

MONITORING PLAN

McCloud Groundwater Systems Monitoring Project

**Prepare For:
California Trout**

**Prepared By:
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I. INTRODUCTION

The ultimate goal of monitoring the McCloud groundwater systems is to gain a better understanding of hydrogeologic conditions in order to preserve the hydrological integrity of the headwater region. Mount Shasta's spring resources feed three major rivers of this region, which are of great importance to other resources throughout California. However, little information exists about the Mt. Shasta springs or groundwater. The collection of monitoring data will assist decision makers to make informed policies regarding groundwater resources of this area to protect them from threats including, but not limited to: climate change, new development pressures, land use practices and water export.

II. BACKGROUND

This springs and groundwater-monitoring project was initiated by California Trout (CalTrout) due to the proposed development of a water bottling facilities in McCloud, by Nestle Waters North America Inc (Nestle). There is very little data on the springs or aquifer that Nestle plans to develop, nor is there significant data on the creeks that could potentially be impacted by the decreased flow due to the water bottling operations.

Using this monitoring plan, CalTrout with the assistance of University of California- Davis (UCD) hopes to obtain a broad understanding of the groundwater system in the McCloud basin. This understanding could assist decision makers (Siskiyou County Planning Department, Siskiyou County Board of Supervisors, McCloud Community Services District) of the potential long-range impacts involved in such a development and work toward countywide groundwater reform.

Ultimately this type of groundwater monitoring and study would be carried out in all the major basins around Mt. Shasta (Shasta River and Upper Sacramento watersheds), with the goal of obtaining enough data to develop a groundwater model and determine a water balance for all the basins. If a groundwater balance could be determined, a vulnerability index (for individual springs and water networks) could be formulated to assist governmental agencies make informed decisions regarding land use and future development.

III. OVERVIEW

In order to develop a water balance for the region or specifically the McCloud basin, we need to define the groundwater systems by establishing the residence time (age) of the springs in the region, as well as the discharge (volume) and recharge area (elevation). In

addition to the information obtained from springs monitoring outlined in this plan, existing geologic, meteorologic and general aquifer information (well logs, groundwater elevations, depths of wells, recharge, volume) will be needed to be gathered to establish the extents of the groundwater systems and is needed to for the groundwater model.

This monitoring plan is specific to monitoring the springs that could potentially be impacted (threatened) by the development of major water export, however could easily be expanded to include the long-range goal of understanding all sources throughout the three basins.

This monitoring plan has been developed for the use of CalTrout, UCD and AquaTerra personnel. CalTrout/AquaTerra personnel are responsible for coordinating and performing the sampling events, including providing sampling equipment, and taking field notes. The following sections provide details of the monitoring plan, including constituents, sampling locations, frequency, and sampling team.

IV. SAMPLING

Components to be field monitored include water temperature, dissolved oxygen, pH, EC and staff gauge (discharge). The field data will be collected monthly to establish any connections between individual springs, if data seems consistent month to month, a quarterly monitoring schedule will be adopted. Water temperature will be continuously collected at the springs using Thermisters. The springs will also be sampled for geochemical components as shown below on a monthly basis. After a quarter of field monitoring and geochemical testing, individual springs will be chosen for additional water testing for tritium and C₁₄, which is outlined below in Table 1. As the project progresses, there may be a need to add or remove sampling sites and to adjust the timing of the sampling events. This monitoring plan will be updated with changes to the locations and schedule as needed.

Constituents

The constituents that may be monitored are temperature, dissolved oxygen, pH, EC, Geochemical (Cations, Deuterium Oxygen, Tritium, Silver Nitrate, geologic nitrogen and phosphorus, and C₁₄) as well as collection of data measuring the staff gauge. The list of sampling constituents and rationale for each is summarized in Table 1 below.

