CHAPTER 9: TRACKING WATERSHED MANAGEMENT PLAN OBJECTIVES

The assessment and monitoring programs presented in this chapter were selected to address existing data gaps, assist landowners and natural resource managers in their efforts to protect and enhance the natural resource base of the watershed, and provide guidance in the implementation of this watershed management plan. The recommended assessment and monitoring programs are designed to answer two questions:

- Are Salmon Creek and its tributaries currently achieving the water quality objectives established by the North Coast Regional Water Quality Control Board?
- Are the beneficial uses of Salmon Creek being maintained and protected, and, if not, what are the limiting factors?

Monitoring is a technical term that denotes collecting a series of observations over time in order to detect changes or trends. Monitoring programs can be very expensive and labor intensive. The repetition of measurements over time for the purposes of detecting change distinguishes monitoring from inventory and assessment. Although inventories and assessments can be based on a single measurement or observation, they can also incorporate a series of observations to either gauge conditions before and after some management action or change or to gain a more accurate estimate of a specific parameter. Often, an assessment or inventory will serve as a first step towards developing a longer term monitoring program. Assessments and inventories can provide important information on baseline or current conditions if conducted properly.

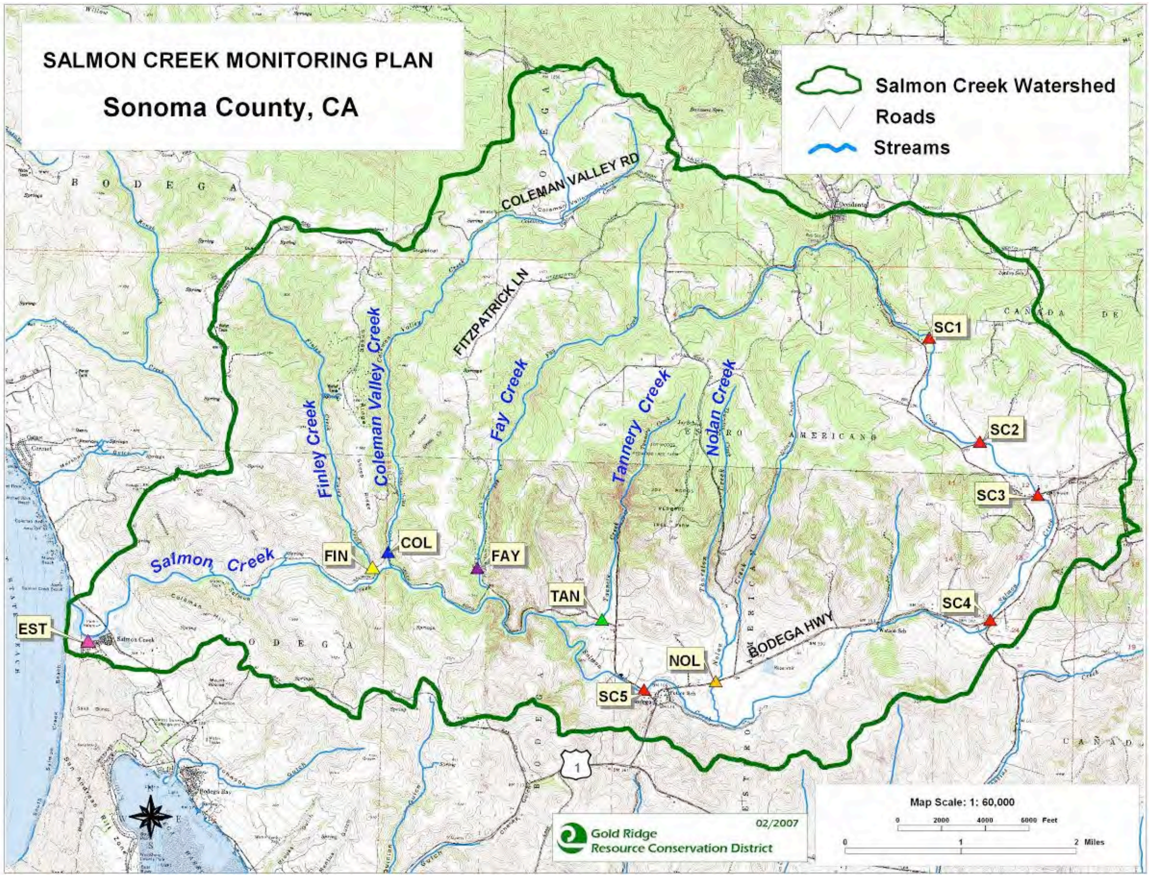
Recommended Monitoring and Assessment Programs:
1. Surface Water Ambient Monitoring Plan
2. Bioassessment Monitoring
3. Geomorphic Monitoring
4. Fisheries Monitoring
5. Streamflow Monitoring
6. Riparian Assessment
7. Residual Dry Matter (RDM) Assessment
8. Manure Land Application Tracking and Assessment

