Rush Creek Project, FERC Project No. 1389

AQ 4 – Water Quality Technical Study Report

January 2025

Energy for What's Ahead[SM]

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List of Acronyms

°C	degrees Celsius
µS/cm	microSiemens per centimeter
Basin Plan	Water Quality Control Plan for the Lahontan Region
CRWQCB	California Regional Water Quality Control Board, Lahontan Region
DO	dissolved oxygen
E. coli	*Escherichia coli*
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GPS	global positioning system
m	meter
mg/L	milligrams per liter
mL	milliliter
MPN	most probable number of bacterial colonies
NTR	National Toxics Rule
NTU	nephelometric turbidity units
ppt	parts per thousand

Project	Rush Creek Project
QA/QC	quality assurance/quality control
SCE	Southern California Edison
TDS	total dissolved solids
TSP	Technical Study Plan
TSR	Technical Study Report
WETLAB	Western Environmental Testing Laboratory

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1 INTRODUCTION

This Technical Study Report (TSR) describes the methods and results associated with implementation of the AQ 4 – Water Quality Technical Study Plan (TSP) for the Rush Creek Project (Project). The Water Quality TSP was included in Southern California Edison's (SCE) Revised Study Plan[1] and was approved by the Federal Energy Regulatory Commission (FERC) on October 26, 2022, as part of Study Plan Determination. After the first year of study, the AQ 4 – TSP was modified by FERC. The California State Water Resources Control Board filed comments[2] to the Initial Study Report (ISR)[3] requesting an additional year of water quality sampling due to anomalous wet year conditions during the 2023 study season. On February 23, 2024, FERC's determination on requests for modifications to the approved study plan required an additional year of study during a normal or dry water year. 2024 was a normal water year and an additional year of water quality data was collected. This report describes the methods and results of AQ 4 – TSP that was implemented in 2023 and 2024, with different water year types.

2 STUDY OBJECTIVES

- Collect seasonal water quality data (physical, chemical, and bacterial) in Project-affected stream segments and Project reservoirs.

- Compare water quality conditions to the objectives/criteria of the Water Quality Control Plan for the Lahontan Region (Basin Plan; California Regional Water Quality Control Board [CRWQCB] 2021) and other water quality standards.

3 STUDY IMPLEMENTATION

The initial Water Quality TSP field work was initiated June 2023 and completed in October 2023 ("wet" water year type). The second year of field work was initiated June 2024 and completed in October 2024 ("normal" water year type). The study elements completed and study variances for both sampling years are discussed below.

3.1 STUDY ELEMENTS COMPLETED

- All study elements related to the field work, data analyses, and reporting have been completed.

[1] SCE filed a Proposed Study Plan on May 26, 2022 (SCE 2022a). Four comment letters were filed on the Proposed Study Plan; and six study plans were revised. Therefore, SCE filed a Revised Study Plan on September 23, 2022 (SCE 2022b). FERC subsequently issued a Study Plan Determination on October 26, 2022, approving all study plans for the Rush Creek Project (FERC 2022).

[2] State Water Resources Control Board filed Initial Study Report comments with FERC on December 21, 2023.

[3] The Initial Study Report was filed with FERC on October 27, 2023.

3.2 STUDY VARIANCES

SCE implemented one voluntary enhancement of the study (not a variance):

- Bacterial water quality samples were tested for *Escherichia coli* (*E. coli*) in addition to total coliform and fecal coliform specified in the TSP. The results have been incorporated into this TSR.

All study variances were relatively minor and did not affect the efficacy of the study results.

- 2023 Variances
  - The study plan identified monthly profile sampling for Gem, Agnew, and Silver Lakes (June to October). In 2023, Gem and Agnew lakes were sampled July to October. Sampling began as soon as the melting snowpack allowed us to access the lakes.
  - Due to a laboratory processing error, fecal coliform analysis was not performed for one of the five bacterial sampling events / samples collected in 2023 at Agnew and Gem lakes. Total coliform and E. coli analyses were performed.
  - During the July 2023 sampling event, the temperature/conductivity sensor malfunction. Troubleshooting in the field partially mitigated the issue; however, temperature and conductivity were not recorded for one of the two profile locations on Gem Lake.
- General Variances
  - Due to the remote nature of much of the Project area, alkalinity measurements were collected as part of the spring runoff and late summer/early fall base flow water quality grab samples and analyzed at a state-certified laboratory rather than measured in the field as in-situ measurements.
  - For some parameters, Western Environmental Testing Laboratory (WETLAB) used different but equivalent analysis methods to those specified in the Water Quality TSP (Standard Methods instead of Environmental Protection Agency [EPA] methods). The methods are summarized in Table AQ 4-1. EPA recognizes the Standard Methods analyses as equivalent.
  - Due to the remote nature of the upper portions of the Project area (i.e. above Agnew Dam), hold times for some samples were exceeded in both the spring runoff period and the late summer/early fall base flow periods. These hold-time exceedances are noted in the TSR.

3.3 OUTSTANDING STUDY ELEMENTS

There are no outstanding study elements.

4 STUDY AREA AND STUDY SITES

The study area for the water quality assessment includes Project-affected stream segments and Project reservoirs. Water quality sampling locations are identified in Table AQ 4-2 and Map AQ 4-1.

5 STUDY APPROACH

The following describes the water quality sampling field program which includes seasonal in-situ water quality measurements; seasonal water quality grab sampling; reservoir/lake profiles; and laboratory analysis and reporting.

5.1 WATER QUALITY SAMPLING LOCATIONS

- Water quality sampling locations are identified in Table AQ 4-2 and depicted on Map AQ 4-1.
- Exact sampling locations were determined in the field based on sampling suitability (i.e., well-mixed and deep enough for representative sampling) and accessibility.
- Sampling locations were documented using hand-held global positioning system (GPS) units.

5.2 SEASONAL IN-SITU FIELD MEASUREMENTS – STREAMS

- In-situ water quality measurements, which included dissolved oxygen (DO) (milligrams per liter [mg/L] and % saturation), pH, specific conductance (microSiemens per centimeter [µS/cm]), salinity (parts per thousand [ppt]), turbidity (nephelometric turbidity units [NTU]), and water temperature (degrees Celsius [°C]) were collected in Rush Creek and Reversed Creek.
- In 2023, measurements were recorded once during the spring runoff (June 26 – 27, 2023, at sites below Gem Dam and July 26, 2023, at sites above Gem Dam), and once during the late summer/early fall base-flow period (September 25 – 28, 2023).
- In 2024, measurements were recorded once during the spring runoff (June 24 – 26, 2024), and once during the late summer/early fall base-flow period (September 17 – 19, 2024).
- At stream sampling locations, measurements were made approximately 0.1 meter (m) beneath the surface in flowing, well-mixed riffle or run areas.
- Samples were collected using a multi-parameter water quality meter (YSI ProDSS).
- Pre- and post-sampling calibration of in-situ instrumentation was conducted following the manufacturer's instructions.
- Alkalinity (mg/L) was collected as part of the Seasonal Water Quality Grab Samples (below), rather than *as* in-situ measurements.

5.3 SEASONAL WATER QUALITY GRAB SAMPLES

- Water quality grab samples were collected at Project-affected stream segments and Reversed Creek; Project reservoirs; and Silver Lake.

  - In 2023, samples were collected twice, once during the spring runoff (June 26 – 27, 2023 below Agnew Dam and July 24 – 26 above Agnew Dam) and once during the late summer/early fall base-flow period (September 25 – 29, 2023) in coordination with the in-situ water quality measurements.

  - In 2024, samples were collected twice, once during the spring runoff (June 24 – 26, 2024) and once during the late summer/early fall base-flow period (September 17 – 19, 2024) in coordination with the in-situ water quality measurements.

  - At stream sampling locations, grab samples were collected approximately 0.1 m beneath the surface in flowing, well-mixed riffle or run areas.

  - At lake sampling locations, grab samples were collected from the epilimnion (1 m deep) and hypolimnion (mid-depth between the thermocline and lake bottom). If the lakes were not stratified, then water grab samples were collected approximately 1 m from the surface and at mid-depth from surface to lake bottom.

  - It should be noted that Gem Lake is located within the Ansel Adams Wilderness Area. Use of a motorized vessel for collection of seasonal water quality grab samples in Gem Lake was not allowed. Instead, field crews utilized a cataraft with an oar frame on both Gem Lake and Agnew Lake. A motorized boat was used for sampling on Silver Lake.

  - Samples were collected consistent with EPA protocols for each analyte (see Laboratory Analysis below) and consistent with general water quality sampling methods found in the National Field Manual for the Collection of Water-Quality Data (United States Geological Survey 2023).

  - The sampling team employed a strict quality assurance/quality control (QA/QC) program. Equipment (bottles / samplers) were clean and thoroughly rinsed in the field with the water being sampled prior to sampling at each sampling location. The Kemmer sampler used for lake surface and mid-column samples was filled and rinsed three times before sampling. Sampling bottles were obtained clean and sterile from the laboratory and remained sealed until sample collection. Specific collection of equipment blanks was not necessary for these samples. Collection of field blanks typically would have required hauling of deionized water into remote sampling areas and was not included in the sampling protocol, however, lab blanks were performed for all parameters. Field replicates / additional sampling was not collected unless exceedances were reported.

  - Water quality samples were decanted into laboratory-supplied sample containers and analyzed at WETLAB, Sparks, Nevada.

  - The sample containers were labeled with the date and time that the sample was collected and the sampling site or identification label.

  - The sample container was preserved (as appropriate), stored, and delivered to a state-certified water quality laboratory for analyses in accordance with maximum holding periods.

  - A chain-of-custody record was maintained with the samples at all times.

5.4 RESERVOIR/LAKE PROFILES

- Reservoir/lake profiles (DO, pH, specific conductance, salinity, turbidity, and water temperature) were collected at Gem, Agnew, and Silver lakes.[4]

  - Samples were collected monthly in June, July, August, September, and October in 2023 and in 2024, as access permitted. During the 2023 sampling, access was not possible at Gem and Agnew lakes until July due to the snowpack.

  - Water quality profiles in the reservoirs/lake were based on a ≤1 m sampling interval through the entire water column.

  - Secchi disk depth measurements of water clarity were also collected in each reservoir/lake.

  - Samples were collected using a multi-parameter water quality meter (YSI ProDSS).

  - Pre- and post-sampling calibration of in-situ instrumentation was conducted following the manufacturer's instructions.

  - Boat use for reservoir/lake profiles was identical to the description in seasonal water quality grab samples above (Section 5.3). Due to wind and lack of a motorized boat on Gem Lake, the reservoir profiles are only approximate due to boat movement during the profile measurements.

5.5 BACTERIAL SAMPLING

- Surface water bacteria samples were collected for total and fecal coliform and for *E. coli* in Gem and Agnew lakes in accessible locations near the dams. Samples were collected during five relatively evenly spaced times in the month of July of 2023 and 2024.

[4] Due to seismic restrictions, Waugh Lake is drained through the summer, fall, and winter. The low-level outlets are left open year-around and water only accumulates in the reservoir during spring / early summer high flows when inflow exceeds the capacity of the low-level outlets.

5.6 LABORATORY ANALYSIS

- Water quality samples collected during the field program were processed by a WETLAB, which has been approved by the State Water Resources Control Board for chemical analysis.

- The parameters analyzed by WETLAB are provided in Table AQ 4-3 and described in Appendix A.

- The laboratory reported each chemical parameter analyzed with the laboratory reporting limit (typically 3x the detection limit). The laboratory attempted to attain reporting limits that were at or below the applicable regulatory criteria.

- Results from the water quality sampling were compared with the water quality objectives/criteria identified in the Basin Plan (CRWQCB 2021), including recent updates to the bacteria criteria (Resolution No. R6T-2023-0025 [CRWQCB 2023]) and with other relevant water quality standards. The other water quality standards are the California Toxics Rule (Federal Register, 65 FR 31682, EPA 2000), National Toxics Rule (NTR) (Federal Register, 57 FR 60848, EPA 1992); and EPA national water quality criteria (65 FR 31682, EPA 2023).

6 STUDY RESULTS

Water quality objectives, seasonal in-situ field measurements, seasonal water quality grab samples, reservoir/lake profiles, and bacterial sampling are described below. Results of the QA/QC of the laboratory reports are also discussed at the end of this section.

6.1 WATER QUALITY OBJECTIVES AND CRITERIA

Table AQ 4-3 provides a summary of the water quality tests, detection and reporting limits, applicable water quality criteria, holding times, and preservative requirements. Applicable water quality criteria for ammonia, which is pH and temperature dependent, are shown in Table AQ 4-4 and criteria for total dissolved solids (TDS), nitrate, total nitrogen, and phosphate for specific water bodies in the Project sampling area are shown in Table AQ 4-5. The Basin Plan (CRWQCB 2021) includes water quality objectives for the protection of beneficial uses in the Project sampling area. Beneficial uses are listed in Table AQ 4-6. They include: (1) municipal and domestic supply; (2) power generation; (3) commercial and sportfishing; (4) water contact recreation; (5) water non-contact recreation; (6) cold freshwater habitat; (7) spawning habitat for fisheries; (8) wildlife habitat; and (9) freshwater replenishment.

6.2 SEASONAL IN-SITU FIELD MEASUREMENTS – STREAMS

Seasonal 2023 in-situ stream results are presented in Table AQ 4-7 for the spring runoff sampling period and in Table AQ 4-8 for the late summer/early fall base-flow period. In 2023, due to prolonged snowpack access issues, the spring runoff period was conducted in June at the lower elevation sites and July at higher elevation sites. Seasonal 2024 in-situ stream results are presented in Table AQ 4-9 for the spring runoff sampling period and in Table AQ 4-10 for the late summer/early fall base-flow period. Each in-situ parameter is discussed below.

6.2.1 Water Temperature

Water temperature was COLD as specified in Basin Plan. During the 2023 spring sampling period (June 26, June 27, and July 26, 2023) stream water temperatures ranged from 3.5°C to 7.7°C. In the 2024 spring sampling period (June 25 - 26) water temperatures ranged from 7.6°C to 13.4°C, which was higher than temperatures observed during the spring runoff in 2023. During the 2023 fall sampling period (September 26 to September 28, 2023) stream water temperatures ranged from 6.9°C to 12.5°C. In the 2024 fall sampling period (September 17 - 19) water temperatures ranged from 7.5°C to 13.4°C, comparable to those observed in 2023. In-situ field measurements are single point measurements taken at each site and the time of day the measurements occurred varied across sites. Continuous water temperature monitoring, which provides better temporal representation of water temperature, was conducted in 2022 and 2023 as part of the AQ 3 – Water Temperature Technical Study Plan and is reported there. That study was not repeated in 2024. The continuous temperature data also show COLD water conditions throughout the Project sampling area in 2022 and 2023.

6.2.2 Dissolved Oxygen

During the 2023 spring runoff sampling period DO ranged from 8.90 to 10.25 mg/L (Table AQ 4-7) and during the fall period DO ranged from 8.82 to 10.78 mg/L (Table AQ 4-8). During the 2024 spring runoff sampling period DO ranged from 8.82 to 9.80 mg/L (Table AQ 4-9) and during the fall period DO ranged from 7.62 to 9.80 mg/L (Table AQ 4-10).All sites were within Basin Plan criteria for minimum dissolved oxygen concentration, ≥80 percent saturation and the typical 7 mg/l identified as suitable for coldwater fish. All sites were also within EPA's (EPA 1986) recommended 8.0 mg/L 1-day minimum dissolved oxygen for water column concentrations recommended to achieve intergravel dissolved oxygen concentrations for coldwater fish egg incubation, including early life stages ≤30 days following hatching, except for three sites in the fall. These sites were just under 8.00 mg/L (ranged from 7.62 to 7.90 mg/L) (Table AQ 4-10) and were 93 to 100 % oxygen saturation for the elevation and water temperature.

6.2.3 Specific Conductance

Specific conductivity sample results generally indicated water with low dissolved solids and low salinity, which is a product of the relatively insoluble watershed geology (granite/volcanic). Conductivity measurements during the 2023 spring runoff ranged from 4.5 to 55.0 µS/cm (Table AQ 4-7) and from 9.0 to 111.0 µS/cm (Table AQ 4-8) during the late summer/early fall base flow sampling period. During the 2024 sampling period, spring runoff ranged from 5.0 to 48 µS/cm while the fall period ranged from 8.2 to 91 µS/cm (Tables AQ 4-9 and 4-10 respectively). Higher conductivity measurements in the fall in both sampling years were generally observed in Reversed Creek, Rush Creek below Agnew Dam, and Rush Creek above Silver Lake. These locations overlay a small section(s) of marine sedimentary rock (Green et al. 1997; SCE 2021: Section 4.7). There are no conductivity criteria in the Basin Plan, but there are criteria for TDS (see Section 6.3 Seasonal Water Quality Grab Samples below).

6.2.4 pH

pH was typical of low alkalinity water derived from granitic and volcanic watersheds (Miller 2002). During the 2023 spring runoff sampling period, pH ranged from 6.60 to 7.30 (Table AQ 4-7) and during the fall sampling period, pH ranged from 6.57 to 7.35 (Table AQ 4-8). During the 2024 spring runoff sampling period, pH ranged from 7.56 to 8.36 (Table AQ 4-9) and during the fall sampling period, pH ranged from 6.82 to 7.76 (Table AQ 4-10). All sites were within the 6.5 to 8.5 pH range identified in the Basin Plan (CRWQCB 2021) and within the NTR 6.5 to 9 pH range for chronic exposure for fish in fresh water (EPA 2023).

6.2.5 Turbidity

Turbidity measurements throughout the Project sampling area were extremely low (high water clarity) for both the spring runoff and fall in-situ sampling in 2023 (all results <1.0 NTU) (Table AQ 4-7 and 7-8). Similar low turbidity values were observed in the spring and fall sampling periods in 2024 (Tables AQ 4-9 and AQ 4-10) except for a single point value taken in Rush Creek above Silver Lake (RC17.6) that read 8.66 NTU. This point is likely an anomaly as turbidity values upstream and downstream of this sampling location were ~1 NTU. This location is downstream of Horsetail Falls and an unnamed tributary inflow, which may have contributed to the high value. There were no Project related activities that contributed to the turbidity. Turbidity samples was well within the objective in the Basin Plan that "waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Increases in turbidity shall not exceed natural levels by more than 10 percent."

6.2.6 Alkalinity

Alkalinity (ability of water to neutralize acids) was low in the Project sampling area, typically <20 mg/L with some higher values up to 85 mg/L during 2023 fall baseflows. This is typical of granitic / volcanic watersheds (Hem 1989; Miller 2002). There are no alkalinity criteria in the Basin Plan and the NTR identifies that a total alkalinity continuous concentration "of 20 mg/l is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25 percent of the natural level" (EPA 2023).

During the spring runoff 2023 and 2024 sampling periods, alkalinity was below 20 mg/L at all but one site on Reversed Creek (RVC0.25), which measured 35.0 mg/L (Table AQ 4-7). Measurements at the remaining sites in both sampling years ranged from 4.6 to 17.6 mg/L. During the fall sampling period alkalinity was higher and only five sites were <20 mg/L (ranging from 2.5 to 17 mg/L) in 2023 and only four sites were <20 mg/L (ranging from 2.5 to 17 mg/L) in 2024. The remaining sites >20 mg/L ranged from 20.0 to 85.0 mg/L (Table AQ 4-8 and Table AQ 4-10). Interestingly, alkalinity was highest in the fall of 2023 at Rush Creek below Agnew Lake (RC18.55), 85 mg/L, which consists of water released from Gem Dam, while at the powerhouse tailrace water (released from

Gem Dam) alkalinity was extremely low, 3.6 mg/L. There is a section of marine sedimentary argillite geology that underlies Agnew Lake and vicinity (Green et al. 1997; SCE 2021: Section 4.7). The water that runs through Agnew Lake likely increase in alkalinity due to the sedimentary geology, particularly at low flows.

6.2.7 Salinity

Salinity is normally estimated indirectly by measuring specific conductivity (see Section 6.2.3). Salinity refers to the mass of dissolved inorganic solids (ions) found in water (cations, anions, and carbonate species) and increases the density of water (Wetzel 2001). There are no salinity criteria in the Basin Plan water quality objectives. In freshwater, TDS is typically used to measure the weight of inorganic solids per volume of water (ppt) instead of salinity (see Section 6.3 Seasonal Water quality Grab Samples); however, TDS can also include mass of dissolved organic matter as well as inorganic solids. Here we approximately convert the electrical conductivity samples to salinity using a simple equation (salinity ppt = 0.4665 [conductivity µS/cm]$^{1.0878}$) (Dohrman 2023). Freshwater usually has a salinity value of <0.5 ppt (Wetzel 2001). Salinity values during the spring runoff and fall sampling period in both 2023 and 2024 ranged from 0.001 to 0.043 ppt (Tables AQ 4-7 through AQ 4-10).

