Southern Subbasin
Findings and Recommendations

Overview

The Southern Subbasin begins at the northern end of Little Lake Valley just north of Willits and includes all of the headwater tributaries. This Subbasin has an area of 64 square miles (40,737 acres) and represents approximately 45% of the Outlet Creek Basin.

Willits is the principal community. Ninety-eight percent of the Subbasin is privately owned. The population is estimated at 11,239 residents.

The dominant geology is Coastal Belt, Pliocene-Pleistocen valleys fill, and Quaternary alluvium. The geology, topography and climate combine to cause high erosion and fine sediment contribution into Outlet Creek, from this subbasin which moves downstream through the Middle and Northern Subbasin and into the Eel river system. Open grasslands, oak woodlands, and mixed coniferous forest cover the east-facing slopes, while redwoods, tan oak and bay trees dominate the west slopes of the valley. The land uses include grazing, ranching, timber production, and small and large rural residential and commercial properties.

The average precipitation is approximately 45 inches per year which mainly falls as rain. There are approximately 27 miles of blueline streams which range in elevation between 1,310 to 2,400 feet.

Chinook and coho salmon, and steelhead trout spawn and rear in this Subbasin. Late fall and early winter rainfall is impounded by six dams located in this Subbasin. Impounding this flow inhibits the upstream adult Chinook and coho salmon spawning migration to Outlet Creek and the Eel River system. During late summer and early fall, flows dry and become subsurface in some of the tributaries, stranding and causing mortality to juvenile salmonids. Natural low flow conditions are severely reduced by legal and illegal dewatering.

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In this subbasin, several species have been introduced such as big and small mouth bass, sunfish, and bull frogs. Sacramento pike minnow were not observed in this subbasin during this study. Invasive plant species included periwinkle, pampas grass, star thistle, Himalayan blackberry, and *Arundo*.

Baechtel and Davis, second order streams, Broaddus, Mill and Willits, first order streams, and Haehl, an intermittent stream, are the largest perennial streams that drain into Little Lake. This subbasin is characterized by high gradient headwater streams draining into a seasonal lake which was channelized to facilitate draining. The overflow of Outlet Creek was the dredged thalweg of Little Lake. The channel characteristics range from high gradient seasonal streams to a seasonal lake. The lower reaches of the streams are characterized by low gradient, low sinuosity and depositional conditions with sand, gravel, and cobble dominated substrates. The upper reaches are higher gradient with large cobble and bedrock substrates (Table X. Attributes of the main tributaries in the Southern Subbasin and Figure X. Southern Subbasin showing large streams and Stream Order).

Table X. Attributes of the main tributaries in the Southern Subbasin

Stream	Length (Mi)	Stream Order	Channel Type	Characteristics
"Outlet" Little Lake	1.8	2nd	F3	A natural deepening of a thalweg-like area existed through Little Lake. This channel was dredged to centralize the flow of the streams flowing into Little Lake. This channel was named Outlet Creek because it was the outlet from Little Lake. This channel connected Broaddus and Baechtel creeks to the thalweg through the Lake.
Baechtel	3.2	1st and 2nd	B2, F4	The gradient is less than 2% and is well confined, slightly entrenched, with the lower reach having leveed stream banks.
Broaddus	2.8	1st	G5, F4	Moderate gradient with entrench gully stream banks or leveed stream banks with the uppers reach having low gradient and well entrenched stream banks. Gradient increases in the headwaters.
Willits	9.3	1st	B4	Moderately entrenched with moderate gradient (2-4)
Davis	12.3	2nd	F4	Well entrenched with meandering riffle/pool channel on low gradients with high width/depth ration dominated gravel substrate.
Mill	4.9	1st	F4	Well entrenched with meandering riffle/pool channel on low gradients with high width/depth ration dominated gravel substrate.
Berry				
Haehl	5.1	Intermittent	G4	Moderate gradient (2-4%) well entrenched, with a low width/depth ratio and predominantly gravel substrate.
Berry	5.5	1st	F4	Low gradient (< 2%) entrenched, meandering riffle/pool channel with high width/depth ratio.

