METHODS

This section discusses the methods used to characterize the stream reaches within the City of Ojai and to measure the Ojai streams water quality. A search was conducted to ensure that relevant information was obtained in order to identify data gaps, review archival aerial photographs and historical records, and familiarize the biologists with past conditions within the study area.

STREAM HABITAT CHARACTERIZATION

Stream habitat characterization studies are useful for determining the level of functional habitat for target species, such as Southern Steelhead. Habitat characterization studies determine the existing hydrological, biological, and environmental conditions and expose the barriers and limiting factors for fish and other wildlife species inhabiting the streams of Ojai.

Conventional field surveys were conducted to assess and characterize the stream habitats for the creeks shown in Figure 5, Map of Water Quality Sampling Stations. The portion of the watershed within the City of Ojai was analyzed for suitability of habitat for spawning, rearing, and migration for Southern Steelhead Trout by mapping and characterizing the instream and adjacent habitats along each stream within the City. Each stream was divided into reaches - based on habitat consistency, changes in those habitats, and fish barriers – and biologists walked the entire length of each stream to map, characterize, and assess their suitability for spawning, rearing, and migration for Steelhead.

In addition to the stream classification, habitat typing, and instream shelter inventory conducted for this study, biologists also assessed the human element in the watershed, focusing on land use practices that impact the watershed. An effort was made to identify practices that are detrimental to healthy watersheds, such as manure from horses and smaller pets that are known to be the primary source of water pollution in many communities. Beneficial land use practices were also highlighted in this study, such as erosion and sediment control on public and private land. This assessment attempts to trace links between watershed conditions and land use practices.

Biologists conducted stream habitat characterizations on 27 May, 7 and 8 June, 13 and 19 August, and 10 September 2004. The general stream characterizations were based on assessments of the following parameters:

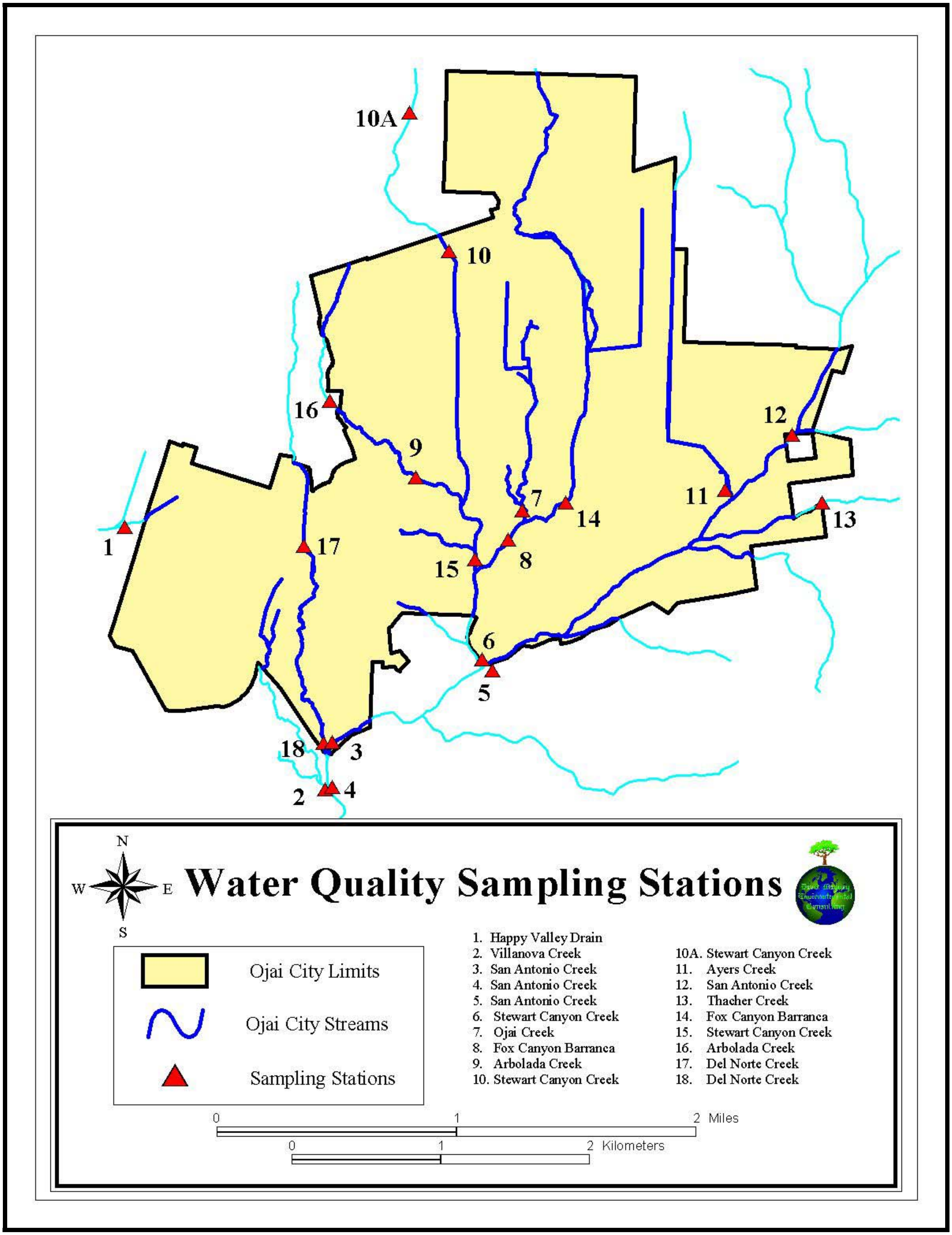
- General flow conditions
- Channel morphology
- Stream type (pool/riffle/run)
- Water depth and width
- Velocity and discharge
- Inundated (yes/no)
- Instream descriptions and cover type (root wads, canopy, logs, etc.)
- Riparian habitat (plant community)
- Shading (percent cover)
- Substrate composition and particle size
- Potential spawning and rearing (yes/no)

