APPENDIX 4

WATER QUALITY SUMMARY

This appendix presents the basic water quality protection approach of identifying beneficial uses and achieving water quality objectives (criteria) and discharge prohibitions to protect those uses. Discharger sketches also are provided; more detail is available in the North Coast Regional Water Quality Control Board's files. The individual data made available to NCWAP and collected by NCWAP staff are presented following a contextual discussion and presentation of desired water quality conditions (water quality objectives and other reference values and ranges used to evaluate the data).

Beneficial Uses Of Water

Existing water quality requirements are described in the *Water Quality Control Plan for the North Coast Basin* (1996) (Basin Plan), which is the tool for comprehensive water quality planning as set forth in both California's Porter-Cologne Water Quality Control Act and the federal Clean Water Act. Among other things, the Basin Plan describes the existing and potential beneficial uses of the surface and ground waters in each of the watersheds throughout the North Coast Region. It also identifies both numeric and narrative water quality objectives, the attainment of which is considered essential to protect the identified beneficial uses.

The Basin Plan identifies the following existing beneficial uses of water in the Gualala River Watershed:

- Municipal and Domestic Supply (MUN)
- Agricultural Supply (AGR)
- Industrial Service Supply (IND)
- Recreational Uses (REC-1 & REC-2)
- Commercial and Sport Fishing (COMM)
- Cold Freshwater Habitat (COLD)
- Wildlife Habitat (WILD)
- Rare, Threatened, or Endangered Species (RARE)
- Migration of Aquatic Organisms (MIGR)
- Spawning, Reproduction, and/or Early Development (SPWN)
- Estuarine Habitat (EST)

The beneficial uses identified above as COMM, COLD, MIGR, WILD, RARE, SPWN, and EST are all related to the Gualala River watershed's cold water fisheries. Beneficial uses associated with the cold water fisheries are among the most sensitive in the watershed. As such, protection of these beneficial uses is presumed to help protect any of the other beneficial uses:

- COMM applies to water bodies in which commercial or sport fishing occurs or historically occurred for the collection of fish, shellfish, or other organisms, including, but not limited to, the collection of organisms intended either for human consumption or bait purposes.
- COLD applies to water bodies that support or historically supported cold water ecosystems, including, but not limited to, the preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
- WILD applies to water bodies that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

- RARE refers to water bodies that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.
- MIGR applies to water bodies that support or historically supported the habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.
- SPWN applies to water bodies that support or historically supported high quality aquatic habitats suitable for the reproduction and early development of fish.
- EST applies to water bodies that support or historically supported estuarine ecosystems, including, but not limited to, the preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).

Water Quality Objectives

The Porter-Cologne Water Quality Control Act specifies that each regional board shall establish water quality objectives which, in the regional board's judgment, are necessary for the reasonable protection of the beneficial uses and for the prevention of nuisances. The water quality objectives are considered to be necessary to protect those present and probably future beneficial uses stated above and to protect existing high quality waters of the state. As new information becomes available, the Regional Water Board reviews the appropriateness of existing and proposed water quality objectives and amends the Basin Plan accordingly.

The following is a summary of water quality objectives for the Gualala River watershed according to the Basin Plan, as amended in 1996.

NARRATIVE WATER QUALITY OBJECTIVES

Objective	Description
Color	Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.
Tastes and Odors	Waters shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin, or that cause nuisance or adversely affect beneficial uses.
Floating Material	Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.
Suspended Material	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
Settleable Material	Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses.
Oil and Grease	Waters shall not contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect beneficial uses.
Biostimulatory Substance	Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.
Sediment	The suspended sediment load and suspended sediment discharge rate of surface water shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
Temperature	The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses. At no time or place shall the temperature of any COLD water be increased by more than 5°F above natural receiving water temperature.
Toxicity	All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.
Pesticides	No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no bioaccumulation of pesticide concentrations found in bottom sediments or aquatic life.
Chemical Constituents	Waters designated for use as agricultural supply (AGR) shall not contain concentrations of chemical constituents in amounts which adversely affect such beneficial uses.

Radioactivity	Radionuclides shall not be present in concentrations which are deleterious to human, plant, animal or aquatic life nor which result in the accumulation of radionuclides in the food web to an extent which presents a hazard to human, plant, animal, or indigenous aquatic life.
Turbidity	Turbidity shall not be increased more than 20 percent above naturally occurring background levels.
pH	The pH of waters shall always fall within the range of 6.5 to 8.5.
Dissolved Oxygen	At a minimum, waters shall contain 7.0 mg/L at all times. Ninety percent of the samples collected in any year must contain at least 7.5 mg/L. Fifty percent of the monthly means in any calendar year shall contain at least 10.0 mg/L.
Bacteria	The bacteriological quality of waters of the North Coast Region shall not be degraded beyond natural background levels. Based on a minimum of not less than five samples for any 30-day period, the median fecal coliform concentrations in waters designated for contact recreation (REC-1) shall not exceed 50/100 ml. Nor shall more than ten percent of total samples during any 30-day period exceed 400/100 ml.
Specific Conductance	Ninety percent of the samples collected in any year must not exceed 220 micromhos at 77°F. Fifty percent of the monthly means in any calendar year shall contain at least 125 micromhos at 77°F.
Total Dissolved Solids	Ninety percent of the samples collected in any year must not exceed 115mg/L. Fifty percent of the monthly means in any calendar year shall contain at least 75 mg/L.

Prohibitions

In addition to water quality objectives, the Basin Plan includes two discharge prohibitions specifically applicable to logging, construction, and other associated non-point source activities. The prohibitions state:

- The discharge of soil, silt, bark, slash, sawdust, or other organic and earthen material from any logging, construction, or associated activity of whatever nature into any stream or watercourse in the watershed in quantities deleterious to fish, wildlife, or other beneficial uses is prohibited.
- The placing or disposal of soil, silt, bark, slash, sawdust, or other organic and earthen material from any logging, construction, or associated activity of whatever nature at locations where such material could pass into any stream or watercourse in the watershed in quantities which could be deleterious to fish, wildlife, or other beneficial uses is prohibited.

Development and implementation of a Total Maximum Daily Load (TMDL) is one means of attaining water quality objectives and protecting beneficial uses in the Gualala River. The TMDL program is required by Section 303(d)(1)(A) of the Clean Water Act (CWA) that states, “Each State shall identify those waters within its boundaries for which the effluent limitations . . . are not stringent enough to implement any water quality standard applicable to such waters.” The same part of the CWA also requires that the State “establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters.” The Gualala River was included on the 1996 and 1998 lists based on the finding that sedimentation is, in part, responsible for the impairment of the cold water fisheries. Section 303(d)(1)(C) of the CWA requires that “Each State shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load...”

As part of California’s 1996 and 1998 303(d) list submittals, the North Coast Regional Water Quality Control Board (RWQCB) identified the Gualala River as water quality limited due to sediment loading and designed the watershed as a high priority for TMDL development. The RWQCB published a Technical Support Document for the TMDL in 2001 (NCRWQCB 2001a).

The Basin Plan also stipulates under point source discharges that “On all other coastal streams and natural drainageways that flow directly to the ocean all new discharges will be prohibited. Existing discharges to these waters will be eliminated at the earliest practicable date.”

Gualala River Watershed – Discharger Information

The Annapolis Milling Company

The Annapolis Milling Company, Incorporated, owns and operates a conventional sawmill near the town of Annapolis in western Sonoma County. The facility is located in the NW1/4, SE1/4 of section 7, T1ON, R13W, MDB&M. The facility consists of a sawmill, equipment maintenance shed, and a five acre dry log deck.

Stormwater runoff from the log deck flows to the west towards Grasshopper Creek and to the east towards an unnamed tributary of Buckeye Creek, both major tributaries of the South Fork Gualala River. Domestic waste is discharged to a septic tank/leachfield system. Steam cleaning waste is discharged onto the ground. Log deck cleanup/solid waste is disposed of at the Sonoma County landfill near Annapolis. Wood shavings and sawdust is sold as landscaping material. The Regional Board adopted Waste Discharge Requirements Order No. 85-176 on December 5, 1985, for this facility.

Comments or Issues -

There is a former underground storage tank (UGST) site at the sawmill which is being handled by the Sonoma County Health Department. The tank was removed in1989, and in March 1990 a remediation workplan was approved and soil excavation began.

In February 1995, staff reported that this facility had not submitted any Self Monitoring Reports since July of 1994, which could result in a violation.

In April 2000, staff inspection found that mill operations were substantially unchanged over the past decade. Bark waste is now sold to reuser in cloverdale, and vineyards are being planted over some of the area formerly used for decking logs.

Recent violations consisted of repeatedly failing to record discharge observations. Several staff inspections in 2000 noted that there was no copy of the storm water pollution prevention plan, storm water permit, or monitoring program available on site.

Mendocino County, South Coast Solid Waste Disposal Site. (SWDS)

The County of Mendocino is the owner and operator of a Class II-2 solid waste disposal site located approximately five miles east of Highway 1 in the S1/2 of Section 4, T11N, R15W, MDB&M. The disposal site property contains 47 acres while the active portion of the disposal site included approximately 10 acres located adjacent to the (Little) North Fork Gualala River. The landfill is unlined and has been in operation since 1970. The landfill is located over the San Andreas Fault and borders the Little North Fork of the Gualala River, located approximately 50 feet southwest of the site. Land within 1000 feet of the disposal site is unimproved forest and range land. The discharger is operating the site as a fill and cover operation with waste being placed in layers behind a compacted earth barrier that is keyed into the native soils. Surface drainage is diverted around the fill area. This disposal site is now in the process of closure.

Comments or Issues –

A staff inspection of the site on February 26, 1987 revealed that a pond used to control sediment discharges from the site was filled to capacity with a liquid that was confirmed to be leachate. The liquid was flowing into the pond from a seep at the toe of the active face of the fill. The pond is located less than a quarter mile from the Little North Fork Gualala River.

In February 1994, staff reported the violation of a broken leachate tank which discharged 2000 gallons to surface water, and a sediment pond discharge pipe triggered a small mudslide to creek.

In April 1995, staff indicated a need to resolve the groundwater separation issue and VOC's reported in monitoring wells.

In May 2000, staff inspection reported that a berm had recently been constructed around the active face of a site to contain leachate. A broken leachate pipe was evident within the berm. The timing of berm placement with respect to origin of leachate flow may have been delayed, and might not have been installed soon enough.

Gualala Community Services District Wastewater Treatment and Disposal Facilities
In January 1992, the Gualala Community Services District submitted a report of waste discharge for the operation of a new wastewater treatment plant located in the NW ¼ of Section 26, T11N, R15W, MDB&M, South of the Community of Gualala in Northwest Sonoma County. The treatment plant is located in the watershed of the Gualala River and the Pacific Ocean.

The discharger proposes to treat wastewater to a secondary level using an aerated pond and polishing clarifier. Solids from this treatment process are retained in a sludge basin and will be removed to an approved disposal site on a periodic basis. Following treatment, the water is stored in ponds and used to irrigate the Sea Ranch Golf Links.

Comments or Issues -
July 1992, an estimated 11,000 gallons of secondary treated, filtered and disinfected wastewater was discharged to Salal Creek.
October 1992, an estimated 40,000 gallons of secondary treated, filtered and disinfected wastewater was discharged to Salal Creek.
January 1993, an estimated 20,000 gallons of treated, un-disinfected wastewater was discharged to a tributary of the Gualala River, and the Gualala River.
May 1993, an estimated 100,800 gallons of advanced treated wastewater was discharged to Salal Creek.
From February 12, 1994 to March 1, 1994 an estimated 900,000 gallons of advanced treated wastewater was discharged to a tributary of the Gualala River and the Gualala River in violation of waste discharge requirements prescribed by the Regional Board.
In June 1995, approximately 584,00 gallons of wastewater was discharged to Salal Creek and the ocean.
In February 1996, there was a discharge of untreated wastewater from the Villa Del Mar Trailer Park in Gualala. It is believed that a good quantity of the discharged waste (8,000 to 10,000 gallons) flowed into China Gulch, into the Gualala River, and out to sea.

Gualala Aggregates, Inc.
Gualala Aggreagates, Inc., operates a sand and gravel plant located adjacent to the South Fork Gualala River west of Annapolis in Section 22, T1ON, R14W, MDB&M. Washwater from the plant is discharged to evaporation/percolation ponds adjacent to the South Fork Gualala River. The Board adopted Order No. 78-135, Waste Discharge Requirements for this facility, on August 24, 1978.

Comments or Issues –
February 1997, a large discharge of fresh concrete had been dumped on a creek bank slope and entered a tributary to Big Gulch Creek. This concrete channel extended from the slide area approximately 250 feet downstream. It was also suspected that this hillside was used for rinsing out the trucks. Remedial actions were to manually break up and remove the concrete from the channel, and revegetate the hillside.

Water Quality Methods
The RWQCB compiled and evaluated existing data that were available as well as collected some new water quality data. The data analysis included in this assessment by RWQCB is for basic water chemistry, water temperature, and sediment parameters. The data gathering, data collection, and data analysis techniques are detailed in our methods manual, NCRWQCB (2001b).

Data Gathering
Data gathering is the process of compiling existing data from Regional Water Board files, other agency files, and other sources. The Regional Water Board has several types of water quality information sources within its office, all of which were evaluated for inclusion into the assessment: Timber Harvest Plan files, water quality monitoring files, TMDL files, grant files, EIRs and other reports. Sources outside the office included data and reports from other agencies (including water rights and diversion information), US EPA's StoRet water quality database, watershed groups, landowners, and public interest groups. As data were gathered, the location and general characteristics of the data were catalogued in a computerized database. Catalogued data included non-water quality data related to the watershed assessment that we made available to the other NCWAP agencies as requested.

Data Collection
RWQCB staff collected water quality measurements three times during 2001 in the Gualala River watershed. Sample collection and analysis was in accordance with methods used by USGS and USEPA. Those methods are further explained and referenced in the RWQCB's NCWAP methods manual (NCRWQCB 2001). While staff had hoped to collect stream channel information, such as pebble counts, we were unable to accomplish this due to access constraints. However, the Gualala River Watershed Council (GRWC) in cooperation with the Gualala Redwoods, Inc. (GRI) collected those types of data at a number of locations in the watershed. Additionally, a GRWC/RWQCB joint effort in temperature monitoring resulted in additional sites being monitored as well as the collection of air temperature data for future modelling activities.

Data Analysis
The data were computerized into formats appropriate for the information, e.g., spreadsheets for dissolved oxygen, flow, temperature. Analysis of the data was specific to the data type and its quality. For example, water temperature data from continuous data loggers were evaluated from raw data plots (when available) over time and summary statistics were compared to the EMDS relationships.

The stream water temperature range for salmonids was developed by the NCWAP team as an average of the needs of several cold water fish species, including coho salmon and steelhead trout. As such, the range does not represent fully suitable conditions for the most sensitive cold water species (usually considered to be coho salmon). The breakdowns follow:

50-60° Fahrenheit (F) (10-15.6° Celsius [C])	"fully suitable"
61-62 F	"moderately suitable
63 F	"somewhat suitable"
64 F	"undetermined"
65 F	"somewhat unsuitable"
66-67 F	"moderately unsuitable"
68 F	"fully unsuitable"

Where we did not have the full raw data set for continuous temperature measurements, we evaluated only the summary statistics.

The analysis included comparison of available data to water quality objectives from the Basin Plan, Total Maximum Daily Load suggested targets, and EMDS dependency relationships (thresholds) and other ranges and thresholds derived from the literature. With the exception of the Basin Plan objectives, these ranges and thresholds are not legal regulatory numbers. Rather, they are based on information available at the time and are expected to change as new data and analyses become available.

Water Quality Parameter	Range or Threshold	Source of Range or Threshold
pH	6.5-8.5	Basin Plan, p 3-3.00
Dissolved Oxygen	7.0 mg/L	Basin Plan, p 3-3.00
Temperature	No alteration that affects BUs [1]	Basin Plan, p 3-3.00
	No increase above natural > 5 F	Basin Plan, p 3-4.00
	50-60°F MWAT 2 – "fully suitable"(see EMDS breakdown above)	EMDS proposed Fully Supportive Range [3]
	75 F daily max (lethal)	Cold water fish rearing, RWQCB (2000), p. 37
Sediment Settleable matter	Not to cause nuisance or adversely affect BUs	Basin Plan, p 3-2.00
Suspended load	Not to cause nuisance or adversely affect BUs	Basin Plan, p 3-2.00, 3-3.00
Turbidity	no more than 20 percent increase above natural occurring background levels	Basin Plan, p 3-3.00

Percent fines <0.85 mm	<14% in fish-bearing streams [4]	Gualala TSD, CRWQCB (2001)
Percent fines <6.4 mm	<30% in fish-bearing streams	Gualala TSD, CRWQCB (2001)
V* in 3rd order streams with slopes 1-4 % [5]	≤0.15 (mean) <0.45 (max)	Gualala TSD, CRWQCB (2001)

[1] BUs = Basin Plan beneficial uses
[2] MWAT=maximum average weekly temperature, to be compared to a 7-day moving average of daily average temperature
[3] EMDS = Ecological Management Decision Support model used as a tool in the fisheries limiting factors analysis. These ranges and thresholds were derived from the literature and agreed upon by a panel of NCWAP experts.
[4] fish-bearing streams=streams with cold water fish species
[5] V* is the percentage of residual pool volume occupied by sediment depositions
[6] CDFG=Calif. Department of Fish and Game habitat threshold (Flosi, et al. 1998. California Salmonid Stream Habitat Restoration Manual. Third Edition. Inland Fisheries Division. California Department of Fish and Game. Sacramento, CA. 495 pp.)

The data we compared to these ranges and thresholds from a water quality perspective were:

- Percent fines < 0.85 mm from McNeil samples and thalweg profiles
- Continuous water temperature data from data loggers
- Dissolved oxygen, pH, conductance (dissolved solids), nutrients (nitrogen, phosphorus)

Turbidity and suspended solids data were not available for this assessment, and represent a limitation in the water quality part of the assessment.

In-stream Sediment

Knopp (1993) measured a variety of instream parameters on 60 North Coast streams within Franciscan geology. The watersheds were divided into three categories based on relative upslope disturbance and erosion potential: Index (little or no land use in the prior 40 years), Moderately Disturbed (recent land management, good stream course protection, avoidance of unstable areas), and Highly Disturbed (recent land management, large areas of disturbed soil, poor stream course protection, inconsistent avoidance of unstable areas). Knopp found a significant difference in median particle size between the Index reaches and those of Moderate and High disturbance.

Median particle size data were available from Gualala Redwoods Inc./Gualala River Watershed Council and Coastal Forest Lands monitoring at 38 low gradient sites (<2 percent slope) in the Gualala Watershed from 1995-2001. However, those sites were predominantly less than 1 percent slope, and Knopp used sites of 1-4 percent. Additionally, the analysis provided in Knopp (1993) does not break down the Franciscan geology into sub-categories. For those reasons, the Knopp (1993) relationship of median particle size to watershed disturbance was not used. However, a workgroup is being developed to evaluate Knopp's raw data, re-site the current GRI/GRWC monitoring locations, and work towards building upon and improving the work that Knopp started.

Percent fine material <0.85 mm and <6.4 mm from McNeil core samples were available from GRI for eight sites in the North Fork Subbasin, spanning the years of 1992-1997, and are presented in a table following this section. Core data were compared to the proposed Gualala TMDL target of less than 14% for particle sizes of 0.85mm.

In addition, thalweg profiles were conducted by GRI and GRWC at 13 sites in the watershed spanning the years 1998-2001, six of them repeated for more than one year. Results are presented following this section.

Water Temperature

Water temperature data as MWATs and seasonal maxima were available from GRI and GRWC for a total of 66 sites in the watershed spanning the years 1994-2001, some monitored discontinuously during that period. Those data are presented in tables following this section.

The temperature range for "fully suitable conditions" of 50-60 F (10-15.6 C) was developed by the EMDS Team as an average of the needs of several cold water fish species, including coho salmon and steelhead trout. As such, the range does not represent fully suitable conditions for the most sensitive cold water species (usually considered to be coho). The lethal maximum temperature of 75 F (23.9 C) was derived from literature reviews presented in

RWQCB (2000). Peak temperatures are important as they may reflect short-term thermal extremes that, unless salmonids are able to escape to cool water refugia, may be lethal to fish stocks. The literature supports a critical peak lethal temperature threshold of 75 F, above which death is usually imminent for many Pacific Coast salmonid species (Brett, 1952; Brungs and Jones, 1977; RWQCB, 2000; Sullivan, et al., 2000).

Data Quality and Limitations

We evaluated existing data for quality with respect to the assessment, and new data collections were at a level to ensure utility in the assessment.

