21st Annual Snapshot Day Report

A Lake Tahoe Basin and Truckee Watershed Citizen Monitoring Event

(May 15, 2021)

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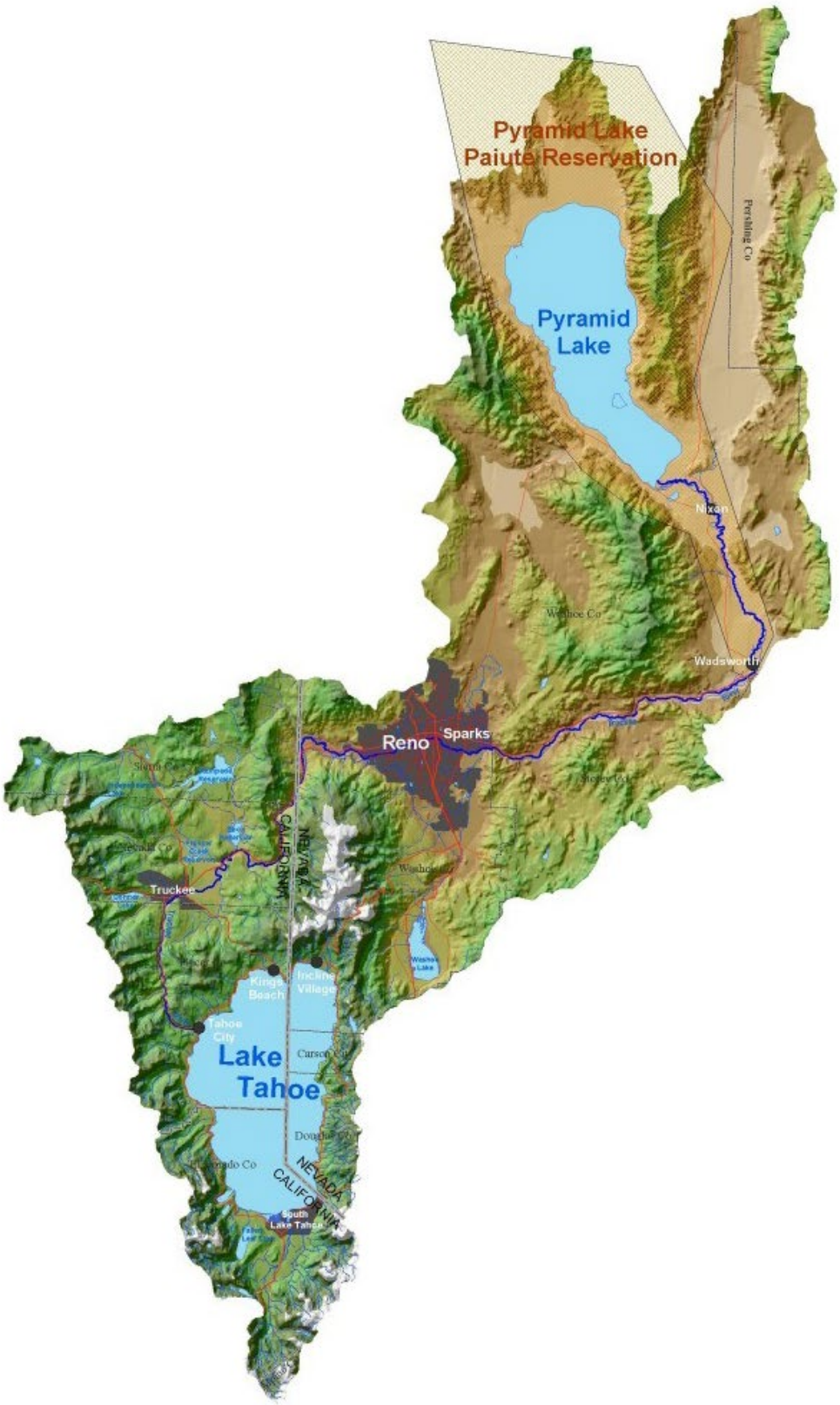
Figure 1: Truckee River Watershed from Lake Tahoe, CA to Pyramid Lake, NV



Introduction

What is Snapshot Day?

Snapshot Day is a one-day, volunteer-based event designed to collect data indicating watershed health at a single point in time. Trained Volunteer Team Leaders bring groups of other volunteers to various pre-determined sites to collect water quality data. 2021 was the 21st anniversary of Snapshot Day; however, as with many other aspects, this was not a "normal" year due to the global pandemic. Volunteer capacity was greatly reduced, thus the number of sites where monitoring was conducted was also lessened. Snapshot Day is sustained by support from dedicated staff, the funding of a few grants and donations, and by citizens who value the watershed they live in. It is important to note that citizen monitoring is designed to supplement existing agency monitoring efforts. All information is provided to the regulatory and resource management agencies whose responsibility it is to protect water quality in the Truckee River Watershed.

What are the objectives of Snapshot Day?

While there is a great deal of high-quality agency and university-sponsored monitoring in the Tahoe-Truckee region, there is still insufficient information to assess the status of all aquatic resources in the Truckee River Hydrologic Unit, including the Lake Tahoe Basin and the Truckee River Watersheds. With proper training and quality assurance, community members can help fill this void by providing valuable watershed management and pollution prevention information.

The primary goals of this effort are two-fold:

1. Promote environmental education and stewardship.
2. Collect valuable water quality information.

In regards to collecting water quality data, this effort aims to:

- Screen for water quality problems, including the identification of sources of pollution and detection of illegal activities (e.g., chemical spills, filling of wetlands, diversions, illicit discharges, destruction of stream environment zones (SEZs), non-compliance with ordinances or regulations in place to protect natural resources, etc.);
- Provide water quality data that may be compared to standards set by the TRPA and the States of California and Nevada;
- Provide water quality data that may be used in status and trend analyses; and
- Provide some pre and post data for evaluating the effectiveness of restoration activities.

Snapshot Day 2021

2021 Event Summary

Snapshot Day provides an annual opportunity to highlight citizen science's contributions to maintaining the Tahoe-Truckee region's environmental health. 2021 Snapshot Day's data demonstrates good water quality overall for the Tahoe-Truckee watershed.

In 2021, Snapshot Day reached its 21st anniversary. It remains one of the longest-running citizen watershed monitoring events on the West Coast of the United States. Snapshot Day continues to highlight successful engagement with the public in active watershed stewardship while providing valuable data to the responsible agencies. As previous data sets are compiled, and data storage is improved, this program can show long-term trends and better assist agencies in watershed conditions analysis.

Volunteers and locations

Snapshot Day 2021 was a collaborative effort between the North Shore Lake Tahoe, South Shore Lake Tahoe, the Middle Truckee River, and the Lower Truckee River.

Volunteer and monitoring site locations are as follows:

Table 1: Volunteer and monitoring site location numbers.

	Volunteers	Locations
South Shore Lake Tahoe	90	40
North Shore Lake Tahoe	12	11
Middle Truckee River	16	25
Lower Truckee River		4
Totals for 2017	**118**	**80**

This collaborative effort was sponsored by the Incline Village General Improvement District, the League to Save Lake Tahoe, the Truckee River Watershed Council, and the Great Basin Outdoor School. For an expanded list of involved organizations, resource partners, and education partners, please see **Appendix A**.

In 2021, volunteers gathered data at a total of 80 locations throughout the Truckee River watershed from south of Lake Tahoe to the Nevada State line. A list of site names and codes can be found in **Appendix B**.

Lake Tahoe Tributaries, South Shore

- Angora Creek
- Bijou Creek
- Burke Creek
- Cascade Creek
- Cold Creek
- Edgewood Creek
- Heavenly Valley Creek
- McFaul Creek
- Meeks Creek
- North Zephyr Creek
- South Zephyr Creek
- Tahoe Keys Marina
- Tallac Creek
- Taylor Creek
- Upper Truckee River
- Trout Creek

Lake Tahoe Tributaries, North Shore

- Burton Creek
- General Creek
- Griff Creek
- Hatchery Creek
- Lake Forest Creek
- Madden Creek
- McKinney Creek
- Quail Creek
- Rosewood Creek
- Secret Harbor Creek
- Tahoe City Urban Ditch

Truckee River Tributaries, Middle Truckee River

- Alder Creek
- Bear Creek
- Cold Stream
- Deep Creek
- Donner Creek
- East Martis Creek
- Main Stem, Truckee River
- Little Truckee River
- Martis Creek
- Pole Creek
- Prosser Creek
- Silver Creek
- Squaw Creek
- Trout Creek
- Union Valley Creek

Truckee River Tributaries, Lower Truckee River

- Galena Creek
- Thomas Creek
- Main Stem, Truckee River
- Whites Creek

Methods of Data Collection

It is important to remember that the measurements made on Snapshot Day were designed to represent a single point in time and do not necessarily represent average conditions. Monitoring results are compiled in **Appendix B**, which includes both the field measurements collected by volunteers and nutrient and bacteria analyses conducted by designated laboratories.