Table 4, Stream Habitat Characterization Field Trips Summary, lists the streams surveyed, shows the dates the streams were surveyed, and lists the biologists that characterized the streams.

Table 4. Stream Habitat Characterization Field Survey Summary

Stream Name	Date	Biologist	Location/Direction
Arbolada Creek	27-May-04	Batchelor, Niessen	North of Ojai Avenue north to Fairview Road
	8-Jun-04	Batchelor, Castle	From Ojai Avenue to its confluence with Stewart Canyon Creek
Ayers Creek	27-May-04	Magney	North of Ojai Avenue north to the City limits
	13-Aug-04	Batchelor, Niessen	From west edge of golf course to its confluence with San Antonio Creek
Del Norte Creek	27-May-04	Batchelor, Niessen	From Fairview Road south to Ojai Avenue
	19-Aug-04		From Ojai Avenue south through golf course to its confluence with San Antonio Creek
	10-Sep-04		Between SR 150 and golf course (on S side of SR33/ SR150 intersection and north of Ojai Bike Path)
	10-Sep-04		At 33/150 intersection north of golf course
Fox Canyon Barranca	27-May-04	Magney	North of Ojai Avenue, from Grand Avenue north to the City limits
	8-Jun-04	Batchelor, Castle	From Grand Avenue south to Creek Road
	10-Sep-04	Batchelor, Niessen	From near Pleasant Road to culvert at Grand Avenue
Grandview-Park Drain	27-May-04	Magney	Pleasant Street between Grandview and Park (downstream end)
Happy Valley Drain	8-Jun-04	Batchelor, Castle	From its confluence with Ojai Meadow Creek to State Route (SR) 33
Oak Creek	10-Sep-04	Batchelor, Niessen	East side Country Club Drive at the Inn & Spa entrance
Ojai Creek	27-May-04	Magney	Small drainage above Olive Street
	27-May-04		From Grand Avenue north to near top of hill
	13-Aug-04	Batchelor, Niessen	From SR 150 south to the south side of the Ojai Bike Path
Ojai Meadows Drain	8-Jun-04	Batchelor, Castle	From its confluence with Happy Valley Drain to SR 33
Post Office Creek	10-Sep-04	Batchelor, Niessen	From just south of the Ojai Post Office to just south of Montgomery Street
San Antonio Creek	7-Jun-04	Batchelor, Castle	From the southern end of Camp Comfort to its intersection with Ojai Avenue
Stewart Canyon Creek	27-May-04	Magney	From Highway (SR) 150 north to City limits
	8-Jun-04	Batchelor, Castle	From Ojai Avenue south to its confluence with Fox Canyon Barranca
Thacher Creek	8-Jun-04	Batchelor, Castle	From Ojai Ave. south to its confluence with San Antonio Creek
Villanova Creek	13-Aug-04	Batchelor, Niessen	From SR 33 south to its confluence with San Antonio Creek (Hermosa & Creek Road intersection)
	10-Sep-04		Culvert exit on the east side of Hermosa Road

Figure 5. Map of Water Quality Sampling Stations in Ojai



WATER QUALITY SAMPLING

Water quality assessment data are needed to determine water chemistry and other specific conditions of the streams and drainages that may affect the quality of habitat for aquatic life, including Southern Steelhead Trout. Water quality was sampled at nineteen (19) stations along various streams in the City of Ojai. Stations were designated based on their location and orientation to adjacent or upstream variables such as golf courses and horse corrals, influences from the City runoff, and input from tributaries.

