

## Bristol County Water Authority's Proposed Plan to Restore the Kickemuit River through the Removal of the Two Kickemuit Reservoir Dams

The two dams on the upper Kickemuit River were constructed to create a public water supply for Bristol County Water Authority (BCWA), the regional water supplier for the communities of Warren, Bristol and Barrington, Rhode Island. The Lower Kickemuit Dam was constructed in 1883 to create the reservoir, and the Upper Kickemuit Dam in 1961 to prevent saltwater intrusion in the upper section of the reservoir. Dams were also constructed in the late 1880's to provide additional supply from the Shad Factory Pond and the Swansea Reservoir in Massachusetts.

The shallow Kickemuit Reservoir was never a good source for potable water, as water quality was poor and quantity was very limited. The water treatment plant, built in 1908, struggled to meet federal water quality regulations, until it was designated for emergency backup only in 2011 and decommissioned in 2019.

The Upper and Lower Kickemuit River Dams became the backup water supply in 1998 once the BCWA secured a primary source of water from the Scituate Reservoir through the East Bay Pipeline. In 2012, BCWA began studies to secure an alternative backup water supply. Continuing water quality deterioration by water pollution and saltwater intrusion from sea level rise has designated the Kickemuit River supply as unusable for potable water.

The Rhode Island Department of Health (RIDOH) in their 2013 *SafeWater RI* report characterized the BCWA's system as critically vulnerable to three hazards related to climate change: sea level rise, coastal flooding and hurricanes. The Lower Kickemuit River Reservoir impoundment is vulnerable today to tidal inundation during moon tides and storm events and will experience more tidal flooding with predicted sea level rise.

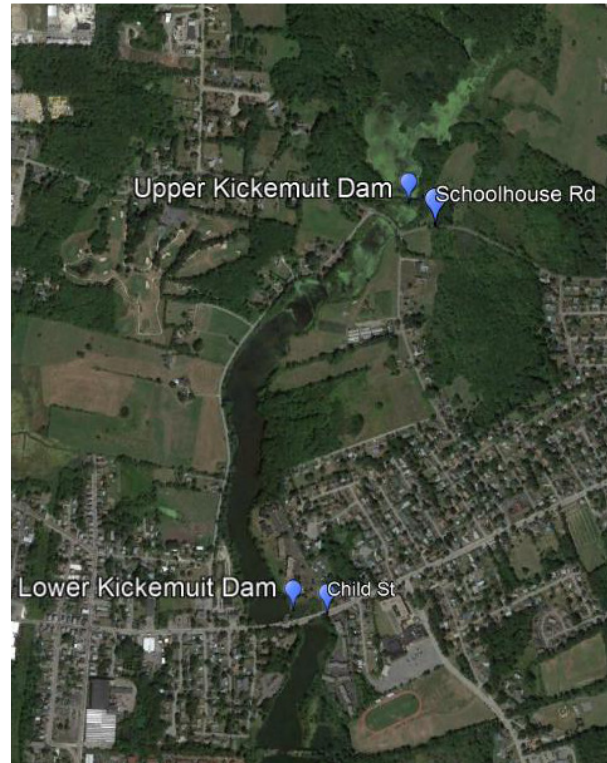


Figure 1: Upper and Lower Kickemuit River dams and impoundments



Figure 2: Tidal flooding of lower impoundment (in foreground) during a king tide

Since 2012, BCWA has taken action on the RIDOH's recommended strategies to prevent losses to drinking water utilities by evaluating their at-risk infrastructure and developing and implementing a plan to abandon the former backup water supply and secure a new backup supply from an independent source. The BCWA studies determined that the best and most economical alternate supply could be provided by Pawtucket Water, with a 30' pipeline to be run through the City of East Providence terminating at the BCWA Providence connection in East Providence. As East Providence participated in the 2012 study, and their connection to Providence Water is at risk, they are considering joining in the project.

The first phase of installing the alternate supply will begin construction in 2021, connecting the BCWA Providence Water connection with the East Providence source from Providence Water. The second phase of securing a new alternate supply is currently in the design phase and includes running a 30-inch main from the East Providence connection to the Pawtucket border to connect to Pawtucket's water supply.