Visual observations and photo documentation are performed in accordance with procedures developed by the California State Water Resources Control Board Clean Water Team. The standardized observation form, the *California Stream and Shore Walk Visual Assessment Form,* has been slightly revised to apply to the region better. At least three photos are taken at each sampling site: streambed conditions, view across the stream; and view upstream from the starting point of the stream walk upstream. However, volunteers are encouraged to photograph as much as possible, especially of team members in the field.

The volunteers use a variety of instruments and kits on Snapshot Day. Much of the equipment has been purchased through the years with grants or donations; the remainder of the equipment is borrowed each year from various partners. All the instruments and kits are calibrated and tested at a quality control session held before the event. For additional information on the monitoring equipment used, see **Appendix C**.

Water Quality Standards

The U.S. EPA has recommended criteria for nutrients and turbidity. Nevada, California, and the Tahoe Regional Planning Agency have specific water quality standards and indicators generally more stringent in certain watersheds and creeks, such as the Tahoe Basin than elsewhere in the Truckee River Watershed. **Table 2** lists some of these standards for the Tahoe Basin.

Table 2: Lake Tahoe water quality standards

Parameter	Standard
Temperature	Shall not exceed 15°C, surface waters of Fallen Leaf Lake (C.A.)
pH	7.0 - 8.4 in Lake Tahoe (C.A. and N.V.)
Conductivity	Shall not exceed 95 µS/cm average in Lake Tahoe (C.A. and N.V.)
Dissolved Oxygen	Mean no less than 6.5 and minimum of 4.0 mg/L for Lahontan waters designated as "cold freshwater habitat" (Lahontan Region, CA)
Turbidity	Shallow water shall not exceed 3 NTU near tributaries and 1 NTU not directly influenced by streams (TRPA)
Algae	Lahontan RWQCB waters shall not contain biostimulatory substances (nutrients) that cause algae to become a nuisance or to affect the water's beneficial uses (C.A.)
Total Nitrogen	Mean annual concentration in May is 0.087 mg/L, but the maximum allowable is a mean of no more than 0.21 mg/L (Lahontan Region, CA).
Soluble inorganic nitrogen	Mean of no more than 0.06 mg/L for most tributaries to Lake Tahoe, Nevada side of Lake Tahoe (NDEP)
Total Phosphorous	Annual average of no more than 0.05 mg/L for most tributaries, Nevada side of Lake Tahoe and no more than 0.008 mg/L for most tributaries, California side of Lake Tahoe. Maximum allowable for California side is 0.018 mg/L (Lahontan Region, CA).
Soluble Reactive Phosphorous	Annual average of no more than 0.007 mg/L (combination of organic and inorganic) for Lake Tahoe, Nevada side (NDEP) and 0.009 mg/L for Lake Tahoe, California side (Lahontan Region, CA).
Fecal Coliform	Log mean of 20 CFU (30-day period) and a maximum of 40 CFU (Lahontan Region, CA).

For additional information on water quality objectives in California, refer to the Lahontan Regional Water Quality Control Board (Lahontan) *Basin Plan* at the following website:
www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml

For additional information on water quality standards in Nevada, refer to the following website:
www.leg.state.nv.us/NAC/NAC-445A.html#NAC445ASec11704

Data Results

This section gives an overview of the parameters measured and the data results. All the measured parameters are discussed, and some of the high and low measurements are highlighted for each of the measured parameters. Specific sites in figures are referred to by code, which can be cross-referenced by site names in **Appendix B**.

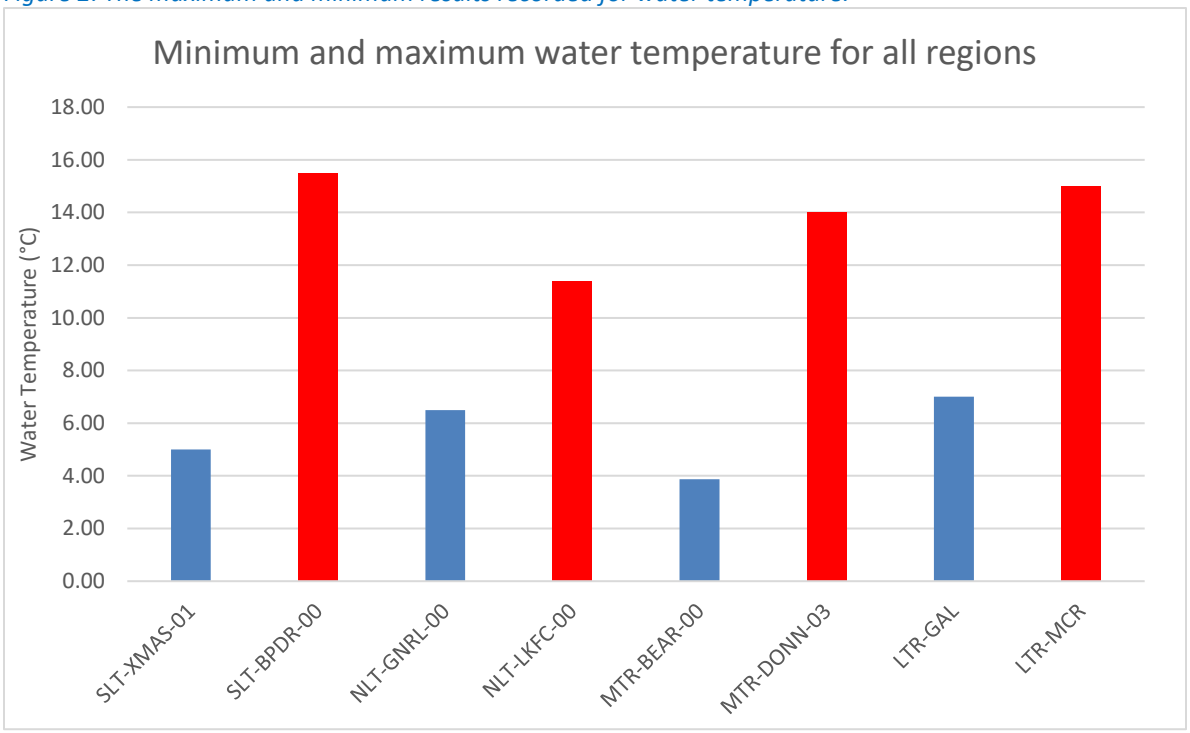
Water temperature

Cooler water temperatures are considered better habitat for aquatic life in mountain streams and lakes since colder water contains more dissolved oxygen, an essential ingredient for fish and invertebrates. Higher temperatures promote nutrient solubility and can occur because of low-flow (shallow) conditions and/or a lack of canopy (vegetation) cover along stream banks, which acts as shade and thus prevents solar heating of the water.

In many Sierra streams, propagation of cold-water fish (i.e., trout or salmon) is a designated beneficial use of the water. In such streams, numerical and narrative water quality standards generally are set at levels that will "support the beneficial use" of a cold-water fishery. Such streams generally require cooler temperatures and higher dissolved oxygen content than water in streams and lakes that do not have "cold-water fishery" as a designated beneficial use. Rainbow trout prefer water temperatures between 12.8° C and 15.6° C, and the upper incipient lethal temperature (temperature at which 50% of the population survives 60 days) is 14.3° C.

In 2021, 75 sites were sampled for water temperature. The lowest recorded temperature from Snapshot Day 2021 was 3.9° C at the Bear Creek sampling location in the Middle Truckee watershed. The highest recorded temperature was 15.5° C recorded at two locations in South Lake Tahoe, the Bijou Park Drainage and Trout Creek at Bellevue Avenue. Figure 2 below represents the lowest (blue) and highest (red) temperatures for each of the four regions sampled during the 2021 event. The high temperatures noted above were collected from tributary streams to Lake Tahoe and did not exceed 15.6° C, the maximum optimal temperature for rainbow trout.

