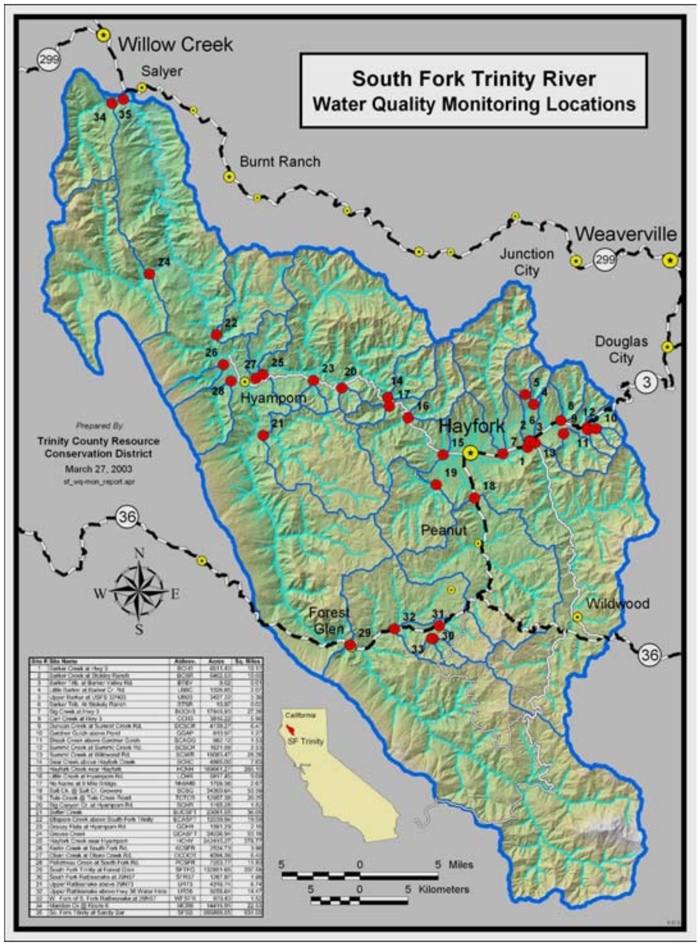
SOUTH FORK TRINITY RIVER
WATER QUALITY MONITORING PROJECT
Agreement No. P0010340 Final Report



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1.0 INTRODUCTION

The South Fork (SF) Trinity River watershed in Trinity County (Figure 1) has been listed as a sediment-impaired waterbody in California's 1995 CWA 303(d) list, adopted by the State of California North Coast Regional Water Quality Control Board (NCRWQCB). This sediment impairment has, according to NCRWQCB, resulted in non-attainment of designated beneficial uses, primarily salmonid habitat. In December 1998, U.S. Environmental Protection Agency (EPA) established a Total Maximum Daily Load (TMDL) for sediment in the SF Trinity River watershed.

Implementation of sediment TMDL standards for a watershed with highly divergent sediment sources, due to differing bedrock geology and land management, such as the SF Trinity River, requires much more detailed information compared to less complex watersheds. Without specific information developed at a sub-watershed level, load allocations and reduction levels to meet specified targets are only crude estimates. Although the SF Trinity River has a considerable amount of existing information in many areas, a number of areas lack any appreciable data, and existing information does not allow refinement of source areas and allocations with any reasonable certainty beyond a main sub-watershed level.

In addition, the South Fork Trinity River Restoration Action Plan set a goal of the maintenance and restoration of anadromous Salmonid populations in the watershed. Inherent in this over-arching goal is the need to assess conditions within the watershed and of the anadromous salmonid populations. Funds have been obtained from the California Fish & Game (SB 271) and State Water Resources Control Board (CWA 205(j)) to conduct two (2) years of data to support this assessment. The combined scopes of work envision fish populations (snorkel surveys), channel form, structure and substrate, sediment (collectively hydrologic and geomorphic monitoring) and temperature monitoring with a total budget of approximately $225,000.

The purpose of this report is to compile, summarize, and analyze baseline hydrologic and sediment transport data for the SF Trinity River watershed that could be used for TMDL implementation and monitoring. This study combines office-based analyses of aerial photographs and GIS coverages with extensive field data collection, primarily involving considerable streamflow, sediment transport, and geomorphic data collection.

1.1 WATERSHED OVERVIEW

The South Fork Trinity River basin is approximately 970 square miles in size, and is the largest tributary of the Trinity River. The terrain is predominately mountainous and forested, with only about 15 percent of the basin available for farmland, most of which occurs in the Hayfork Valley, the largest tributary of the South Fork. Elevations in the basin range from more than 7,800 feet above sea level in the headwater areas, to less than 400 feet at the confluence with the Trinity River.

The South Fork Trinity River has historically been recognized as a major producer of chinook and coho salmon and steelhead trout. The South Fork originates in the North Yolla Bolly Mountains about 50 miles southwest of Redding, and runs northwest for approximately 90 miles before reaching its confluence with the Trinity River near Salyer (Figure 1). The South Fork Trinity flows mostly through

Trinity County, forming the boundary between Trinity and Humboldt Counties in its lower 12 miles. The South Fork is the longest unregulated river in California. The 56-mile stretch from Forest Glen to the mouth is protected by the California Wild and Scenic Rivers Act.

Historically, the South Fork Trinity River was estimated to have total spawning escapements often over 10,000 fish. Anadromous fish species include chinook and coho salmon, steelhead trout, and Pacific lamprey. A dramatic decline in numbers of anadromous fish was observed shortly after the large flood of December 1964, when a large flood event combined with poor land use practices relating primarily to timber harvest, and unstable geology led to unprecedented sediment delivery. Sedimentation from tributaries and inner gorge landslides completely overwhelmed the mainstem channel, causing channel change, filling pools, eliminating riparian vegetation and impacting spawning gravels. The degraded habitat limits the productive capacity of the river, and recovery from the 1964 flood and subsequent storm events has been slow.

2.0 SCOPE AND OBJECTIVES

The health and recovery of anadromous salmonids in the SFTR depend on a better understanding of instream conditions and associated long-term trends. The overall goal of this monitoring program is to provide landowners and land managers in the South Fork Trinity River Basin current data to assist in management decisions related to the implementation of the Sediment TMDL by the NCRWQCB and to assist land managers in their interactions with regulatory agencies. Hydrologic and geomorphic monitoring conducted in this study will assist in establishing baseline conditions, and form the basis for long-term trend monitoring of channel characteristics and sediment loads, with comparison to previous datasets where possible. Sampling will occur at locations throughout the SFTR basin.

In order to achieve these goals, the following general objectives have been developed:

Objective 1: Pre-TMDL Implementation Plan base line: This is a broad effort and must be conducted with the recognition that data will not identify sources of sediment. Instead this is an effort to provide data on sediment loads from the various geologic types within the South Fork Trinity River watershed recognizing that there are existing mixed uses in each.

- Collect and analyze sediment distribution data from approximately 15 sites throughout the watershed to provide a "snapshot" of conditions to measure future Implementation Plan and associated actions against, with the intent of using these data to [a] screen and refine more detailed sub-basin monitoring in the future and [b] sort baseline conditions by geology, with an understanding generally of the land management types and existing disturbances.

- At the present, funding for implementation of this monitoring plan and baseline assessment has allowed for two winters of data collection: Water Year 2002 (Oct 2001-Sept 2002) and Water Year 2003 (Oct 2002-Sept 2003). However, final reports to the funding agencies must be submitted by April and July 2003.

Objective 2: Provide limited Sub-basin Effectiveness Monitoring: This monitoring will involve the development of multi-station monitoring within selected sub-watersheds to facilitate adaptive management of various sediment reduction and restoration actions.
The activities undertaken as part of this project included the following specific short-term (current grant timeframe) implementation actions:

1) Review past and present monitoring efforts,
2) Identify reproducible past monitoring data,
3) Compile instream monitoring methods and protocols,
4) Reoccupy old sampling locations, as appropriate,
5) Establish new sampling sites, as required,
6) Install required monitoring equipment,
7) Collect hydrologic and geomorphic data for Water Years 2002 and 2003,
8) Analyze data,
9) Summarize data in water year reports, and compare to previous data where appropriate.

Long-term objectives of the SF Trinity Monitoring Program include:

1) Establish rating curves and/or relationships between water quality and quantity parameters at both a watershed and a site specific scale, enabling watershed-wide monitoring as well as BMP effectiveness monitoring,
2) Collect channel characteristic data (cross sections, profiles, bulk samples, pebble counts, residual pool volumes) every 5 years or after large flood events,
3) Document trends and changes in channel condition, and water quantity and quality,
4) Produce reports at appropriate intervals updating the results and trends of all monitored parameters.

As such, implementation of the Monitoring Program is a collaborative endeavor developed by a range of interested agencies, organizations, and individuals. As will be discussed later, the comprehensive work outlined in the Monitoring Plan is being implemented primarily by the US Forest Service and the Trinity County RCD. Coordination between these groups has resulted in the establishment of protocols that will provide comparable datasets.

Since this report is required to be prepared prior to the end of the sampling season, it cannot be comprehensive in scope, as considerable data remain to be analyzed. Instead, the data presented are intended to be illustrative of the overall methods used in this investigation. Likewise, although mention is made of the USFS monitoring program and elements, this report does not include any USFS data, with the exception of water temperature data.

3.0 DEVELOPMENT OF MONITORING PLAN AND QAPP

One of the first steps taken in this project was the development of a detailed hydrologic and geomorphic monitoring plan for the SF Trinity watershed. The plan was prepared in November 2001. Shortly thereafter, Quality Assurance Project Plans (QAPP) were developed for Surface Water, Channel Characteristics, and Sediment Laboratory Analysis. Since water temperature monitoring is being almost exclusively performed by the USFS at this time, a QAPP for that monitoring element was not prepared.

4.0 METHODS

Introduction

The purpose of this section is to provide a succinct overview of field methodologies employed for streamflow and sediment transport monitoring, geomorphic reference reach establishment, and bulk sampling/permeability of spawning gravels. Detailed descriptions of these procedures are provided in the *Surface-Water Quality-Assurance Plan for the SF Trinity Geomorphic and Hydrologic Monitoring Project* (SWQA) and in the *Channel Characteristics Quality-Assurance Plan for the SF Trinity Geomorphic and Hydrologic Monitoring Project* (CCQA).

All field notes and data collection forms for all phases of this project were regularly photocopied and organized into notebooks by water year. All computer files and digital photographs are organized into a project file that is backed up to disks stored both on and off-site.

Site Selection

In order to characterize basin-wide hydrology and sediment production, thirty-four sites were chosen for streamflow and sediment transport monitoring on the basis of access, access permission, safety issues during storms and good channel hydraulics for gaging stations (Figure 1). Sub-basin areas ranged from a few acres (BTBV) to 379 mi^2 (HCHY) (Table 1). Most were located near culverts or bridges, though some (ECASFT, BCHC) were remote and required hiking or boat access. Some tributaries had multiple gaging stations (Barker Creek, Summit Creek, Rattlesnake Creek), while other stations (HCNH, HCHY, SFTFG) were located in large channels below major confluences.

The USFS established another 18 sampling sites, including three continuous recording stations (Figure 2). Four of these sites had sediment and streamflow data collected by TCRCD. No USFS sediment data are presented in this report.

4.1 SURFACE WATER MONITORING

4.1.1 Stage Measurement

At each of the 34 stations, a stage reference was established in a sheltered, low velocity area, upstream of a hydraulic control. Staff plates attached to channel iron driven into the streambed were installed at three of the study locations as stage measuring devices (HCNH, SFTFG, GCASFT). At the other 32 stations, river stage was measured from the water surface to the top of a fence post using a pocket surveyor's tape and initially recorded as a negative stage. All fence post tops were assigned a positive reference elevation (stage height correction factor) so the data could then be recorded in standard form: initial stage reading was added to the correction factor to create a positive river stage from the streambed to the water surface. The advantages of fence posts are: (1) low material cost, particularly when numerous stations are being installed, (2) simple, quick installation, and (3) low vandalism potential compared to more obvious staff gages.

Crest-stage gages, which allow measurement of the highest stage attained at a site during a given period, were installed at all sites. A pipe, perforated at its base, is securely attached to a fencepost or channel iron at a station, and finely ground cork is placed in the pipe which floats up as water rises and enters the pipe. The cork adheres, at the highest stage, to a wooden rod that had been placed inside the pipe. The cork line is read with a pocket surveyor's tape and initially recorded as a negative stage. The elevation of the crest-stage gage is surveyed into the site reference elevation to allow conversion of the crest-stage reading to the station gage height reading.

All stage references were surveyed to locally established benchmarks using an auto level. If sites were disturbed (by vandalism or high flows), the original gage datum could be re-established. Crest gages were installed at all stations to record the peak or maximum river stage during storm events.

4.1.2 Continuous Stage Recorders
Continuous stage recorders (dataloggers) were installed at 15 stations in the South Fork Trinity River Watershed. The full site name, site acronym, associated watershed area, whether a datalogger was installed at the site, and whether a geomorphic reference reach was established, is shown in Table1.

All continuous stage recorder installations except one, utilized Global Water Level Loggers series #WL-15-15 or #WL-14-15. Due to manufacturing defects and subsequent malfunction, it became necessary to replace seven dataloggers during the study period. The other datalogger (at HCNH) is a Campbell Scientific CR10 with a Druck pressure transducer. This site was originally installed by the TCRCD in July 1996. Synthetic records were generated where necessary to fill in missing periods of data. Global Water Level Loggers are of a pressure transducer type, utilizing a silicon diaphragm, and have a 15 foot range. Recording intervals were set to 15 minutes. Batteries were replaced and dataloggers were downloaded to a laptop computer on a regular monthly schedule. Gage height records were checked against observed values and adjusted to compensate for drift as necessary. Any error was distributed over the period of record between known (observed) gage heights.

All dataloggers were contained in locked steel gage houses anchored to trees or mounted to 4 x 6 inch posts set in 3 foot deep holes filled with concrete. Conduit from gage house to pressure transducer was provided by 1.5 or 2 inch galvanized pipe, either buried or tightly contoured to the slope profile, and clamped to t-posts. Photographs were taken of most gages (Figure 3). The original USGS gaging stations for South Fork Trinity at Forest Glen (USGS No. 11528100) and Hayfork Creek near Hyampom (USGS No. 11528500) were successfully re-occupied (Figure 4).

4.1.3 Streamflow Measurements
Direct streamflow discharge measurements were taken at all stations using standard or modified USGS methods. Most measurements were performed by wading at the gage location; however, high flow measurements were taken from bridges. One high flow measurement was performed with a boat and an Acoustic Doppler Profiler. Some very low flows were measured at culvert outlets using volumetric techniques.

In general, and when practical, standard USGS methods were used when making discharge measurements. During periods of rapidly changing river stage, however, fewer verticals were used in order to improve the accuracy of the measurement. Most discharge measurements contained 15-35 verticals. Stream flow equipment for wading included: 4 foot top-set wading rod, Keson 300 foot tape, JBS Instruments AquaCalc 5000-Advanced Stream Flow Computer, and either a Price AA or Pygmy current meter. Almost all measurements were performed with the magnetic head version of the Price AA or Pygmy meter. High flow measurements from bridges were made using a bridge-board, an A-reel, a Price AA meter, and a Columbus 50 lb. sounding weight.
The timing and magnitude of large-scale, infrequent floods, often precludes direct discharge measurement (Figure 5), as these peak flows often occur at night and substantial amounts of debris may also be present which can foul meters and make such measurements particularly hazardous. High flow measurements from bridges were typically collected during daylight hours on the falling limb of the storm hydrograph when far lower debris volumes are present. A peak discharge determined by indirect methods (slope-

area) is often the best means of defining the upper portions of the stage-discharge relation (rating curve). Because extrapolation of a rating curve beyond twice the highest measured discharge may be unreliable, discharge measurements for peak flood peaks made by indirect methods are preferable to rating curve extensions (Rantz and others, 1982, p.334).

Indirect discharge measurements for peak flows were computed at six sites (HCNH, HCHY, SFTFG, BUCSFT, PCHR and GCASFT) using the slope-area method and the USGS Slope-Area Computation program. Crest gages installed on previously surveyed cross sections provided water surface slopes and cross section stage elevations during flood events (Figure 6). Roughness (Manning's n) values were assigned using one or more of the following techniques: solving for "n" at a known discharge, comparing field observations with published values (Barnes 1964, Hicks and Mason 1991), comparing derived values to reach specific n-values previously assigned by the USGS, and/or verification with the USGS NCALC program. At two additional sites (SCWR and TCTCR), slope-area reaches were reconnoitered after peak flows and will be surveyed for future computations.

4.2 SEDIMENT TRANSPORT MONITORING

Sampling

Depth-integrated turbidity and suspended sediment sampling was performed at all locations. Sampling was performed using either a US DH-48 Depth-Integrating Suspended Sediment Sampler (for wadable flows) or a US DH-76 Depth-Integrating Suspended Sediment Sampler (rope-deployed from bridges at unwadeable flows). In the case of the US DH-48, handles of different lengths were used depending on the flow depth. The US DH-76 is a rope-deployed sampler and is typically utilized from bridges. Sampling locations were located at or near stage locations. Standard methods, as developed by the USGS and described in Edwards and Glysson (1988) and in the SWQA, were generally used for sampling. However, due to the large number of sites being sampled, a tag line was not always set during sampling; instead distance between verticals was estimated. For each sample, the location, time, stage, number and duration of verticals, distance between verticals, bottle #, and whether a field replicate was taken, were recorded. At locations where it was not possible to get a true depth-integrated sample, grab samples or modified depth-integrated samples were taken and this information was recorded.

Samples were kept chilled after collection and stored in ice chests. Turbidity values were computed within 48 hours using a LaMotte 2020 turbidimeter. Suspended sediment concentrations were computed in the GMA sediment lab following USGS and ASTM D-3977 protocols. A laboratory QAPP was also prepared and submitted as part of this project.

4.3 GEOMORPHIC MONITORING

4.3.1 Geomorphic Reference Reaches

Site Selection and Monumentation

Six sites were chosen for geomorphic reference reaches, each of which was named according to the associated continuous recording station. Gaging station benchmarks and newly established benchmarks at the upstream and downstream ends of reaches were surveyed to the same datum. Stamped aluminum caps (atop a 5/8" rebar set in concrete) and monuments set by other agencies (such as the USGS reference marks at HCHY) were used as benchmarks and photographed (Figure 7). Level-loops of cross section endpoints and benchmarks were performed with an engineer's auto level to verify total station survey elevations. All surveys were checked for closure and held to a maximum error of 0.03 feet. Two-peg tests of the instrument were performed before each level-loop survey as per Harrelson et al. (1994).

Additional photo documentation was performed at each cross section. With a tape strung to identify the cross section, a field technician held a story board (indicating the cross section number) to one side of the body to describe a left bank or right bank view (Figure 6). Similarly, the story board was held overhead to indicate an upstream view, or below the waist to indicate a downstream view (Figure 8, bottom photo).

Channel Geometry: Cross Section and Longitudinal Profile Surveys

Surveys were conducted using field and documentation methods described by Harrelson et al. (1994). Cross section endpoints were installed on the left and right banks of the channel, well above bankfull stage and in locations not subject to washout, using four foot lengths of 5/8" diameter rebar. In some large channels, additional pins were set near the edge of water. For safety reasons, all rebar was driven deep enough that only a few inches were exposed, and then fitted with a secure plastic or aluminum cap. Pin elevations were surveyed with the caps on. Cross section numbers were stamped into caps and/or aluminum tags which were attached to the rebar. Six-foot fence posts driven five feet deep were used for endpoints in sandy areas.

Most cross sections were located at thalweg cross-over points (typically a riffle or a pool tail), because such areas provide greater resolution for evaluating channel change: pools do not typically store mobile coarse sediment. Each cross section was surveyed with a total station to obtain coordinate data for all cross section endpoints, used in the creation of site maps and allowing re-occupation even in the event of pin destruction. The left bank pin was generally set as Station "0", and all measurements were taken from left bank to right bank. Cross sections were oriented perpendicular to the high flow current vector. Survey points were taken at all slope breaks, generally at a minimum of 2 feet on center, along all cross sections. Approximate bankfull stage elevations, crest gage elevations, obvious high water marks, and abrupt changes in roughness elements (for slope-area computations) were surveyed on each cross section.

All longitudinal profile reach lengths exceeded the minimum of 25 times the width of the active channel as specified in the Channel Characteristics QAPP (CCQA). Longitudinal profiles of the thalweg were surveyed using a total station and prism pole, since it is nearly impossible to accurately stretch a tape down a meandering channel. The total station records angles and distances between survey shots. The longitudinal profile surveys were measured along the entire length of each reach, and recorded all pools, riffle crests, and slope changes. The distance between consecutive survey points was a function of grade change and the size of the channel, as smaller channels require more closely spaced survey points. However, distance between consecutive points did not exceed one-third of the active channel width.

Channel Characteristics: Substrate

Surface particle counts were conducted along the cross sections following methods described by Wolman (1954), modified for the use of a portable sampling frame (Bunte and Abt 2001). Each of the 100+ particles for each count was obtained from the intersection of the wire intercepts on the frame and then measured using a "gravelometer" template with square openings. The pebble counts were entered as the number of particles retained in each sieve class, for subsequent conversion to the cumulative percentage (by number) finer than the corresponding sieve size. Surface particle count results were entered in the project field book at the sampling location. On cross sections with multiple homogeneous sub-populations (facies), more than one particle count was conducted.

Channel Characteristics: The V* Method

V* is a method for assessing substrate quality that measures the fraction of residual pool volume impacted with fine sediment (usually fine sand to medium gravel) (Hilton and Lisle 1993). This fraction (V*) is the ratio of fine sediment volume to pool water volume plus fine sediment. Residual pool volumes were calculated from (1) depth soundings to the top/bottom of the sediment layer along cross section transects

(Figure 8 – top photo), and (2) the difference in depth (bed elevation) between a pool and the downstream riffle crest. At least three riffle crests depths were taken with a graduated rod. The depth of fine sediment was measured by driving a 1.5 cm graduated metal probe into the fine graded sediment portion of the pool until coarser sediment was felt. Six to twenty soundings were taken along four to ten transects in all pools along the surveyed longitudinal profile. Sampling intensity was adjusted meet to the complexity of the scenario encountered: fewer soundings were taken in simple pools with no fine sediment.

4.3.2 Bulk Sampling and Permeability of Mainstem Spawning Gravels

<u>Site Selection and Establishment</u>

Three South Fork Trinity River mainstem sites were chosen: one near Forest Glen (SFTFG), one in Hyampom upstream of the Hayfork Creek confluence (SFTHR), and one below the Hayfork Creek conluence near Eltapom Creek (SFTEC). SFTFG overlapped an existing geomorphic reference reach. Sampling sites were chosen in accordance with well-documented criteria for spawning habitat site selection by anadromous salmonids (Bjornn and Reiser 1991). Within a week of completion, chinook salmon (*Oncorhynchus tshawytscha*) were observed spawning within a few feet of chosen sampling locations at SFTHR and SFTEC.

For each site, a monumented cross section was established using 5/8" rebar on each bank as endpins. Cross sections and associated benchmarks were surveyed with a total station. Bulk sample locations along the cross section were randomly determined and surface particle counts were obtained prior to sampling. A tape was strung between endpins to precisely locate the sample site along each cross-section. Each site was photographed (Figure 9).

<u>Bulk Sampling</u>

Either a 1.5 or 2 foot diameter McNeil type sampler was used. Two samples per cross section were taken by working the samplers into the gravel bed. The surface layer, defined as the depth of the largest surface particle (intermediate axis), was kept separate from the subsurface component of each sample. Most surface samples consisted of a single bucket, to be analyzed separately. The remaining bed material was transferred to buckets until the hole was excavated to a depth of 1.0 feet, the assumed typical egg-pocket depth for chinook salmon (Bjornn and Reiser, 1991). The excavated sample material was then dried in the field, on large tarps spread out in full exposure of the sun.

A Gilson TS-1 sample processor and generator were transported into the field on a trailer for shaker-sieve processing. However, the motor failed while processing the first sample and all samples had to be transported to the lab where they are still being processed. All bed materials down to 45 mm in diameter were hand-processed and weighed in the field using the "gravelometer" template and an Ohaus Model FG-30K digital scale.

<u>Permeability</u>

Permeability is a measure of the ability of a porous medium to pass water and as such, is a characteristic of spawning gravels that directly influences the delivery of oxygenated water to, and the removal of wastes from, developing salmonid embryos. Intragravel permeability was measured at no less than four locations adjacent to each bulk sampling location using a modified Terhune (1958) method with a backpack electric pump (Figure 9). An additional measurement of permeability was taken within each of the bulk sample locations. Five replicate measurements were taken at each of the five sample points (one measurement point in the center of the sampling location, four around the outside). The permeability standpipe was driven into the gravel until the bottom of the perforated portion was 35 cm below the bed surface. A permeability rate was calculated by recording the time required to fill the cylinder with a measured volume of water.

4.4 WATER TEMPERATURE

Only one water temperature station has been maintained by TCRCD since 2000, that of Hayfork Creek near Hayfork. This site has been in operation since July 1996. Prior to 1998, the TCRCD in conjunction with NRCS, USFS, and Timber Products Company had maintained a network of temperature gages (Farber et. al.1998).

4.5 GIS

GIS coverages were obtained from a variety of sources including U.S. Forest Service and Trinity County. Existing road networks based on USFS and Trinity County datasets were supplemented by examination of the 1994 orthophoto quads. Harvest areas were determined from USFS plantation coverages and then updated for private lands by mapping from the 1994 orthophoto quads.

5.0 RESULTS

Introduction

As of March 31, 2003, discharge and sediment data from six gaging stations have been completely processed. Three of these six sites were included in the geomorphic component of this study. Cross sections, longitudinal profiles, photographs, slope-area computations, and site maps have been completed for these three geomorphic reaches. Particle size distributions (from pebble counts and bulk samples), permeability, and V* analyses are currently being completed. Sediment data are still arriving for the March 15, 2003 storm.

5.1 STREAMFLOW

5.1.1 Discharge Measurements and Peak Discharges

For the six sites included in this report, a total of 52 discharge measurements were taken in WY 2002 and WY 2003. Seven additional discharge measurements were included for HCNH from WY 1999.

Peak discharges were obtained from known stage heights by either (1) extending the rating curve, or (2) computing a slope-area estimate (Table 2). The December 16, 2002 peak discharge at HCNH exceeded the January, 1997 peak, as evidenced by stage observations during both events.

All discharge measurements were entered and cataloged using the standard USGS-type 9-207 discharge measurement summary form (Table 3).

5.1.2 Rating Curves

Stage/discharge relationships (rating curves) were developed for all sites. Stage/discharge pairs were plotted on standard rating paper (USGS-type 9-279) and a best-fit line was hand drawn following standard USGS procedures, for four of the six sites presented in this report (HCHY, HCNH, BCSR and SFTFG) (Figure 11). Hand plotted ratings tend to be more accurate, since few gaging sites have an entirely linear relationship between stage and discharge. For TCTCR and SCWR, the Excel generated regression trendline ($r^2 > 0.99$) was used and no hand plot was drawn (Figure 12), as the more labor-intensive hand techniques would not likely improve the results. Skeletal rating points were then extracted from the best-fit lines to develop rating tables (used in subsequent hydrograph generation and sediment load computations). Surface Water, a software package developed by Western Hydrologic Systems, was used to automatically expand rating tables from the skeletal points. Rating tables are: (1) used by the Surface Water program internally to compute annual discharge summaries, (2) converted to a vertical record for sediment and discharge computations, and (3) formatted into an Excel table for use by field personnel (Table 4).