6.3 Seasonal Water Quality Grab Samples

General water quality samples in 2023 and 2024 for nitrate/nitrite, ammonia, total nitrogen, total phosphorus, orthophosphate, and total suspended solids in the high flow and low flow seasons were all low or not detected and within Basin Plan standards (or there are no standards, e.g., total phosphorous and total suspended solids) (Tables AQ 4-11 through AQ 4-14). Table AQ 4-5 shows the Basin Plan criteria and Table AQ 4-15 and Table AQ 4-16 shows the 2023 and 2024 calculated ammonia criteria (pH and temperature dependent). Water quality samples for ammonia, however, were all non-detect.

Alkalinity was naturally low in the Rush Creek Watershed. Fifty-eight of the 80 total samples were below the NTR alkalinity criterion ≥20 mg/L, however, the criterion does not apply to situations where alkalinity is naturally low (e.g., granitic / volcanic watersheds), which is the case for the study area (see the alkalinity discussion in Section 6.2.6 above). The locations where alkalinity was higher, particularly in the fall, were Rush Creek below Agnew Dam, Reversed Creek, and Rush Creek above Silver Lake. These are the same locations that have higher TDS (see below) and higher conductivity (all interrelated measures of water quality). Likely the few locations where sedimentary geology is present (Agnew Lake and Reversed Creek), the sedimentary geology (greater dissolution of ions) is responsible for increased alkalinity, TDS, and conductivity.

In 2023, TDS was high compared to the Basin Plan standard at a few sites, Rush Creek above Silver Lake / within Silver Lake (Tables AQ 4-9 and AQ 4-10). Table AQ 4-5 shows the Basin Plan TDS criteria, which are not uniform in the study sampling area (e.g., 100 mg/L in Reverse Creek and 45 mg/L in Silver Lake) and only apply to a few areas. The observed high TDS in Silver Lake in 2023 (and inflow) appears to be the result of high TDS in Reversed Creek (84 mg/L and 95 mg/L, spring and fall, respectively). For example, the Reversed Creek values are not above the 100 mg/L criteria, but Reversed Creek inflow into Silver Lake increases the TDS in Silver Lake above the 45 mg/L criteria for Silver Lake. Higer TDS in Reversed Creek is likely naturally occurring because much of the lower Reversed Creek Watershed (Gull Lake and below) includes marine sedimentary geology (Green et al. 1997; SCE 2021: Section 4.7), which weathers and increases TDS, alkalinity, and conductivity. TDS results in 2024 were all below the Basin Plan criteria.

6.4 Reservoir/Lake Profiles

Reservoir profiles showing water temperature, dissolved oxygen, conductivity / salinity, and pH for Gem, Agnew and Silver lakes are shown in Figures AQ 4-1 to AQ 4-10. Sampling locations for both 2023 and 2024 are shown in Figure AQ 4-11. In 2023 profiles were collected monthly July to October in Gem and Agnew lakes and June to October 2023 in Silver Lake. Access to Gem and Agnew lakes in 2023 was not possible in June due to the snowpack. In 2024, profiles were collected from June to October at all three reservoirs. Turbidity profiles recorded at all sampling locations were negligible (<1 NTU) and therefore are not plotted.

Gem Lake was deepest, followed by Agnew Lake, and then Silver Lake. Water clarity was high in all of the lakes in both years. Water depths and Secchi depths at the profile locations are as follows:

Lake	Site/Location	Approx. Depth Range meters (feet)	2023 Secchi Depth Range meters (feet)	2024 Secchi Depth Range meters (feet)
Gem Lake	GL-1 mid-lake	55 to 73 (180 to 239)	7 to 12 (24 to 40)	4.5 to 11 (14.5 to 36)
	GL-2 near dam	26 to 41 (85 to 134)	6 to 13 (21 to 44)	6 to 11 (19 to 36)
Agnew Lake	AL mid-lake	19 to 20 (62 to 66)	5 to 11 (15 to 35)	5 to 8 (16 to 25)
Silver Lake	SL-1 mid-lake	16 to 17 (52 to 56)	8 to 14 (27 to 45)	6 to 9 (20 to 29)
	SL-2 near outlet	4 to 8 (13 to 26)	Lake bottom	Lake bottom

Water temperature in the lakes was cold, approximately <15°C in 2023 (including at the surface epilimnions). In 2024, July and August epilimnion water temperatures were higher than 15°C, but did not exceed ~18°C. Hypolimnions were much colder, typically <10°C or colder when they were present. The Gem Lake hypolimnion was particularly cold, <5°C.

Gem Lake was stratified in all sampling months (July to October 2023 and June to October 2024). The GL-1 sampling location was in the upper natural lake portion of Gem Lake and the location of the epilimnion in August to October 2023 was approximately at the elevation of the “land bridge” between the two natural lakes, 8,979 feet (see Figure AQ 4-11). This correlation was less evident in 2024. In some months (August and September) the epilimnion occurred deeper than the “land bridge”. During other months (June, July, and October) the epilimnion was approximately at the “land bridge” elevation.

Agnew Lake was stratified July to September 2023, but destratified in October 2023. In 2024, Agnew showed stratification from June through early October.

Silver Lake was only strongly stratified in August in 2023 and only moderately stratified in June and July in 2024. In other months, Silver Lake was weakly stratified or not stratified at all. The near outlet site (SL-2) of Silver Lake was shallow and not indicative of potential stratification in the reservoir.

Dissolved oxygen in the reservoirs in 2023 was >8 mg/L in all profiles except in the lower portion of the hypolimnion of Agnew and Silver lakes in August and September, where there was a reduction in dissolved oxygen, 5-6 mg/L. In 2024 dissolved oxygen in the epilimnion was >8 mg/L in Silver Lake. Agnew Lake dissolved oxygen was >8 mg/L in all months in the epilimnion except in July when the top 5 meters of the water column were just under 8 mg/L (7.68 to 7.87 mg/L) during the warmest water temperature period(15 to 15.6 °C). Similarly, dissolved oxygen in Gem Lake was >8 mg/L in epilimnion in all months except in July when the top 6 meters of the water column were just under 8 mg/L (7.53 to 7.86 mg/L) when water temperatures were at their warmest (~16.8 to 17.5°C). In 2024 there was significant hypolimnetic reduction in dissolved oxygen observed June through October in Agnew Lake and July through October in Silver Lake as a result of microbial respiration. This did not occur in Gem Lake.

pH was typically low in the lakes but above 6.5 pH (Basin Plan) except in the lower portion of the hypolimnions where carbon dioxide can accumulate due to microbial respiration and reduce pH. Hypolimnion pH was lowest in Gem Lake where alkalinity (acid buffering capacity) was lowest (<6 pH) and pH was highest in Silver Lake where alkalinity/TDS/conductivity were higher.

Specific conductivity (a measure of salinity) was uniquely distributed in the lakes. Conductivity was low in the epilimnion of Gem Lake (<10 µS/cm) in the downstream arm / natural lake portion of the reservoir but increased with depth up to 39 µS/cm in the hypolimnion of the upstream arm of the reservoir that is separated / isolated from the downstream arm by an underwater “land bridge.” In Agnew Lake, specific conductivity was up to 75+ µS/cm in 2023 and 325 µS/cm in 2024 in the hypolimnion. Silver Lake had specific conductivity up to 46+ µS/cm in the hypolimnion. Likely the long water contact time and geology (marine sedimentary rocks) of Agnew Lake increases soluble inorganic / ionic compounds. Silver Lake conductivity is primarily determined by a mix of inflow water. High conductivity inflows from Reversed Creek (e.g., 100 µS/cm) and lower conductivity releases from the portion of Gem Lake (lower arm) that has lower conductivity. There are no conductivity criteria in the Basin Plan, but there are criteria for TDS in Silver Lake (see Section 6.3 Seasonal Water Quality Grab Samples).

6.5 Bacterial Sampling

A new Basin Plan water quality objective for bacteria was recently proposed by the Lahontan Region Water Quality Control Board (June 2023) and adopted by the State Water Resources Control Board (January 2024). The new criteria removed fecal coliform as the recreational contact objective and replaced it with *E. coli* as the recreational contact water quality objective. EPA has recommended *E. coli* as the recreational water contact indicator bacteria since 2012 (EPA 2012) for freshwater (e.g., <1 ppt salinity). The California bacteria water quality objective for contact recreation is as follows:

> A six-week rolling geometric mean (GM) of *E. coli* not to exceed 100 colony forming units (cfu) per 100 milliliters (mL), calculated weekly, and a Statistical Threshold Value (STV) of 320 cfu/100 mL not to be exceeded by more than 10 percent of the samples collected in a calendar month, calculated in a static manner. (CRWQCB 2023)

For the five water samples collected for bacterial testing near Agnew Dam and near Gem Dam during July 2023, *E. coli* was either non-detect and/or ≤1 most probable number of bacterial colonies (MPN)/100 milliliters (mL; Table AQ 4-17). *E. coli* concentrations in both 2023 and 2024 were well below the 100 colony forming units / 100 mL (or 100 MPN/100 mL) specified in the updated Basin Plan criteria. Only one of five *E. coli* samples showed presence at Gem Lake on July 22, 2024, with a result of 31.5 MPN/100mL (Table AQ 4-17). There were some samples with high total and fecal coliform numbers at Gem Lake in 2023 (potentially wildlife, horses, or other sources of fecal coliform), but it is *E. coli* that has been determined to be correlated to swimming-associated gastroenteritis (EPA 2012). In 2024, fecal coliform was not detected at Gem Lake and total coliform was significantly lower than observed in 2023 (Table AQ 4-17). All samples were transported to the lab within 8 hours (no hold times were exceeded).

6.6 Laboratory Analysis and Quality Assurance / Quality Control Procedures

A detailed summary of the QA/QC review of the seasonal water quality grab sampling reports received from WETLAB can be found in Table B-1 and Table B-2 in Appendix B. The QA/QC review of reports from WETLAB indicated that most of the samples were acceptable (i.e., holding times, preservation, sample containers, etc. were appropriate). There were a few potential issues with quality control as noted at the bottom of Table D-1 related to hold time exceedances and lab equipment results. Based on review of the laboratory reports, values in Tables AQ 4-11 through AQ 4-14 were flagged with footnotes (hold time, modified methods, etc.).

7 SUMMARY

- Water quality sampling was successfully implemented in 2023 and 2024, which were “wet” and “normal” water years, respectively. Both the higher runoff season and lower base flow season were sampled in each year.

- Water quality in the sampling area was high quality (e.g., cold, high oxygen, no contaminants). No project related water quality issues were identified. Water quality meets Basin Plan objectives except in the case of some natural watershed characteristics (e.g., instances of low pH, low alkalinity, higher TDS).

- Watershed geological characteristics appear to be the primary determinant of water quality. The slow weathering granitic / volcanic geology in the upper watershed (e.g., above Gem Dam) corresponds with water quality that is low in specific conductivity / salinity, alkalinity, pH and TDS; whereas, the faster weathering marine sedimentary geology at Agnew Lake and in Reversed Creek corresponds with water that is higher in specific conductivity / salinity, alkalinity, pH and TDS.

- 2023 Bacterial sampling in Gem and Agnew lakes near the dams, indicated that the water was free from *E. coli* (≤ 1 MPN / 100 mL) contamination. In 2024, one of five samplings at each lake showed low presence of *E. coli* (<100vMPN / 100mL) but was not detectable during the bulk of the sampling period.

8 REFERENCES

California Regional Water Quality Control Board, Lahontan Region (CRWQCB). 2021. Water Quality Control Plan for the Lahontan Region, North and South Basins (Basin Plan). Revised September 2021. Available at: https://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.html.

———. 2023. Adoption of Amendment to the Water Quality Control Plan for the Lahontan Region to Remove The Regionwide Bacteria Water Quality Objectives and Insert Discussion Of The Rec-1 Bacteria Provisions. California Regional Water Quality Control Board Lahontan Region Resolution No. R6T-2023-0025. Available at: https://www.waterboards.ca.gov/rwqcb6/board_decisions/adopted_orders/2023/docs/r6t-2023-0025-bacteria-resolution.pdf.

Dohrman, Paul. 2023. How to Convert Specific Conductivity to Salinity. Last modified December 7, 2023. Available at: https://sciencing.com/convert-specific-conductivity-salinity-5915328.html.

EPA (Environmental Protection Agency). 1986. Quality Criteria for Water.

———. 1992. National Toxics Rule (NTR) “Water Quality Standards: Establishment of Numeric Criteria for Priority Toxic Pollutants.” Federal Register, 57 FR 60848.

———. 2000. California Toxics Rule (CTR) “Water Quality Standards: Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California.” Federal Register, 65 FR 31682.

———. 2012. Recreational Water Quality Criteria. Office of Water 820-F-12-058. Available at: https://www.epa.gov/sites/default/files/2015-10/documents/rwqc2012.pdf.

———. 2013. Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater. April.

———. 2023. National Recommended Water Quality Criteria – Aquatic Life Criteria Table. Retrieved December 2023. Available at: https://www.epa.gov/wqc/aquatic-life-criteria-and-methods-toxics.

FERC (Federal Energy Regulatory Commission). 2022. Rush Creek Hydroelectric Project (FERC Project No. 1389). Study Plan Determination. October.

Green, D.C., R. Schweickert, and C.H. Stevens. 1997. Roberts Mountains allochthon and the western margin of the Cordilleran miogeocline in the Northern Ritter Range pendant, eastern Sierra Nevada, California. *Geological Society of America Bulletin* 109(10):1294–1305.

Hem, J.D. 1989. Study and Interpretation of the Chemical Characteristics of Natural Water. Third Edition. U.S. Geological Survey Water-Supply Paper 2254.

Miller, R. 2002. Influence of Rock Composition on the Geochemistry of Stream and Spring Waters from Mountainous Watersheds in the Gunnison, Uncompahgre, and Grand Mesa National Forests, Colorado. U.S. Geological Survey Professional Paper 1667.

SCE (Southern California Edison Company). 2021. Rush Creek Project (FERC Project No. 1389) Pre-Application Document. December.

———. 2022a. Rush Creek Hydroelectric Project (FERC Project No. 1389) Proposed Study Plan. May.

———. 2022b. Rush Creek Hydroelectric Project (FERC Project No. 1389) Revised Study Plan. September.

United States Geological Survey. 2023. National Field Manual for the Collection of Water-Quality Data.; Revised July 17, 2023. Available at: https://www.usgs.gov/mission-areas/water-resources/science/national-field-manual-collection-water-quality-data-nfm.

Wetzel, R.G. 2001. Limnology Lake and River Ecosystems. Third Edition. Academic Press, New York. pp 169–186; 205–237; 289–330.

TABLES

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Table AQ 4-1. AQ-4 – TSP Analysis Methodology Versus the Equivalent Testing Methods Used by Western Environmental Testing Laboratory

Parameter	Analysis Method Identified in the TSP	Equivalent Analysis Method Performed by Lab	Sample Locations to be Analyzed
Laboratory Analysis Parameter			
General Parameters			
Ammonia as N	EPA - 350.1	Timberline Ammonia	All
Total Phosphorus	EPA - 365.2	SM 4500-P E	All
Orthophosphate	EPA - 365.1	SM 4500-P E	All
Total Dissolved Solids	EPA - 160.1	SM 2540C	All
Total Suspended Solids	EPA - 160.2	SM 2540D	All
Total Alkalinity	EPA - 310.1	SM 2320B	All
Bacteria			
Total Coliform	EPA - SM9222B	SM 9223B	Gem and Agnew lakes
Fecal Coliform	EPA - SM9222B	IDEXX Quant/Colilert-18	Gem and Agnew lakes

Notes:
EPA = Environmental Protection Agency
SM = Standard Methods

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Table AQ 4-2. Water Quality Sampling Locations

Stream Segment Name	Segment Length (miles) / River Miles (RM)	Sampling Location River Mile / Site ID	Coordinates (Lat/Long)	Number of Sampling Locations	In-situ Field Measurements	Water Quality Grab Samples	Reservoir / Lake Profiles
Rush Creek							
Waugh Lake[a]	1.51 (RM 22.24–23.75)	RM 23.0 / RC23.0	37.750307, -119.199346	1	X	X	—
Rush Creek Below Rush Meadows Dam	1.83 (RM 20.41–22.24)	RM 21.65 / RC21.65	37.752283, -119.174247	1	X	X	—
Gem Lake[b]	0.93 (RM 19.48–20.41)	GL-1 (mid-lake) /GL-2 (near the dam)	37.750250, -119.152487 / 37.751017, -119.143615	2	—	X	X
Rush Creek Below Gem Dam	0.30 (RM 19.18–19.48)	RM 19.25 / RC19.25	37.751656, -119.138584	1	X	X	—
Agnew Lake	0.58 (RM 18.60–19.18)	AL-1 (mid-lake)	37.755631, -119.134912	1	—	X	X
Rush Creek Below Agnew Dam	0.40 (RM 18.2–18.60)	RM 18.55 / RC18.55	37.758446, -119.131156	1	X	X	—
Rush Creek Horsetail Falls	0.54 (RM 17.66–18.2)	—	—	—	—	—	—
Rush Creek Powerhouse Tailrace	—	PHTR	37.766638, -119.122514	1	X	X	—
Rush Creek Above Silver Lake	0.94 (RM 16.72–17.66)	RM 17.15 / RC17.15 RM 17.6 / RC17.6	37.769607, -119.124606 / 37.765648, -119.122137	2	X	X	—
Silver Lake	0.83 (RM 15.89–16.72)	SL-1 (mid-lake) / SL-2 (near outlet)	37.775939, -119.125454 / 37.782729, -119.124709	2	X	X	X
Rush Creek Below Silver Lake	2.69 (RM 13.20–15.89)	RM 15.2 / RC15.2	37.790468, -119.123420	1	X	X	—
South Rush Creek							
South Rush Creek	0.46 (RM 0.0–0.46)	RM 0.15 / SRC0.15	37.764596, -119.121035	1	X	X	—
Reversed Creek							
Reversed Creek	—	100–200 feet upstream of the confluence with South Rush Creek / RVC0.26	37.764414, -119.117985	1	X	X	—

Notes:
RM = River Mile

[a] The low-level outlet at Rush Meadows Dam remains open such that little/no water is currently impounded in Waugh Lake. Rush Creek essentially flows unimpeded through the historic lakebed. Therefore, Waugh Lake is treated as a stream segment for water quality sampling.

[b] Water quality sampling in Gem Lake is contingent on obtaining any required Forest Service authorization for use of a motorized boat.

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Table AQ 4-3. Summary of Water Quality Analytical Tests, Including Laboratory Methods and Reporting Limits, and Chemical Water Quality Objectives

Analyte	Units	Analysis Method[1]	Reporting Limit (RL)	Water Quality Criteria			Sample Container	Hold Time	Preservative/ Comment
				Basin Plan[2]	CA Toxics Rule (CTR)[3]	National Toxics Rule (NTR)[4]			
In-Situ/Profile Measurements									
Water Temperature	Celsius (°C)	Water Quality Meter	NA	No Change	NS	NS	NA	NA	None
Dissolved Oxygen (DO)	mg/L	Water Quality Meter	NA	8.0 (5.0)[5]	NS	NS	NA	NA	None
Turbidity	NTU	Water Quality Meter	NA	Var[6]	Narr[7]	NS	NA	NA	None
Conductivity	µS/cm at 25°C	Water Quality Meter	NA	NS	NS	NS	NA	NA	None
pH	unitless	Water Quality Meter	NA	Change < 0.5	NS	6.5 – 9.0	NA	NA	None
Salinity	ppt	Calculated	NA	NS	NS	NS	NA	NA	None
Seechi Depth	feet	Secchi Disk	NA	NS	NS	NS	NA	NA	None
General Parameters									
Nitrate/Nitrite (NO_3)	mg/L	EPA 353.2	0.020	See Table AQ 4-5[8]	NS	NS	500mL plastic	48 hours	H_2SO_4, maintain at ≤6°C
Ammonia as N	mg/L	Timberline Ammonia-001	0.10	See Table AQ 4-4	NS	Depends on pH & temperature	500mL plastic	28 days	H_2SO_4, maintain at ≤6°C
Total Kjeldahl Nitrogen (TKN)	mg/L	EPA 351.2	0.20	See Table AQ 4-5[8]	NS	NS	500mL plastic	28 days	H_2SO_4, maintain at ≤6°C
Total Phosphorus	µg/L	SM 4500-P E	0.020	NS	NS	NS	500mL plastic	28 days	H_2SO_4, maintain at ≤6°C
Orthophosphate	mg/L	SM 4500-P E	0.020	See Table AQ 4-5[8]	NS	NS	1000mL plastic	48 hours	Maintain at ≤6°C
Total Dissolved Solids	mg/L	SM 2540C	25.0	See Table AQ 4-5[8]	NS	NS	1000mL plastic	7 days	Maintain at ≤6°C
Total Suspended Solids	mg/L	SM 2540D	10.0	NS	NS	NS	1000mL plastic	7 days	Maintain at ≤6°C
Total Alkalinity (as CaCO3)	mg/L	SM 2320B	1.0	NS	NS	>20[10, 11]	1000mL plastic	14 days	Maintain at ≤6°C
Nitrate Nitrogen[9]	mg/L	EPA 300.0	0.030	See Table AQ 4-5[8]	NS	NS	500mL plastic	48 hours	H_2SO_4, maintain at ≤6°C
Nitrite Nitrogen[9]	mg/L	EPA 300.0	0.020	NS	NS	NS	500mL plastic	48 hours	H_2SO_4, maintain at ≤6°C
Bacteria									
Total Coliform	MPN/100 mL	SM 9223B	1.0[12]	NS	NS	NS	100 mL glass	8 hours	Maintain at ≤6°C
Fecal Coliform	MPN/100 mL	IDEXX Quant/Colilert	1.0[12]	20/100[13]	NS	NS	100 mL glass	8 hours	Maintain at ≤6°C
E. coli[14]	MPN/100 mL	SM 9223B	1.0	NS	NS	126[14]	100 mL glass	8 hours	Maintain at ≤6°C

Notes:
MDL = method detection limit (the minimum measured concentration of a substance that can be reported with 99 percent confidence that the measured concentration is distinguishable from method blank results)
MPN = most probable number of bacterial colonies per 100 mL of water
MRL = method reporting limit (the lowest concentration of a substance that can be reliably reported under current laboratory operating conditions)
NA= Not Applicable
NS = no standard available

Footnotes

[1] Analysis methods are periodically updated by the EPA. The most recent methods available were used for the water quality analysis. Methods used were dictated by the state-certified laboratory.