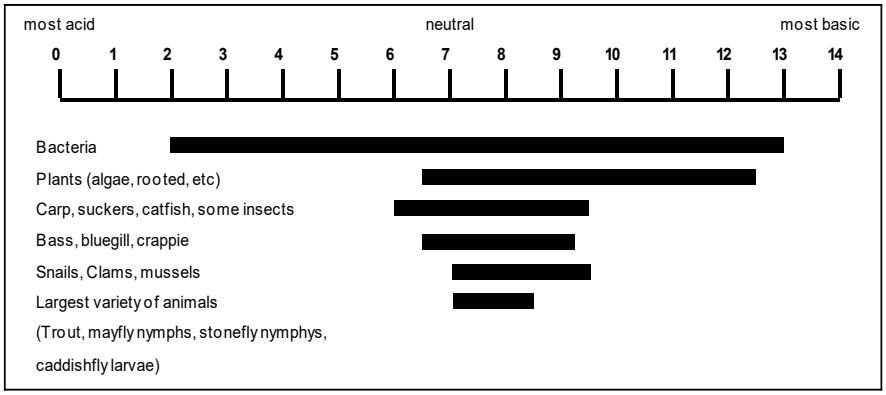
Figure 2: The maximum and minimum results recorded for water temperature.



pH

pH is a measurement of the degree to which water is "acidic" or "basic." pH is measured on a scale of 0 (very acidic) to 14 (very basic), with 7 in the middle as "neutral." Most aquatic life prefers a pH close to 7. **Figure 2** displays the pH ranges that support aquatic life.

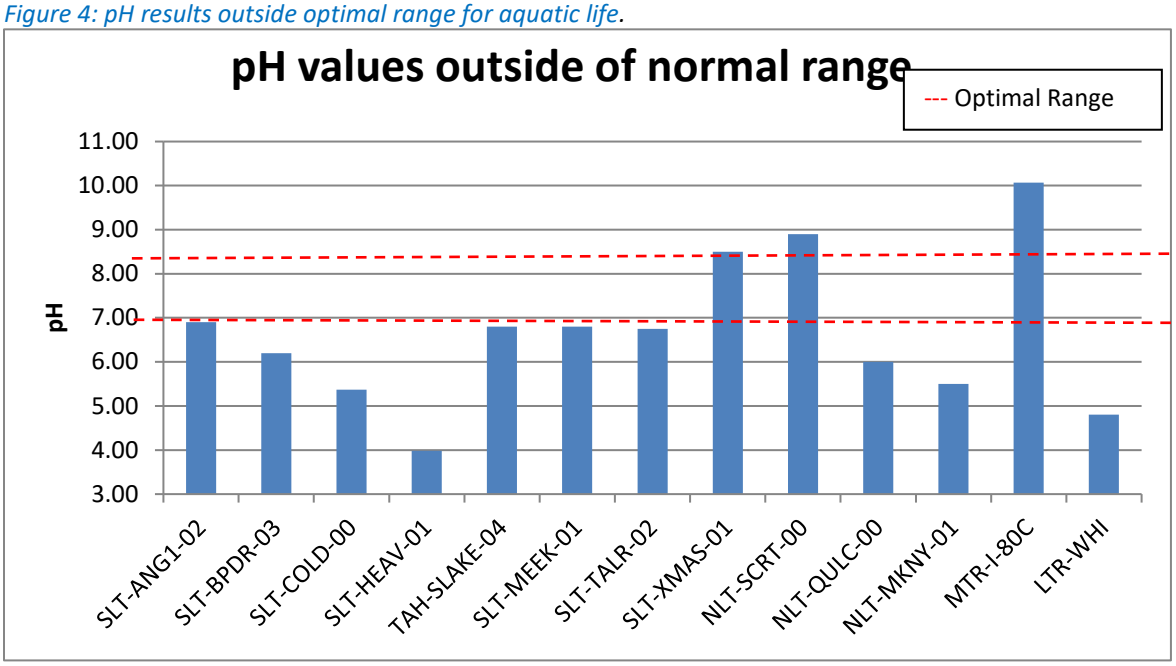
Figure 3: pH range that supports aquatic life



pH ranges that support aquatic life.

Water in California within the Lake Tahoe Basin should not be below 7 or above 8.4. The Regional Water Board recognizes that some waters of the region may have natural pH levels outside the 7.0 to 8.4 range. This is commonly found in the tributaries to Lake Tahoe.

Figure 4: pH results outside optimal range for aquatic life.



The lowest pH measurement for Snapshot Day 2021 was 3.99, taken at Heavenly Valley Creek in South Lake Tahoe. The highest pH measurement was 10.07, taken at the main stem of the Truckee River at Floriston by the I-80 in the Middle Truckee River region. Of the 75 sites that took pH readings, 10 sites had a pH below the optimal range, and 3 sample sites had a pH value above the optimal range.

Dissolved Oxygen (D.O.)

Dissolved oxygen is a measure of the amount of gaseous oxygen (O_2) dissolved in water. Dissolved oxygen is necessary to support aquatic life. Stress occurs in aquatic life, especially fish when dissolved oxygen levels drop too low.

Low dissolved oxygen concentrations are typically the result of:

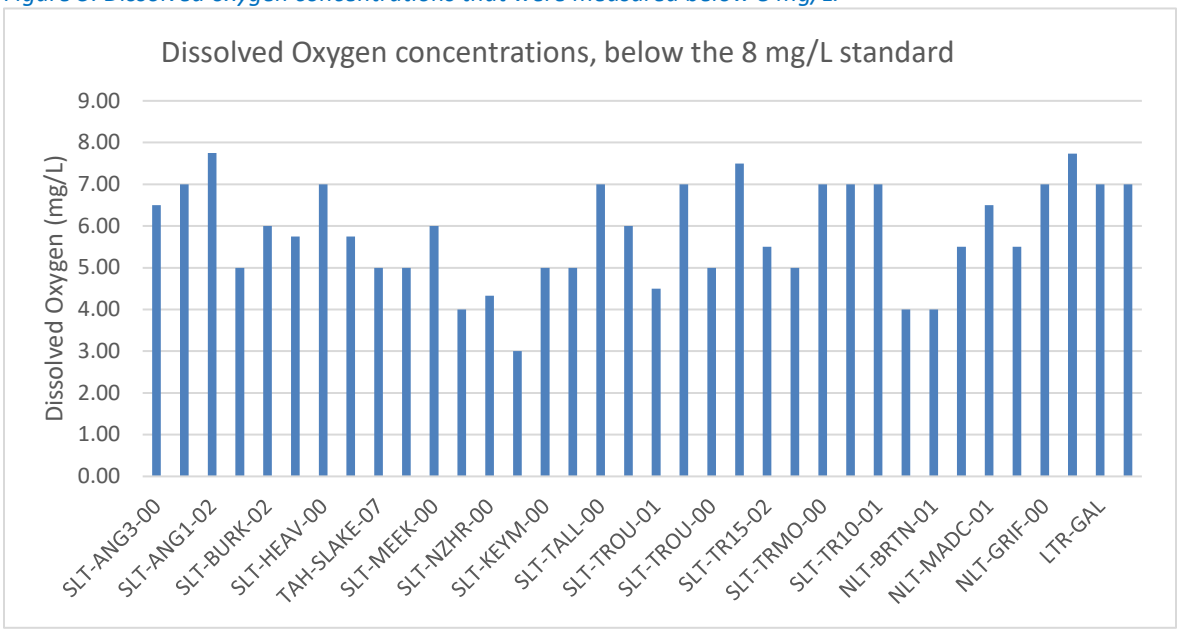
- Warming water: warmer water can dissolve and hold less oxygen than cooler water.
- Excess nutrients: too many nutrients in the water can fuel algae and bacteria growth, consuming oxygen upon decay.
- Slow or stagnant water: movement allows for oxygen and water to mix; slow or stagnant water thus has less dissolved oxygen than water in motion.

Water quality objectives for dissolved oxygen vary from Region to Region; most waters within the Lake Tahoe Basin have a dissolved oxygen concentration standard of at least 8.0 mg/L. Waters of the Truckee River have a dissolved oxygen standard of 5.0 mg/L or 6.0 mg/L depending on the reach of the river. Measurements below 5 mg/L are considered dangerous for cold water aquatic life.

The lowest recorded dissolved oxygen content for 2021 was 3.00 mg/L, recorded at South Zephyr Creek in South Lake Tahoe. Three sampling locations had dissolved oxygen readings of 4.0 mg/L, two in North Lake Tahoe: Tahoe City Urban Ditch, and Burton Creek at Star Harbor, and one in South Lake Tahoe at Meeks Creek above Highway 89.