1. Surface Water Ambient Monitoring Plan (MP)

Gold Ridge RCD prepared a water quality monitoring and assessment program plan as a component of the development of the SCICWMP. The purposes of the MP were to assess the overall health of the Salmon Creek Watershed and to establish current baseline conditions. (Refer to Chapter 5 for an analysis of water quality and the associated goals, recommendations, and actions.)

The objectives of monitoring selected locations in the Salmon Creek Watershed were to:
- Document baseline conditions to allow for comparison with future and as yet unplanned monitoring. This comparison will provide for assessment of management measure effectiveness and serve as a guide for the systematic development of restoration projects;
- Assess the efficacy and necessity of future water quality improvement projects; and
- Use the water quality monitoring data as a benchmark for developing watershed-wide BMPs.

Figure 12. Water quality monitoring sites map.



How the Monitoring Data Was Used

Because the SCICWMP is a planning document rather than an implementation project, the overall plan sought to characterize existing conditions in the watershed at a planning level, enabling the development of site-specific restoration or remediation projects. The data gathered provided the information necessary to make implementation decisions necessary at the reach scale.

Pre-project Conditions and Water Quality

Standardized water quality monitoring data were not available for the Salmon Creek Watershed at the onset of this project. Available stream ambient water quality data had been collected by SCWC through a volunteer monitoring program funded by CDFG (2003-2006). A summary of this information is included in Chapter 5, and the full report is found in Appendix B.

Additional Monitoring Objectives

The current Gold Ridge RCD monitoring program should continue in order to document long-term trends and watershed-scale responses to the implementation of recommended BMPs.

Monitoring Activities

Sampling and analysis will include field-measured parameters and laboratory analysis for selected parameters that are key indicators of water quality. Field-measured parameters will include stream discharge, temperature, DO, conductivity and pH.

With the exception of temperature and DO, water quality sampling will be done monthly and in response to the storm events. Grab samples will be taken for turbidity and TSS analyses. These samples will be taken from the established monitoring and other suitable locations where access is granted by landowners. Additional monitoring that is outside of Gold Ridge RCD's SWRCB-approved monitoring plan and quality assurance project plan are noted as recommendations below.

WQ Monitoring Recommendation 1: Conduct and implement a continuous temperature monitoring program throughout the Salmon Creek Watershed during low-flow conditions.

Scientific Reasoning

Watersheds and their associated biological communities are complex. A wide range of watershed conditions and human activities can affect water quality in ways that aren't always obviously related. Temperature, for example, affects both water chemistry and the biological functions of aquatic organisms. Water temperature influences the amount of oxygen that can be dissolved in water, the rate of photosynthesis by algae and other aquatic plants, the metabolic rates of aquatic organisms, the sensitivity of organisms to toxic wastes, parasites and diseases, and timing of reproduction and migration.

The impacts on water quality from watershed conditions and human activities depend on the type of activity and its timing, location, duration, and intensity. Many land uses affect the watershed function and contribute pollutants to the stream system. The mobilization, movement, and concentration of pollutants vary by season, by day, and sometimes from hour to hour. This can make it difficult to accurately measure representative water quality conditions. It is critical to build a data record over time to assess how different conditions affect water quality throughout a watershed.