Annual discharge summaries for each of the 15 continuous recording stations will be included in the final report, along with detailed station descriptions (Table 5). An additional output option using the annual discharge summary is the Mean Daily Discharge Hydrograph (Figure 13), which will also be generated for each site in the final report.

5.1.3 Hydrographs

Once developed, the rating tables were used to determine the discharge for all stages in the continuous gaging records (15-minute gage height intervals) retrieved from the dataloggers. This technique assumes the hydraulic control remains stable throughout the hydrograph period, especially during storm events;

e.g. the control does not scour, nor does it become artificially elevated by the accumulation of large woody debris. Figure 14 illustrates the series of large storms in December 2002 and two smaller storms in January and March 2003. The shapes of the other site hydrographs are quite similar.

When datalogger failure resulted in missing periods of record, synthetic records were generated using a nearby station record: discharge values (computed from a wide range gage heights when both gages were operating) were plotted against one another, and the resulting regression was used to compute the missing flow record. This method proved more accurate than others, including percent basin area relationships and the use of separate regression equations for periods of rise and fall. Synthetic records were checked against observed gage heights and adjusted if necessary. Synthetic records are indicated as such on printed hydrographs (Figure 15).

5.2 SEDIMENT TRANSPORT

5.2.1 Turbidity and Suspended Sediment Concentration Measurements

A complete summary for the six sites presented in this report is given in Table 6. Suspended sediment concentration (SSC) and turbidity were computed for depth-integrated samples, while only turbidity was computed for grab samples. Samples that did not meet the criteria outlined in the SWQA were not included in subsequent sediment load computations.

Suspended sediment and turbidity relationships were developed for the entire watershed as a whole and for each site individually. Individual site relationships developed included: SSC versus turbidity, turbidity versus discharge, SSC versus discharge, and suspended sediment load versus discharge. The equations and r^2 values (based on simple linear regressions) developed for each of these relationships are shown in Table 7.

All data were combined to develop the relationship between SSC and turbidity for the entire South Fork Trinity River Watershed (Figure 16). For the six sites included here, relationships for suspended sediment load versus discharge are shown collectively (Figure 17), and by individual station (Figure 18). Suspended sediment load and discharge were normalized by watershed area to develop individual relationships for comparison by site (Figure 19). Finally, total suspended sediment load for each site was plotted against drainage area (Figure 20).

5.2.2 Suspended Sediment Loads

Suspended sediment loads were computed from the regression equations and the 15 minute discharge hydrographs for WY 2002 and WY 2003 through March 1 (Table 8). Accuracy of load values derived from this type of analysis is dependent upon the number of samples and the range of discharges sampled at each station. Some sites, such as HCHY, clearly require more samples at higher discharges. The maximum observed turbidity at HCHY (499 NTU) was obtained from a grab sample by a volunteer during the highest observed discharge during the study period, the December 16, 2002 storm. Had this volunteer been able to take a depth integrated sample, the relationship between suspended sediment concentration and discharge could have been more accurately defined, increasing confidence in annual load estimates for this station.

Given the relatively small number of samples, specific site sediment relationships for intra-storm time or stage trends (hysteresis – variability in sediment transport rates based on hydrograph position, such as rising and falling stage), though frequently observed in sediment transport studies, was not examined here. Often, computations of transport records, that do not consider such hysteresis, may lead to considerable errors.

5.3 GEOMORPHIC MONITORING

Geomorphic Reference Reaches

Data collected at geomorphic reference reaches provide a "snapshot" of existing channel conditions, which becomes increasingly relevant as measurements are repeated over time, especially following large flood events. A complete summary of geomorphic parameters obtained for each of the six sites is given in Table 9. Previous work (by the USGS and USFS) will allow evaluations of channel change at some sites.

All longitudinal (thalweg) profile reach lengths exceeded the minimum of 25 times the width of the active channel (CCQA) (Figure 21). Cross-sections were used not only as a baseline description of channel geometry, but as a key component for hydraulic modeling techniques such as the slope-area method (Figure 22). Since surveys were done with a total station, cross section and longitudinal profile data were used to generate site maps.

Site photographs are stored in digital files. Residual pool volume (V*) and surface particle size distributions are currently being computed.

5.3.1 Hayfork Creek near Hayfork (HCNH)

The longitudinal profile extends from just downstream of the Tule Creek confluence nearly a mile to the Mercil Bridge (Figure 23). All cross sections (except Cross Section 3, the gaging section) were surveyed across riffles or pool tails. Two new concrete benchmarks were established at the upstream end of the reach and surveyed to the original gage reference elevation. A prominent bedrock outcrop near the Mercil Bridge, and the bridge foundation itself, were used as reference elevations at the downstream end. A galvanized crest gage was installed at the bridge to obtain water surface slope profile for the entire reach during peak flows.

The lower portion of this reach is heavily used for grazing by cattle, which were actively using the stream at the time of data collection. While the data for V* has not been computed as of this report, qualitative observations suggest an increase in the volume of sediment stored in pools adjacent to grazing areas. This may demonstrate the local effects of bank erosion from cattle use, and not an overall trend in fine sediment storage for Hayfork Creek.

5.3.2 Butter Creek above South Fork Trinity (BUCSFT)

Four of the surveyed cross sections were included in the longitudinal profile length, which begins approximately 0.9 mile above the confluence with the South Fork Trinity (Figure 24). The other two represent re-occupied USFS cross sections (surveyed in 1989 and 1992) downstream of the geomorphic reach. All cross sections, including the original USFS cross sections, were photographed. Aluminum caps in concrete and gage structures were used as benchmarks.

5.3.3 Grouse Creek above South Fork Trinity (GCASFT)

The reference reach for Grouse Creek extends from the USFS Route 6 bridge down to the cascade created by Devastation Slide. A large volume of sediment is stored above the slide, through which Grouse Creek meanders unconfined. To accommodate slope-area observations, the four cross sections were located in the steeper, more confined segment, from the bridge down to the beginning of the alluvial deposit above the slide (Figure 25). More cross sections and a longer profile are required to monitor changes in sediment storage above the slide, and changes to the slide cascade.

Aluminum caps in concrete, bridge structures, and the large boulder used in previous surveys, were used as benchmarks. In August, 1997, the USFS (Six Rivers NF) surveyed three cross sections and a longitudinal profile of 4680 feet, from the bridge to the bottom of the cascade created by the slide. No USFS cross section pins could be located, but the longitudinal profiles can be compared.

5.3.4 Hayfork Creek in Hyampom (HCHY)

The longitudinal profile for HCHY extends from the gage site (Cross Section 1), nearly one mile to the riffle below the Hyampom Road Bridge (Figure 26). As previously described, HCHY is a re-occupation of the original USGS gage near Hyampom (Figure 4). Both of the original USGS (brass cap) reference marks were used as benchmarks (Figure 7). Since the original USGS gage datum was obtained from the 2002 survey, USGS stage/discharge relations can be compared. Using the original USGS high flow measurement data will further allow changes to Cross Section 2 to be evaluated: it is located directly beneath the original USGS cableway. Further, original slope-area survey notes, which have been requested from USGS archives, will facilitate an evaluation of changes to the longitudinal profile.

5.3.5 Pelletreau Creek at Hyampom Road (PCHR)

The geomorphic reach on Pelletreau Creek begins below the last major bedrock constriction above the highly aggraded (1964 flood) alluvial plain visible from the Hyampom Road Bridge (Figure 27). The stream channel above the bridge is highly unstable, often braided, other times confined against one side of the valley by the accumulation of stored sediment, cutting into the erodible valley wall, causing bank erosion and landslides. Below the bridge, the channel becomes even less stable, migrating within the alluvial plain. Changes to the longitudinal profile near the gage are evidenced by a shift in the rating curve after the January 1997 storm.

Two concrete benchmarks were established near the bridge, and a scribe on the bridge pier (with an elevation painted next to it) was surveyed. The USFS surveyed six cross sections and a long profile each year from 1989 to 1991, and again in 1993 and 1997. Five of these cross sections were successfully re-occupied, and new rebar pins were installed at endpoints. All USFS sketch maps of pin locations were repeated. Some of the original USFS photo points were repeated. The USFS surveys will be compared to the 2002 surveys to evaluate changes to the cross sections and longitudinal profile. Potentially, using the thalweg depths in pools as a datum (where Pelletreau has cut down to bedrock), changes to the volume of sediment stored in the reach upstream of the bridge can be computed.

Since V* requires a water surface for a reference, and since most of the stream flowed sub-surface at the time of survey, V* was not performed. An irrigation diversion in the cascade above the reach diverts a substantial amount of the flow. Hundreds of juvenile salmonids were observed trapped in the warm, shallow pools below this diversion.

5.3.6 South Fork Trinity at Forest Glen (SFTFG)

The original USGS gaging site, and the current gage, are located approximately in the middle of this reference reach (Figure 28). The longitudinal profile begins 3000 feet upstream of the Highway 36 Bridge and ends approximately 1800 feet below the bridge. Caps in concrete, USFS concrete structures, and a state highway bridge reference mark were used as benchmarks.

Bulk Sampling and Permeability

Data obtained from bulk samples will be entered into a spreadsheet as the weight retained in each sieve class and converted to the cumulative percentage (by weight) finer than the corresponding sieve size.

Surface particle size distribution counts (performed before bulk samples were excavated) will be entered into spreadsheets as the cumulative percent finer by number (described previously).

All permeability data for each site will be entered into a site spreadsheet file. The permeability worksheet (adapted from McBain and Trush 2000) takes measurements entered as elapsed time and cm of water inflow, and converts them to inflow rate (ml/s), raw permeability (cm/hr) from a curve generated by Terhune (1958) and Barnard and McBain (1994), final permeability (cm/hr) adjusted by a water temperature factor (Terhune 1958), mean permeability for each sample location, and mean permeability for the entire site.

All bulk sample and permeability data are currently being processed.

5.4 WATER TEMPERATURE MONITORING

USFS maintained 33 water temperature sites in WY2002. Table 10 provides a summary of those data, including site location name and map reference number (Figure 10), maximum daily average, maximum temperature, and 7-day running maximum average temperature. Sites are subdivided (by color) in Table 10 and Figure 10 into those sites with 7-day maximum averages greater than 68.4^{o}F (20^{o} C) (in red) and those less than 68.4^{o}F (blue). In general, sites along the mainstem of the South Fork Trinity and along the mainstem of Hayfork Creek exceeded this threshold, and often by a significant amount. 7-day maximum averages for mainstem SF Trinity sites ranged from 66.8 (above Powell) to 78.2 (below Slide), with most sites in the mid to upper 70s. 7-day maximum averages for mainstem Hayfork Creek sites ranged from 77.8 (at Arnold Ranch) to 83.4 (at Hyampom). Hayfork Creek temperatures were the highest in the basin. Many of the smaller tributaries had 7-day maximum averages below or well below the threshold, including Big Creek, Butter Creek, East Fork Hayfork Creek, Eltapom Creek, Powell Creek, and Silver Creek.

5.5 GIS DATA ANALYSIS

5.5.1 Ownership

Detailed ownership maps for the watershed were obtained from a variety of sources including Trinity County and the USFS in a GIS-based format. The majority of the basin is under some form of public ownership, including the Shasta-Trinity National Forest, Six Rivers National Forest, Bureau of Land Management, and various state and county entities.

Figure 29 shows overall ownership patterns in the study area, while Table 11 quantifies the distribution both for the entire watershed and on a study watershed level. In the basin, 82.2% of the area is managed by the U.S. Forest Service mostly in Shasta-Trinity NF, with a smaller amount in Six Rivers NF. A significant amount of the private ownership in the watershed is owned by industrial timberland (Sierra-Pacific Industries, Simpson Timber Company, and Timber Products Company.

Six of the study watersheds are entirely privately owned, while a seventh (Gardner Gulch) is 96.4% privately held. No study watersheds are entirely publicly owned, but a 11 of them are over 90% publicly owned.

5.5.2 Slope Analysis

A slope analysis of the watershed was conducted using 10-meter DEM GIS data provided by the U.S. Forest Service. Figure 30 graphically presents the results of this analysis by color-coded slope class.

Table 12 summarizes the areas of the entire watershed and the study watersheds by slope class in terms of both acres and percent watershed area. Surprisingly, slopes along South Fork Mountain are mostly in the 20-30% range. Some of the steepest slopes are not in study watersheds, which generally reflect their remote locations with poor access. The steepest study watersheds are Big Canyon Creek, Gardner Gulch, and Shock Creek, all with over 60% of their area with slopes greater than 50%. Overall, about 27% of the watershed has slopes steeper than 50%.

5.5.3 Geology

North Coastal California contains two parallel geologic provinces that differ in age, lithology, structure, and metamorphism: the Coast Range Province and the inland Klamath Mountains Province. The Coast Range Province, containing the well-known Franciscan Assemblage that is composed of unstable sedimentary and volcanic rocks, occupies a small area in southern and northwestern portions of the study area. East of the Coast Ranges are the older Klamath Mountains, underlain by metamorphic and plutonic rocks. The two provinces are separated by the South Fork Mountain Schist, a formation found to be quite unstable after disturbance (Raines 1998).

Figure 31 shows the distribution of geologic terranes in the watershed, while Table 13 summarizes the areas of the entire watershed and the study watersheds by geologic terrane in terms of both acres and percent watershed area. Overall, only 3.4% of the watershed consists of alluvial deposits, reflecting the rugged nature of the basin. About 66% of the watershed is underlain by the Hayfork Terrane, the Rattlesnake Creek Terrane, or granitics, while about 30% is underlain by the more unstable Galice Formation, the South Fork Mountain Schist, and the Franciscan Formation. The division between study watersheds located in predominately stable or unstable geologic settings is evident: Madden, Grouse, Kerlin, Pelletreau, and the SF Trinity above Forest Glen all have the majority of their areas underlain by these potentially highly unstable geologic formations.

5.5.4 Fire History

A fire history of the watershed was developed by combining two GIS coverages, a polygon coverage of larger fires, and a point coverage of smaller fires. These two coverages were merged and data on burned acres by study watershed by decade were obtained. Because of the combination of the two types of data, a figure graphically depicting the fire areas could not be prepared, however, the fire areas by decade and by study watershed in terms of acres and percent are provided in Table 14. Relatively small percentages of the watershed (0-5%) have burned in all decades except the 1980s. 67% of all acres burned by fires in the 1910-2000 period occurred in the 1980s, when over 68,000 acres burned. Significant percentages of certain study watersheds (Butter Creek, Grassy Flats Creek, and Olsen Creek) were burned in this decade. A large percentage of Carr Creek (66%) burned in the 1990s. Otherwise, most study watersheds have relatively little fire history in the past almost 100 years.

5.5.5 Landslides

Landslides mapped during the sediment source analysis for the SF Trinity River are shown in Figure 32 as a point coverage. Since these data come from different sources, not all of which have volumetric data for slide delivery, there was no means of actually computing volumes of landslide delivery by study watershed. The figure does readily depict that most landslides in the watershed are clearly related to the more unstable geologic formations along the western edge of the watershed. Virtually all of the landslides have occurred along the mainstem and west side tributaries, except in the lower watershed, where some landslides have occurred to the east of the mainstem in the Rattlesnake Creek terrane. Very low rates of landsliding are found areas underlain by the more stable geologic formations, such as the Hayfork Creek watershed.

5.5.6 Harvest Areas

Timber harvest has historically been by far the single largest land use activity in the SF Trinity River watershed. GIS-based plantation coverages were obtained from the USFS and harvest areas on private lands were determined by mapping from the 1994 orthophoto quads.

Table 15 and Figure 33 provide the extent of timber harvest in the watershed from about 1970 to 1995. Harvest areas for this period by study watershed are provided in table 15. The data indicate that as a whole, about 15% of the watershed has been harvested in the past 30 years. Since there was no way to differentiate the private harvest areas by time period, no attempt was made to evaluate harvest history by decade.

With the exception of several watersheds in Summit Creek watershed (Carr Creek, Gardner Gulch, Shock Creek) and Kerlin Creek, most of the study watersheds had relatively modest amounts of timber harvest (<25%) in the 1970-1995 period. In part, this is the result of many harvest areas not being included in the selected study areas, such as along the lower SF Trinity, or along parts of South Fork Mountain.

5.5.7 Roads

Road data were developed from various sources and compiled into the project GIS. USFS provided much of the base data, which had originally been obtained from the USGS topographic maps. USGS cartographic feature files matching the standard 7.5-minute quad were corrected by USFS to the USGS Digital Orthophoto Quads (DOQs). Newer roads, primarily on private lands, found on the 1994 DOQs were also digitized in order to complete the coverage.

According to the GIS road coverage developed in this study, there are currently 3,035 miles of roads in the SF Trinity Watershed, which translates to a basin-wide road density of 3.26 mi/mi^2 (Table 16). Table 16 shows the existing road network distributed by road surfacing type by study watershed. The highest road density in the study watersheds is Kerlin Creek with a density of 5.65 mi/mi^2, followed by Gardner Gulch at 5.59 mi/mi^2, WF Rattlesnake Creek (5.33 mi/mi^2), and the SF Rattlesnake Creek (5.12 mi/mi^2). Notably lower road densities were found in Bear and Little Creeks, in portions of the Barker Creek watershed, and in Madden Creek (< 2.5 mi/mi^2).

Surface types were assigned according to data included with the original coverages from USFS and RCD, and all segments added from the DOQs were assumed to be native because of their locations.

6.0 ANALYSIS

6.1 ASSESS WY2002 AND 2003 IN HISTORICAL FRAMEWORK

Given the relative short timeframe of this study, it is important to assess the significance of the water years studied (2002 and 2003) in terms of historical record (i.e. were these wet or dry years), as this has an important bearing on the interpretation of the sediment yields. There are several means to assess the relative magnitude of these two winters in comparison to long-term historical records of storm intensity, duration, and frequency in order to develop a mechanism for translating data from WY 2001 into average yields (for example a 10-20 year period). Two approaches were used to accomplish this: (1) by comparing annual precipitation totals, and by (2) comparison to flood frequency values for two gages with longer-term flow records in the area (USGS SF Trinity below Hyampom,1965-present, and USGS Hayfork Creek near Hyampom, 1954-1974).

6.1.1 Precipitation

Precipitation in the SF Trinity Watershed, as is typical of California, is highly seasonal, with 90 percent falling between October and April. Rainfall runoff dominates the hydrologic budget, although depending on location in the watershed and the water year type, snowmelt runoff can be significant. There are few long-term annual precipitation records in the watershed, and instead records from Weaverville were used. Weaverville has a mean annual precipitation of 36.29 inches, for 1906-2001, excluding 1981-1983 during which the records are incomplete.

The mean annual precipitation at Weaverville for the 1906-2001 period (96-year record, missing 1981-1983) is 36.29 inches. For Weaverville, the wettest year contained in this record is 1974, when precipitation totals reached 63.58 inches, only slightly wetter than 1998, the next highest, when 63.27 inches were recorded. The driest year at Weaverville was 1977, when only 12.57 inches of precipitation were recorded. For WY2002, annual precipitation in Weaverville was 26.3" considerably below the long-term average. For WY2003, annual precipitation to date is over 36", indicating that this year will be somewhat wetter than normal. However, annual precipitation is only a crude indicator of the geomorphic significance of a given year, as a significant storm may occur in an otherwise dry year.

6.1.2 Flood Frequency

Flood frequency analysis is a method used to predict the magnitude of a flood that would be expected to occur, on average, in a given number of years (recurrence interval) or to have a specific probability of occurrence in any one year (1% chance event, for example). Typically, the observed annual maximum peak discharges are fitted to the distribution using a generalized or station skew coefficient, although numerous other distributions may also used. When long records are available, the station skew is generally used exclusively. DWR (1991) and GMA (1998) and included flood frequency of the USGS gage records using the Log-Pearson Type III distribution for the gages respective periods of record. For Hayfork Creek near Hyampom, the Q_2 event (flood event that would occur on average once every 2 years) was 12,000 cfs and Q_5 was 20,000 cfs. Although the GMA gage on Hayfork Creek near Hyampom was not installed until after the annual maximum peak flow would have occurred in WY2002, it is estimated that the return interval of the peak discharge was less than a two year event. In WY 2003, the computed peak discharge of 15,600 cfs has a recurrence interval of 3-4 year flow. Data for the USGS gage below Hyampom were not yet available at the time of this report.

6.2 WATERSHED LEVEL RELATIONSHIPS

Figure 17 shows the combined relationship of suspended sediment load versus discharge for all six sites computed to date. The combined relationship has an r^2 value of 0.74, although there is almost 3 orders of magnitude difference between extreme data points in portions of the relationship. Overall, little can be learned from watershed level relationships. Figure 18 segregates these same data points into the individual sites, showing how much improved the relationships become, and that real differences exist between sites.

6.3 INDIVIDUAL SITE RELATIONSHIPS

Given the relatively small number of sites that have been fully computed at the time of this report, only a brief review of individual site relationships is possible. The best way to compare individual sites with divergent areas is by normalizing discharge and sediment transport loads by watershed area. In Figure 19, suspended sediment load versus unit discharge (cfs/mi^2) is presented for the six sites computed to date. Preliminary analysis of these data yields a number of conclusions:

- Tule Creek has substantially lower sediment yields than the other sites. Tule Creek drains a watershed with stable geology, has moderate road density (3.77 mi/mi^2), and 15% of the watershed has been harvested in the last 25 years. Tule Creek has relative mild slopes and is 96% publicly owned, thus the harvest probably occurred at least 10 years ago. It would appear that the combination of moderate slopes and stable geology and with little recent harvest, results in low suspended sediment transport rates.
- Hayfork Creek near Hayfork has somewhat greater transport rates that Hayfork Creek near Hyampom. This implies that the watershed between these sites has much lower sediment yields.
- Summit Creek and SF Trinity at Forest Glen have very similar sediment transport rates per unit discharge. This occurs despite extreme differences in geology and land use. At present, there is no apparent explanation for this.
- Barker Creek at Stokely Ranch and Hayfork Creek near Hayfork have similar transport rates and are the highest of the six sites computed to date. The Barker Creek watershed is underlain by stable geology (Hayfork Terrane), has moderate slopes (25.6% of the watershed has 50% slopes or steeper), a moderate road density (3.25), and low harvest rates (8.9%). The only apparent explanation for these high transport rates lies in the road network and the effects of land use in the privately held portions. Analysis of other sites within this watershed will provide additional information on how the various portions of this watershed delivery sediment.
- Differences between the highest and lowest sediment transport rates per unit discharge of these six sites are greater than an order of magnitude for study watersheds in similar geologic terranes. Differences must be related to land use.

6.4 DETAILED STUDY WATERSHED SITE RELATIONSHIPS

Two watersheds were selected for more detailed study by sub-division of the watershed into multiple sub-watersheds. The two watersheds selected were Barker Creek and Rattlesnake Creek. Since most of the sites within these two watersheds have not yet been computed, this section must wait until the final report for the entire project.

6.5 ANALYSIS OF SEDIMENT LOAD VALUES BY GEOLOGIC TERRANE

Figure 31 shows the study sites overlain on a simplified geology map of the watershed. The WY2002-

2003 data were stratified by geology to evaluate possible differences between sediment generation and transport rates in the various geologic terranes. As mentioned previously and as depicted in Figure 19, five of the six sites computed to date lie in the Hayfork Creek watershed which generally have similar geology. Given the scatter observed in these analyses, it is apparent that geology by itself does not explain much of the variability between watersheds in terms of observed sediment loads or turbidity. The extent of management activities appears to play a more significant role that geology in determining sediment yields. As sites in other geologic terranes are computed, the significance of geology may become better defined.

6.6 RELATIONSHIP TO TMDL DATA

Raines (1998) developed management and non-management sediment yields as part of the sediment source analysis for the South Fork Trinity River. Total rates (management and non-management rates combined) were 317, 282, and 182 tons/mi^2/yr for the 1975-1990 period for the Lower South Fork, Upper South Fork, and Hayfork sub-areas, respectively. This is the most recent and comparable period to the rates computed in this study. For the Hayfork Creek near Hayfork site, WY2003 suspended sediment yield was computed at 158 tons/mi^2. Although this is only the suspended sediment portion of total load, the bedload component is unlikely to be more than 10% of the suspended load. Thus, for WY2003 the estimated total yield of Hayfork Creek is approximately 173 tons/mi^2. Given that the peak discharge in WY2003 was apparently a 3-4 year event, this implies that the average sediment yield would likely be smaller than WY2003. Thus, the yield estimates for Hayfork Creek from the TMDL would appear to be somewhat higher than those measured. However, these values are still relatively similar.

6.7 COMPARISONS TO HISTORIC DATA

Comparisons to historic data will be possible only for certain data types and in certain areas only.

Geomorphic data can be compared to USFS surveys at Butter Creek, Pelletreau Creek, Grouse Creek, Hayfork Creek at Hyampom, and perhaps at SF Trinity River at Forest Glen. Such comparisons will likely only involve cross sections and profiles. Data obtained from bulk sampling may be compared to the nearest sample site from DWR of CDFG substrate date sets.

Where available, these comparisons will be presented in the final report.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Although only a small portion of the data collected in this study have been computed as of this date, a few preliminary conclusions have been developed and are presented here:

- Significant differences between sediment transport rates have been observed at six sites computed to date.
- The relative stability of the various geologic terranes appears to have little relationship to sediment yield in WY2002 and 2003.
- The highest sediment transport rates were found at the Hayfork Creek near Hayfork site at 211 tons/mi^2. Unit sediment yield varied by a factor of 5 between the 6 sites computed.
- Sediment yields do not appear to be related to simple metrics of watershed disturbance such as road density or percent watershed harvested.
- A detailed program of streamflow and sediment transport measurement has quantified substantial differences in sediment yield between sites.

The following preliminary recommendations are made:

- Although not yet fully computed, review of data collected within sub-watersheds indicates that measurement of streamflow and sediment transport can be an effective technique to identify sub-watershed areas that are producing sediment at higher rates.
- The strength of relationships between turbidity and suspended sediment for individual sites, suggests that measurement of turbidity could define sediment yields at a management level once streamflow rating curves had been developed. Since turbidity is far easier and less expensive to measure than suspended sediment, this may be a more cost effective approach to evaluating relative sediment yields.