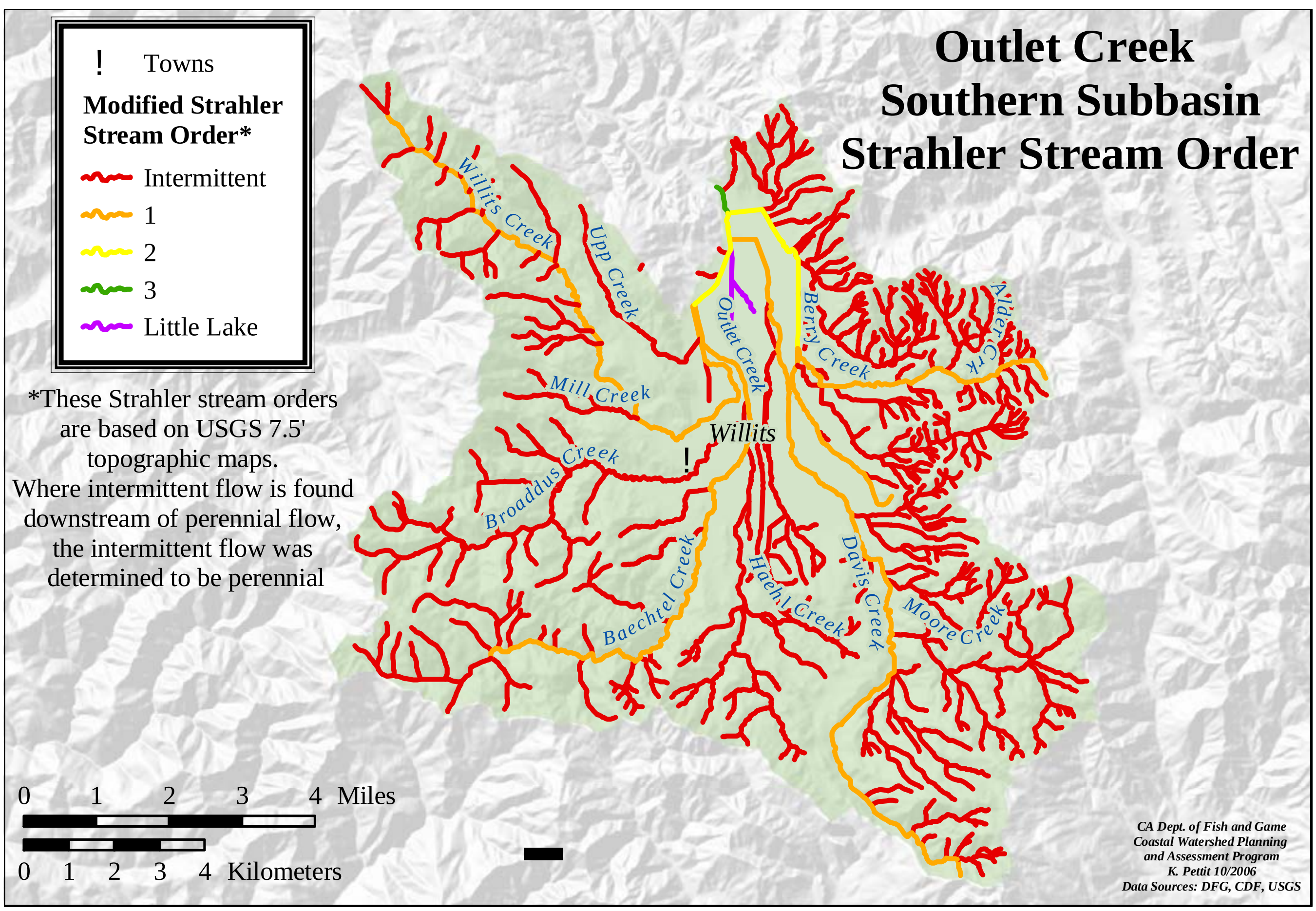

Figure X. Southern Subbasin showing large streams and Stream Order

Issues
Public scoping meetings with Outlet Creek Basin residents and constituents, and initial analyses of available data by DFG fishery biologists developed this working list of general issues:

- Decreases in the salmonid populations have occurred and well as reduced habitat quantity and quality;
- Flows are impounded by six dams located on Boy Scout/Rowe, Davis, and Willits creek;
- Low or no flow conditions eliminate summer rearing habitat.
- Residents state that bypass flow releases do not exist regularly on Davis creek;
- Significant Legal and illegal dewatering occurs throughout this subbasin;
- Summer water temperatures are unsuitable in most tributaries;
- Fine sediment contribution from poorly maintained roads and stream crossings affect the instream habitat in this subbasin and is transported to the Middle and Northern Subbasins.
- Fine sediment from alluvium geology in this subbasin is transported and deposited into the Northern and Middle subbasins;
- Stream bank erosion is common to Coastal Belt geology, but is significantly increased by the placement of roads and railroad lines in the floodplains, absent or sparse riparian cover, and grazing livestock;
- Stream bank erosion caused by down cutting from dams, livestock and absence or sparse riparian is common;
- Stream routing and channelization for city and farm roads and railroad, farming, ranching, and subdivisions have significantly changed the fluvial continuity of the lower reaches of the tributaries in the Southern Subbasin.
- Water quality may be affected by nutrients and bacteria from livestock and sewage and other inorganic pollutants;
- Low canopy density over the streams is contributing to water evaporation and elevated summer water temperatures;
- Timber harvests in the riparian zone prior to the Forest Practice Rules has reduced the instream large woody debris recruitment potential;
- Natural and man-made barriers decrease available spawning habitat in several tributaries;
- Investigate the Morris Dam effluent;
- Canopy cover is limiting on Davis and Conklin creeks;
- Invasive plant species can be observed;
- Non-native introduced species, such as bullfrogs are preying upon young-of-the-year, and juvenile salmonids as they migrate down stream to the mainstem Eel River;
- Legacy effects are still being transported downstream from the 1955 and 1964 floods and are still impacting Little Lake and the lower reaches of the tributaries. These effects can be observed by widened floodplains, absent riparian vegetation, and elongated sediment bars.

Fish Habitat Relationship

Historic Habitat Conditions

Analyses of the past conditions of the Southern Subbasin were reconstructed from the best available data, historic photographs, newspapers, diaries, and anecdotal information.

Flow and Water Quality

- Fall and winter rains provided flows which were unobstructed by dams and levees;
- Summer and fall flows were used by fish, wildlife, and a few hundred Pomo Indians;
- A seasonal lake called "Little Lake" formed by early fall and winter rain.

Erosion and Fine Sediment

- Instream fine sediment was lower because of the floodplains were connected to the stream banks;
- Stream banks were covered with native plant species;
- Spawning substrate was available and regularly recruited to the channel from stream banks and landslides.

Riparian and Instream Habitat

- Riparian areas were well developed and the vegetation consisted of willow, alder and ash and included more coniferous species;
- Old growth redwood and Douglas Fir species were part of the riparian and upslope vegetation;
- The riparian area helps insolate streams from solar radiation reducing stream water temperatures;
- Large woody debris was recruited from the well developed, old growth riparian area;
- Stream banks shifted course naturally and meandered.