Instream water temperatures vary both spatially and temporally (diurnally and seasonally) throughout a watershed. High stream temperatures are of most concern during the lower flow, higher air temperature conditions of summer and fall. See Water Quality Recommendation 2 in Chapter 5 for an overview of the importance of and potential impacts on water temperature.

Most water quality monitoring is conducted via grab samples and subsequent chemical analysis. Grab sampling takes a snapshot of the water quality conditions occurring at that particular spot at that particular time. However, water quality sampling can be designed to take a number of instantaneous samples over time to examine trends in water quality (e.g., decline or improvement) and to potentially catch a pollution event or critical threshold condition when it occurs. This sampling method has been occurring on a monthly basis through the volunteer and professional monitoring efforts, but a finer scale, more frequent monitoring design can greatly assist with the use of water quality data to assess the quality of aquatic habitat.

Implementation Measures

- Calibrate and deploy continuous temperature data loggers throughout the Salmon Creek Watershed in order to spatially represent stream temperature conditions, particularly to evaluate the effects of thermal inputs from significant tributaries.

- Collect continuous temperature data throughout the watershed at 30-minute intervals from May through October.
- Depending on the sampling design, either deploy data loggers in the areas with highest quality aquatic habitat values to evaluate the thermal refugia available to aquatic organisms or, conversely, deploy loggers in areas where stream temperatures are thought to be a limiting factor to the survival and persistence of sensitive aquatic organisms.
- Coordinate with other associated monitoring efforts, such as UCCE coho broodstock monitoring program, to maximize monitoring data and funding resources, and make data applicable to as many assessment and restoration efforts as possible.

WQ Monitoring Recommendation 2: Conduct and implement a continuous DO monitoring program throughout the Salmon Creek Watershed during low-flow conditions.

Scientific Reasoning

DO concentrations vary diurnally and seasonally based on stream temperature, biological and chemical oxygen demands, and aquatic organism respiration. See Water Quality Recommendation 3 in Chapter 5 for more information about how DO levels influence the growth, reproduction, and survival of aquatic organisms.

Salmon Creek volunteer water quality monitoring.

Microorganisms such as bacteria are responsible for decomposing organic waste. When organic matter such as dead plants, algae, leaves, grass clippings, manure, or sewage is present in a stream, particularly under low-flow conditions, bacteria will begin the process of breaking down the waste. When this happens, DO is consumed by aerobic bacteria, decreasing the DO concentration and lessening the amount available to other aquatic organisms.

Additionally, the presence of aquatic plants such as algae can cause diurnal fluctuations in DO concentrations. Photosynthetic processes under daylight conditions can artificially increase the DO content, creating super-saturated (>100% saturation) DO conditions, while oxygen levels drop at night due to consumption during the respiration of aquatic plants and animals. Most monitoring is conducted during the daytime, which biases measurements towards the higher DO concentration conditions while missing the critical low DO conditions, which are lowest just before dawn.

As stated in Water Quality Recommendation 3, DO concentrations can "vary rapidly, but even short episodes of very low oxygen can cause critical impairment and mortality to aquatic organisms." To measure these seasonal and diurnal variations in DO concentration, continuous DO meters should be deployed under low-flow conditions in reaches where DO concentration is thought to be a limiting factor for sensitive aquatic organisms.

Implementation Measures

- Calibrate and deploy continuous DO data loggers throughout the Salmon Creek Watershed in order to spatially represent DO concentration conditions, particularly in areas where DO levels are thought to be a limiting factor.
- Collect continuous DO concentration data in as many locations as possible at 30-minute intervals from May through October. However, deployable DO meters are expensive, and it will likely only be feasible in a couple of locations.
- Depending on the sampling design, either deploy loggers in the areas with highest quality aquatic habitat value to evaluate the refugia available to aquatic organisms or, conversely, deploy loggers in areas where DO levels are thought to be a limiting factor to the survival and persistence of sensitive aquatic organisms.
- Coordinate with other monitoring efforts, such as NCRWQCB SWAMP monitoring program, to maximize monitoring data and funding resources, and make data applicable to as many assessment and restoration efforts as possible.

