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GOVERNOR

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION



MELANIE LOYZIM
COMMISSIONER

**WATER QUALITY ASSESSMENT
MEMORANDUM**

TO: Kyle Olcott, Hydropower Coordinator, Bureau of Land Resources
FROM: Wendy Garland, Director
Division of Environmental Assessment, Bureau of Water Quality
DATE: December 14, 2023
RE: Green Lake Hydroelectric Project Water Quality Assessment

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This Water Quality Assessment Memorandum (WQAM) provides a summary of the Bureau of Water Quality’s Division of Environmental Assessment staff review of the Green Lake Hydroelectric Project (Project) Water Quality Certification (WQC) application. Additionally, staff provides a preliminary assessment of whether the Project attains applicable State water quality standards and staff recommendations for WQC conditions or mitigation measures.

This WQAM is advisory in nature and does not contain any Department findings or constitute a Department action related to the Project WQC application. The Department’s WQC Order, signed by the Commissioner, will represent the Department’s findings regarding the Project’s attainment of water quality standards and will include any applicable conditions.

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Project Description

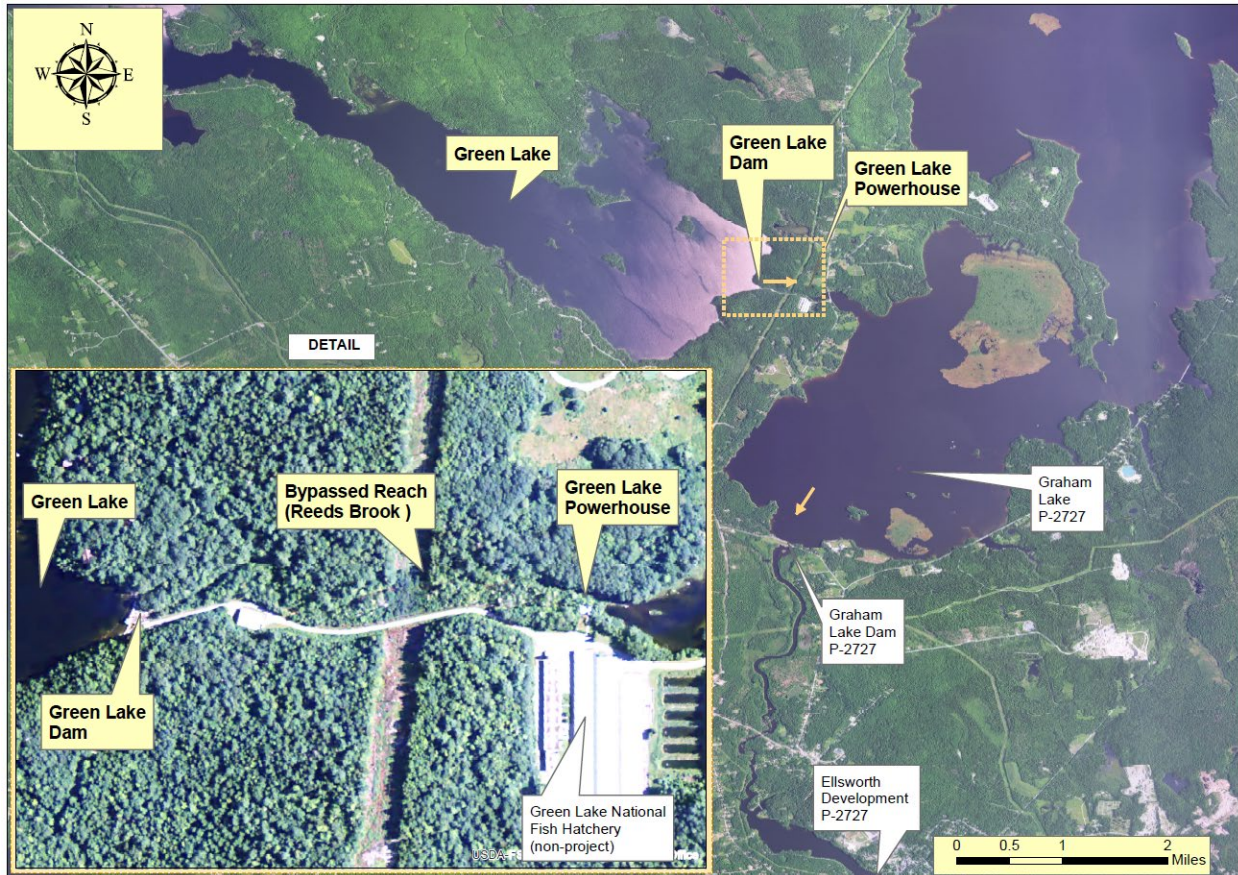
The existing Green Lake Project consists of: (1) a 272.2-foot-long, 7.5-foot-high dam that includes: (a) an 83-foot-long concrete-gravity section with a 79.8-foot-long spillway that has a crest elevation of 160.7 feet National Geodetic Vertical Datum of 1929 (NGVD 29), and is topped with a 2-foot-high fish screen; (b) a 12-foot-long concrete intake structure with a 4.5-foot-wide, 4.5-foot-high sluice gate equipped with an 8-foot-wide, 12-foot-high trashrack with a 1-inch clear bar spacing; (c) a 20.2-foot-long concrete gate structure with two approximately 6-foot-wide, 7-foot-high sluice gates, each equipped with a vertical lift, fish screen with an approximately 0.75-inch mesh size; and (d) a 157-foot-long section that includes: (i) a 35.5-foot-long auxiliary spillway with a crest elevation of 161.5 feet NGVD 29; (ii) a 71-foot-long auxiliary spillway with a crest elevation of 163.4 feet NGVD 29; and (iii) a 50.5-foot-long auxiliary spillway with a crest elevation of 163.8 feet NGVD 29; (2) an impoundment (Green Lake) with a surface area of 2,989 acres at an elevation of 160.7 feet NGVD 29; (3) an approximately 92-foot-long concrete channel that conveys flows from the spillway to Reeds Brook; (4) a 1,744-foot-long penstock; (5) a 27-foot-long, 35-foot-wide concrete powerhouse containing a 400-kilowatt (kW) Allis-Chalmers tube turbine-generator unit and a 25-kW centrifugal pump turbine-generator unit, for a total installed capacity of 425 kW; (6) a 35.38-foot-long, 5-foot-diameter discharge pipe and a 42.25-foot-long, 5-foot-diameter discharge pipe from the powerhouse; (7) a 4.8/12.47-kilovolt (kV) step-up transformer and a 650-foot-long, 12.47-kV underground transmission line that connects the generators to the regional grid; and (8) appurtenant facilities. The project creates an approximately 1,900-foot-long bypassed reach of Reeds Brook.