All four regions had dissolved oxygen sites below 8.0 mg/L, with 36 records in total. In 2021, 13 sites had dissolved oxygen results less than 5 mg/L, compared to seven sites in 2020. The highest recorded dissolved oxygen content was 12.03 mg/L, collected at Donner Creek at the confluence with the Truckee River, in the Middle Truckee region. The highest dissolved oxygen reading in the Lake Tahoe basin was 10 mg/L recorded at Hatchery Creek at Star Harbor and Burke Creek at the mouth.

Figure 5: Dissolved oxygen concentrations that were measured below 8 mg/L.



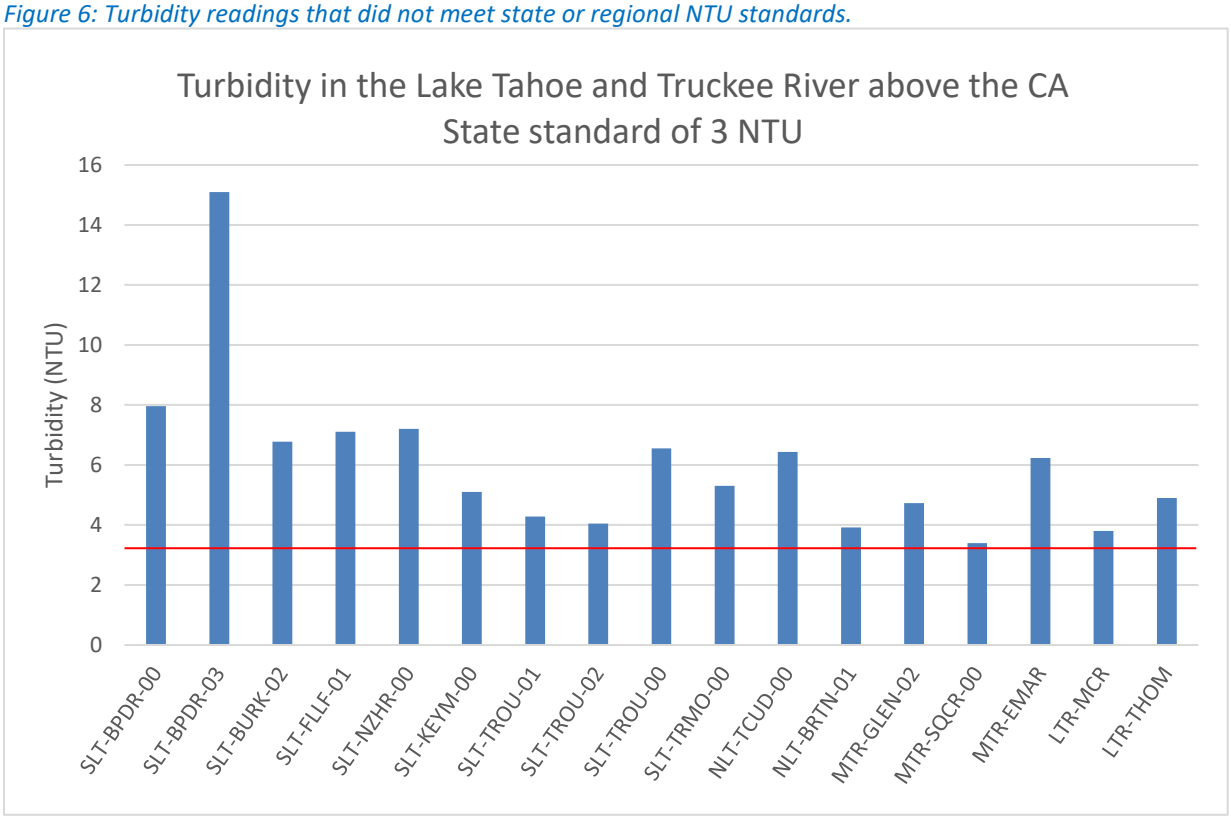
Turbidity

Turbidity is a measure of the number of suspended particles in the water column. Turbidity is measured in NTUs (Nephelometric Turbidity Units); high NTU levels indicate poor water clarity, low NTU levels indicate high clarity. Algae, suspended fine sediment particles, organic matter, and some pollutants can cloud the water making it more turbid. High sediment loads can clog the gills of fish, negatively affect gravel beds and smother fish eggs and benthic invertebrates. The sediment can also carry pathogens, pollutants, and nutrients that affect Lake Tahoe's water quality.

The U.S. EPA's recommended criteria for turbidity in streams in Eco-Region II (forested mountains in the western U.S.) is at or below 1.3 NTU. The California portion of the Truckee River Watershed is located within this Eco-Region; however, the State of Nevada outside of the Tahoe Basin is located right outside this Eco-Region. The TRPA and Lahontan have a nearshore turbidity standard of 1-3 NTUs (measured by monthly means) in Lake Tahoe. The standard for the Lower Truckee River and associated tributaries in Nevada is 10 NTU.

For the 2021 Snapshot Day event, 17 of the 75 sample sites had turbidity readings above the 3 NTU standard established by Lake Tahoe Regulatory Agencies. The highest turbidity reading for the 2021 Snapshot Day event was 15.1 NTU from the Bijou Park Drainage in South Lake Tahoe; this sample was the only result over 10 NTU during the 2021 event.

Figure 6: Turbidity readings that did not meet state or regional NTU standards.



Streamflow

Streamflow is the measure of the volume of water that is flowing, which varies with precipitation. Streamflow can have significant impact on water quality; during low flow conditions, high water temperature, low levels of dissolved oxygen, and elevated presence of toxins can all be exacerbated. During high flow conditions, the likelihood of increased erosion and excess sediment transfer can be of concern. Streamflow conditions can also impact fish habitat and other aquatic organisms and may affect the ability to spawn and/or reproduce.

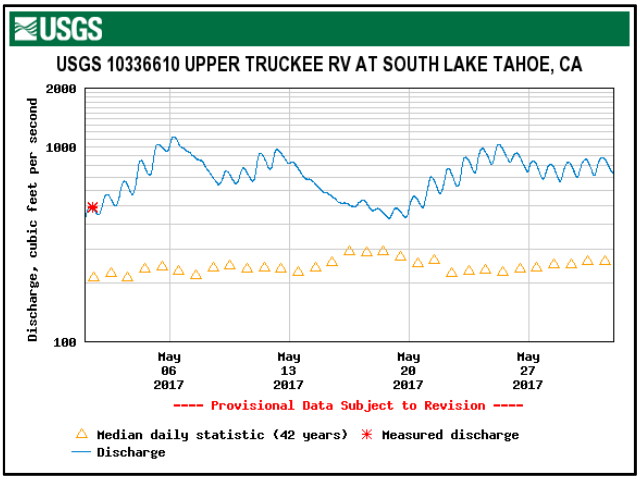
The water year of 2021 (Oct. 2020-September 2021) was an extremely dry year, with most of the Sierra Nevada region experiencing 44% or less of the average snowpack, which dramatically affects the amount of runoff from tributary streams as well as the water levels in the multiple reservoirs that serve as the primary water source for the greater Reno/Sparks area.

The graphs below show streamflow data collected by the U.S. Geological Survey (USGS) at two separate monitoring locations: a) Upper Truckee River upstream of Lake Tahoe; and b) Middle Truckee River at the Town of Truckee. This data illustrates the 2021 flow levels compared to an extremely wet year of 2017.

With the likelihood of the Lake Tahoe and Truckee region entering another drought cycle in 2022, fish and other aquatic life will be affected by low-water conditions, which unfortunately is becoming more common within the region.

Figure 7: Streamflow data from the Upper Truckee River above Lake Tahoe, California, during May for 2017 and 2021, respectively.

