TRIP REPORT

State of Alaska
Department of Fish and Game

Field Dates: April 3 and 22, 2026
Location: **Fort Knox Mine – Water Supply Reservoir (WSR)**
Objective: Late Winter Water Quality Monitoring of WSR
Participants: Chad Bear and Kieren Vasquez
Weather: -12°C, 10 MPH wind, 0.3 m of snow on WSR, 15 cm of overflow.
Access: State trucks and two snowmobiles

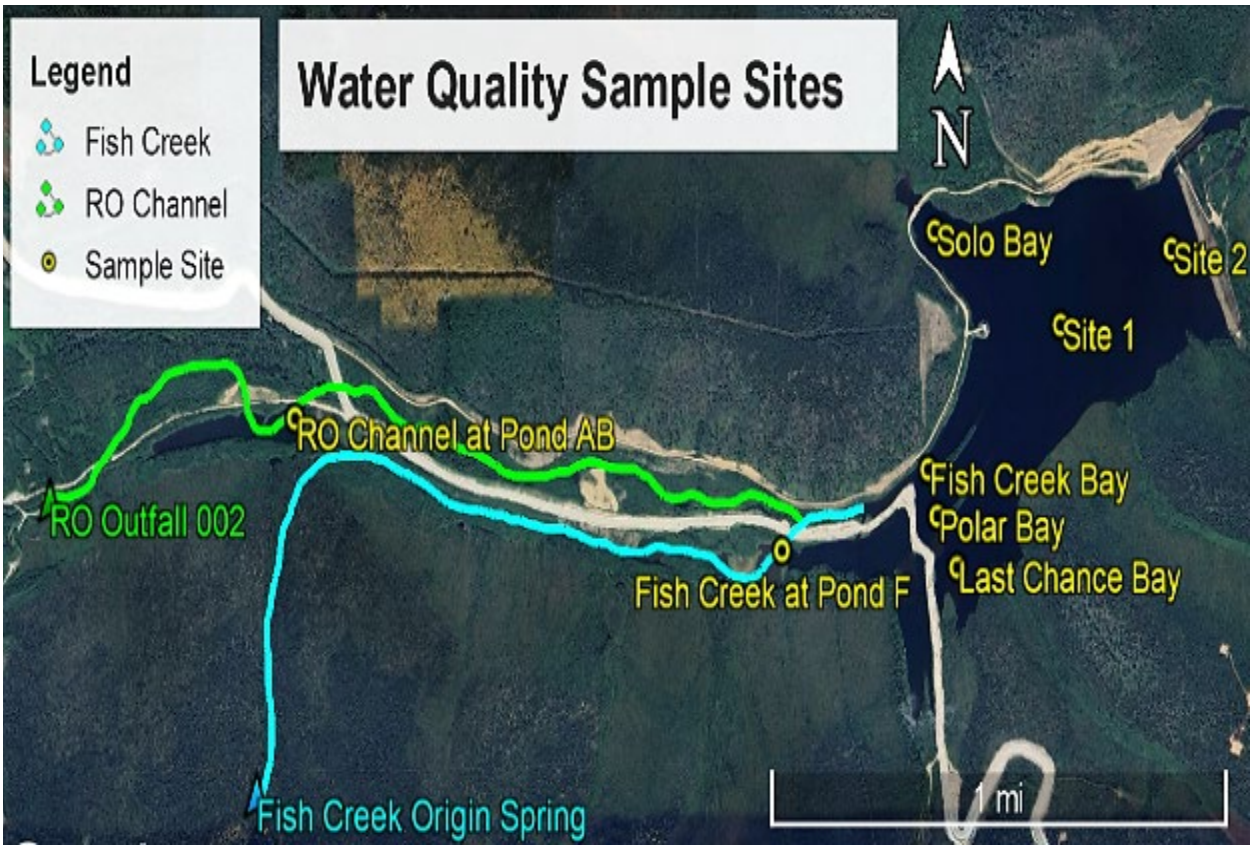

Figure 1.–Fort Knox Water Supply Reservoir water quality sample sites, April 3, 2026.

Since 1998, six sites within the WSR have been sampled annually to evaluate winter water conditions that may affect aquatic life. Beginning in 2019, two additional sites—Fish Creek and the RO Channel—were added to assess these natural and mine-discharge water sources (Figure 1). In 2026, water quality sampling was conducted on April 3, when the WSR was ice-covered, while Fish Creek and the RO Channel had open sections with flowing water.

Vertical profiles of water temperature (°C), dissolved oxygen (DO) concentration (mg/L), DO percent saturation, pH, specific conductivity (µS/cm), ORP, and depth (m) were measured using an annually calibrated handheld YSI ProQuatro *Professional Plus* multiparameter instrument. Measurements were taken at 1 m intervals from just below the ice to the reservoir bottom at the six WSR sites, and at 1 m depth at the Fish Creek and RO Channel sites.

On April 3, Fish Creek was almost completely frozen. Ice near the Pond F outlet appeared firm and thick. A hole was chipped through the ice downstream of the outlet culvert to obtain water measurements (Figure 2). The Fish Creek water temperature at the Pond F outlet was 0.1 °C. Pond AB in the RO Channel was also mostly frozen over; however, ice conditions appeared soft and thin. The RO Channel water temperature measured in open water below the Pond AB outlet culverts, was 2.9 °C (Figure 3).

Ice thickness in the WSR was consistent with previous years, measuring slightly less than one meter across all six sampling locations (Figure 1). Beneath approximately 0.3 m of snow, about 15 cm of slushy overflow was present at most sites. This overflow may have influenced water-quality readings at the one-meter depth due to mixing during drilling, but it did not affect measurements from the remainder of the water column.

Figure 2.–Fish Creek frozen over downstream of the Pond F outlet, April 3, 2026.

Figure 3.–RO Channel downstream of Pond AB outlet culverts, April 3, 2026.

A second site visit was conducted on April 22 to deploy HOBO temperature loggers in Fish Creek at Pond F and in the RO Channel near Pond AB. These loggers will record peak hourly water temperatures throughout the spring Arctic grayling project, which occurs from late April to mid-May. Fish Creek had an open-water section near the Pond F outlet, and the water temperature was 0.4 °C, consistent with measurements from previous years during the spring. The RO Channel was dry because RO water discharge had been temporarily halted on April 9 for facility maintenance and quality control of treatment processes. As a result, Pond AB was at a lower-than-average water level, as water had exited through the outlet culverts and no RO inflow was occurring (Figure 4). RO water discharge is expected to resume within the next few weeks.

On April 22, the WSR outlet spillway was mostly frozen over, with water flowing through the low-flow channel. Similar to the high RO discharge years of 2019–2022, 2 to 3 meters of aufeis had accumulated and covered the lower portion of the spillway (Figure 5).

Figure 4.–Pond AB water levels during RO discharge on April 3, 2026 (left), and when RO was temporarily ceased, April 22, 2026 (right).

Figure 5.–Fort Knox WSR Spillway, April 22, 2026 (left) and March 31, 2020 (right).

To compare annual WSR conditions, Site 2 is used as the primary indicator. As the deepest station (17 m), it represents the largest water volume and allows evaluation of vertical stratification rather than only surface conditions. Freshwater inputs from Fish Creek, Solo Creek, Last Chance Creek, and the RO Discharge Channel mix within the WSR and flow past Site 2 before exiting through the dam spillway. Sites located closer to these inflows are less representative of overall reservoir conditions.