- Water temperature and stream channel measurements provided by the GRWC and GRI were collected with acceptable methods and quality assurance and control for use in the assessment. However, we were unable to evaluate the data in raw form in most cases because it either was not provided or staffing and time constraints prevented that analysis.
- NCRWQCB's water chemistry analysis was limited to available USEPA StoRet data for the period April of 1974 to June of 1988 at three locations, and three samples obtained by NCRWQCB at five locations in 2001. The sampling frequency and small number of locations did not allow for any detailed temporal analysis.
- Pesticide data were not available from StoRet, nor collected in the NCRWQCB sampling of 2001.
- Collection of additional water quality data on daily dissolved oxygen, pH, conductance, and temperature at locations near the confluences of major tributaries did not occur due to access limitations.
- NCRWQCB analyzed water temperature and in-channel data supplied by the GRWC and GRI for the period from 1992 to 2001. Not all locations received sampling throughout that period, limiting the ability to compare across years and among sites. Streambed substrate data were collected in areas below 1% gradient and not comparable to the Knopp (1993) study.
- In-channel data and most temperature data were provided as summary statistics (medians, means, maxima), limiting the ability to factor variability into the analysis, and not allowing for independent checks on the data quality. As such, the analyses and subsequent assessment are limited in scope.
- Analysis of temperature information is without knowledge of the extent of a thermal reach upstream of the continuous data logger.
- The water quality data gathered in the past and more recently in 2001 were adequate for the analysis performed and provide a general sense of the basic water chemistry.
- Turbidity and suspended solids data were not available, though critical to water quality assessment.
- The primary limitations to the data we evaluated were related to matters of scale—that is, the representativeness of a measurement in a specific location with respect to characterizing a subwatershed. In that context, the data often determine the coarseness of the assessment as some data are more appropriately applied over a larger area than others.

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8/13/1999, Elk Prairie THP
10/23/1999, Flats South THP
4/8/1999, Groshong Ridge THP
11/17/1997, North Fork Flat THP
9/28/1998, Pepperwood '98 THP
7/9/1999, Ripple THP
11/24/1997, Rockeye THP
5/27/1999, Signal Ridge THP
2/28/1999, South Fork '98 THP
9/18/1998, Stanley '98 THP
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Methods used by GRI and GRWC

Riparian condition was inventoried by GRI and GRWC in two ways:

Canopy cover percent was measured with a vertical densiometer during the watershed-monitoring program conducted by GRI and GRWC from 1998 to 2001. Measurements were taken every 200' along the monitoring reach at the center of channel, left and right bank full and 50' into the riparian zone from bank full on the left and right bank. Center of channel measures the effect of the riparian zone on the stream. The measurement taken 50' inside the riparian zone, measures the condition of the riparian forest. This is important because in the wider channels it may be impossible to significantly affect the channel with riparian shade. Current forest practice rules target 85% canopy cover as a desirable post harvest condition within 75' of bank full.

A riparian vegetation inventory was conducted during the watershed-monitoring program conducted by GRI and GRWC from 1998 to 2001. Inventory plots using the Forest Projection System inventory design were located on both sides of the channel every 200'. Tree size, species, live crown ratio, distance to the stream were measured. In addition, understory vegetation, snags and down logs were measured.

For biotic parameters GRI used electro shocking conducted between 1988 and 2001 by DFG, snorkel surveys conducted by GRI between 1997 and 2001 and Macroinvertebrate surveys conducted by GRI in 2000.

The snorkel surveys are principally a presence absence survey with a rough estimate of abundance by age class. Dennis Halligan, a fisheries biologist working for Natural Resource Management, Inc, conducted all the surveys.

The macroinvertebrate samples were taken by Jon Lee, a third party expert and analyzed in his state certified lab. The use of macroinvertebrates as indicators of stream condition is a well accepted and long established method (Erman 1991). An inventory of macroinvertebrate fauna in stream riffles can measure changes in chemical and physical stream properties. These changes ultimately determine the presence and distribution of resident biota (Usinger 1956). Such an inventory is indicative of current as well as past environmental conditions. This method of sampling emphasizes the collection of bottom dwelling insects, which are relatively fixed in their habitat, unlike fish or plankton which can move to more favorable conditions (Usinger 1956).

GRI used the "California Stream Bioassessment Procedure" (Cal. Dept. of Fish and Game 1999). The following metrics (measures based on benthic macroinvertebrates in a benthic sample) suggested by the California Stream Bioassessment Procedure are currently being used to monitor streams on GRI properties.

Taxa Richness
This is a measure of the total number of distinct taxa within a sample. Macroinvertebrates are determined to the lowest practical taxonomic level (generally genus)as suggested by the CAMLnet Standard Taxonomic Effort (Cal. Dept. of Fish and Game 2000). Taxa richness generally decreases with decreasing water quality (Weber 1973; Resh and Grodhaus 1983). (((Taxa richness generally increases with increasing water quality, habitat diversity, and/or habitat suitability (Plafkin et al. 1989).))) The following table will help describe the quality of the stream in the coastal Mendocino region when Taxa Richness is used as a metric. (Personal Com. Jon Lee 1994; Harrington et al. 1999) :

	Poor	Average	Good
Richness	<26	26 to 35	>35

Community Diversity Index
The most common measures of stream health are diversity indices. Diversity indices measure species richness rather than abundance. A healthy stream should exhibit high diversity evidenced by a large number of taxa without

any one taxon dominating.

The Simpson diversity index is the most commonly used diversity index when addressing aquatic communities (Magurran 1988, Rosenberg and Resh 1992).

The Simpson index is based upon species dominance. The Simpson diversity index ranges from 0 - 1.0. As the index approaches 1.0, the more diverse the sample is thought to be. The following table will help describe the quality of the stream when the Simpson index is used (Personal Com. Jon Lee 1994):

	Poor	Average	Good
Simpson Diversity Index	.7 to .79	.8 to .89	.9 to 1.0.

Percent Dominant Taxon
The Percent Dominant Taxon is the ratio of individuals in the most abundant taxon to the total number of organisms in the sample. A sample dominated by relatively few taxa would indicate environmental stress, as would a sample composed of several taxa but numerically dominated by only one or two. An abundance of taxa with a fairly equal distribution of individuals within the sample is indicative of community balance.

The following table will help describe the health of the stream when using Percent Contribution of the Dominant taxa (EPA 444/4-89-001) :

	Poor	Average	Good
% Contribution of Dominant Taxa	> 39 %	39 - 15 %	<15%

Biotic Index
The Hilsenhoff Index is a biotic index. This index weights the relative abundance of each taxon in terms of its organic pollution tolerance to determine a community score. Generally the higher the score the poorer the water quality (Hilsenhoff 1982).

Index	Condition
0.85 to 1.75	Excellent
1.76 to 2.25	Very Good
2.26 to 2.75	Good
2.76 to 3.50	Fair
3.51 to 4.25	Poor
4.26 +	Very Poor

A tolerance value based on the Hilsenhoff Biotic Index is currently being used in the Pacific Northwest. Taxa tolerant of organic enrichment are also generally tolerant of warm water, fine sediment, and heavy filamentous algal growth (Wisseman 1996). The tolerance value is based on a scale of 0 (intolerant) to 10 (very tolerant). The value is expected to increase with a stressed environment. The following table will help describe the health of a stream when using this tolerance value (Harrington et al. 1999):

	Poor	Average	Good
Tolerance Value	<4.6	4.6 to 3.1	>3.1

Abundance
This is rough estimate of the total number of macroinvertebrates per sample and hence per unit area of stream. Very low abundances would be considered a negative when evaluating the relative health of a stream.

WATER QUALITY DATA SUMMARY – HISTORIC AND CURRENT

Basic Water Chemistry

General water quality data were available from:

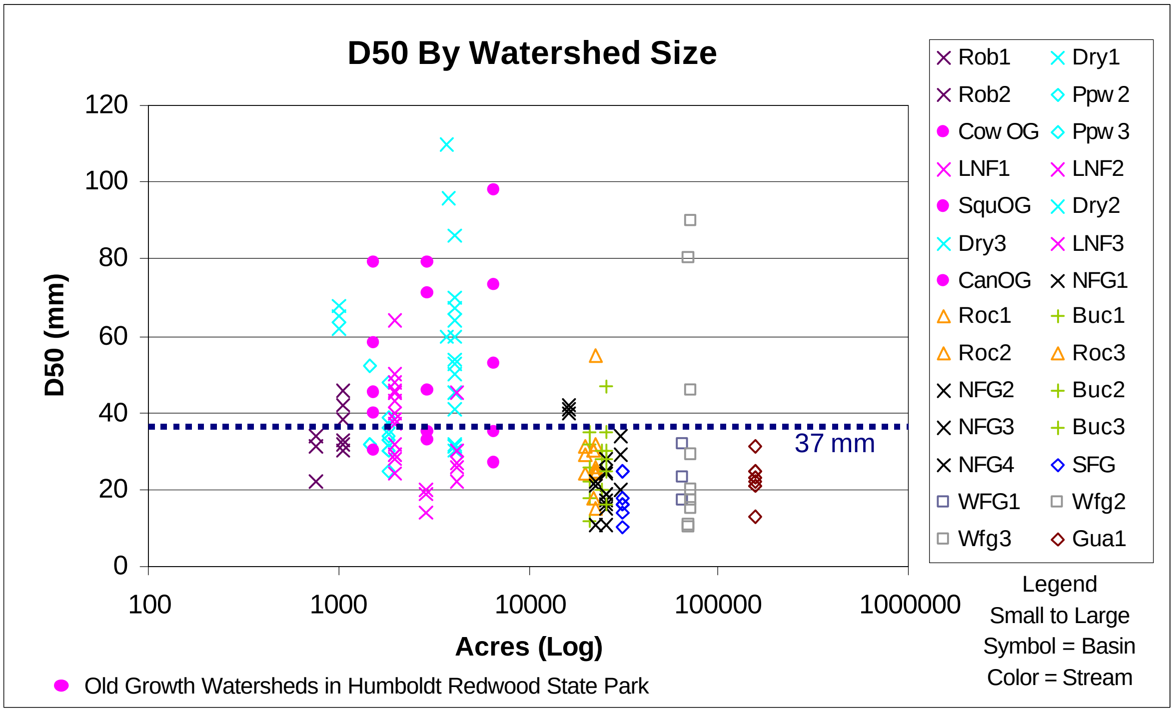
- StoRet data from USEPA are available for three sites on the Gualala River from: Gualala River near Gualala monthly from February 13, 1975 to April 4, 1985, Wheatfield Fork at the YMCA camp on January 6 and June 3, 1988, and South Fork at Valley Crossing in April and September from 1974 to 1988. All those data indicate a moderatley hard water oligotrophic stream with pH slightly above neutral, high dissolved oxygen, low dissolved solids, and low nutrients (nitrogen and phosphorus). There were no large differences among the stations, though South Fork pH and hardness values were somewhat higher than in the Gualala.
- RWQCB sampling on February 13, May 8, and June 27 at five stations: House Creek, Wheatfield Fork near Valley Crossing, South Fork at Hauser Bridge and near Valley Crossing, and mainstem Gualala River at the Regional Park. All the data indicate a moderately oligotrophic waterbody—low nitrogen and phosphorus levels, moderately buffered, moderately hard water, low heavy metals concentrations, low organic load. House Creek appears to have a higher hardness and conductance than the larger mainstem sites sampled in the watershed. Additional sampling in the future will help explain this potential difference.

In-Channel Sediment

Knopp (1993) measured a variety of instream parameters on 60 North Coast streams within Franciscan geology. The watersheds were divided into three categories based on relative upslope disturbance and erosion potential: Index (little or no land use in the prior 40 years), Moderately Disturbed (recent land management, good stream course protection, avoidance of unstable areas), and Highly Disturbed (recent land management, large areas of disturbed soil, poor stream course protection, inconsistent avoidance of unstable areas). Knopp found a significant difference in median particle size between the Index reaches and those of Moderate and High disturbance.

Median particle size data were available from Gualala Redwoods Inc./Gualala River Watershed Council and Coastal Forest Lands monitoring at 38 low gradient sites (<2 % slope) in the Gualala Watershed from 1995-2001. However, those sites were predominantly less than 1% slope, and Knopp used sites of 1-4%. Additionally, the analysis provided in Knopp (1993) does not break down the Franciscan geology into sub-categories. For those reasons, the Knopp (1993) relationship of median particle size to watershed disturbance was not used. However, a workgroup is being developed to evaluate Knopp's raw data, re-site the current GRI/GRWC monitoring locations, and work towards building upon and improving the work that Knopp started.

GRI provided the following plot of D_{50} versus watershed size with the Gualala River data points, as well as for some streams in Humboldt County which contain varying amounts of old growth redwood. Differences in geology, soils, and climate have not been factored into the plot. No relationship of watershed size to D_{50} was obvious. Water Quality staff are developing a workgroup to evaluate the use of Knopp (1993) and median particle size for future assessments.



<u>Thalweg surveys</u>

The vertical complexity of the stream channel was measured by the Cooperative Watershed Monitoring Program using thalweg surveys at the GRI/GRWC monitoring reaches. Following a large sediment event, a significant aggradation of the channel (>1') is expected, followed by a slow degradation over the next several years (Madej, 1999). A stable channel is expected to fluctuate a little (< ± 0.5') each year. Six thalweg surveys were re-measured since 1998. No measurement has exceeded ± 0.5' from the original measurement. Channel aggradation would be observed as a steady increase in the elevation of the channel and filling in of pools and other features. Conversely, degradation from a prior aggradation would be seen as a decrease in the elevation and appearance of more features, increasing the variability of the thalweg.

Madej, (1999) suggests using the variation index as a way of quantifying the roughness of a stream and hence its suitability for fish. The variation index is defined as [(standard deviation of residual water depths/bankfull depth) * 100]. A flat wide streambed with sediment filled pools would have a low variation index. A stream with many deep pools interspersed with riffles would have a high variation index. As the streams in the Madej study cleared of flood deposits after major events, the variation index approached or exceeded 20. The extent to which these indices are directly comparable to Gualala River's geology, fluvial network and processes, and hydrology is not specifically known. However, when the variation index was calculated for the GRI GRWC thalweg survey data using the maximum bankfull depth measured in the CDFG 2001 habitat surveys in the Gualala, most of the variation indexes were well above 20.

Variation index of thalweg profiles from the Watershed Cooperative Monitoring Program (1998 - 2000)

Watershed	Site Number	Watershed* Size (acres)	Variation Index			
			1998	1999	2000	2001
North Fork Subbasin						
North Fork	473	30,600				36.8
North Fork	204	25,433		43.6		49.6
Little North Fork	404**	4,217				46.8
Little North Fork	203**	1,963	23.1	20.9	20.9	20.2

Robinson	207	1,068		18.2		
Dry Creek	211	4,104	63.3	57.6	58.8	55.6
Dry Creek	212**	3,756			43.8	
Rockpile Subbasin						
Rockpile Creek	221	22,373	19.0	11.9		
Buckeye Subbasin						
Buckeye Creek	223	25,588			46.4	
Buckeye Creek	231	21,198	53.4			
South Fork Subbasin						
South Fork	217**	157,415	39.1		36.5	33.9
South Fork	402**	31,081		21.0		
Pepperwood Creek	218**	1,825	19.5	17.5		

*Watershed size is calculated as the area above the monitoring site.

**Maximum Bankfull depth estimated from cross-section surveys

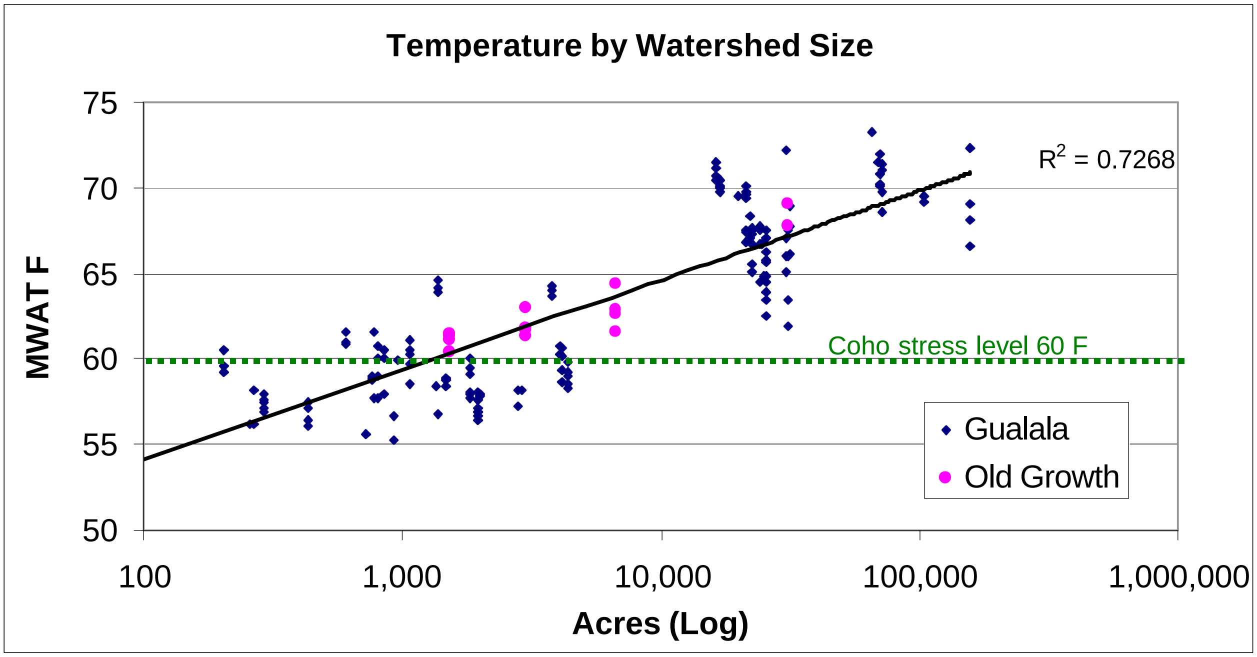
Water Temperature

GRI also provided a plot of water temperatures expressed as MWAT for streams in the Gualala River watershed and the same Humboldt County streams as for the D50. GRI's summary of the plot states:

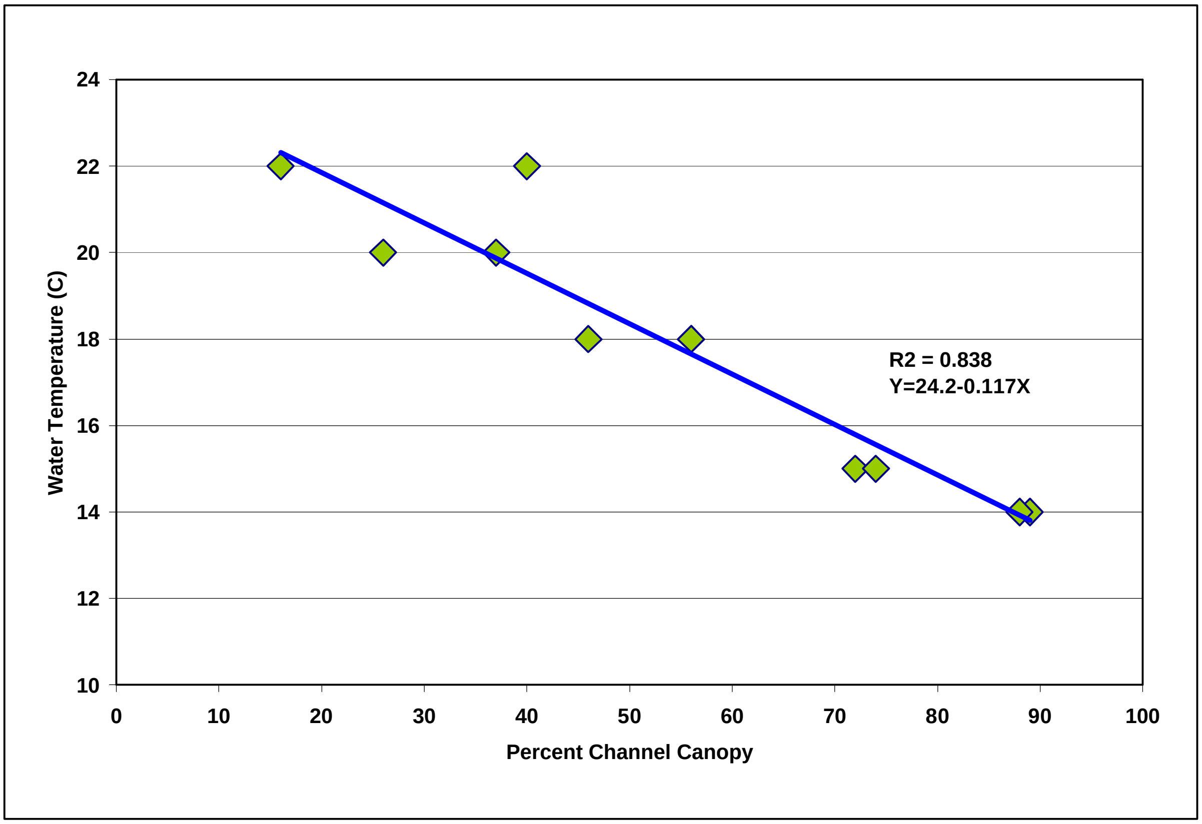
> Between 1994 and 2000, 154 continuous water temperature records were collected at 54 sites in the Gualala watershed. A trend has emerged indicating that smaller watersheds have lower water temperatures. The Forest Science Project's report in 2000 found a similar trend.
>
> It may be that the larger streams naturally have temperatures above the 60° F Coho stress level. To test this, Gualala temperatures were compared with temperatures collected in old growth watersheds in Humboldt Redwood State Park. The small circles in Figure ___ represent 14 continuous water temperature records collected at 4 sites between 1995 and 1999 by the Pacific Lumber Company. The old growth watersheds, by increasing acreage, are Cow Creek (93% uncut old growth), Squaw Creek (61% uncut old growth) Canoe Creek (62% uncut old growth) and Bull Creek, where the stream flows through 3 miles of uncut old growth, including the Rockefeller Grove, before it gets to the Bull Creek temperature station. The trend line equation for the old growth (y=2.2886Ln(x)+43.713) was almost identical to the equation for the Gualala trend line (y=2.2707Ln(x)+43.683). The R^2 value for the old growth trend line was 0.8292.