Upper Truckee River:



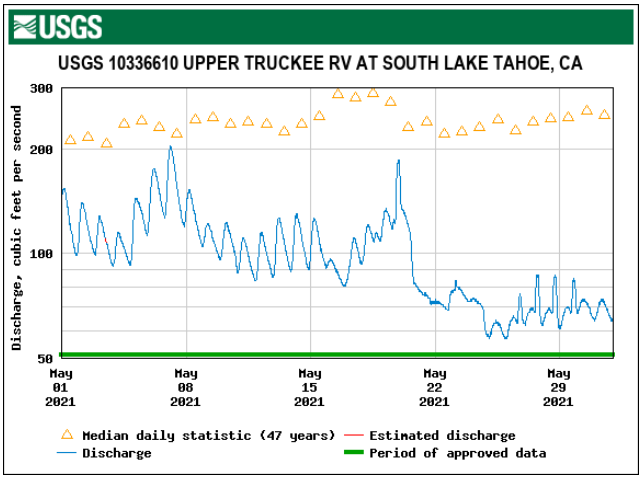
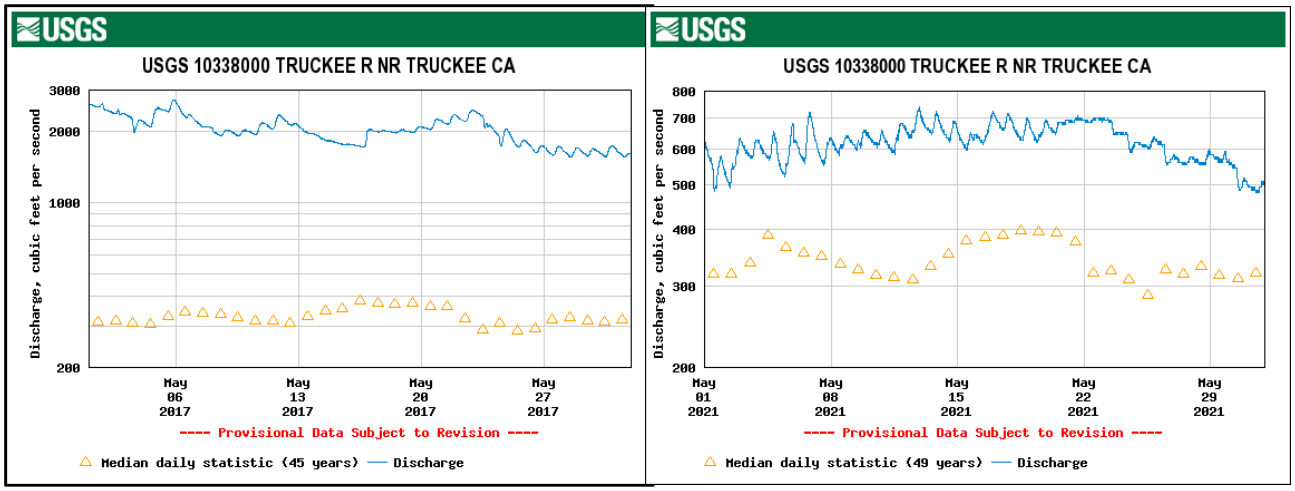


Figure 8: Streamflow data from the Middle Truckee River at the Town of Truckee, California, during May for 2017 and 2020, respectively.

Middle Truckee River:



Conductivity

Conductivity is a measure of water's ability to pass an electric current. In water, conductivity is affected by the presence of inorganic dissolved solids such as chloride, nitrate, calcium, sulfate, and others. Conductivity in rivers and streams is mainly influenced by the geology through which the water flows.

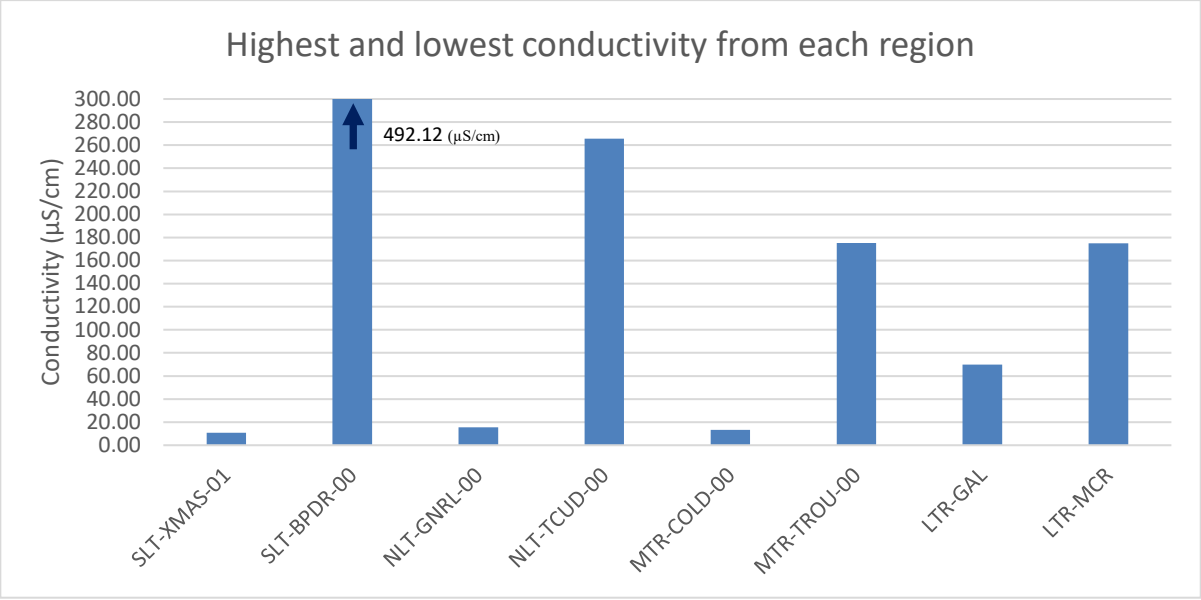
Electrical conductivity is also sensitive to flows – at high flows, the charged particles that make conductivity are diluted, so measured conductivity should be lower. At low flows, the particles are more concentrated, and conductivity measurements will often be higher. Primary sources of charged particles in the Truckee River watershed are road sands, road de-icers, and natural sources. Typically, urban areas or sites adjacent to high traffic roads will show higher electrical conductivity readings.

Abrupt changes in conductivity may indicate that new water sources or wastewaters are being diverted into a stream or river. Acceptable ranges for water conductivity are dependent on the water type. **Table 4** displays acceptable conductivity ranges for several water types. Conductivity was measured at 32 sample sites for Snapshot Day 2021. Conductivity and was calculated from Total Dissolved Solids for 7 North Lake Tahoe sites, and 35 South Lake Tahoe sites. The lowest conductivity recorded was 10.94 µS/cm, measured at the Upper Truckee River at Christmas Valley in South Lake Tahoe. The highest conductivity recorded was 429.12 µS/cm at the Bijou Park Drainage in South Lake Tahoe.

Table 3: Acceptable conductivity for different water types.

Water Type	**Conductivity** µS/cm (micro Siemens per centimeter**)**
Distilled Water	0.5 - 3.0
Melted snow	2 - 42
Potable water in the U.S.	30 - 1500
Irrigation Supply Water	< 750

Figure 9: Highest and lowest conductivity values from Snapshot Day 2021 by Region.