Since the Upper and Lower Kickemuit River Dams are no longer needed for the water supply, BCWA is working with its partners including the Town of Warren, Save The Bay, National Oceanic and Atmospheric Administration's (NOAA) Restoration Center and the State of RI's Chief Resilience Officer to remove both the Upper and Lower Kickemuit River Dams.

Removal of both dams will increase the ecological health of the Kickemuit River by restoring the tidal estuary, increasing both salt marsh and freshwater wetland habitat, improving habitat for fish and wildlife, and restoring the connectivity of this tributary with the estuary. The removal of these obstructions to tidal flow, coupled with anticipated sea level rise will restore salt marsh habitat in the lower impoundment and will create area for salt marsh migration.

Removing the dams will reduce stagnant conditions and increase tidal flushing, significantly improving both water quality and habitat for a wide variety of fish and wildlife. Combined, these benefits will provide sustainable and lasting ecological benefits and will restore natural ecosystem function to the Kickemuit River. The dam removals, along with upgrading of the culverts under Schoolhouse Road, will enhance fish passage for river herring and eels and create new habitat for estuarine forage fish such as mummichog, striped killifish, and menhaden. The increase in habitat for forage fish will benefit recreationally important species such as striped bass and blue fish. Other species like blue crab will also benefit from the restoration and have been observed in the lower impoundment due to its brackish conditions.



*Figure 3: Algae bloom in lower impoundment*

The dam removals will also provide community resiliency benefits by increasing flood storage capacity of the wetlands and reducing flooding of Schoolhouse Road during precipitation events. As part of this project, BCWA and its partners have secured a commitment from the Rhode Island Department of Transportation (RIDOT) to elevate Schoolhouse Road and resize its culverts. This low-lying road just downstream of the upper impoundment will no longer flood during large precipitation events and will provide an important alternative evacuation route for the eastern part of Warren.

The dam removals will enhance public access to the Kickemuit River for kayaking, fishing and recreation. Presently the area is restricted to public access since it was a designated watershed for BCWA's backup drinking water supply. Once an alternate supply is secured, the area is intended to be opened for low impact public recreation such as walking, fishing and kayaking.

**Project Background:**

The Upper Kickemuit River Dam (Warren Reservoir Upper Dam - State I.D. 480) is an earthen embankment; 965 feet in length and 14 feet in height. The Upper Kickemuit River Dam, built in 1961 to prevent saltwater intrusion, is approximately 0.8 miles upstream of the Lower Kickemuit River Dam and the tidal estuary. A large wetland exists adjacent to the Upper Kickemuit Reservoir and is predicted to convert to salt marsh or intertidal habitat with sea level rise. The Lower Kickemuit River Dam (Warren Reservoir Lower Dam - State I.D. 479), built in 1883 for water supply purposes, is 130 feet long. The dam prevents tides from flowing into the impoundment under most tide conditions except during moon tides and storm events.



Figure 4: Upper Kickemuit River dam

When the impoundments were a water supply, RIDEM with funding from NOAA, and other federal and state partners collaborated to enhance fish passage by constructing a fish ladder at the Lower Kickemuit River Dam in 2007. RIDEM’s Division of Fish and Wildlife has stocked the lower impoundment with herring since 2010 and have observed herring below the fish ladder but not in the impoundment. The biologists conducted an electrofishing survey of the impoundment in 2012 and did not document juvenile herring in the Lower Kickemuit impoundment. The herring population has not returned as projected since the installation of the fish ladder due in part to brackish water conditions and poor water quality in the lower impoundment. Additionally, blocked culverts under Schoolhouse Road and check valves on the outlets of the Upper Kickemuit River Dam prevent migratory fish from accessing the upper impoundment and three miles of upstream spawning habitat.