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SOUTH FORK TRINITY RIVER WATERSHED
General Site Descriptions for Sites Administered by Graham Matthews and Associates

(Stations in bold type are included in this report)

GEOGRAPHIC UNIT	SITE #	SITE NAME	ACRONYM	Watershed Area (mi^2)	Datalogger installed	Crest Gage Installed	Geomorphic Reach Established
Barker Creek	**1**	Barker Creek at Hwy 3	BCH3	10.17		yes	
	2	**Barker Creek at Stokely Ranch**	BCSR	10.00	yes	yes	
	3	Barker Trib. at Barker Valley Rd.	BTBV	0.01		yes	
	4	Little Barker at Barker Cr. Rd.	LBBC	2.07		yes	
	5	Upper Barker at USFS 32N03	UBO3	5.36		yes	
	6	Barker Trib. at Stokely Ranch	BTSR	0.02		yes	
Upper Hayfork Creek	**7**	Big Creek at Hwy 3	BGCH3	27.26	yes	yes	
	8	Carr Creek at Hwy 3	CCH3	5.96		yes	
	9	Duncan Creek at Summit Creek Rd.	DCSCR	6.47		yes	
	10	Gardner Gulch above Pond	GGAP	1.27		yes	
	11	Shock Creek above Gardner Gulch	SCAGG	1.53		yes	
	12	Summit Creek at Summit Creek Rd.	SCSCR	2.53		yes	
	13	**Summit Creek at Wildwood Rd.**	SCWR	28.26	yes	yes	
Lower Hayfork Creek	**14**	Bear Creek above Hayfork Creek	BCHC	7.63	yes	yes	
	15	**Hayfork Creek near Hayfork**	HCNH	265.10	yes	yes	yes
	16	Little Creek at Hyampom Rd.	LCHR	9.09		yes	
	17	No Name at 9 Mile Bridge.	NN9MB	2.67		yes	
	18	Salt Creek at Salt Cr. Growers	SCSG	53.59	yes	yes	
	19	**Tule Creek at Tule Creek Road**	TCTCR	20.25	yes	yes	
Hyampom	**20**	Big Canyon Cr. at Hyampom Rd.	BCHR	1.82		yes	
	21	Butter Creek	BUCSFT	36.08	yes	yes	yes
	22	Eltapom Creek above South Fork Trinity	ECASFT	19.59	yes	yes	
	23	Grassy Flats at Hyampom Rd.	GCHR	2.16		yes	
	24	Grouse Creek	GCASFT	53.18	yes	yes	yes
	25	**Hayfork Creek near Hyampom**	HCHY	378.77	yes	yes	yes
	26	Kerlin Creek at Hyampom Rd.	KCHR	3.96	yes	yes	
	27	Olsen Creek at Olsen Creek Rd.	OCOCR	6.40		yes	
	28	Pelletreau Creek at Hyampom Rd.	PCHR	11.80	yes	yes	yes
Forest Glen	**29**	**South Fork Trinity at Forest Glen**	SFTFG	207.58	yes	yes	yes
	30	South Fork Rattlesnake at 29N57	SFR57	1.98		yes	
	31	Upper Rattlesnake above 29N73	UR73	6.74		yes	
	32	Upper Rattlesnake above Hwy 36 Water Hole	UR36	14.47		yes	
	33	W. Fork of S. Fork Rattlesnake at 29N57	WFSFR	1.52		yes	
Lower S.F. Trinity	**34**	Madden Creek at Route 6	MCR6	22.53	yes	yes	

Mainstem Sites: Bulk Sampling and Spawning Gravel Permeability	South Fork Trinity at Forest Glen	SFTFG
	South Fork Trinity at Hyampom Road	SFTHR
	South Fork Trinity near Eltapom Creek	SFTEC

	TOTALS
Continuous Data Recording (datalogger) Stations	**15**
Manual (crest gage only) Stations	**19**
Geomorphic Monitoring Sites	**6**
Bulk Sampling Sites	**3**

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SOUTH FORK TRINITY RIVER WATERSHED
Discharge Data Collection Summary for 6 Stations
WY 2002 and 2003

Station	Total # of Streamflow Measurements	WY 2002 Date	WY 2002 Peak Discharge (cfs)	WY 2003 Date	WY 2003 Peak Discharge (cfs)
BCSR	7	1/2/02	258	12/28/02	278
SCWR	8	1/2/02	1,040	12/16/02	1,680
HCNH	15	1/2/02	11,000	12/16/02	13,500 **
TCTCR	8	1/2/02	1,330	12/28/02	1,470
HCHY	9	2/20/02	3,590 *	12/16/02	15,600 **
SFTFG	12	1/2/02	7,200 **	12/16/02	11,600 **

* gage installed after annual peak flow

** peak flow determined by slope-area method: all others by extensions of rating curve

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EXAMPLE OF FORM 9-207 DISCHARGE MEASUREMENT SUMMARY SHEET

GRAHAM MATTHEWS & ASSOCIATES

Hydrology -- Geomorphology -- Stream Restoration

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DISCHARGE SUMMARY SHEET

LOCATION: South Fork Trinity River at Forest Glen **WATER YEAR: 2002, 2003**

Measurement Number	WY Msmt #	Date	Made By:	Width (feet)	Mean Depth (feet)	Area (ft^2)	Mean Velocity (ft/sec)	Gage Height (feet)	Discharge (cfs)	Rating		Method	No. of Msmt sections	Begin Time (hours)	End Time (hours)	Msmt Rating	Recorder level	Notes
										Shift Adj.	Percent Diff							
1	2002-01	11/15/2001	S. Pittman	60.3	1.31	79.20	0.53	0.76	42.3		-5%	Wading	43	900	1130	Good		AA malfunctioned; used pygmy
2	2002-02	11/27/2001	S. Pittman	79.5	2.36	188.00	0.61	1.31	114		0%	Wading	39	1030	1122	Good		
3	2002-03	2/24/2002	Pittman/Pryor	n/a	n/a	n/a	n/a	3.38	1010		-3%	Boat	12 passes	1100	1235	Good		ADP measurement
4	2002-04	3/14/2002	S. Pittman	76.0	3. 2	230.00	2.11	2.45	486		-2%	Wading	31	1355	1540	Good		
5	2002-05	3/22/2002	S. Pittman	90.0	2.01	181.00	1.93	2.16	349		-5%	Wading	29	1430	1526	Good		
6	2002-06	4/30/2002	K. Faucher	89.0	2.42	215.00	0.92	1.67	205		4%	Wading	27	12:00	13:12	Fair		
7	2002-07	8/21/2002	K. Faucher	37.0	0.79	28.40	0.58	0.42	16.6		1%	Wading	34	14:21	15:46	Good		
8	2003-01	2/13/2003	L. Cornelius	90.0	2.09	188.00	2.29	2.36	431		-5%	Wading	28	1210	1255	Good		
9	2003-02	2/19/2002	S. Pittman	n/a	n/a	n/a	n/a	4.25	1530		-7%	Indirect	n/a	n/a	n/a	Good		Slope Area No. 1 (WY 2002)
10	2003-03	12/17/2001	S. Pittman	n/a	n/a	n/a	n/a	5.18	2380		0%	Indirect	n/a	n/a	n/a	Fair		Slope Area No. 2 (WY 2002)
11	2003-04	1/2/2002	S. Pittman	n/a	n/a	n/a	n/a	9.03	7200		7%	Indirect	n/a	n/a	n/a	Fair		Slope Area No. 3 (WY 2002)
12	2003-05	12/16/2002	S. Pittman	n/a	n/a	n/a	n/a	12.71	11600		-9%	Indirect	n/a	n/a	n/a	Poor		Slope Area No. 4 (WY 2003)

Graham Matthews & Associates

BARKER CREEK AT STOKELY RANCH

RATING TABLE NO. 1 -- Begin Date 11/17/01

GH	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	1st Diff	2nd Diff
1.1									0	0.28		
1.2	0.55	0.83	1.10	1.38	1.66	1.93	2.21	2.48	2.76	3.03	2.76	
1.3	3.31	3.59	3.86	4.14	4.41	4.69	4.97	5.24	5.52	5.79	2.76	0.00
1.4	6.07	6.34	6.62	6.90	7.17	7.45	7.72	8.00	8.38	8.77	3.10	0.34
1.5	9.17	9.58	10.00	10.40	10.80	11.20	11.70	12.10	12.60	13.00	4.33	1.23
1.6	13.50	13.90	14.30	14.80	15.20	15.70	16.10	16.60	17.00	17.50	4.46	0.13
1.7	18.00	18.40	18.90	19.40	19.90	20.40	20.90	21.40	21.90	22.50	5.04	0.58
1.8	23.00	23.60	24.20	24.90	25.50	26.20	26.80	27.50	28.20	28.80	6.53	1.49
1.9	29.50	30.20	30.90	31.70	32.40	33.10	33.90	34.60	35.40	36.10	7.40	0.87
2	36.9	37.7	38.5	39.3	40.1	41.0	41.8	42.6	43.5	44.3	8.28	0.88
2.1	45.2	46.1	47.0	47.9	48.8	49.7	50.6	51.5	52.5	53.4	9.17	0.89
2.2	54.4	55.3	56.3	57.3	58.3	59.3	60.3	61.3	62.4	63.4	10.10	0.90
2.3	64.4	65.5	66.6	67.6	68.7	69.8	70.9	72.0	73.1	74.3	11.00	0.91
2.4	75.4	76.6	77.7	78.9	80.1	81.2	82.4	83.6	84.8	86.1	11.90	0.92
2.5	87.3	88.5	89.8	91.0	92.3	93.6	94.9	96.2	97.5	98.8	12.80	0.92
2.6	100	101	103	104	106	107	108	110	111	112	13.70	0.93
2.7	114	115	117	118	120	121	123	124	126	127	14.70	0.94
2.8	129	130	132	133	135	136	138	139	141	143	15.60	0.94
2.9	144	146	147	149	151	152	154	156	157	159	16.60	0.95
3	161	163	164	166	168	169	171	173	175	177	17.50	0.96
3.1	178	180	182	184	186	187	189	191	193	195	18.50	0.96
3.2	197	199	201	203	204	206	208	210	212	214	19.50	0.97
3.3	216	218	220	222	224	226	228	230	233	235	20.40	0.97
3.4	237	239	241	243	245	247	249	252	254	256	21.40	0.98
3.5	258	260	263	265	267	269	271	274	276	278	22.40	0.98
3.6	281	283	285	287	290	292	294	297	299	302	23.40	0.99
3.7	304	306	309	311	314	316	318	321	323	326	24.40	0.99
3.8	328	331	333	336	338	341	343	346	349	351	25.40	1.00
3.9	354	356	359	361	364	367	369	372	375	377	26.40	1.00

NOTES: This rating based upon 7 measured discharges in WY 2001, 2002 and 2003.
Highest gage height at which a discharge was measured = 2.96 ft.

SOUTH FORK TRINITY RIVER
Water Quality Monitoring Project

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TABLE 4

EXAMPLE OF ANNUAL STATION DATA AND MEAN DAILY DISCHARGE SUMMARY FORM

SOUTH FORK TRINITY RIVER BASIN

SOUTH FORK TRINITY AT FOREST GLEN

LOCATION: Lat 40°22'30", Long 123°19'35", in SE 1/4 SE 1/4 sec. 13, T1S, R7E, Trinity County, Hydrologic Unit 18010212, on left bank, 60 yards upstream of Highway 36 bridge, 30 yards downstream of confluence with Glen Creek. Original USGS gage elevation = 2253.49 feet (NGVD 29).

DRAINAGE AREA: Total drainage area is 208 mi^2.

PERIOD OF RECORD: Established October 1, 1959 by USGS (No. 11528100), discontinued Sept 30, 1965. Re-established by Graham Matthews and Associates on October 11, 2001 at original location (new datum).

GAGE: Continuous recording gage is a Global Water WL-14 Pressure Transducer/Datalogger, located in a steel gage house.

REMARKS: Records good. Lower end of discharge rating is not well defined and may under-predict minimum flows.

AVERAGE DISCHARGE: 5 calendar years (USGS records, 1960-1964), 393 cfs, 285,000 acre-feet/year. Water Year 2002 (partial), 361 cfs, 253,500 acre-feet/year.

EXTREMES FOR PERIOD OF RECORD: USGS Records (1960-1964): Maximum discharge: 41,200 cfs, gage height of 27.8 feet on December 22, 1964. Minimum daily discharge: 15.0 cfs, September 24, 1962.

EXTREMES OUTSIDE PERIOD OF RECORD: Remarks in the 1964 USGS slope area summary refer to an apparent peak discharge of 42,400 cfs for the December 22, 1955 event, based on a (poor) 2-section slope area measurement.

EXTREMES FOR CURRENT YEAR: Maximum predicted discharge: 6,870 cfs (from rating) on January 6, 2002, gage height 9.15 feet; maximum estimated discharge 7200 cfs (slope area) on January 2, 2002, gage height 9.03 feet; minimum daily discharge: 5.1 cfs on October 12, 2001.

Peak Discharges above base of 4000 cfs:

Date	Time	Discharge	Gage Ht.
06-Jan-02	0930	6,870	9.15
15-May-01	330	6,700	9.03

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 2001 TO SEPTEMBER 2002
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1		8.8	1,220	2,930	349	598	345	199	95	36	19	13
2		5.2	1,210	5,570	332	546	352	185	90	35	19	13
3		5.3	916	2,900	313	502	366	173	86	33	18	12
4		5.6	503	1,780	294	466	368	166	83	32	16	11
5		5.6	701	2,010	283	459	367	159	82	31	18	11
6		6.5	1,560	6,150	277	538	350	154	78	31	18	11
7		7.6	929	3,540	636	628	332	149	75	31	19	12
8		8.1	596	2,730	1,010	547	321	144	72	30	19	13
9		8.9	469	2,100	714	515	337	141	70	30	18	13
10		9.9	372	1,620	615	552	350	138	70	29	18	13
11		14	307	1,330	551	561	329	135	68	28	17	13
12	5.1	51	260	1,140	513	563	319	133	66	27	17	12
13	5.6	63	311	984	490	540	310	130	63	28	16	11
14	6.6	56	1,340	858	461	511	337	127	61	27	16	11
15	6.6	44	710	747	435	499	321	126	60	26	16	10
16	6.3	53	610	658	415	475	296	122	58	25	15	11
17	7.1	62	1,870	598	399	449	287	121	56	24	15	11
18	32	44	1,230	537	373	417	266	120	57	24	14	12
19	23	46	1,560	495	707	395	253	119	55	24	14	12
20	17	65	1,500	459	2,080	382	243	137	52	24	14	12
21	15	223	1,050	521	1,510	371	235	128	50	24	14	11
22	27	571	966	488	1,190	388	224	120	50	23	14	11
23	47	186	886	428	1,210	458	217	114	48	24	15	11
24	71	214	726	399	1,040	457	209	111	46	23	15	11
25	87	223	612	394	890	428	205	107	45	22	14	10
26	99	146	548	556	785	403	202	104	43	21	14	10
27	108	111	613	503	715	380	191	103	41	21	14	9.9
28	114	419	897	453	656	363	179	104	40	20	14	9.9
29	115	852	1,170	413	------	355	180	102	38	20	14	10
30	214	360	1,300	378	------	346	205	101	37	19	13	10
31	100	------	2,140	358	------	344	---	97	------	19	13	------
TOTAL	1,106.30	3,874.50	29,082	44,027	19,243	14,436	496	4,069	1,835	811	490	340.8
MEAN	55.3	129	938	1,420	687	466	283	131	61.2	26.2	15.8	11.4
MAX	214	852	2,140	6,150	2,080	628	368	199	95	36	19	13
MIN	5.1	5.2	260	358	277	344	179	97	37	19	13	9.9
AC-FT	2,190	7,690	57,680	87,330	38,170	28,630	850	8,070	3,640	1,610	972	676

WTR YR 2002 **TOTAL** 127,811 **MEAN** 361 **MAX** 6,150 **MIN** 5.1 **AC-FT** 253,500

SOUTH FORK TRINITY RIVER
WATER QUALITY MONITORING PROJECT

TRINITY COUNTY RESOURCE CONSERVATION DISTRICT

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TABLE 5

SOUTH FORK TRINITY RIVER WATERSHED
Suspended Sediment Data Collection Summary for 6 Stations

Station	Depth Integrated Samples	Grab samples	WY 2002 Maximum Observed Turbidity (NTU)	WY 2002 Maximum Observed SSC (mg/l)	WY 2003 Maximum Observed Turbidity (NTU)	WY 2003 Maximum Observed SSC (mg/l)
BCSR	24	7	110	1100	320	1020
SCWR	22	2	78	290	200	341
HCNH	18	13	100	40	220	403
TCTCR	23	0	36	108	26	89
HCHY	24	8	60	N/A	499	361
SFTFG	17	20	48	106	163	363
SFTR Watershed Total	**596**	**145**				

Notes: Overall maximum observed values were 1,000 NTU and 2,340 mg/l, both at Barker Creek at Highway 3 on Dec. 14, 2002.
Data represents samples processed as of March 25, 2003.

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TABLE
6

SOUTH FORK TRINITY RIVER WATERSHED
WY 2002-2003 Regression Equations and r^2 Values by Station

Station	SSC vs. T		T vs. Q		SSC vs. Q		SSL vs. Q	
	y =	r^2	y =	r^2	y =	r^2	y =	r^2
BCSR	3.565x + 7.894	0.80	$0.6845x^{0.9163}$	0.55	$0.0835x^{1.6443}$	0.79	$2.2525E^{-04}x^{2.6443}$	0.90
SCWR	3.210x - 31.33	0.85	$0.1590x^{0.8687}$	0.67	$9.526E^{-0.3}x^{1.428}$	0.81	$2.570E-^{0.5}x^{2.428}$	0.92
HCNH	2.247x + 34.84	0.94	$0.01246x^{1.0254}$	0.61	$0.4071x^{0.7574}$	0.56	$1.098E^{-03}x^{1.757}$	0.87
TCTCR	$0.6239x^{1.4694}$	0.91	$0.1604x^{0.7443}$	0.31	$0.0300x^{1.1543}$	0.43	$8.102E-^{05}x^{2.154E+00}$	0.72
HCHY	2.987x - 1.906	0.96	$4.051E^{-04}x^{1.407}$	0.81	$7.009E-^{0.5}x^{1.721}$	0.78	$1.890E^{-0.7}x^{2.721}$	0.89
SFTFG	$1.008x^{1.338}$	0.88	$1.553E^{-0.3}x^{1.203}$	0.82	$3.966E^{-0.4}x^{1.465}$	0.80	$1.070E^{-0.6}x^{2.465}$	0.92

SSC = suspended sediment concentration (mg/l), T = turbidity (NTU), Q = discharge (cfs), SSL = suspended sediment load (tons/mi^2)

SOUTH FORK TRINITY RIVER
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TABLE
7

SOUTH FORK TRINITY RIVER WATERSHED
Total Suspended Sediment Yield

Station	Watershed Area (mi^2)	WY 2002 Suspended Sediment Load (tons)	WY 2002 SSLPA* ($tons/mi^2$)	WY 2003 Suspended Sediment Load (tons)	WY 2003 SSLPA ($tons/mi^2$)
BCSR	10.00	498	50	1,090	109
SCWR	28.26	695	25	1,470	52
HCNH	265.10	36,800	139	56,000	211
TCTCR	20.25	690	34	857	42
HCHY	378.77	1990**	5**	60,000	158
SFTFG	207.58	8650	42	18,800	91

* Suspended Sediment Load Per Watershed Area

** partial water year

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SOUTH FORK TRINITY RIVER WATERSHED
Geomorphic Monitoring Site Summary

SITE	Length of Thalweg Profile (ft)	# of Surveyed Cross Sections	# of Pebble Counts (n=100)	# of Photos Taken	# of Pools Measured for V*	# of Gaged Cross Sections for Slope Area	# of Permanent Benchmarks
HCNH	5110	7	10	39	7	7	3
BUCSFT	646	6	7	26	6	4	2
GCASFT	3700	4	5	21	8	3	3
HCHY	5220	5	10	14	9	4	2
PCHR	2510	7	14	22	N/A *	N/A *	2
SFTFG	4830	7	7	20	6	5	3

* Reach attributes did not meet criteria for indicated method

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USFS SHASTA-TRINITY NATIONAL FOREST SFMU

2002 Temperature Data Site Summary Table

Sort by Alpha

Site Location	Map #	# of days measured	Maximum Daily Average (°F)	Maximum Temp (°F)	7-Day Running Maximum Average (°F)
Bear Creek	5	147	61.1	63.7	**62.7**
Big Creek at Bridge	17	154	61.7	64.2	**63.3**
Butter Creek at 2N10 Bridge	22	144	61.5	63.7	**62.7**
Butter Creek at McCaslin's	23	159	62.9	65.7	**65.0**
Dubakella Creek	18	159	61.6	64.9	**63.7**
East Fork Hayfork Creek	19	147	67.0	68.9	**67.8**
East Fork South Fork Trinity	34	159	62.6	67.0	**66.3**
Eltapom Creek at 4N09 Bridge	1	144	60.6	63.4	**61.8**
Eltapom Creek near mouth	2	130	65.8	67.4	**66.7**
Glen Creek near HWY 36	24	146	61.2	62.8	**62.0**
Hayfork at Hyampom	6	130	76.8	84.6	**83.4**
Hayfork Creek at Arnold Ranch	20	147	73.2	80.6	**77.8**
Hayfork Creek below Bear	7	147	74.4	82.3	**80.1**
Hayfork Creek below Miners	8	126	75.4	79.1	**78.2**
Miners Creek	10	143	62.2	65.2	**64.3**
Naufus Creek	25	74	66.4	80.0	**77.3**
Pelletreau Creek	3	63	70.7	83.8	**80.4**
Philpot Creek	11	147	62.6	65.0	**63.7**
Plummer Creek	26	134	65.9	69.3	**68.5**
Post Creek	27	146	64.7	71.3	**70.1**
Potato Creek	21	147	65.1	69.2	**68.1**
Powell Creek	35	159	63.0	65.5	**64.5**
Rattlesnake Creek near FG station	29	146	67.5	71.6	**70.3**
Shell Mtn.Creek	36	145	66.8	72.2	**70.7**
Silver Creek	37	144	64.6	67.0	**66.3**
Smokey Creek	38	140	66.0	70.2	**69.2**
South Fork Trinity above Powell	39	159	62.9	68.1	**66.8**
South Fork Trinity above Shell	40	145	68.4	79.0	**77.1**
South ForkTrinity at Concrete Bridge	42	159	73.8	76.9	**76.2**
South Fork Trinity above Smokey	41	144	68.5	72.3	**71.3**
South Fork Trinity at Forest Glen	31	127	72.0	76.1	**75.4**
South Fork Trinity above Plummer	30	134	73.8	76.9	**76.2**
South Fork Trinity at Hyampom	32	70	75.6	78.7	**77.6**
South Fork Trinity below Slide	4	130	73.3	79.6	**78.2**

Source: USFS

Sites/temps with 7-day Maximum Average > 68.4°F (20°C)

Sites/temps with 7-day Maximum Average < 68.4°F (20°C)

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SOUTH FORK TRINITY RIVER WATER QUALITY MONITORING PROJECT
DISTRIBUTION OF PRIVATE/PUBLIC LAND OWNERSHIP BY STUDY WATERSHED

STUDY SITE WATERSHED	SITE ACRONYM	PRIVATE OWNERSHIP (acres)	PERCENT TOTAL AREA	PUBLIC OWNERSHIP (acres)	PERCENT TOTAL AREA	WATERSHED AREA (acres)
Barker Creek at Hwy 3	BCH3	2,011.2	30.9%	4,500.6	69.1%	6,511
Bear Creek above Hayfork Creek	BCHC	153.9	3.2%	4,731.1	96.8%	4,885
Big Canyon Cr. at Hyampom Rd.	BCHR	1,165.3	100.0%			1,165
Barker Creek at Stokley Ranch	BCSR	1,902.4	29.7%	4,500.5	70.3%	6,403
Big Creek at Hwy 3	BGCH3	1,693.0	9.7%	15,755.9	90.3%	17,449
Barker Trib. at Barker Valley Rd.	BTBV	9.0	100.0%			9
Barker Trib. At Stokely Ranch	BTSR	10.9	100.0%			11
Butter Creek above SF Trinity	BUCSFT	860.9	3.7%	22,230.7	96.3%	23,092
Carr Creek at Hwy 3	CCH3	2,581.5	67.6%	1,234.7	32.4%	3,816
Duncan Creek at Summit Creek Rd.	DCSCR	1,767.1	42.7%	2,372.1	57.3%	4,139
Eltapom Creek above South Fork Trinity	ECASFT	1,114.8	8.9%	11,425.2	91.1%	12,540
Grouse Creek above SF Trinity	GCASFT	13,678.9	40.2%	20,358.1	59.8%	34,037
Grassy Flats at Hyampom Rd.	GCHR	4.7	0.3%	1,376.6	99.7%	1,381
Gardner Gulch above Pond	GGAP	782.0	96.4%	29.0	3.6%	811
Hayfork Creek near Hyampom	HCHY	49,599.7	20.5%	192,775.0	79.5%	242,415
Hayfork Creek near Hayfork	HCNH	42,389.7	25.0%	127,231.2	75.0%	169,661
Kerlin Creek at South Fork Road	KCSFR	1,241.0	49.0%	1,293.7	51.0%	2,535
Little Barker at Barker Cr. Rd.	LBBC	180.3	13.6%	1,146.6	86.4%	1,327
Little Creek at Hyampom Rd.	LCHR	6.1	0.1%	5,811.3	99.9%	5,817
Madden Ck @ Route 6	MCR6	1,640.8	11.4%	12,777.6	88.6%	14,419
No Name at 9 Mile Bridge.	NN9MB	1,706.6	100.0%			1,707
Olsen Creek at Olsen Creek Rd.	OCOCR	268.1	6.5%	3,826.3	93.5%	4,094
Pelletreau Creek at South Fork Rd.	PCSFT	5,608.4	74.2%	1,945.4	25.8%	7,554
Shock Creek above Gardner Gulch	SCAGG	812.6	82.7%	169.5	17.3%	982
Summit Creek at Summit Creek Rd.	SCSCR	1,269.4	78.3%	352.6	21.7%	1,622
Salt Ck. @ Salt Cr. Growers	SCSG	3,608.6	10.5%	30,692.1	89.5%	34,301
Summit Creek at Wildwood Rd.	SCWR	12,063.9	66.7%	6,019.6	33.3%	18,083
South Fork Rattlesnake at 29N57	SFR57	1,267.9	100.0%			1,268
So. Fork Trinity at Sandy Bar	SFSB	105,997.8	17.8%	489,783.4	82.2%	595,900
South Fork Trinity at Forest Glen	SFTFG	7,561.3	5.7%	125,245.7	94.3%	132,852
Tule Creek @ Tule Creek Road	TCTCR	402.5	3.1%	12,554.9	96.9%	12,957
Upper Barker at USFS 32N03	UB03	513.2	15.0%	2,914.0	85.0%	3,427
Upper Rattlesnake ab Hwy 36 Water Hole	UR36	101.6	1.1%	9,157.1	98.9%	9,259
Upper Rattlesnake above 29N73	UR73	25.8	0.6%	4,291.0	99.4%	4,317
W. Fork of S. Fork Rattlesnake at 29N57	WFSFR	970.4	100.0%			970
TOTAL FOR WATERSHED		105,997.8	17.8%	489,783.4	82.2%	595,900