The current FERC license requires Green Lake Power to: (1) maintain the elevation of Green Lake between 159.7 feet and 160.7 feet NGVD 29 from June 1 through Labor Day weekend each year, and between 157.5 feet and 160.7 feet NGVD 29 for the remainder of the year; (2) complete the fall drawdown of Green Lake by October 15 of each year; (3) reduce the elevation of Green Lake during the spring drawdown to no lower than the elevation attained on the previous October 15 of each year; and (4) release a year-round minimum flow to Reeds Brook of one cubic foot per second (cfs), or inflow to Green Lake, whichever is less, for the protection and enhancement of fish and wildlife resources downstream of the dam. In addition, the current license requires Green Lake Power to provide flows of up to 30 cfs to the FWS's Green Lake National Fish Hatchery.

The current license also requires Green Lake Power to install screens at the project intake to protect fish from turbine entrainment and prevent out-migration of adult salmonids from Green Lake.

The average annual generation of the project was approximately 1,657.8 megawatt-hours from 2016 through 2020.

Green Lake Power proposes to modify the trashrack structure to reduce a gap on the side of the trashrack from 2 inches to 1 inch. Green Lake Power is not proposing any changes to project operation.



Applicable Standards

Water Quality Standards and the water quality classifications of all surface waters of Maine are established by the Maine Legislature (38 M.R.S. § 464-468). Green Lake, which is impounded by the Project, is classified as Class GPA. Reeds Brook, which is located downstream of the Green Lake Dam, is classified Class B ((38 M.R.S.A § 467(7)(A)(7)). Reeds Brook flows approximately 2,000 feet from the Green Lake Dam to the confluence with Graham Lake and is partially fed by the Project's bypass dam leakage flow of 1 cfs.

Water Quality Assessment

Division of Environmental Assessment (DEA) staff reviewed the WQC application and evaluated associated data to assess whether the Project meets applicable water quality standards. DEA staff assessments for each water quality standard are summarized below.

a. Impoundment Trophic State

Based on the results of sampling and information contained in the WQC application, the Project impoundment meets applicable Class GPA water quality standards and is free of culturally induced algal blooms.