Table 1 Sampling Constituents

Constituent	Purpose	Comment
Temperature	General water quality Determine recharge area	Electronic meter/probe.
Dissolved oxygen	General water quality	Electronic meter/probe.
pH	General water quality	Electronic meter/probe
Ec	General water quality	Electronic meter/probe
Deuterium Oxygen (isotopes)	Determine elevation of recharge area Age	Lab sample Monthly-then ¼-ly
Silver Nitrate	Age	Lab sample Monthly -then ¼-ly

Tritium	Age	2X per year for consistency
C ₁₄	Age	Few streams 2X per year

Water temperature will be taken by using Thermister probes placed in the springs, but are not directly exposed to the sun's radiation and/or are shaded by a device.

River cross sections will be established at staff gauge locations to convert staff readings to discharge.

A minimum of two photo points will also be established to show any changes in the springs over time. Photos will be taken quarterly to show visual seasonal fluctuation or any structural changes that may occur at the springs.

Sampling Locations

Table 2 below describes the location of each spring sampling site. Thermister temperature probes will be placed in each spring listed below. Field measurements will be taken at each of the seven McCloud springs, along with lab sampling on a monthly basis, until it is determined quarterly sampling would prove sufficient.

Based on field conditions, the program may be modified by the project team during the sampling event to ensure the collection accurate and thorough. Any changes made to the plan will be documented within the field notebooks and added to this Monitoring Plan as Appendices.

Table 2. Sampling Locations

<i>Springs Location</i>	<i>Equipment needed/Samples</i>	<i>Note</i>
<i>1. Intake Springs</i>	<i>Thermister Staff Gauge Geochemical</i>	<i>MCSD may already be monitoring spring will coordinate with them for this effort. Need to gain access from Nestle/MCSD.</i>
<i>2. Elk Springs</i>	<i>Thermister Staff Gauge Geochemical</i>	<i>MCSD may already be monitoring spring will coordinate with them for this effort. Need to gain access from Nestle/MCSD.</i>
<i>3. Lower Elk Springs</i>	<i>Thermister Staff Gauge Geochemical</i>	<i>MCSD may already be monitoring spring will coordinate with them for this effort. Need to gain access from Nestle/MCSD.</i>
<i>4. Esperanza Spring</i>	<i>Thermister Staff Gauge Geochemical</i>	
<i>5. Widow Springs</i>	<i>Thermister</i>	<i>May be related to Big Springs will</i>

	<i>Staff Gauge Geochemical</i>	<i>compare geochemical to Big Springs</i>
<i>6. Spring below Lower Falls</i>	<i>Thermister Staff Gauge Geochemical</i>	<i>May be related to Big Springs will compare geochemical to Big Springs</i>
<i>7. Muir Falls</i>	<i>Thermister Staff Gauge Geochemical</i>	<i>May be related to Big Springs will compare geochemical to Big Springs</i>

Sampling Frequency and Schedule

Installation of Thermisters and staff gauges will be scheduled when UCD staff is available with early August as a goal. Monthly sampling will be continued until the November Technical Advisory meeting, it is anticipated that monitoring protocol may be adjusted due to findings.

Sampling Team

Initially the seven springs will be sited and equipment will be installed by UCD, with assistance from AquaTerra. After initial set-up and sampling, the monthly sampling will be performed by AquaTerra or CalTrout staff and delivered to UCD staff for transport to laboratory.

V. REPORTING

Results obtained from the field investigation parameters are to be validated for quality, accuracy, and completeness. The data are then to be tabulated in database format and included in the CalTrout Watershed Information System.

VI. ADDITIONAL RECONNAISSANCE MONITORING

During the initial Technical Advisory meeting it was determined that other springs in the other two basin should be profiled and data collected as a way to move forward in the ultimate goal of the mountain wide water balance.

The following spring were listed as higher priority to start gathering data:

- Mt. Shasta Big Springs
- Trout Camp Spring
- Black Butte Springs
- Boles Creek Spring
- Little Shasta
- Big Springs
- Hole in the Ground
- Carrot Creek
- Beaughton Creek Spring

These springs (if access can be established) will also be monitored, using the multi-meter to monitor temperature, DO, pH, EC, and possibly additional constituents (isotopes), depending upon funding.