WSR water temperatures recorded in 2026 ranged from 0.2° C to 2.6° C (Figure 6). The minimum temperature of 0.2° C was recorded in Fish Creek Bay, just below the ice surface. The maximum temperature of 2.6° C was recorded at Site 2 at 16 m depth, just above the reservoir bottom. At all

six sampling sites, water temperature increased with depth. The 2026 Site 2 water column average temperature was warmer than recent years, with 2023 remaining the warmest recorded since 1997 (Figure 7).

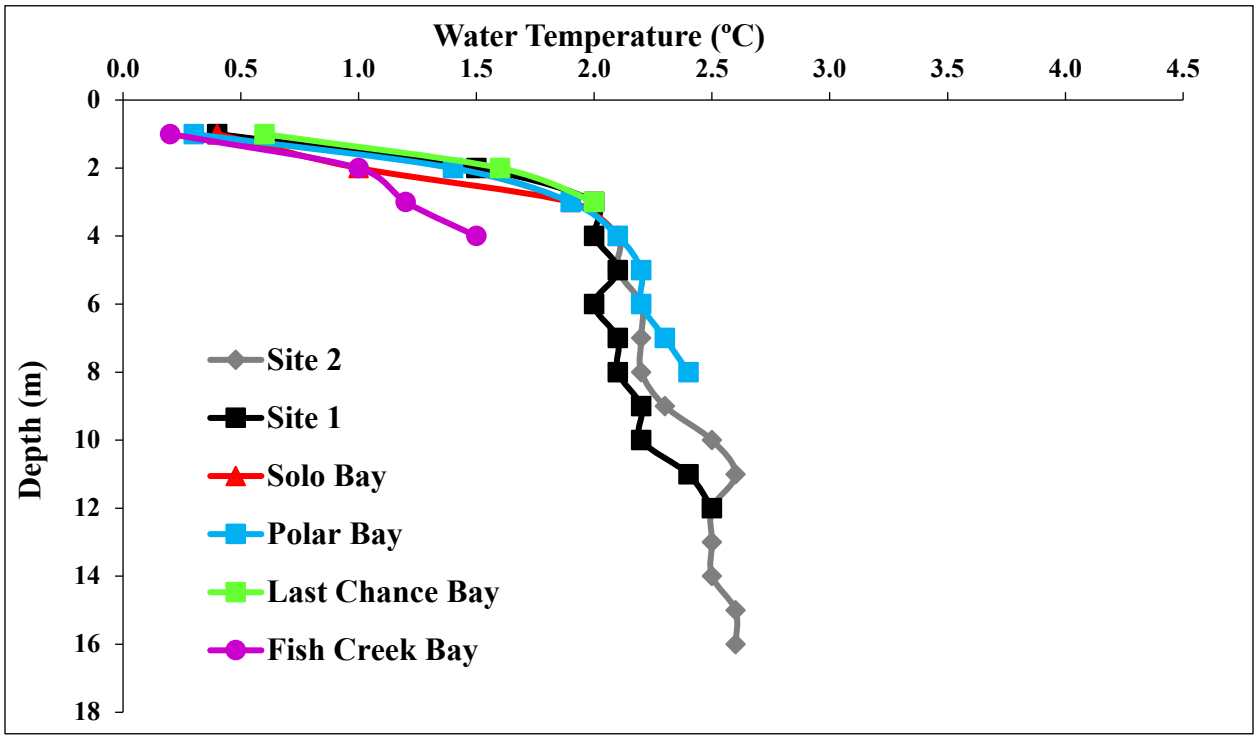

Figure 6.–Water temperature (°C) vertical profiles in the WSR, April 3, 2026.

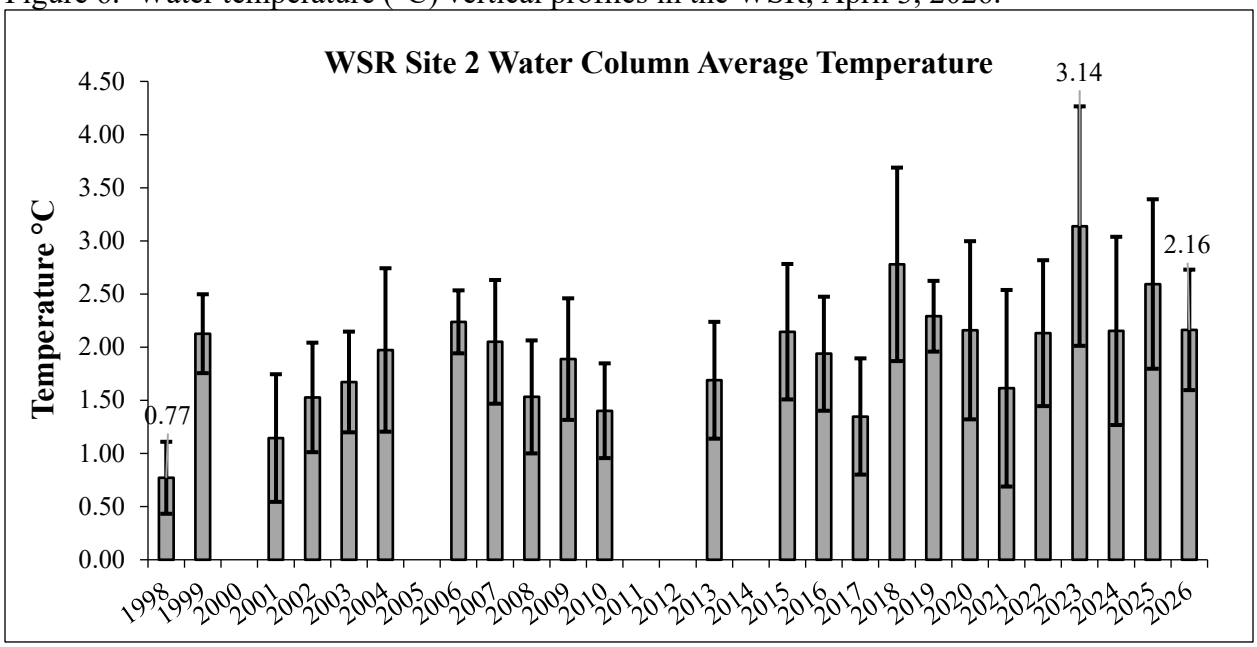

Figure 7.–Annual water column average temperature (°C) at Site 2 in the WSR, 1998–2026.

Adequate dissolved oxygen (DO) levels are essential for fish, aquatic invertebrates, and plants. The Alaska Department of Environmental Conservations (ADEC) standard for freshwater fish propagation requires DO greater than 7 mg/L at the surface, with a minimum of ≥ 5 mg/L in spawning gravel interstices. Stratified lake waters become hypoxic when DO falls below 2 mg/L and anoxic as DO approaches 0 mg/L, conditions that typically occur below approximately 8 m of depth in the WSR. In 2026, the highest DO concentrations were recorded in Fish Creek Bay at 11.3 mg/L, followed by Solo Bay at 10.5 mg/L, both at 1 meter depth. (Figure 8). These maxima exceed pre-2015 levels, likely due to RO water discharge initiated in March 2015.