Differences in geology, hydrology, stream aspect, stream flow, relative ground water contribution, canopy, and climate are not accounted for in this plot. However, the relationship of increased temperatures with increased watershed size is evident, as water generally warms as it travels downstream. The ranges for any size watershed are fairly high, spanning from about 2 F to 10 F.

While water temperatures generally warm as one moves downstream (larger watershed area), the influences of climate and hydrology add complexity to the relationship, e.g., the situation observed in the Gualala River watershed with higher water temperatures coming off the eastern headwaters areas, then being cooled by tributary inflow, or larger contributions from the groundwater in some areas of a stream.

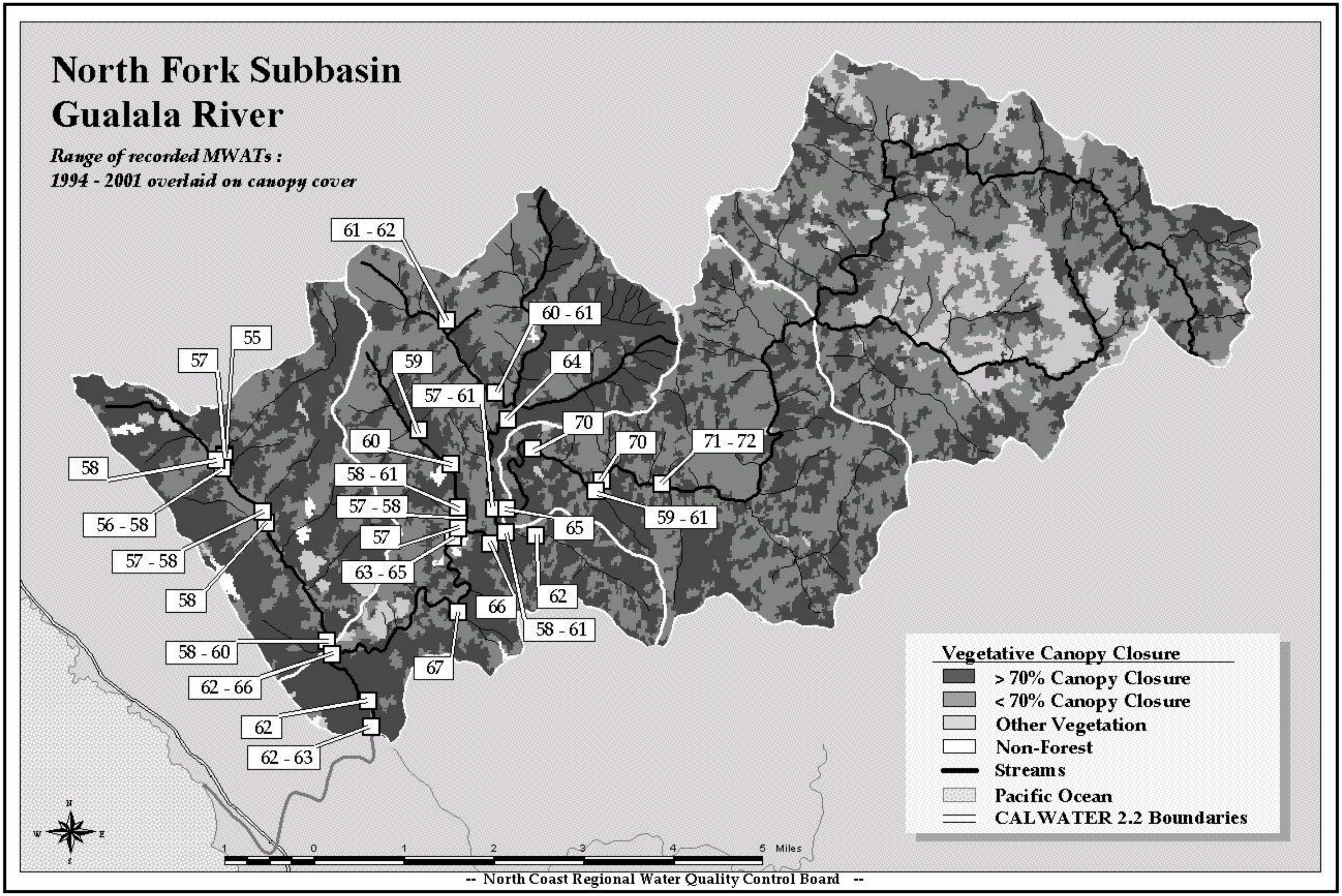


Water Quality staff performed a linear regression of MWAT and seasonal maximum versus channel canopy at 11 sites in the Gualala Watershed, using GRI/GRWC data, which shows a relationship of decreasing temperatures with increasing canopy.

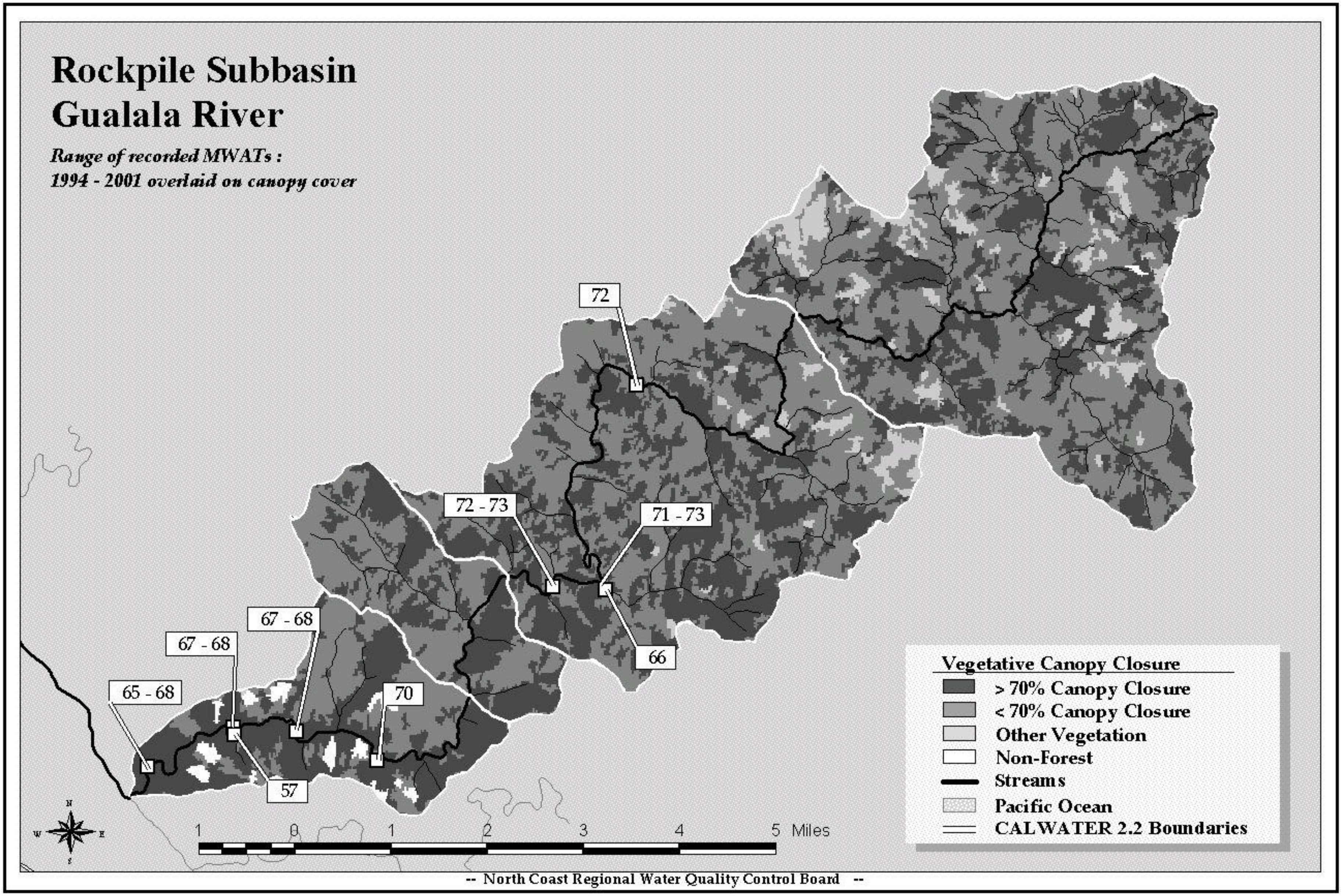


Neither analysis includes the factors of stream flow, stream aspect, thermal reach length, air temperature, relative location in the watershed, contributions from tributaries and groundwater inflow, and differences among years were not included. Further analysis by the GRWC using the spot temperatures from the DFG habitat typing for 2001 is planned, as is a search for data from the upper areas of the watersheds. GRWC is actively seeking access for temperature monitoring locations in the upper watershed areas for the coming years to develop more information and explore the temperature relationships in the Watershed.

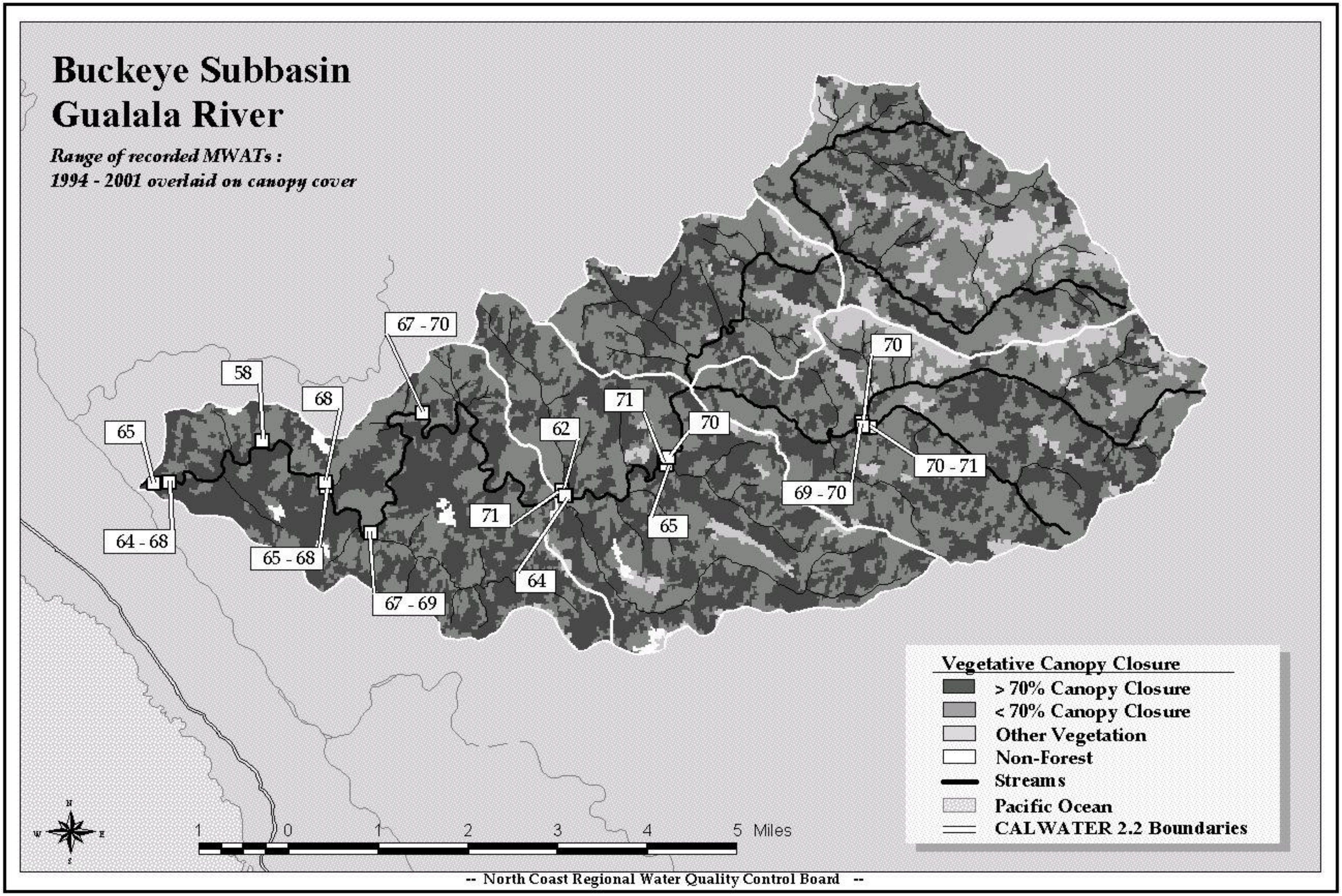
As mentioned above, water temperatures were warmer in the mainstems than in tributaries, and were warmer coming off the eastern areas, cooling as the mainstems flowed downstream. In many cases, the influence of cooler tributary flows and coastal influence are evident. Graphics of maximum MWATs plotted on Subbasin maps with the canopy coverage derived from 1994 LandSat imagery are presented in the following pages.



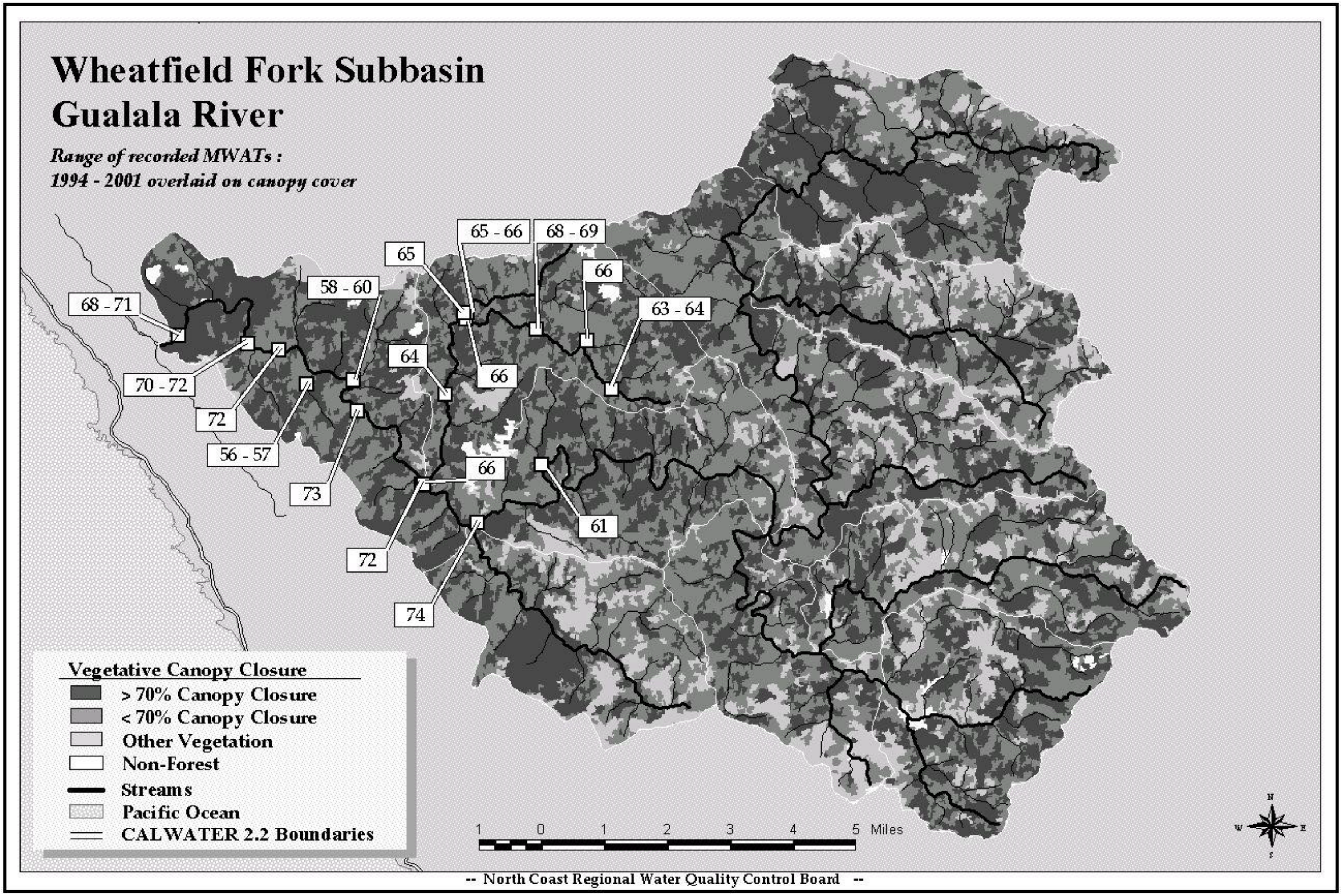
Maximum MWATs for the North Fork Gualala Subbasin displayed on 1994 US Forest Service LandSat vegetation image.



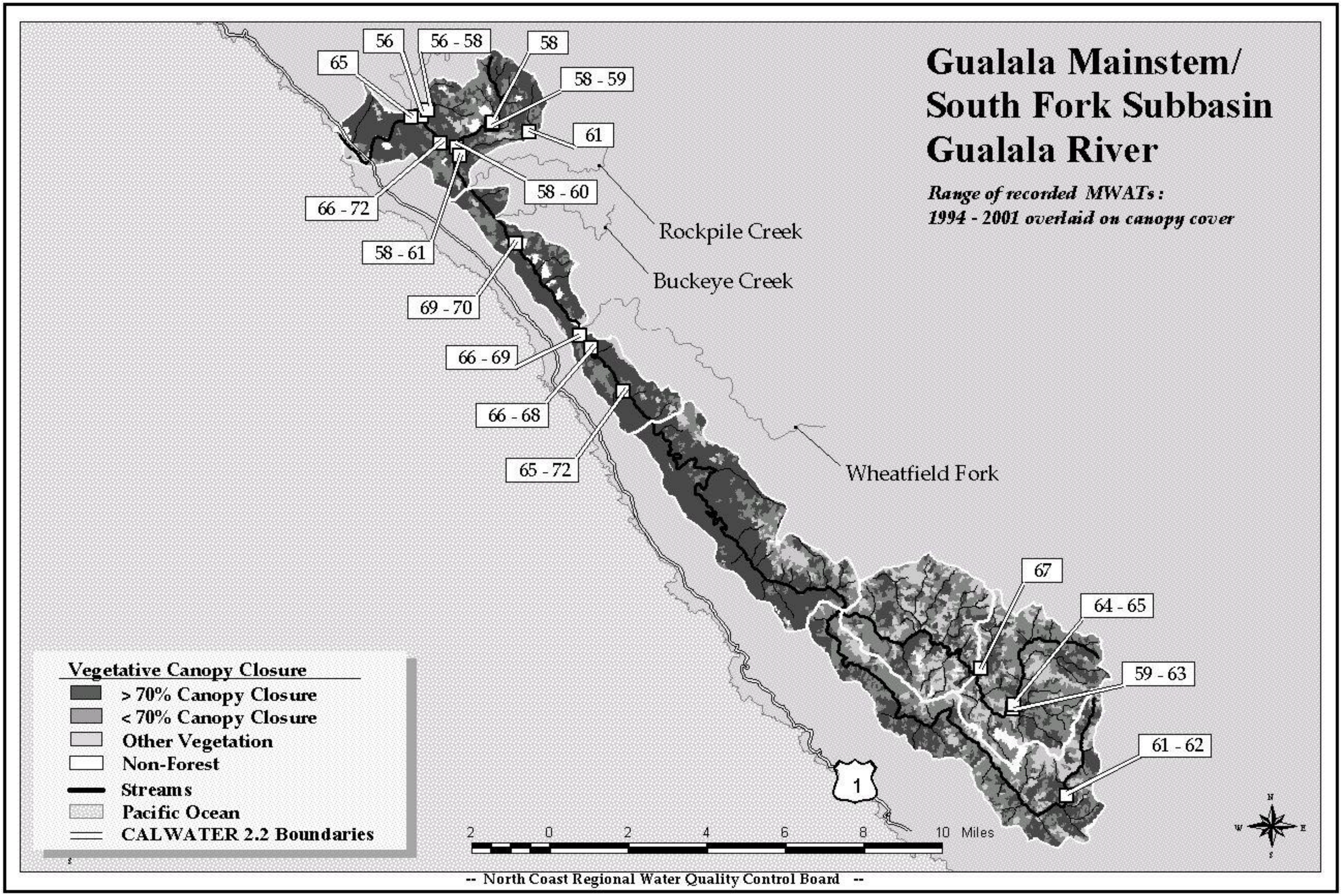
Maximum MWATs for the Rockpile Creek Subbasin displayed on 1994 US Forest Service LandSat vegetation image.



Maximum MWATs for the Buckeye Creek Subbasin displayed on 1994 US Forest Service LandSat vegetation image.