[2] 1995 Water Quality Control Plan for the Lahontan Region (Basin Plan) [with amendments through September 22, 2021] provides narrative and numerical water quality objectives which define the upper concentration or other limits that the Regional Board considers protective of beneficial uses (CRWQCB 2021).

[3] California Toxics Rule (CTR) criteria are based primarily on EPA standards developed under the Clean Water Act for human consumption of water and aquatic organisms with an adult risk for carcinogens estimated to be one in one million as contained in the Integrated Risk Information System (IRIS) as of October 1, 1996.

[4] The National Toxics Rules are based on USEPA standards developed under the Clean Water Act for human consumption of water and aquatic organisms with an adult risk for carcinogens estimated to be one in one million as contained in the IRIS as of October 1, 1996. These criteria are to be applied to all states not complying with the Clean Water Act section 303(c)(2)(B).

[5] For water designated as COLD or SPWN 1 Day Minimum: 8.0 (5.0) and 7 Day Mean: 9.5 (6.5). Note: These are water column concentrations recommended to achieve the required intergrade dissolved oxygen concentrations shown in parentheses. For species that have early life stages exposed directly to the water column (SPWN), the figures in parentheses apply. (Table 3.6 Water Quality Control Plan for the Lahontan Region (Basin Plan) Chapter III: Water Quality Objectives, pg. 3-24 September 22, 2021).

[6] Waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Increases in turbidity shall not exceed natural levels by more than 10 percent.

[7] Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits: where natural turbidity is between 0 and 5 NTU's, increases shall not exceed 1 NTU. Where natural turbidity is between 5 and 50 NTU's, increases shall not exceed 20%. Where natural turbidity is between 50 and 100 NTU's, increases shall not exceed 10 NTU's. Finally, where natural turbidity is greater than 100 NTU's, increases shall not exceed 10%.

[8] Where available data were sufficient to define existing ambient levels of constituents, these levels were used in developing the numerical objectives for specific water bodies. By utilizing annual mean, 90th percentile values and flow-weighted values, the objectives are intended to be realistic within the variable conditions imposed by nature. (Water Quality Control Plan for the Lahontan Region (Basin Plan) Chapter III: Water Quality Objectives, pg. 3-2 September 22, 2021).

[9] Due to WETLAB instrumentation maintenance issues, testing as NO3 was not possible for grab samples collected during the late summer/early fall base flow period. Instead, samples were run using EPA 300.0 and flagged to bring the RL down. Values reported should be considered estimates per the lab.

[10] The CCC of 20 mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25 percent of the natural level.

[11] Alkalinity measurements were not collected during in-situ field measurements; however, they were collected as part of the spring runoff and late summer/early fall base flow, water quality grab sample periods.

[12] When samples are heavily diluted by the lab, analysts may dilute the sample to read the test results properly. This dilution will increase the reporting limit. Some tests were run with an increased RL identified in this TSR.

[13] The fecal coliform concentration during any 30-day period shall not exceed a log mean of 20/100 ml, nor shall more than 10 percent of all samples collected during any 30-day period exceed 40/100 ml. The log mean shall ideally be based on a minimum of not less than five samples collected as evenly spaced as practicable during any 30-day period. However, a log mean concentration exceeding 20/100 ml for any 30-day period shall indicate violation of this objective even if fewer than five samples were collected. (Water Quality Control Plan for the Lahontan Region (Basin Plan) Chapter III: Water Quality Objectives, pg. 3-6 September 22, 2021).

[14] *E. coli* was not a water quality parameter identified in the AQ-4 TSP; however, testing was performed by the state-certified laboratory and results are included in this TSR voluntarily. Lab reporting only identified presence/absence.

Table AQ 4-4. Applicable Water Quality Criteria for Ammonia

ONE-HOUR AVERAGE CONCENTRATION FOR AMMONIA[1,2]

Waters Designated as COLD, COLD with SPWN, COLD with MIGR (Salmonids or other sensitive coldwater species present)

	Temperature, C						
pH	0	5	10	15	20	25	30
Un-ionized Ammonia (mg/liter NH_3)							
6.50	0.0091	0.0129	0.0182	0.026	0.036	0.036	0.036
6.75	0.0149	0.021	0.030	0.042	0.059	0.059	0.059
7.00	0.023	0.033	0.046	0.066	0.093	0.093	0.093
7.25	0.034	0.048	0.068	0.095	0.135	0.135	0.135
7.50	0.045	0.064	0.091	0.128	0.181	0.181	0.181
7.75	0.056	0.080	0.113	0.159	0.22	0.22	0.22
8.00	0.065	0.092	0.130	0.184	0.26	0.26	0.26
8.25	0.065	0.092	0.130	0.184	0.26	0.26	0.26
8.50	0.065	0.092	0.130	0.184	0.26	0.26	0.26
8.75	0.065	0.092	0.130	0.184	0.26	0.26	0.26
9.00	0.065	0.092	0.130	0.184	0.26	0.26	0.26
Total Ammonia (mg/liter NH_3)							
6.50	35	33	31	30	29	20	14.3
6.75	32	30	28	27	27	18.6	13.2
7.00	28	26	25	24	23	16.4	11.6
7.25	23	22	20	19.7	19.2	13.4	9.5
7.50	17.4	16.3	15.5	14.9	14.6	10.2	7.3
7.75	12.2	11.4	10.9	10.5	10.3	7.2	5.2
8.00	8.0	7.5	7.1	6.9	6.8	4.8	3.5
8.25	4.5	4.2	4.1	4.0	3.9	2.8	2.1
8.50	2.6	2.4	2.3	2.3	2.3	1.71	1.28
8.75	1.47	1.40	1.37	1.38	1.42	1.07	0.83
9.00	0.86	0.83	0.83	0.86	0.91	0.72	0.58

[1] To convert these values to mg/liter N, multiply by 0.822

[2] Source: U. S. Environmental Protection Agency. 1986. Quality criteria for water, 1986. EPA 440/5-86-001.

Source: Water Quality Control Plan for the Lahontan Region (Basin Plan) Chapter III: Water Quality Objectives, pg. 3-19, 3-21 Table 3-1 and Table 3-3 (CRWQCB 2021)

Table AQ 4-5. Applicable Basin Plan Water Quality Objectives for Project Waterbodies

	Objective (mg/L)[1, 2, 3]			
Surface Waters	TDS	NO_3-N	Total N (TKN)	PO_4
Reversed Creek (Silver Lake Inlet)	100	0.1	0.2	0.16
Rush Creek (SCE Inlet)	41	0.1	0.1	0.02
Silver Lake	45	0.1	N/A	0.06

Notes:

[1] Annual Average Value

[2] Objective are as mg/L and are defined as follows:
N Nitrogen, Total
NO_3-N Nitrate as Nitrogen
PO_4 Orthophosphate, Dissolved
TDS Total Dissolved Solids (Total Filterable Residue)

[3] Table to only include relevant parameters. From Water Quality Control Plan for the Lahontan Region (Basin Plan) Chapter III: Water Quality Objectives, pg. 3-44 (CRWQCB 2021)

Table AQ 4-6. Project Beneficial Uses of Water – Water Quality Control Plan for the Lahontan Region

Beneficial Use	Definition	Applicable Project Waterbody
Municipal and Domestic Supply (MUN)	Beneficial uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.	• Silver, Agnew, Gem Lakes • Rush Creek (above Grant Lake) • Reversed Creek
Hydropower Generation (POW)	Beneficial uses of waters used for hydroelectric power generation.	• Rush Creek (above Grant Lake)
Commercial and Sportfishing (COMM)	Beneficial uses of waters used for commercial or recreational collection of fish or other organisms including, but not limited to, uses involving organisms intended for human consumption.	• Silver, Agnew, Gem Lakes • Rush Creek (above Grant Lake) • Reversed Creek
Water Contact Recreation (REC-1)	Beneficial uses of waters used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, and use of natural hot springs.	• Silver, Agnew, Gem Lakes • Rush Creek (above Grant Lake) • Reversed Creek
Non-contact Water Recreation (REC-2)	Beneficial uses of waters used for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities.	• Silver, Agnew, Gem Lakes • Rush Creek (above Grant Lake) • Reversed Creek
Cold Freshwater Habitat (COLD)	Beneficial uses of waters that support cold water ecosystems including, but not limited to, preservation and enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates.	• Silver, Agnew, Gem Lakes • Rush Creek (above Grant Lake) • Reversed Creek
Wildlife Habitat (WILD)	Beneficial uses of waters that support wildlife habitats including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl.	• Silver, Agnew, Gem Lakes • Rush Creek (above Grant Lake) • Reversed Creek

Beneficial Use	Definition	Applicable Project Waterbody
Spawning, Reproduction and/or Early Development (SPWN)	Beneficial uses of waters that support high quality aquatic habitat necessary for reproduction and early development of fish and wildlife.	• Silver, Agnew, Gem Lakes • Rush Creek (above Grant Lake) • Reversed Creek
Freshwater Replenishment (FRSH)	Beneficial uses of waters used for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).	• Rush Creek (above Grant Lake)

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Table AQ 4-7. Summary of In-Situ Stream Measurements Collected During the 2023 Spring Sampling Event

Sampling Location / Site ID	Stream Segment Name	Date	Time of Day	Temperature (°C)	Dissolved Oxygen (mg/L) / (% Saturation)	Specific Conductance (µS/cm at 25 °C)	pH	Alkalinity[1] (mg/L)	Turbidity[2] (NTU)	Salinity[3] (ppt)
Rush Creek										
RC23.0	Waugh Lake	7/26/2023	0645	3.5	9.50 / 96	4.5	6.83	11.0	<1.0	0.00131
RC21.65	Rush Creek Below Rush Meadows Dam	7/26/2023	0700	7.7	8.90 / 104	4.6	6.60	10.0	<1.0	0.00134
RC19.25	Rush Creek Below Gem Dam	6/27/2023	1330	3.9	10.25 / 105	14.3	7.15	5.6	<1.0	0.00459
RC18.55	Rush Creek Below Agnew Dam	6/27/2023	1430	5.2	9.95 / 107	45.0	7.08	7.6	<1.0	0.01599
PHTR	Rush Creek Powerhouse Tailrace	6/26/2023	1140	3.6	10.04 / 98	12.4	6.95	4.7	<1.0	0.00393
RC17.15	Rush Creek Above Silver Lake	6/26/2023	1208	5.7	9.59 / 100	22.0	7.10	8.9	<1.0	0.00734
RC17.6	Rush Creek Above Silver Lake	6/26/2023	1115	5.8	9.68 / 101	17.7	7.01	7.9	<1.0	0.00579
RC15.2	Rush Creek Below Silver Lake	6/26/2023	1235	6.8	9.36 / 100	29.9	6.94	12.0	<1.0	0.01025
South Rush Creek										
SRC0.15	South Rush Creek	6/26/2023	1105	5.9	9.84 / 103	16.7	7.23	6.4	<1.0	0.00544
Reversed Creek										
RVC0.26	Reversed Creek (Upstream of Confluence with South Rush Creek)	6/26/2023	1034	7.2	9.26 / 100	55.0	7.30	35.0	<1.0	0.01989

Notes:
[1] Alkalinity field test kits were not used. Alkalinity was measured during the Spring/Fall grab samplings by the laboratory
[2] Turbidity values of "<1.0" indicate that turbidity measurements were within the instruments margin of error of +/- 1.0 NTU.
[3] Salinity was calculated by converting conductivity measurements (Dohrman 2023).

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Table AQ 4-8. Summary of In-Situ Stream Measurements Collected During the 2023 Fall Sampling Event

Sampling Location / Site ID	Stream Segment Name	Date	Time of Day	Temperature (°C)	Dissolved Oxygen (mg/L) / (% Saturation)	Specific Conductance (µS/cm at 25 °C)	pH	Alkalinity[1] (mg/L)	Turbidity[2] (NTU)	Salinity[3] (ppt)
Rush Creek										
RC23.0	Waugh Lake	9/26/2023	1530	11.8	**10.02 /** 132[5]	9.0	6.62	16.0	<1.0	0.00278
RC21.65	Rush Creek Below Rush Meadows Dam	9/26/2023	1730	11.8	**10.30 /** 130[5]	9.0	6.57	2.5	<1.0	0.00278
RC19.25	Rush Creek Below Gem Dam	9/25/2023	1230	10.9	**10.78 /** 130[5]	17.7	7.27	6.7	<1.0	0.00579
RC18.55	Rush Creek Below Agnew Dam	9/26/2023	1345	12.5	9.20 / 118	71.0	7.09	85.0	<1.0	0.02626
PHTR	Rush Creek Powerhouse Tailrace	9/28/2023	0950	12.4	8.99 / 98	9.5	7.13	3.6	<1.0	0.00294
RC17.15	Rush Creek Above Silver Lake	9/28/2023	1005	9.0	9.31 / 102	76.2	6.77	36.0	<1.0	0.02836
RC17.6	Rush Creek Above Silver Lake	9/28/2023	0940	7.6	9.91 / 98	111.0	7.35	48.0	<1.0	0.04269
RC15.2	Rush Creek Below Silver Lake	9/28/2023	1050	12.2	8.82 / 98	53.4	7.02	21.0	<1.0	0.01926
South Rush Creek										
SRC0.15[4]	South Rush Creek	9/28/2023	0920	6.9	9.86 / 106	44.0	6.67	17.0	<1.0	0.01560
Reversed Creek										
RVC0.26	Reversed Creek (Upstream of Confluence with South Rush Creek)	9/28/2023	1030	7.9	9.46 / 104	110.0	7.00	53.0	<1.0	0.04227

Notes:
[1] Alkalinity field test kits were not used. Alkalinity was measured during the Spring/Fall grab samplings by the laboratory
[2] Turbidity values of "<1.0" indicate that turbidity measurements were within the instruments margin of error of +/- 1.0 NTU.
[3] Salinity was calculated by converting conductivity measurements (Dohrman 2023).
[4] SRC0.15 was dry in September. Samples taken at culvert crossing and confluence with an unnamed creek. This unnamed creek was still flowing in September, contributing to Rush Creek.
[5] Likely there was an issue with high elevation calibration resulting meter readings with over-saturation.

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Table AQ 4-9. Summary of In-Situ Stream Measurements Collected During the 2024 Spring Sampling Event

Sampling Location / Site ID	Stream Segment Name	Date	Time of Day	Temperature (°C)	Dissolved Oxygen (mg/L) / (% Saturation)	Specific Conductance (µS/cm at 25 °C)	pH	Alkalinity[1] (mg/L)	Turbidity[2] (NTU)	Salinity[4] (ppt)
Rush Creek										
RC23.0	Waugh Lake	6/25/2024	0830	7.6	9.50 / 107	5.0	7.97	7.2	<1.0	0.00146
RC21.65	Rush Creek Below Rush Meadows Dam	6/25/2024	0950	10.5	8.95 / 101	4.6	8.38	6.5	<1.0	0.00134
RC19.25	Rush Creek Below Gem Dam	6/25/2024	1230	11.5	9.43 / 114	7.5	8.36	8.0	<1.0	0.00228
RC18.55	Rush Creek Below Agnew Dam	6/25/2024	1450	13.4	9.31 / 122	10.4	7.99	9.8	1.75	0.00325
PHTR	Rush Creek Powerhouse Tailrace	6/26/2024	0740	10.9	9.49 / 106	11.1	7.84	8.8	<1.0	0.00349
RC17.15	Rush Creek Above Silver Lake	6/26/2024	0745	11.1	9.66 / 107	14.2	7.56	12.0	<1.0	0.00456
RC17.6	Rush Creek Above Silver Lake	6/26/2024	0735	12.7	9.58 / 102	11.4	7.69	10.0	8.66[3]	0.00359
RC15.2	Rush Creek Below Silver Lake	6/26/2024	0800	12.5	8.82 / 98	17.9	7.64	12.0	<1.0	0.00587
South Rush Creek										
SRC0.15	South Rush Creek	6/26/2024	0725	12.5	9.41 / 110	10.8	7.70	9.8	<1.0	0.00339
Reversed Creek										
RVC0.26	Reversed Creek (Upstream of Confluence with South Rush Creek)	6/26/2024	0715	10.1	9.80 / 102	48.1	7.87	34.0	<1.0	0.01719

Notes:
[1] Alkalinity field test kits were not used. Alkalinity was measured during the Spring/Fall grab samplings by the laboratory.
[2] Turbidity values of "<1.0" indicate that turbidity measurements were within the instruments margin of error of +/- 1.0 NTU.
[3] This measurement is likely an anomaly from Horsetail Fals or inflow from an upstream, unnamed tributary as values upstream and downstream of RC17.6 were normal.
[4] Salinity was calculated by converting conductivity measurements (Dohrman 2023).

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Table AQ 4-10. Summary of In-Situ Stream Measurements Collected During the 2024 Fall Sampling Event

Sampling Location / Site ID	Stream Segment Name	Date	Time of Day	Temperature (°C)	Dissolved Oxygen (mg/L) / (% Saturation)	Specific Conductance (µS/cm at 25 °C)	pH	Alkalinity[1] (mg/L)	Turbidity[2] (NTU)	Salinity[3] (ppt)
Rush Creek										
RC23.0	Waugh Lake	9/17/2024	1500	11.0	8.33 / 103	8.2	7.74	6.2	<1.0	0.00251
RC21.65	Rush Creek Below Rush Meadows Dam	9/17/2024	1555	13.0	7.62 / 93	12.2	7.76	7.2	<1.0	0.00387
RC19.25	Rush Creek Below Gem Dam	9/18/2024	1025	12.1	7.90 / 100	10.6	7.50	9.0	<1.0	0.00332
RC18.55	Rush Creek Below Agnew Dam	9/18/2024	1210	10.9	8.63 / 107	75.5	6.82	38.0	<1.0	0.02807
PHTR	Rush Creek Powerhouse Tailrace	9/19/2024	1023	13.4	8.30 / 104	10.1	7.35	7.2	<1.0	0.00315
RC17.15	Rush Creek Above Silver Lake	9/19/2024	1012	9.6	8.95 / 103	60.5	7.37	36.0	<1.0	0.02206
RC17.6	Rush Creek Above Silver Lake	9/19/2024	1030	7.5	9.46 / 98	83.0	7.59	44.0	<1.0	0.03112
RC15.2	Rush Creek Below Silver Lake	9/19/2024	1005	13.0	7.80 / 96	37.9	7.20	20.0	<1.0	0.01326
South Rush Creek										
SRC0.15[4]	South Rush Creek	9/19/2024	1040	9	8.49 / 97	60.0	7.29	38.0	<1.0	0.02186
Reversed Creek										
RVC0.26	Reversed Creek (Upstream of Confluence with South Rush Creek)	9/19/2024	1055	7.7	9.8 / 107	90.9	7.63	56.0	<1.0	0.03435

Notes:
[1] Alkalinity field test kits were not used. Alkalinity was measured during the Spring/Fall grab samplings by the laboratory
[2] Turbidity values of "<1.0" indicate that turbidity measurements were within the instruments margin of error of +/- 1.0 NTU.
[3] Salinity was calculated by converting conductivity measurements (Dohrman 2023).