2. Bioassessment Monitoring

Another monitoring strategy is bioassessment—employing stream biota to assess the water quality conditions and overall stream health. By looking at and analyzing the type, number, distribution, age, and size of aquatic macroinvertebrates, algae, fish, etc., one can infer a wide range of information about the quality of water and habitat over time. The mere presence or absence of certain common sensitive species can provide information about both the quality of the water and the ability of that stream to support other sensitive species.

Bio Monitoring Recommendation 1: Conduct and implement a bioassessment monitoring program, including benthic macroinvertebrate (BMI) and algae community sampling, to evaluate aquatic conditions and suitability for sensitive aquatic organisms.

Scientific Reasoning

The use of multiple bioindicators, such as adding algae to BMI sampling, will facilitate the "weight-of-evidence" approach to interpretation of biomonitoring results, which can be used to corroborate assumptions about stressors and limiting factors for stream biota. As primary producers, algae are the most directly responsive of the common bioindicators to nutrients and can be very valuable for assessing nutrient impairment (Fetscher & McLaughlin 2009).

Implementation Measures

- Conduct monitoring using SWAMP bioassessment protocols and producing data that is SWAMP-compatible.
- Depending on the sampling design, either sample BMIs in the areas with highest quality aquatic habitat value during spring to characterize the refugia available to aquatic organisms or, conversely, sample BMIs in the fall in areas where stream conditions are thought to be a limiting factor to the survival and persistence of sensitive aquatic organisms.

- Conduct algae community monitoring in conjunction with BMI monitoring.
- Coordinate with other monitoring efforts, such as NCRWQCB SWAMP and/or UCCE coho broodstock monitoring program, to maximize monitoring data and funding resources, and make data applicable to as many assessment and restoration efforts as possible.

3. Geomorphic Monitoring

Improving instream habitat for salmonids and other aquatic organisms is a stated goal of this Plan, and many of the implementation recommendations were developed to meet this goal. Five geomorphic reference reaches were established in 2006 to quantify channel morphology and sediment-related habitat conditions; see Appendix A. The reference reaches were monumented for repeat measurements and long-term monitoring. In addition to the detailed reference reaches, sections of Salmon Creek Watershed were assessed for LWD frequency, pool characteristics, streambank erosion, and channel type. In 2001 and 2002, CDFG performed habitat assessments along mainstem Salmon Creek and all the major tributaries. Evaluating the ecological effectiveness of many of the proposed implementation projects in this Plan requires long-term, repeated monitoring of the stream's geomorphic conditions.

Geomorphic Monitoring Recommendation 1: Implement a long-term monitoring program in Salmon Creek to track instream physical habitat conditions and document Plan effectiveness.

Scientific Reasoning

Agencies tasked with recovering salmonid populations and protecting beneficial uses of the northern California waterways have been developing standards to measure instream habitat quality (CDFG 2004; RWQCB 2006a and 2006b; NMFS 2010). National Marine Fisheries Service (2010) has compiled many of the habitat condition indicators and set rankings and targets for the indicators; see Table 16 below for geomorphic-related indicators. To improve the viability of streams for salmonid population recovery, it is necessary for existing habitat conditions to be ranked as GOOD, or for conditions to be trending towards GOOD over time.

Table 16. Related coho salmon habitat-quality indicators and their target values.
Compiled and developed by NMFS Southwest Region (NMFS 2010)

Habitat Attribute	Indicator	Ranking		
		Poor	Fair	Good
Pool Habitat and Velocity Refuge	Frequency of Primary Pools	<30% pools by length	30-40%	40-50%
	LWD Frequency	<4 key pcs/100m	4-6/100m	6-11/100m
	Shelter Rating	Score of <60 per km	60-80	80-100
Riparian Vegetation	Canopy Cover	<75% avg. over km	75-85%	85-95%
	Species Composition	<25% of historic diversity	25-50%	>50%

Implementation Measures

- Resurvey and sample geomorphic reference reaches every 5 to 10 years (depending upon upstream projects and hydrologic conditions) to track changes in channel features related to instream habitat conditions. Parameters to be monitored include:
  - Channel longitudinal profile and cross sections (pool depths, riffle/pool spacing, bankfull dimensions, floodplain development).
  - Bed sediment size distribution (riffles).
  - V* or pool fine sediment volume.
  - Canopy cover and riparian buffer width/complexity; see RA Monitoring Recommendation #1.
  - Instream shelter rating.
- Locate, monument, and survey other geomorphic reference reaches as needed.
- Survey LWD and pool frequency throughout salmonid bearing sections of watershed every 10 years to track habitat conditions, as well as effectiveness of implementation and outreach projects. Compare data to baseline conditions in 2006 and salmonid habitat metrics.