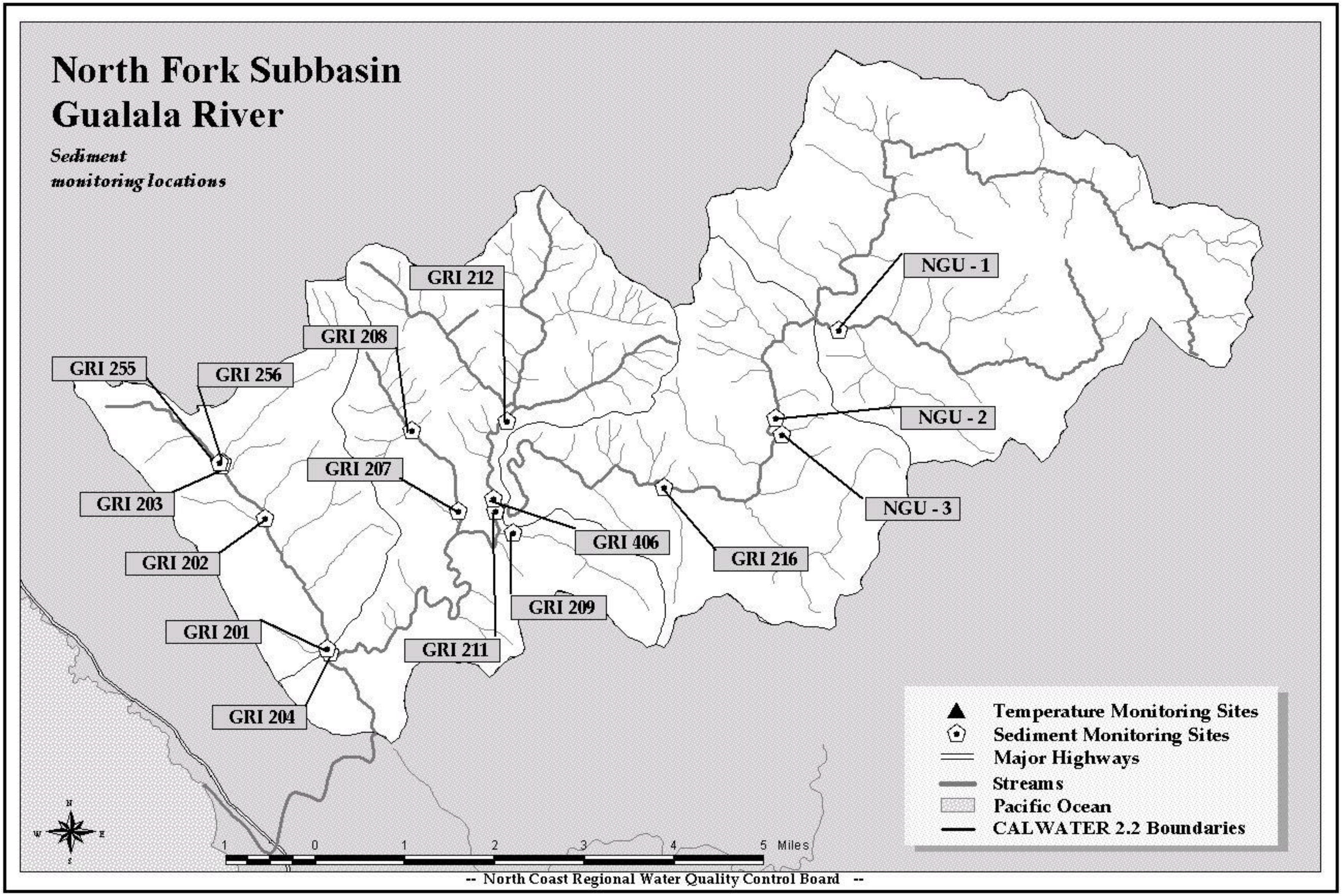


Maximum MWATs for the Wheatfield Fork Subbasin displayed on 1994 US Forest Service LandSat vegetation image.

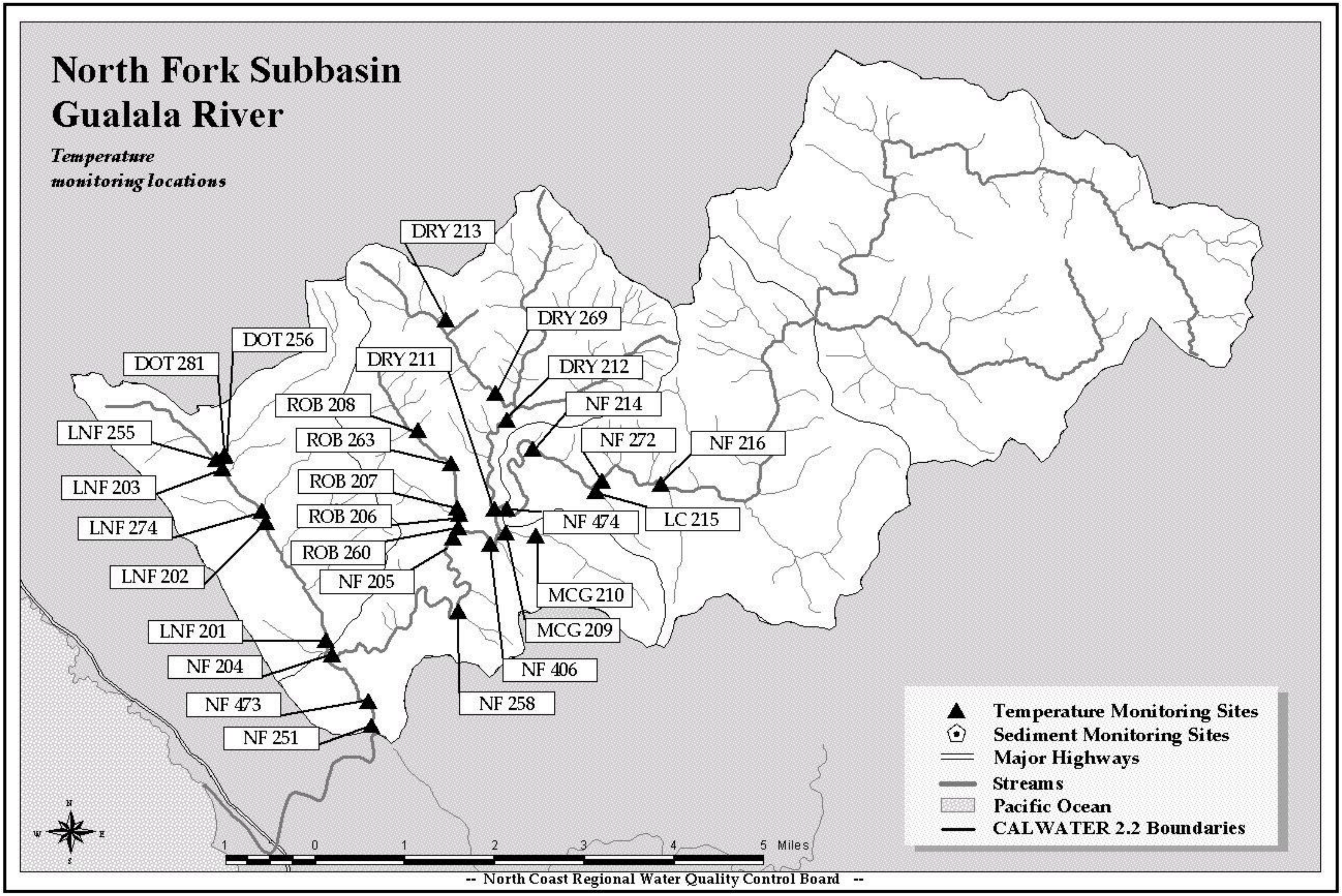


Maximum MWATs for the Main/South Fork Subbasin displayed on 1994 US Forest Service LandSat vegetation image.

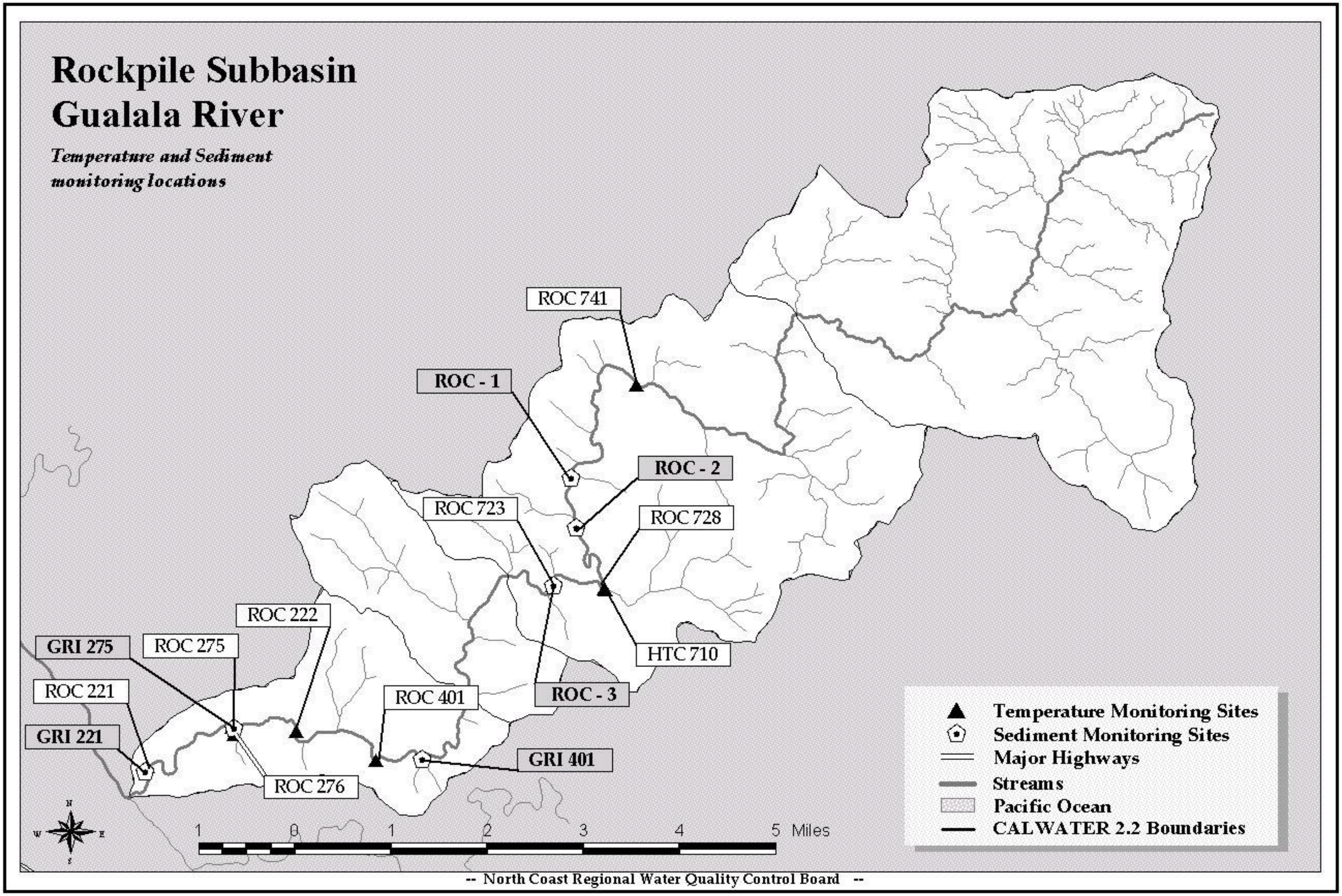
Water Temperature and In-stream Sediment Sampling Sites, GRI, GRWC, CFL



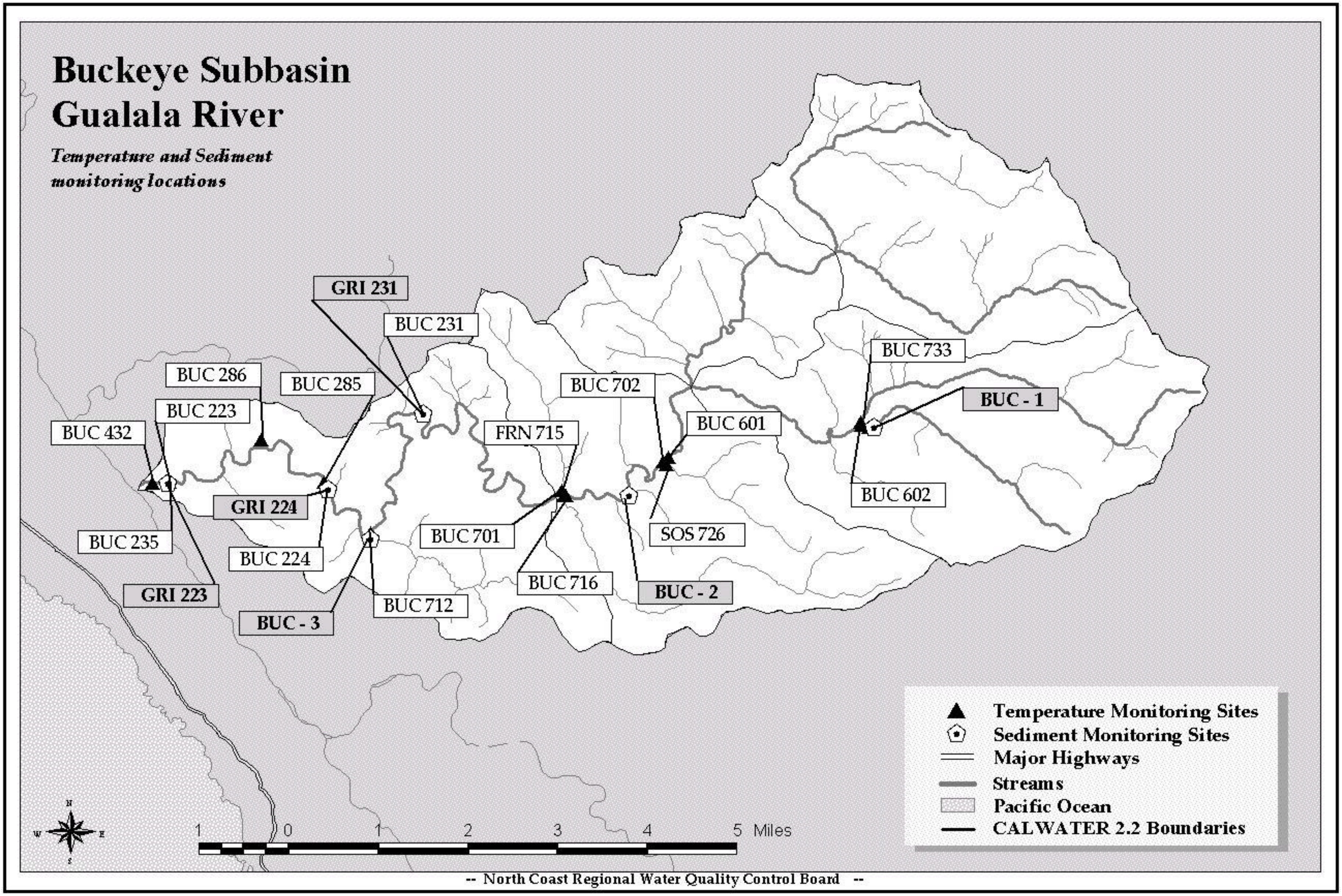
In-stream sediment sampling sites in the North Fork Gualala Subbasin.



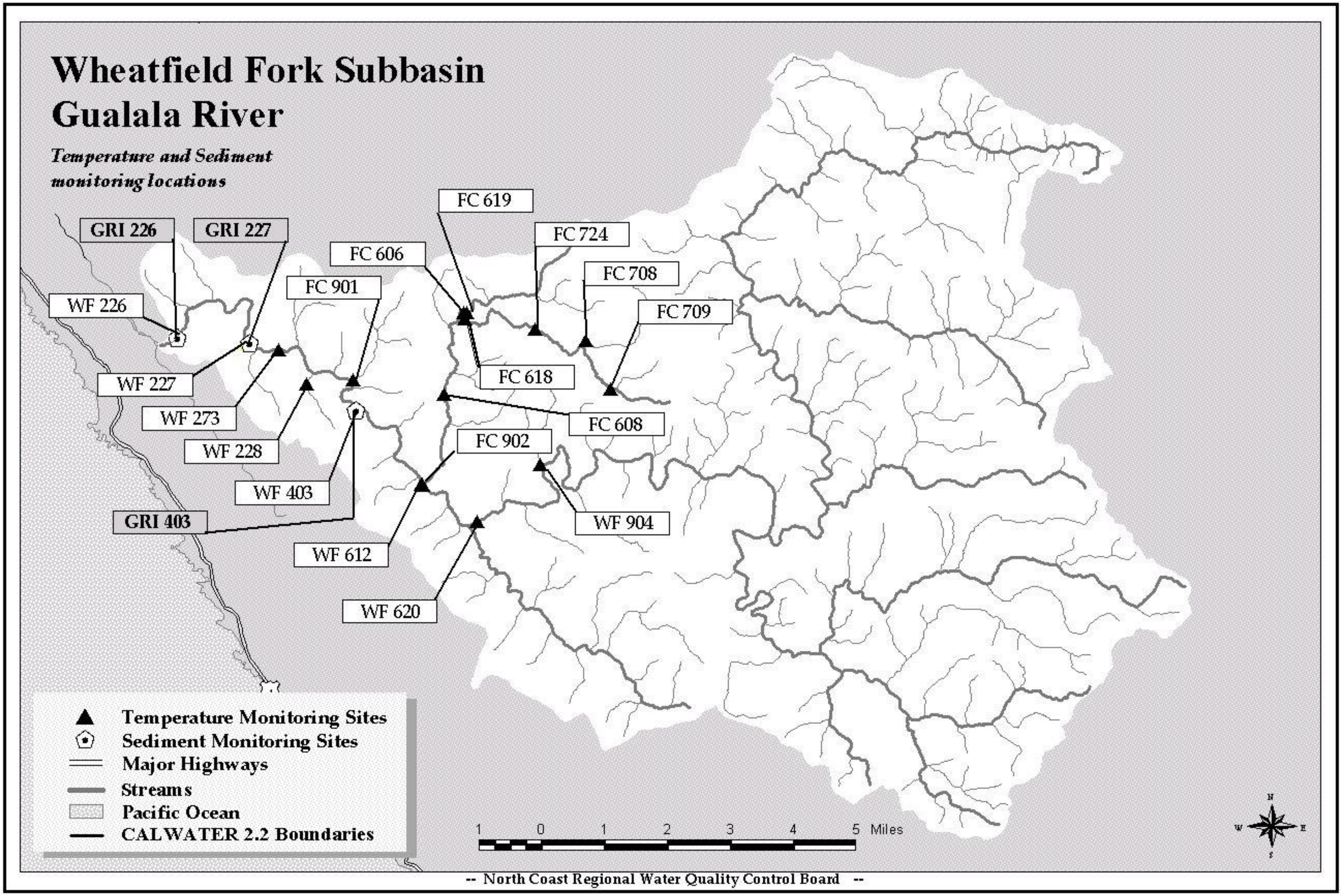
Water temperature sampling sites in the North Fork Gualala Subbasin.



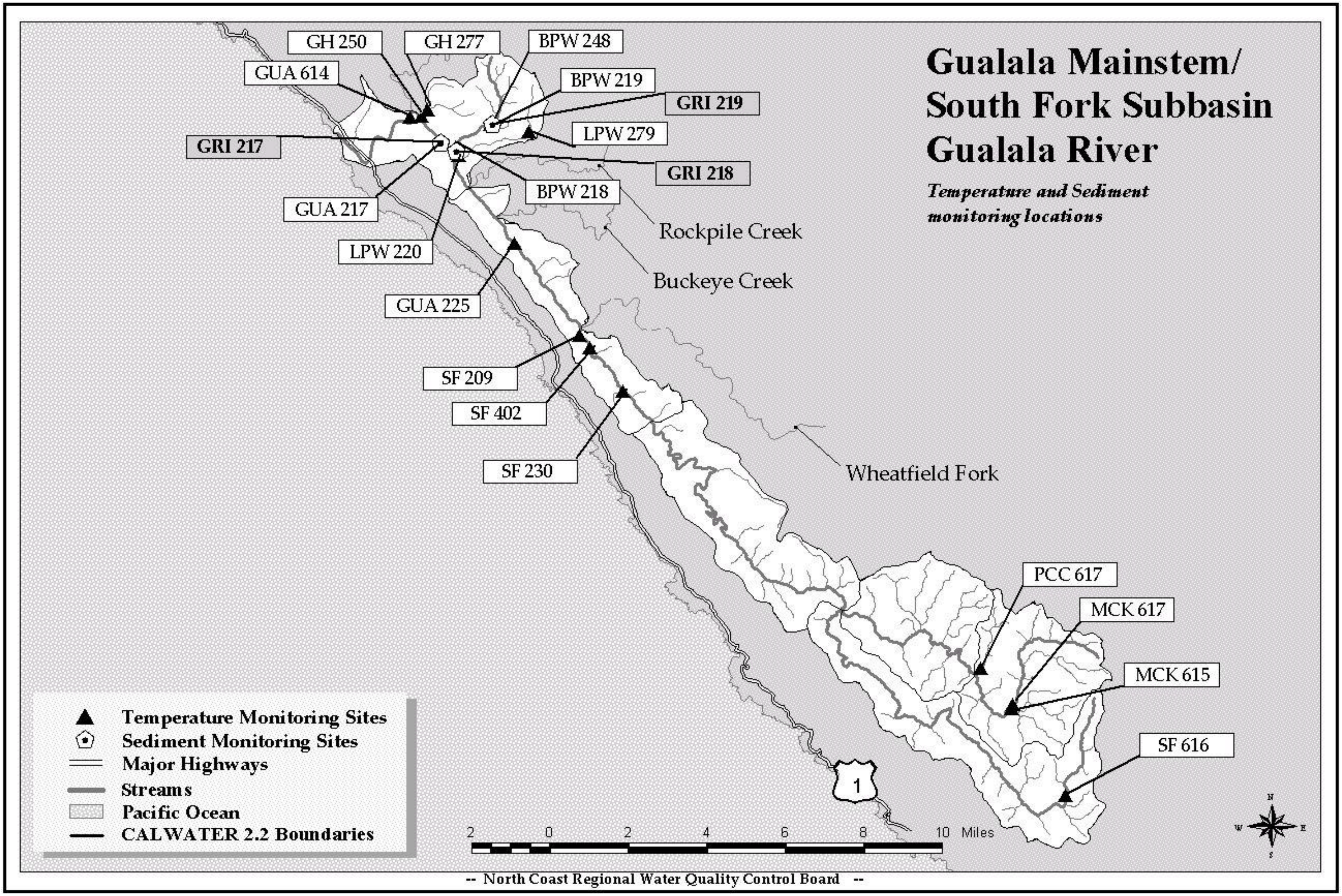
Water temperature and in-stream sediment sampling sites in the Rockpile Creek Subbasin.