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Table AQ 4-11. Summary of Seasonal Grab Sample Results Collected During the 2023 Spring Sampling Event

General Parameters	Units	Reporting Limit	WQ Criteria	Site ID, Stream Segment, Date, Time																			
				RC23.0	RC21.65	GL-1 (surface)	GL-1 (mid-Column)	GL-2 (surface)	GL-2 (mid-column)	RC19.25	AL-1 (surface)	AL-1 (mid-column)	RC18.55	PHTR	RC17.15	RC17.6	SL-1 (surface)	SL-1 (mid-column)	SL-2 (surface)	SL-2 (mid-column)	RC15.2	SRC0.15	RVC0.26
				Waugh Lake	Rush Creek Below Rush Meadows Dam	Mid-Lake	Mid-Lake	Near Gem Dam	Near Gem Dam	Rush Creek Below Gem Dam	Mid-Lake	Mid-Lake	Rush Creek Below Agnew Dam	Rush Creek Powerhouse Tailrace	Rush Creek Above Silver Lake	Rush Creek Above Silver Lake	Mid-Lake	Mid-Lake	Near Outlet	Near Outlet	Rush Creek Below Silver Lake	South Rush Creek	Reversed Creek
				7/26/2023	7/26/2023	7/24/2023	7/25/2023	7/24/2023	7/25/2023	6/27/2023	7/25/2023	7/25/2023	6/27/2023	6/26/2023	6/26/2023	6/26/2023	6/26/2023	6/26/2023	6/26/2023	6/26/2023	6/26/2023	6/26/2023	6/26/2023
				0545	0655	1430	0945	1415	1045	1345	1315	1330	1500	1135	1205	1115	1415	1430	1445	1455	1240	1105	1020
Nitrate + Nitrite (NO2 + NO_3)	mg/L	0.020	0.1 [See Table AQ-4-5[2, 3]]	0.032	ND	ND	ND	ND[M]	ND	0.042	ND	ND	0.038	0.038	0.033	0.035	0.025	0.028	0.023	0.022	0.026	0.035	ND
Ammonia as N	mg/L	0.10	Varies See Table AQ 4-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Kjeldahl Nitrogen (TKN)	mg/L	0.20	0.1 - 0.2 [See Table AQ-4-5[2, 3]]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.29**	ND	ND	ND	ND	ND	ND[M]
Total Phosphorus	mg/L	0.020	NS	ND	ND	ND	ND	ND	ND	0.024	ND	ND	ND	ND	ND	ND	ND	0.024	ND	ND	ND	ND	0.020
Orthophosphate (PO_4)	mg/L	0.020	0.02 - 0.16 [See Table AQ-4-5[2, 3]]	ND[HT]	ND[HT]	ND[HT]	ND[HT]	ND[HT]	ND[HT]	ND	ND[HT]	ND[HT]	ND	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids[1] (TDS)	mg/L	25	41 - 100 [See Table AQ-4-5[2, 3]]	ND[HT]	ND[HT]	ND[HT]	ND[HT]	ND[HT]	ND[HT]	29	ND[HT]	ND[HT]	ND	ND	39	**58**	**49[QD]**	30	**70**	**79**	**86**	25	84
Total Suspended Solids (TSS)	mg/L	10	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity	mg/L as CaCO3	1.0	>20[4]	**11**	**10**	**13**	**12**	97	**13**	**5.6**	**14**	**14**	**7.6**	**4.7**	**8.9**	**7.9**	37	**12**	**12**	**12**	**12**	**6.4**	35

Notes: Bold values do not meet the listed criteria
ND = not detected; NS = no standard available
RL = reporting limit (the lowest concentration of a substance that can be reliably reported under current laboratory operating conditions).
NS = No standard available

Footnotes:

[1] Due to a system error at WETLAB, the EPA recommended holding time for total dissolved solids was missed for eight sample sites. Samples were delivered within appropriate time windows

[2] Water quality objective from the 2018 Water Quality Control Plan for the Tulare Lake Basin Second Edition (CRWQCB 2021)

[3] Nitrate/Nitrite, TDS, TKN and PO4 for Reversed Creek, Silver Lake and Rush Creek have varying criteria for the Mono Basin and apply only to certain locations within the Project area. These are presented as annual average values in the Basin Plan.

[4] The CCC of 20 mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25 percent of the natural level.
HT: Sample analyzed beyond the accepted holding time
QD: The sample duplicate or matrix spike duplicate analysis demonstrated sample imprecision. The reported result should be considered an estimate.
M: The matrix spike (MS) value for the analysis of this parameter was outside acceptance criteria due to sample concentration or possible matrix inference. The reported result should be considered an estimate

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Table AQ 4-12. Summary of Seasonal Grab Sample Results Collected During the 2023 Fall Sampling Event

General Parameters	Units	RL	WQ Criteria	Site ID, Stream Segment, Date, Time																			
				RC23.0	RC21.65	GL-1 (surface)	GL-1 (mid-Column)	GL-2 (surface)	GL-2 (mid-column)	RC19.25	AL-1 (surface)	AL-1 (mid-column)	RC18.55	PHTR	RC17.15	RC17.6	SL-1 (surface)	SL-1 (mid-column)	SL-2 (surface)	SL-2 (mid-column)	RC15.2	SRC0.15[1]	RVC0.26
				Waugh Lake	Rush Creek Below Rush Meadows Dam	Mid-Lake	Mid-Lake	Near Gem Dam	Near Gem Dam	Rush Creek Below Gem Dam	Mid-Lake	Mid-Lake	Rush Creek Below Agnew Dam	Rush Creek Powerhouse Tailrace	Rush Creek Above Silver Lake	Rush Creek Above Silver Lake	Mid-Lake	Mid-Lake	Near Outlet	Near Outlet	Rush Creek Below Silver Lake	South Rush Creek	Reversed Creek
				9/26/2023	9/26/2023	9/26/2023	9/26/2023	9/26/2023	9/26/2023	9/25/2023	9/25/2023	9/25/2023	9/27/2023	9/28/2023	9/28/2023	9/28/2023	9/29/2023	9/29/2023	9/29/2023	9/29/2023	9/28/2023	9/28/2023	9/28/2023
				1530	1730	1045	1045	1130	1130	1230	1100	1100	1330	0955	1010	0945	0930	0930	1030	1030	1100	0930	1030
Nitrate + Nitrite (NO2 + NO_3)	mg/L	0.020	0.1 [See Table AQ-4-5[2, 3]]	ND	ND	ND	ND	ND[HT]	ND[HT]	ND[HT]	ND[HT]	ND[HT]	ND	ND[U, D]	ND[U, D]	ND[U, D]	ND[U, D]	ND[U, D]	ND[U, D]	ND[U, D]	ND[U, D]	ND[U, D]	0.06[J]
Ammonia as N	mg/L	0.10	Varies See Table AQ 4-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Kjeldahl Nitrogen (TKN)	mg/L	0.20	0.1 - 0.2 [See Table AQ-4-5[2, 3]]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Phosphorus	ug/L	0.020	NS	ND	ND	ND	0.11	ND	ND	ND	ND	ND	0.038	ND	ND	ND	ND	ND	ND	ND	0.14	ND	0.1
Orthophosphate (PO_4)	mg/L	0.020	0.02 - 0.16 [See Table AQ-4-5[2, 3]]	ND	ND	ND	ND	ND	ND	ND[HT]	ND[HT]	ND[HT]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (TDS)	mg/L	25	41 - 100 [See Table AQ-4-5[2, 3]]	ND	ND	ND	ND	ND	ND	ND	44	66	63	ND	**64**	**79**	**51**	32	43	41	43	40	95
Total Suspended Solids (TSS)	mg/L	10	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity	mg/L as CaCO3	1.0	>20[4]	**16**	**2.5**	**2.6**	**2.6**	**16**	**3**	**6.7**	37	36	85	**3.6**	36	48	29	**15**	31	31	21	**17**	53

Notes: Bold values do not meet the listed criteria
ND = not detected
NS = no standard available
RL = reporting limit (the lowest concentration of a substance that can be reliably reported under current laboratory operating conditions)

Footnotes:

1 SRC0.15 was dry in September. Samples taken at culvert crossing and confluence with an unnamed creek. This unnamed creek was still flowing in September, contributing to Rush Creek.

2 Water quality objective from the 2018 Water Quality Control Plan for the Tulare Lake Basin Second Edition (CRWQCB 2021)

3 Nitrate/Nitrite, TDS, TKN and PO4 for Reversed Creek, Silver Lake and Rush Creek have varying criteria for the Mono Basin and apply only to certain locations within the Project area. These are presented as annual average values in the Basin Plan.

4 The CCC of 20 mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25 percent of the natural level.

5 Due to WETLAB instrumentation maintenance issues, testing as NO3 was not possible for grab samples collected during the late summer/early fall base flow period. Instead, samples were run using EPA 300.0 and flagged to bring the RL down. Values reported should be considered estimates per the lab.

HT: Sample analyzed beyond the accepted holding time
U: The analyte was analyzed for but was not detected above the level of the reported sample reporting/quantitation limit. The reported result should be considered an estimate.
J: The reported value is between the lab method detection limit and the lab practical quantity limit. The result should be considered an estimate.
D: Due to the sample matrix dilution was required in order to properly detect and report the analyte. Reporting limit was adjusted accordingly.

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Table AQ 4-13. Summary of Seasonal Grab Sample Results Collected During the 2024 Spring Sampling Event

General Parameters	Units	Reporting Limit	WQ Criteria	Site ID, Stream Segment, Date, Time																			
				RC23.0	RC21.65	GL-1 (surface)	GL-1 (mid-Column)	GL-2 (surface)	GL-2 (mid-column)	RC19.25	AL-1 (surface)	AL-1 (mid-column)	RC18.55	PHTR	RC17.15	RC17.6	SL-1 (surface)	SL-1 (mid-column)	SL-2 (surface)	SL-2 (mid-column)	RC15.2	SRC0.15	RVC0.26
				Waugh Lake	Rush Creek Below Rush Meadows Dam	Mid-Lake	Mid-Lake	Near Gem Dam	Near Gem Dam	Rush Creek Below Gem Dam	Mid-Lake	Mid-Lake	Rush Creek Below Agnew Dam	Rush Creek Powerhouse Tailrace	Rush Creek Above Silver Lake	Rush Creek Above Silver Lake	Mid-Lake	Mid-Lake	Near Outlet	Near Outlet	Rush Creek Below Silver Lake	South Rush Creek	Reversed Creek
				6/25/2024	6/25/2024	6/24/2024	6/24/2024	6/24/2024	6/24/2024	6/25/2024	6/25/2024	6/25/2024	6/25/2024	6/26/2024	6/26/2024	6/26/2024	6/26/2024	6/26/2024	6/26/2024	6/26/2024	6/26/2024	6/26/2024	6/26/2024
				0830	0945	1125	1130	1240	1245	1230	1355	1400	1450	0740	0750	0735	0920	0920	0950	0950	0800	0730	0715
Nitrate + Nitrite (NO2 + NO_3)	mg/L	0.020	0.1 [See Table AQ-4-5[1, 2]]	ND	0.031	ND[HT]	ND[HT]	ND[HT]	ND[HT]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ammonia as N	mg/L	0.10	Varies See Table AQ 4-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Kjeldahl Nitrogen (TKN)	mg/L	0.20	0.1 - 0.2 [See Table AQ-4-5[1, 2]]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	ND[B]	0.22[B]	ND[B]	ND[B]	ND	ND	ND
Total Phosphorus	mg/L	0.020	NS	0.28	0.65	0.40	0.44	0.097	ND	0.21	ND	ND	ND	ND	ND	0.73	ND	ND	0.087	ND	ND	ND	0.042
Orthophosphate (PO_4)	mg/L	0.020	0.02 - 0.16 [See Table AQ-4-5[1, 2]]	ND	ND[M]	ND[HT]	ND[HT]	ND[HT]	ND[HT]	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (TDS)	mg/L	25	41 - 100 [See Table AQ-4-5[1, 2]]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	27
Total Suspended Solids (TSS)	mg/L	25	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity	mg/L as CaCO3	1.0	>20[3]	**7.2**	**6.5**	**8.8**	**8.2**	**8.2**	**9.5**	**8.0**	**9.0**	**14**	**9.8**	**8.8**	**12**	**10**	**13**	**14**	**13**	**13**	**12**	**9.8**	34

Notes: Bold values do not meet the listed criteria
ND = not detected; NS = no standard available
RL = reporting limit (the lowest concentration of a substance that can be reliably reported under current laboratory operating conditions).

Footnotes:

[1] Water quality objective from the 2018 Water Quality Control Plan for the Tulare Lake Basin Second Edition (CRWQCB 2021)

[2] Nitrate/Nitrite, TDS, TKN and PO4 for Reversed Creek, Silver Lake and Rush Creek have varying criteria for the Mono Basin and apply only to certain locations within the Project area. These are presented as annual average values in the Basin Plan.

[3] The CCC of 20 mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25 percent of the natural level.

HT: Sample analyzed beyond the accepted holding time
B: The analysis of the method blank revealed concentrations of the target analyte above the reporting limit. The client results were greater than ten times the blank amount or non-detect; therefore, the data was not impacted

M: The matrix spike (MS) value for the analysis of this parameter was outside acceptance criteria due to sample concentration or possible matrix inference. The reported result should be considered an estimate

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Table AQ 4-14. Summary of Seasonal Grab Sample Results Collected During the 2024 Fall Sampling Event

General Parameters	Units	Reporting Limit	WQ Criteria	Site ID, Stream Segment, Date, Time																			
				RC23.0	RC21.65	GL-1 (surface)	GL-1 (mid-Column)	GL-2 (surface)	GL-2 (mid-column)	RC19.25	AL-1 (surface)	AL-1 (mid-column)	RC18.55	PHTR	RC17.15	RC17.6	SL-1 (surface)	SL-1 (mid-column)	SL-2 (surface)	SL-2 (mid-column)	RC15.2	SRC0.15	RVC0.26
				Waugh Lake	Rush Creek Below Rush Meadows Dam	Mid-Lake	Mid-Lake	Near Gem Dam	Near Gem Dam	Rush Creek Below Gem Dam	Mid-Lake	Mid-Lake	Rush Creek Below Agnew Dam	Rush Creek Powerhouse Tailrace	Rush Creek Above Silver Lake	Rush Creek Above Silver Lake	Mid-Lake	Mid-Lake	Near Outlet	Near Outlet	Rush Creek Below Silver Lake	South Rush Creek	Reversed Creek
				9/17/2024	9/17/2024	9/18/2024	9/18/2024	9/18/2024	9/18/2024	9/18/2024	9/18/2024	9/18/2024	9/18/2024	9/19/2024	9/19/2024	9/19/2024	9/19/2024	9/19/2024	9/19/2024	9/19/2024	9/19/2024	9/19/2024	9/19/2024
				1455	1455	0925	0925	0835	0835	1025	1135	1135	1210	0740	1010	1038	0830	0830	0915	0915	1000	1035	1055
Nitrate + Nitrite (NO2 + NO_3)	mg/L	0.020	0.1 [See Table AQ-4-5[1, 2]]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.091	ND	ND	ND	ND	ND	0.056	ND	ND	ND
Ammonia as N	mg/L	0.10	Varies See Table AQ 4-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Kjeldahl Nitrogen (TKN)	mg/L	0.20	0.1 - 0.2 [See Table AQ-4-5[1, 2]]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND[QD]	ND	ND	ND	ND	ND	ND
Total Phosphorus	ug/L	0.020	NS	0.041	0.050	0.038	0.039	ND	ND	0.025	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.039
Orthophosphate (PO_4)	mg/L	0.020	0.02 - 0.16 [See Table AQ-4-5[1, 2]]	ND	ND	0.020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Dissolved Solids (TDS)	mg/L	25	41 - 100 [See Table AQ-4-5[1, 2]]	ND	ND	ND	ND	ND	ND	ND	38	56	44	ND	ND	34	ND	ND	ND	ND	ND	ND	84
Total Suspended Solids (TSS)	mg/L	10	NS	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Alkalinity	mg/L as CaCO3	1.0	>20[3]	**6.2**	**7.2**	**7.5**	**7.2**	**7.8**	**7.0**	**9.0**	39.0	39.0	38	**7.2**	36	44	**19**	**19**	**19**	**19**	20	38	56

Notes: Bold values do not meet the listed criteria
ND = not detected; NS = no standard available
RL = reporting limit (the lowest concentration of a substance that can be reliably reported under current laboratory operating conditions).

Footnotes:

[1] Water quality objective from the 2018 Water Quality Control Plan for the Tulare Lake Basin Second Edition (CRWQCB 2021)

[2] Nitrate/Nitrite, TDS, TKN and PO4 for Reversed Creek, Silver Lake and Rush Creek have varying criteria for the Mono Basin and apply only to certain locations within the Project area. These are presented as annual average values in the Basin Plan.

[3] The CCC of 20 mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25 percent of the natural level.

QD: The sample duplicate or matrix spike duplicate analysis demonstrated sample imprecision. The reported result should be considered an estimate.

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Table AQ 4-15. Calculated Ammonia Concentration Criteria for the 2023 Spring and Fall Sampling Events

Sampling Location	Date	pH	Temperature (°C)	EPA Ammonia Chronic Criteria[1]	EPA Ammonia Acute Criteria[1]	Ammonia Concentration[2] (mg/L)
Spring Sampling						
RC23.0	7/26/2023	6.83	3.5	4.61	27.49	ND
RC21.65	7/26/2023	6.60	7.7	4.63	31.28	ND
GL-1 (surface)	7/24/2023	7.25	15.2	2.28	18.61	ND
GL-1 (mid-Column)	7/25/2023	6.64	8.7	4.31	30.70	ND
GL-2 (surface)[3]	7/24/2023	-	-	-	-	ND
GL-2 (mid-column)[3]	7/25/2023	-	-	-	-	ND
RC19.25	6/27/2023	7.15	3.9	4.08	20.84	ND
AL-1 (surface)	7/25/2023	7.20	13.9	2.55	19.73	ND
AL-1 (mid-column)	7/25/2023	6.85	9.5	3.90	27.12	ND
RC18.55	6/27/2023	7.08	5.2	4.22	22.38	ND
PHTR	6/26/2023	6.95	3.6	4.44	25.14	ND
RC17.15	6/26/2023	7.10	5.7	4.18	21.94	ND
RC17.6	6/26/2023	7.01	5.8	4.35	23.89	ND
SL-1 (surface)	6/26/2023	8.60	7.5	0.66	1.77	ND
SL-1 (mid-column)	6/26/2023	6.83	5.6	4.61	27.49	ND
SL-2 (surface)	6/26/2023	6.85	7.7	4.38	27.12	ND
SL-2 (mid-column)	6/26/2023	6.81	7.7	4.43	27.86	ND
RC15.2	6/26/2023	6.94	6.8	4.46	25.35	ND
SRC0.15	6/26/2023	7.23	5.9	3.91	19.06	ND
RVC0.26	6/26/2023	7.30	7.2	3.70	17.51	ND

Sampling Location	Date	pH	Temperature (°C)	EPA Ammonia Chronic Criteria[1]	EPA Ammonia Acute Criteria[1]	Ammonia Concentration[2] (mg/L)
Fall Sampling						
RC23.0	9/26/2023	6.62	11.8	3.54	30.99	ND
RC21.65	9/26/2023	6.57	11.8	3.57	31.70	ND
GL-1 (surface)	9/26/2023	7.11	11.5	3.12	21.72	ND
GL-1 (mid-Column)	9/26/2023	5.55	3.8	5.20	38.16	ND
GL-2 (surface)	9/26/2023	6.77	12.0	3.39	28.58	ND
GL-2 (mid-column)	9/26/2023	6.45	11.3	3.75	33.20	ND
RC19.25	9/25/2023	7.27	10.9	2.97	18.17	ND
AL-1 (surface)	9/25/2023	7.08	10.6	3.35	22.38	ND
AL-1 (mid-column)	9/25/2023	7.07	10.6	3.36	22.60	ND
RC18.55	9/27/2023	7.09	12.5	2.95	22.16	ND
PHTR	9/28/2023	7.13	12.4	2.91	21.28	ND
RC17.15	9/28/2023	6.77	9.0	4.12	28.58	ND
RC17.6	9/28/2023	7.35	7.6	3.49	16.41	ND
SL-1 (surface)	9/29/2023	7.10	12.5	2.93	21.94	ND
SL-1 (mid-column)	9/29/2023	7.05	11.9	3.12	23.03	ND
SL-2 (surface)	9/29/2023	7.10	12.8	2.88	21.94	ND
SL-2 (mid-column)	9/29/2023	7.10	12.4	2.95	21.94	ND
RC15.2	9/28/2023	7.02	12.2	3.10	23.68	ND
SRC0.15	9/28/2023	6.67	6.9	4.79	30.24	ND
RVC0.26	9/28/2023	7.00	7.9	4.12	24.10	ND

Notes:

[1] Ammonia criterion calculated using guidelines from the EPA's 2013 Aquatic Life Ambient Water Quality Criteria for Ammonia - Freshwater, which is based on ambient pH and temperature conditions.

[2] ND: Analyte was not detected above the method detection limit (MDL) and is therefore considered a non-detect. The MDL for ammonia is 0.015 mg/L.

[3] Values cannot be given due to water quality meter sensor malfunction on day of sampling at this location. Grab sample values were ND.