Fish Creek Bay had the highest average water column DO (9.45 mg/L) for the eleventh consecutive year, followed by Solo Bay at 8.98 mg/L. Across all six WSR sites, DO levels were high in the upper water column and declined with depth, with the lowest values measured near the reservoir bottom. (Figure 8). The 2026 vertical DO profile does not show a stratification with reduced DO levels below 8 m that was present in 2025, a year with low RO discharge. Instead, the 2026 vertical profile resembles those of 2021 and 2022, years with high RO discharge volumes that produced uniform DO levels throughout the water column, including near the reservoir bottom (Figures 8 and 9). Last Chance Bay consistently exhibits lower average DO than the other sites, likely due to its location in the southwest corner of the WSR, farthest from the primary RO discharge water flow path through the WSR (Figure 1).

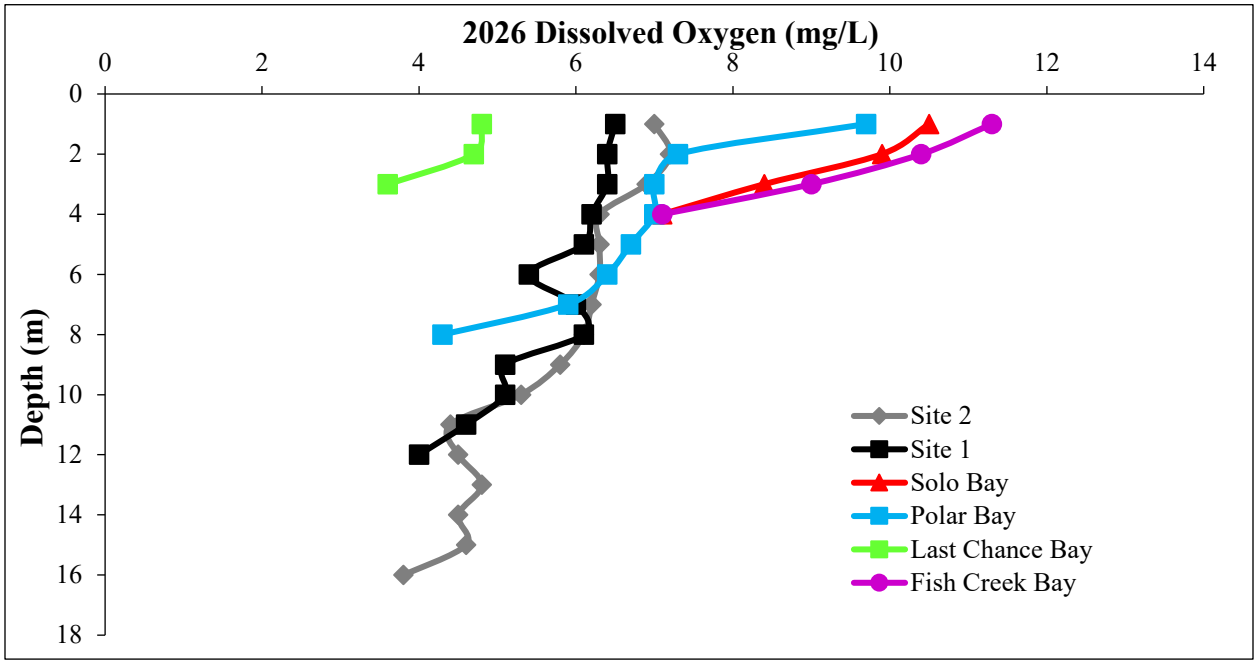

Figure 8.–Dissolved oxygen (mg/L) vertical profiles in the WSR, April 3, 2026.

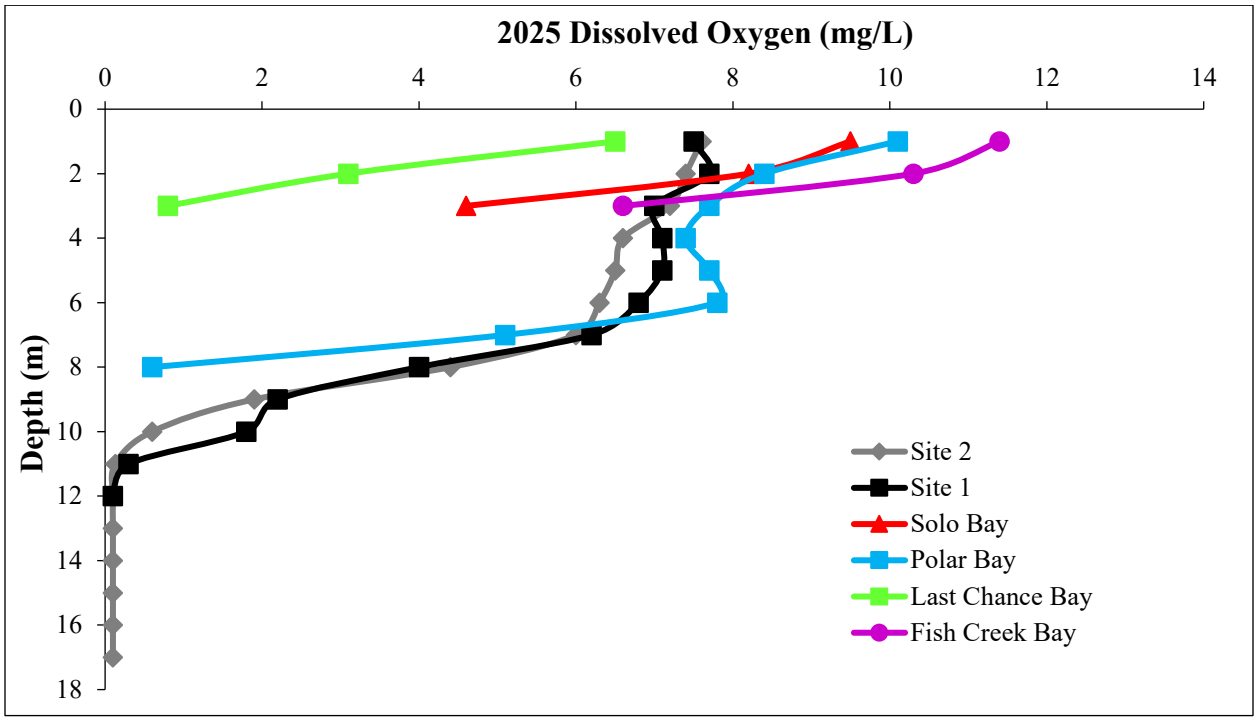

Figure 9.–Dissolved oxygen (mg/L) vertical profiles in the WSR, April 4, 2025.

In 2026, the winter water-column average DO at Site 2 (5.63 mg/L) was higher than both the pre-RO average (2.03 mg/L) and the post-RO average (4.57 mg/L), reflecting the increased RO discharge during winter 2025–2026 (Figure 10).