Notes: GIS Data combined from various sources

SOUTH FORK TRINITY RIVER
Water Quality Monitoring Project

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TABLE 11

SOUTH FORK TRINITY RIVER WATER QUALITY MONITORING PROJECT
AREAS AND PERCENTAGES OF SLOPE CLASSES BY STUDY WATERSHED

LOCATION	ACRES OF INDICATED SLOPE CLASS 0-20%	20-30%	30-40%	40-50%	50-60%	60-70%	> 70%	TOTAL (acres)
SFSB	109,014.8	106,639.5	120,060.5	99,238.5	72,327.5	46,640.7	41,871.0	595,792.4
BUCSFT	7,653.6	5,350.0	4,238.7	2,719.8	1,599.0	850.4	679.8	23,091.2
ECASFT	2,410.6	2,507.0	2,586.4	1,932.1	1,259.6	781.8	1,061.3	12,538.8
GCASFT	2,247.0	5,723.5	8,862.5	7,008.7	4,868.0	2,936.6	2,383.7	34,030.0
KCSFR	472.9	709.5	589.1	338.5	183.9	100.9	140.1	2,535.0
MCR6	1,484.7	1,615.8	1,989.3	2,315.8	2,434.8	2,173.4	2,403.4	14,417.2
OCOCR	748.6	714.3	742.5	700.5	593.1	350.1	245.3	4,094.4
PCSFR	1,053.3	1,974.1	1,817.0	1,220.2	758.0	412.4	319.1	7,554.1
HCHY	47,341.3	35,780.5	43,337.3	42,581.5	34,503.1	22,188.9	16,624.3	242,357.0
BCHC	191.4	261.2	605.2	1,055.8	1,240.0	920.6	610.4	4,884.6
BCHR	31.3	36.3	113.7	265.1	309.7	232.1	177.1	1,165.2
GCHR	269.4	255.2	251.5	207.5	164.5	120.0	113.2	1,381.3
LCHR	271.0	370.9	777.3	1,150.4	1,353.6	1,093.9	800.2	5,817.2
NN9MB	57.0	85.3	219.3	352.1	412.7	339.9	240.6	1,706.9
HCNH	38,912.9	28,163.5	32,382.4	28,756.9	20,837.2	12,235.6	8,323.6	169,612.1
BGCH3	2,312.4	1,476.8	2,478.4	3,237.8	3,430.5	2,603.4	1,902.1	17,441.4
SCSG	8,311.2	7,508.7	7,349.9	5,227.9	3,203.0	1,659.2	1,040.8	34,300.6
TCTCR	2,604.9	2,755.0	2,879.3	2,198.5	1,294.8	723.7	501.0	12,957.2
BCH3	1,377.7	940.3	1,294.3	1,279.4	924.4	452.5	240.7	6,509.2
BTSR	3.2	1.6	1.8	1.5	0.9	1.0	0.9	10.9
BTBV	1.6	1.5	1.8	1.4	0.8	1.0	0.9	9.0
BCSR	1,331.0	919.8	1,277.5	1,270.3	917.8	447.4	236.4	6,400.2
LBBC	70.9	119.3	259.3	367.9	304.8	141.0	62.9	1,326.1
UB03	298.1	549.7	832.6	783.1	541.2	269.9	151.4	3,425.9
SCWR	3,409.5	2,106.0	2,835.3	3,385.1	3,006.8	1,923.8	1,408.6	18,075.2
CCH3	287.4	440.5	810.5	948.8	724.3	380.3	222.4	3,814.1
DCSCR	631.4	381.3	510.8	755.9	822.8	580.5	456.6	4,139.4
GGAP	34.4	34.9	86.6	153.8	196.8	175.1	129.4	810.9
SCAGG	72.7	69.4	88.0	152.4	223.5	197.6	178.3	981.9
SCSCR	249.3	282.4	298.5	303.2	243.3	142.8	98.2	1,617.7
SFTFG	21,249.1	28,519.7	33,109.6	23,828.0	13,658.7	7,023.8	5,441.0	132,829.9
UR36	2,123.1	2,275.6	2,185.6	1,400.0	730.4	344.9	199.3	9,258.9
SFR57	207.0	264.4	325.9	231.0	128.1	66.0	45.5	1,267.8
UR73	1,178.7	1,162.6	979.8	571.3	267.2	110.7	46.4	4,316.8
WFSFR	121.9	175.8	251.7	198.4	120.1	68.2	34.5	970.7

LOCATION	PERCENT WATERSHED AREA OF INDICATED SLOPE CLASS 0-20%	20-30%	30-40%	40-50%	50-60%	60-70%	> 70%	% AREA >50%
SFSB	18.3%	17.9%	20.2%	16.7%	12.1%	7.8%	7.0%	27.0%
BUCSFT	33.1%	23.2%	18.4%	11.8%	6.9%	3.7%	2.9%	13.6%
ECASFT	19.2%	20.0%	20.6%	15.4%	10.0%	6.2%	8.5%	24.7%
GCASFT	6.6%	16.8%	26.0%	20.6%	14.3%	8.6%	7.0%	29.9%
KCSFR	18.7%	28.0%	23.2%	13.4%	7.3%	4.0%	5.5%	16.8%
MCR6	10.3%	11.2%	13.8%	16.1%	16.9%	15.1%	16.7%	48.6%
OCOCR	18.3%	17.4%	18.1%	17.1%	14.5%	8.6%	6.0%	29.0%
PCSFR	13.9%	26.1%	24.1%	16.2%	10.0%	5.5%	4.2%	19.7%
HCHY	19.5%	14.8%	17.9%	17.6%	14.2%	9.2%	6.9%	30.3%
BCHC	3.9%	5.3%	12.4%	21.6%	25.4%	18.8%	12.5%	56.7%
BCHR	2.7%	3.1%	9.8%	22.7%	26.6%	19.9%	15.2%	61.7%
GCHR	19.5%	18.5%	18.2%	15.0%	11.9%	8.7%	8.2%	28.8%
LCHR	4.7%	6.4%	13.4%	19.8%	23.3%	18.8%	13.8%	55.8%
NN9MB	3.3%	5.0%	12.8%	20.6%	24.2%	19.9%	14.1%	58.2%
HCNH	22.9%	16.6%	19.1%	17.0%	12.3%	7.2%	4.9%	24.4%
BGCH3	13.3%	8.5%	14.2%	18.6%	19.7%	14.9%	10.9%	45.5%
SCSG	24.2%	21.9%	21.4%	15.2%	9.3%	4.8%	3.0%	17.2%
TCTCR	20.1%	21.3%	22.2%	17.0%	10.0%	5.6%	3.9%	19.4%
BCH3	21.2%	14.4%	19.9%	19.7%	14.2%	7.0%	3.7%	24.9%
BTSR	29.0%	15.0%	16.8%	13.6%	8.4%	9.1%	8.2%	25.6%
BTBV	18.1%	16.7%	20.0%	15.6%	8.8%	11.0%	9.9%	29.6%
BCSR	20.8%	14.4%	20.0%	19.8%	14.3%	7.0%	3.7%	25.0%
LBBC	5.3%	9.0%	19.6%	27.7%	23.0%	10.6%	4.7%	38.4%
UB03	8.7%	16.0%	24.3%	22.9%	15.8%	7.9%	4.4%	28.1%
SCWR	18.9%	11.7%	15.7%	18.7%	16.6%	10.6%	7.8%	35.1%
CCH3	7.5%	11.5%	21.3%	24.9%	19.0%	10.0%	5.8%	34.8%
DCSCR	15.3%	9.2%	12.3%	18.3%	19.9%	14.0%	11.0%	44.9%
GGAP	4.2%	4.3%	10.7%	19.0%	24.3%	21.6%	16.0%	61.8%
SCAGG	7.4%	7.1%	9.0%	15.5%	22.8%	20.1%	18.2%	61.0%
SCSCR	15.4%	17.5%	18.5%	18.7%	15.0%	8.8%	6.1%	29.9%
SFTFG	16.0%	21.5%	24.9%	17.9%	10.3%	5.3%	4.1%	19.7%
UR36	22.9%	24.6%	23.6%	15.1%	7.9%	3.7%	2.2%	13.8%
SFR57	16.3%	20.9%	25.7%	18.2%	10.1%	5.2%	3.6%	18.9%
UR73	27.3%	26.9%	22.7%	13.2%	6.2%	2.6%	1.1%	9.8%
WFSFR	12.6%	18.1%	25.9%	20.4%	12.4%	7.0%	3.6%	23.0%

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SOUTH FORK TRINITY RIVER WATER QUALITY MONITORING PROJECT
GEOLOGIC TERRANES BY STUDY WATERSHED

STUDY SITE WATERSHED	ACRES OF INDICATED GEOLOGIC TERRANE							WATERSHED TOTAL (ACRES)
	Alluvial Deposits	Hayfork Terrane	Granitics	Rattlesnake Creek Terrane	Galice Formation	Franciscan Formation	South Fork Mountain Schist	
Barker Creek at Hwy 3	1,255.3	5255.9						6,511.3
Bear Creek above Hayfork Creek		2001.7	2,883.3					4,885.0
Big Canyon Cr. at Hyampom Rd.		334.1	626.6	204.6				1,165.3
Barker Creek at Stokley Ranch	1,154.8	5247.5						6,402.4
Big Creek at Hwy 3	1,556.2	15891.8						17,448.0
Barker Trib. at Barker Valley Rd.	9.0	0.0						9.0
Barker Trib. At Stokely Ranch	10.8	0.0						10.9
Butter Creek above SF Trinity		7.2	3,389.0	19445.7	249.7			23,091.5
Carr Creek at Hwy 3	113.4	3702.5						3,816.0
Duncan Creek at Summit Creek Rd.	722.2	3417.1						4,139.3
Eltapom Creek above South Fork Trinity		1193.1	5,767.7	5571.6				12,532.4
Grouse Creek above SF Trinity			2,740.1	2755.5	8067.2	14535.6	5865.6	33,964.2
Grassy Flats at Hyampom Rd.				1381.3				1,381.3
Gardner Gulch above Pond	9.7	801.2						810.9
Hayfork Creek near Hyampom	18,043.4	111091.0	67,762.3	43983.9		1525.5		242,406.0
Hayfork Creek near Hayfork	17,174.9	89650.4	31,921.9	29385.4		1525.5		169,658.1
Kerlin Creek at South Fork Road	0.8			516.0	492.4		1524.2	2,533.4
Little Barker at Barker Cr. Rd.		1326.8						1,326.8
Little Creek at Hyampom Rd.		5061.7	755.7					5,817.4
Madden Ck @ Route 6			3,316.2	3273.4	7340.3		475.0	14,405.0
No Name at 9 Mile Bridge.		95.9	1,459.8	150.9				1,706.6
Olsen Creek at Olsen Creek Rd.	267.9		455.8	3370.7				4,094.4
Pelletreau Creek at South Fork Rd.	0.2			189.4	3335.4		4014.0	7,539.0
Shock Creek above Gardner Gulch	92.0	890.1						982.1
Summit Creek at Summit Creek Rd.	277.6	1344.1						1,621.7
Salt Ck. @ Salt Cr. Growers		11639.2	7,748.4	13799.4		1113.6		34,300.6
Summit Creek at Wildwood Rd.	3,851.2	14231.6						18,082.8
South Fork Rattlesnake at 29N57			78.6	988.6	200.7			1,267.9
So. Fork Trinity at Sandy Bar	20,319.5	112291.2	113,878.2	171270.6	61011.8	46949.8	69936.5	595,657.5
South Fork Trinity at Forest Glen			16,585.7	40438.3	12179.8	30693.7	32924.2	132,821.7
Tule Creek @ Tule Creek Road	36.5	1842.5	4,116.0	6962.4				12,957.4
Upper Barker at USFS 32N03		3427.1						3,427.1
Upper Rattlesnake ab Hwy 36 Water Hole			1,317.9	6467.7	1473.1			9,258.6
Upper Rattlesnake above 29N73			273.3	4043.4				4,316.7
W. Fork of S. Fork Rattlesnake at 29N57			433.8	183.3	353.4			970.4
TOTAL FOR WATERSHED								595,657.5

STUDY SITE WATERSHED	PERCENT WATERSHED AREA OF INDICATED GEOLOGIC TERRANE						
	Alluvial Deposits	Hayfork Terrane	Granitics	Rattlesnake Creek Terrane	Galice Formation	Franciscan Formation	South Fork Mountain Schist
Barker Creek at Hwy 3	19.3%	80.7%	--	--	--	--	--
Bear Creek above Hayfork Creek	--	41.0%	59.0%	--	--	--	--
Big Canyon Cr. at Hyampom Rd.	--	28.7%	53.8%	17.6%	--	--	--
Barker Creek at Stokley Ranch	18.0%	82.0%	--	--	--	--	--
Big Creek at Hwy 3	8.9%	91.1%	--	--	--	--	--
Barker Trib. at Barker Valley Rd.	99.6%	0.4%	--	--	--	--	--
Barker Trib. At Stokely Ranch	99.7%	0.3%	--	--	--	--	--
Butter Creek above SF Trinity	--	--	14.7%	84.2%	1.1%	--	--
Carr Creek at Hwy 3	3.0%	97.0%	--	--	--	--	--
Duncan Creek at Summit Creek Rd.	17.4%	82.6%	--	--	--	--	--
Eltapom Creek above South Fork Trinity	--	9.5%	46.0%	44.5%	--	--	--
Grouse Creek above SF Trinity	--	--	8.1%	8.1%	23.8%	42.8%	17.3%
Grassy Flats at Hyampom Rd.	--	--	--	100.0%	--	--	--
Gardner Gulch above Pond	1.2%	98.8%	--	--	--	--	--
Hayfork Creek near Hyampom	7.4%	45.8%	28.0%	18.1%	--	0.6%	--
Hayfork Creek near Hayfork	10.1%	52.8%	18.8%	17.3%	--	0.9%	--
Kerlin Creek at South Fork Road	--	--	--	20.4%	19.4%	--	60.2%
Little Barker at Barker Cr. Rd.	--	100.0%	--	--	--	--	--
Little Creek at Hyampom Rd.	--	87.0%	13.0%	--	--	--	--
Madden Ck @ Route 6	--	--	23.0%	22.7%	51.0%	--	3.3%
No Name at 9 Mile Bridge.	--	5.6%	85.5%	8.8%	--	--	--
Olsen Creek at Olsen Creek Rd.	6.5%	--	11.1%	82.3%	--	--	--
Pelletreau Creek at South Fork Rd.	--	--	--	2.5%	44.2%	--	53.2%
Shock Creek above Gardner Gulch	9.4%	90.6%	--	--	--	--	--
Summit Creek at Summit Creek Rd.	17.1%	82.9%	--	--	--	--	--
Salt Ck. @ Salt Cr. Growers	--	33.9%	22.6%	40.2%	--	3.2%	--
Summit Creek at Wildwood Rd.	21.3%	78.7%	--	--	--	--	--
South Fork Rattlesnake at 29N57	--	--	6.2%	78.0%	15.8%	--	--
So. Fork Trinity at Sandy Bar	3.4%	18.9%	19.1%	28.8%	10.2%	7.9%	11.7%
South Fork Trinity at Forest Glen	--	--	12.5%	30.4%	9.2%	23.1%	24.8%
Tule Creek @ Tule Creek Road	0.3%	14.2%	31.8%	53.7%	--	--	--
Upper Barker at USFS 32N03	--	100.0%	--	--	--	--	--
Upper Rattlesnake ab Hwy 36 Water Hole	--	--	14.2%	69.9%	15.9%	--	--
Upper Rattlesnake above 29N73	--	--	6.3%	93.7%	--	--	--
W. Fork of S. Fork Rattlesnake at 29N57	--	--	44.7%	18.9%	36.4%	--	--
TOTAL FOR WATERSHED	3.41%	18.85%	19.12%	28.75%	10.24%	7.88%	11.74%

Notes: GIS Data combined from various sources

SOUTH FORK TRINITY RIVER
WATER QUALITY MONITORING PROJECT

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TABLE

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FIRE AREAS BY DECADE BY SUB-WATERSHED, 1910-2000

Study Site Watershed	FIRE AREAS BY DECADE (acres)										FIRE AREA	STUDY WATERSHED	PERCENT BURNED
	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s	TOTAL	TOTAL AREA	1910-2000
Barker Creek at Hwy 3									2.0		2.0	6,511	0.0%
Bear Creek above Hayfork Creek					6.4						6.4	4,885	0.1%
Big Canyon Cr. at Hyampom Rd.					67.9						67.9	1,165	5.8%
Barker Creek at Stokley Ranch									2.0		2.0	6,403	0.0%
Big Creek at Hwy 3					1,340.0						1,340.0	17,449	7.7%
Butter Creek above SF Trinity		2,123.1						10,464.3			12,587.4	23,092	54.5%
Carr Creek at Hwy 3									2,518.5		2,518.5	3,816	66.0%
Duncan Creek at Summit Creek Rd.		4.2		129.3		169.6					303.1	4,139	7.3%
Eltapom Creek above South Fork Trinity	298.5							2,511.4			2,809.9	12,540	22.4%
Grouse Creek above SF Trinity	213.6	931.3	1,318.9			303.8					2,767.7	34,037	8.1%
Grassy Flats at Hyampom Rd.								732.1			732.1	1,381	53.0%
Gardner Gulch above Pond						5.7					5.7	811	0.7%
Hayfork Creek near Hyampom		1,826.3		309.8	3,696.2	5,392.7	547.9	13,621.4	6,193.2	1,089.8	32,677.1	242,415	13.5%
Hayfork Creek near Hayfork		1,158.4		309.8	1,485.4	5,392.7	547.9	8,373.4	6,193.2	142.6	23,603.3	169,661	13.9%
Little Barker at Barker Cr. Rd.									2.0		2.0	1,327	0.1%
Little Creek at Hyampom Rd.		2.2			1,865.3					53.2	1,920.7	5,817	33.0%
Madden Ck @ Route 6			100.5		148.3						248.8	14,419	1.7%
Olsen Creek at Olsen Creek Rd.								2,182.8			2,182.8	4,094	53.3%
Pelletreau Creek at South Fork Rd.								399.0			399.0	7,554	5.3%
Summit Creek at Summit Creek Rd.						970.2					970.2	1,622	59.8%
Salt Ck. @ Salt Cr. Growers		560.8						4,838.3	678.2		6,077.3	34,301	17.7%
Summit Creek at Wildwood Rd.		4.2		181.3		1,545.1	542.3		4,690.5		6,963.4	18,083	38.5%
So. Fork Trinity at Sandy Bar	1,785.1	7,239.5	3,490.7	309.8	3,963.6	9,118.1	547.9	68,286.3	6,193.2	1,089.8	102,024.0	595,900	17.1%
South Fork Trinity at Forest Glen		2,052.7	74.8			3,256.2		13,291.0			18,674.7	132,852	14.1%
Tule Creek @ Tule Creek Road								2,550.0			2,550.0	12,957	19.7%
Upper Rattlesnake ab Hwy 36 Water Hole								6.1			6.1	9,259	0.1%
											-		
TOTAL FOR WATERSHED BY DECADE	1,785.1	7,239.5	3,490.7	309.8	3,963.6	9,118.1	547.9	68,286.3	6,193.2	1,089.8	102,024.0		
% OF TOTAL PERIOD	1.7%	7.1%	3.4%	0.3%	3.9%	8.9%	0.5%	66.9%	6.1%	1.1%	100.0%		

Study Site Watershed	PERCENT WATERSHED AREA BURNED BY DECADE									
	1910s	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
Barker Creek at Hwy 3	-	-	-	-	-	-	-	-	0.0%	-
Bear Creek above Hayfork Creek	-	-	-	-	0.1%	-	-	-	-	-
Big Canyon Cr. at Hyampom Rd.	-	-	-	-	5.8%	-	-	-	-	-
Barker Creek at Stokley Ranch	-	-	-	-	-	-	-	-	0.0%	-
Big Creek at Hwy 3	-	-	-	-	7.7%	-	-	-	-	-
Butter Creek above SF Trinity	-	9.2%	-	-	-	-	-	45.3%	-	-
Carr Creek at Hwy 3	-	-	-	-	-	-	-	-	66.0%	-
Duncan Creek at Summit Creek Rd.	-	0.1%	-	3.1%	-	4.1%	-	-	-	-
Eltapom Creek above South Fork Trinity	2.4%	-	-	-	-	-	-	20.0%	-	-
Grouse Creek above SF Trinity	0.6%	2.7%	3.9%	-	-	0.9%	-	-	-	-
Grassy Flats at Hyampom Rd.	-	-	-	-	-	-	-	53.0%	-	-
Gardner Gulch above Pond	-	-	-	-	-	0.7%	-	-	-	-
Hayfork Creek near Hyampom	-	0.8%	0.0%	0.1%	1.5%	2.2%	0.2%	5.6%	2.6%	0.4%
Hayfork Creek near Hayfork	-	0.7%	0.0%	0.2%	0.9%	3.2%	0.3%	4.9%	3.7%	0.1%
Little Barker at Barker Cr. Rd.	-	-	-	-	-	-	-	-	0.1%	-
Little Creek at Hyampom Rd.	-	0.0%	-	-	32.1%	-	-	-	-	0.0
Madden Ck @ Route 6	-	-	0.7%	-	1.0%	-	-	-	-	-
Olsen Creek at Olsen Creek Rd.	-	-	-	-	-	-	-	53.3%	-	-
Pelletreau Creek at South Fork Rd.	-	-	-	-	-	-	-	5.3%	-	-
Summit Creek at Summit Creek Rd.	-	-	-	-	-	59.8%	-	-	-	-
Salt Ck. @ Salt Cr. Growers	-	1.6%	-	-	-	-	-	14.1%	2.0%	-
Summit Creek at Wildwood Rd.	-	0.0%	-	1.0%	-	8.5%	3.0%	-	25.9%	-
So. Fork Trinity at Sandy Bar	0.3%	1.2%	0.6%	0.1%	0.7%	1.5%	0.1%	11.5%	1.0%	0.2%
South Fork Trinity at Forest Glen	-	1.5%	0.1%	-	-	2.5%	-	10.0%	-	-
Tule Creek @ Tule Creek Road	-	-	-	-	-	-	-	19.7%	-	-
Upper Rattlesnake ab Hwy 36 Water Hole	-	-	-	-	-	-	-	0.1%	-	-

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TABLE

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SOUTH FORK TRINITY RIVER WATER QUALITY MONITORING PROJECT
AMOUNT OF TIMBER HARVEST BY STUDY WATERSHED FROM 1970 TO PRESENT

STUDY SITE WATERSHED	SITE ACRONYM	NUMBER OF HARVEST UNITS	HARVEST TOTAL 1970-Present (acres)	WATERSHED AREA (acres)	PERCENT HARVESTED
Barker Creek at Hwy 3	BCH3	86	517.8	6,511	7.95%
Bear Creek above Hayfork Creek	BCHC	7	191.4	4,885	3.92%
Big Canyon Cr. at Hyampom Rd.	BCHR	32	152.9	1,165	13.13%
Barker Creek at Stokley Ranch	BCSR	86	517.8	6,403	8.09%
Big Creek at Hwy 3	BGCH3	194	1,801.4	17,449	10.32%
Butter Creek above SF Trinity	BUCSFT	307	5,109.4	23,092	22.13%
Carr Creek at Hwy 3	CCH3	8	2,167.3	3,816	56.79%
Duncan Creek at Summit Creek Rd.	DCSCR	11	1,083.3	4,139	26.17%
Eltapom Creek above South Fork Trinity	ECASFT	128	1,620.8	12,540	12.93%
Grouse Creek above SF Trinity	GCASFT	397	8,700.0	34,037	25.56%
Grassy Flats at Hyampom Rd.	GCHR	16	98.3	1,381	7.11%
Gardner Gulch above Pond	GGAP	5	765.2	811	94.36%
Hayfork Creek near Hyampom	HCHY	1701	33,325.5	242,415	13.75%
Hayfork Creek near Hayfork	HCNH	1156	28,012.5	169,661	16.51%
Kerlin Creek at South Fork Road	KCSFR	35	879.7	2,535	34.70%
Little Barker at Barker Cr. Rd.	LBBC	8	34.3	1,327	2.58%
Little Creek at Hyampom Rd.	LCHR	44	397.2	5,817	6.83%
Madden Ck @ Route 6	MCR6	116	3,360.5	14,419	23.31%
No Name at 9 Mile Bridge.	NN9MB	38	114.0	1,707	6.68%
Olsen Creek at Olsen Creek Rd.	OCOCR	70	782.5	4,094	19.11%
Pelletreau Creek at South Fork Rd.	PCSFT	32	811.3	7,554	10.74%
Shock Creek above Gardner Gulch	SCAGG	3	675.7	982	68.81%
Summit Creek at Summit Creek Rd.	SCSCR	3	49.7	1,622	3.06%
Salt Ck. @ Salt Cr. Growers	SCSG	203	3,882.1	34,301	11.32%
Summit Creek at Wildwood Rd.	SCWR	58	6,736.7	18,083	37.25%
South Fork Rattlesnake at 29N57	SFR57	11	94.9	1,268	7.48%
So. Fork Trinity at Sandy Bar	SFSB	4391	89,478.6	595,900	15.02%
South Fork Trinity at Forest Glen	SFTFG	827	14,811.9	132,852	11.15%
Tule Creek @ Tule Creek Road	TCTCR	273	1,946.2	12,957	15.02%
Upper Barker at USFS 32N03	UB03	73	391.2	3,427	11.41%
Upper Rattlesnake ab Hwy 36 Water Hole	UR36	89	725.9	9,259	7.84%
Upper Rattlesnake above 29N73	UR73	25	271.5	4,317	6.29%
W. Fork of S. Fork Rattlesnake at 29N57	WFSFR	14	105.0	970	10.83%
			-		
TOTAL FOR WATERSHED		4391	89,478.6	595,900	15.02%

Notes: Data combined from USFS files and aerial photo analysis

SOUTH FORK TRINITY RIVER
Water Quality Monitoring Project

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TABLE
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SOUTH FORK TRINITY RIVER WATER QUALITY MONITORING PROJECT
MILES OF ROAD TYPES AND ROAD DENSITY BY STUDY WATERSHED

STUDY SITE WATERSHED	MILES OF ROADS OF INDICATED TYPE				WATERSHED	DRAINAGE	ROAD DENSITY
	NATIVE	ROCKED	PAVED	HIGHWAY	ROAD TOTAL (mi)	AREA (mi^2)	(mi/mi^2)
Barker Creek at Hwy 3	34.8	10.0			44.8	10.17	4.40
Bear Creek above Hayfork Creek	8.3				8.3	7.63	1.08
Big Canyon Cr. at Hyampom Rd.	6.9	1.2			8.0	1.82	4.42
Barker Creek at Stokley Ranch	34.3	10.0			44.3	10.00	4.42
Big Creek at Hwy 3	76.3	9.3	10.4	0.1	96.2	27.26	3.53
Barker Trib. at Barker Valley Rd.					-	0.01	0.00
Barker Trib. At Stokely Ranch	0.1				0.1	0.02	3.25
Butter Creek above SF Trinity	119.2	38.4	6.3		163.9	36.08	4.54
Carr Creek at Hwy 3	29.7	0.7			30.3	5.96	5.09
Duncan Creek at Summit Creek Rd.	20.7				20.7	6.47	3.20
Eltapom Creek above South Fork Trinity	38.5	14.1	10.7		63.4	19.59	3.24
Grouse Creek above SF Trinity	176.5	45.9	10.5		232.8	53.18	4.38
Grassy Flats at Hyampom Rd.	3.9	1.6			5.5	2.16	2.54
Gardner Gulch above Pond	7.1				7.1	1.27	5.59
Hayfork Creek near Hyampom	954.7	156.8	95.1	37.1	1,243.6	378.77	3.28
Hayfork Creek near Hayfork	760.1	108.5	75.2	37.1	980.8	265.10	3.70
Kerlin Creek at South Fork Road	19.5	2.8	0.0		22.4	3.96	5.65
Little Barker at Barker Cr. Rd.	4.8	0.1			4.9	2.07	2.36
Little Creek at Hyampom Rd.	22.5	0.1			22.6	9.09	2.48
Madden Ck @ Route 6	25.5	16.5	8.4		50.5	22.53	2.24
No Name at 9 Mile Bridge.	6.5	4.7	0.0		11.3	2.67	4.23
Olsen Creek at Olsen Creek Rd.	17.0	7.3	2.5		26.8	6.40	4.19
Pelletreau Creek at South Fork Rd.	35.8	2.3	3.0		41.1	11.80	3.48
Shock Creek above Gardner Gulch	6.1				6.1	1.53	3.99
Summit Creek at Summit Creek Rd.	10.5			2.4	12.9	2.53	5.11
Salt Ck. @ Salt Cr. Growers	130.3	18.8	1.9	18.0	169.0	53.59	3.15
Summit Creek at Wildwood Rd.	118.5	2.0	0.1	7.0	127.6	28.26	4.52
South Fork Rattlesnake at 29N57	4.2	5.9			10.1	1.98	5.12
So. Fork Trinity at Sandy Bar	2,282.8	503.9	195.2	52.8	3,034.7	931.09	3.26
South Fork Trinity at Forest Glen	507.3	104.2	20.9	8.9	641.3	207.58	3.09
Tule Creek @ Tule Creek Road	53.1	18.5	4.9		76.4	20.25	3.77
Upper Barker at USFS 32N03	18.2	7.8			26.0	5.36	4.85
Upper Rattlesnake ab Hwy 36 Water Hole	40.9	19.9		5.2	65.9	14.47	4.56
Upper Rattlesnake above 29N73	19.1	7.3		1.9	28.2	6.74	4.19
W. Fork of S. Fork Rattlesnake at 29N57	4.7	3.4			8.1	1.52	5.33
TOTAL FOR WATERSHED	2,282.8	503.9	195.2	52.8	3,034.7	931.09	3.26