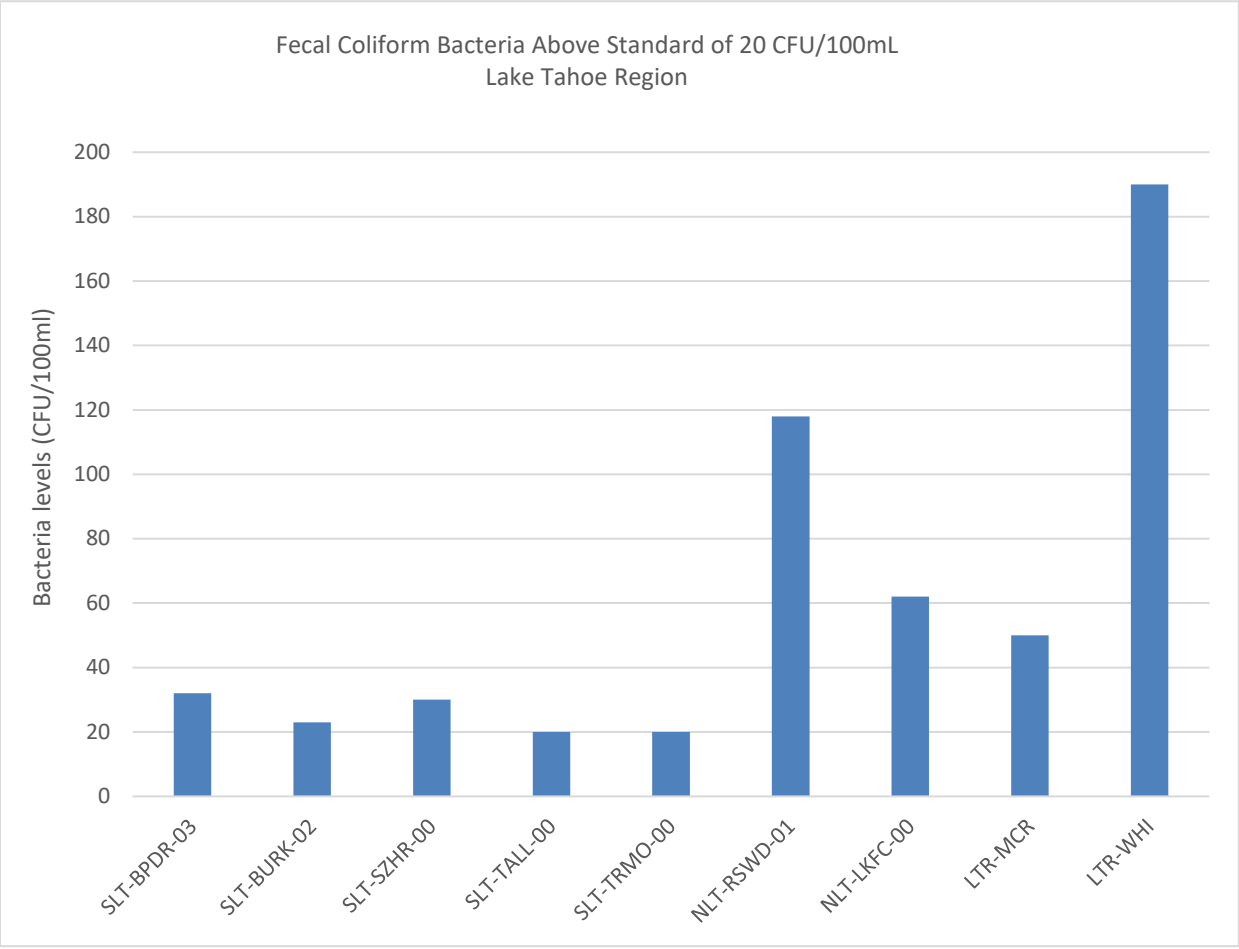
Fecal Coliform Bacteria

Coliform bacteria are found in the feces of warm-blooded animals, including humans, pets, livestock, beavers, and birds. Fecal coliform is measured in colony-forming units (CFUs) counted per 100 milliliters of water (CFU/100 mL). CFUs are roughly equivalent to the number of bacteria cells. The Lahontan standard for fecal coliform is 20 counts per 100 mL for a single occurrence based on a logarithmic mean of 5 samples taken within 30 days. By using 20 CFU/100 mL as guidance for a tolerable threshold of coliform, we can determine if that threshold is exceeded for the Tahoe/Truckee regions.

Escherichia coli (*E. coli*) is the major species in the fecal coliform group. Of the five general groups of bacteria that comprise the total coliforms, only *E. coli* is generally not found growing and reproducing in the environment. Consequently, *E. coli* is considered to be the species of coliform bacteria that is the best indicator of fecal pollution and the possible presence of pathogens. As a result, testing for coliform bacteria can be a reasonable indication of whether other pathogenic bacteria are present.

Fecal coliform was measured at 59 locations at Snapshot Day 2021. Across all four regions, nine of the samples had readings greater than 20 CFU/100 ml, and 25 samples had zero bacteria recorded.

Figure 10: Fecal coliform bacteria counts above 20CFU/100 mL standard – Lake Tahoe Region.



Nutrients

Sixty-four water samples collected at Snapshot Day 2021 were analyzed for nitrogen and phosphorus, which are of most concern for algal growth and water clarity. Along with excess algae growth, nutrient concentrations that are too high can lead to odors, discolored waters, loss of clarity, and nighttime oxygen depletion.

Nitrogen stimulates algal growth, which in turn can lead to eutrophication in aquatic systems. The most common source of nitrate is runoff from fertilized areas such as lawns or other landscaped areas. Nitrate (a sub-component of nitrogen) is also a byproduct of septic systems – it is a naturally occurring chemical left after the decomposition of human (and other animal) waste.

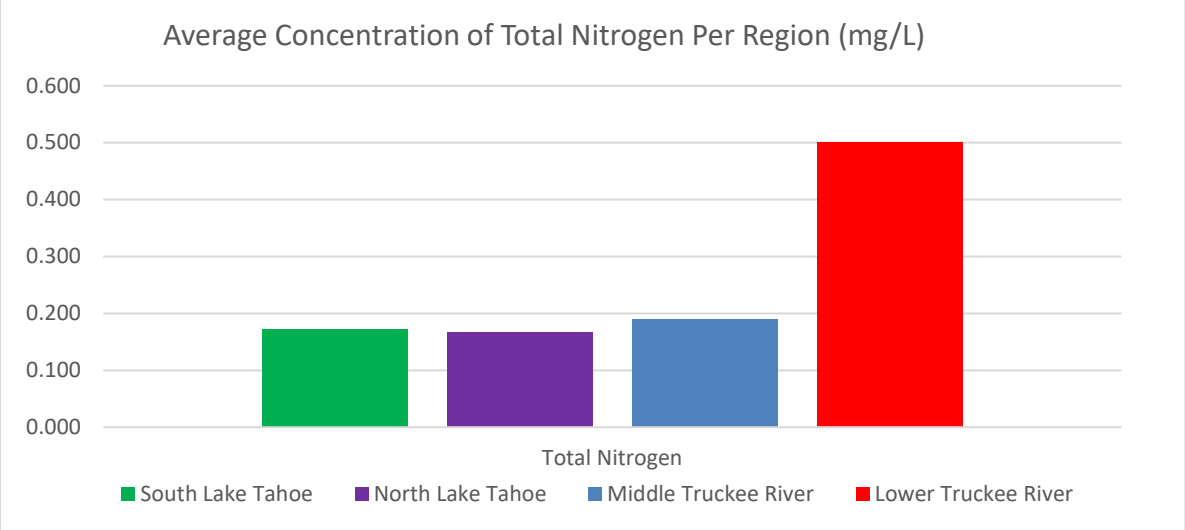
Excess phosphorus also stimulates high amounts of algal growth in aquatic systems. Phosphorus is naturally present in the environment in granitic and volcanic rocks, which are both found throughout the Tahoe Truckee watershed. Anthropogenic sources include various soaps and detergents, fertilizers, and other household chemicals.

In 2021 the types of nutrients analyzed varied substantially amongst the participating entities. The variability of data collection makes an accurate comparison difficult throughout the watershed. The following information summarizes where the highest concentrations of nutrients were analyzed per region. Additionally, graphic representations of the average concentration of Total Phosphorus and Total Nitrogen are provided.

Nitrogen

Total Nitrogen (T.N.)
Total nitrogen was analyzed throughout all four regions for Snapshot Day 2021, with 64 results. The Lahontan region has a total nitrogen standard of annual mean concentration of 0.087 mg/L, but the maximum allowable monthly mean is no more than 0.21 mg/L. South Lake Tahoe had a maximum detection of 0.431 mg/L at the Upper Truckee River at the Airport site. North Lake Tahoe had a maximum detection of 0.257 mg/L of Total Nitrogen at the Tahoe City Urban Ditch. The Middle Truckee River region had a maximum detection of Total Nitrogen at the Upstream of Glenshire Pond site with a result of 0.625 mg/L. The Lower Truckee River region had one detection of Total Nitrogen at the McCarran Ranch site with a result of 0.5 mg/L.

Figure 11: Total Nitrogen average concertation by region for 2021.



Ammonia (NH3)
The highest ammonia (NH3) level was detected for 2021 at the Tahoe City Urban Ditch in North Lake Tahoe, measuring 0.075 mg/L. All South Lake Tahoe sites were analyzed at the laboratory minimum detection rate of < 0.020 mg/L. The Middle Truckee River had maximum ammonia (NO3) detection of 0.013 mg/L at the Upstream of Glenshire Pond site. The Lower Truckee River region had ammonia results at the laboratory minimum detection rate of <0.1 mg/L at all four sample locations.