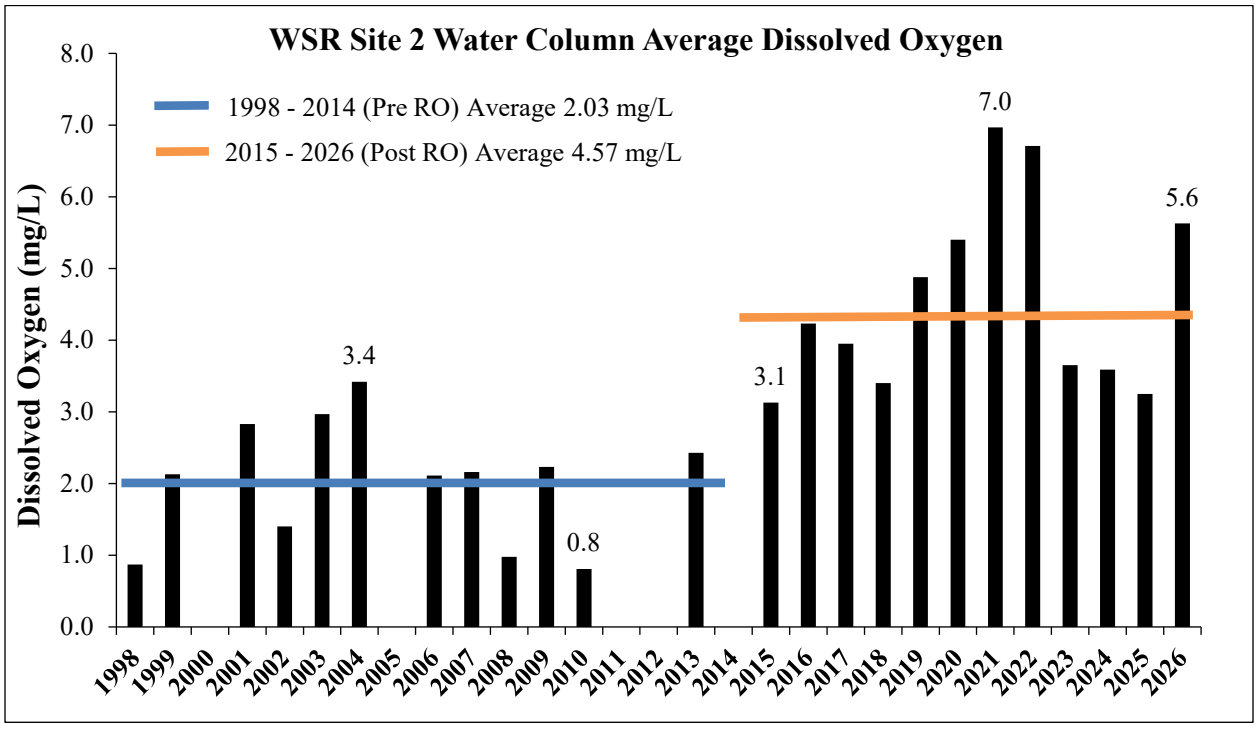

Figure 10.–Water column average dissolved oxygen (mg/L) at Site 2 in the WSR, 1998–2026.

In 2026, temperature-specific DO percent saturation was relatively uniform throughout the water column (Figure 11), mirroring the DO (mg/L) profile (Figure 8). This pattern resembles years such as 2022, when higher RO discharge volumes promoted mixing within the WSR and reduced oxygen stratification (Figure 12). In contrast, the 2025 vertical DO profile resembles typical winter lake oxygen stratification pattern that occurs under minimal freshwater input (Palshin 2021). The 2026 profile is consistent with conditions observed during past sampling years with high winter RO water input, resulting in more uniform DO levels with depth.

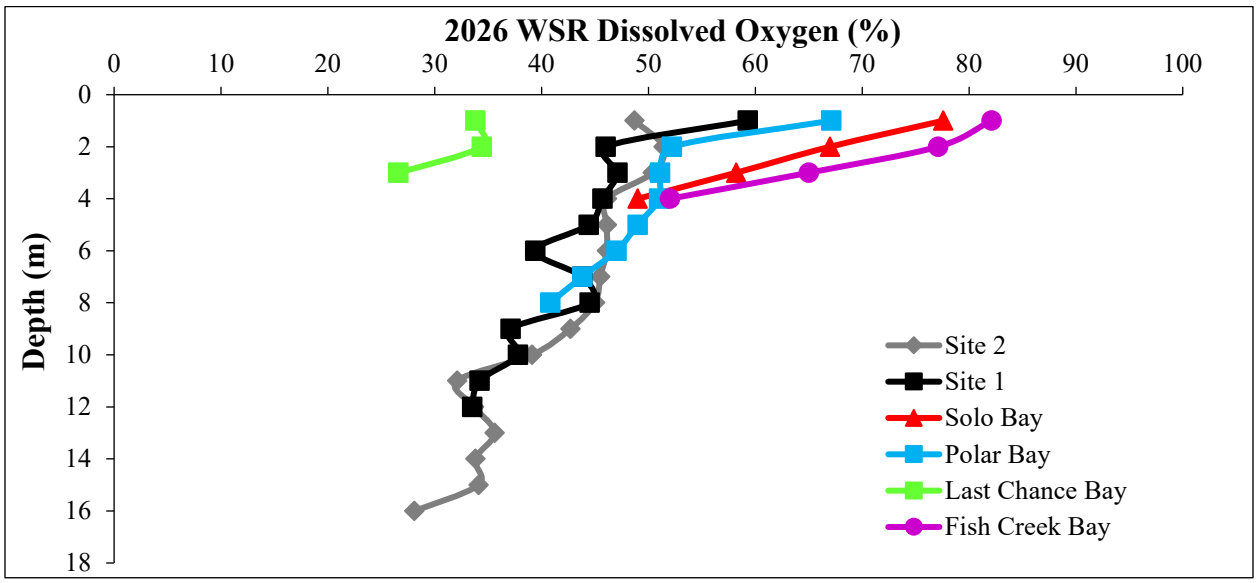

Figure 3.–Temperature-specific dissolved oxygen (% saturation) vertical profiles in the WSR, April 3, 2026.

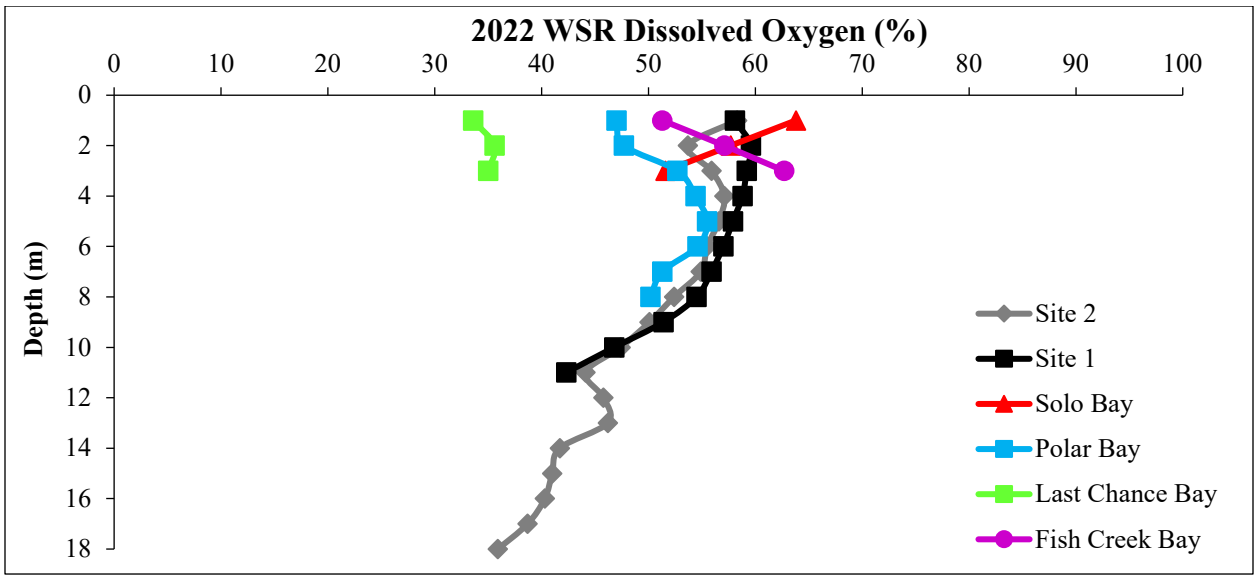

Figure 12.–Temperature-specific dissolved oxygen (% saturation) vertical profiles in the WSR, April 14, 2022.