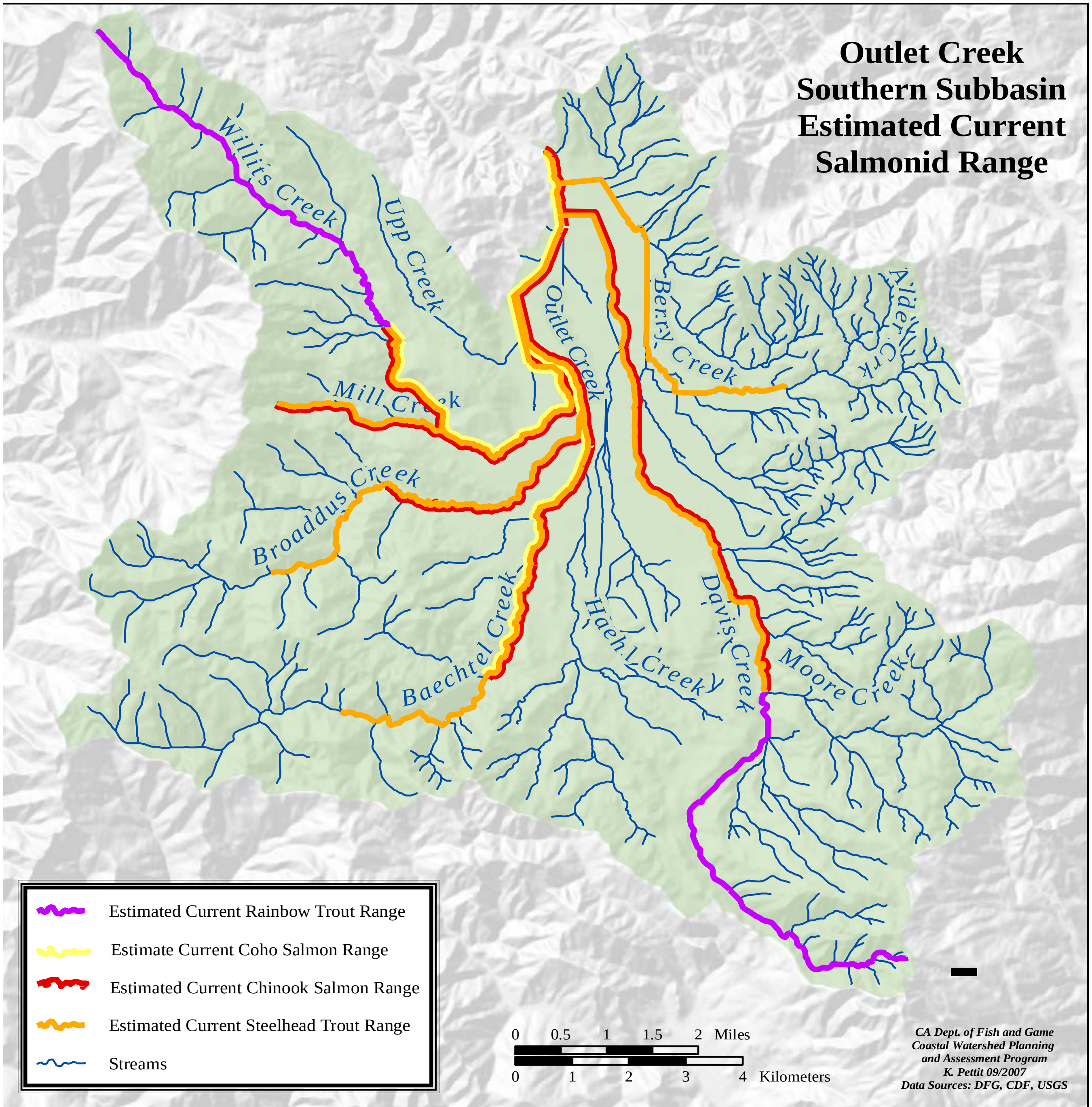

Figure X. Outlet Southern Subbasin Estimated Current Salmonid Range

Current Habitat Conditions

Chinook salmon, coho salmon, and steelhead trout utilize headwater streams such as Bechtel, Broaddus, Willits, Davis, and Mill creeks, through Little Lake out to Outlet Creek, the Eel River estuary, and the Pacific Ocean for parts of their life history cycles. There are several factors necessary for the successful completion of an anadromous salmonid life history.

The subbasin is inhabited by Chinook and coho salmon, steelhead, and rainbow trout. Coho salmon have been infrequently observed in the recent past. No population data has been collected nor have estimates been made for salmonids in the subbasin. In 2004, snorkel surveys were conducted according to the Ten Pool protocol at the GRTS survey sites which had some flow. Juvenile salmonids were observed at the sites surveyed. The current summer and fall water temperatures and low flow conditions in this subbasin are more supportive to Chinook and steelhead trout than to the coho life history.

Flow and Water Quality

Suitable flow and summer water temperatures are vital to maintaining healthy salmonid populations.

In the freshwater phase in salmonid life history, adequate flow, free passage, good stream conditions, and functioning riparian areas are essential for survival. Adequate instream flow during low flow periods is essential for fish passage in the summer time, and is necessary to provide juvenile salmonids free forage range, cover from predation, and utilization of localized temperature refugia from seeps, springs, and cool tributaries.

Stream condition includes several factors: adequate stream flow, suitable water quality, suitable stream temperature, and complex habitat. For successful salmonid production, stream flows should follow the natural hydrologic regime of the basin. A natural regime minimizes the frequency and magnitude of storm flows and promotes better flows during dry periods of the water year. Salmonids of the Outlet Creek Basin, such as those in the Southern Subbasin and its tributaries evolved with the natural hydrograph, and changes to the timing, magnitude, and duration of low flows and storm flows disrupt the ability of fish to follow their life history cues.

Important aspects of water quality for anadromous salmonids are temperature, turbidity, chemistry, and sediment load. In general, suitable temperatures for salmonids are between 48-56°F for successful spawning and incubation, and between 50-52°F and 60-64°F, depending on species, for growth and rearing. Additionally, cool water holds more oxygen, and salmonids require high levels of dissolved oxygen for all stages of their life cycle.

Another important aspect of water quality is turbidity. Fine suspended inorganic or organic materials (turbidity) affect nutrient levels in streams that in turn affect primary productivity of aquatic vegetation and insect life. This eventually reverberates through the food chain and affects salmonid food availability. Additionally, high levels of turbidity interfere with a juvenile salmonids’ ability to feed and can lead to reduced growth rates and survival (Bill Trush, Trush & Associates; personal communication).

Water velocity requirements differ with the salmonids life cycle (Table X Water velocity and temperature suitability ranges for coho salmon life stages). Water velocities requirements range from 0.30-8.0 ft/s while temperatures requirements range from 35-65 F.

Table X. Water velocity and temperature suitability ranges for coho salmon life stages.