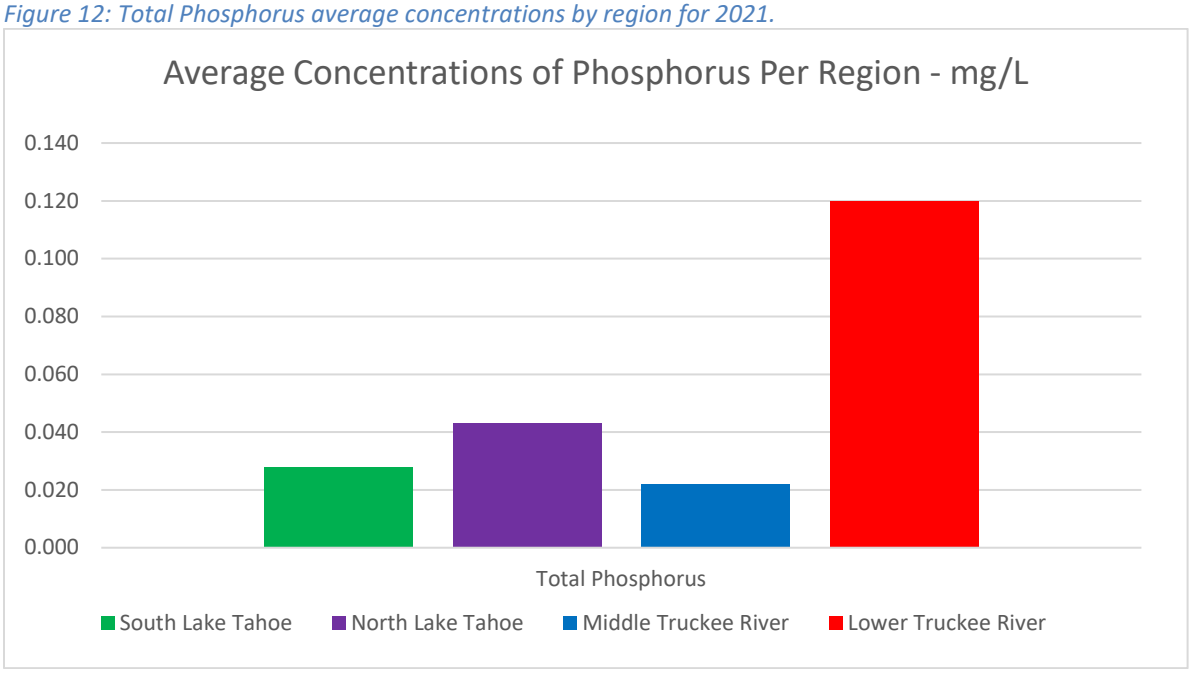
Nitrite (NO2)
All sites analyzed for Nitrite throughout the watershed were recorded at the laboratory minimum detection rate for their region. All Lake Tahoe sites were <0.01 mg/L, and Lower Truckee River sites were <0.01 mg/L. The Middle Truckee River region did not analyze sites for Nitrite.

Nitrate (NO3)
Only Lake Tahoe samples were analyzed for nitrate during the 2021 Snapshot Day event. The maximum detection was 0.301 mg/L taken at the Upper Truckee River at Airport sample site in South Lake Tahoe. The maximum Nitrate result in North Lake Tahoe was 0.049 mg/L taken at Secret Harbor Creek at mouth. In total, 41 samples were analyzed for nitrate in both Lake Tahoe Regions, with 35 results at the laboratory minimum detection rate of <0.01 mg/L.

Phosphorus

Total Phosphorus (T.P.)
For the 2021 Snapshot Day event, all four regions analyzed samples for Total Phosphorus. South Lake Tahoe had a maximum Total Phosphorus result of 0.068 mg/L from the Trout Creek at Bellevue Ave site. The maximum Total Phosphorus result for North Lake Tahoe of 0.108 mg/L was taken from Burton Creek at Star Harbor. Martis Creek had the highest Total Phosphorus result for the Middle Truckee River region of 0.051 mg/L. The Lower Truckee River region's maximum Total Phosphorus result was taken on Thomas Creek at Sage Ridge School, and the result was 0.15 mg/L.

Figure 12: Total Phosphorus average concentrations by region for 2021.



Orthophosphates (PO4)

The Lower Truckee River region analyzed all four sample sites for orthophosphate. The maximum result was taken from Thomas Creek at Sage Ridge School, 0.05 mg/L. The minimum result of 0.01 mg/L was taken from Galena Creek.

Visual Observations

Visual observations are also collected as a component of Snapshot Day monitoring. Visual observations included cloud cover, precipitation, wind, water clarity, in-stream flow, sample color, sample odor, and other items observed in the samples. This information helps to provide context to the water quality parameters that are being monitored and allows for the identification of potential causes of degraded water quality (i.e., presence of urban development)

Visual observations were recorded at 79 from Snapshot Day 2021. Visual observations included cloud cover, precipitation, wind, water clarity, in-stream flow, sample color, sample odor and other items observed in the samples.

Table 4: Number of monitored sites with In-Stream Flow

In Stream Flow

dry creekbed	isolated pools	trickle	slow/ smooth	moderate rippling	rapid/ turbulent	flooding
5	**1**	**5**	**25**	**32**	**8**	**0**

Table 5: Number of monitored sites for each sample color classification

Sample Color

None	amber	yellow	green	brown	gray	other
71	0	0	0	1	0	1

Table 6: Number of monitored sites for each sample odor classification

Sample odor

None	Fresh algae	Chlorine	Rotten eggs	Sewage	Other
71	2	0	0	0	0

Table 7: Number of monitored sites with the presence of the objects noted.

Other presence

Algae or other water plants	Oily Sheen	Foam or suds	Litter or trash	Other
35	1	9	8	10

Discussion

Compared to many other watersheds in the nation, data collected within the Truckee River watershed indicates good overall water quality. Mountain streams and snowmelt conditions feed the Truckee River watershed which contains heavily forested headwaters as well as urban concentrations (Reno/Sparks) located in the lower portion of the watershed. The presence of concentrated urban development and high amounts of impervious surface areas exist within all regions of the watershed (upper, middle & lower). These land-use conditions can have a significant impact on water quality. They should continue to be monitored to assess the watershed's condition and ensure local water bodies meet regional and state standards.

The data collected for Snapshot Day 2021 show 80% of sites monitored have water quality objectives meeting regulatory requirements. The 2021 dataset shows a decrease in the number of sample sites with elevated pH levels, with only 20% of sites sampled recording pH values above 8.4 compared to 50% in 2020. Dissolved oxygen depletion has improved with 48% of samples below 8 mg/L compared to 50% in 2020. Dissolved oxygen levels below 8 mg/L are of concern for fish and other aquatic organisms. The low water levels in 2021 show an expected increase in water temperature and pH levels and a subsequent decrease in dissolved oxygen. If this trend continues into the future, we will likely see a substantial increase in algal blooms and increased degradation of viable aquatic habitat that supports spawning and reproductive capacity of the organisms dependent on our streams, lakes, and waterways.

As previous data sets from the past 21 years are compiled, and data storage is improved, this program will have the ability to show long-term trends and better assist agencies. It has been funded primarily through local, state, and private agencies. The extensive event coordination is partner-driven, and participation from an almost entirely volunteer basis is exceptional. The collaboration and continued dedication of those involved, from dedicated staff to engaged volunteers, makes Snapshot Day a success each year. The ongoing success of this type of event exemplifies the value of citizen science and shows how community members can provide invaluable data collection and learn about their watershed at the same time.

For more information about how to get involved with water quality monitoring activities, contact the following agencies and organizations:

- *North Lake Tahoe:* Sarah Vidra (775) 832-1284; Incline Village GID Waste Not
- *South Lake Tahoe:* Emily Frey (530) 541-5388; League to Save Lake Tahoe
- *Middle Truckee River (Tahoe City to Nevada State Line)*: Eben Swain, (530) 550-8760, x7; Truckee River Watershed Council
- *Lower Truckee River (Nevada State Line to Pyramid Lake)*: Meghan Walsh, (775) 324-0936; Great Basin Outdoor School

References

Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion II, U.S. Environmental Protection Agency, December 2000

California State Water Resources Control Board Clean Water Team website: http://www.swrcb.ca.gov/water_issues/programs/swamp/cwt_volunteer.shtml

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The California Streamside Biosurvey: An Introduction to Using Aquatic Invertebrates as Water Quality Indicators, California State Water Resources Control Board, September 2001

Water Quality Control Plan for the Lahontan Region, California Regional Water Quality Control Board, Lahontan Region, 1993 Revision

Water Supply Outlook, Natural Resource Conservation Service website, www.nrcs.us.gov

Appendices

Appendix A – Resource Partners

2021 Snapshot Day sponsors

- California State Water Resource Control Board
- Great Basin Outdoor School
- Lahontan Regional Water Quality Control Board
- Lake Tahoe Community College
- League to Save Lake Tahoe
- Nevada Division of Environmental Protection
- Nevada State Health Laboratory
- Pyramid Lake Paiute Tribe
- South Tahoe Public Utility District
- Tahoe Environmental Research Center
- Tahoe Water Suppliers Association
- Truckee River Watershed Council
- United States Geologic Survey
- Waste Not, Incline Village General Improvement District