The general quality of the streams were based on assessments of the following parameters: Conductivity and Specific Conductance; Temperature; Dissolved Oxygen and Carbon Dioxide; Turbidity; *p*H; Salinity; and Total Coliform Bacteria.

The water quality sampling equipment, used for measuring these parameters include:

Conductivity (not temperature compensated) (µS, mS) and **Temperature** (°C) were measured with YSI Model 85 Handheld Digital Meter and Smart Water Analysis Laboratory LaMotte CON 5 Meter.

Specific Conductance (temperature compensated conductivity) (µS, mS) and **Salinity** (ppt) were measured with the YSI Model 85 Handheld Digital Meter.

Dissolved Oxygen was measured with the YSI Model 85 Handheld Digital Meter as mg/L or percent (%) saturation and/or the Smart Water Analysis Laboratory LaMotte Dissolved Oxygen Test Kit. This test kit uses the azide modification of the Winkler Method for determining dissolved oxygen. Instead of measuring dissolved oxygen as mg/L or % saturation, this test determines it as Total Dissolved Solids (TDS) or parts per million (ppm).

Carbon Dioxide was measured with the Smart Water Analysis Laboratory LaMotte Alkalinity/Carbon Dioxide Test Kit. This test determines Carbon Dioxide as TDS/ppm.

Turbidity was measured using the Orbeco-Hellige Model 966 Turbidimeter. The Turbidimeter measures the clarity or cloudiness of any type of colorless fluid by measuring the amount of light reflected at a 90° angle by any particles suspended in the fluid, and comparing it to the light scattered by a standard reference suspension. As a true nephelometer, it tests at the officially mandated 90° angles between its photo-detector and incident light beam. Its direct-reading LCD display gives results over three turbidity ranges: 0-20.00, 0-200.0, and 0-1000. It measures in NTUs (or nephelometric turbidity units) and in FTUs (Formazin Turbidity Units). Test resolution is 0.01 NTU in the lowest range.

***p*H** (0-14) was measured with the YSI Model 85 Handheld Digital Meter and/or the Smart Water Analysis Laboratory LaMotte *p*H 5 Meter.

The presence of **Total Coliform Bacteria** was tested using the LaMotte Model TC-5 Coliform Indicator Test Kit. This coliform test kit provides a test tube method to indicate the presence of Total Coliform Bacteria in a drinking water supply via a coliform-indicating test tablet, a gelling substance, and a *p*H indicator. The tablet neutralizes water samples containing chlorine that tends to suppress coliform bacteria growth, and provides growth-supporting nutrients for coliform bacteria. If coliform organisms are present in the sample (a positive result), the bacteria metabolizing the nutrients in the tablet will generate gases. The gasses will be trapped in the gelling substance causing the gel to rise in the tube. The *p*H indicator changes color from red to yellow, indicating coliform bacteria activity.

Figure 5 provides the station locations as well as the streams studied for this project. Some creek/drainage names were invented for the sake of discussion. The station number, creek name, station location, and date sampled are listed in Table 5, Ojai Basin Streams Water Quality Sampling Sites, for each sampling station (following page).

DETERMINING LIMITING FACTORS

Since restoring and improving instream and adjacent habitats for Southern Steelhead in the City of Ojai will vary considerably from site to site, the Limiting Factor Analysis will be used to identify restoration projects for implementation as part of the restoration plan. Environmental factors considered to limit Southern Steelhead natural production include the following:

- **Deficient stream flow**: In general, ephemeral drainages are a limiting factor to the spawning and rearing activities of Steelhead. Steelhead prefer to spawn in perennial streams since generally one to three years is required for offspring to mature and reach the ocean (if ever). However, Steelhead can spawn in intermittent streams, and the juveniles will survive if they can migrate to perennial reaches to oversummer. Streams with flows fewer than five months out of the year are considered a limiting factor for Steelhead; however, reaches with flows most of the year, had to contain additional habitat requirements for Steelhead to be considered potential spawning and rearing habitat.
- **Poor water quality**: Steelhead require cool, clear, well-oxygenated freshwater water flows for survival. Several parameters were studied during the water quality assessment including velocity, pH, dissolved oxygen as mg/L, temperature, conductivity, salinity, and turbidity. Stream reaches with water quality measurements below the Steelhead threshold (as discussed in detail in the Water Quality subsection of the Existing Conditions section of this report), were considered to be a limiting factor for Steelhead.
- **Fish passage barriers:** Steelhead require unobstructed streams for migration to upper stream reaches where potential spawning and rearing habitat exists. Steelhead generally require a 1.25:1 pool-to-jump ratio in order to jump a barrier; with sufficient pool depth, an adult Steelhead can jump up to 6 to 9 feet (Gunther 2000, Herron et al. 2004). Creek reaches containing barriers with a pool-to-jump ratio less than 1.25:1 were considered a limiting factor for Steelhead.
- **Lack of deep pools:** Pools include large woody debris, large substrate particles such as large cobble, boulders, or some geomorphic feature that would support a pool. Juvenile Steelhead generally prefer to inhabit riffles and pools, and as stated above for fish passage barriers, Steelhead generally require a 1.25:1 pool-to-jump ratio in order to jump a barrier. Creek reaches containing pools with a pool-to-jump ratio less than 1.25:1 were considered to be a limiting factor for Steelhead.
- **Lack of spawning substrate:** Adult Steelhead have been reported to spawn in substrates from 0.2 to 4.0 inches in diameter (Reiser and Bjornn 1979). Steelhead utilize mostly gravel-sized material for spawning; however, they will also use mixtures of sand-gravel and gravel-cobble. Fry and juvenile Steelhead prefer cobbles, which is slightly larger than the gravels preferred by adults for spawning (Bovee 1978). The gravel must be highly permeable to keep incubating eggs well oxygenated, and should contain < 5% sand and silt. Creek reaches containing no gravel or cobbles or contained gravels or cobbles with silt or sand were considered to be a limiting factor for Steelhead.
- **Lack of shade canopy:** Percent shading is recorded as the estimated amount of shade or cover created by the canopy of the surrounding riparian vegetation. Proper shade aids in the cooling of water to provide cooler temperatures for Steelhead migration, spawning, and rearing activities. As temperatures rise, fish have increasing trouble extracting oxygen from water, while at the same time the amount of oxygen in the water decreases. Creek reaches containing shading of less than 76% were considered to be a limiting factor for Steelhead.
- **Excessive sediment yield (high turbidity levels):** Turbidity is a measure of the amount of sediment in the water column. Over the long term, sediment settles on the bottom and fills the interstices (spaces and cracks) between streambed gravels and rocks decreasing the amount of desirable spawning habitat as well as habitat required by smaller organisms (insects) which are a vital source of food for fish. Over the short term, turbidity reduces the ability of fish to see and feed. Water quality begins to degrade by suspended sediment between turbidities of 3 and 5 NTU, and impacts on Steelhead begin to be noticeable above 25 NTU. Since the EPA has suggested a turbidity limit of 1.9 NTU for streams in this region, creek reaches containing turbidity measurements higher than 1.9 NTU were considered to be a limiting factor for Steelhead.
- **Lack of instream cover:** Instream cover is composed of elements within a stream channel that provide aquatic vertebrate species protection from predation, reduce water velocities so as to provide resting areas, and reduce intraspecific competition through increased living space within the stream (Hamilton and Bergersen 1984). Instream cover is recorded as objects under water providing shade and resting areas, including over-hanging vegetation, submerged boulders, logs, root wads, submerged vegetation, and undercut banks. Creeks with fewer than three instream cover types is considered a limiting factor specifically to Steelhead rearing and a potential limiting factor for resting migrating Steelhead.

Each stream reach was evaluated for habitat parameters directly and indirectly associated with the above listed limiting environmental factors, and those that fall outside acceptable conditions for Steelhead are identified as a limiting factor. The reaches consisting of one or more habitat limiting factors are assigned specific recommendations for restoration and a feasibility assessment.

Data for each limiting factor were gathered along each reach of the Ojai streams. These data were used here to identify opportunities and constraints to improve habitat conditions for Southern Steelheaderies as well as other wildlife. It should be noted that simply eliminating, or mitigating for, existing limiting factors may not restore the fishery; however, it is a reasonable tool for identifying areas of the City streams that may inhibit or limit the use or passage by Southern Steelhead Trout, and that successful recolonization of each stream in Ojai may not be practical.