Water temperature and in-stream sediment sampling sites in the Buckeye Creek Subbasin.



Water temperature and in-stream sediment sampling sites in the Wheatfield Fork Subbasin.



Water temperature and in-stream sediment sampling sites in the Main/South Fork Subbasin.

Water Temperature Data

North Fork Subbasin
Seasonal Maximum Temperature (F)
Data provided by GRI, GRWC, and Forest Science Project

Stream Name	Site ID	1994	1995	1996	1997	1998	1999	2000	2001
Little North Fork	lnf 201	60.4	62.1	60.6	62.1	61.3			61.8
Little North Fork	lnf 202	61.5							
Little North Fork	lnf 274		61.5	60.9					
Little North Fork	lnf 203	59.3	60.4	59.5	60.4	59.4	59.2	59.5	59.4
Little North Fork	lnf 255	60.7							
Lost Creek	lc 215		61.5	60.4		62.6			
Doty Creek	dot256	57.3							
Doty Creek	dot 281					58.6			
Robinson Creek	rob 260	58.4							
Robinson Creek	rob 206		68.7	62.3	61.5	61.8		64.4	
Robinson Creek	rob 207		67.3	67.3	68.4	65.2		62.9	
Robinson Creek	rob 263	63.8							
Robinson Creek	rob 208		61.8	61.5	62.1	61.2			
McGann Gulch	mcg 209		62.1	61.5	59.9				
McGann Gulch	mcg 210		68.7						
Dry Creek	dry 211		63.8	63.8	62.4			61.8	61.5
Dry Creek	dry 212		69.6	69.3	68.9	69.0			
Dry Creek	dry 269	61.2				63.5			
Dry Creek	dry 213		62.6	63.2	64.0				
North Fork Mainstem	nf 251			66.2	66.7			66.3	
North Fork Mainstem	nf 473								66.7
North Fork Mainstem	nf 204		69.0	68.1	66.9	68.4		67.9	65.5
North Fork Mainstem	nf 258	76.0							
North Fork Mainstem	nf 205		70.5	68.7	70.0				66.7
North Fork Mainstem	nf 406					70.5			
North Fork Mainstem	nf 474								72.3
North Fork Mainstem	nf 214		75.1	74.7	75.2	75.7			
North Fork Mainstem	nf 272	76.0							75.4
North Fork Mainstem	nf 216		78.6	79.4	80.4				

North Fork Subbasin
Maximum Weekly Average Temperature (F)
Data provided by GRI, GRWC, and Forest Science Project

Stream Name	Site ID	1994	1995	1996	1997	1998	1999	2000	2001
Little North Fork	lnf 201	58.5	59.2	58.3	59.8	59.0			58.7
Little North Fork	lnf 202	58.2							
Little North Fork	lnf 274		58.2	57.3					
Little North Fork	lnf 203	56.4	57.6	56.6	58.1	56.9	56.9	57.1	56.3
Little North Fork	lnf 255	57.7							
Lost Creek	lc 215		59.6	59.2		60.5			
Doty Creek	dot256	55.3							
Doty Creek	dot 281					56.6			
Robinson Creek	rob 260	56.8							
Robinson Creek	rob 206		57.5	57.5	56.9	58.0		57.2	
Robinson Creek	rob 207		60.5	60.3	61.1	59.7		58.5	
Robinson Creek	rob 263	60.0							
Robinson Creek	rob 208		58.7	59.0	58.8	58.7			
McGann Gulch	mcg 209		60.5	60.1	58.0				
McGann Gulch	mcg 210		61.6						
Dry Creek	dry 211		60.2	60.6	59.4			58.7	57.4
Dry Creek	dry 212		64.2	64.0	64.3	63.7			
Dry Creek	dry 269	60.2				60.8			
Dry Creek	dry 213		60.9	61.0	61.5				
North Fork Mainstem	nf 251			61.9	63.4			61.6	
North Fork Mainstem	nf 473								61.8
North Fork Mainstem	nf 204		63.5	65.6	64.8	63.9		62.6	62.0
North Fork Mainstem	nf 258	66.7							
North Fork Mainstem	nf 205		63.9	64.1	64.6				62.5
North Fork Mainstem	nf 406					65.5			
North Fork Mainstem	nf 474								65.1
North Fork Mainstem	nf 214		69.7	70.0	70.1	70.4			
North Fork Mainstem	nf 272	70.4							69.9
North Fork Mainstem	nf 216		70.7	71.2	71.5				

Rockpile Subbasin
Seasonal Maximum Temperature and Maximum Weekly Average Temperature (F)
Data provided by GRI, GRWC, and Forest Science Project

Site	Seasonal Maximum Temperature (F)							Maximum Weekly Average Temperature (F)						
ID	1994	1995	1996	1997	1998	2000	2001	1994	1995	1996	1997	1998	2000	2001
roc221		73.5	72.3	72.3	73.8	71.8	70.7		67.3	66.7	67.5	67.7	65.1	65.2
roc275				68.2	75.1						67.0	68.4		
roc276 (tributary)				59.4	58.9						57.4	57.1		
roc222	71.4	74.2	71.7	72.3				66.8	67.4	66.9	67.6			
roc401					74.7							69.5		
roc 723				86.0	80.0						73.0	72.0		
roc 728				81.0	81.0						71.0	73.0		
roc 741				81.0							72.0			
htc710				70.0	70.0						66.0	66.0		

Buckeye Subbasin
Seasonal Maximum Temperature (F)
Data provided by GRI, GRWC, and Forest Science Project

Stream Name	Site ID	1994	1995	1996	1997	1998	1999	2000	2001
Buckeye Creek	buc235	69.9							
Buckeye Creek	buc 223		73.3	70.6	72.3	72.9	70.1		69.9
Buckeye Creek	buc 224		75.1	71.7	72.9			69.6	
Buckeye Creek	buc 231	71.1	76.0	74.7	74.7	75.1			75.7
Buckeye Creek	buc 601							78.7	78.0
Buckeye Creek	buc 285					74.0			
Buckeye Creek	buc 712				76.0	68.0			
Buckeye Creek	buc 716				72.0	70.0			
Buckeye Creek	buc 701				79.0	78.0			
Buckeye Creek	buc 702				77.0	81.0			
Buckeye Creek	buc 733				82.0	83.0			
Franchini Creek	frn715				71.0	67.0			
Soda Springs	sos726				70.0	72.0			
Lower Tributary	buc 286					59.2			
Flat Ridge Creek	buc 602				79.0	79.0		78.0	77.3

Buckeye Subbasin
Maximum Weekly Average Temperature (F)
Data provided by GRI, GRWC, and Forest Science Project

Stream Name	Site ID	1994	1995	1996	1997	1998	1999	2000	2001
Buckeye Creek	buc235	64.9							
Buckeye Creek	buc223		66.2	65.8	67.1	67.5	64.4		64.4
Buckeye Creek	buc224		67.8	66.8	67.6			64.5	
Buckeye Creek	buc231	67.5	69.6	69.4	70.1	69.7			68.9
Buckeye Creek	buc601							69.8	69.6
Buckeye Creek	buc285					68.0			
Buckeye Creek	buc712				69.0	67.0			
Buckeye Creek	buc716				64.0	64.0			
Buckeye Creek	buc701				71.0	71.0			
Buckeye Creek	buc702				71.0	71.0			
Buckeye Creek	buc733				70.0	71.0			
Franchini Creek	frn715				62.0	62.0			
Soda Springs	sos726				65.0	65.0			
Lower Tributary	buc286					57.7			
Flat Ridge Creek	buc602				70.0	70.0		69.7	68.8

Wheatfield Fork Subbasin
Seasonal Maximum Temperature (F)
Data provided by GRI, GRWC, and Forest Science Project

Stream Name	Site ID	1995	1996	1997	1998	1999	2000	2001
Wheatfield Fork	wf 226	77.9	74.8	73.6	76.4			73.8
Wheatfield Fork	wf 227		75.1	77.5	75.8		77.5	
Wheatfield Fork	wf 273	79.5						
Wheatfield Fork	wf 403				79.5			
Wheatfield Fork	wf 612							78.0
Wheatfield Fork	wf 620						82.0	78.8
Tributary	wf 228	58.1	57.2	58.6	57.3			
Annapolis Falls Creek	fc 901		65.0			60.2		
Fuller Creek	fc 902					75.2	73.8	
Fuller Creek	fc 608							69.7
Fuller Creek	fc 606							73.8
South Fork Fuller Creek	fc 618						72.5	72.5
North Fork Fuller Creek	fc 619						72.8	72.8
Crocker Creek	wf 904			64.0				
South Fork Fuller Creek	fc 708			72.0	72.0			
South Fork Fuller Creek	fc 709			67.0	71.0			
South Fork Fuller Creek	fc 724			78.0	77.0			

Wheatfield Fork Subbasin
Maximum Weekly Average Temperature (F)
Data provided by GRI, GRWC, and Forest Science Project

Stream Name	Site ID	1995	1996	1997	1998	1999	2000	2001
Wheatfield Fork	wf 226	69.7	68.6	71.3	71.0			67.9
Wheatfield Fork	wf 227		70.1	72.0	70.8		70.2	
Wheatfield Fork	wf 273	71.5						
Wheatfield Fork	wf 403				73.3			
Wheatfield Fork	wf 612							72.4
Wheatfield Fork	wf 620						73.6	73.6
Tributary	wf 228	57.1	56.1	57.5	56.4			
Annapolis Falls Creek	fc 901		60.0			58.0		
Fuller Creek	fc 902					65.9	66.4	
Fuller Creek	fc 608							64.0
Fuller Creek	fc 606							65.2
South Fork Fuller Creek	fc 618						66.4	65.6
North Fork Fuller Creek	fc 619						65.8	64.9
Crocker Creek	wf 904			61.0				
South Fork Fuller Creek	fc 708			66.0	66.0			
South Fork Fuller Creek	fc 709			63.0	64.0			
South Fork Fuller Creek	fc 724			69.0	68.0			

Wheatfield Fork Subbasin
Seasonal Maximum Temperature (F)
Data provided by GRI, GRWC, and Forest Science Project

Stream Name	Site ID	1994	1995	1996	1997	1998	1999	2000	2001
Gualala River	gua 614							73.1	
South Fork	gua 217	72.9	77.5	76.0	76.3			73.8	73.9
Gualala River	gua 225		76.6		71.8				
South Fork	sf 229		74.1	71.8	78.1				
South Fork	sf 402					71.8		72.3	
South Fork	sf 230		73.3	71.2	75.9	72.7			
South Fork	sf 616							66.9	67.7
Groshong Gulch	gh 250			57.3					
Groshong Gulch	gh 277					57.0		64.0	
Big Pepperwood	bpw 218	60.6	61.8	61.2	63.1	62.9	60.6	61.2	
Big Pepperwood	bpw 219		62.6	62.1	64.0	63.2			
Big Pepperwood	bpw 248	62.9							
Little Pepperwood	lpw 220	60.4	67.0	64.1	62.1	64.1			
Palmer Canyon Creek	pcc 621							74.5	
McKenzie Creek	mck 615							60.8	69.0
McKenzie Creek	mck 617							69.3	68.3
Little Pepperwood	lpw 279					61.0			

Wheatfield Fork Subbasin
Maximum Weekly Average Temperature (F)
Data provided by GRI, GRWC, and Forest Science Project

Stream Name	Site ID	1994	1995	1996	1997	1998	1999	2000	2001
Gualala River	gua 614							65.1	
South Fork	gua 217	66.6	69.1	68.1	72.3			66.6	66.5
Gualala River	gua 225		69.5		69.2				
South Fork	sf 229		67.8	66.2	68.9				
South Fork	sf 402					67.5		66.0	
South Fork	sf 230		66.0	65.1	72.2	67.0			
South Fork	sf 616							62.1	61.5
Groshong Gulch	gh 250			55.6					
Groshong Gulch	gh 277					56.2		58.2	
Big Pepperwood	bpw 218	57.9	59.1	57.7	60.0	59.4	58.0	58.1	
Big Pepperwood	bpw 219		58.7	58.4	58.9	58.8			
Big Pepperwood	bpw 248	58.4							
Little Pepperwood	lpw 220	57.7	60.7	59.0	60.8	60.0			
Palmer Canyon Creek	pcc 621							66.7	
McKenzie Creek	mck 615							59.2	63.4
McKenzie Creek	mck 617							64.9	63.5
Little Pepperwood	lpw 279					58.0			

In-stream Sediment Data

Median particle size data as the mean of 3 transects for the South Fork Gualala/Mainstem Gualala Subbasin. Source=Gualala Redwoods, 2001.

Site	Year	D50(mm)
sf402	1997	13
sf402	1999	20
gua217	1998	25
gua217	2000	20
gua225	1998	25
bpw218	1997	31
bpw218	1998	40
bpw218	1999	31
bpw219	1997	39

Summary data for median particle size measurements, Main/South Fork Subbasin.

Stream Name	Years	No. of Sites	No. of Samples *	Minimum (mm)	Mean (mm)	Maximum (mm)
Upper South Fork	97-99	1	2	13	16	20
Lower South Fork	98, 00	2	3	20	23	25
Big Pepperwood	97, 98, 99	2	4	31	35	40
* no. of samples = number of averages						

Median particle size data (mm) for the Wheatfield Fork Gualala Subbasin.

Gualala Redwoods, 2001				Coastal Forest Lands, 1997	
Site	1997	2000		Site	1995-96
wf226	45	30		SFU-1	31
wf227	34			SFU-2	20
wf403	24			SFU-3	38

Median particle size data (mm) for the North Fork Gualala Subbasin.

Gualala Redwoods, 2001							Coastal Forest Lands, 1997	
Site	1997	1998	1999	2000	2001		Site	1995-96
dry211	31	45	62	60	64		NGU-1	11
dry212	89						NGU-2	36
dry405	65						NGU-3	25
lnf404	26				37			
lnf202	18							
lnf203	35	34	46	43	42			
nf204	14		20					
nf216	41							
nf406	18							
nf473					28			
rob207	38		36					
rob208	29							

In-stream Sediment Data (cont'd.)

McNeil core data for percent fines <0.85 mm as the mean of 8 samples for the North Fork Gualala Subbasin.

Gualala Redwoods, 2001						
Site	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
dot256		16	11	17	17	17
dry211			17	16	15	12
lnf255		19		12	24	28
lnf201	11	21	20	21	15	16
lnf202		12	13	18	18	22
lnf203		17	20	11	20	19
mcg209				19	27	20
rob207				15	18	18

Median particle size data (mm) for the Buckeye Creek Subbasin.

Gualala Redwoods, 2001					Coastal Forest Lands, 1997	
Site	**1997**	**1998**	**2000**		**Site**	**1995-96**
buc223	25		37		BUC-1	38
buc224	26				BUC-2	22
buc231	24	24			BUC-3	16

Median particle size data (mm) for the Rockpile Creek Subbasin.

Gualala Redwoods, 2001					Coastal Forest Lands, 1997	
Site	**1997**	**1998**	**1999**		**Site**	**1995-96**
roc221	27	25	32		ROC-1	24
roc275	26				ROC-2	18
roc401	28				ROC-3	9

Surface Water Ambient Monitoring Data (SWAMP) from year 2001 sampling by the N. Coast Regional Water Quality Control Board.

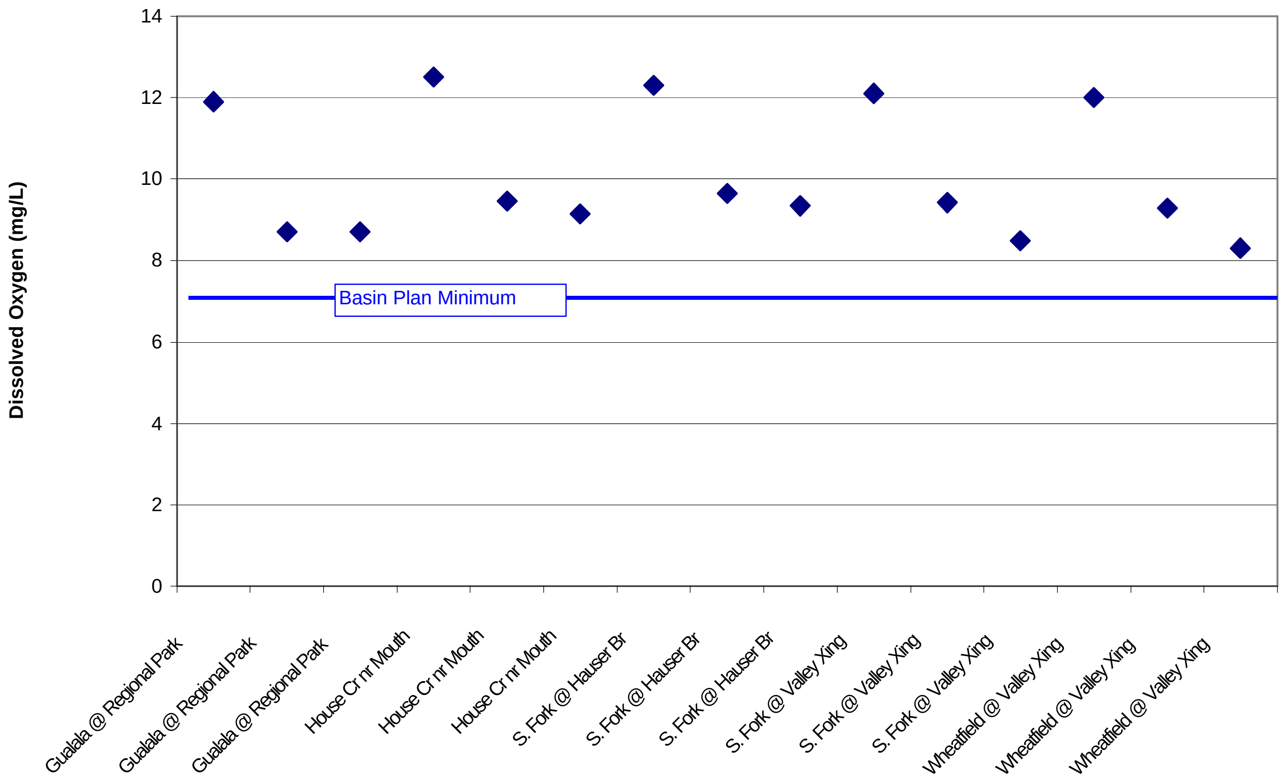
Sample Location	Date	Time	Diss. Oxygen mg/L	pH	Specific Cond. umho/ cm	Water Temp (C)	Air Temp (C)	Turb (FTU)	Total Alk mg/L	Ammonia-N mg/L	Nitrate-N mg/L	Kjeldahl-N mg/L
Gualala @ Regional Park	2/13/01	1515	11.9	7.22	156	7.7	15	20				
Gualala @ Regional Park	5/8/01	1320	8.7	6.78	235	18.6	18		86	<0.050	<0.050	<0.50
Gualala @ Regional Park	6/27/01	1455	8.7	7.72	193	16.1	14.5	0.87	78	<0.050	<0.050	<0.50
House Cr nr Mouth	2/13/01	1142	12.5	7.93	170	6.6	14	11				
House Cr nr Mouth	5/8/01	1135	9.45	7.75	321	21.1	27		152	<0.050	<0.050	<0.50
House Cr nr Mouth	6/27/01	1250	9.15	8.56	256	18	16	0.6	130	<0.050	<0.050	<0.50
S. Fork @ Hauser Br	2/13/01	1005	12.3	7.54	122	5.7	7.5	14				
S. Fork @ Hauser Br	5/8/01	1030	9.65	7.03	212	15.7	24.5		98	<0.050	<0.050	<0.50
S. Fork @ Hauser Br	6/27/01	1200	9.34	8.18	202	16.7	15.5	1.7	82	<0.050	<0.050	<0.50
S. Fork @ Valley Xing	2/13/01	1415	12.1	7.26	135	6.9	18.5	15				
S. Fork @ Valley Xing	5/8/01	1255	9.42	6.87	235	18.8	19.5		88	<0.050	<0.050	<0.50
S. Fork @ Valley Xing	6/27/01	1415	8.48	7.88	259	16.9	14.5	0.68	100	0.24	<0.050	<0.50
Wheatfield @ Valley Xing	2/13/01	1355	12	7.32	147	7.9	19	17				
Wheatfield @ Valley Xing	5/8/01	1235	9.28	6.9	252	18.5	22		112	<0.050	<0.050	<0.50
Wheatfield @ Valley Xing	6/27/01	1345	8.3	7.84	244	17.5	15	0.18	100	<0.050	<0.050	<0.50

Surface Water Ambient Monitoring Data (SWAMP) from year 2001 sampling (cont'd).