Notes: GIS Data combined from various sources

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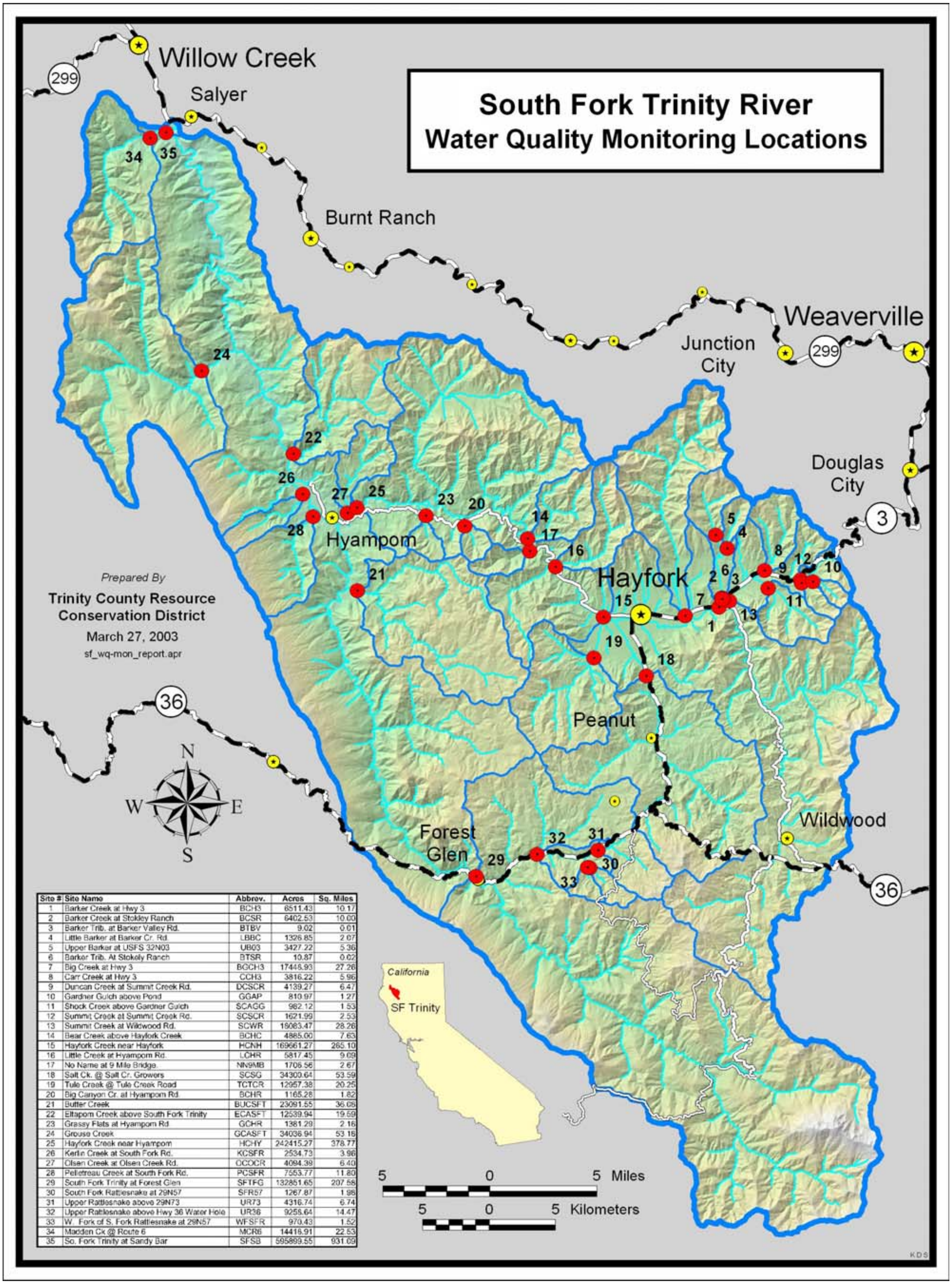
TABLE 16



Site #	Site Name	Abbrev.	Acres	Sq. Miles
1	Barker Creek at Hwy 3	BCH3	6511.43	10.17
2	Barker Creek at Stokley Ranch	BCSR	6402.53	10.00
3	Barker Trib. at Barker Valley Rd.	BTBV	9.02	0.01
4	Little Barker at Barker Cr. Rd.	LBBC	1326.85	2.07
5	Upper Barker at USFS 32N03	UB03	3427.22	5.36
6	Barker Trib. At Stokely Ranch	BTSR	10.87	0.02
7	Big Creek at Hwy 3	BGCH3	17448.93	27.26
8	Carr Creek at Hwy 3	CCH3	3816.22	5.96
9	Duncan Creek at Summit Creek Rd.	DCSCR	4139.27	6.47
10	Gardner Gulch above Pond	GGAP	810.97	1.27
11	Shock Creek above Gardner Gulch	SCAGG	982.12	1.53
12	Summit Creek at Summit Creek Rd.	SCSCR	1621.99	2.53
13	Summit Creek at Wildwood Rd.	SCWR	18083.47	28.26
14	Bear Creek above Hayfork Creek	BCHC	4885.00	7.63
15	Hayfork Creek near Hayfork	HCNH	169661.27	265.10
16	Little Creek at Hyampom Rd.	LCHR	5817.45	9.09
17	No Name at 9 Mile Bridge.	NN9MB	1706.56	2.67
18	Salt Ck. @ Salt Cr. Growers	SCSG	34300.64	53.59
19	Tule Creek @ Tule Creek Road	TCTCR	12957.38	20.25
20	Big Canyon Cr. at Hyampom Rd.	BCHR	1165.28	1.82
21	Butter Creek	BUCSFT	23091.55	36.08
22	Eltapom Creek above South Fork Trinity	ECASFT	12539.94	19.59
23	Grassy Flats at Hyampom Rd.	GCHR	1381.29	2.16
24	Grouse Creek	GCASFT	34036.94	53.18
25	Hayfork Creek near Hyampom	HCHY	242415.27	378.77
26	Kerlin Creek at South Fork Rd.	KCSFR	2534.73	3.96
27	Olsen Creek at Olsen Creek Rd.	OCOCR	4094.39	6.40
28	Pelletreau Creek at South Fork Rd.	PCSFR	7553.77	11.80
29	South Fork Trinity at Forest Glen	SFTFG	132851.65	207.58
30	South Fork Rattlesnake at 29N57	SFR57	1267.87	1.98
31	Upper Rattlesnake above 29N73	UR73	4316.74	6.74
32	Upper Rattlesnake above Hwy 36 Water Hole	UR36	9255.64	14.47
33	W. Fork of S. Fork Rattlesnake at 29N57	WFSFR	970.43	1.52
34	Madden Ck @ Route 6	MCR6	14416.91	22.53
35	So. Fork Trinity at Sandy Bar	SFSB	595899.55	931.09

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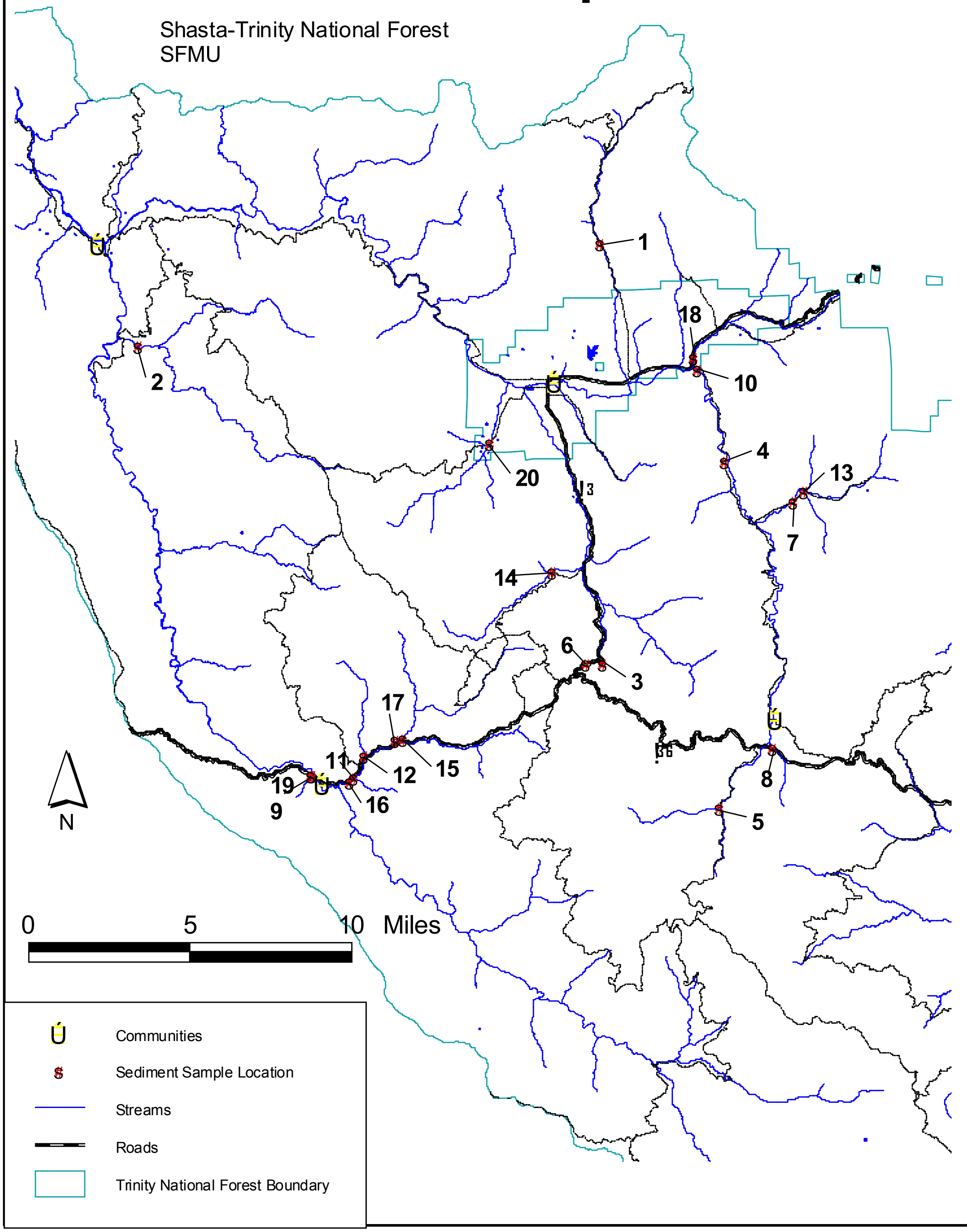
FIGURE

1

SFMU Sediment Sample Locations



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Steel gage house contour-mounted to downstream side of tree on Eltapom Creek.

Steel gage house mounted to 4x6 posts in concrete: South Fork Trinity at Forest Glen.

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GMA gage built atop the excavated USGS (11528500) Hayfork Creek near Hyampom gage.

Close-up of the old USGS stilling well and inside staff plate for the Hayfork Creek near Hyampom Gage.

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Tule Creek near bankfull stage during the December 14-16, 2002 storm.

Salt Creek during the December 14-16, 2002 storm. White circle shows location of gage intake.

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Story board to the left of body indicates: Cross Section 1, left bank (HCNH).

Left bank Cross Section 5 (HCHY), showing slope-area crest gage for recording flood peaks.

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GMA benchmark: aluminum capped 5/8 in. rebar in concrete (HCNH BM #2).


USGS Reference Mark near the Hayfork Creek in Hyampom Gage.

Residual pool volume (V*) soundings along transect near South Fork Trinity at Forest Glen.

Pebble count sampling grid on Grouse Creek mid-channel bar, Cross Section 4.

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Bulk sampling of mainstem spawning gravels along a surveyed cross section (SFTEC).

24 inch McNeil sampler and backpack mounted permeability pump on the mainstem at Hyampom Road.

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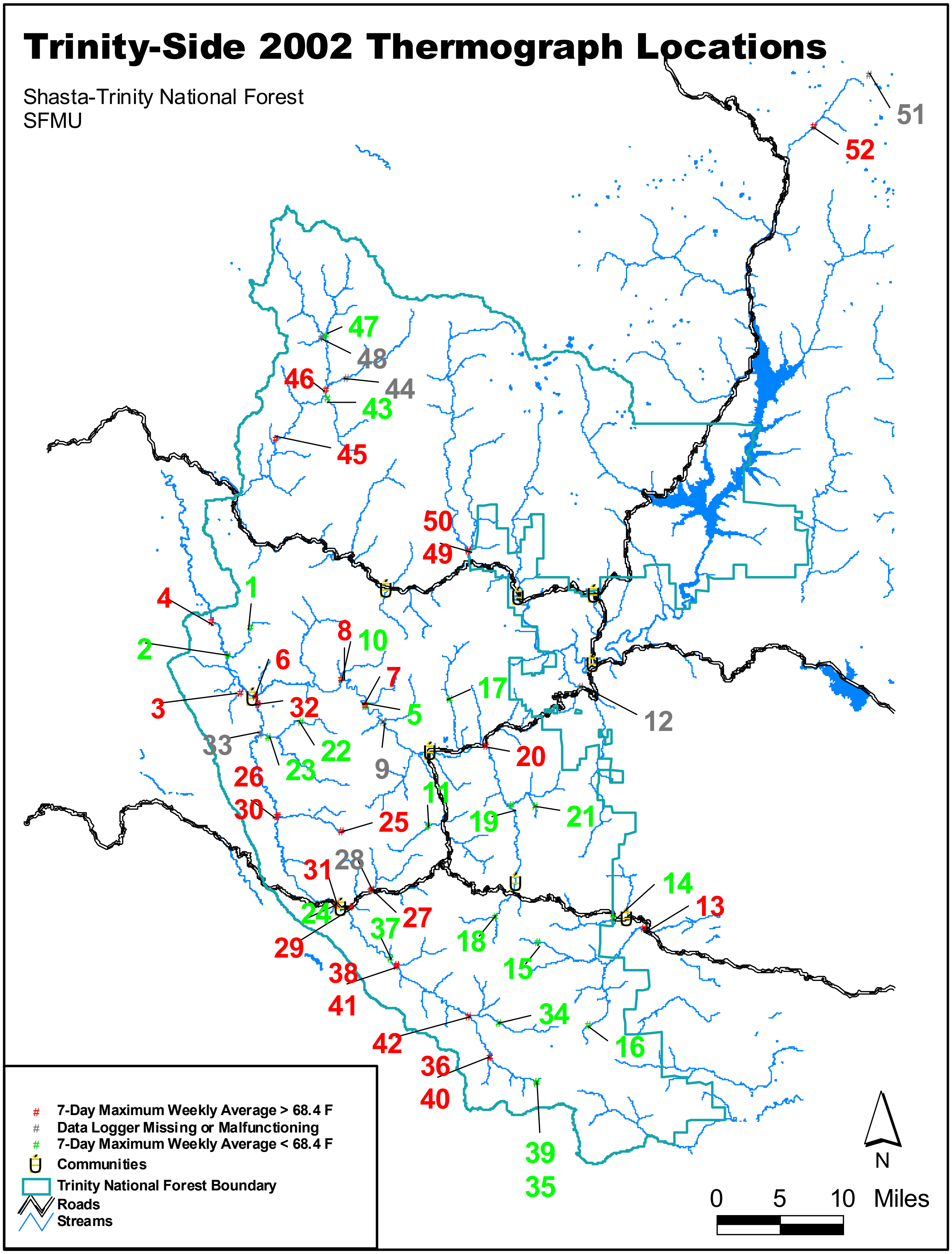

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FIGURE

10

Example of hand-drawn Discharge Rating Curve: Hayfork Creek near Hyampom. Circles indicate direct discharge measurements (meter), triangles indicate indirect discharge measurements (slope-area method).