Table 5. Ojai Basin Streams Water Quality Sampling Station

Station No.	Dates Sampled	Stream or Drainage Name	Directions
1	4 & 23 Feb. 2004 2 Mar. 2004 20 Oct. 2004 3 Dec. 2004 5 Jan. 2005	Happy Valley Drain (Reach 1)	Just upstream of confluence with Nordhoff Drain
2	4 & 23 Feb. 2004 2 Mar. 2004 20 Oct. 2004 8 Dec. 2004 5 Jan. 2005	Villanova Creek (Reach 1)	Lower end of Villanova Creek at Hermosa Road, just upstream of San Antonio Creek
3	4 & 23 Feb. 2004 2 Mar. 2004 20 Oct. 2004 8 Dec. 2004 5 Jan. 2005	San Antonio Creek (Reach 1)	Just upstream from its confluence with Del Norte Creek.
4	4 & 23 Feb. 2004 2 Mar. 2004 20 Oct. 2004 9 Dec. 2004 5 Jan. 2005	San Antonio Creek (Reach 1)	Below confluence of Stewart Canyon Creek under Creek Road bridge at Hermosa Road
5	4 & 23 Feb. 2004 2 Mar. 2004 20 Oct. 2004 9 Dec. 2004 5 Jan. 2005	San Antonio Creek (Reach 2)	Below confluence of Fox Canyon Barranca below Creek Road bridge
6	4 & 23 Feb. 2004 2 Mar. 2004 20 Oct. 2004 9 Dec. 2004 5 Jan. 2005	Stewart Canyon Creek (Reach 1)	Upstream of narrow bridge on Creek Road (at 10 mph curve)
7	4 & 23 Feb. 2004 3 Mar. 2004 20 Oct. 2004 9 Dec. 2004 5 Jan. 2005	Ojai Creek (Reach 1)	Upstream of confluence with Fox Canyon Barranca, north of South Montgomery Street, near lower Libbey Park Tennis Courts
8	4 & 23 Feb. 2004 3 Mar. 2004 20 Oct. 2004 9 Dec. 2004 5 Jan. 2005	Fox Canyon Barranca (Reach 1)	Upstream of creek confluence near intersection of Ventura Street and South Montgomery Street-Buckboard Lane bridge at Montgomery Street

Table 5. Ojai Basin Streams Water Quality Sampling Sites (continued)

Site No.	Dates Sampled	Stream or Drainage Name	Directions
9	4 Feb. 2004 23 Feb. 2004 3 Mar. 2004 20 Oct. 2004 7 Dec. 2004 5 Jan. 2005	Arbolada Creek (Reach 3)	Lower end of Arbolada Creek, near business building on corner of Ojai Avenue and Bristol Street
10	4 Feb. 2004 23 Feb. 2004 3 Mar. 2004	Stewart Canyon Creek (Reach 5)	Inflow into Stewart Debris Basin at top of Signal Street at Pratt Trail Head
10A	20 Oct. 2004 7 Dec. 2004 5 Jan. 2005	Stewart Canyon Creek (Reach 5)	Where the Foothill Road bridge crosses Stewart Canyon Creek, upstream from Station 10
11	4 Feb. 2004 23 Feb. 2004 2 Mar. 2004 20 Oct. 2004 8 Dec. 2004 5 Jan. 2005	Ayers Creek (Reach 1)	Drainage at the end of Fairway Lane (it drains south to San Antonio Creek)
12	4 Feb. 2004 23 Feb. 2004 2 Mar. 2004 20 Oct. 2004 8 Dec. 2004 5 Jan. 2005	San Antonio Creek (Reach 3)	Under bridge on Ojai Avenue between Gridley Avenue and Boardman Road
13	4 Feb. 2004 23 Feb. 2004 2 Mar. 2004 20 Oct. 2004 8 Dec. 2004 6 Jan. 2005	Thacher Creek (Reach 1)	Under bridge on Boardman Road south of entrance to Soule Park
14	2 Mar. 2004 20 Oct. 2004 8 Dec. 2004 6 Jan. 2005	Fox Canyon Barranca (Reach 1)	At south end of Fox Street under walking bridge on Athletics Club facility premises
15	2 Mar. 2004 20 Oct. 2004 8 Dec. 2004 6 Jan. 2005	Stewart Canyon Creek (Reach 1)	Upstream from confluence with Fox Canyon Barranca (west of Ventura Street)
16	20 Oct. 2004 8 Dec. 2004 9 Jan. 2005	Arbolada Creek (Reach 3)	North of 509 Palomar Road on the west side
17	20 Oct. 2004 8 Dec. 2004 9 Jan. 2005	Del Norte Creek (Reach 2)	North of intersection of Ojai Avenue and Del Norte Street
18	9 Dec. 2004 9 Dec. 2004 6 Jan. 2005	Del Norte Creek (Reach 1)	Lower end of Del Norte Creek near Hermosa Road, just upstream of San Antonio Creek