**Water Quality:** Monitoring conducted of the two impoundments and upper estuary in the summer of 2020 by BCWA and Save The Bay - through URI’s Watershed Watch program - documented that the lower impoundment has already converted to a brackish system since moon tides flow into the lower impoundment over the

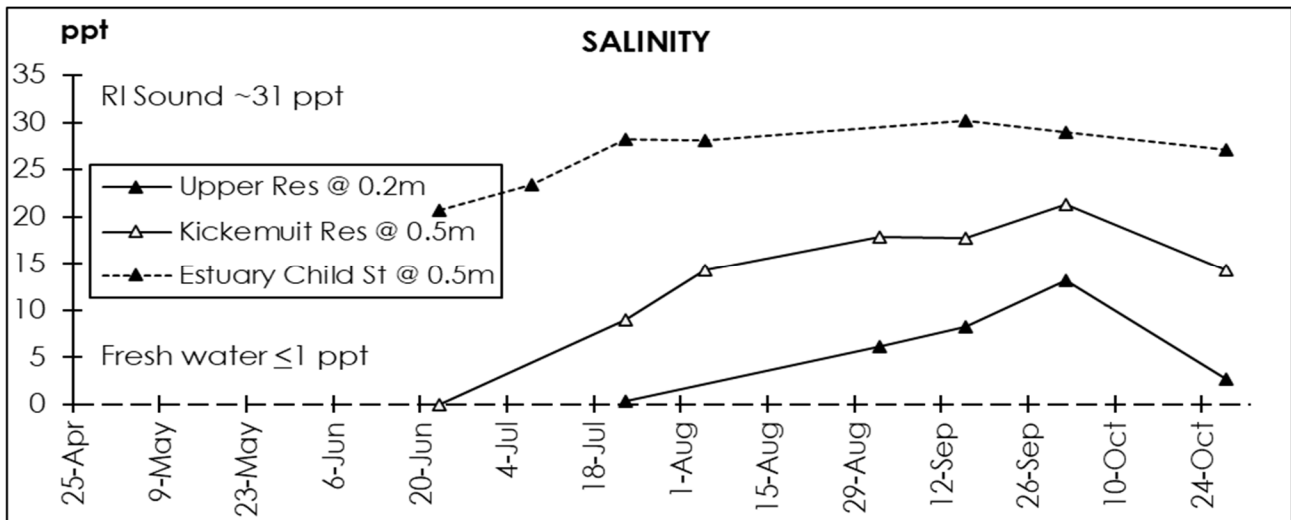


Figure 5: Salinity data of upper and lower impoundments and upper estuary at Child St. from 2020

spillway. The monitoring data also documented high nutrient and bacteria levels in both impoundments and downstream of the lower dam at Child Street. Nutrient pollution is evident from the extensive algae blooms during the summer and early fall. Algae blooms result in low oxygen conditions that create degraded habitat



conditions for fish and aquatic life. The brackish waters and low oxygen levels have hampered the return of spawning river herring, despite the construction of the fish ladder at the lower Kickemuit dam.

**Project Planning:** In 2014, the Upper Kickemuit River Dam safety report identified the dam as needing to address deficiencies highlighted by a statewide dam assessment, including the removal of vegetation to protect embankment stability. Based upon the fact that the dam no longer served its intended purpose, in 2015 BCWA decided to hire Pare engineering to assess dam removal. Pare was aware that the RIDEM was assessing new dam regulations, and it may cost BCWA \$500,000-\$600,000 to bring the dam up to the new standards.

As part of the assessment, Pare Corporation conducted hydrologic modeling to assess future flooding scenarios with the removal of the Upper Kickemuit River Dam. The modeled conditions indicated that the dam breach resulted in decreased depth and extent of flooding during precipitation events in residential neighborhoods in Rhode Island and Massachusetts, including Schoolhouse Road east of the dam.

However, the section of Schoolhouse Road directly downstream of the dam was identified as being more vulnerable to flooding if the Upper Kickemuit River Dam was removed. Based upon this assessment, the State's Chief Resilience Officer coordinated meetings with RIDOT staff and project partners to discuss changing the Transportation Improvement Plan and reprioritizing Schoolhouse Road from a repaving project to a road raising project. In 2019, RIDOT committed to elevating Schoolhouse Road and upgrading its culverts to prevent flooding of the roadway once the dam is removed. RIDOT hired an engineer to design and permit the Schoolhouse Road upgrades and culvert resizing, and construction is targeted for 2021 or 2022.