Life Stage	Velocity (ft/s)	Reference	Water Temp (F)	Reference
Migrating Adult	<8.0	Reiser and Bjornn 1979	44.6-59.0	Reiser and Bjornn 1979
Spawning Adult	0.98-2.46; 1.2; 1.9 0.98-2.99	Briggs 1953 Reiser and Bjornn 1979 Reiser and Bjornn 1991	39.2-48.2	Reiser and Bjornn 1991
Rearing juvenile	0.30-0.98 (preferred age 0) 1.02-1.51 (riffle) 0.3-0.79 (pool)	Reiser and Bjornn 1979 PFMC 1999	35 lower lethal 78.8-83.8 upper lethal 48-59.9 optimum 63.7-64.9 MWAT 62.1 MWAT	Reiser and Bjornn 1991 Flosi et al. 1998 Ambrose and Hines 1997 Hines and Ambrose ND Welsh et al. 2001
Egg and Fry	0.82-2.95	PFMC 1999	39.2-51.8 39.2-55.4 32.-62.6	Davidson and Hutchinson 1938 Reiser and Bjornn 1991 PFMC 1999

During the summer and fall of 1995 and 2004, flows were taken as part of the habitat inventory and GRTS surveys on Willits, Broaddus, Baechtel, Berry, and Davis creeks. The flows ranged from 0.25- 2.0 cfs in 2003. In 2004, flows were subsurface on Baechtel, Broaddus and Mill creeks however no flow conditions were observed at numerous locations throughout the Subbasin which were not surveyed due to random sampling protocols. In both 1995 and 2004, DFG survey crews encountered many legal and illegal sites where water extraction operations were draining pools and creating areas of dry channel (barriers) resulting in juvenile salmonid mortality

Eight sites had thermographs deployed in the Southern Subbasin beginning in 2000 and continuing to 2004. Not all of the 8 sites were sampled every year except in 2004 for this watershed assessment. Three of the sites had multiple years of data. (Figure X. MWAT survey sites in 2004 in the Southern Subbasin). For the five year average summer water temperature of the 8 sites was 65.9, which is considered somewhat suitable for salmonids. (Table X. MWATs from the monitoring sites in the Southern Subbasins from 2000- 2004 and Figure X. MWAT survey sites in 2004 in the Southern Subbasin).

Summer water temperatures may be limiting factor in the Southern Subbasin on the lower Baechtel and lower Broaddus creeks sites from 2000-2004. Baechtel, Broaddus, and Willits creeks provide thermal refugia to juvenile coho and steelhead trout.

Table X. MWATs from the monitoring sites in the Southern Subbasins from 2000- 2004

Tributary and Location	MWAT (°F)	MWAT (°C)	Week Starting	EMDS Suitability Rating
Willits Creek below Summer Lake 2004	62.5	16.9	July 25	Somewhat suitable
Willits Creek above Summer Lake 2004	67	19.4	July 22	Moderately unsuitable
Willits Creek Upper above Lake Emily 2004	62.7	17.1	July 22	Somewhat suitable
Broaddus (Lower) 2004	66	18.9	July 24	Somewhat Unsuitable
Broaddus (Lower) 2002	63.7	17.6	July 10	Somewhat suitable

Broaddus (Lower) 2001	63.2	17.3	July 31	Somewhat suitable
Broaddus (Lower) 2000	66.2	19	June 15	Undetermined
Baechtel (Upper) 2004	74.4	23.6	September 4	Unsuitable
Baechtel (Lower) 2004	65.7	18.7	July 23	Somewhat unsuitable
Baechtel (Lower) 2002	63.3	17.4	July 18	Somewhat suitable
Davis Creek Lower (2004)	68.7	20.4	July 3	Unsuitable
Davis Creek Upper (2004)	71.0	21.7	July 3	Unsuitable
Conklin Creek 2003	63.4	17.4	Aug 31	Somewhat suitable
Southern Subbasin 2000-04	65.9	18.8	July 15-Aug 31	Somewhat suitable

MWATs: fully suitable (50-60°F), moderately suitable (61-62°F), somewhat suitable (63°F), undetermined (between somewhat suitable and somewhat unsuitable) (64°F), somewhat unsuitable (65-66°F), moderately unsuitable (67°F), unsuitable (>68°F). Seasonal Maximum Temperature: >75°F lethal.