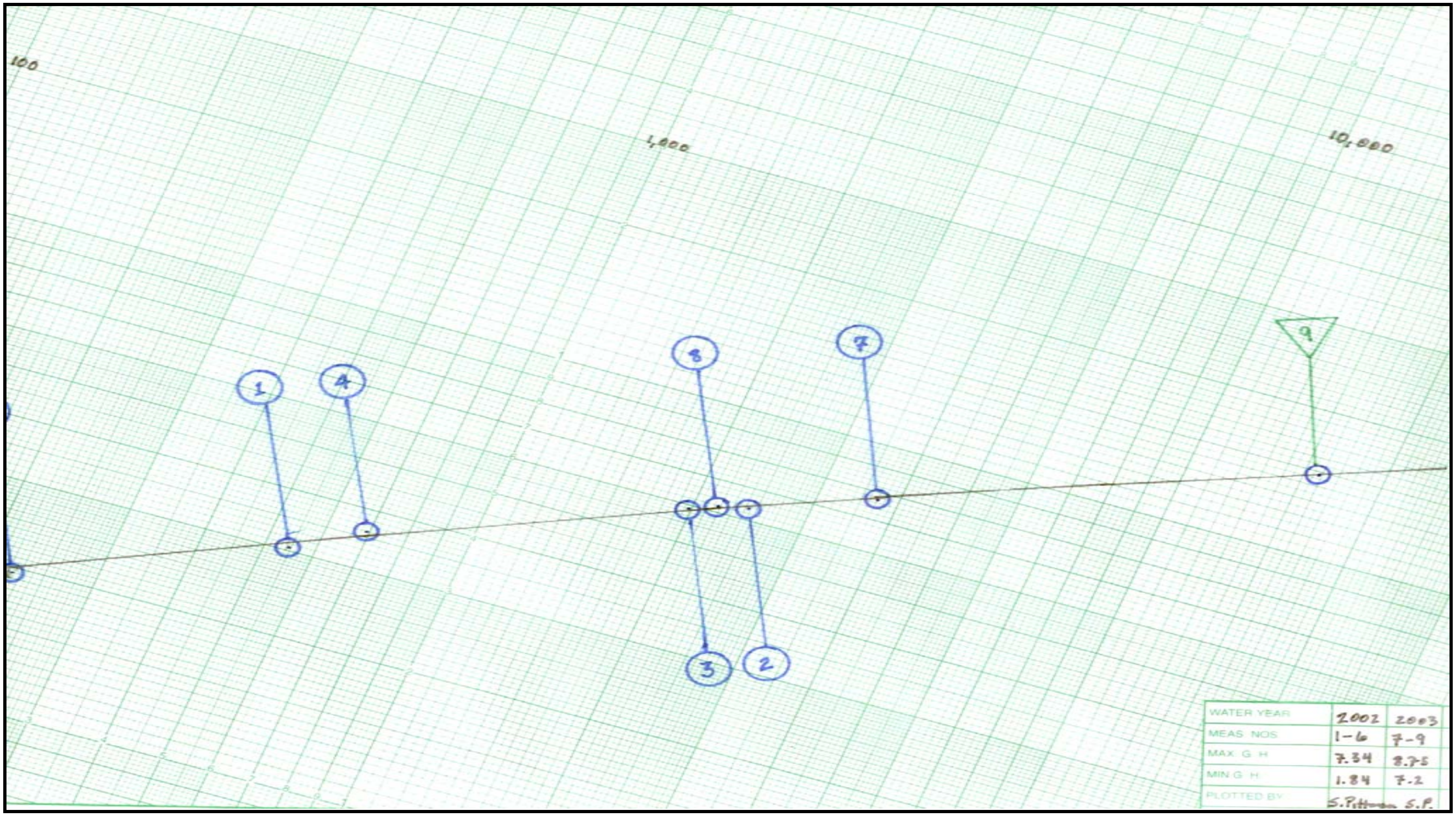

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FIGURE

11

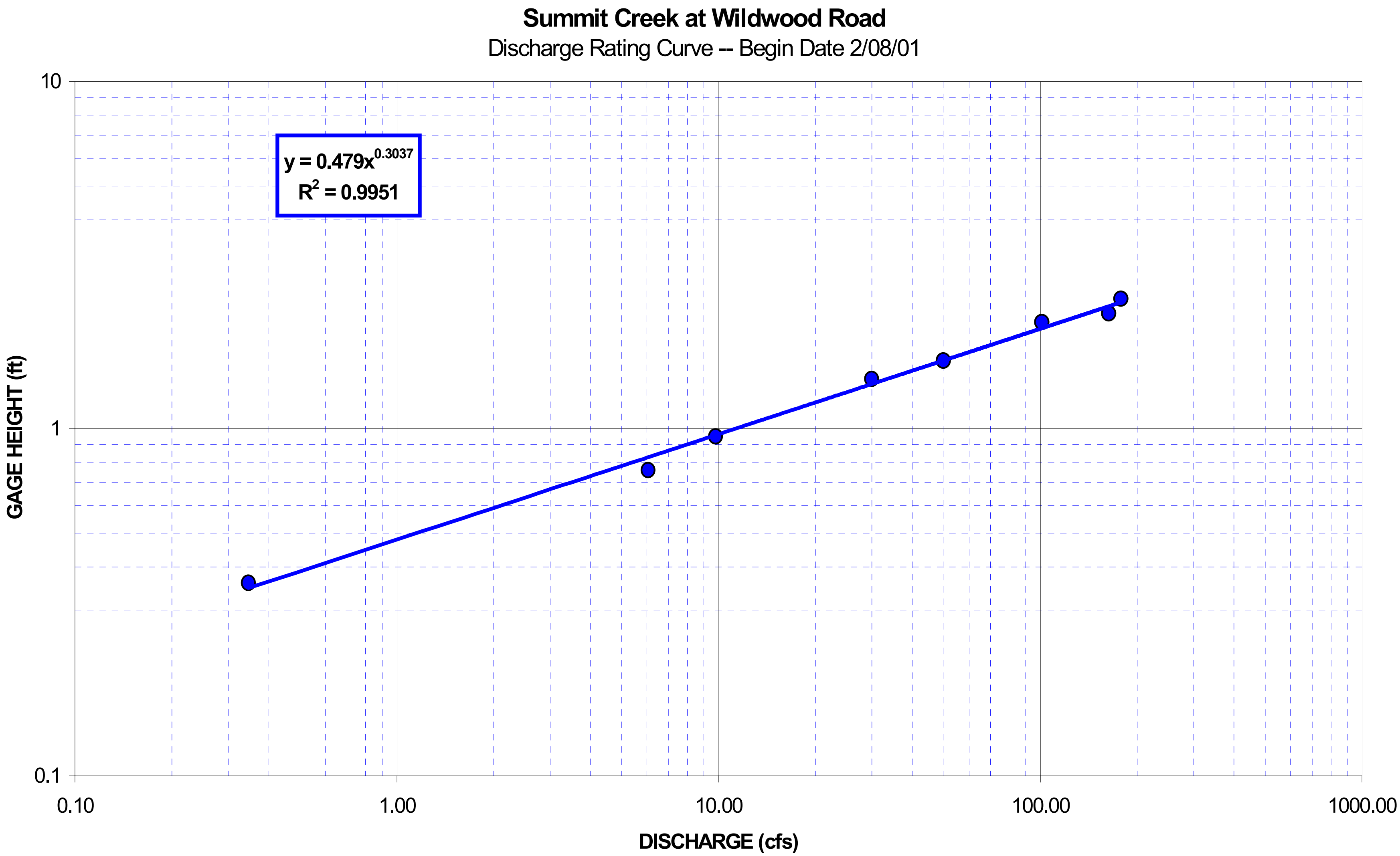

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FIGURE

12

SOUTH FORK TRINITY AT FOREST GLEN
Mean Daily Discharge -- WY2002

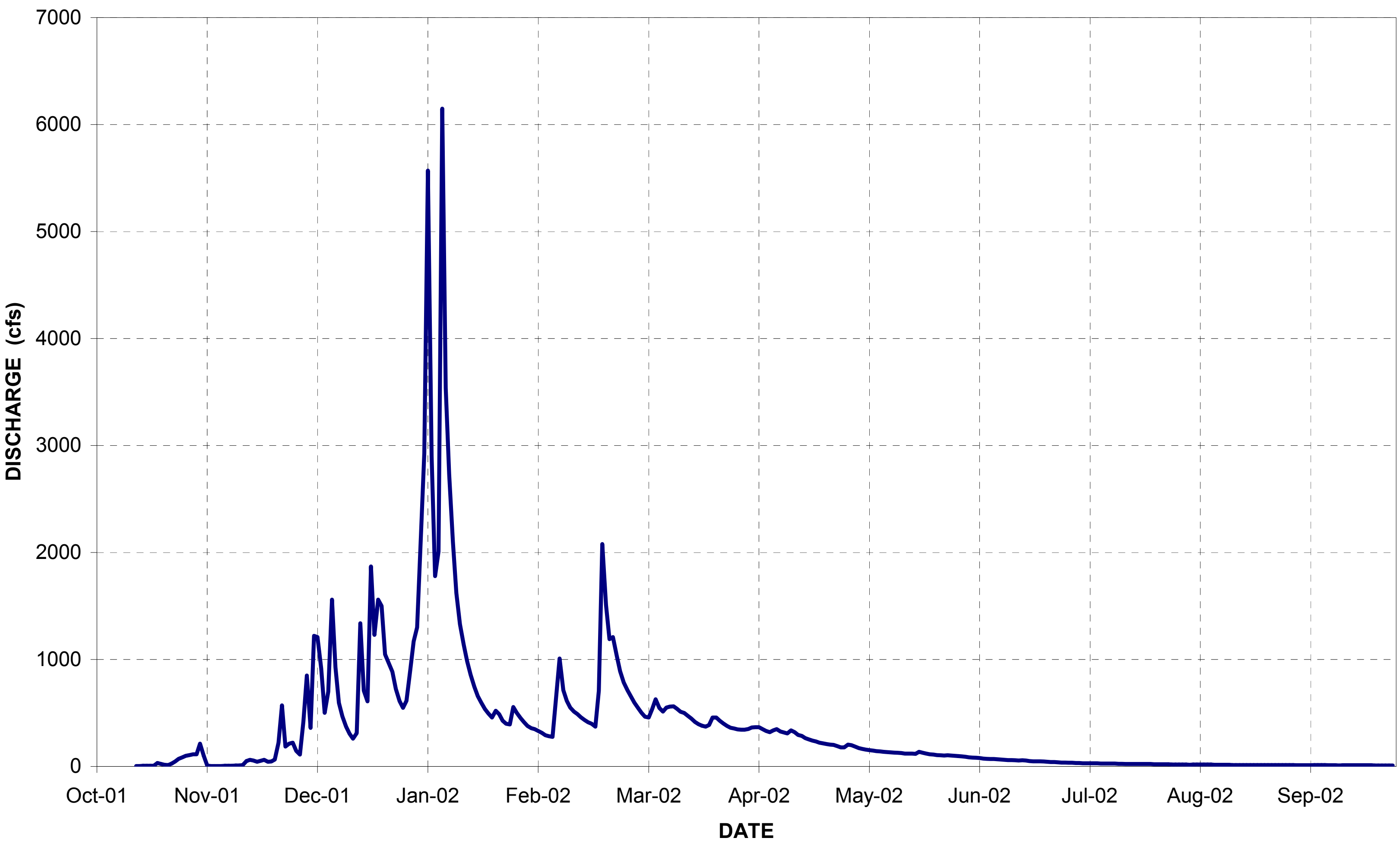

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FIGURE

13

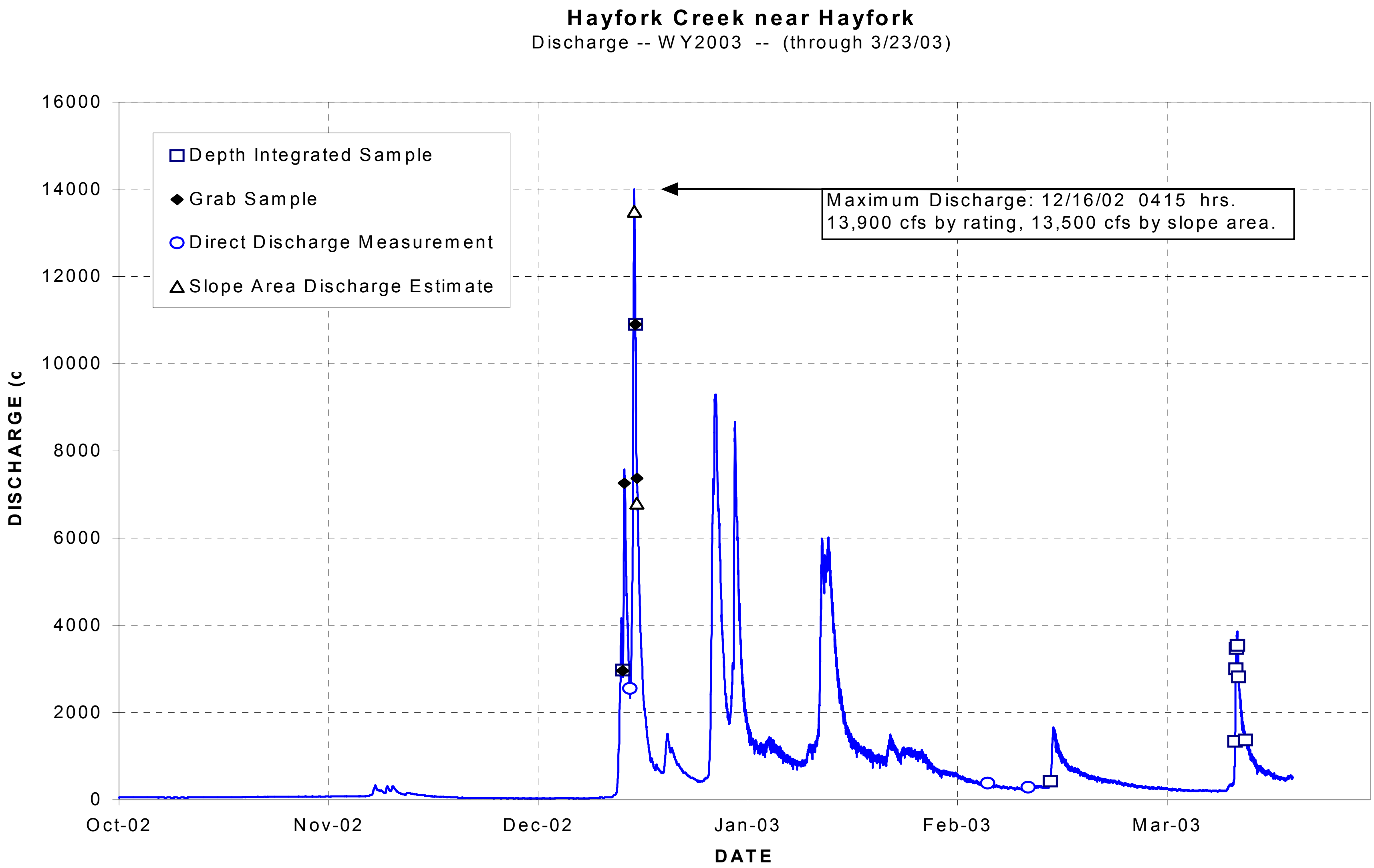

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FIGURE

14

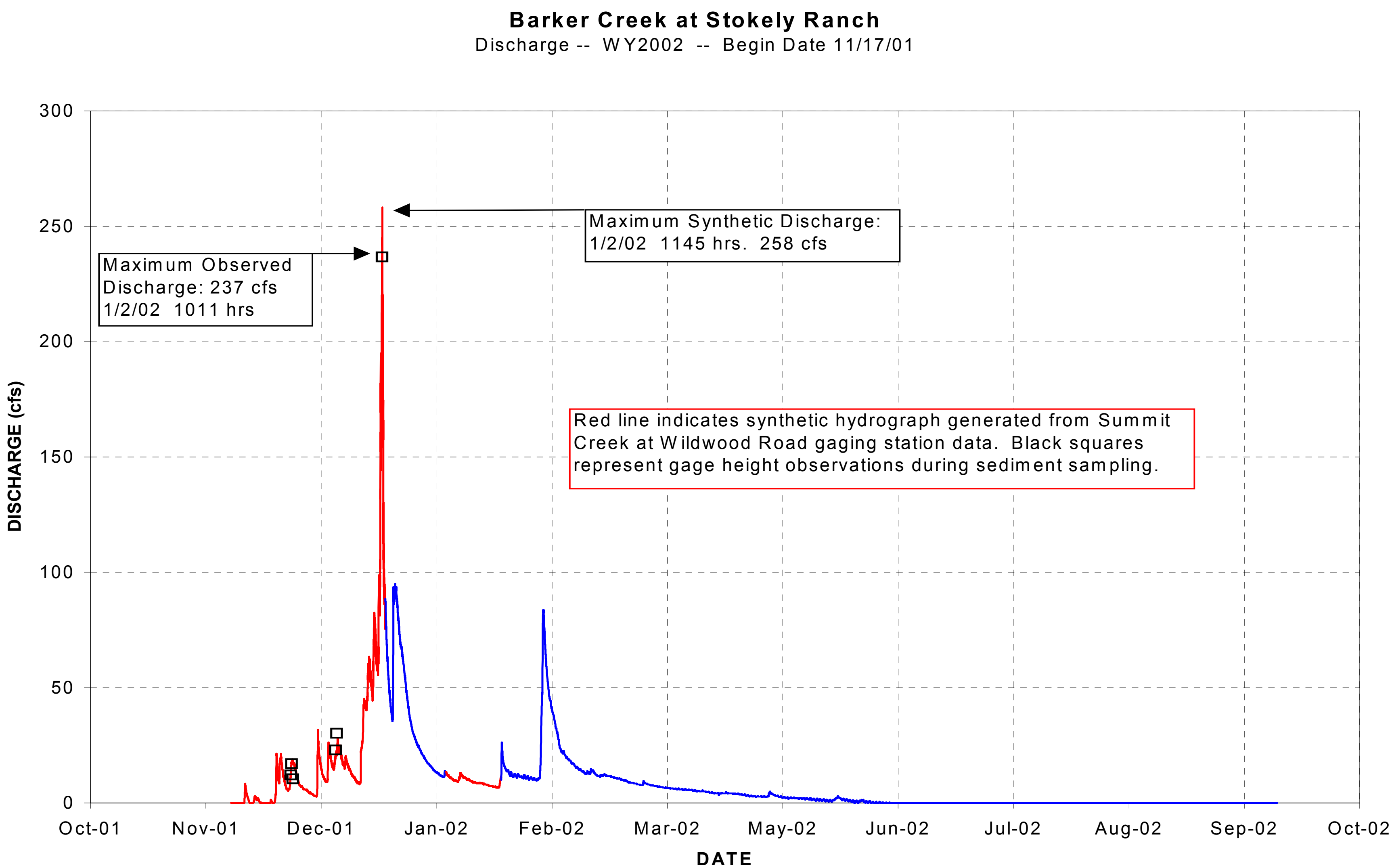

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FIGURE 15

SOUTH FORK TRINITY RIVER WATERSHED

Suspended Sediment Concentration vs. Turbidity Rating Curve, WY2001 - WY 2003, All Data

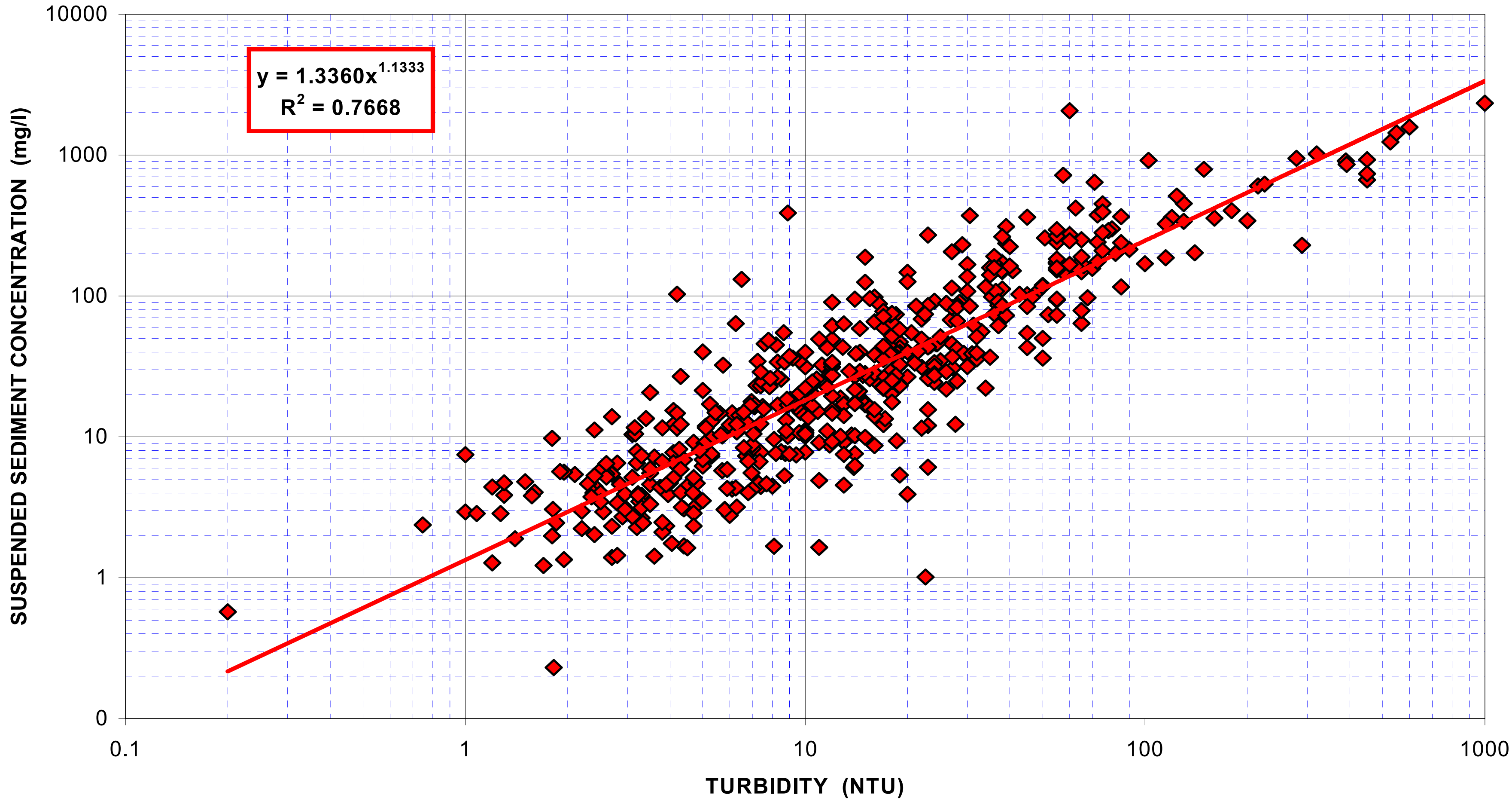

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FIGURE

16

SOUTH FORK TRINITY RIVER WATERSHED

Suspended Sediment Load vs. Discharge Rating Curve, WY2001 - WY 2003, 6 Sites Combined