The pH of water influences aquatic plants and invertebrates, with potential effects on fish reproduction, recruitment, growth rates, and overall health. In 2026, WSR pH values were highest in the upper water column just beneath the ice and decreased in depth. Single point values ranged from 6.8 at Site 2 to 8.0 in Fish Creek Bay (Figure 13). All 2026 WSR pH values were within the ADEC standard for aquatic life (6.5 to 8.5).

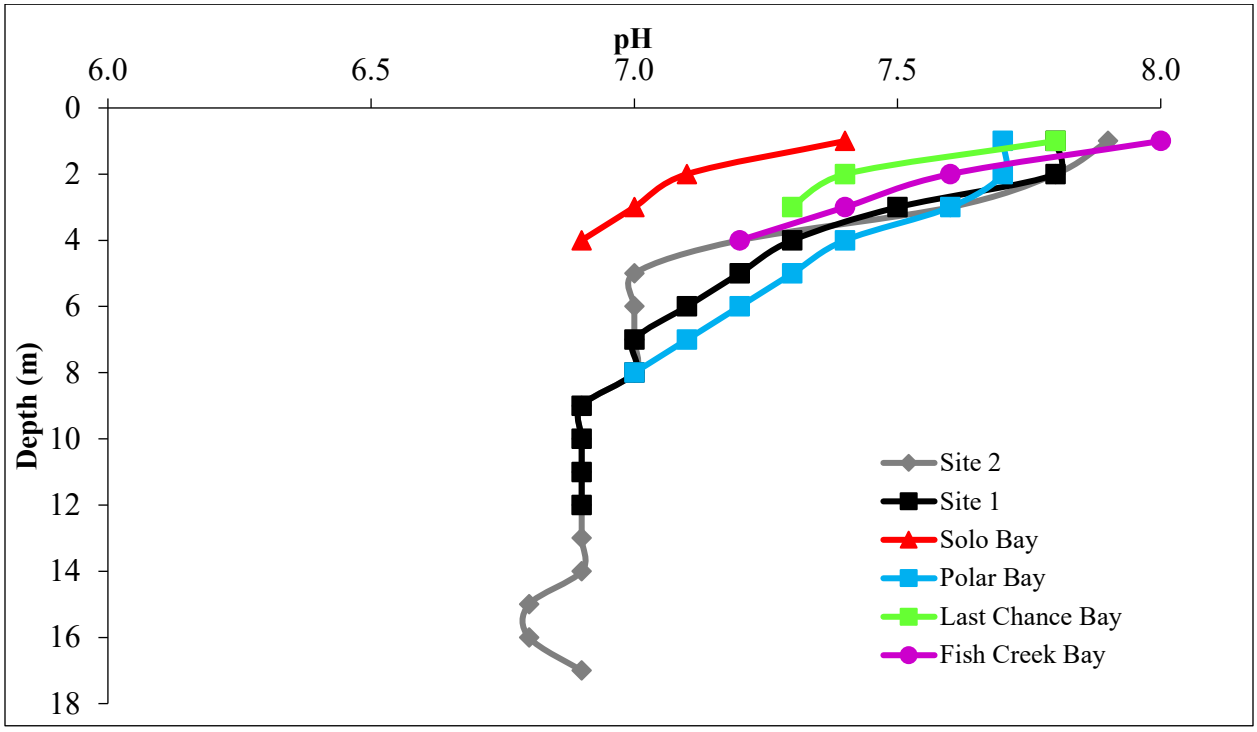

Figure 13.–pH vertical profiles in the WSR, April 3, 2026.

Specific conductance reflects the ability of water to conduct electrical current, which increases with higher concentration and mobility of dissolved ions. Elevated specific conductance indicates greater concentrations of dissolved solids, including chloride, nitrate, phosphate, sodium, magnesium, calcium, and iron and serves as an important indicator of water quality. In 2026, specific conductance values were consistent across all six WSR sites and generally increased with depth as minerals settle from the surface and accumulate near the bottom (Figure 14).

The 2026 WSR specific conductance single point values ranged from 78.1 µS/cm in Last Chance Bay just below the ice to 239.0 µS/cm at Site 2 near the bottom of the reservoir. At Site 2, the 2026 water column average conductance was 170.4 µS/cm, compared to 396.7 µS/cm in 2021 and 427.2 µS/cm in 2022 (Figure 15).

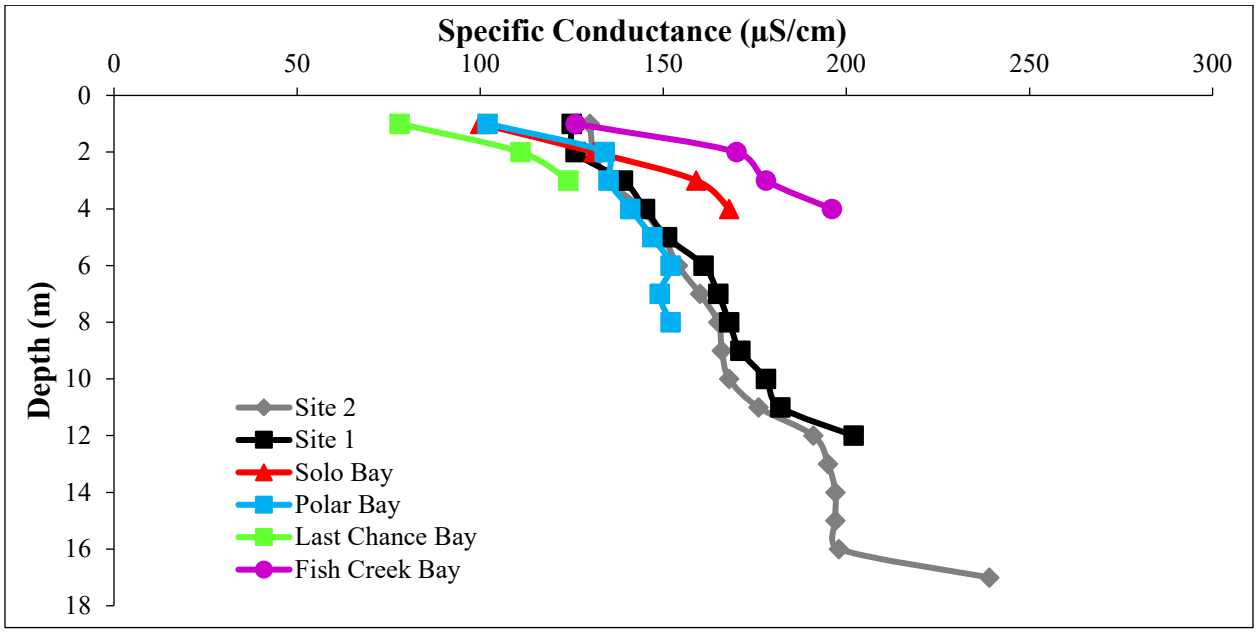

Figure 4.–Specific conductance (µS/cm) vertical profiles in the WSR, April 3, 2026.