4. Fisheries Monitoring

In response to the precipitous decline of coho salmon populations throughout northern and central coastal California, landowners and agencies have engaged in conservation and restoration of critical habitat. These efforts in Salmon Creek Watershed have opened the door for the next step in coho salmon recovery efforts, the reintroduction of the endangered species through release of adult fish into the watershed.

Fisheries Monitoring Recommendation 1: Monitor fish populations to assess success of reintroduction of coho salmon into the Salmon Creek Watershed.

Scientific Reasoning

In an effort to reestablish coho salmon populations in the Salmon Creek Watershed, CDFG released adult fish from the Russian River Coho Broodstock Program into the mainstem of Salmon Creek in December 2008 and 2009. No follow-up monitoring has been conducted by the program, although CDFG supported Gold Ridge RCD in conducting spawning surveys in 2009.

The most efficient way to measure the success of coho salmon reintroduction and recovery efforts is to directly monitor the presence, abundance, and distribution of target fish populations. Surveying Salmon Creek and its significant tributaries for coho salmon will evaluate the effectiveness of the CDFG broodstock releases by documenting if the released fish have successfully spawned and ultimately whether the resulting juveniles are able to reestablish a population of wild coho in the watershed. Specific monitoring objectives include estimating spawning success and abundance and survival of juveniles.

Implementation Measures

- Juvenile monitoring employing snorkel surveys during the summer rearing period to determine presence and distribution of juvenile coho salmon within different reaches of the watershed.

- Spawner surveys conducted bimonthly from November through February to document the presence and distribution of live adult salmonids, redds, and salmonid carcasses. This information will be used to determine if adults are returning to and spawning within the watershed and to identify their distribution and preferred spawning habitat. Pit tag scans will be used to differentiate between hatchery and wild fish.
- Coordinate with other monitoring efforts, such as the Russian River coho broodstock monitoring program, CDFG, and NOAA Fisheries, to maximize monitoring data and funding resources; make data applicable to as many assessment and restoration efforts as possible.

5. Streamflow Monitoring

Impacts on summer rearing habitat from regional and local water withdrawals include reduced pool depths, reduced DO levels, and higher water temperatures. Temperatures frequently exceed optimal levels, and DO has been recorded at 1-2 mg/L in pools within the project reaches. Fish become stranded and are unable to seek better habitat when pools become disconnected. The objective of streamflow augmentation projects should be to increase the amount of water available for instream flow, lengthen the period of riffle connectivity within the project reaches, and subsequently improve water quality in the pools during the summer and early fall dry season.

SF Monitoring Recommendation 1: Conduct and implement a streamflow monitoring program that tracks water depth in pools, connectivity of pools, and trends in streamflow.

Scientific Reasoning

Annual variations in rainfall and hydrologic patterns strongly determine streamflow characteristics and water quality conditions. Limited reach-specific physical baseline data exists with which to quantify the effectiveness of streamflow restoration projects. Thus, streamflow data collected during the initial monitoring period of projects, or over a hydrologic cycle of wet and dry years, is unlikely to show definitive or immediate results. This additional monitoring recommendation is presented to collect baseline data and evaluate long-term trends.

Implementation Measures

- Utilize pressure transducers (stage recorders) to continuously monitor variations in water depths in pools associated with riparian water diversion changes. Longitudinal thalweg surveys will be used to relate stage readings to actual pool depths and riffle connectivity.
- Visually assess and document flow over riffles within project reaches and continuous stage sensors. Any implemented streamflow augmentation project should show a trend of later timing of pool disconnection and decreasing number of days pools remain disconnected.
- Maintain at least one long-term streamflow gage in the watershed, including a mainstem Salmon Creek gage in Bodega. As part of the long-term streamflow monitoring program, surveys and discharge measurements should be taken to check and maintain the stage-to-discharge rating curve.