Citizen Monitoring Working Group Snapshot Day Planning Committee

- Eben Swain (Truckee River Watershed Council)
- Emily Frey (League to Save Lake Tahoe)
- Sarah Vidra (Incline Village General Improvement District)
- Joe Hill (Incline Village General Improvement District)
- Meghan Walsh (Great Basin Outdoor School)

Organizations hosting Snapshot Day 2021

- Incline Village General Improvement District
- League to Save Lake Tahoe
- Truckee River Watershed Council
- Great Basin Outdoor School
- Tahoe Water Suppliers Association
- Lahontan Regional Water Quality Control Board
- U.S. Geological Survey, Carnelian Bay Field Station
- Lake Tahoe Community College

Laboratory Analyses (Nutrients and Bacteria)

- Nevada State Public Health Laboratory
- South Tahoe Public Utility District
- Lahontan Regional Water Quality Control Board Laboratory
- United States Geologic Survey
- High Sierra Water Lab

Equipment and Contact

- California State Water Resource Clean Water Team, Erick Burres
- Incline Village General Improvement District, Sarah Vidra
- League to Save Lake Tahoe, Emily Frey
- Tahoe Environmental Research Center
- Truckee River Watershed Council, Eben Swain
- United States Geological Survey, Paul Honeywell

Resource Partners

- U.S. Geological Survey
- Great Basin Institute
- City of South Lake Tahoe

Special thanks to

- Sabrina Rice, Lahontan, for bacteria and turbidity analysis
- Paul Honeywell, U.S. Geologic Survey, Truckee CA office, for coordinating bacterial analysis
- Rebecca Sawyer Williams, IVGID, for turbidity analysis
- Ann Liston, Tahoe Environmental Resource Coalition, for hosting equipment calibration
- Soroptimist International of the Tahoe Sierra, for funding the event
- Dan Arce, South Tahoe Public Utility District for nutrient analyses
- **And all the volunteers that make Snapshot Day possible!**

Appendix B – Site names and codes

Snapshot Day site and site code are listed below.

South Lake Tahoe	
Angora Creek at Upper Truckee River Confluence	SLT-ANG3-00
Angora Creek at Washoe Meadows State Park	SLT-ANG2-01
Angora Creek upstream of Lake Tahoe Boulevard	SLT-ANG1-02
Bijou Creek at Mouth	SLT-BJCR-00
Bijou Creek downstream of Fairway Dr	SLT-BJCR-01
Bijou Creek upstream of Pioneer	SLT-BJCR-02
Bijou Park Drainage at Mouth	SLT-BPDR-00
Bijou Park Drainage upstream of Verdon Lane	SLT-BPDR-03
Burke Creek at Mouth	SLT-BURK-00
Burke Creek downstream of Highway 50	SLT-BURK-02
Cold Creek at Trout Creek Confluence	SLT-COLD-00
Edgewood Creek at Mouth	SLT-EDGE-00
Edgewood Creek upstream of Highway 50	SLT-EDGE-01
Fallen Leaf Lake near Dam	SLT-FLLF-01
Glen Alpine Creek at Fallen Leaf Lake	SLT-GLEN-00
Heavenly Valley Creek at Trout Creek Confluence	SLT-HEAV-00
Heavenly Valley Creek upstream of Pioneer Trail	SLT-HEAV-01
Lake Tahoe at Nevada Beach	TAH-SLAKE-05
Lake Tahoe at Regan Beach	TAH-SLAKE-04
Lake Tahoe at Roundhill Pines	TAH-SLAKE-07
McFaul Creek at Mouth	SLT-MCFA-00
McFaul Creek downstream of Highway 50	SLT-MCFA-01
Meeks Creek at Mouth	SLT-MEEK-00
Meeks Creek upstream of Highway 89	SLT-MEEK-01
North Zephyr Creek at Mouth	SLT-NZHR-00
South Zephyr Creek at Mouth	SLT-SZHR-00
Tahoe Keys East Channel	SLT-KEYM-00
Tahoe Keys West Channel	SLT-KEYS-00
Tallac Creek at Mouth	SLT-TALL-00
Taylor Creek at Mouth	SLT-TALR-00
Taylor Creek upstream of Hwy 89	SLT-TALR-02
Trout Creek at Bellevue Avenue	SLT-TROU-01
Trout Creek at Grinding Stone	SLT-TROU-02

Trout Creek at Mouth	SLT-TROU-00
Trout Creek at Saxon Creek Confluence	SLT-TROU-03
Upper Truckee River at Airport	SLT-TR15-02
Upper Truckee River at Christmas Valley	SLT-XMAS-01
Upper Truckee River at Mouth	SLT-TRMO-00
Upper Truckee River downstream of Elks Club Drive	SLT-TR20-01
Upper Truckee River upstream of Lake Tahoe Boulevard	SLT-TR10-01
North Lake Tahoe	
Secret Harbor Creek at mouth	NLT-SCRT-00
Griff Creek at mouth	NLT-GRIF-00
Tahoe City Urban Ditch at lake	NLT-TCUD-00
Burton Creek at Star Harbor	NLT-BRTN-01
Quail Creek at mouth	NLT-QULC-00
General Creek at mouth	NLT-GNRL-00
Rosewood Creek abv Third	NLT-RSWD-01
Lake Forest Creek at mouth	NLT-LKFC-00
Hatchery Creek at Star Harbor	NLT-STAR-01
Madden Creek at mouth	NLT-MADC-01
McKinney Creek at HW-89	NLT-MKNY-01
Middle Truckee River	
ACOE boundary @ Lahontan	MTR-MART-01
Martis Creek at Mouth	MTR-MART-00
Prosser Creek below dam	MTR-PROS-01
Downstream of dam	MTR-DONN-03
Donner @ confluence	MTR-DONN-00
Donner Creek @ 89	MTR-DONN-01
Tahoe Donner Clubhouse	MTR-TROU-02
Upstream of Glenshire Pond	MTR-GLEN-02
Union Valley Creek	MTR-GLEN-00
LTR below Boca dam	MTR-BOCA-00
LTR @ Boyington	MTR-BOCA-01
Prosser Creek @89	MTR-PROS-02
Bear Creek - west of confluence w Truckee	MTR-BEAR-00
Squaw - west of confluence w/ Truckee	MTR-SQCR-00
Truckee River in Town	MTR-TOWN
Alder Creek	MTR-ALDR
East Martis @ Bridge	MTR-EMAR
Mainstem below Tahoe dam	MTR-TR01
Coldstream Canyon	MTR-COLD-00

I80 @ Floriston	MTR-I-80C
Silver Creek above 89	MTR-SILV
Pole Creek above 89	MTR-POLE-00
Deep Creek above 89	MTR-DEEP
Trout Creek @ mouth	MTR-TROU-00
Lower Truckee River	
Galena Creek at Regional Park	LTR-GAL
Truckee River at McCarran Ranch	LTR-MCR
Thomas Creek at Sage Ridge School	LTR-THOM
White's Creek at Mountain View Montessori	LTR-WHI

Appendix C – Monitoring equipment

Most monitoring teams are assigned the following field instruments:

- Armored Envirosafe thermometers (alcohol-filled, 0.5° C resolution);
- Standard pH indicator strips (0.5 pH unit resolution) or handheld Hannah pH meters (0.02 unit resolution);
- Handheld Oakton TDS Tester Conductivity meters (10 µS/cm resolution or Oakton Conductivity Low+ meters 1 µS/cm resolution); and
- Chemetrics dissolved oxygen kits (colorimetric, indigo carmine dye reaction, 1 mg/L resolution below 6 mg/L and 2 mg/L resolution above 6 mg/L)

Turbidimeters used at the staging locations were supplied by Truckee River Watershed Council, the League to Save Lake Tahoe, and the Tahoe Water Supplies Association.

Nutrient and bacteria samples are kept chilled with ice or blue ice in coolers from the point of collection until arrival at the lab for analysis. Bacteria samples are collected in sterile Whirl-packs; nutrient and turbidity samples are collected in clean plastic bottles.

Bacteria samples are then transported from drop-off points at Lake Tahoe and Truckee to either the Lahontan Water Quality Lab in South Lake Tahoe or the U.S. Geologic Survey in Truckee. The need for multiple labs for such a large area is to ensure sample analysis within the allotted 4-hour holding time. Quality assurance is comparable as each lab uses the same method, SM9222 from Standard Methods for Water and Wastewater Analysis, 21 Edition, 2007.

Nutrient samples collected within the Lake Tahoe Basin are delivered to South Tahoe Public Utility District in South Lake Tahoe within the allotted hold time. Middle Truckee River samples are sent to High Sierra Labs for analysis.