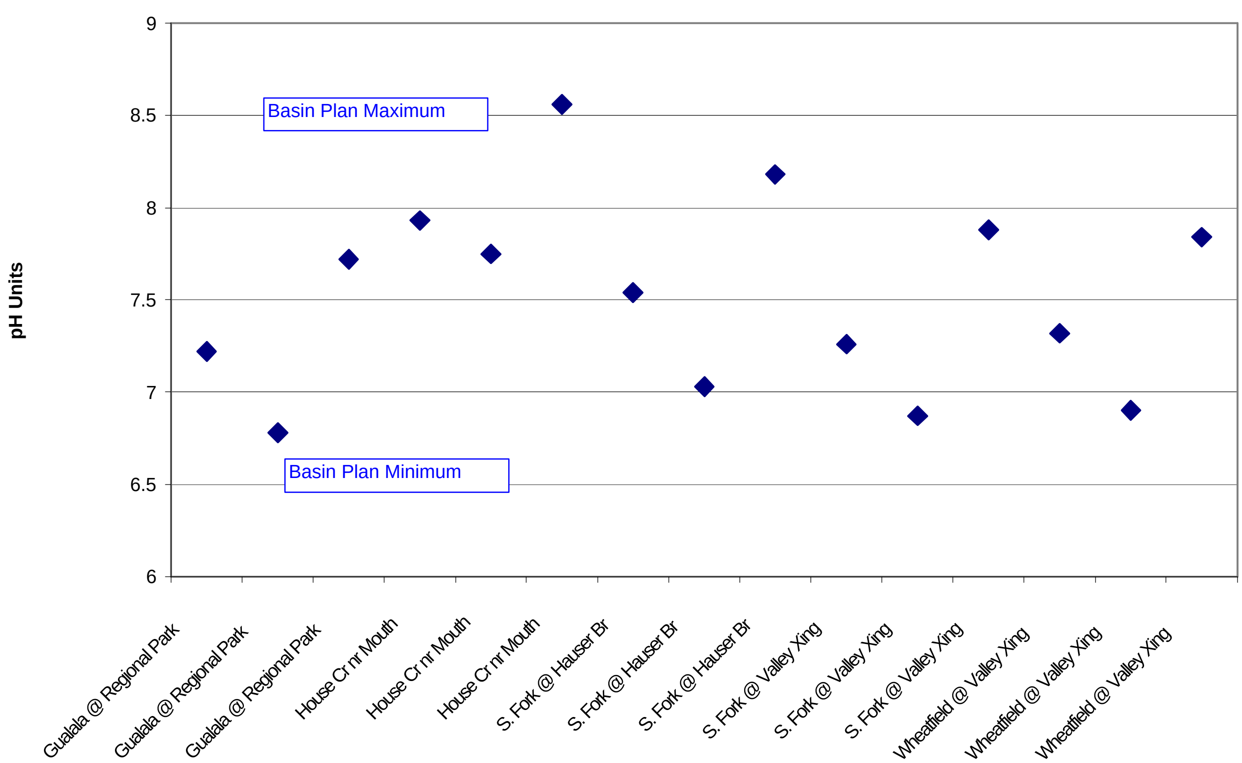
Sample Location	Date	Time	Ortho-phosphate-P mg/L	Chl-a mg/L	Hardness mg/L	Heavy Metals *	Minerals
Gualala @ Regional Park	2/13/01	1515					
Gualala @ Regional Park	5/8/01	1320	<0.050		92.9	ND	minerals are on file
Gualala @ Regional Park	6/27/01	1455	<0.050	<0.00050	68	ND	
House Cr nr Mouth	2/13/01	1142					
House Cr nr Mouth	5/8/01	1135	<0.050		158	ND	
House Cr nr Mouth	6/27/01	1250	<0.050	0.0014	130	ND	
S. Fork @ Hauser Br	2/13/01	1005					
S. Fork @ Hauser Br	5/8/01	1030	<0.050		83.7	ND	
S. Fork @ Hauser Br	6/27/01	1200	<0.050	<0.00050	84	ND	
S. Fork @ Valley Xing	2/13/01	1415					
S. Fork @ Valley Xing	5/8/01	1255	<0.050		99.8	ND	
S. Fork @ Valley Xing	6/27/01	1415	<0.050	<0.00050	110	ND	
Wheatfield @ Valley Xing	2/13/01	1355					
Wheatfield @ Valley Xing	5/8/01	1235	<0.050		101	ND	
Wheatfield @ Valley Xing	6/27/01	1345	<0.050	0.0013	99	ND	

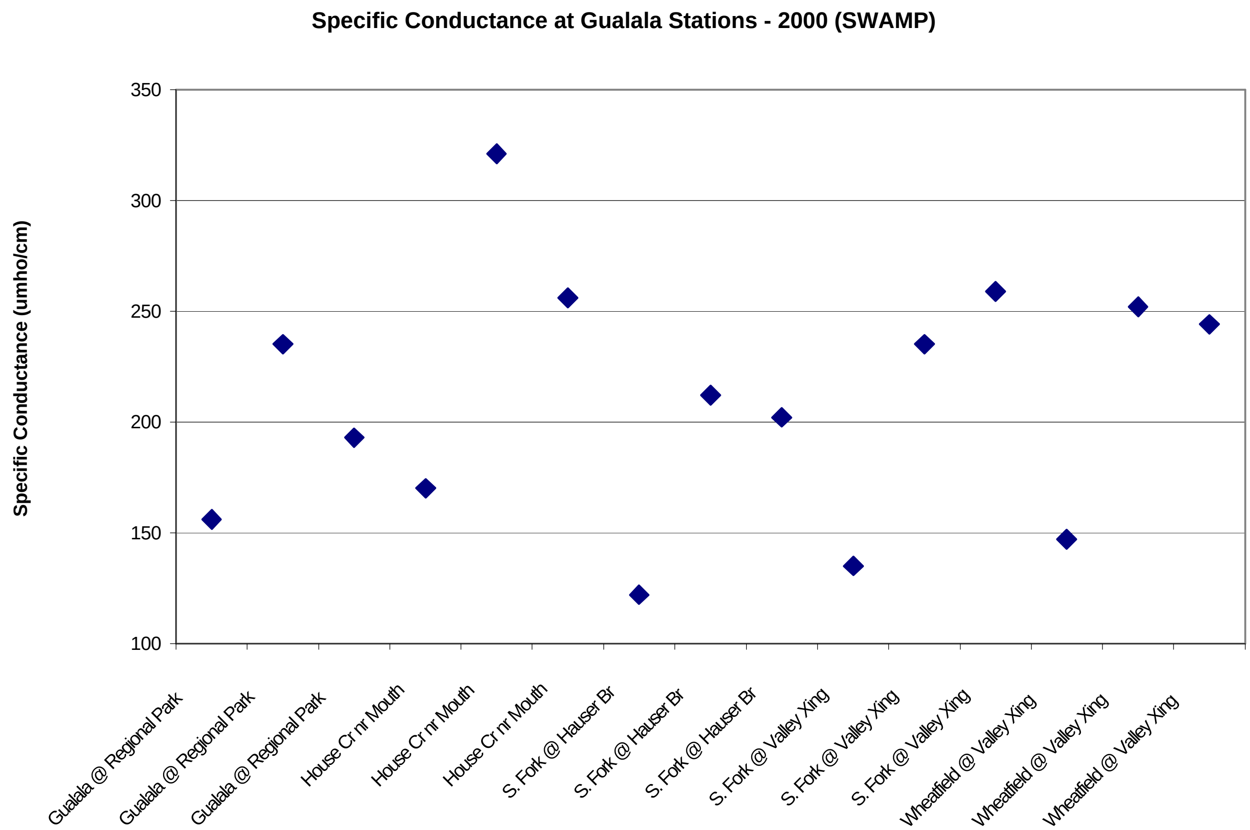
* Metals = cadmium, chromium, copper, lead, nickel, zinc, mercury at reporting levels of 10, 10, 10, 75, 30, 20, 0.200 ug/L, respectively

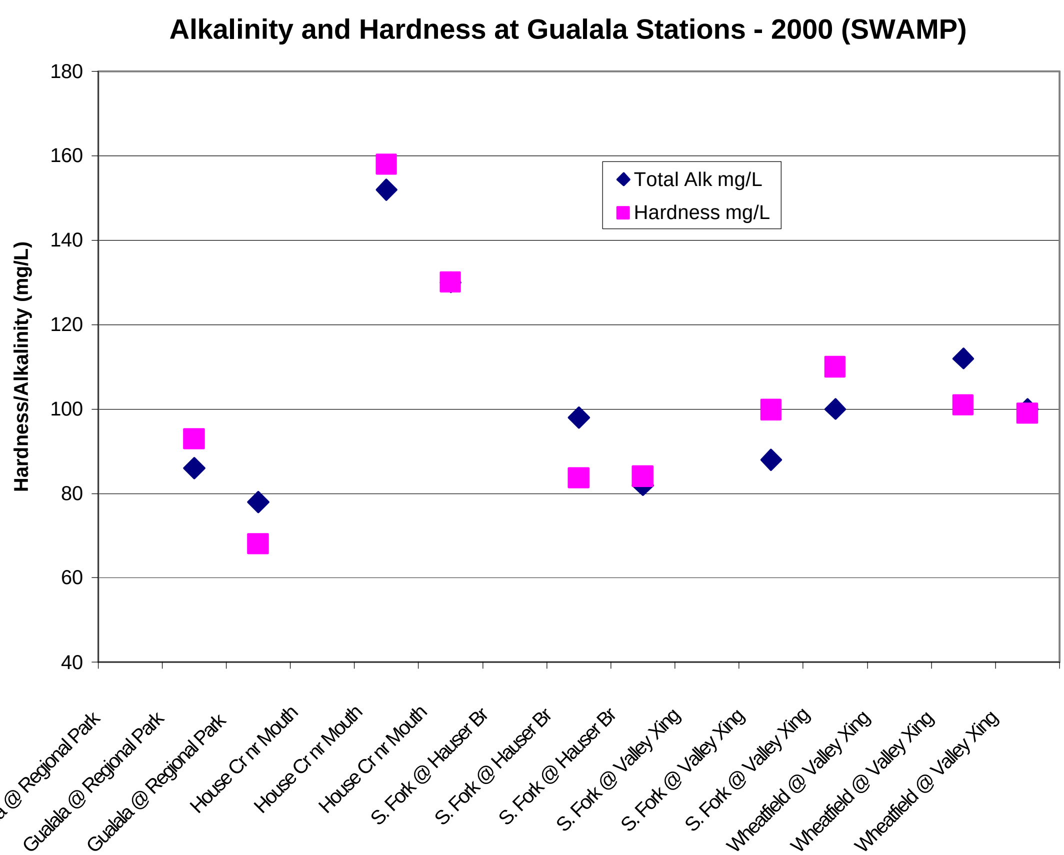
Dissolved Oxygen at Gualala Stations - 2001 (SWAMP)



pH at Gualala Stations - 2001 (SWAMP)




Specific Conductance at Gualala Stations - 2000 (SWAMP)
Specific Conductance (umho/cm)
350
300
250
200
150
100
Gualala @ Regional Park
Gualala @ Regional Park
Gualala @ Regional Park
House Cr nr Mouth
House Cr nr Mouth
House Cr nr Mouth
S. Fork @ Hauser Br
S. Fork @ Hauser Br
S. Fork @ Hauser Br
S. Fork @ Valley Xing
S. Fork @ Valley Xing
S. Fork @ Valley Xing
Wheatfield @ Valley Xing
Wheatfield @ Valley Xing
Wheatfield @ Valley Xing


Alkalinity and Hardness at Gualala Stations - 2000 (SWAMP)
Hardness/Alkalinity (mg/L)
180
160
140
120
100
80
60
40
Total Alk mg/L
Hardness mg/L
Gualala @ Regional Park
Gualala @ Regional Park
Gualala @ Regional Park
House Cr nr Mouth
House Cr nr Mouth
House Cr nr Mouth
S. Fork @ Hauser Br
S. Fork @ Hauser Br
S. Fork @ Hauser Br
S. Fork @ Valley Xing
S. Fork @ Valley Xing
S. Fork @ Valley Xing
Wheatfield @ Valley Xing
Wheatfield @ Valley Xing
Wheatfield @ Valley Xing

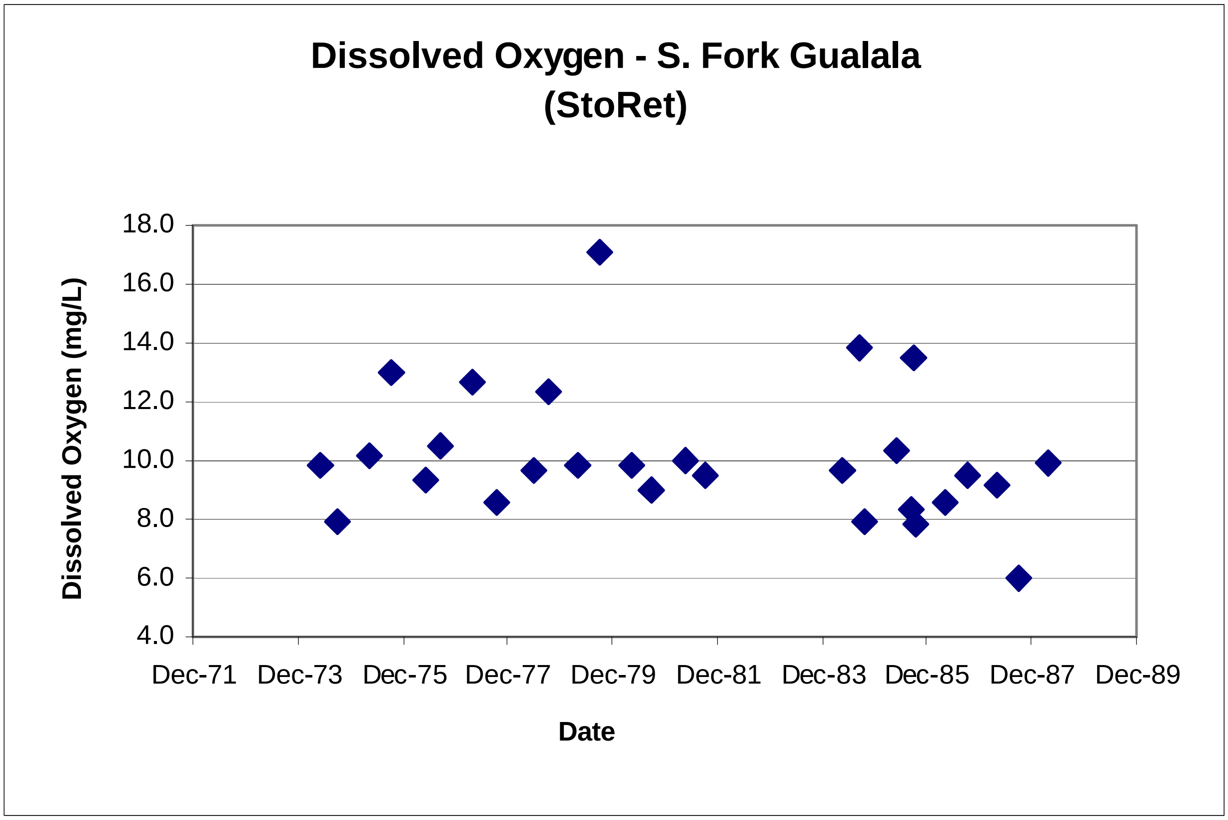
StoRet Data for the South Fork Gualala River near Valley Crossing

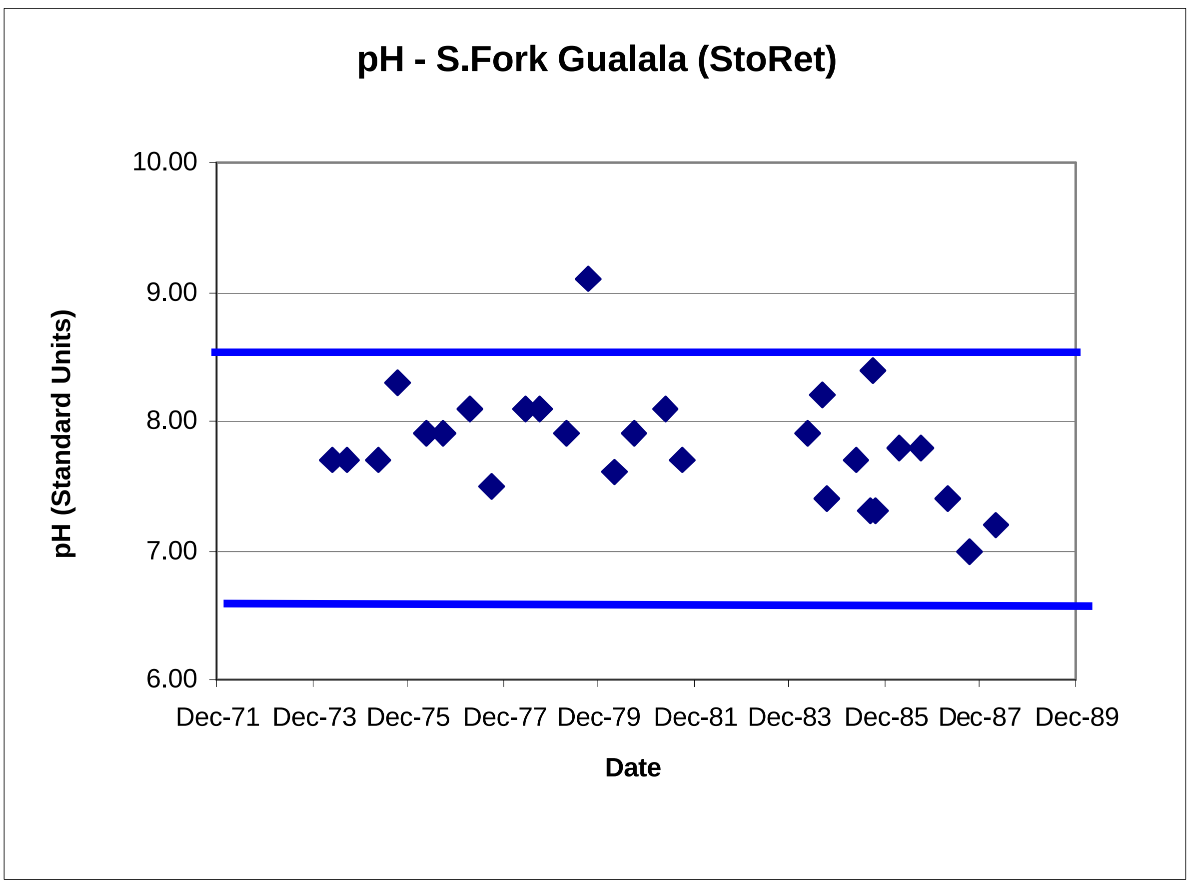
GUALALA R S F NR ANNAPOLIS, CA WATER RES CNTRL BD, F8110000,38.702778 LAT, 123.416667 LONG, HUC 18010109