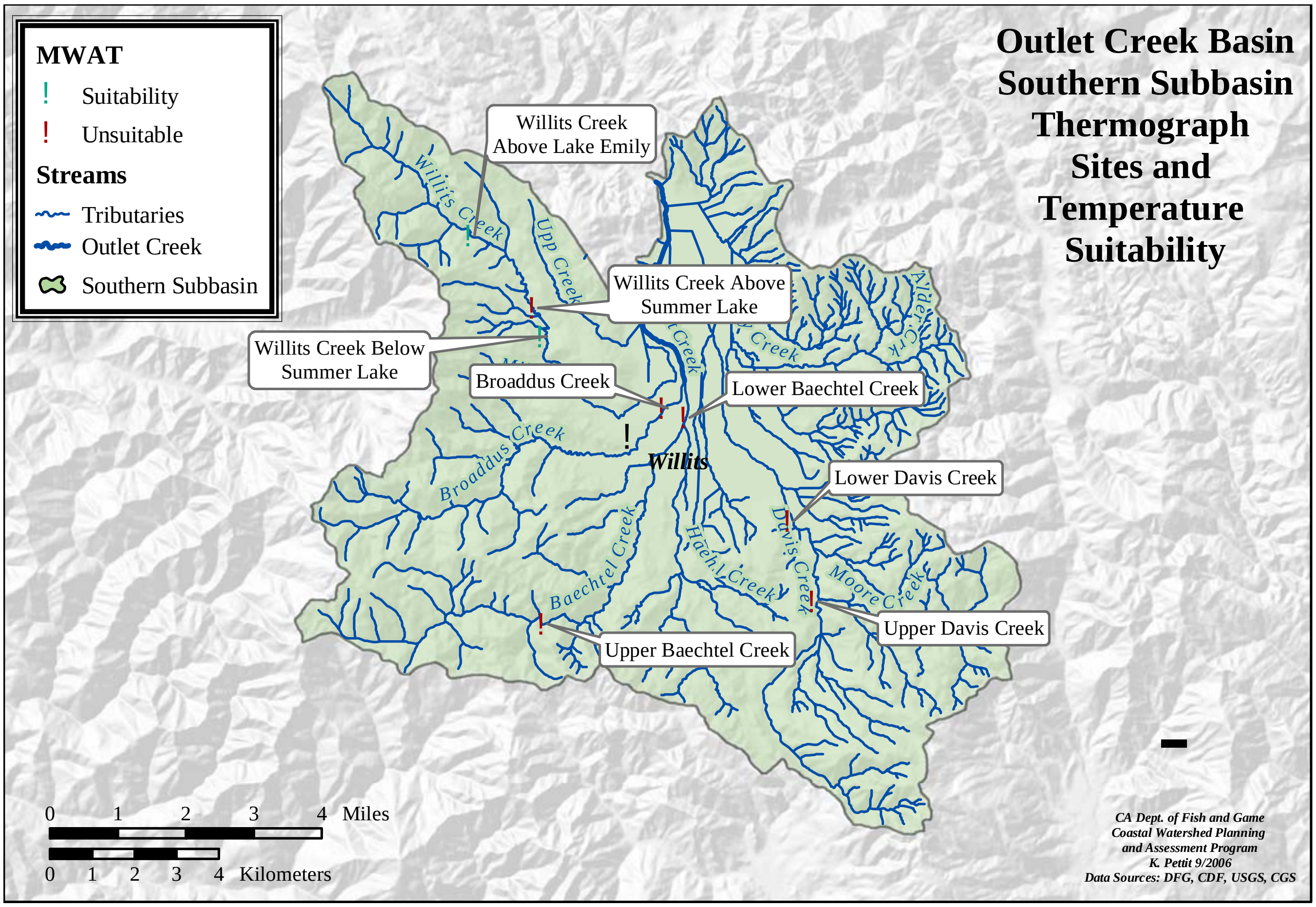

Figure X. MWAT survey sites in 2004 in the Southern Subbasin.

Turbidity and conductivity samples were taken at each of the 24 GRTS site in 2004. In the Southern Subbasin overall, turbidity and conductivity ranged from 1.1-80.0 and 346-1,110, respectively. Berry Creek's turbidity and conductivity ranged from 3.2-17.0 and 660-1,110, respectively. Baechtel Creek's turbidity and conductivity ranged from 1.1-3.7 and 285-574, respectively. Broaddus Creek's turbidity and conductivity ranged from 1.9-4.1 and 350-931, respectively. Davis Creek's turbidity and conductivity ranged from 1.2-45.0 and 347-947, respectively. Willits Creek's turbidity and conductivity ranged from 1.2-45 and 350-582, respectively. Mill Creek's turbidity and conductivity was 7.5 and 902, respectively.