Table AQ 4-16. Calculated Ammonia Concentration Criteria for the 2024 Spring and Fall Sampling Events

Sampling Location	Date	pH	Temperature (°C)	EPA Ammonia Chronic Criteria1	EPA Ammonia Acute Criteria1	Ammonia Concentration2 (mg/L)
Spring Sampling						
RC23.0	6/25/2024	7.97	7.6	1.80	5.94	ND
RC21.65	6/25/2024	8.38	10.5	0.79	2.70	ND
GL-1 (surface)	6/24/2024	7.99	14.1	1.15	5.72	ND
GL-1 (mid-Column)	6/24/2024	7.40	8.4	3.19	15.34	ND
GL-2 (surface)[3]	6/24/2024	7.97	13.8	1.21	5.94	ND
GL-2 (mid-column)[3]	6/24/2024	7.52	4.7	3.17	12.89	ND
RC19.25	6/25/2024	8.36	11.5	0.76	2.80	ND
AL-1 (surface)	6/25/2024	8.09	12.3	1.12	4.73	ND
AL-1 (mid-column)	6/25/2024	7.74	11.0	1.95	9.01	ND
RC18.55	6/25/2024	7.99	13.4	1.21	5.72	ND
PHTR	6/26/2024	7.84	10.9	1.74	7.55	ND
RC17.15	6/26/2024	7.56	11.1	2.34	12.12	ND
RC17.6	6/26/2024	7.69	12.7	1.85	9.81	ND
SL-1 (surface)	6/26/2024	7.31	13.3	2.48	17.29	ND
SL-1 (mid-column)	6/26/2024	7.09	8.7	3.77	22.16	ND
SL-2 (surface)	6/26/2024	7.16	12.6	2.83	20.62	ND
SL-2 (mid-column)	6/26/2024	6.92	10.7	3.54	25.75	ND
RC15.2	6/26/2024	7.64	12.5	1.98	10.66	ND
SRC0.15	6/26/2024	7.70	12.7	1.83	9.64	ND
RVC0.26	6/26/2024	7.87	10.1	1.76	7.15	ND

Sampling Location	Date	pH	Temperature (°C)	EPA Ammonia Chronic Criteria1	EPA Ammonia Acute Criteria1	Ammonia Concentration2 (mg/L)
Fall Sampling						
RC23.0	9/17/2024	7.74	11.0	1.95	9.01	ND
RC21.65	9/17/2024	7.76	13.0	1.67	8.70	ND
GL-1 (surface)	9/18/2024	7.35	12.8	2.49	16.41	ND
GL-1 (mid-Column)	9/18/2024	7.33	12.6	2.56	16.85	ND
GL-2 (surface)	9/18/2024	7.58	12.6	2.09	11.74	ND
GL-2 (mid-column)	9/18/2024	7.62	4.9	2.88	11.01	ND
RC19.25	9/18/2024	7.50	12.1	2.32	13.28	ND
AL-1 (surface)	9/18/2024	7.64	11.2	2.15	10.66	ND
AL-1 (mid-column)	9/18/2024	7.22	10.9	3.06	19.28	ND
RC18.55	9/18/2024	6.82	10.9	3.60	27.68	ND
PHTR	9/19/2024	7.35	13.4	2.40	16.41	ND
RC17.15	9/19/2024	7.37	9.6	3.02	15.98	ND
RC17.6	9/19/2024	7.59	7.5	2.87	11.56	ND
SL-1 (surface)	9/19/2024	7.20	13.2	2.67	19.73	ND
SL-1 (mid-column)	9/19/2024	7.22	13.1	2.66	19.28	ND
SL-2 (surface)	9/19/2024	6.38	13.1	3.37	33.95	ND
SL-2 (mid-column)	9/19/2024	6.82	13.2	3.10	27.68	ND
RC15.2	9/19/2024	7.20	13.0	2.70	19.73	ND
SRC0.15	9/19/2024	7.29	9.0	3.32	17.73	ND
RVC0.26	9/19/2024	7.63	7.7	2.72	10.84	ND

[1] Ammonia criterion calculated using guidelines from the EPA's 2013 Aquatic Life Ambient Water Quality Criteria for Ammonia - Freshwater, which is based on ambient pH and temperature conditions.

[2] ND: Analyte was not detected above the method detection limit (MDL) and is therefore considered a non-detect. The MDL for ammonia is 0.015 mg/L.

Table AQ 4-17. Summary of Analytical Results for Bacterial Sampling at Agnew and Gem Lakes in July 2023 and July 2024

Sample Location	Test[1, 2]	Sample Dates				
		7/5/2023	**7/10/2023**	**7/14/2023**	**7/20/2023**	**7/31/2023**
Agnew Lake	*Total Coliform (MPN/100mL)*	8.4	14.8	13.5	85.7	47.3
	Fecal Coliform (MPN/100mL)	*Not Tested*	1.0	ND	ND	ND
	E. coli (MPN/100mL)	ND	ND	ND	1.0	ND
Gem Lake	*Total Coliform (MPN/100mL)*	290.9	12997.0[3]	13.4	24196.0[3]	1553.1
	Fecal Coliform (MPN/100mL)	*Not Tested*	1355.0[3]	ND	1408.0[3]	ND
	E. coli (MPN/100mL)	ND	ND[3]	ND	ND	ND
Sample Location	**Test[1, 2]**	**7/1/2024**	**7/8/2024**	**7/10/2024**	**7/15/2024**	**7/22/2024**
Agnew Lake	*Total Coliform (MPN/100mL)*	24.6	206.4	209.8	261.3	1413.6
	Fecal Coliform (MPN/100mL)	ND	ND	1.0	ND	1.0
	E. coli (MPN/100mL)	ND	ND	2.0	ND	ND
Gem Lake	*Total Coliform (MPN/100mL)*	44.1	96.0	37.9	53.8	39.7
	Fecal Coliform (MPN/100mL)	ND	ND	ND	ND	ND
	E. coli (MPN/100mL)	ND	ND	ND	ND	31.5

Notes:

A result of zero (0) indicates absence for both fecal coliform and *E. coli* meaning the water meets the microbiological requirements of the EPA Safe Water Drinking Act. A result of one (1) for either test indicates presence, and the water does not the water does not meet the Safe Water Drinking Act requirements. MPN = Most probable number of bacterial colonies per 100 mL of water.

[1] *E. coli* testing was conducted by the state-certified laboratory, though it was not required by the AQ-4 TSP.

[2] Due to a processing error at the state-certified laboratory, Fecal Coliform tests were not performed for Agnew or Gem Lake on July 5, 2023

[3] Reporting Limit increased from 1.0 to 10.0. When samples are heavily diluted by the laboratory, analysts may dilute the sample to read the test results properly. This dilution will increase the reporting limit.

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FIGURES

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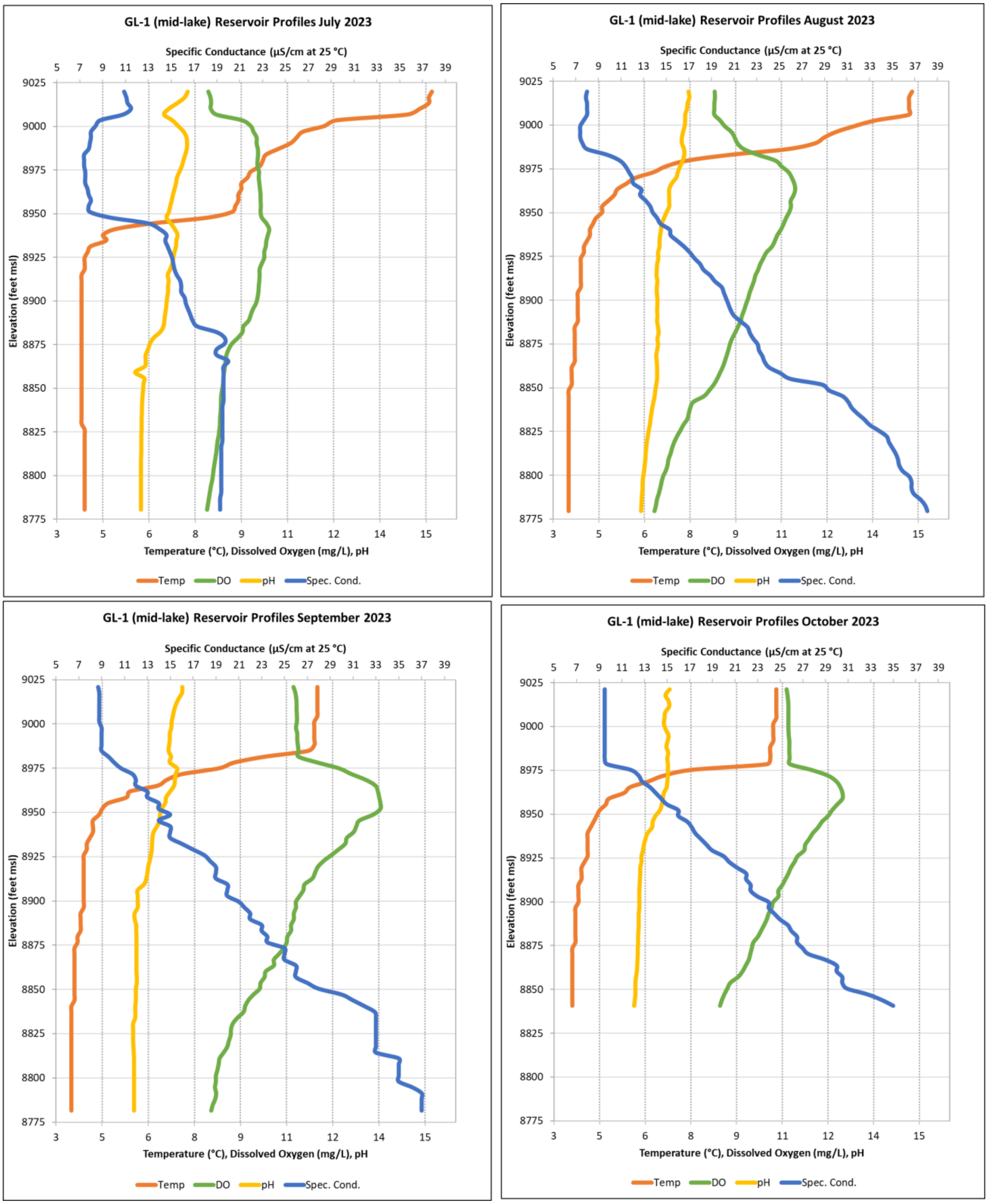

Figure AQ 4-1. Gem Lake (GL-1; Mid-Lake) Profiles for Water Temperature, DO, pH, and Specific Conductance from July Through October 2023

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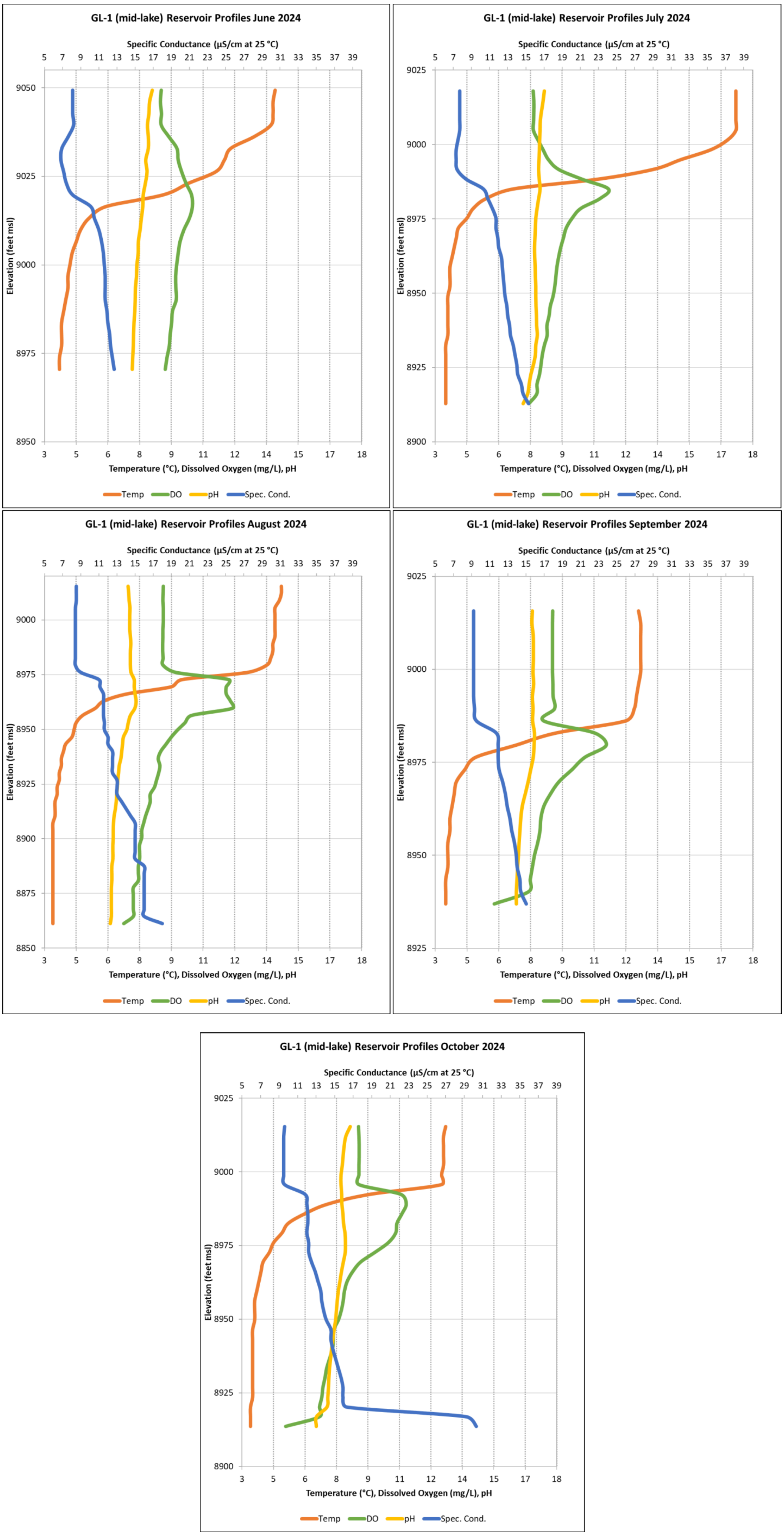

Figure AQ 4-2. Gem Lake (GL-1; Mid-Lake) Profiles for Water Temperature, DO, pH, and Specific Conductance from June Through October 2024

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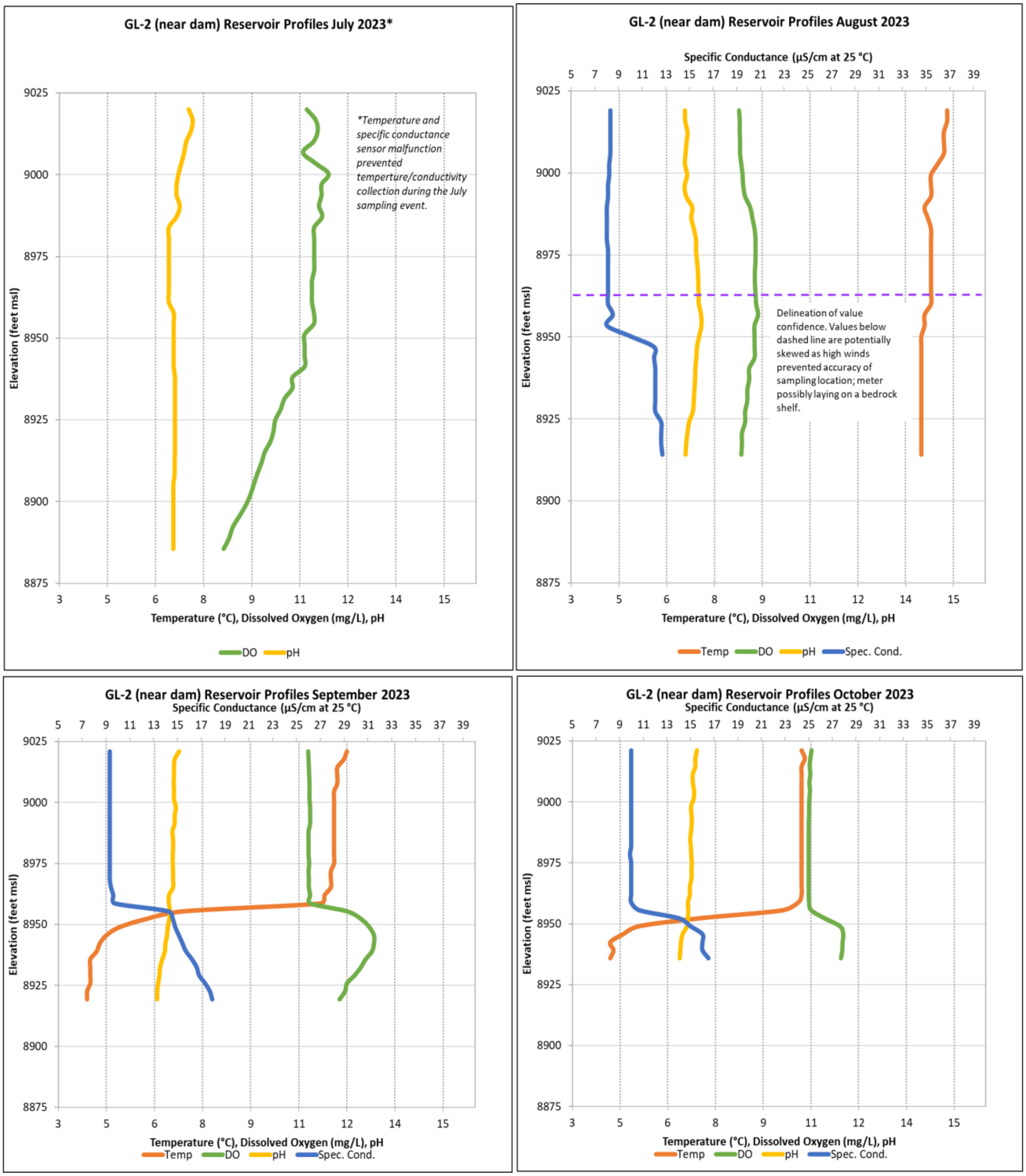

Figure AQ 4-3. Gem Lake (GL-2; Near Dam) Profiles for Water Temperature, DO, pH, and Specific Conductance from July Through October 2023

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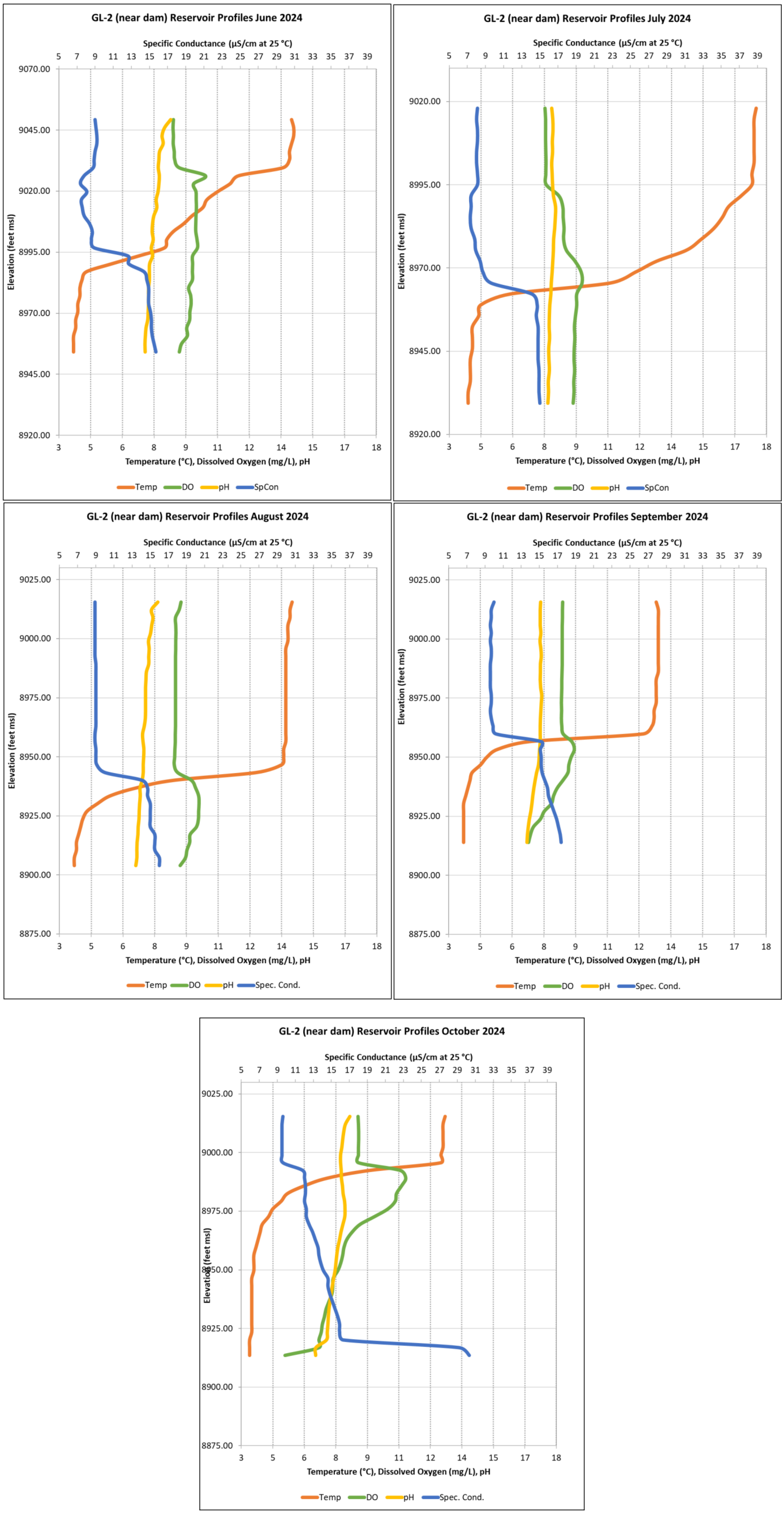