6. Riparian Assessment

Assessing, protecting, and enhancing riparian habitat are stated goals of this watershed management plan. Riparian areas in the watershed will be periodically assessed to measure the achievement of this goal. Restoring and protecting riparian vegetation along streams will improve water quality and instream and riparian habitat and will significantly reduce sediment loading to Salmon Creek and its tributaries from streambank erosion.

RA Monitoring Recommendation 1: Track the abundance and distribution of riparian vegetation at least once every 5 years.

Scientific Reasoning

Numerous riparian corridor restoration studies have been conducted on streams in arid and semi-arid areas incorporating controlled livestock access to riparian areas (Lewis 2002). In most areas, very little else was needed to affect substantial recovery, although rates of recovery vary. Restoring riparian corridors has important benefits for reduction in peak runoff and flood routing. Increased water retention capabilities of soils and presence of perennial and wet meadow grasses retard runoff from upland areas, spreading runoff events over a longer time period and reducing flood peaks. Changes in hydraulic geometry of stream channels associated with riparian recovery (deepening, narrowing) assist in this process of natural runoff management.

Recovery of riparian areas can be greatly accelerated by a judicious planting program using selected successional and climax species. Strategic plantings of various herbaceous and woody species may eliminate the necessity of actively “treating” the entire riparian corridor by acting as seed stock for downstream areas (Circuit Rider Productions, Inc., 1986).

Implementation Measures

- Riparian area assessments will be conducted using high-resolution aerial photography. Stream segments will be coded based on the abundance of vegetation in the riparian zone, approximately 50’ on each side of the stream. This information will be added to an existing riparian assessment GIS data layer. In addition, the GIS data layer will be updated each time a stream segment is stabilized and revegetated.
- In riparian vegetation enhancement and riparian fencing reaches document existing species density and diversity by establishing vegetation transects. Monitor these transects on a 5 to 10 year basis for changes over time and effectiveness of restoration projects.

7. Residual Dry Matter (RDM) Assessment

Grazing management practices influence sheet and rill erosion on rangeland. Overgrazing can result in low RDM, reducing site fertility and infiltration rates and exposing soil to more rainfall, which increases erosion and runoff (Lewis et al. 2005). Treatment for low RDM includes better site preparation, seeding and fertilization, and increased grazing management.

RDM Assessment Recommendation 1: Conduct RDM assessments on priority conservation parcels and increase RDM values by 15% using conservation management measures and practices.

Implementation Measures

- Work with livestock ranches and dairies to update ranch plans and to conduct RDM assessment in order to develop better grazing practices. Conservation-oriented ranch plans will include an inventory of existing resources and resource conditions, operational goals, water quality management issues and objectives, and a prioritized list of projects designed to reduce soil loss and agricultural runoff (USDA 1997).

8. Tracking Land Manure Application

Gold Ridge RCD, in collaboration with UCCE and NRCS, will design and promote the adoption of a manure land application tracking system as part of a larger nutrient budgeting and nutrient management planning program. Soil, vegetation, and manure sampling will be conducted to evaluate nutrient content and fertilization requirements for individual dairies. A land application tracking system will be implemented to record current waste loads applied on a per field basis. Sampling results will be used to calibrate land application rates and timing the following year.

The end goal of these efforts is to have dairy operators quantify and better manage on-farm nutrient production and consumption. Through this process, operators will be able to assess and calculate potential excess nutrient loads and address any nutrient imbalance through export of nutrients from the watershed, composting strategies, or other effective management strategies.

TLM Assessment Recommendation 1: Assist dairy operators in the watershed to better track land application of manure, and to promote application at agronomic rates based on soil, manure and vegetation sampling.

Implementation Measures

- Work with dairies to adopt nutrient budgeting and management planning.
- Develop a manure land application tracking system.
- Document reductions in nutrient concentration along the mainstem of Salmon Creek.