Table X. Turbidity and conductivity collected in 2004 in the Southern Subbasin

Stream	Number of Sites	Range of Turbidity (NTU)	Range of Conductivity
Berry Creek	2	3.2-17	660-1110
Baechtel Creek	3	1.1-3.7	285-574
Broaddus Creek	5	1.9-4.1	350-931
Davis Creek	7	1.4-80	347-947
Willits Creek	6	1.2-45	350-582
Mill	1	7.5	902
Southern	24	1.1-80	346-1110

Instream Habitat (1995, 2003, and 2004)

There are 39.4 perennial stream miles on 6 perennial tributaries in this subbasin. The surveys included channel typing using the classification system developed by Rosgen (1996), habitat typing and biological sampling as described in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al. 1998). In addition, the 2004 survey sites were photo documented, recorded the amphibians species observed, conducted pebble counts, and LWD surveys.

Analyses of the current conditions in the Southern Subbasin were based upon stream habitat inventories conducted in 1995 and 2003 which surveyed Broaddus, Baechtel, Willits, Haehl and part of Davis creeks (Figure X. Southern Subbasin Habitat Surveys 1995 and 2003). The General Random Tessellation Surveys conducted in 2004 surveyed random sections of the streams, with the addition of Davis, Mill and Berry creeks, and the exclusion of Haehl Creek (Figure X. GRTS Sampling in the Southern Subbasin in 2004). Only streams where land owner access was granted were available to be surveyed in 1995 through 2004.

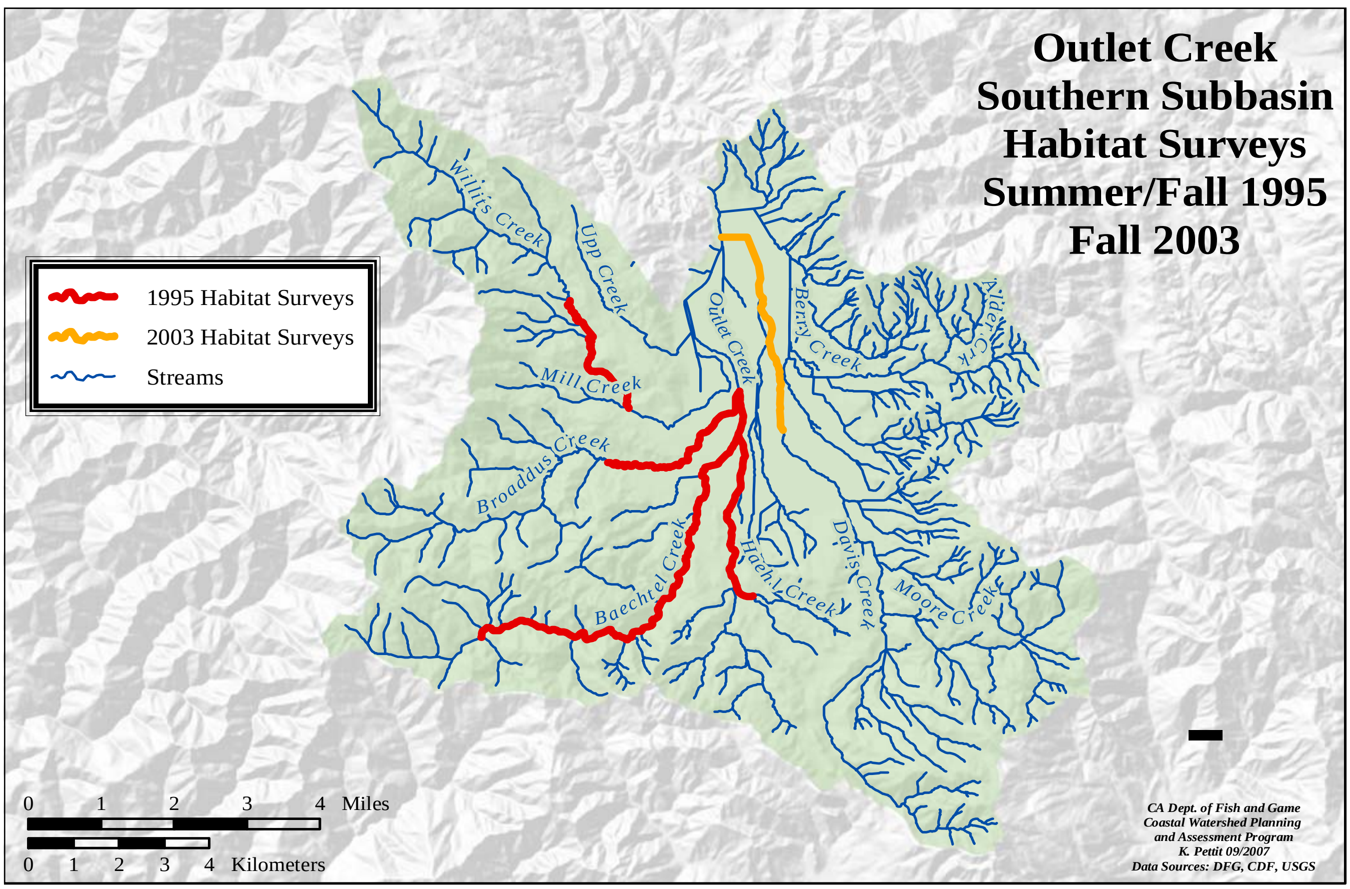

Figure X. Southern Subbasin Habitat Surveys 1995 and 2003.