Figure AQ 4-4. Gem Lake (GL-2; Near Dam) Profiles for Water Temperature, DO, pH, and Specific Conductance from June Through October 2024

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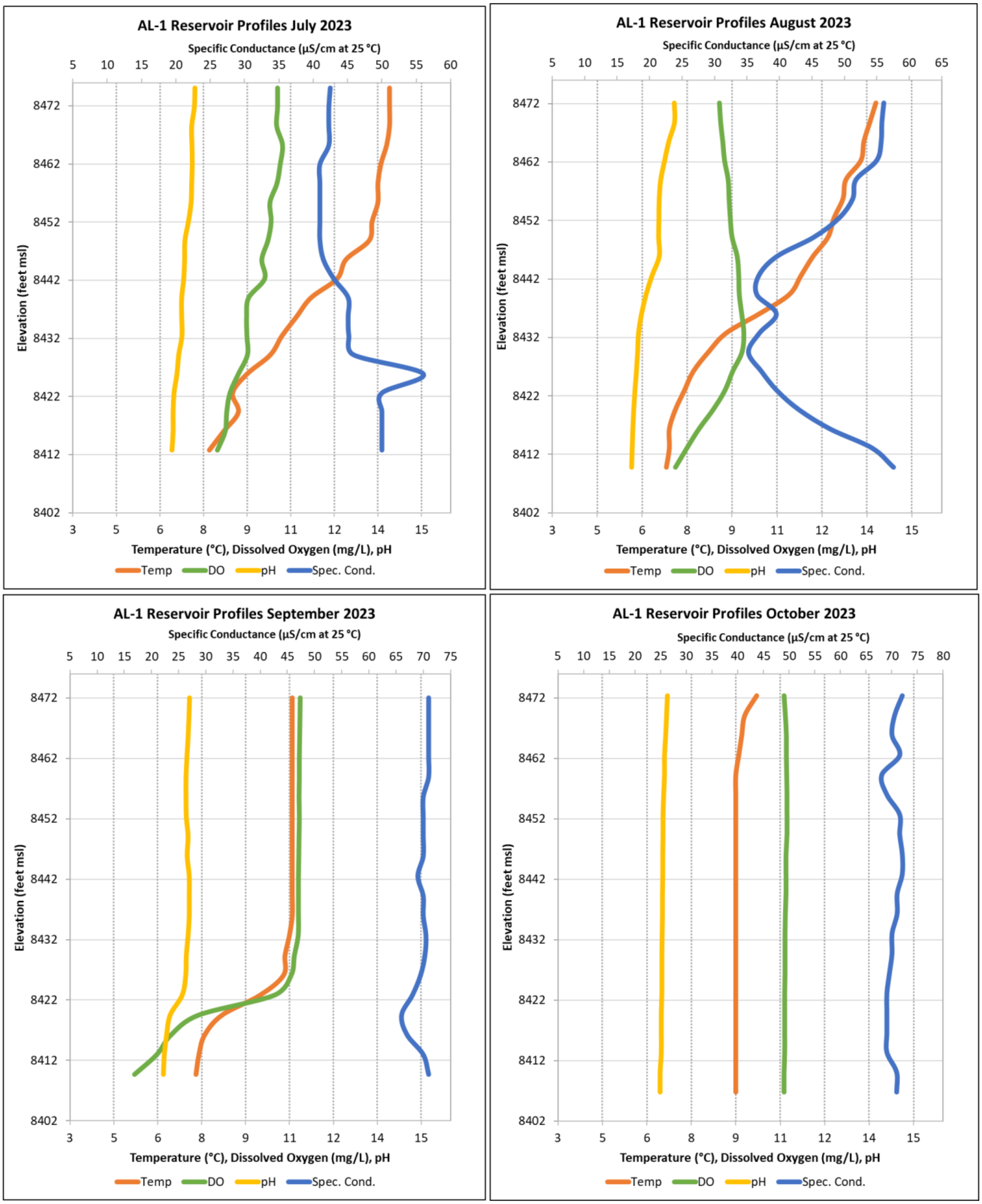

Figure AQ 4-5. Agnew Lake Profiles for Water Temperature, DO, pH, and Specific Conductance from July through October 2023

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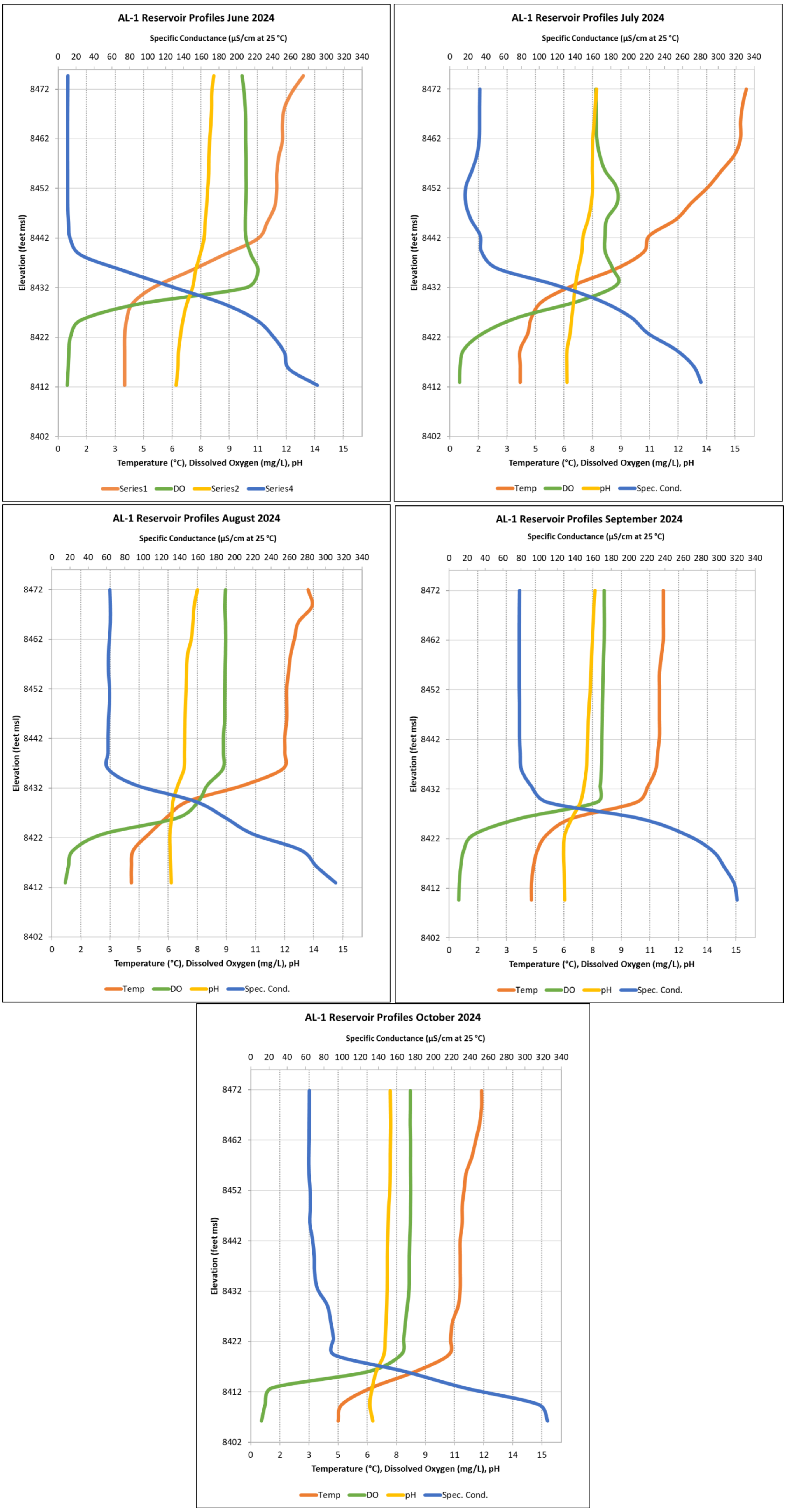

Figure AQ 4-6. Agnew Lake Profiles for Water Temperature, DO, pH, and Specific Conductance from June through October 2024

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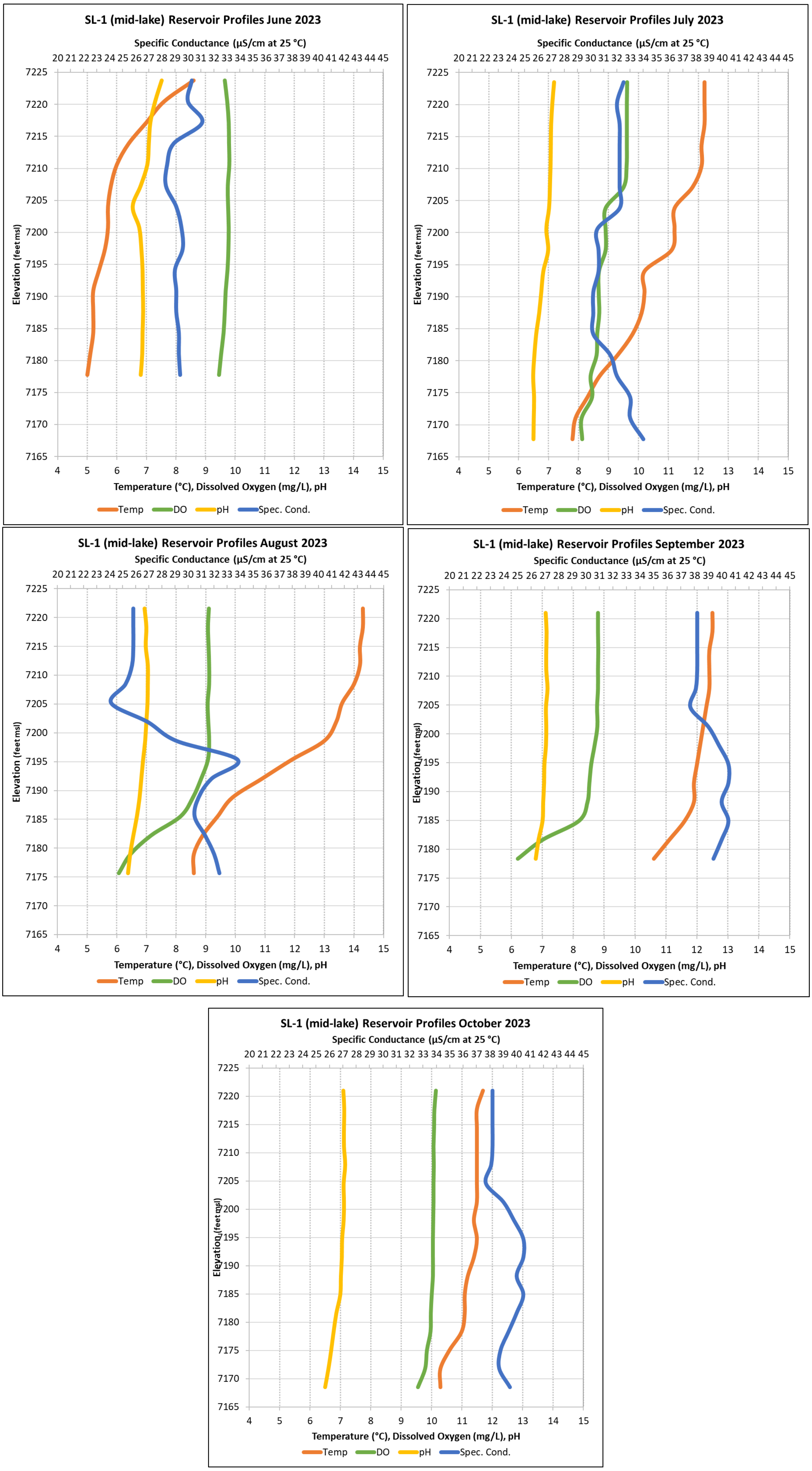

Figure AQ 4-7. Silver Lake (SL-1; Mid-Lake) Profiles for Water Temperature, DO, pH, and Specific Conductance from June through October 2023

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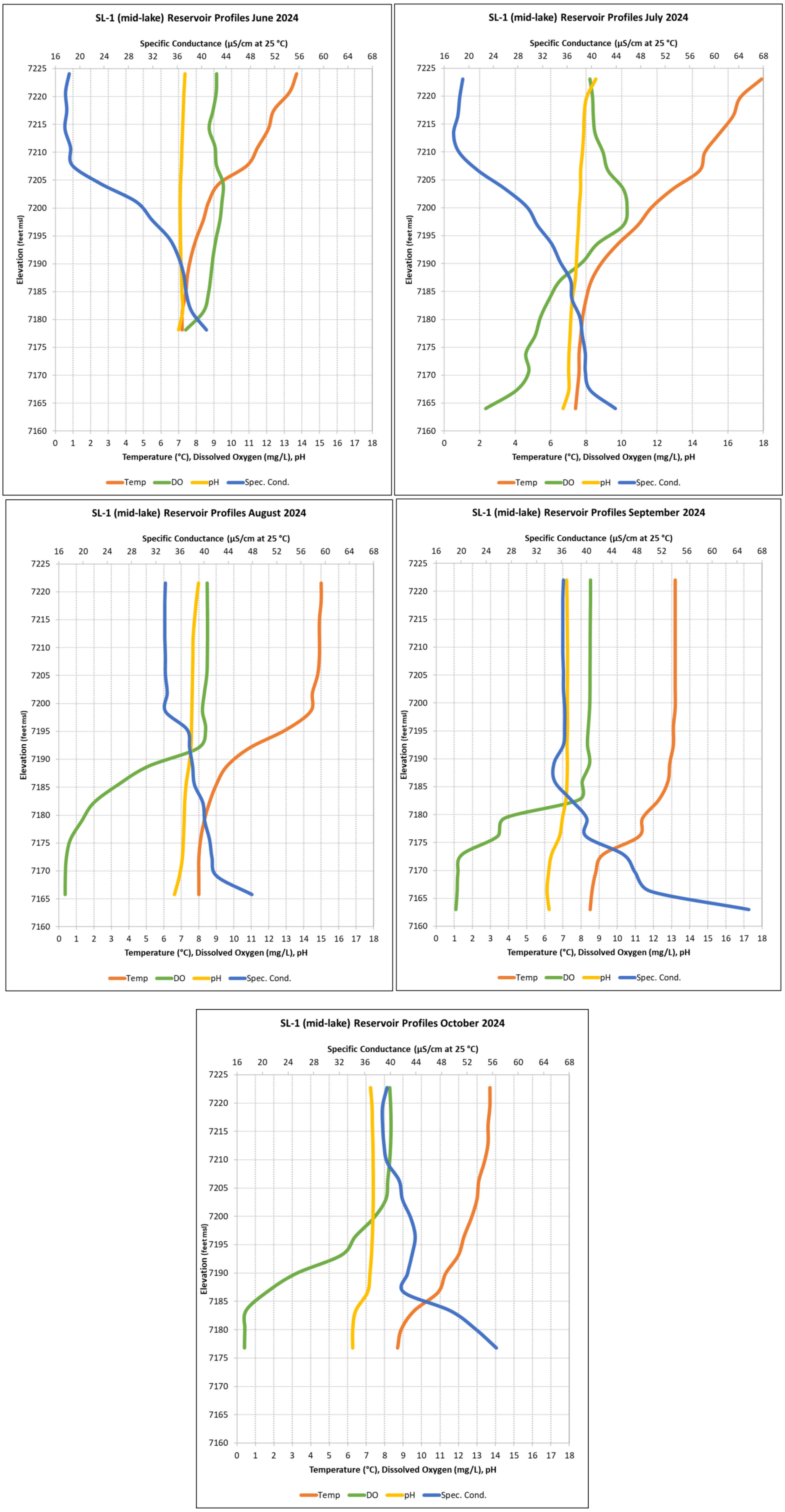

Figure AQ 4-8. Silver Lake (SL-1; Mid-Lake) Profiles for Water Temperature, DO, pH, and Specific Conductance from June through October 2024

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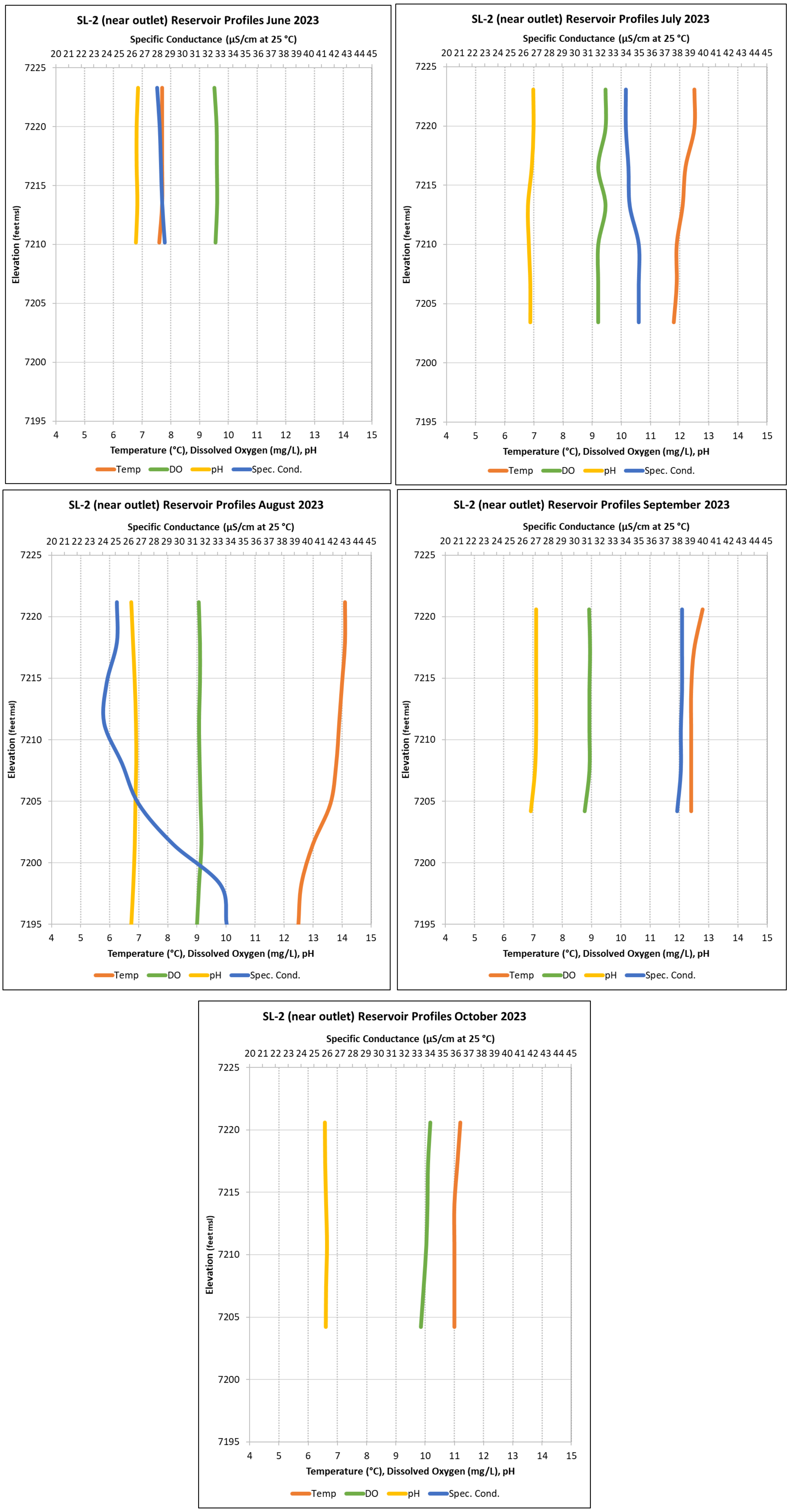

Figure AQ 4-9. Silver Lake (SL-2; Near Outlet) Profiles for Water Temperature, DO, pH, and Specific Conductance from June through October 2023