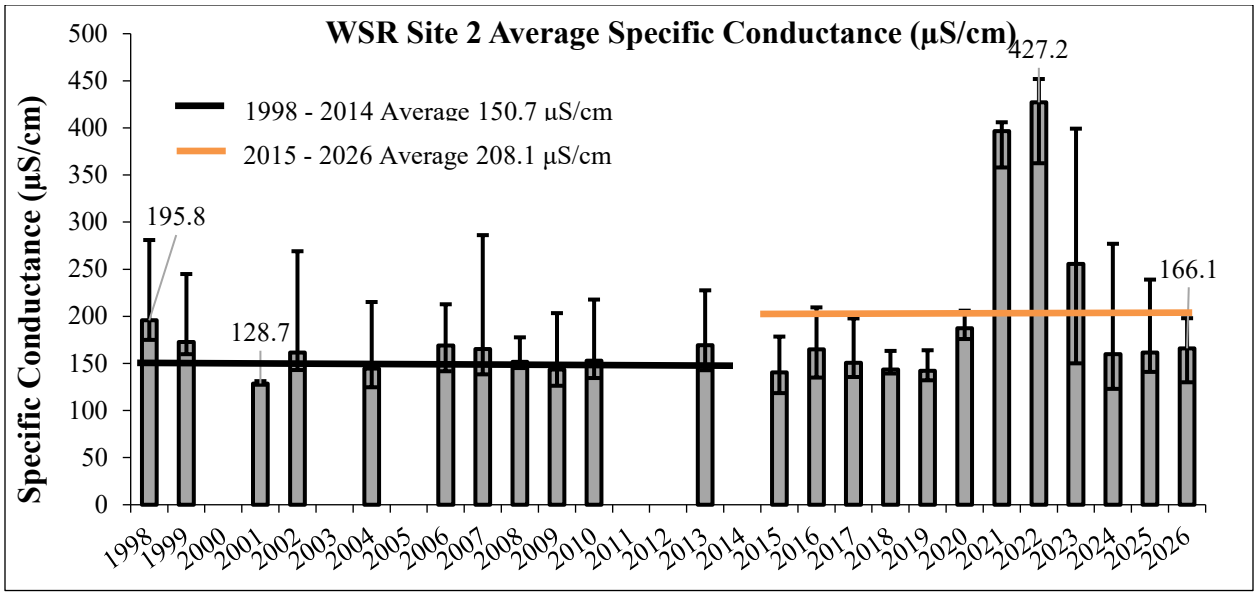

Figure 5.–Water column average specific conductance (µS/cm) at Site 2 in the WSR with pre-RO (1998–2014) and post-RO (2015–2026) averages.

Oxidation–reduction potential (ORP) reflects the capacity of a lake or river system to oxidize waste products, including contaminants and decomposing organic matter. Higher ORP values indicate greater availability of dissolved oxygen to support bacterial decomposition. In 2026, ORP measurements ranged from 173 to 272 mV (Figure 16). At Site 2, ORP remained relatively uniform throughout the 17 m water column, in contrast to years with pronounced dissolved oxygen (DO) stratification at approximately 8 m depth, when ORP is typically reduced near the reservoir bottom.

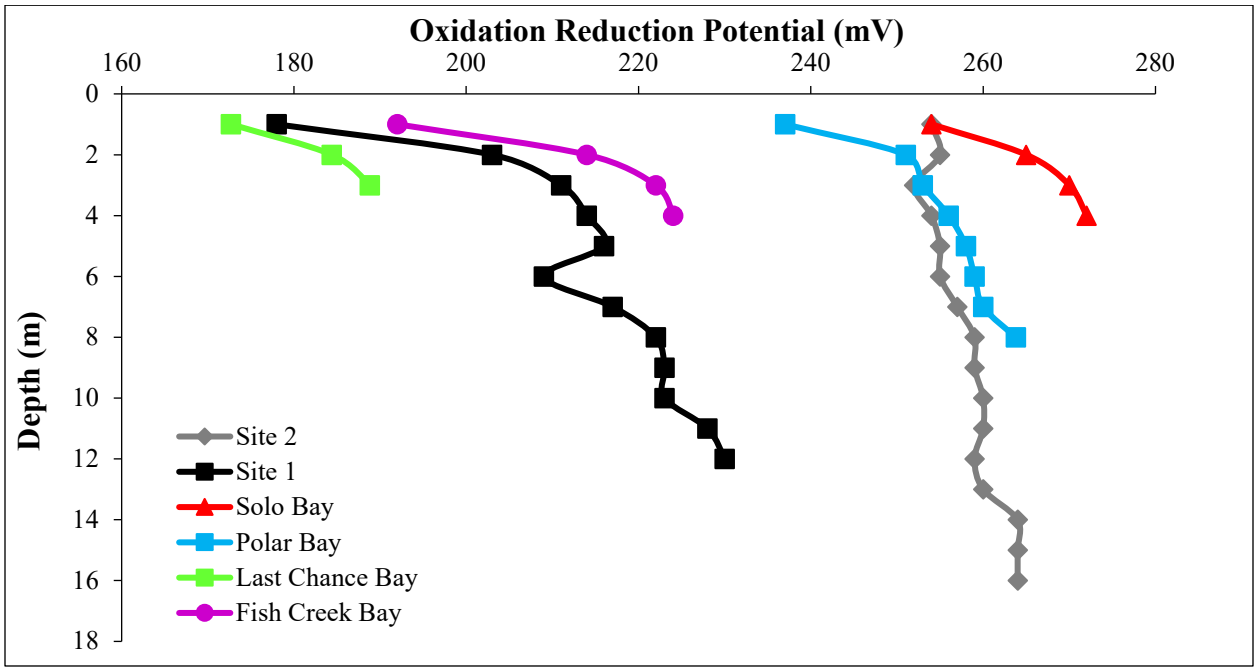

Figure 16.–Oxidation-reduction potential (mV) vertical profiles in the WSR, April 3, 2026.

Fish Creek and RO Channel Water Quality:

From 2019 to 2026, water quality data were collected in Fish Creek and the RO Channel downstream of Outfall 002 at 1 m depth (Figure 1). On April 3, 2026, RO Channel water temperature at the Pond AB outlet was 2.9°C, while Fish Creek at Pond F was 0.1°C (Figure 17).