This is further supported by past water quality data, which has been collected from sampling stations 1 & 2 since the mid-1970s and from station 3 since the early 1980s. (See Appendix and www.lakesofmaine.org.) Water quality data from all three stations indicate that the lake's trophic state hovers around the transition between mesotrophy and oligotrophy. Both chlorophyll-a and total phosphorus concentrations are low at all three stations. Very little dissolved oxygen depletion has been observed in the deepest area (station 1, northwest region). Some dissolved oxygen depletion is seen at the shallower stations, with the most depletion observed at the shallowest station (station 3). Given the size of the lake, and abundance of well oxygenated deep, colder water, it is unlikely that fish are significantly stressed by this depletion. Transparency records suggest that the water quality has been improving over the last 50 years.



b. Impoundment Aquatic Life and Habitat

Average Secchi disk transparency measured in the impoundment was determined to be 27.5 feet; the littoral depth, calculated as twice the Secchi disk transparency measurement, therefore, is 55 feet. Maximum drawdown of the impoundment is 3.2 feet. The Applicant calculated that the littoral zone area dewatered by the maximum drawdown in 14.4% and the volume drawdown is a maximum of 13.3%.

Based on this information, the Project maintains at least 75% of the littoral zone of Green Lake, which provides wetted conditions in the littoral zone sufficient to meet aquatic life and habitat criteria in Green Lake.

c. Stream Aquatic Life

The applicant completed a Benthic Macroinvertebrate Study between August 27 and September 24, 2020 to demonstrate whether current in-stream flow releases affect attainment of aquatic life criteria in Reeds Brook downstream of the Project dam. Benthic macroinvertebrate samplers were deployed in accordance with the Department's sampling protocol, and the Department analyzed resulting data using its linear discriminant model.

The study included three sample sites, one in the bypass reach and two in the tailrace. The two tailrace sites did not meet Class B aquatic life criteria and only attained criteria for Class C; however, DEA staff determined that it is not appropriate to use results for these sites in its WQC evaluation because the macroinvertebrate community is likely influenced by the Green Lake Fish Hatchery discharge and periodic backwatering of Graham Lake.

DEA staff determined that monitoring results for the Reeds Brook bypass reach site met Class B aquatic life criteria.

d. Stream Dissolved Oxygen

The Applicant conducted a Dissolved Oxygen (DO) and Temperature Study in Reeds Brook downstream of the Project dam in accordance with the Department's Sampling Protocol for Hydropower Studies between July and October 2020. Data were gathered downstream of the dam but upstream of the Green Lake Fish Hatchery filter backwash discharge, in the tailrace downstream of the powerhouse, in the confluence of the tailrace and the Reeds Brook bypass reach, and in Reeds Brook bypass directly upstream of the confluence of the bypass and the tailrace. DO concentrations recorded during the study ranged from 7.59 mg/L to 9.14 mg/L and between 85.2% and 112% saturation.

Analysis of the sampling results indicates that DO concentration met applicable Class B water quality standards in Reeds Brook both downstream of the Project dam and downstream of the powerhouse tailrace. Based on the results of DO and temperature monitoring results, the Department concludes that the Applicant has provided sufficient information to demonstrate that the Project outlet stream meets applicable Class B dissolved oxygen numeric criteria under critical water quality conditions.

e. Stream Aquatic Habitat

The Applicant conducted a Cross-Section Flow Study in December 2020 and January 2021 within the Reeds Brook bypass reach downstream of the Project dam to evaluate the sufficiency of in-stream flow releases from the Project dam. Wetted area and habitat characteristics were recorded for four different flows (2 cfs, 5.5 cfs, 11 cfs, and 22 cfs) at four transects in Reeds Brook to determine the flow at which at least 75% of the bankfull area is wetted at all times. The Applicant reports that even at the lowest flow of 2 cfs at least 81.42% of the bankfull width is wetted at all times.

Based on this information, the Project maintains at least 75% stream wetted width, which provides wetted conditions sufficient to meet aquatic habitat criteria in Reeds Brook.

Recommended Conditions/Mitigation Measures

Based on the information and assessments provided above, the Department finds that the Project attains applicable State water quality standards. No conditions or mitigation measures are proposed for the Project.