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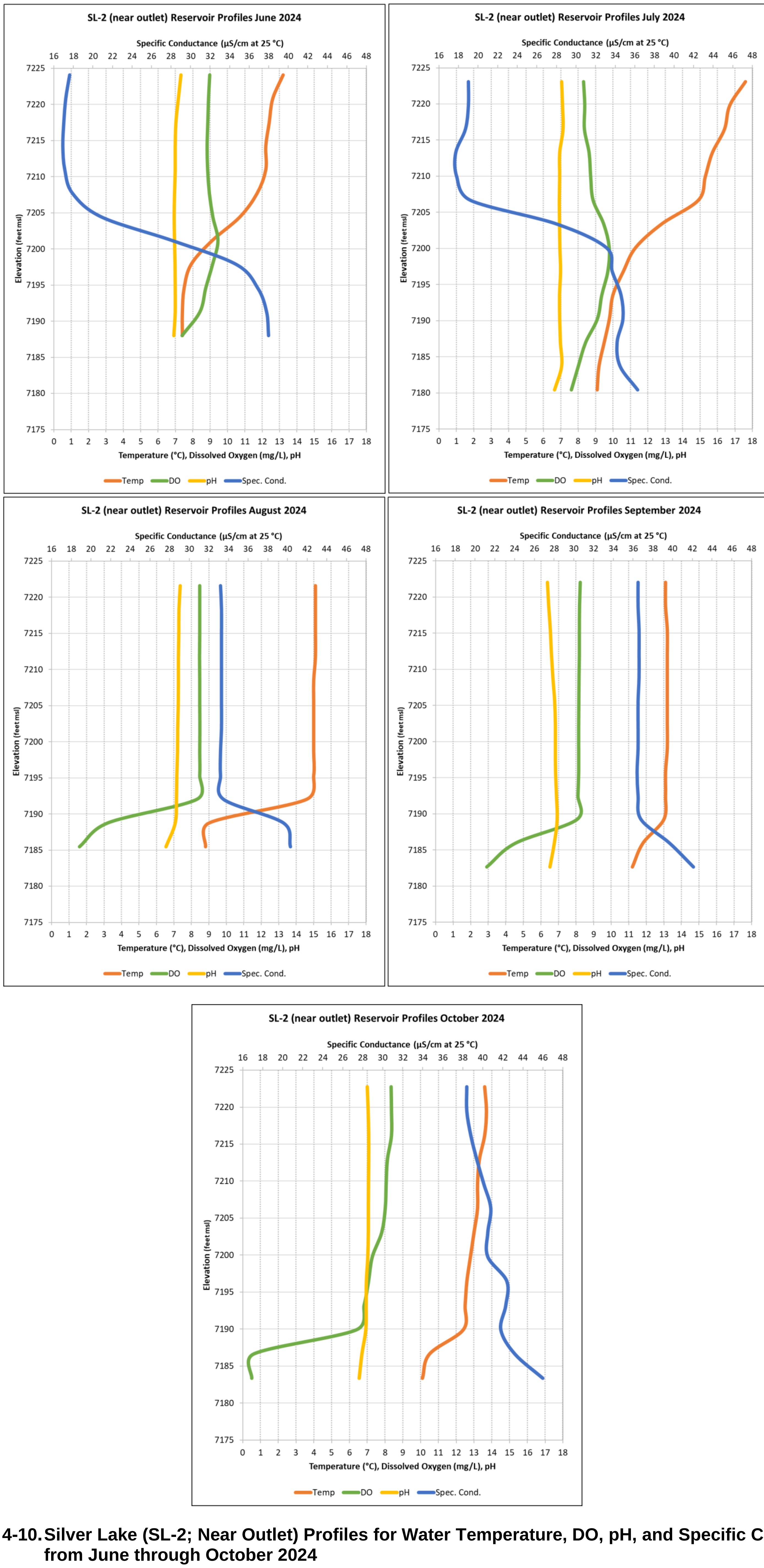

Figure AQ 4-10. Silver Lake (SL-2; Near Outlet) Profiles for Water Temperature, DO, pH, and Specific Conductance from June through October 2024

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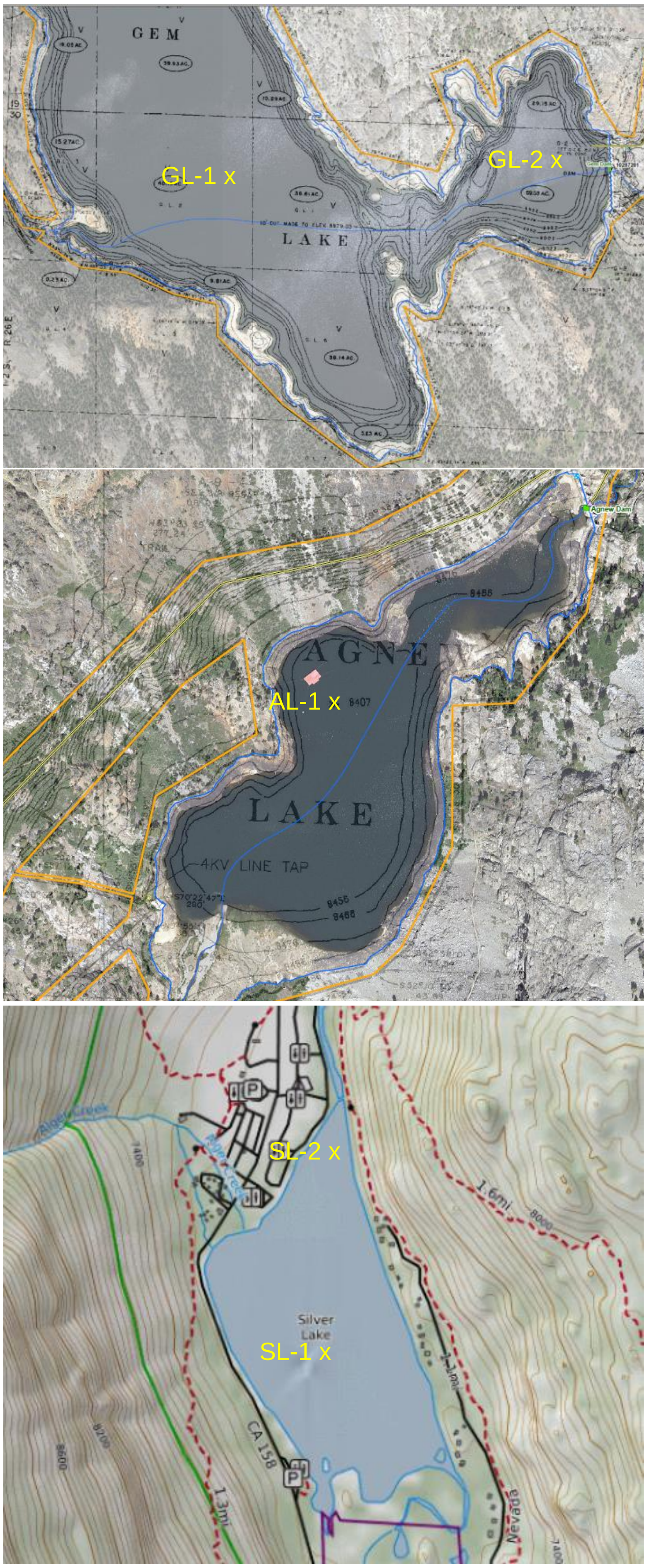

Figure AQ 4-11. Gem, Agnew, and Silver Lake Profile Sampling Locations

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MAPS

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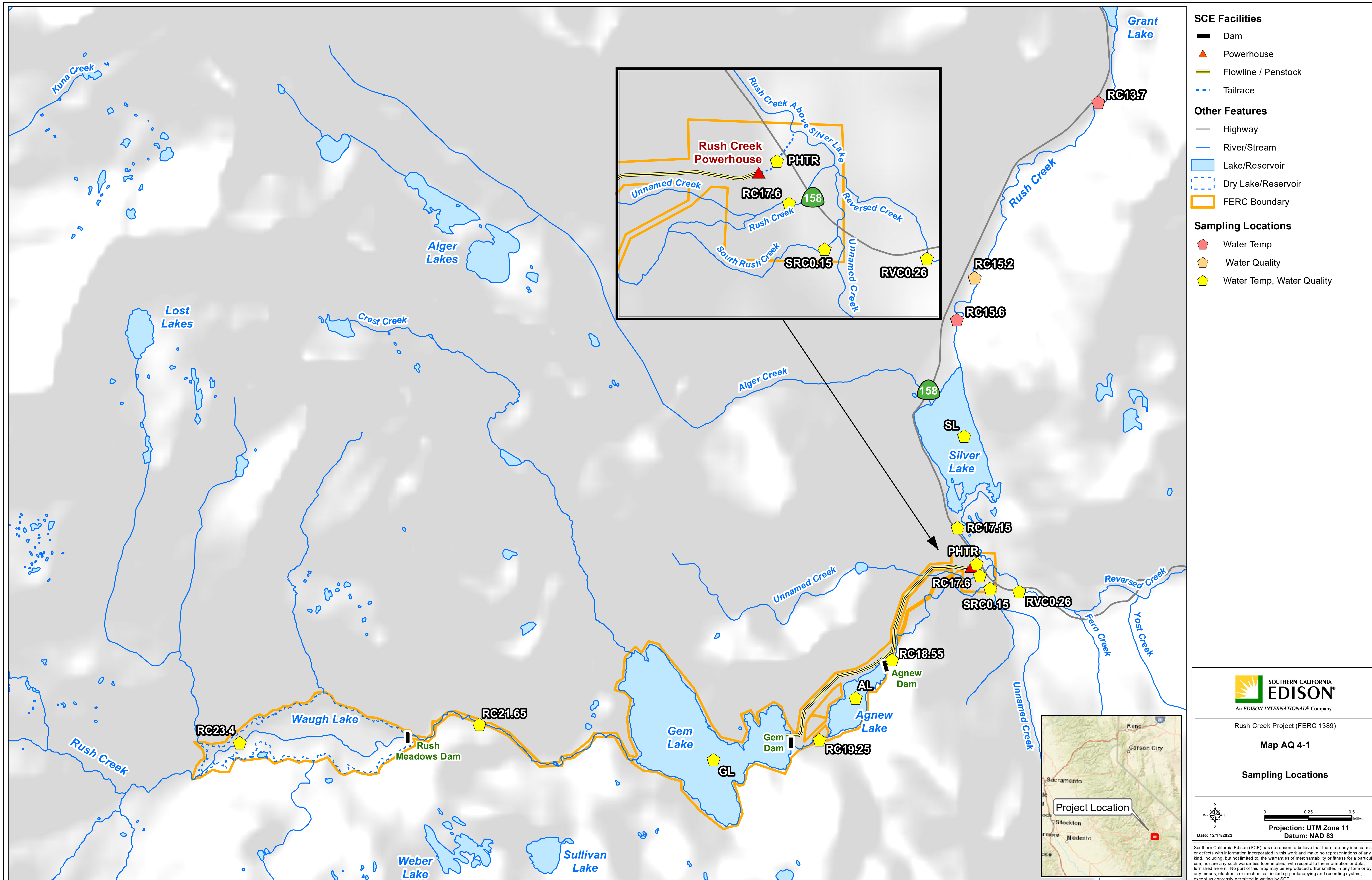

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APPENDIX A

Description Water Quality Parameters

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1 WATER QUALITY MONITORING PARAMETER

1.1 IN-SITU FIELD MEASUREMENTS – STREAMS

1.1.1 Water Temperature

Ambient water temperature is a measurement of the intensity of heat stored in a volume of water and is generally reported in degrees Celsius (°C) or Fahrenheit (°F). Natural heat sources include solar radiation, air transfer, condensation of water vapor at the water surface, sediments, precipitation, surface runoff, and groundwater. Anthropogenic sources of heat include industrial effluents, agriculture, forest harvesting, decreases in streamside vegetation coverage, urban development, and mining.

Water temperature has important effects on aquatic biota. Increased water temperature reduces oxygen solubility while elevating metabolic oxygen demand. This causes lower oxygen concentrations that may be detrimental to some aquatic organisms. Reproductive and other biological activities, such as migration, spawning, egg incubation, and fry rearing, are often triggered by water temperature. A rise in water temperature can also provide conditions for the growth of disease-causing organisms. Temperature also influences the solubility of many chemical compounds, thus affecting their toxicity to aquatic life (EPA 1986, MELP 1998).

1.1.2 Dissolved Oxygen (DO)

Dissolved oxygen (DO) is a measure of the amount of oxygen dissolved in water. Values for DO in water analyses are commonly provided in mg/L, although a percentage of saturation may also be used. The concentration of DO in surface water is usually less than 10 mg/L (MELP 1998). The actual concentration will vary with other parameters such as temperature, elevation, photosynthetic activity, biotic activity, stream discharge, and the concentration of other solutes (Hem 1989, Michaud 1994). The maximum solubility of oxygen (fully saturated) at sea level is 12.75 mg/L at 5°C and 8 mg/L at 25°C. DO concentrations decrease within increasing temperatures or elevation (MELP 1998).

Dissolved oxygen is derived from the atmosphere and photosynthetic production by aquatic plants. Atmospheric oxygen is changed to dissolved oxygen when it enters the water, with more mixing occurring in turbulent waters. Dissolved oxygen is essential for the respiration of fish and other aquatic organisms (Michaud 1994). As water moves past their breathing apparatus (such as gills in fish), oxygen gas bubbles in the water (DO) are transferred from the water to their blood. The transfusion is efficient only above certain concentrations. Oxygen is also used for the decomposition of organic matter and other biological and chemical processes. Anoxic waters have obvious detrimental effects on aerobic organisms. These conditions can also lead to the accumulation of chemically reduced compounds, such as ammonium and hydrogen sulfide, in the bottom sediments that can be toxic to benthic organisms (Michaud 1994).

Nutrient solubility and availability rely partly on DO levels, and thus DO also affects the productivity of aquatic ecosystems. In streams, DO concentrations tend to be higher in faster moving waters. During the summer, in particular, when discharges and velocities decrease in streams, DO concentrations can be quite low. Pollution can cause decreases in average DO concentrations by contributing organic matter that uses oxygen or nutrients and stimulates the growth of algae.

1.1.3 Specific Conductance (Conductivity)

Conductivity is a measurement of the ability of water to conduct an electric current and provides an estimate of the concentration of dissolved solids. This property is related to water temperature and total ion content (e.g. chloride, sulfate, sodium, and calcium), and depends on the concentration of dissolved metals and other dissolved materials. Water carries more current with increased ion content in the water. Conductivity is lower in cooler waters. Conductivity is measured in terms of resistance and reported in microSiemens per centimeter (μm/cm) at 25°C. Water source and geologic composition of the watershed are important controlling factors of conductivity. Streams that flow through granite bedrock, for example, have lower conductivity than those that flow through limestone or clay soils. The conductivity of pure waters is 0.055 μS/cm. The conductivity of freshwater at 25°C varies between 50 and 1,500 μm/cm (Hem 1989, MELP 1998). Conductivity measurements in streams flowing through granitic, siliceous, or other igneous rocks usually range between 10 and 50 μS/cm. In comparison, it generally ranges between 150 and 500 μS/cm in streams that are flowing through limestones. Conductivity itself is not an aquatic health concern but serves as an indicator of other water quality concerns.

1.1.4 pH

A pH value is a measure of the activity of hydrogen ions in a water sample. Various types of chemical reactions that occur in natural waters produce hydrogen ions, which are then consumed by participating in subsequent chemical reactions in the system. These interrelated chemical reactions that produce and consume hydrogen ions control the pH value of a water body. It is a useful index of the status of equilibrium reactions in which the water participates. A pH of 7 is considered neutral, values less than 7 are acidic, and values greater than 7 are basic. The units of pH are logarithmic; so, a difference of one unit represents a 10-fold change in hydrogen ion concentration. The higher the pH, the fewer free hydrogen ions are present in the water. The pH of natural fresh waters ranges from 4.0 to 10.0, with most waters falling between 6.5 and 8.5 (EPA 1986, Hem 1989, MELP 1998).

The pH of water determines the solubility (the amount that can be dissolved in water) and biological availability (the amount that can be used by aquatic biota) of chemical constituents, such as nutrients (e.g., carbon, nitrogen, and phosphorus) and heavy metals (e.g., lead, copper). Unusually high or low pH can have adverse effects on aquatic biota. Values above 9.5 and below 4.5 are considered lethal to aquatic organisms (EPA 1996, MELP 1998). For heavy metals, the degree to which they are soluble determines their toxicity. They tend to be more toxic when pH is lower because they are more soluble and bioavailable.

The pH of water is naturally variable, although the amount of change in natural waters tends to be very small due to many chemical reactions. This ability of the water to maintain a stable pH is called buffering capacity. The initial pH of water is influenced by the geology of the watershed and the original source of the water. In particular, alkalinity, which is typically low in granitic drainages, is usually the primary factor that influences pH values. This causes the waters to be more acidic (pH <7.0) in these types of watersheds (Wetzel 2001). The greatest natural cause for variation is the daily and seasonal changes in photosynthesis. Photosynthesis uses up hydrogen molecules and therefore increases the pH. The pH increases during the day (with maximum values up to 9.0) and decreases at night. Respiration and decomposition processes lower pH. The pH also tends to be higher during the growing season when photosynthesis is greater. As a result, most streams that drain coniferous forests tend to be slight acidic (6.5 to 6.8) (Hem 1989, Michaud 1994, Wetzel 2001).

1.1.5 <u>Turbidity</u>

Turbidity is a measurement of the amount of light that is scattered or absorbed from a water sample. It is an indicator of suspended particulate matter in a water body. More suspended particles in the water cause greater scattering. Materials that contribute to turbidity include silt, clay, finely divided organic material, soluble organic compounds, and microorganisms (Michaud 1994, MELP 1998). Turbidity values are reported in NTUs. In general, turbidity values of 10 NTU or less represent very clear water; 50 NTU is cloudy; and 100 to 500 NTU is very cloudy or muddy. Rivers and streams in the Sierra Nevada are typically very clear, with turbidity measurements ranging between 1.65 and 5.73 NTU (EPA 2000).

High turbidity levels can have adverse effects in aquatic ecosystems. High turbidity reduces light penetration, which impairs photosynthesis of submerged vegetation and algae (MELP 1998, Michaud 1994). A reduction in plant growth will reduce the production of aquatic invertebrates and fish species. In addition, as particulates settle, they can adversely affect larvae by filling in the spaces between the rocks that may be used as habitat. High turbidity also affects the ability of fish to find and capture food and can impair gill function in some fish under chronically high levels (Michaud 1994). High turbidity also increases the total available surface area of suspended solids upon which metals and other pollutants can attach and bacteria can grow.

Turbidity values can be naturally variable. Waters are often more turbid following rain events, which may increase erosion and urban runoff. Turbidity increases can also be caused by effluents from wastewater and septic systems, decaying plants and animals, and bottom-feeding fish.

1.1.6 <u>Alkalinity</u>

See Total Alkalinity (as CaCo3) in Section 2.1

1.1.7 <u>Salinity</u>

Salinity refers to the total concentration of all ions in water and increases the density of water (Boyd 2015). Salinity also affects the dissolved oxygen level in water, as the solubility of oxygen in water decreases with increased salinity (Horiba 2023).

2 LABORATORY ANALYSIS PARAMETER

2.1 WATER QUALITY GRAB SAMPLES - GENERAL PARAMETERS

2.1.1 Nitrate/Nitrite

Nitrate (NO_3^-) and nitrite (NO_2^-) ions are produced during nitrification of reduced and organic forms of nitrogen. Nitrate and nitrite are typically reported in mg/L or µg/L. Nitrite is usually present in only minute quantities in water (<0.001 mg/L) because it in an intermediate, unstable form of nitrogen within the nitrogen cycle (MELP 1998). It is formed from nitrate or ammonium ions by certain microorganisms found in soil and water (EPA 1986). Nitrate is formed by the complete oxidation of ammonium by microorganism in the soil and water. It is the most oxidized and stable form of nitrogen in water, and therefore is the principal form of combined nitrogen. Most surface waters contain less than 0.01 mg/L of nitrite and less than 0.2 mg/L nitrate (MELP 1998, Wetzel 2001).

Nitrate is the primary form of nitrogen used during plant growth. Excessive amounts of nitrate may cause phytoplankton or macrophyte outbreaks. Nitrite is toxic to aquatic life at relatively low concentrations (MELP 1998). Although it is an essential plant nutrient, excessive nitrogen can cause proliferation of algae and macrophytes, resulting in eutrophic water conditions. Eutrophication causes decreased oxygen levels which may cause stress or mortality of fish and invertebrates (EPA 1986). Sources of elevated nitrate and nitrite come from municipal and industrial wastewaters, agricultural runoff, urban development, and automobile exhausts.

2.1.2 Ammonia

Ammonia is found in two forms, ammonium (NH_4^+) that is not toxic and NH_3, which is (EPA 1986). Ammonium is readily adsorbed onto mineral surfaces (Hem 1989). It is reported as mg/L or µg/L, with typical surface water values less than 0.1 mg/L (MELP 1998, Wetzel 2001). Ammonia as NH_3 is reported to be toxic to various aquatic organisms over a range of concentrations (0.53 to 22.8 mg/L) (Oram 2007).