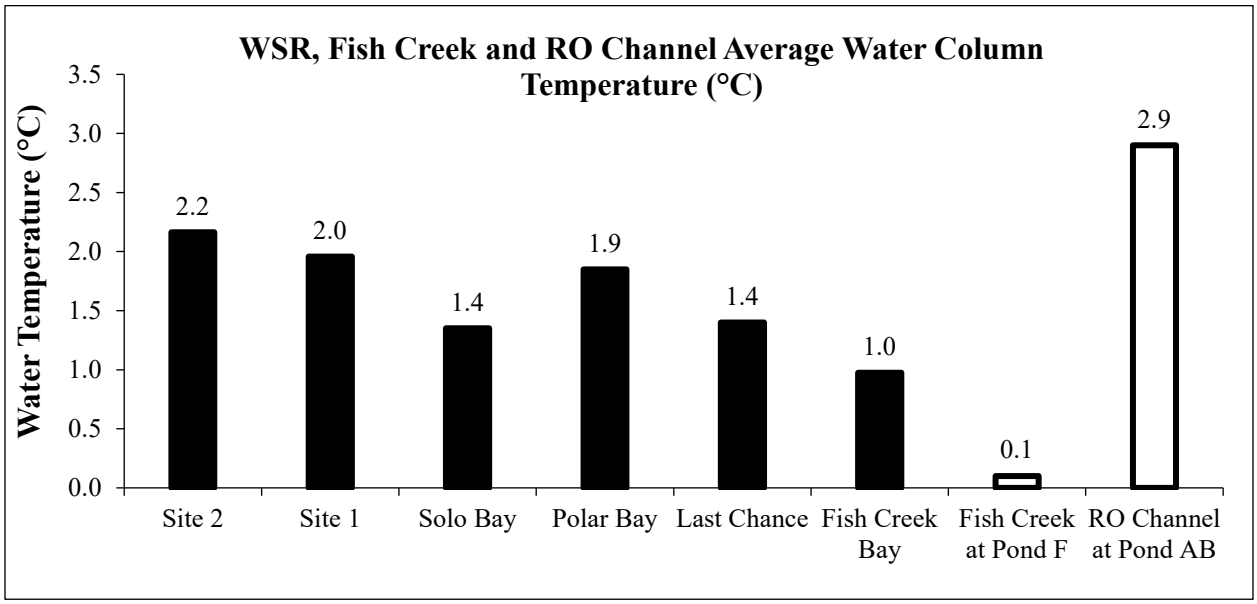

Figure 6.–Water temperature (°C) in Fish Creek and RO Channel (1 m depth; unfilled bars) and Fort Knox WSR (average for water column; filled bars), April 3, 2026.

On April 3, 2026, DO levels in the flowing waters of Fish Creek and the RO Channel (1 m depth) were higher than the average DO levels measured across the six WSR sample sites, where DO is typically low in ice-covered lakes (Figure 18). Fish Creek originates from an artesian spring and provides relatively consistent year-round flow. Although its groundwater initially has low DO, it becomes naturally oxygenated through hydraulic turbulence as it moves downstream into the WSR. The winter RO discharge rate is set by FGMI based on the mine's water balance requirements. DO levels increase during treatment processes and through atmospheric exposure while traveling through the RO channel. Together, these two oxygen-rich water sources help sustain dissolved oxygen levels in the WSR for overwintering fish.

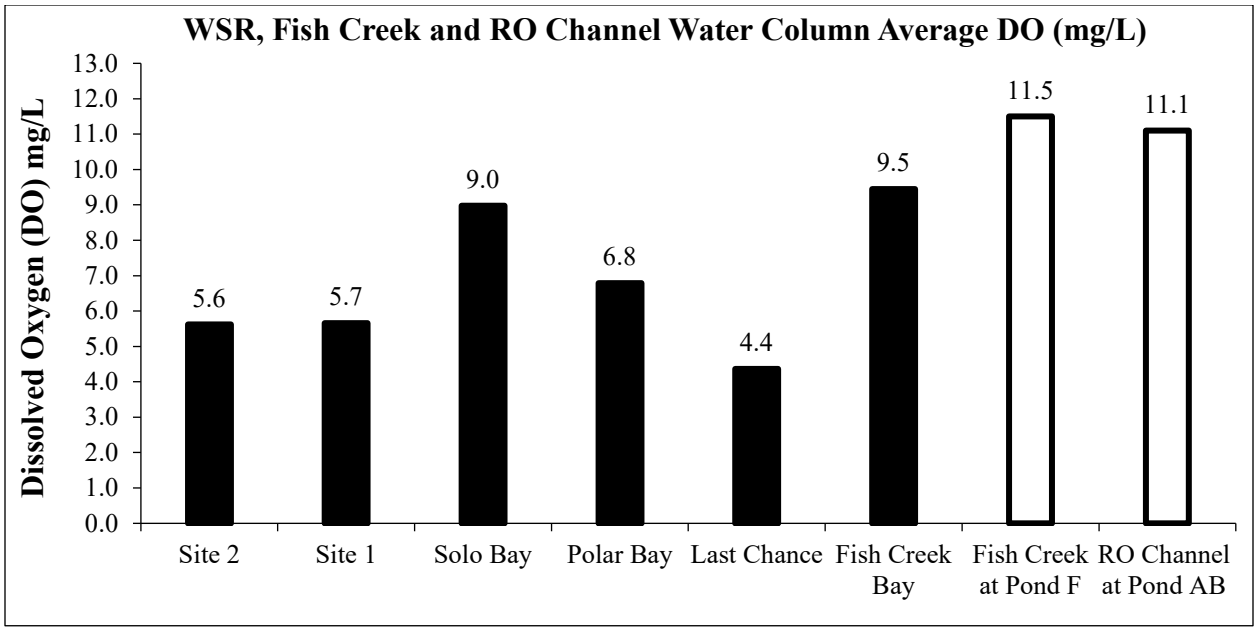

Figure 18.–Dissolved oxygen (mg/L) in Fish Creek and RO Channel (1 m depth; unfilled bars) and the WSR (average for water column; filled bars), April 3, 2026.

RO water typically exhibits low specific conductance due to the removal of dissolved minerals during treatment. RO permeate discharged from Outfall 002 is blended with non-contact groundwater from pit dewatering wells and tailings seepage well water to reintroduce minerals removed during the RO process before entering Fish Creek. As a result, final discharge specific conductance is governed by the minerals added during this reintroduction process and was near 50 µS/cm during 2026, though individual measurements may be higher depending on blend ratios and seasonal dewatering needs. In comparison, Fish Creek's natural artesian spring water measured 120.0 µS/cm on April 3, 2026.

From January 1 to December 31, 2025, RO discharge totaled 4,294 acre-feet. In comparison, 2019-2022 were higher RO-discharge years, with annual discharge volumes up to 9,663 acre-feet. On April 3, 2026, specific conductance at the Pond AB outlet was 72.0 µS/cm, consistent with values measured in 2023 - 2025 (average 50.2 µS/cm) (Figure 19). During the high-RO discharge years (2019–2022), specific conductance was generally higher, with April 15, 2021, measuring 455 µS/cm, for example. This resulted in elevated specific conductance levels at all WSR sites compared to 2026, with 2021 used as an example (Figure 20). The higher specific conductance values during high-discharge years were likely driven by the well-water blending ratios used during remineralization of the RO permeate.

