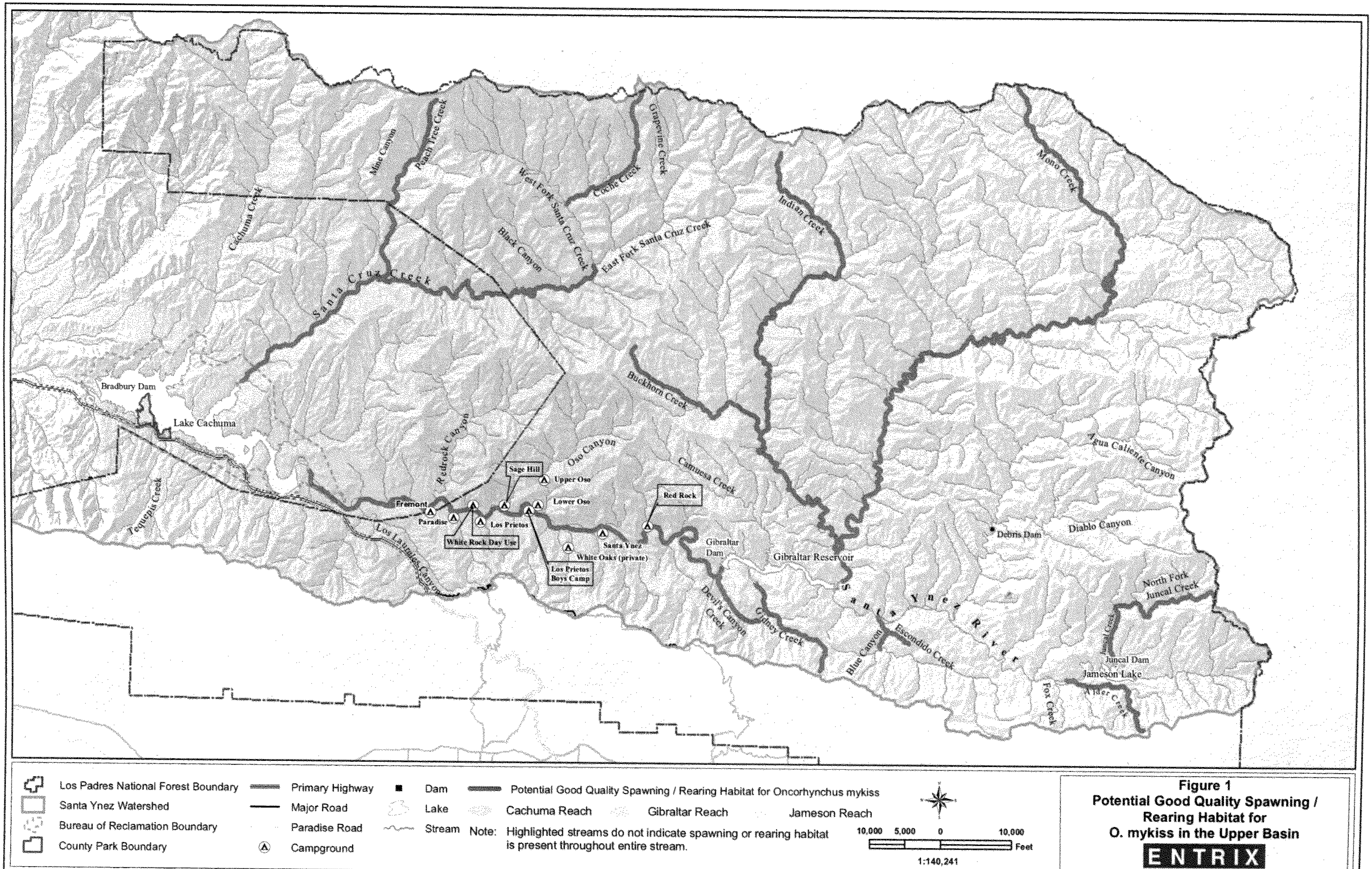

Figure 1
Potential Good Quality Spawning / Rearing Habitat for O. mykiss in the Upper Basin

ENTRIX