Complex nitrogen cycling and processes occur within aquatic systems. Nitrogen is an essential plant nutrient which contributes to the productivity of a water body. However, excessive ammonia over-stimulates the growth of algae and other plants, leading to eutrophication of a water body. The resulting decrease of oxygen levels may cause stress and mortality of fish and invertebrates (EPA 1986). High ammonia concentrations are also toxic to aquatic life. The specific concentration at which ammonia is harmful to organism depends upon the temperature and pH of the water. At higher temperatures and pH, a greater proportion of the total ammonia is present as NH_3, increasing the toxicity of the water (EPA 1986). The distribution of ammonia in surface waters varies spatially and seasonally depending upon productivity and the amount of organic matter. Anthropogenic sources of ammonia include fertilizers, livestock wastes, residential effluents (e.g. cleaning products), mining, sewage treatments plans, and effluent from various types of industries (Oram 2007).

2.1.3 Total Kjeldahl Nitrogen

Total kjeldahl nitrogen (TKN) is a measure of both the ammonia and organic forms of nitrogen. Organic nitrogen includes organic compounds, such as proteins, polypeptides, amino acids, and urea. TKN is reported in mg/L or μg/L (MELP 1998). In Sierra Nevadan rivers and streams, TKN values typically range between 0.025 and 0.65 mg/L (EPA 2000).

High ammonia concentrations can be deleterious to aquatic life, as it contributes to the eutrophication of water bodies. Organic nitrogen is not biologically available. As a result, it does not influence plant growth or water quality condition until it is transformed to the inorganic forms of nitrogen (MELP 1998). Natural sources of TKN include decaying organic material such as plants and animals' wastes. Some species of streamside vegetation, such as alders, are nitrogen fixers. Elevated nitrogen concentrations have been measured in waters with decaying alder leaves (Wetzel 2001). Anthropogenic sources of TKN include effluents from sewage treatment plants and industry, agriculture (fertilizers), urban developments, paper plants, recreation, and mining.

2.1.4 Total Phosphorus

Phosphorus (P) is a nutrient that is essential for growth and is a measure of both organic and inorganic forms of phosphorus. It can be measured as total phosphorus or ortho-phosphate. Total phosphorus is the total amount of phosphorus in the sample. Ortho-phosphate is the portion that is available to organisms for growth. Total phosphorus measurements include phosphorus that is in biological tissue, as well as the insoluble mineral particles (Michaud 1994, MELP 1998). Phosphorus is fairly abundant in sediments, but concentrations are usually less than a few tenths of a milligram per liter in surface waters (Hem 1989). Total phosphorus concentrations in the rivers and streams in the Sierra Nevada typically range between 2.5 and 485 μg/L (EPA 2000). It is usually reported in μg/L or mg/L.

Phosphorus is essential for plant growth and is often the most limiting nutrient for plant growth in surface waters. As a result, inputs of phosphorus into surface waters can cause algal blooms. Anthropogenic sources of phosphorus include effluents from sewage treatment plants and industry, agriculture, and urban developments (EPA 1986, Hem 1989, MELP 1998).

2.1.5 Orthophosphate

Orthophosphate (PO_4) is a measure of the inorganic oxidized form of soluble phosphorus. It is generally reported in mg/L or μg/L. Background concentrations of orthophosphate in surface waters generally average 0.01 mg/L (Hem 1989).

Along with nitrogen, phosphorus is a necessary nutrient for plant growth. Orthophosphate is the most readily available form of phosphorus for uptake during photosynthesis. Animals obtain phosphorus through the consumption of plant materials. Excess ortho-phosphate causes prolific algal growth, causing the same detrimental water conditions as described for nitrogen and total phosphorus (MELP 1998). Since phosphorus is typically the most limiting nutrient for plant growth in fresh water, additions of this element are often the primary causes of eutrophication of water bodies. Phosphate ions readily and strongly adsorb onto soils, suspended solids, and streambed sediments. As a result, soil erosion can be a source of ortho-phosphate. Other sources include agricultural, urban, and industrial wastewater effluents.

2.1.6 Total Dissolved Solids

Total dissolved solids (TDS) are a measure of the concentration of inorganic salts (e.g. sodium, chloride, potassium, calcium, magnesium, and sulfate), small amounts of organic material, and dissolved materials in the water column and is reported in mg/L. The value of TDS in fresh water naturally ranges from 0 to 1,000 mg/L (EPA 1986, MELP 1998). Concentrations tend to be comparatively low in streams in granitic and sandstone-dominated watersheds than watersheds with abundant limestone.

The effect of elevated TDS levels on aquatic biota depends on the ionic composition of the dissolved material and the extent of the increase in concentration. Under natural conditions, all aquatic life must be able to survive a range of TDS concentrations (EPA 1986). Sources of total dissolved solids include sewage, stormwater and agricultural runoff, salts from roads, and industrial and water treatment plant wastewater discharges. Total dissolved solids can also be derived from natural sources, including carbonate and salt deposits and mineral springs.

2.1.7 Total Suspended Solids

Total suspended solids (TSS) are a measurement of particulate matter suspended in the water column and is typically reported in mg/L (MELP 1998). Nephelometric Turbidity Units (NTUs) correspond approximately to TSS concentrations. Total suspended solids fluctuate with stream flow and may increase significantly during snowmelt and runoff from rain events. Streams in forested watersheds tend to have low TSS concentrations, usually less than 50 mg/L, although concentrations can be naturally much higher in some streams and rivers (Windell 1992). Waters with TSS concentrations less than 20 mg/L are usually considered to be clear. Concentrations between 40 and 80 mg/L are considered to be cloudy. Waters with concentrations greater than 150 mg/L appear dirty.

High TSS concentrations can increase turbidity, resulting in reduced light penetration, reduced primary productivity, damage to fish gills, and impaired fish feeding ability. Once the suspended solids settle on the stream or lake bottom, invertebrate and other benthic organisms and fish spawning can be adversely affected (EPA 1986).

The freshwater aquatic life criterion for TSS set forth in the EPA's *Quality Criteria for Water* (1976) states that 'settable and suspended solids should not reduce the depth of the composition point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life.' In other words, light penetration should not be decreased more than 10 percent.

2.1.8 Total Alkalinity (as CaCo3)

Alkalinity is a measurement of the ability of water to neutralize acids (buffering capacity). Alkalinity is the concentration of bases in dissolved in water. These bases are usually carbonate and bicarbonate but can also be hydroxides. These buffers are important because they slow the rate at which the pH changes. The pH can change naturally because of photosynthetic activity of the aquatic vegetation. When the pH is very high (greater than 9) hydroxide ions may also be present. In addition, carbonate and bicarbonate reduce the toxicity of some toxic heavy metals (EPA 1986, Hem 1989, Wetzel 2001). Alkalinity is typically expressed as an equivalent amount of calcium carbonate ($CaCO_3$) in mg/L and generally ranges from 0 to 500 mg/L in fresh waters (MELP 1998). Alkalinity levels up to 400 mg/L are not considered to be detrimental to human health (EPA 1986). Alkalinity values less than 10 mg/L are considered very low and the pH of these waters is very susceptible to acid inputs. Alkalinity values are often very low in granitic drainages (Wetzel 2001). Values between 10 and 20 mg/L are considered moderately susceptible to acid inputs.

In general, very low or high alkalinity itself does not cause detrimental effects to aquatic organisms. However, the concentration of the dissolved materials (alkalinity) and their ratio to one another determines the actual pH and buffering capacity in a given water system (EPA 1986, Wetzel 2001). Waters with very low alkalinity values have little capacity to buffer acid inputs and are thus susceptible to acidification (MELP 1998). As previously discussed, extreme pH values can adversely affect aquatic biota, particularly in low pH (acidic) waters. Acidified drainage basins are known to possess increased sulfate and dissolved aluminum concentrations, as well as significant changes in the ion species and ratios (Wetzel 2001). In some inland waters of extremely high salinity, hydroxide, borate, silicate, phosphate, and sulfide may be the major sources of alkalinity (Wetzel 2001). Relatively few aquatic organisms are adapted to these unusual conditions.

2.2 BACTERIAL SAMPLING

2.2.1 Total Coliform

Coliform bacteria are a group of several genera of relatively harmless microorganisms that live in soil, water, and the intestines of cold- and warm-blooded animals including humans (Murphy 2007). Total coliform concentrations are reported as the most probable number of bacteria colonies present per 100 milliliters (mL) of sample water (Michaud 1994).

Total coliform bacteria occur naturally in surface and shallow ground waters and are essential in the breakdown or organic matter in water. Oxygen is not a requirement for these bacteria, but they can use it. They produce acid and gas from the fermentation of lactose. Coliform bacteria are not pathogenic and are only mildly infectious. The total coliform group is relatively easy to culture in the lab, and therefore, has been selected as the primary indicatory bacteria for the presence of disease-causing organisms. If large numbers of coliform bacteria are found in water, there is a high probability that pathogenic bacteria or organisms, such as Giardia may be present. Coliform bacteria, rather than actual pathogens, are used to assess water quality because they are easier to isolate and identify (Murphy 2007).

2.2.2 Fecal Coliform

Fecal coliform is a subgroup of the coliform bacteria that live in the intestinal tract and feces of warm-blooded animals (Murphy 2007). The most common member of this group is *Escherichia coli*. Fecal coliform concentrations are reported as the number of bacteria colonies present per 100 mL of sample water (#/100 mL, Michaud 1991). Fecal coliform bacteria can multiply quickly under optimum growing conditions and die off rapidly when conditions change. For this reason, fecal coliform counts are difficult to predict (Michaud 1994).

Fecal coliform species by themselves are not usually harmful, but are an indicator of the possible presence of pathogenic organisms, such as bacteria, viruses, and parasites, that live in the same environment (Windell 1992; Murphy 2007). Thus, it is used as a parameter for testing the quality of waters used for recreation. The presence of fecal coliform indicates contamination from the feces of humans or other animals. Swimming in waters with high levels of fecal coliform bacteria (over 200 colonies/100 mL) presents a health risk of contracting diseases such as typhoid fever, hepatitis, gastroenteritis, ear infection, and dysentery (Windell 1992; Murphy 2007). Some strains of *E. coli*, such as *E. coli* O157:H7, which is found in the digestive tract of cattle, can cause intestinal illness. The major sources of fecal coliform to freshwater are wastewater treatment plant effluent, failing septic systems, and human and animal wastes. Human and animal wastes can be washed into storm drains, streams, and lakes during storms (Michaud 1994; Murphy 2007).

2.2.3 E. coli

Escherichia coli (*E. coli*) is the most common organism in the fecal coliform group, a subgroup of coliform bacteria that live in the intestinal tract and feces of warm-blooded animals (Murphy 2007). *E. coli* concentrations are reported as the most probable number of bacteria colonies present per 100 mL of sample water. The EPA conducted studies in the 1970s and 1980s evaluating fecal coliform, *E. coli*, and enterococci as indicators of fecal contamination and found that *E. coli* is a good predictor of gastrointestinal illness in fresh waters (EPA 2012).

Fecal coliform species by themselves are not usually harmful, although some strains of *E. coli*, such as *E. coli* O157:H7, which is found in the digestive tract of cattle, can cause intestinal illness. The presence of *E. coli* indicates contamination from the feces of humans or other animals, which can contain pathogenic organisms such as bacteria, viruses, and parasites that cause gastrointestinal illness (Windell 1992, Murphy 2007). The major sources of *E. coli* entering freshwater are wastewater treatment plant effluent, failing septic systems, storm water runoff, animal carcasses, and animal and human wastes, including runoff from animal manure and manure storage areas. Human and animal wastes can be washed into storm drains, streams, and lakes during storms (Michaud 1994, Murphy 2007; EPA 2015).

3 REFERENCES

EPA (Environmental Protection Agency). 1976. Quality Criteria for Water, 1976. EPA 440-9-76-023. U.S. Environmental Protection Agency, Washington D.C. 20460.

EPA (Environmental Protection Agency). 1986. Quality Criteria for Water, 1986. EPA 440/5-86-001. Office of Water Regulations and Standards, Environmental Protection Agency, Washington D.C.

EPA (Environmental Protection Agency). 1996. The Metals Translator: Guidance for calculating a total recoverable permit limit for a dissolved criterion. June 1996. EPA 823-B-96-007.

EPA (Environmental Protection Agency). 2000. Ambient Water Quality Criteria Recommendations Information Supporting the Development of State and Tribal Nutrient Criteria for Rivers and Streams in Nutrient Ecoregion II. EPA-822-B-00-015. Office of Water, Office of Science and Technology, Health and Ecological Criteria Division, Washington DC.

EPA (Environmental Protection Agency). 2012. Recreational Water Quality Criteria.

EPA (Environmental Protection Agency). 2015. *E. Coli* and enterococci fact sheet. Available at: https://www.epa.gov/sites/production/files/2015-09/documents/ecoli.pdf.

Hem, J.D. 1989. Study and Interpretation of the Chemical Characteristics of Natural Water. Third Edition. U. S. Geological Survey Water-Supply Paper 2254.

MELP (Ministry of Environment, Lands and Parks, British Columbia). 1998. Guidelines for Interpreting Water Quality Data. Resources Inventory Committee Publications. Available: ilmbwww.gov.bc.ca/risc/pubs/aquatic/interp/index.htm.

Michaud, J. 1994. A Citizen's Guide to Understanding and Monitoring Lakes and Streams. January 1994. Washington State, Department of Ecology. 73 pp.

Murphy, S. 2007. General Information on Fecal Coliform. Boulder Area Sustainability Information Network (BASIN). Available online at: bcn.boulder.co.us/basin/data/FECAL/info/FColi.html.

Oram, B. 2007. Watershed Assessment, Education, Training, Monitoring Resources In Northeastern Pennsylvania. Wilkes University Center for Environmental Quality Environmental Engineering and Earth Sciences. Available: http://www.water-research.net/Watershed.

Wetzel, R.G. 2001. Limnology Lake and River Ecosystems. Third Edition. New York: Academic Press. Pp 169-186; 205-237; 289-330.

Windell, J.T. 1992. Stream Riparian and Wetland Ecology. TRUIS Corp for the Colorado Division of Wildlife. Pp. 95-114.

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APPENDIX B

Quality Assurance/Quality Control Laboratory Review

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INTRODUCTION

Table B-1 summarizes the quality assurance/quality control (QA/QC) review of the laboratory reports received from Western Environmental Testing Laboratory (WETLAB). The review consisted of (1) checking that the sample identification numbers, sample dates and times, and analytes requested on the chain of custody forms matched the sample identification numbers, sample dates and times, and analytes measured in the laboratory reports; (2) checking that the sample identification numbers were consistent throughout the laboratory reports; (3) identifying any samples that did not meet the required holding times; and (4) noting which samples were flagged with quality control data issues by the laboratories.

Table B-1. Quality Assurance/Quality Control Review of Spring and Fall 2023 Sample Laboratory Analyses

	Spring Sampling			Fall Sampling	
WETLAB Report ID	23060699	23060755	23070798	23090704	23090768
Sample Locations	RVC0.26 SRC0.15 RC17.6 PHTR RC17.15 RC15.2 SL-1 (surface) SL-1 (mid-column) SL-2 (surface) SL-2 (mid-column)	RC19.25 RC18.55	GL-2 (surface) GL-2 (mid-column) GL-1 (surface) GL-1 (mid-column) AL-1 (surface) AL-1 (mid-column) RC23.0 RC21.65	RC23.0 AL-1 (surface) AL-1 (mid-column) GL-2 (surface) GL-2 (mid-column) GL-1 (surface) GL-1 (mid-column) RC21.65 RC19.25 RC18.55	PHTR RC17.15 RC17.6 SRC0.15 RC15.2 RVC0.26 SL-1 (surface) SL-1 (mid-column) SL-2 (surface) SL-2 (mid-column)
WETLAB Sample ID Numbers	23060699-001 23060699-002 23060699-003 23060699-004 23060699-005 23060699-006 23060699-007 23060699-009 23060699-010	23060755-001 23060755-002	23070798-001 23070798-002 23070798-003 23070798-004 23070798-005 23070798-006 23070798-007 23070798-008	23090704-001 23090704-002 23090704-003 23090704-004 23090704-005 23090704-006 23090704-007 23090704-008 23090704-009 23090704-0010	23090768-001 23090768-002 23090768-003 23090768-004 23090768-005 23090768-006 23090768-007 23090768-008 23090768-009 23090768-0010
Date Sampled	6/26/2023	6/27/2023	7/24/2023	9/25/2023 - 9/26/2023	9/28/2023
Analysis	General Parameters	General Parameters	General Parameters	General Parameters	General Parameters
Do all samples match COC?	Yes	Yes	No. Sample Locations GL-1 (Surface) & GL-1 (mid-column) are referenced as "GL-3". Also known as Customer Sample ID.	Yes	Yes
Is sample ID consistent throughout report?	Yes	Yes	Yes	Yes	Yes
Were all sample holding times met?	Yes	Yes	No. HT: Orthophosphate for all Sample ID numbers (received by lab expired or close to expiration) HT: Total Dissolved Solids for all Sample ID numbers (due to system error at WETLAB)	No. HT: The analysis for Nitrate Nitrogen / Nitrite Nitrogen on samples 23090704-002, 003, 004, 005 & 009 and the analysis for Orthophosphate on samples 23090704-002, 003 and 009 were performed past the holding times.	
Were there any quality control data issues?	Yes QD: Total Dissolved Solids for sample 23060699-007 [SL-1 (Surface)] M: TKN for sample 23060699-001 (RVC0.26)	No	Yes M: Nitrate + Nitrite Nitrogen for sample 23070798-001 [(GL-2 (Surface)]	No	Yes U, D: Nitrate Nitrogen and Nitrite Nitrogen for all samples excluding Nitrate Nitrogen for 23090768-006 (see below) J: Nitrate Nitrogen for 23090768-006 (RVC0.26)

Notes:
WETLAB: Western Environmental Testing Laboratory
WETLAB Codes:
QD: The sample duplicate or matrix spike duplicate analysis demonstrated sample imprecision. The reported result should be considered an estimate.
M: The matrix spike (MS) value for the analysis of this parameter was outside acceptance criteria due to sample concentration or possible matrix inference. The reported result should be considered an estimate,
U: The analyte was analyzed for but was not detected above the level of the reported sample reporting/quantitation limit. The reported result should be considered an estimate.
HT: Sample analyzed beyond the accepted holding time
J: The reported value is between the lab method detection limit and the lab practical quantity limit. The result should be considered an estimate.
D: Due to the sample matrix dilution was required to properly detect and report the analyte. Reporting limit was adjusted accordingly.

Table B-2. Quality Assurance/Quality Control Review of Spring and Fall 2024 Sample Laboratory Analyses

	Spring Sampling	Fall Sampling			
WETLAB Report ID	24060709	24090644	24090645	24090688	24090689
Sample Locations	AL-1 (surface) AL-1 (mid-column) SL-1 (surface) SL-1 (mid-column) SL-2 (surface) SL-2 (mid-column) PHTR RC17.15 RC17.6 RC23.0 RC21.65 GL-1 (surface) GL-1 (mid-column) GL-2 (surface) GL-2 (mid-column) RC19.25 RC18.55 RC15.2 SRC0.15 RVC0.26	RC23.0 RC21.65 GL-1 (surface) GL-1 (mid-column) GL-2 (surface) GL-2 (mid-column) RC19.25 AL-1 (surface) AL-1 (mid-column)	RC18.55	RVC0.26	RC15.2 SL-1 (surface) SL-1 (mid-column) SL-2 (surface) SL-2 (mid-column) RC17.15 PHTR RC17.6 SRC0.15
WETLAB Sample ID Numbers	23060709-001 23060709-002 23060709-003 23060709-004 23060709-005 23060709-006 23060709-007 23060709-009 23060709-010 23060709-011 23060709-012 23060709-013 23060709-014 23060709-015 23060709-016 23060709-017 23060709-018 23060709-019 23060709-020	24090644-001 24090644-002 24090644-003 24090644-004 24090644-005 24090644-006 24090644-007 24090644-008 24090644-009 24090644-0010	24090645-001	24090688-001	24090689-001 24090689-002 24090689-003 24090689-004 24090689-005 24090689-006 24090689-007 24090689-008 24090689-009
Date Sampled	6/24/2024 - 6/26/2024	9/172024 - 9/18/2024	9/18/2024	9/19/2024	9/19/2024
Analysis	General Parameters	General Parameters	General Parameters	General Parameters	General Parameters
Do all samples match COC?	Yes	Yes	Yes	Yes	Yes
Is sample ID consistent throughout report?	RC23.0 noted as RC23.4	Yes	Yes	Yes	RC23.0 noted as RC23.4
Were all sample holding times met?	No HT: The analysis for Nitrate Nitrogen / Nitrite Nitrogen and Orthophosphate on samples 223060709-012, 013, 014, 015 were performed past the holding times.	Yes	Yes	Yes	Yes
Were there any quality control data issues?	Yes B: For samples 23060709-001 through 017, TKN analysis, the analysis of the method blank revealed concentrations of the target analyte above the reporting limit. The client results were greater than ten times the blank amount or non-detect; therefore, the data was not impacted	No	No	No	No

Notes:
WETLAB: Western Environmental Testing Laboratory
WETLAB Codes:
HT: Sample analyzed beyond the accepted holding time
B: The analysis of the method blank revealed concentrations of the target analyte above the reporting limit.

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