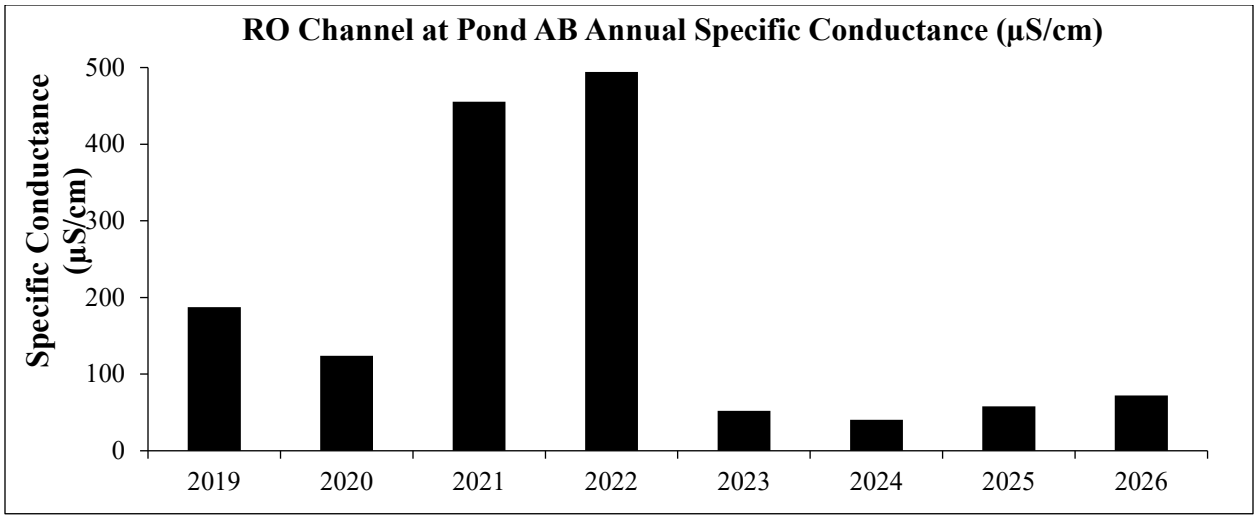

Figure 19.–Specific conductance (µS/cm) in the RO Channel at Pond AB, 2019–2026.

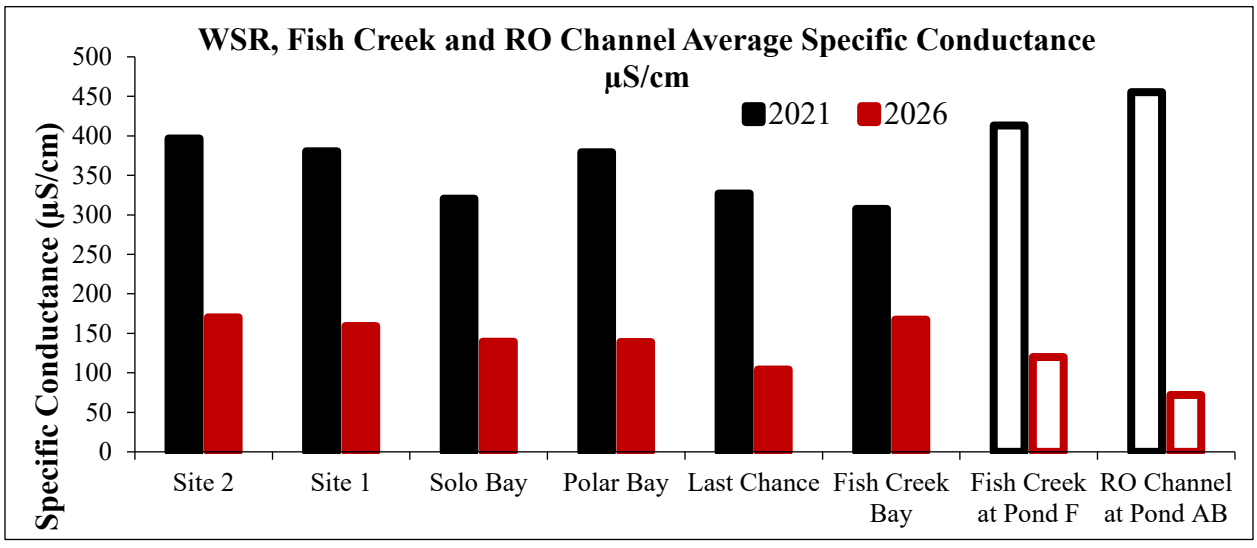

Figure 20.–Specific conductance (µS/cm) in the WSR (average for water column; filled bars), Fish Creek and RO Channel (1 m depth; unfilled bars), April 2021 (black) and 2026 (red).

In 2026, single-point pH measurements collected at the RO Channel at Pond AB (7.3) and Fish Creek at Pond F (7.6) were similar to the WSR water-column averages (Figure 21). Individual measurements across WSR sites ranged from a low of 6.8 at Site 1 to a high of 8.0 at Fish Creek Bay. All recorded pH values from the WSR, Fish Creek, and RO Channel were within the ADEC aquatic life standard of 6.5 to 8.5.

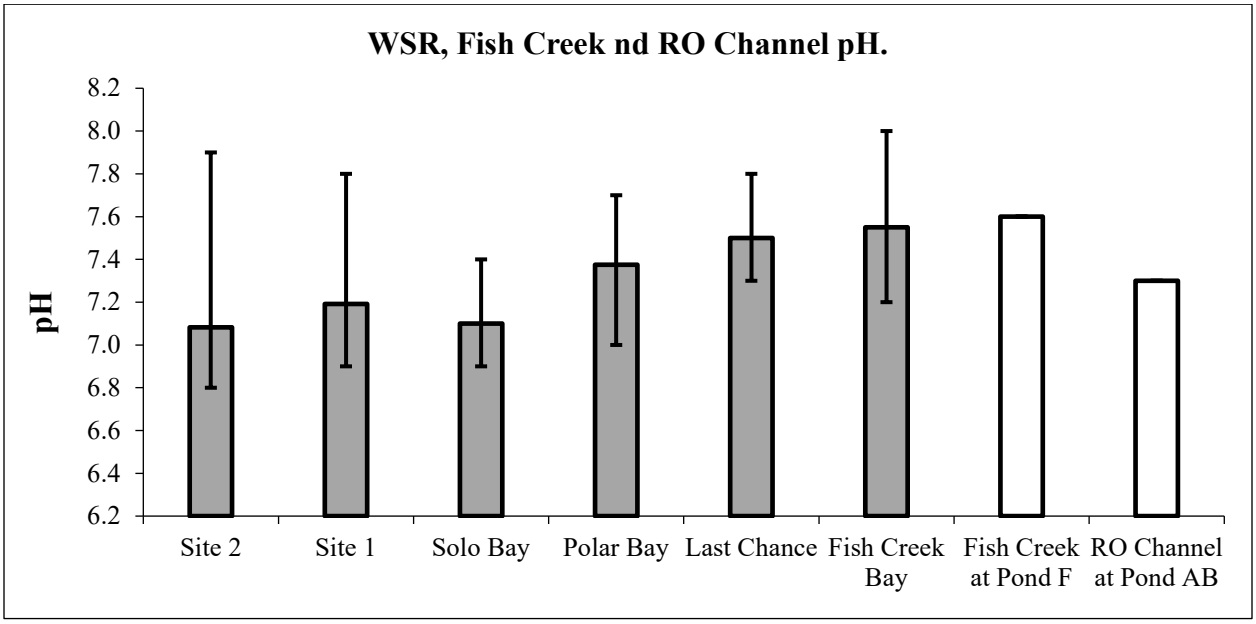

Figure 7.–pH in the WSR (average for water column; filled bars), Fish Creek and the RO Channel (1 m depth; unfilled bars) April 3, 2026.

Literature Cited:

Palshin, N. 2021. OPI Publishing Conference Series: Dissolved oxygen stratification in a small lake depending on water temperature, density, and wind impact. Earth and Environmental Science 937 (2021) 032019.