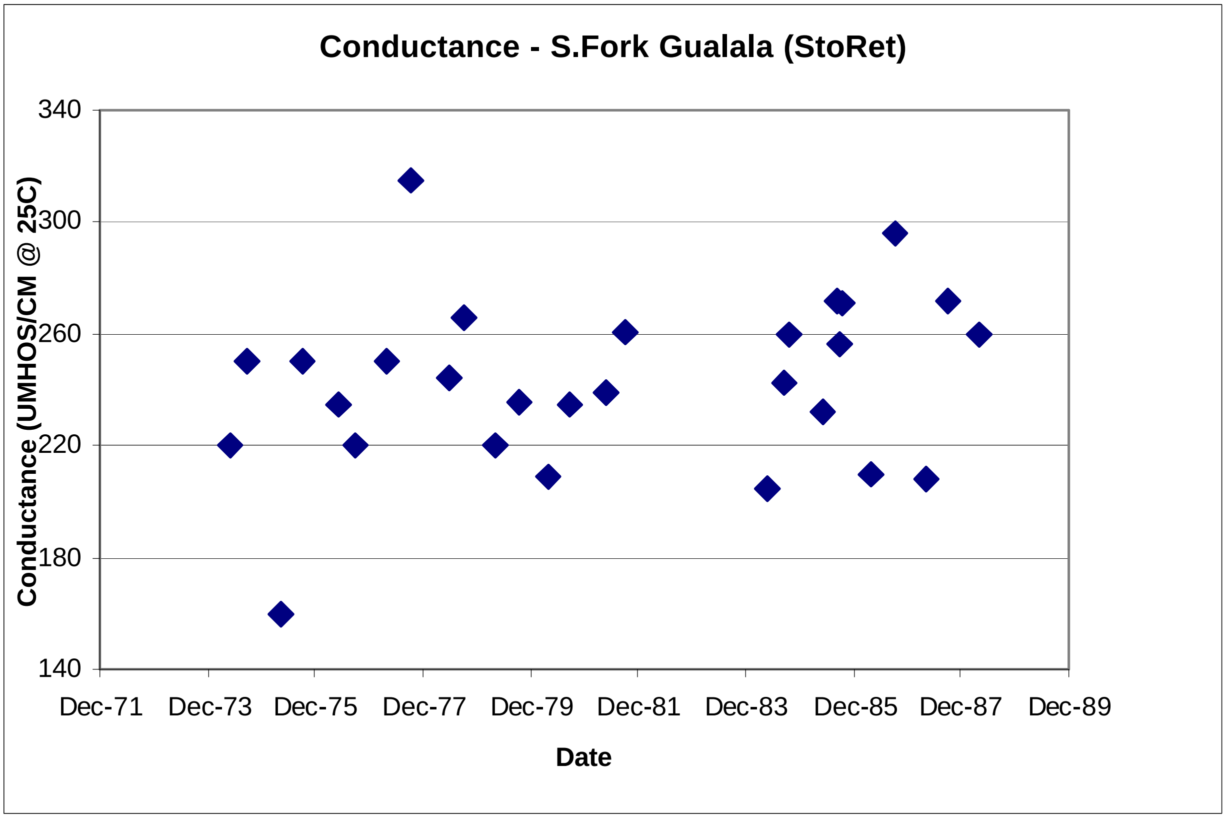
START DATE	START TIME	WATER TEMP (C)	WATER TEMP (F)	FIELD SPECIFIC CONDUCTANCE (UMHOS/CM @ 25C)	TURBIDITY, HACH TURBIDIMETER (FORMAZIN TURB UNIT)	DISS OXYGEN (MG/L)	DISS OXYGEN (% SAT)	PH (STANDARD UNITS)
21-May-74	1550	18.3	65	220	1	9.8	103.34	7.7
11-Sep-74	1330	20.6	69	250	1	7.9	87.94	7.7
24-Apr-75	1530	11.7	53	160	90	10.2	94.61	7.7
18-Sep-75	1600	20.0	68	250	0	13.0	141.56	8.3
14-May-76	1000	17.8	64	235	0	9.3	98.07	7.9
3-Sep-76	1030	19.4	67	220	0	10.5	111.90	7.9
12-Apr-77	1230	17.8	64	250	0	12.7	133.93	8.1
21-Sep-77	1430	20.6	69	315	0	8.6	95.73	7.5
9-Jun-78	1545	22.8	73	244	0	9.7	111.70	8.1
21-Sep-78	1415	20.6	69	266		12.3	136.91	8.1
18-Apr-79	1545	15.6	60	220		9.8	98.18	7.9
19-Sep-79	1400	24.4	76	236	0	17.1	201.54	9.1
16-Apr-80	1415	17.2	63	209		9.8	101.21	7.6
4-Sep-80	1115	18.3	65	235		9.0	94.91	7.9
6-May-81	1350	18.3	65	239		10.0	105.45	8.1
16-Sep-81	1445	22.2	72	261		9.5	108.15	7.7
3-May-84	1215	15.6	60	205		9.7	97.17	7.9
23-Aug-84	1740	22.2	72	243		13.8	157.10	8.2
25-Sep-84	1210	17.2	63	260		7.9	81.59	7.4
8-May-85	1345	17.8	64	232		10.3	108.62	7.7
27-Aug-85	1045	19.0		272	1	8.3	88.46	7.3
12-Sep-85	1345	20.6	69	256	2	13.5	150.27	8.4
26-Sep-85	1045	17.2		271	1	7.8	80.56	7.3
10-Apr-86	1030	14.7		210	1	8.6	84.47	7.8
11-Sep-86	840	17.5		296	1	9.5	98.11	7.8
14-Apr-87	1300	15.5		208		9.2	90.36	7.4
10-Sep-87	845	17.9		272		6.0	63.27	7.0
6-Apr-88	1500	15.8		260		9.9	99.18	7.2

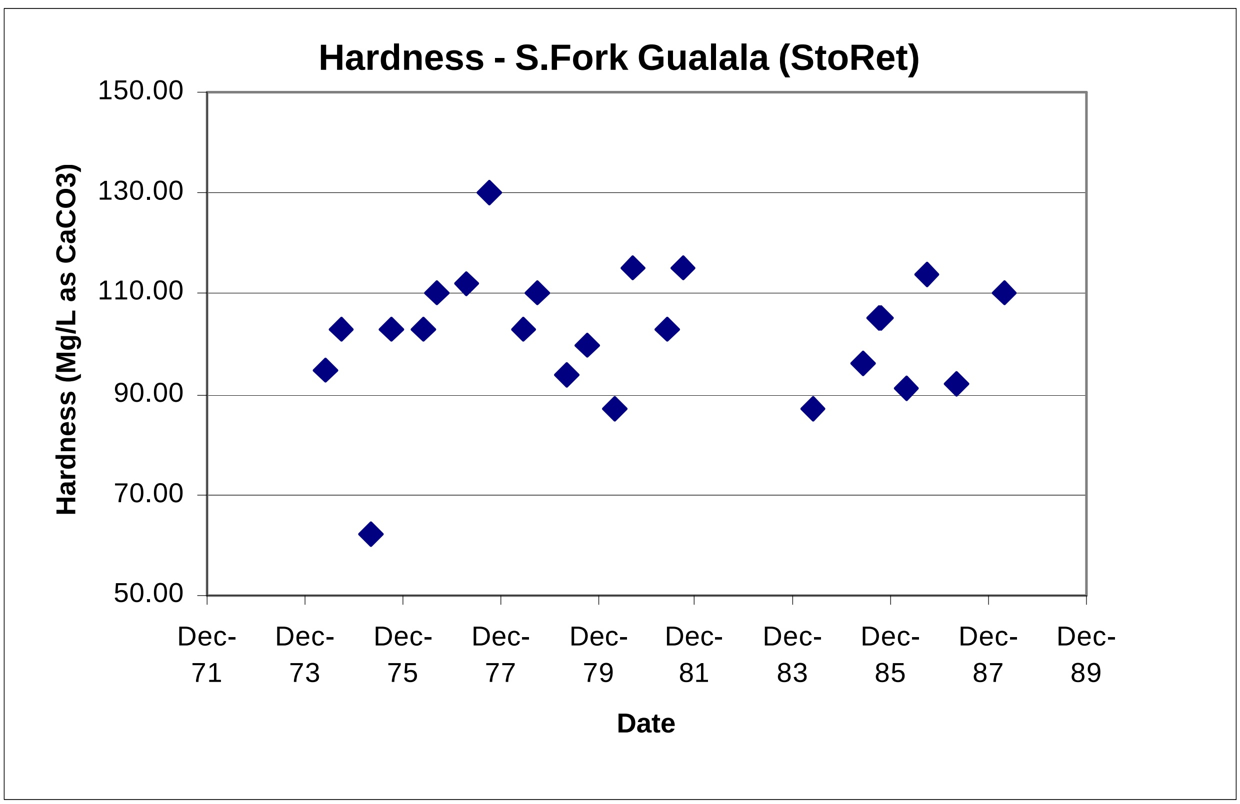
StoRet Data for the South Fork Gualala River near Valley Crossing (cont'd.)

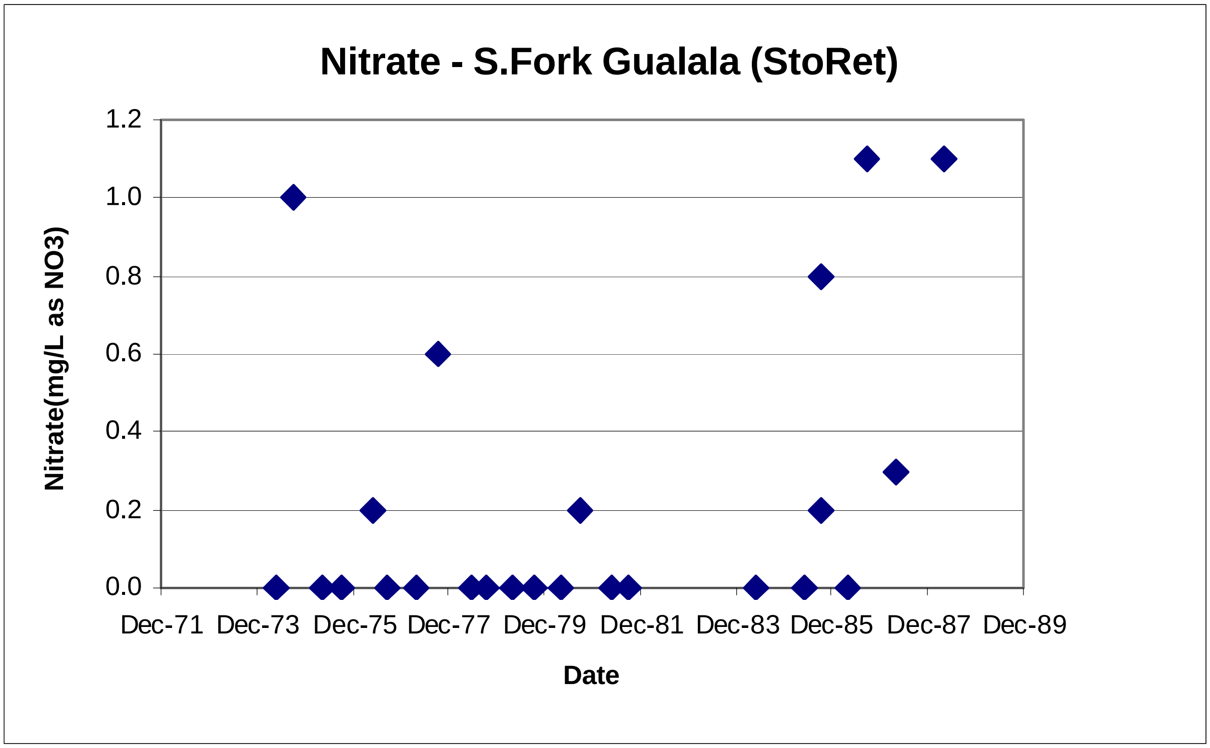
START DATE	START TIME	TOTAL ALKALINITY (MG/L AS CACO3)	ALKALINITY, FILTERED SAMPLE (AS CACO3 MG/L)	TOTAL HARDNESS (MG/L AS CACO3)	DISS NITRATE NITROGEN (MG/L AS NO3)	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (MG/L AS P)	METALS
21-May-74	1550	94		95	0.0		All Nondetect
11-Sep-74	1330	108		103	1.0		
24-Apr-75	1530	61		62	0.0		
18-Sep-75	1600	109		103	0.0		
14-May-76	1000	105		103	0.2		
3-Sep-76	1030	114		110	0.0		
12-Apr-77	1230	109		112	0.0		
21-Sep-77	1430	129		130	0.6		
9-Jun-78	1545	100		103	0.0		
21-Sep-78	1415	113		110	0.0		
18-Apr-79	1545			94	0.0		
19-Sep-79	1400			100	0.0		
16-Apr-80	1415			87	0.0		
4-Sep-80	1115		112	115	0.2		
6-May-81	1350		103	103	0.0		
16-Sep-81	1445		114	115	0.0		
3-May-84	1215		86	87	0.0		
23-Aug-84	1740					0.04	
8-May-85	1345		100	96	0.0		
27-Aug-85	1045					0.01	
12-Sep-85	1345		111	105	0.2		
26-Sep-85	1045		109	105	0.8		
10-Apr-86	1030		92	91	0.0	0.02	
11-Sep-86	840		117	114	1.1	0.01	
14-Apr-87	1300		89	92	0.3	0.01	
10-Sep-87	845						
6-Apr-88	1500		101	110	1.1		All Nondetect

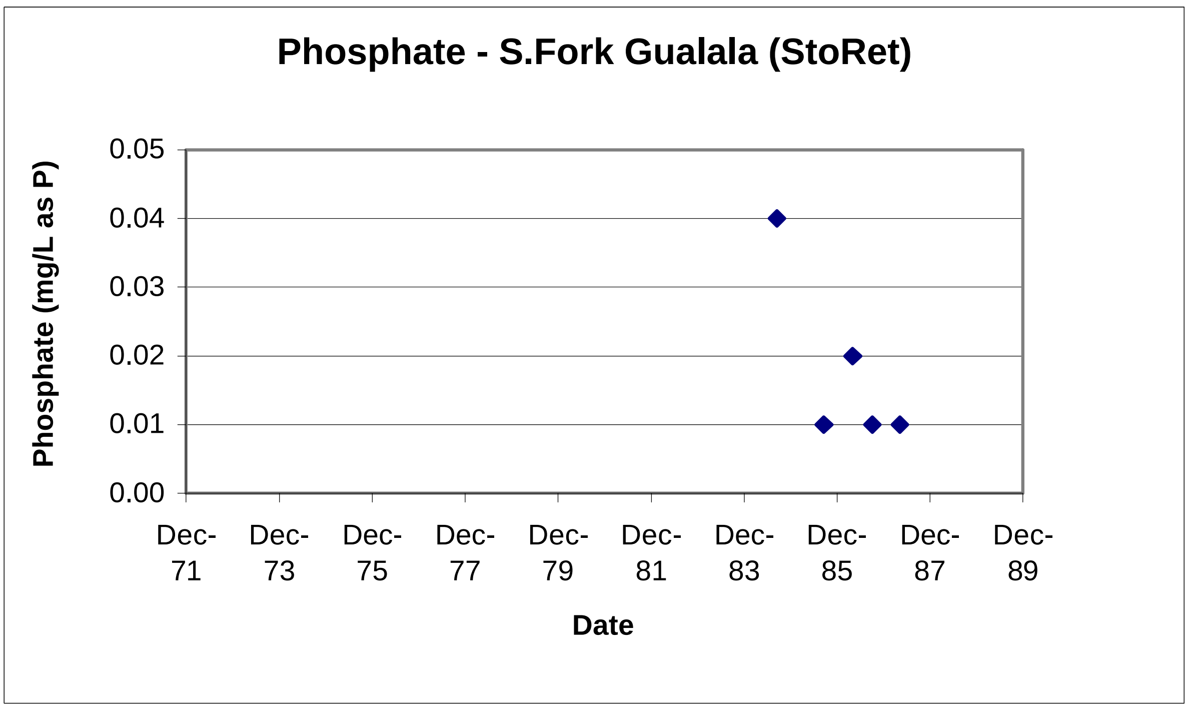

Dissolved Oxygen - S. Fork Gualala
(StoRet)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
Dissolved Oxygen (mg/L)
Dec-71
Dec-73
Dec-75
Dec-77
Dec-79
Dec-81
Dec-83
Dec-85
Dec-87
Dec-89
Date


pH - S.Fork Gualala (StoRet)
10.00
9.00
8.00
7.00
6.00
pH (Standard Units)
Dec-71
Dec-73
Dec-75
Dec-77
Dec-79
Dec-81
Dec-83
Dec-85
Dec-87
Dec-89
Date


Conductance - S.Fork Gualala (StoRet)
Conductance (UMHOS/CM @ 25C)
340
300
260
220
180
140
Dec-71
Dec-73
Dec-75
Dec-77
Dec-79
Dec-81
Dec-83
Dec-85
Dec-87
Dec-89
Date


Hardness - S.Fork Gualala (StoRet)
Hardness (Mg/L as CaCO3)
150.00
130.00
110.00
90.00
70.00
50.00
Dec-71
Dec-73
Dec-75
Dec-77
Dec-79
Dec-81
Dec-83
Dec-85
Dec-87
Dec-89
Date


Nitrate - S.Fork Gualala (StoRet)
Nitrate(mg/L as NO3)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Dec-71 Dec-73 Dec-75 Dec-77 Dec-79 Dec-81 Dec-83 Dec-85 Dec-87 Dec-89
Date


Phosphate - S.Fork Gualala (StoRet)
Phosphate (mg/L as P)
0.05
0.04
0.03
0.02
0.01
0.00
Dec-71 Dec-73 Dec-75 Dec-77 Dec-79 Dec-81 Dec-83 Dec-85 Dec-87 Dec-89
Date

StoRet Data for the Wheatfield Fork Gualala River near Valley Crossing

WHEATFIELD FK GUALALA R @ BERK YMCA CAMP CA WATER RES CNTRL BD WB01B138401000138.669444 LAT 123.298611 LONG
HUC 18010109

START DATE	START TIME	WATER TEMP (C)	TURBIDITY ,LAB (NTU)	SPECIFIC CONDUCTANCE (UMHOS/CM @ 25C)	PH, LAB (STANDARD UNITS)	TOTAL ALKALINITY (MG/L AS CACO3)	TOTAL NITRATE NITROGEN (MG/L AS N)	TOTAL NITRITE NITROGEN (MG/L AS N)
6-Jan-88	1300	10	36.0	140	8.00	80	0.04	<0.03
3-Jun-88	1400	22	1.6	320	8.30	140	0.05	<0.03

START DATE	START TIME	TOTAL HARDNESS (MG/L AS CACO3)	PHOSPHORUS, TOTAL ORTHOPHOSPHATE (MG/L AS P)	DISS OXYGEN (MG/L)	DISS OXYGEN (% SAT)	AMMONIA, UNIONZED (MG/L AS N)	METALS
6-Jan-88	1300	62.00	0.02	12.60	112	0.00	All Nondetect
3-Jun-88	1400	120.00	0.05	8.70	99	0.00	All Nondetect

StoRet Data for the Mainstem Gualala River near Gualala

GUALALA R NR GUALALA CA WATER RES CNTRL BD F810070038.775556 LAT 123.498611 LONG HUC 18010109

START DATE	START TIME	AIR TEMP (C)	WATER TEMP (F)	DISS NITRATE NITROGEN (MG/L AS N)	FIELD SPECIFIC CONDUCTANCE (UMHOS/CM @ 25C)	TURBIDITY,HACH TURBIDIMETER (FORMAZIN TURB UNIT)
13-Feb-75	2500			0.50	87	500
14-Sep-76	1040	18.3	65	0.03	220	
14-Sep-76	1815	18.3			216	1
14-Sep-76	2130	17.0			218	1
15-Sep-76	500	15.0			218	1
15-Sep-76	820	15.0			218	
15-Sep-76	1100	17.8			218	
30-Nov-76	1430	11.1			230	3
1-Dec-76	930	7.8	46	0.00	230	0
1-Dec-76	1705	11.0			220	1
1-Dec-76	2045	9.5			244	2
2-Dec-76	545	8.0			232	1
2-Dec-76	900	9.0				1
2-Dec-76	1200	9.5				1
8-Mar-77	1600	15.6			240	
9-Mar-77	1530	13.0		0.04	225	0
9-Mar-77	1800	12.8			233	1
9-Mar-77	2100	11.7			235	1
10-Mar-77	530	8.9			232	1
10-Mar-77	1000	10.0			240	1
17-Mar-77	1130	11.8			210	5
24-May-77	1315	20.0			250	
25-May-77	830	14.4			245	
25-May-77	1740	17.2	63	0.26	245	0
25-May-77	1900	15.0			215	
26-May-77	945	15.6			235	
27-May-77	700	13.3			240	
13-Oct-77	1620	16.7	62	0.00	240	
14-Oct-77	520	12.8			240	
14-Oct-77	830	12.8			240	
4-Apr-85	1235	16.7	62		176	3

StoRet Data for the Mainstem Gualala River near Gualala (cont'd.)