*Figure 6: Schoolhouse Rd flooding during rain event (March 2018)*

The modeling also predicted that downstream flooding of Serpentine Road, a town road, along the Lower Kickemuit River impoundment will increase if the Lower Kickemuit River Dam remained in place. Based upon this analysis, in the fall of 2019, BCWA and its partners decided to coordinate the removal of both the Upper and Lower Kickemuit River Dams simultaneously to reduce flooding during precipitation events while restoring estuarine habitat and enhancing migratory fish passage while restoring the water quality of the River.

The assessment of the Lower Kickemuit River Dam removal has included sediment analysis, a bathymetric and topographic survey, stream profile modeling and wetlands delineation, coastal surge modeling and identification and assessment of private wells adjacent to the lower impoundment. The storm surge analysis determined that the Lower Kickemuit River Dam provides no coastal flood mitigation benefits under existing and future scenarios. The dam removal will result in a slight flood increase when coastal surge is combined with a precipitation event under a worst-case scenario. BCWA also conducted an assessment of the effects of the dam removal on private drinking water wells adjacent to the lower impoundment. The sediment assessment found exceedances of copper in some of the samples due to past treatment of the drinking water supply. Pare Engineering has developed a sediment management plan that includes removal of the contaminated sediment.

The engineering and design of the dam removal projects is being coordinated with the sizing of the culverts under Schoolhouse Road. To date, Pare has developed 60% plans for the removal of the Upper and Lower Kickemuit River Dams. The design and engineering of the dam removals has been funded in part by two grants of \$75,000 each from CRMC's Coastal and Estuarine Habitat Restoration Trust Fund. Additionally \$1.2 million in funds for the dam removals was secured from the State's Climate Resilience Fund in 2020. Save The Bay has been collaborating with BCWA on writing the grants for state and federal funds for design and construction.

**Partner and public engagement:** BCWA formed the Committee to Study the Removal of the Kickemuit Dams in 2016 including the Town of Warren, the Kickemuit River Council, the Town of Swansea, Save The Bay, and the State of Rhode Island's Chief Resilience Officer. The Chief Resilience Officer has highlighted this project as a model resiliency project that requires interagency coordination between RIDOT, RIDEM, RI Department of Health, BCWA and the local municipality, the Town of Warren.

BCWA has held a number of meetings with the committee of stakeholders since 2016. BCWA has provided updates to the Warren Town Council on the dam removal planning and assessment in January 2021 and in May of 2020. BCWA has held two public meetings including the abutters to review the dam removal plans in November of 2019 and December of 2020.

**Permitting:** The Upper Kickemuit River dam removal project will require a RIDEM Freshwater Wetlands permit, RIDEM Water Quality Certification, an Army Corps 404 permit. The Lower Kickemuit River dam removal project will require a Coastal Resources Management Council Assent, a RIDEM Water Quality Certification and an Army Corps 404 permit. BCWA and Pare Engineering have had a pre permitting meeting with DEM and CRMC to discuss the permitting of both dam removals.

#### **Project Construction and Phasing:**

The Upper Kickemuit Dam will be breached after Schoolhouse Road is elevated and the culverts replaced. The removal will occur in an incremental fashion, allowing sediment contained behind the dam to mobilize in stages. Sediment will collect in the basin downstream of the dam created by Schoolhouse Road. Flow will be controlled at the Schoolhouse Road culverts. As the basin above Schoolhouse Road fills, sediment will be mechanically removed from the site – this process will be repeated until most of the sediment has been removed. It is anticipated that some sediment will flow into the lower reservoir, where it will be managed in conjunction with the existing sediment as part of the Lower Kickemuit River Dam removal. At the Lower Kickemuit River dam, sediment with elevated levels of copper will be removed. As the dam is removed, sediment will collect in the basin created by the Child Street bridge and will be mechanically removed from the site.

Once the dams are removed, the exposed areas of the riverbed will be restored with plant growth native to the former estuary. Soil samples taken in the reservoir revealed plant roots that can reestablish in the brackish water. The river basin will fill at high tide and reduce to a tidal creek at low tide, creating an ever changing but much healthier environment.