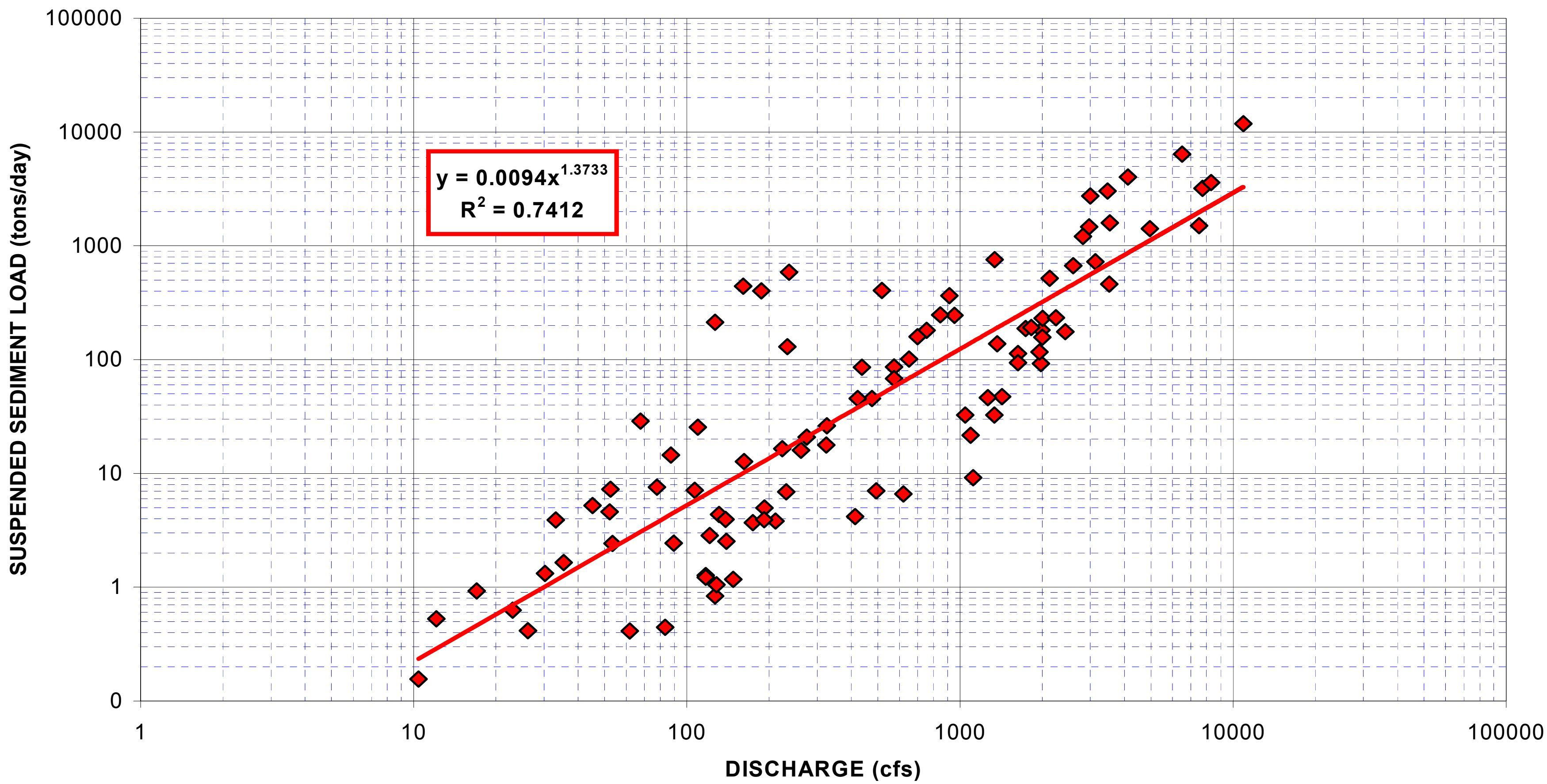

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FIGURE

17

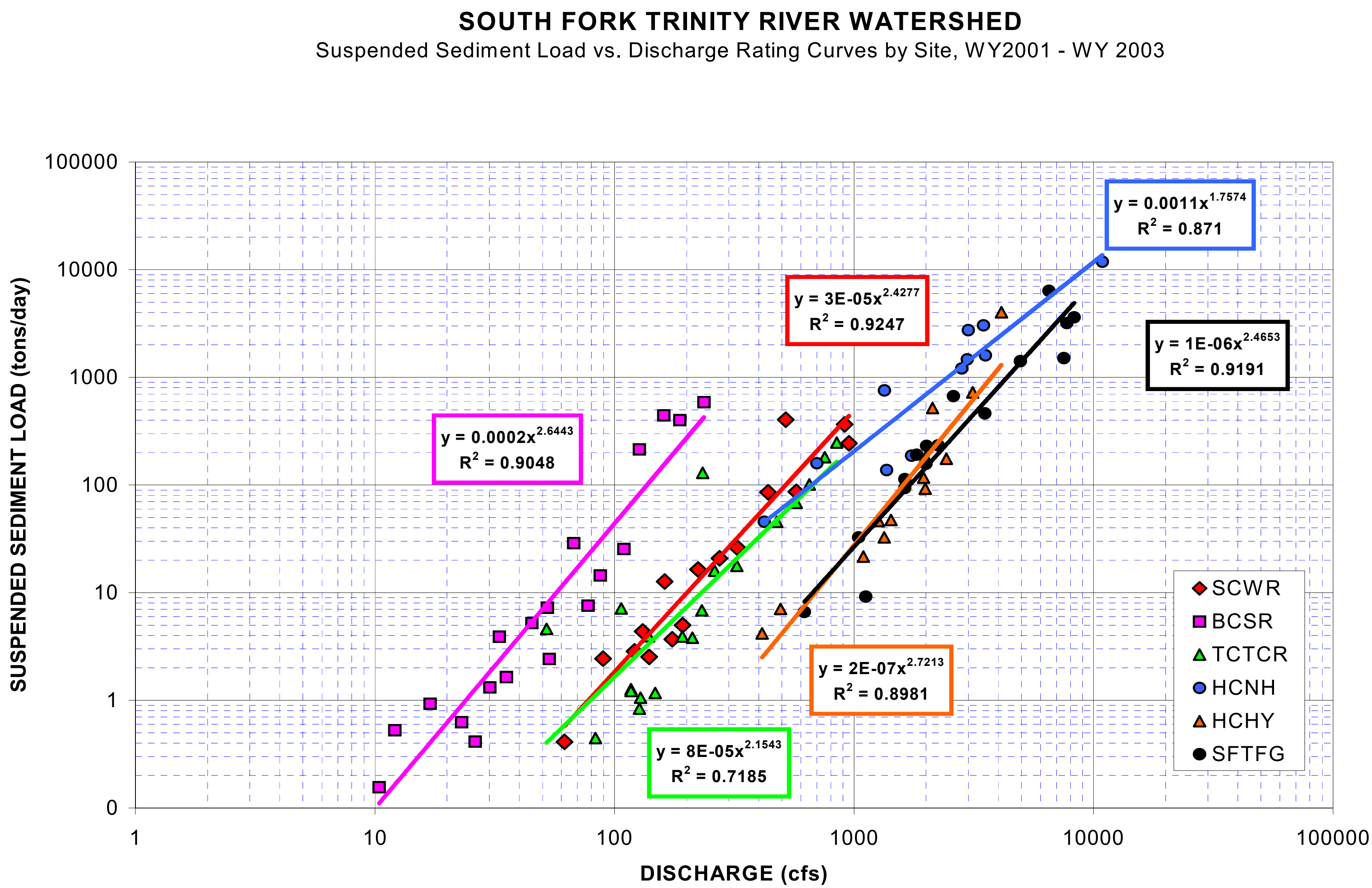

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FIGURE
18

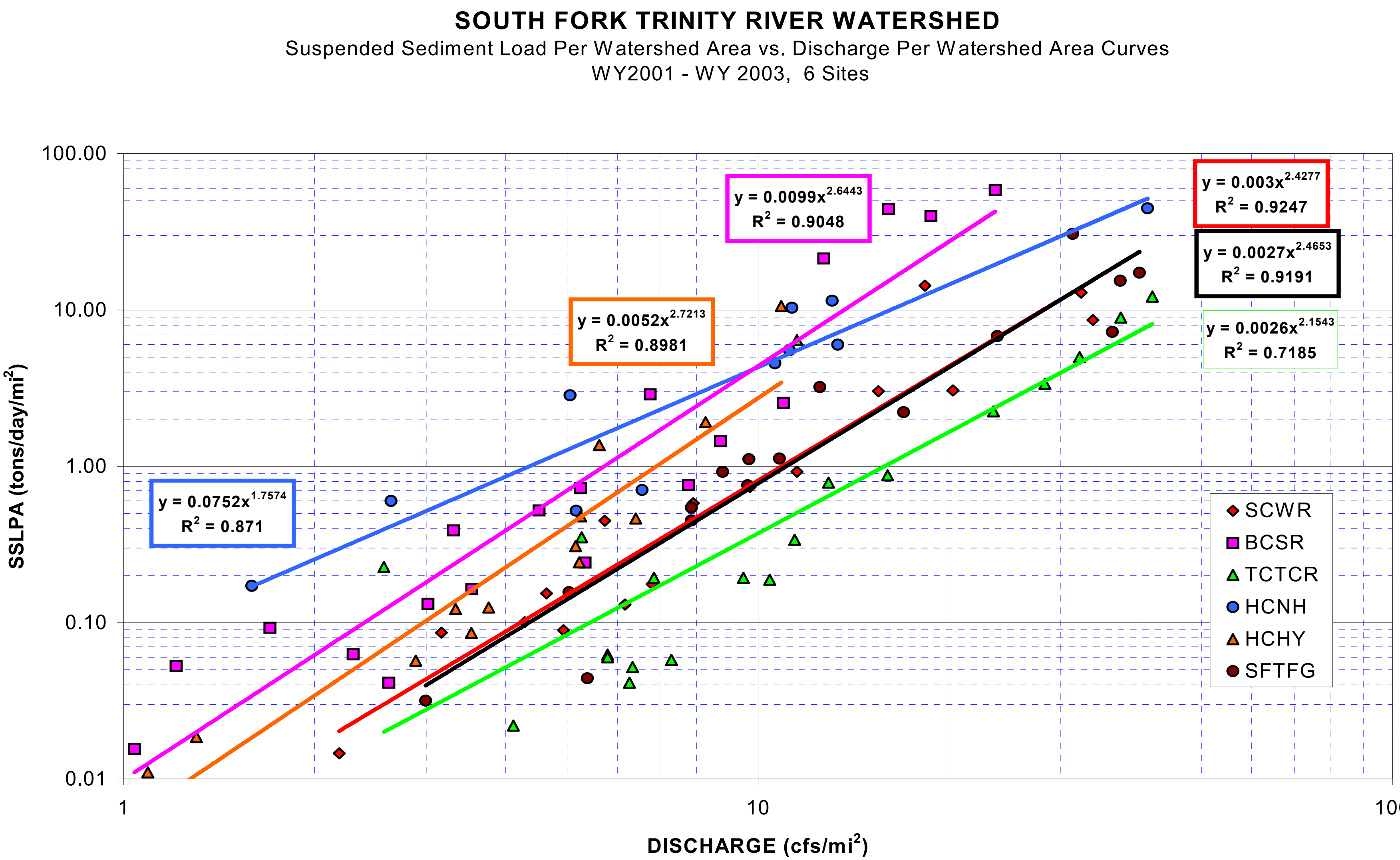

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FIGURE
19

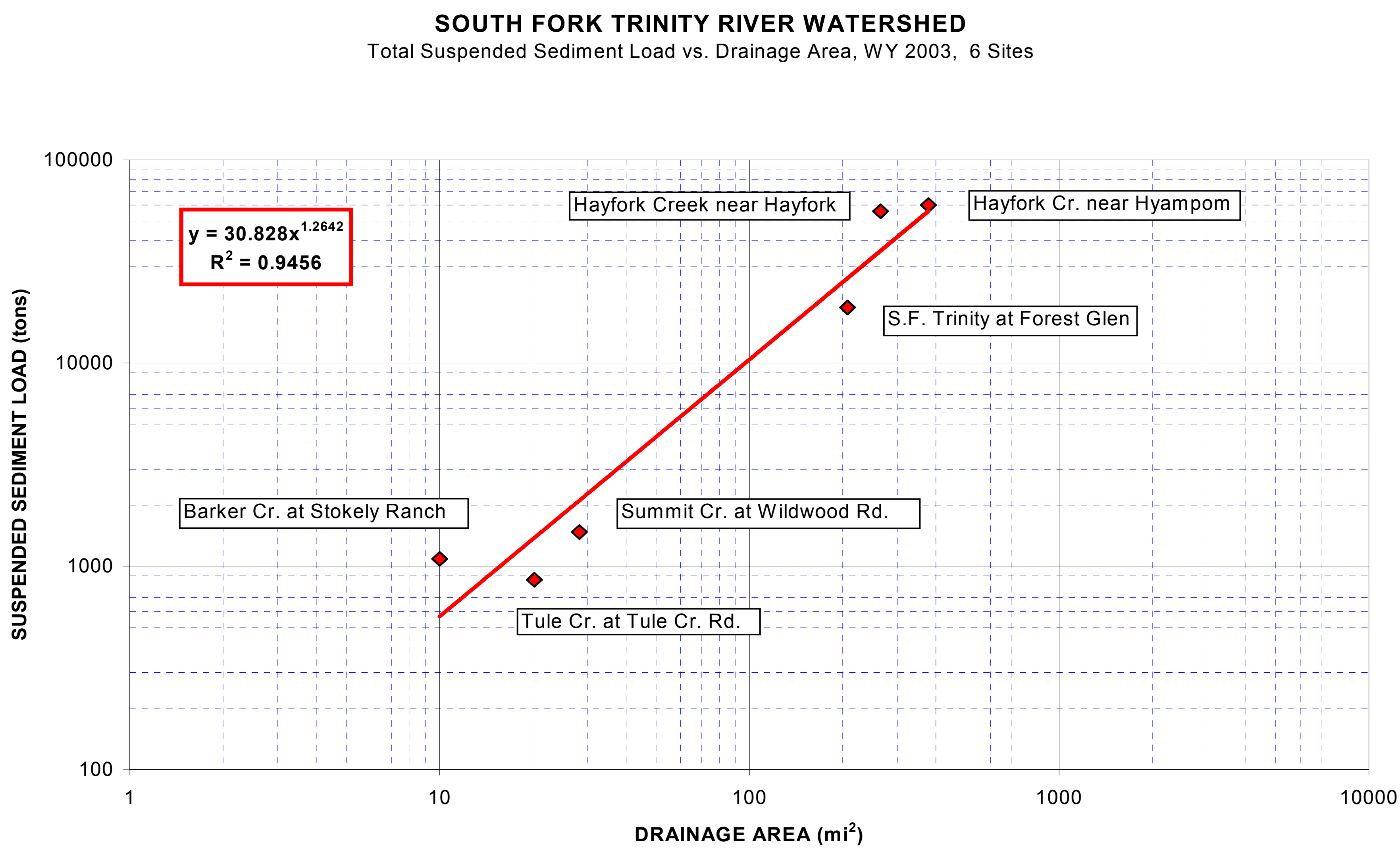

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FIGURE
20

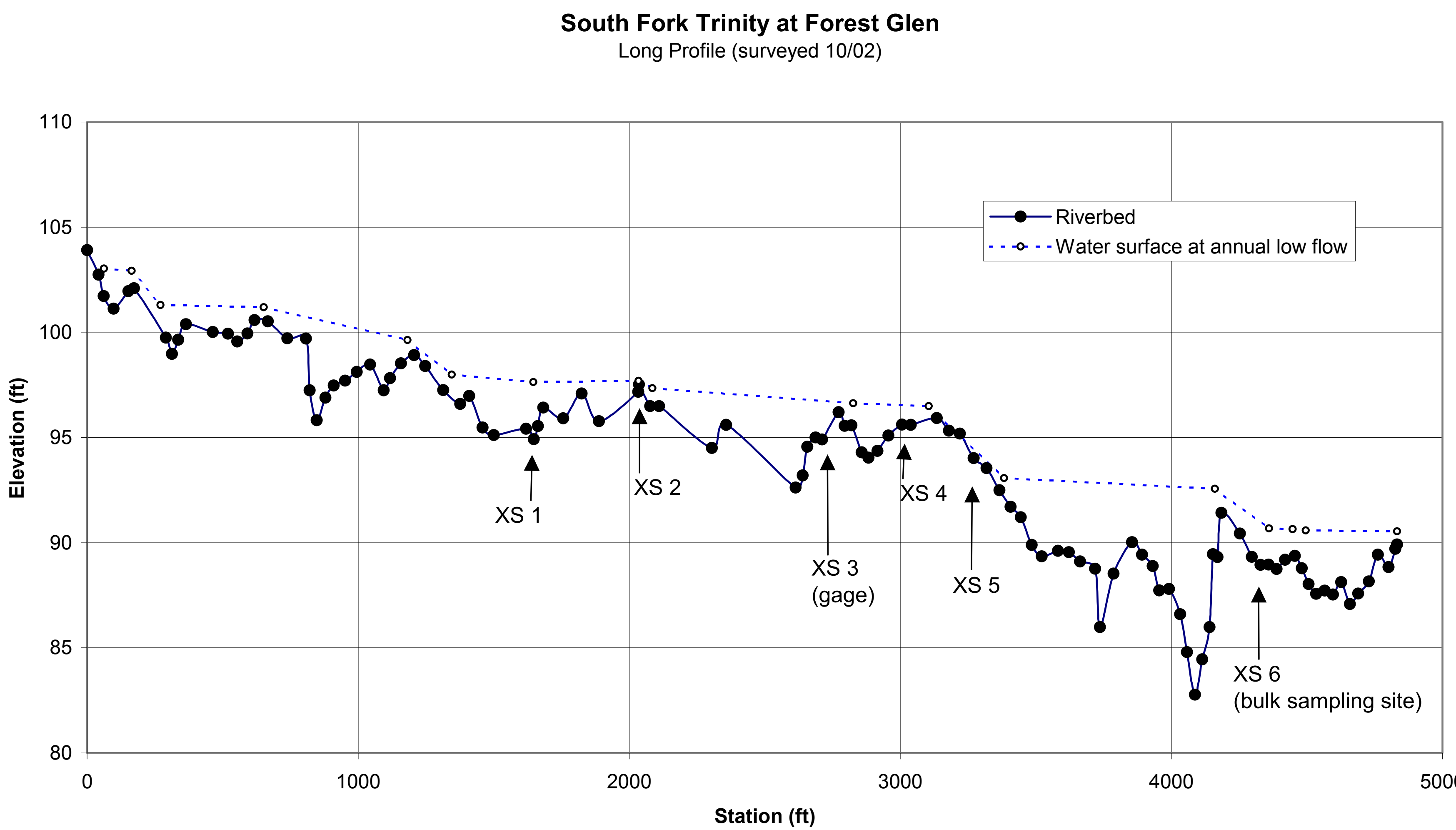

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FIGURE

21

South Fork Trinity at Forest Glen

Cross Section 3 (gage), surveyed 10-24-01

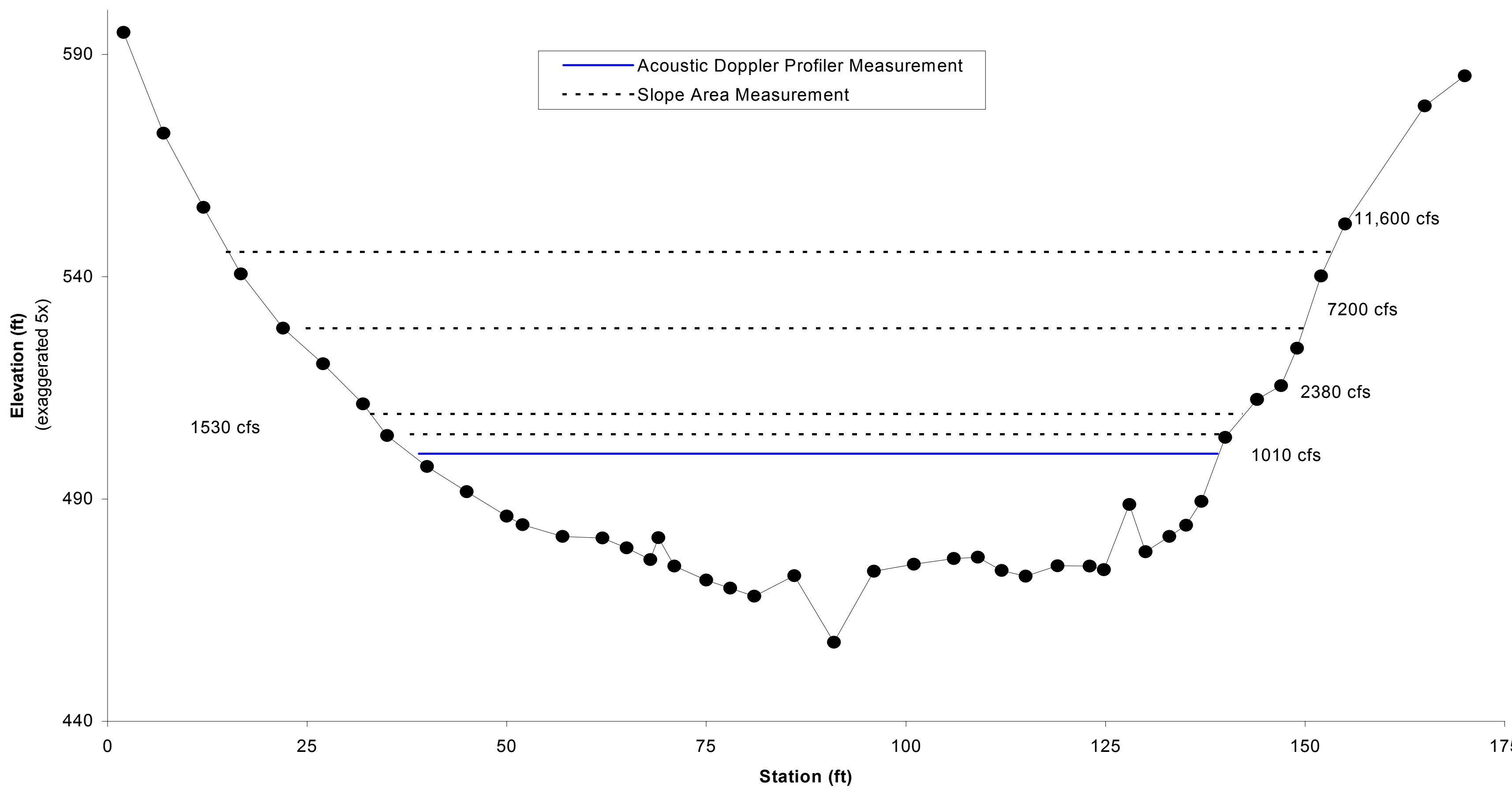

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FIGURE 22

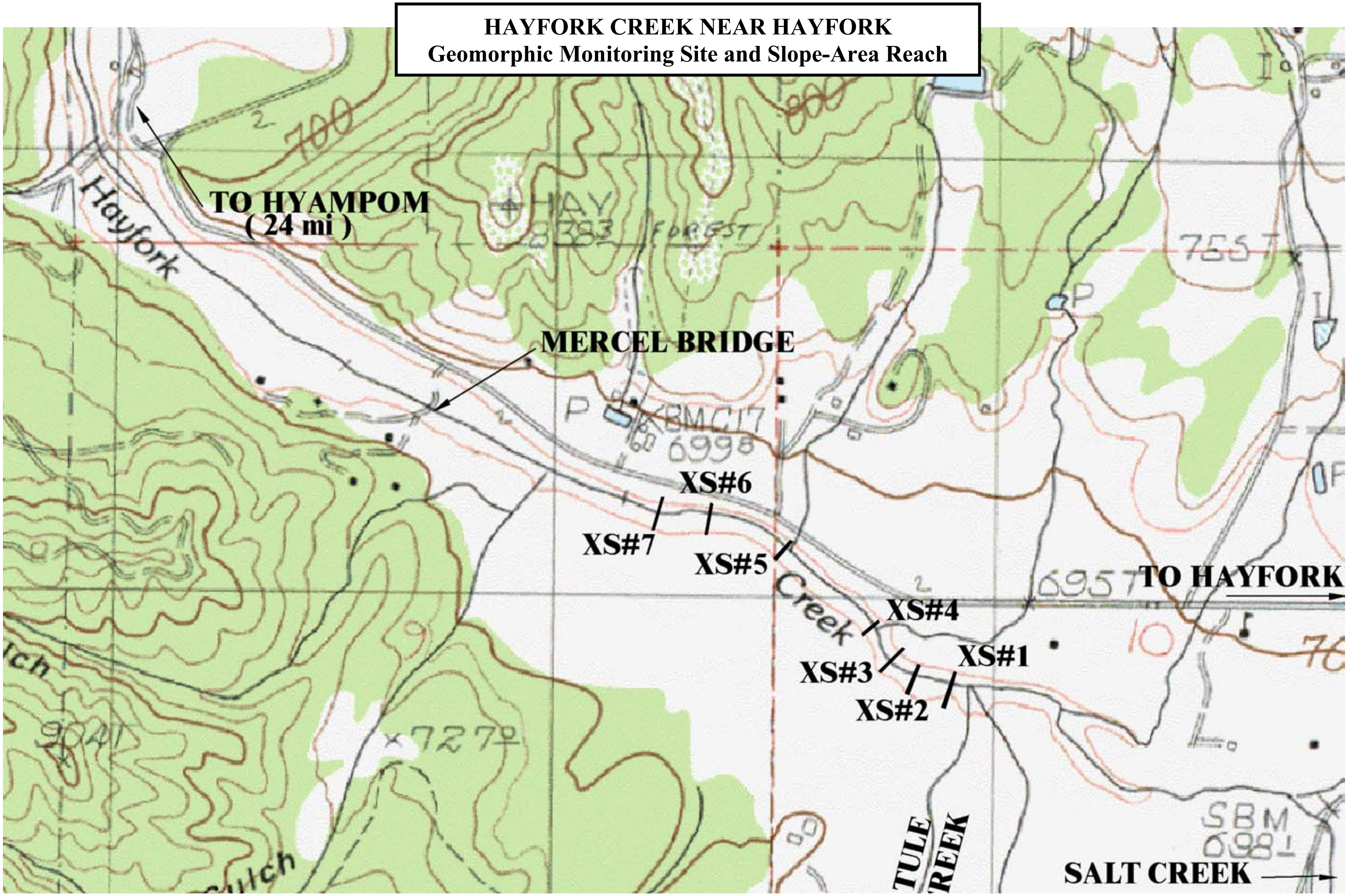

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FIGURE
23

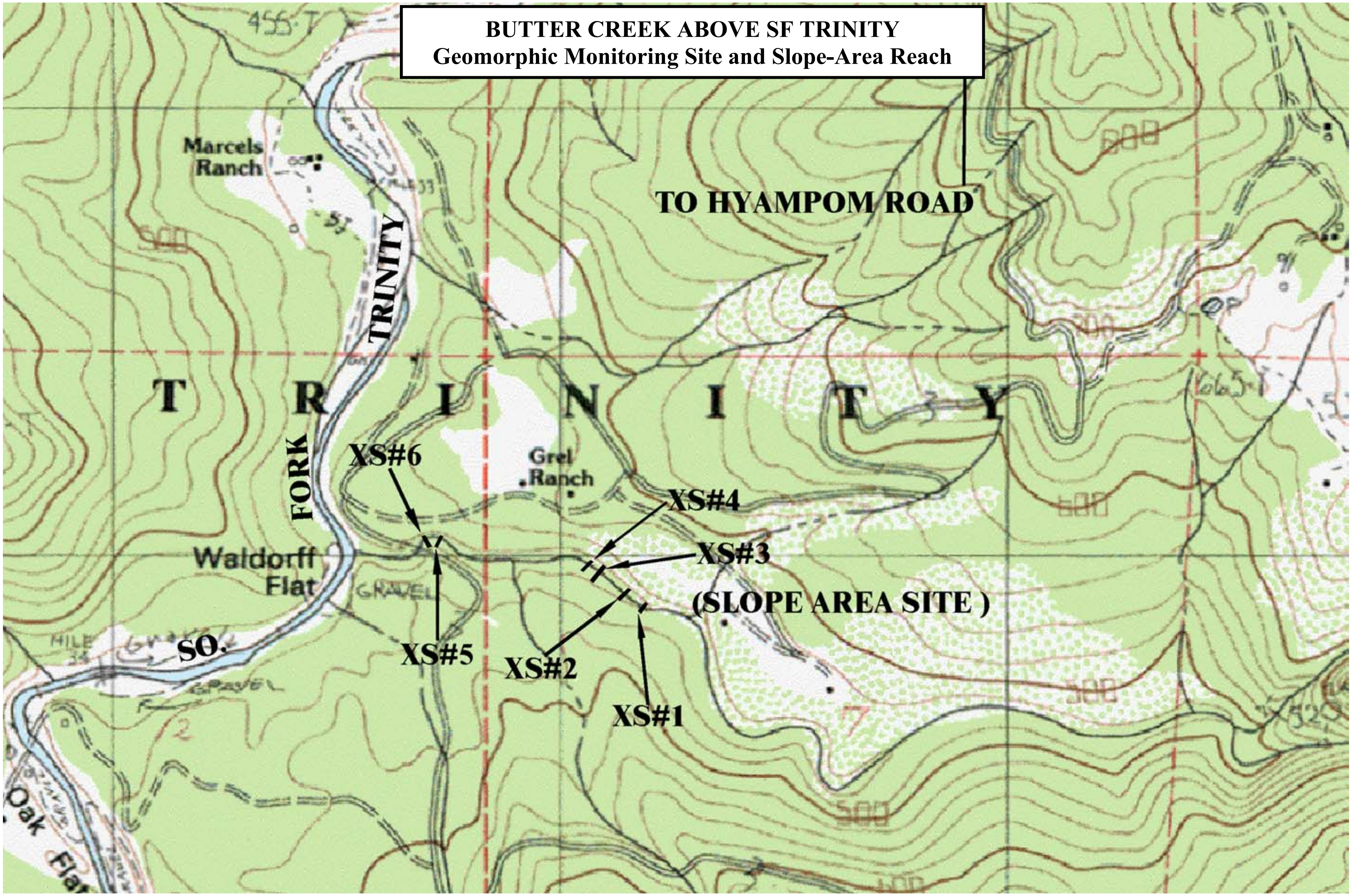

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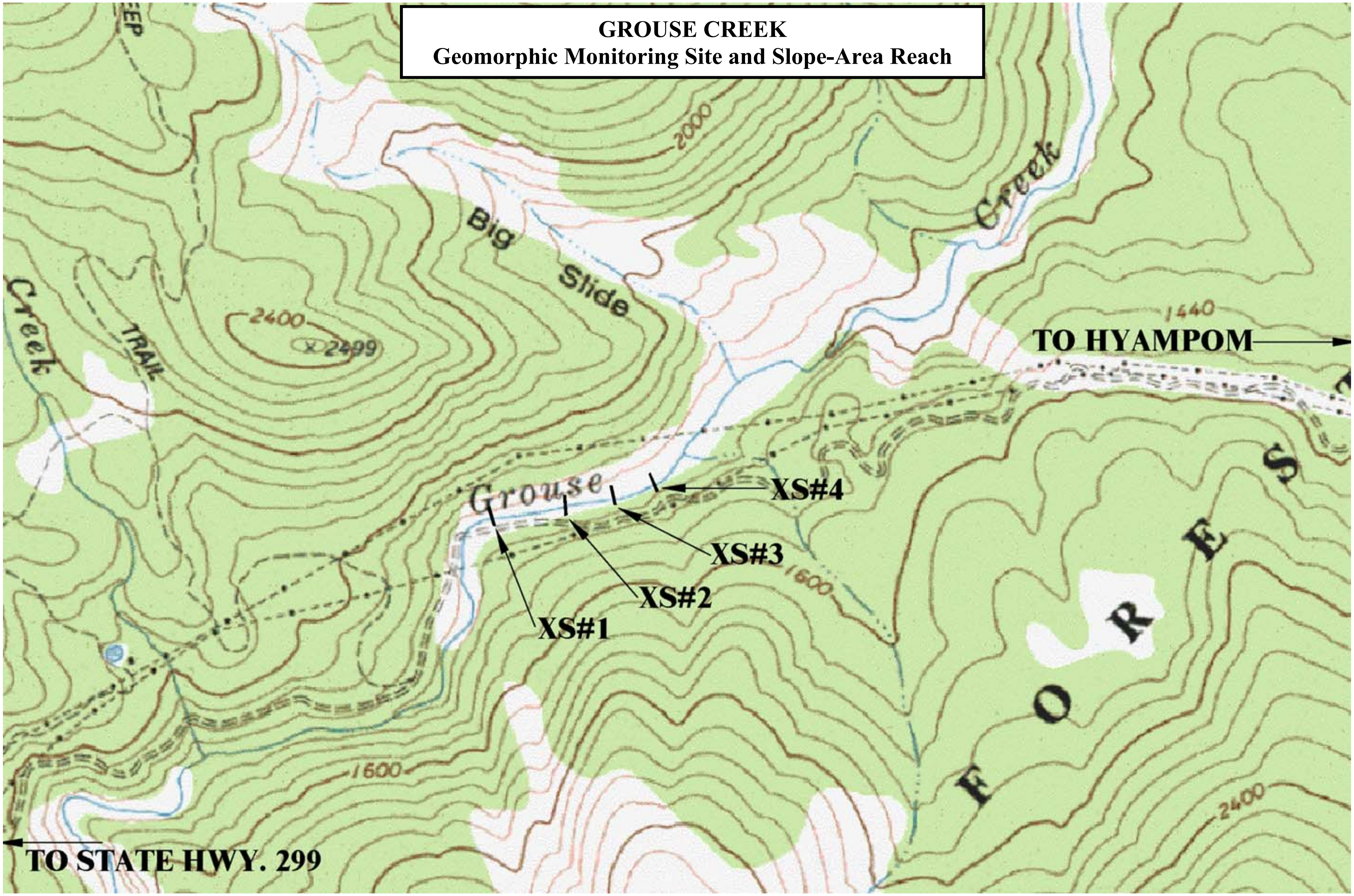
FIGURE

24

GROUSE CREEK
Geomorphic Monitoring Site and Slope-Area Reach



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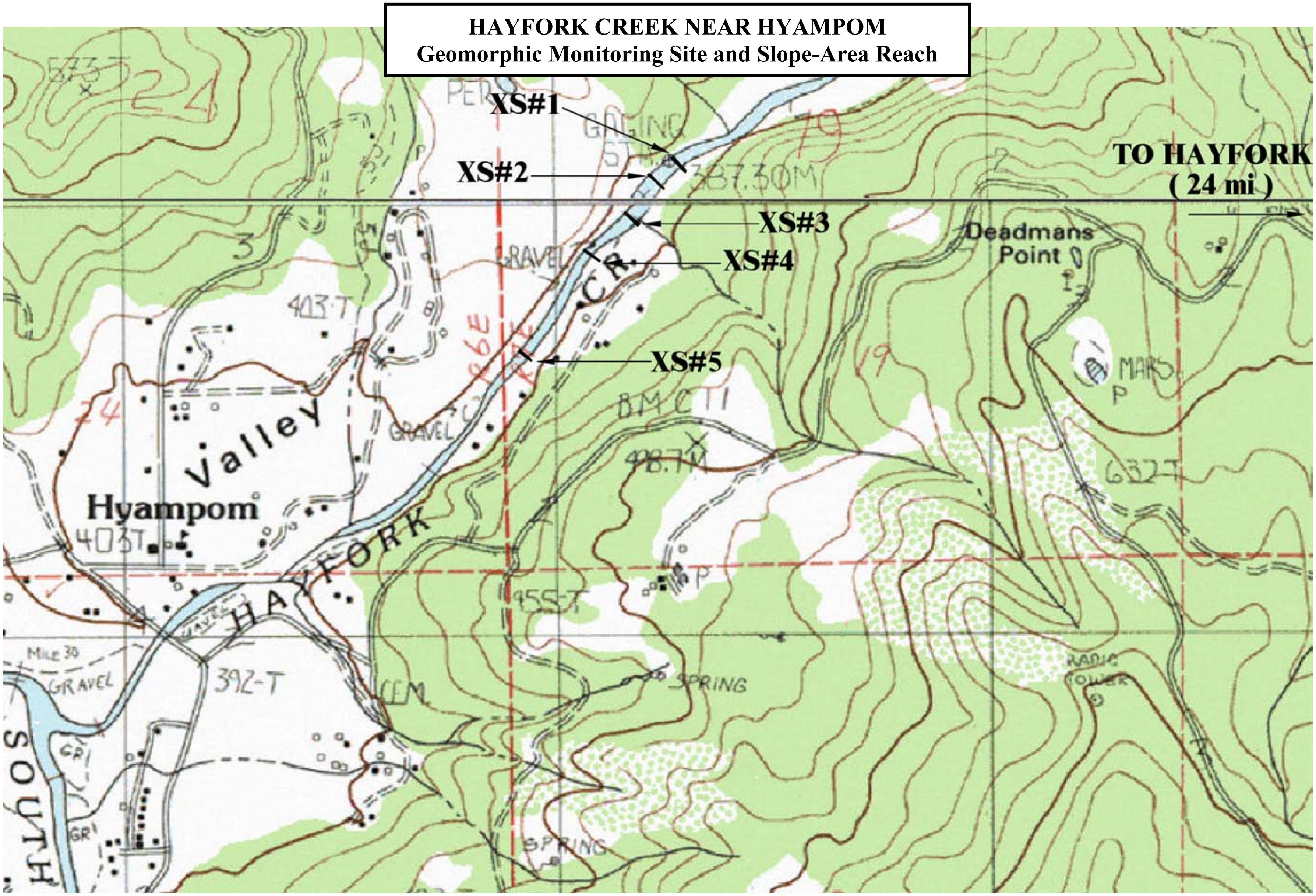

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FIGURE
26

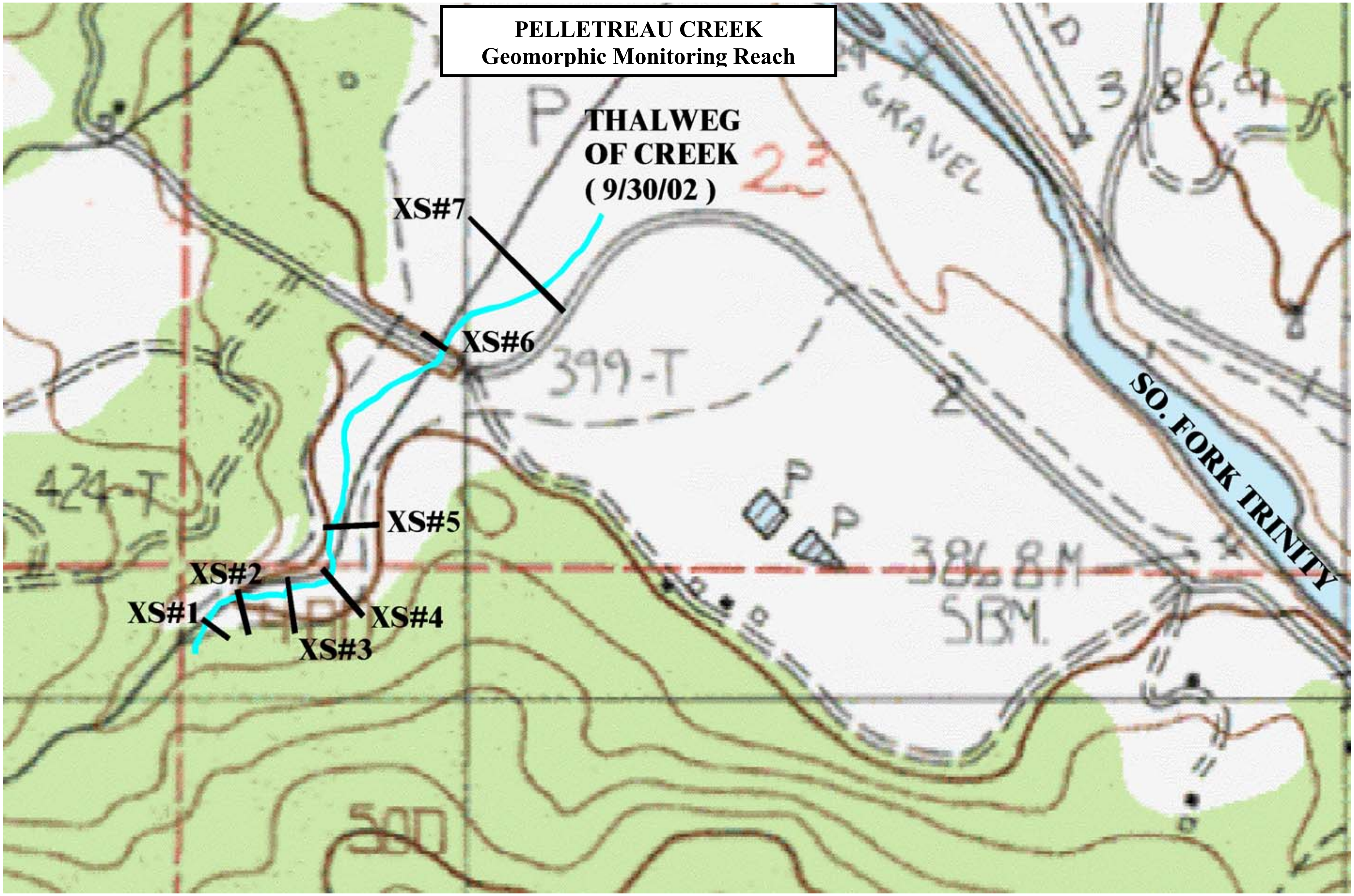

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FIGURE

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SOUTH FORK TRINITY RIVER AT FOREST GLEN
Geomorphic Monitoring Site and Slope-Area Reach