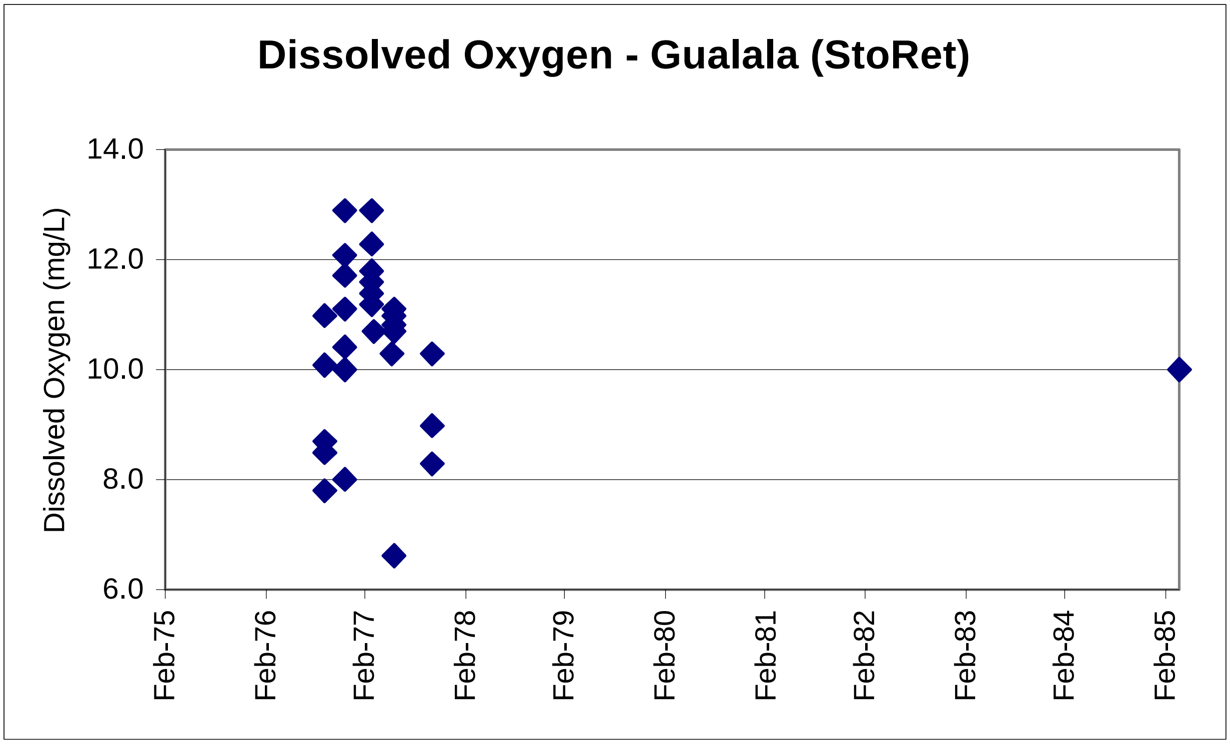
START DATE	START TIME	DISS OXYGEN (MG/L)	DISS OXYGEN (% SAT)	PH (STANDARD UNITS)	PH, LAB (STANDARD UNITS)	SPECIFIC CONDUCTANCE (UMHOS/CM @ 25C)
13-Feb-75	2500				7.4	
14-Sep-76	1040	11.0	116.04		8.2	210
14-Sep-76	1815	8.5	89.67		7.3	214
14-Sep-76	2130	8.5	87.82		7.5	218
15-Sep-76	500	7.8	76.64		7.4	218
15-Sep-76	820	8.7	85.48		7.4	
15-Sep-76	1100	10.1	106.55		7.3	
30-Nov-76	1430	12.9	116.47		7.6	232
1-Dec-76	930	11.7	98.53		8.0	227
1-Dec-76	1705	8.0	72.23		7.4	244
1-Dec-76	2045	10.0	86.39		7.5	
2-Dec-76	545	10.4	87.58		7.6	
2-Dec-76	900	11.1	95.90		7.5	232
2-Dec-76	1200	12.1	104.54		7.5	230
8-Mar-77	1600	11.8	118.26		8.1	
9-Mar-77	1530	12.9	121.96		8.1	226
9-Mar-77	1800	11.4	107.78		7.8	233
9-Mar-77	2100	11.6	107.64		8.0	
10-Mar-77	530	11.2	96.76		7.7	224
10-Mar-77	1000	12.3	109.09		7.7	234
17-Mar-77	1130	10.7	99.29	7.5	7.7	215
24-May-77	1315	10.3	112.20	7.4		
25-May-77	830	10.8	104.07	7.4		
25-May-77	1740	11.1	114.68	7.6	8.1	235
25-May-77	1900	6.6	64.85	7.0		
26-May-77	945	11.0	110.24	7.6		
27-May-77	700	10.7	101.16			
13-Oct-77	1620	10.3	106.42	7.4	8.3	188
14-Oct-77	520	8.3	78.47	7.3		
14-Oct-77	830	9.0	85.09	7.3		
4-Apr-85	1235	10.0	103.32	7.4		

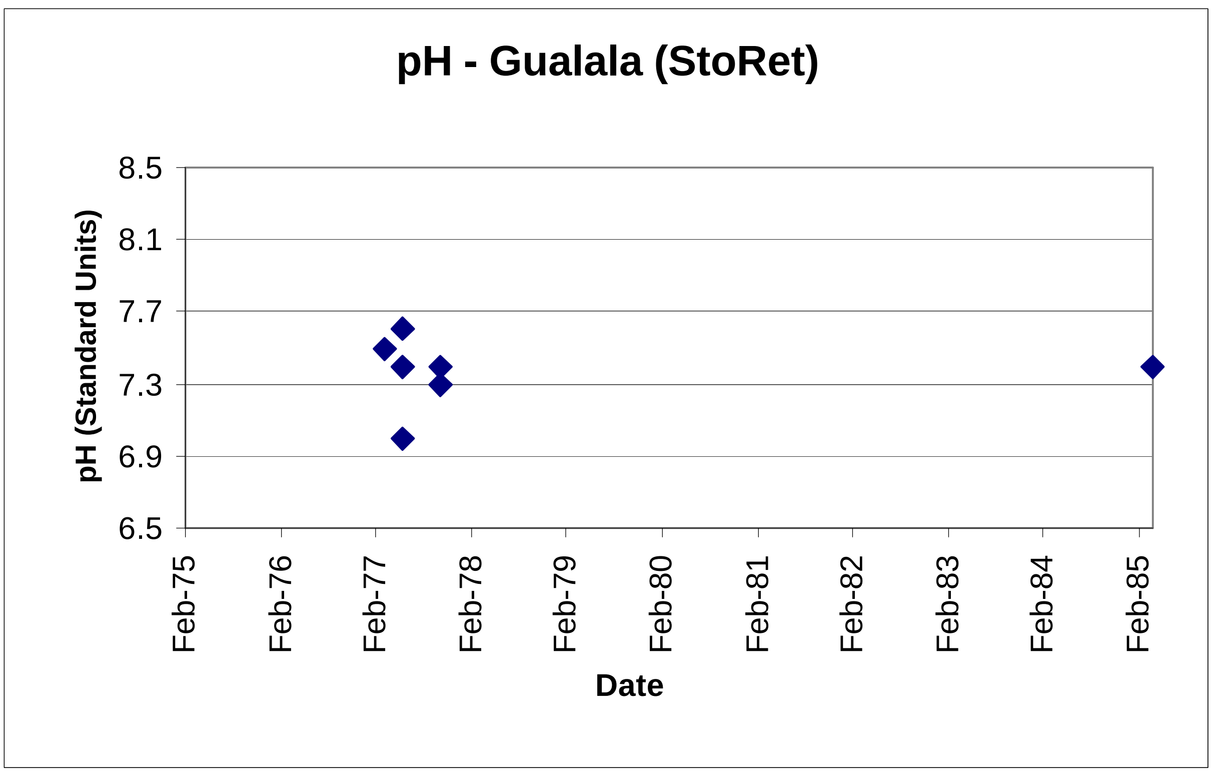
StoRet Data for the Mainstem Gualala River near Gualala (cont'd.)

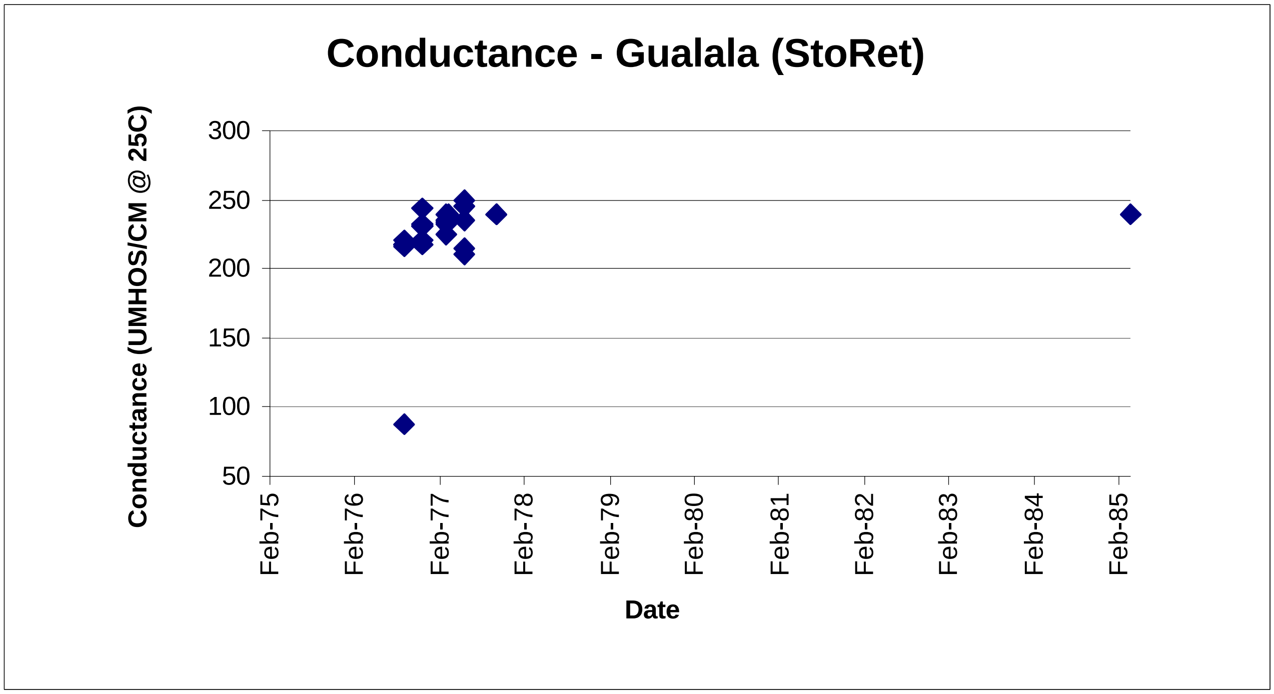
START DATE	START TIME	TOTAL ALKALINITY (MG/L AS CACO3)	DISS NITRATE NITROGEN (MG/L AS NO3)	UNIONIZED AMMONIA (MG/L)	TOTAL NITROGEN, AMMONIA (MG/L AS N)	TOTAL HARDNESS (MG/L AS CACO3)
13-Feb-75	2500		0.50			33.86
14-Sep-76	1040	94	0.03	0.00	0.01	87.00
14-Sep-76	1815					
14-Sep-76	2130					
15-Sep-76	500					
15-Sep-76	820					
15-Sep-76	1100					
30-Nov-76	1430					
1-Dec-76	930	98	0.00	0.00	0.00	91.00
1-Dec-76	1705					
1-Dec-76	2045					
2-Dec-76	545					
2-Dec-76	900					
2-Dec-76	1200					
8-Mar-77	1600					
9-Mar-77	1530	94	0.04	0.00	0.00	92.00
9-Mar-77	1800					
9-Mar-77	2100					
10-Mar-77	530					
10-Mar-77	1000					
17-Mar-77	1130					
24-May-77	1315					
25-May-77	830					
25-May-77	1740	99	0.26	0.00	0.00	92.82
25-May-77	1900					
26-May-77	945					
27-May-77	700					
13-Oct-77	1620	78	0.00	0.00	0.00	77.00
14-Oct-77	520					
14-Oct-77	830					
4-Apr-85	1235					

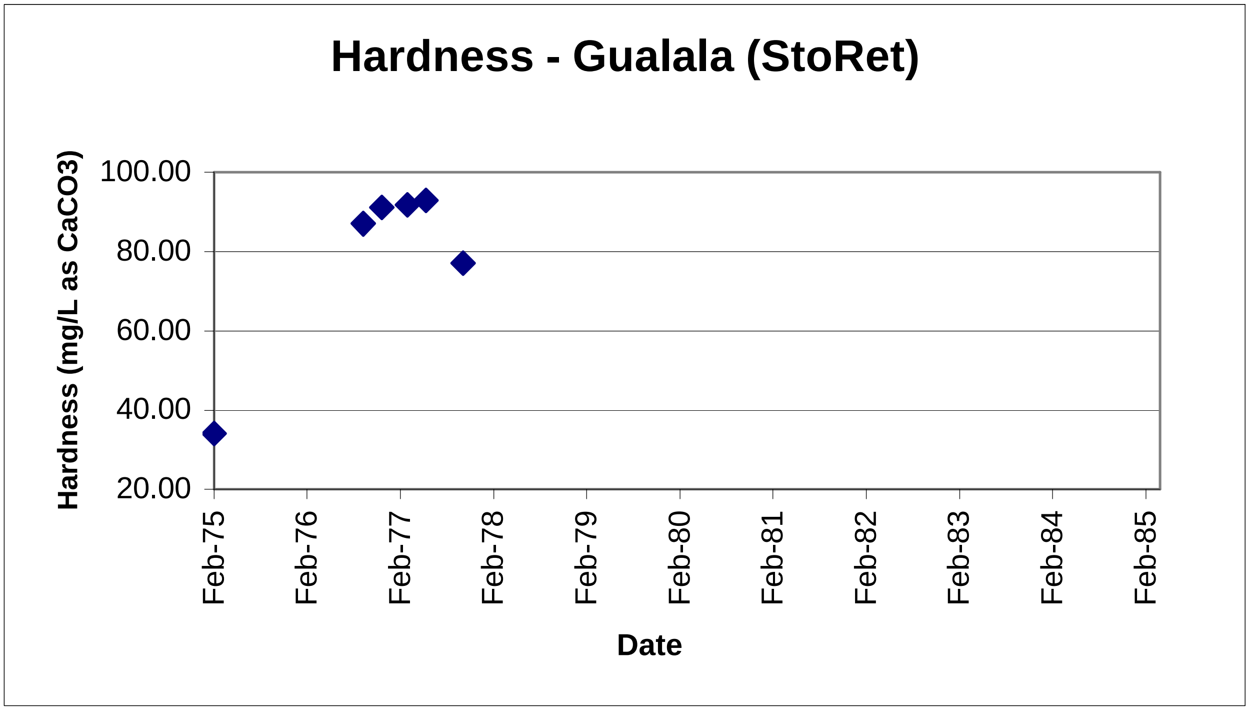
StoRet Data for the Mainstem Gualala River near Gualala (cont'd.)

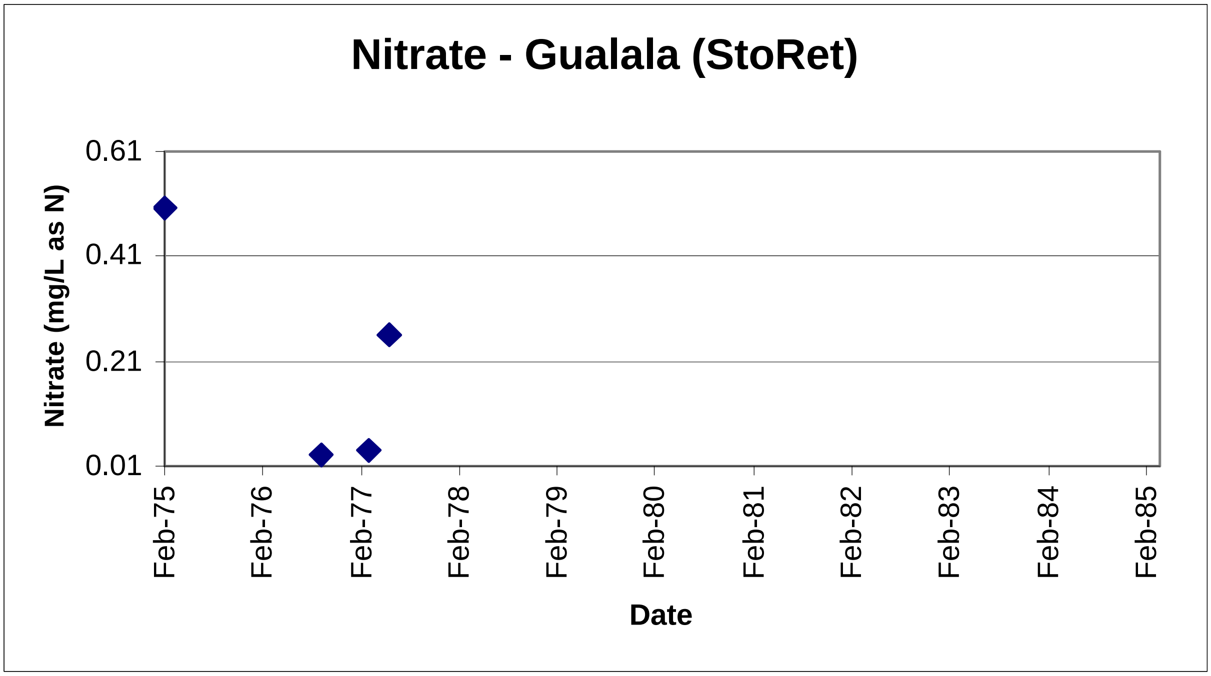
START DATE	START TIME	PHOSPHORUS, DISSOLVED ORTHOPHOSPHATE (MG/L AS P)	METALS
13-Feb-75	2500		All Nondetect
14-Sep-76	1040	0.04	All Nondetect
14-Sep-76	1815		
14-Sep-76	2130		
15-Sep-76	500		
15-Sep-76	820		
15-Sep-76	1100		
30-Nov-76	1430		
1-Dec-76	930	0.02	
1-Dec-76	1705		
1-Dec-76	2045		
2-Dec-76	545		
2-Dec-76	900		
2-Dec-76	1200		
8-Mar-77	1600		
9-Mar-77	1530	0.03	
9-Mar-77	1800		
9-Mar-77	2100		
10-Mar-77	530		
10-Mar-77	1000		
17-Mar-77	1130		
24-May-77	1315		
25-May-77	830		
25-May-77	1740	0.01	
25-May-77	1900		
26-May-77	945		
27-May-77	700		
13-Oct-77	1620	0.03	
14-Oct-77	520		
14-Oct-77	830		
4-Apr-85	1235		

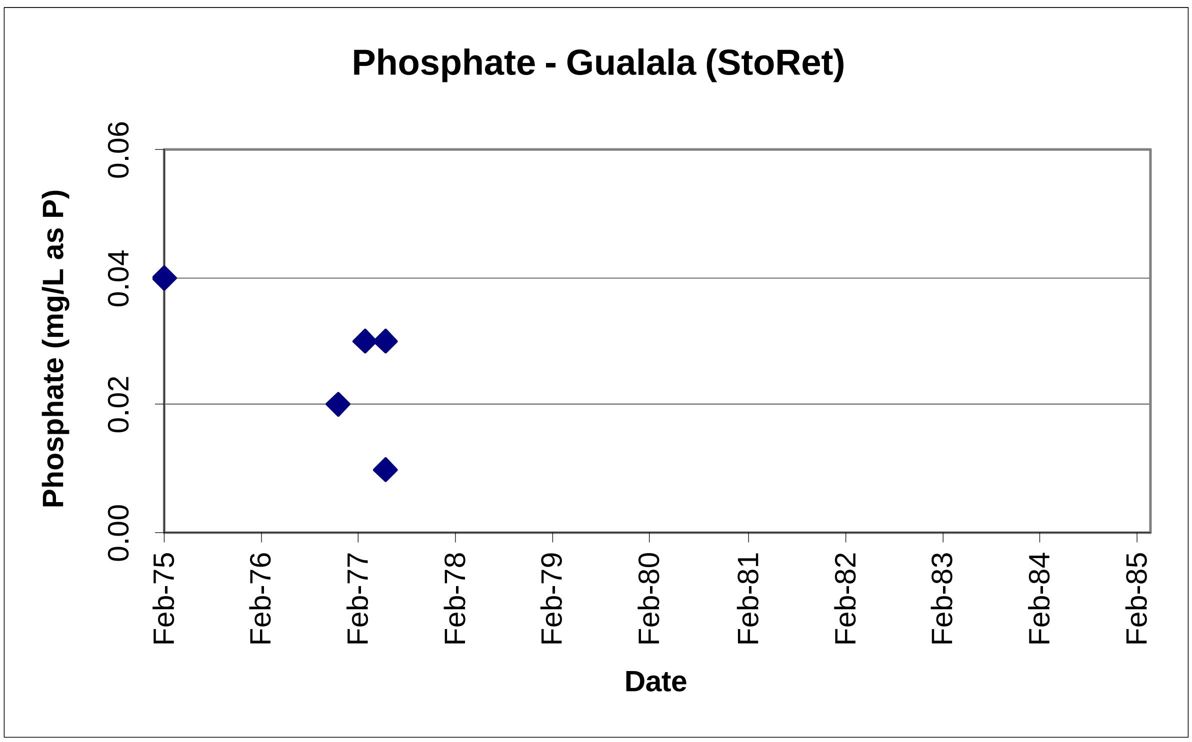

Dissolved Oxygen - Gualala (StoRet)
Dissolved Oxygen (mg/L)
14.0
12.0
10.0
8.0
6.0
Feb-75
Feb-76
Feb-77
Feb-78
Feb-79
Feb-80
Feb-81
Feb-82
Feb-83
Feb-84
Feb-85


pH - Gualala (StoRet)
pH (Standard Units)
8.5
8.1
7.7
7.3
6.9
6.5
Feb-75
Feb-76
Feb-77
Feb-78
Feb-79
Feb-80
Feb-81
Feb-82
Feb-83
Feb-84
Feb-85
Date


Conductance - Gualala (StoRet)
Conductance (UMHOS/CM @ 25C)
300
250
200
150
100
50
Feb-75
Feb-76
Feb-77
Feb-78
Feb-79
Feb-80
Feb-81
Feb-82
Feb-83
Feb-84
Feb-85
Date


Hardness - Gualala (StoRet)
Hardness (mg/L as CaCO3)
100.00
80.00
60.00
40.00
20.00
Feb-75
Feb-76
Feb-77
Feb-78
Feb-79
Feb-80
Feb-81
Feb-82
Feb-83
Feb-84
Feb-85
Date


Nitrate - Gualala (StoRet)
Nitrate (mg/L as N)
0.61
0.41
0.21
0.01
Feb-75
Feb-76
Feb-77
Feb-78
Feb-79
Feb-80
Feb-81
Feb-82
Feb-83
Feb-84
Feb-85
Date


Phosphate - Gualala (StoRet)
Phosphate (mg/L as P)
0.06
0.04
0.02
0.00
Feb-75
Feb-76
Feb-77
Feb-78
Feb-79
Feb-80
Feb-81
Feb-82
Feb-83
Feb-84
Feb-85
Date