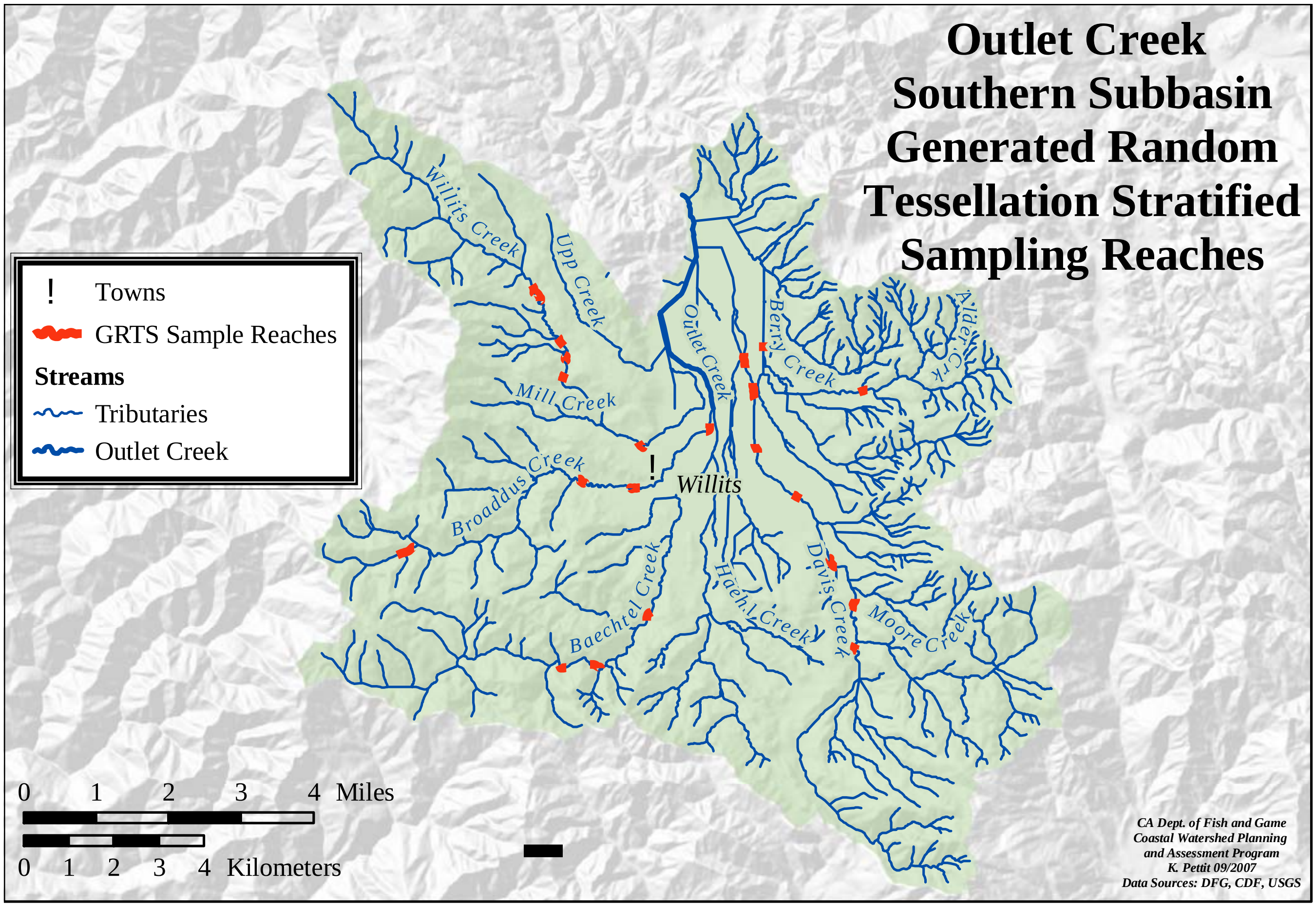

Figure X. GRTS Sampling in the Southern Subbasin in 2004.