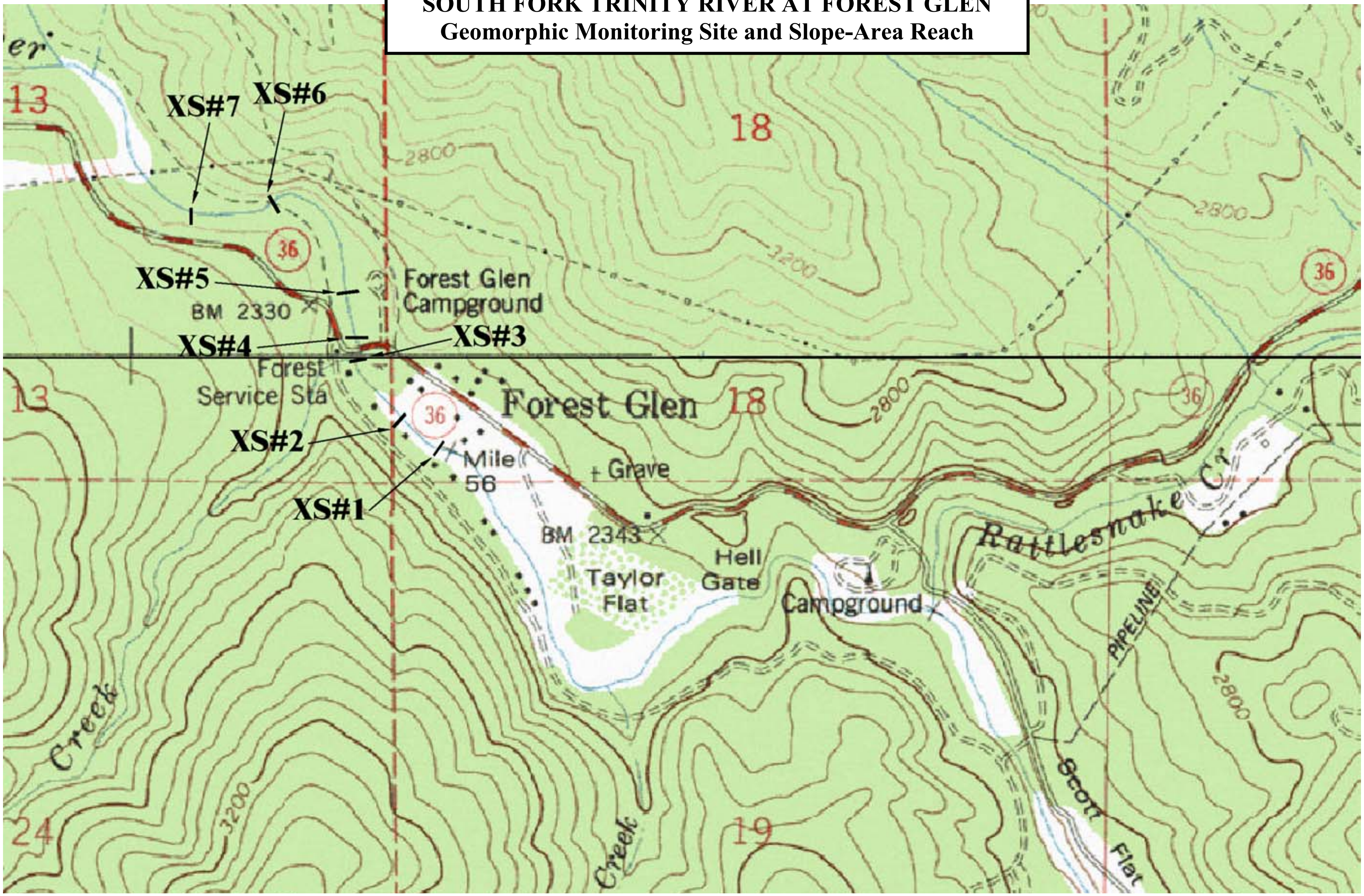

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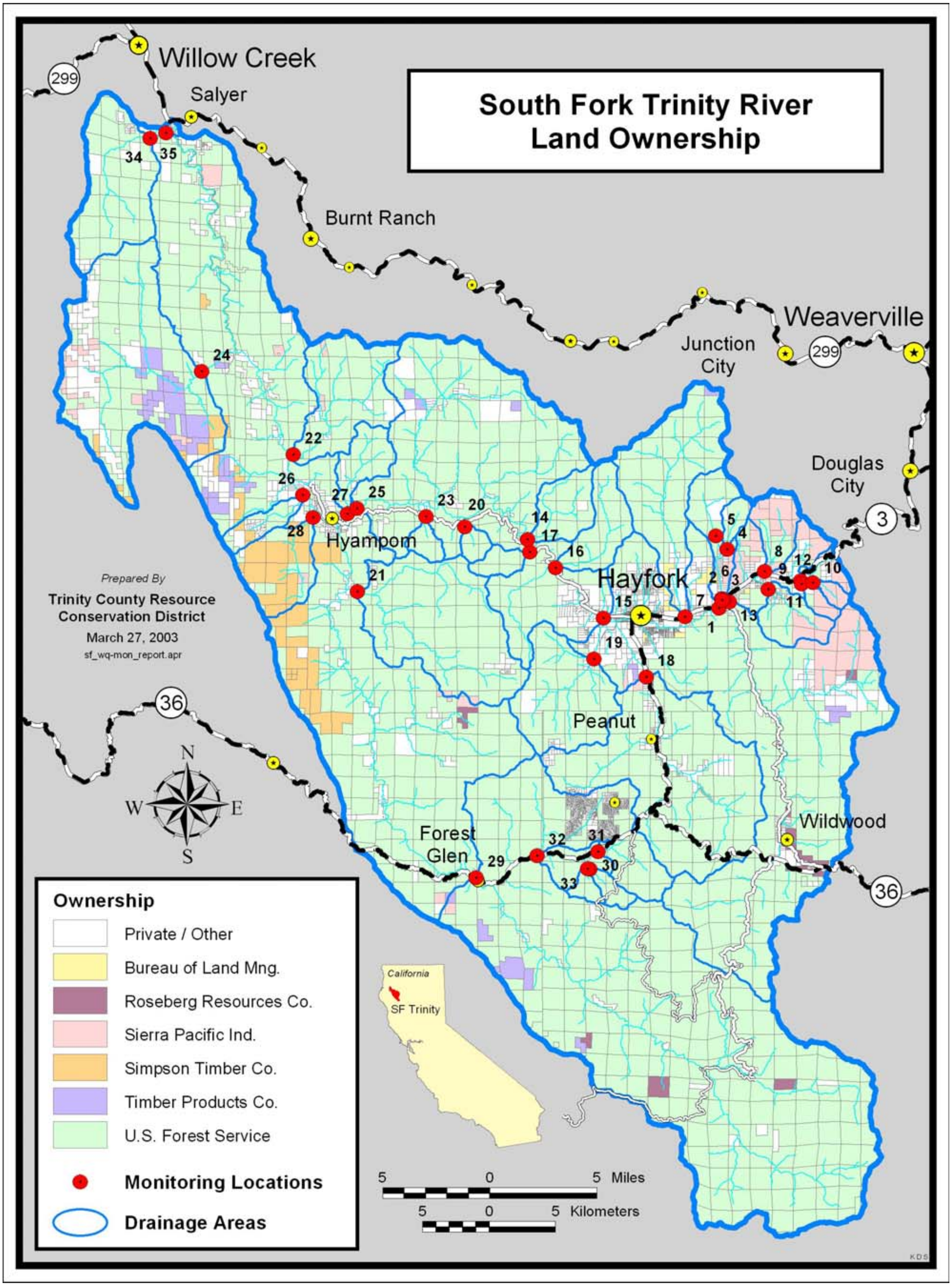
FIGURE 28



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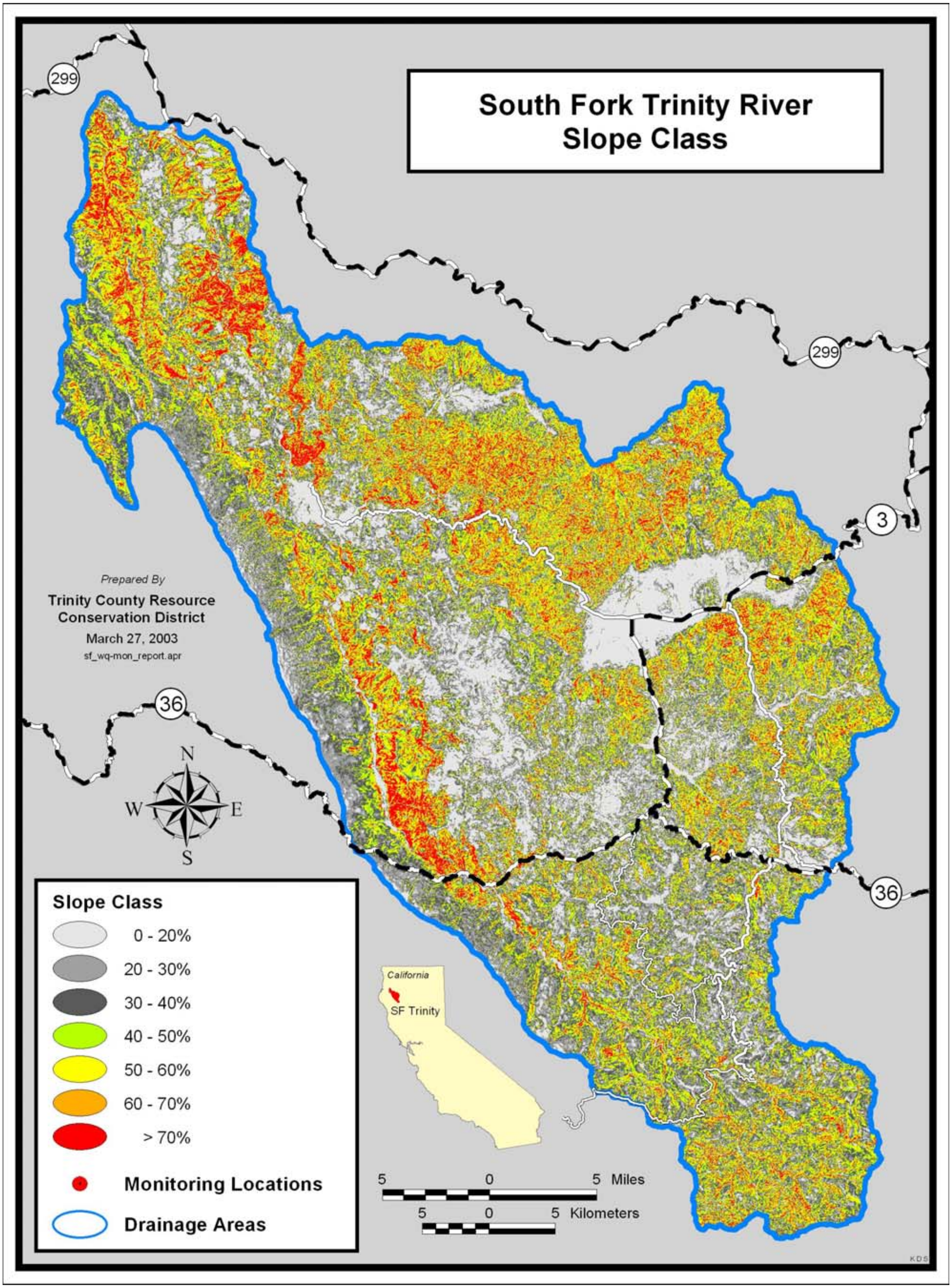

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FIGURE

30

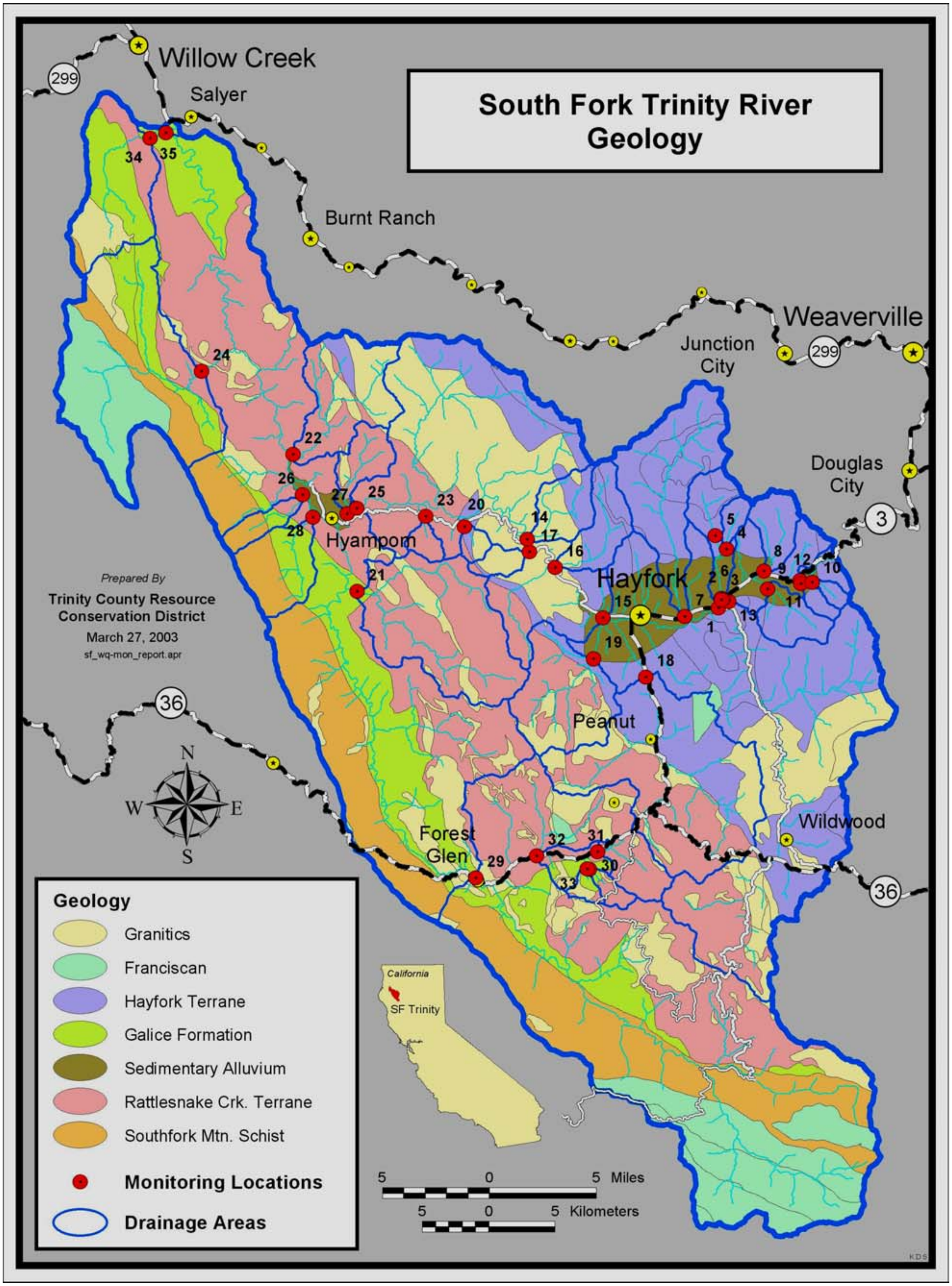

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FIGURE

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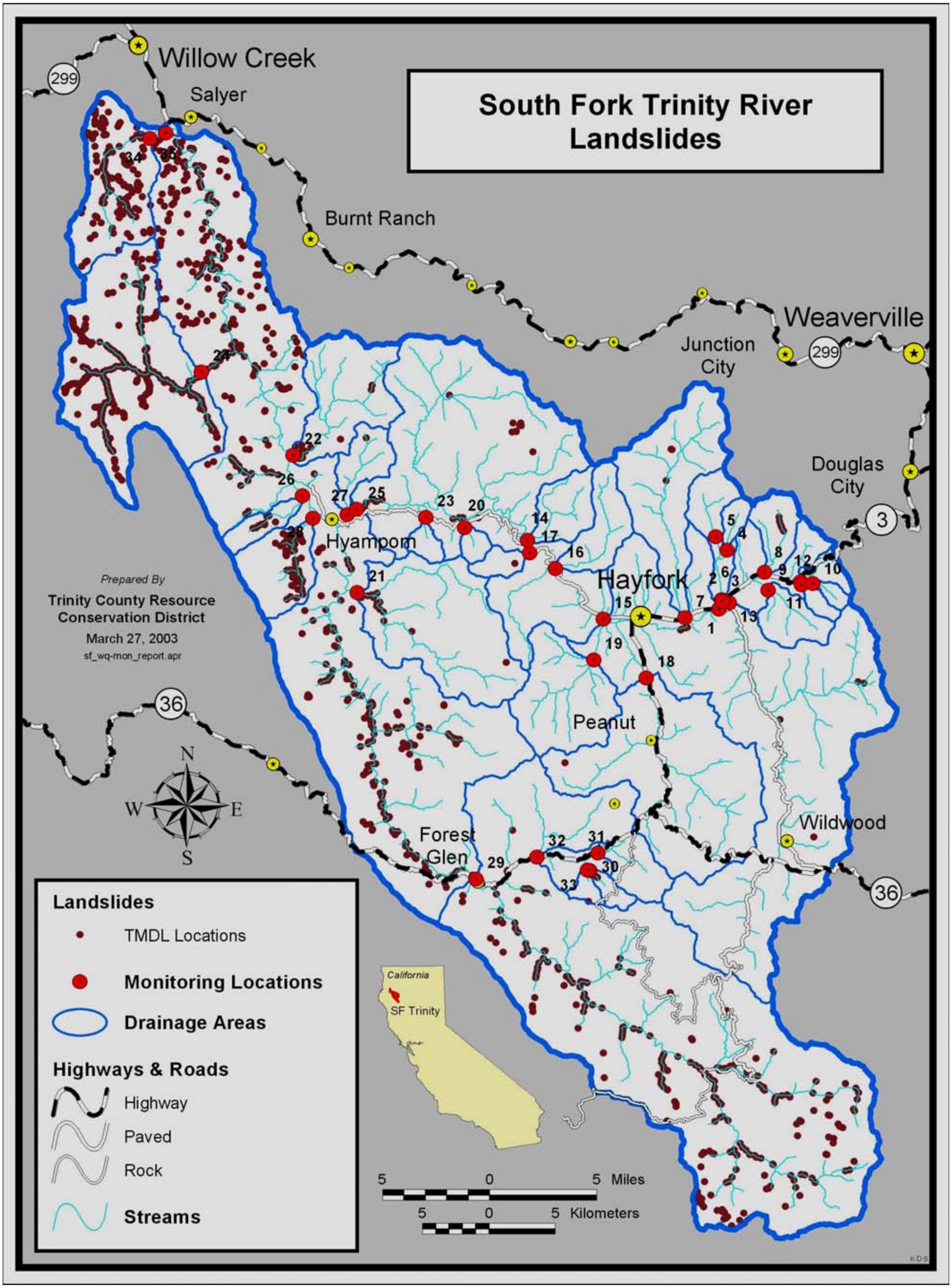

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FIGURE

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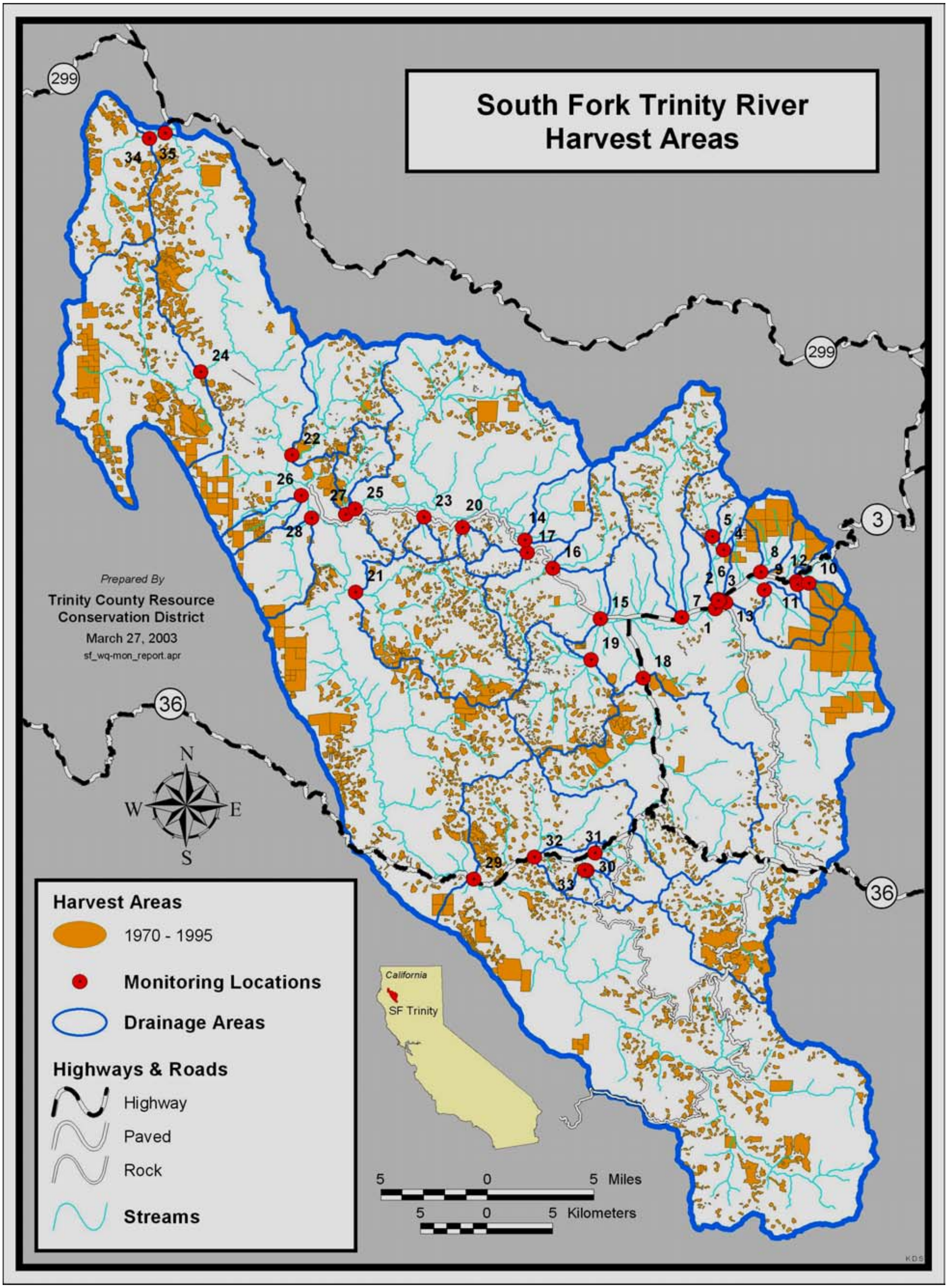

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FIGURE

33

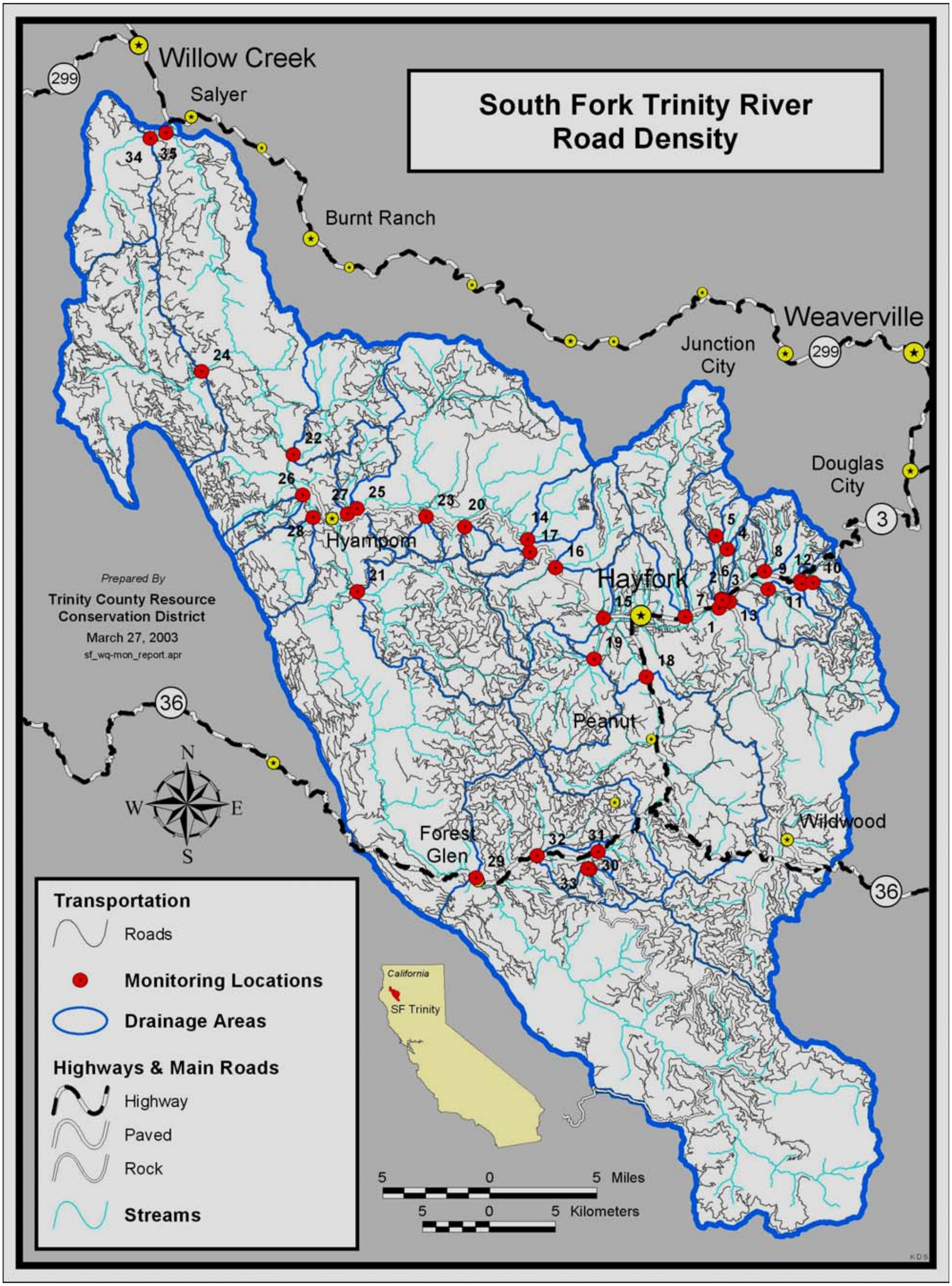

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FIGURE

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