



Lower Granite Adult Fish Ladder Temperature Improvement System

U.S. ARMY CORPS OF ENGINEERS

BUILDING STRONG.

New system expected to eliminate thermal barrier to migrating lower Snake River adult salmon and steelhead at Lower Granite Lock and Dam fish ladder

As part of the construction of four dams on the lower Snake River between the 1950s and 1980s, the U.S. Army Corps of Engineers (Corps) built adult fish ladders to allow passage of upstream-migrating adult salmon and steelhead (salmonids) on their way to their natal spawning areas. Since construction, the Corps has made both facility and operational improvements to assist adult salmonid migration as needed.

Historically, the Snake River is known to have experienced high summer water temperatures in years prior to construction of dams. In summer 2013, elevated water temperatures began to occur in Columbia-Snake basin river reaches with and without dams due to unusually hot weather dominating the basin. At Lower Granite Lock and Dam's adult fish ladder, longer-duration elevated water temperatures began to form a "thermal barrier" to upstream migrating salmon and steelhead, slowing and/or stopping adult fish migration upstream.

In response, the Corps developed both an interim solution to the thermal barrier in 2014-2015, plus a permanent solution installed in early 2016.

2015 was the hottest year on record, and fish perished throughout the West in rivers with and without dams due to elevated water temperatures. A total of 510,705 sockeye that originated in numerous watersheds passed Bonneville Dam on the lower Columbia River. Snake River-born sockeye comprised about 4,069 of the more-than-510,000 sockeye run, or less than one percent of the total run, as confirmed by Passive Integrated Transponder (PIT) tag analysis.

By the time the survivors of those initial 4,069 Snake River sockeye reached Ice Harbor Dam, the first dam encountered on the lower Snake River, 74.1 percent had perished in the lower Columbia River, and their numbers were reduced to 1,052 Snake River sockeye to migrate up the Snake River. Survivors of those 1,052 Snake River sockeye reaching Lower Granite Dam totaled 440, or 41.8 percent of the Snake River sockeye first counted at Ice Harbor Dam.

Using Dworshak reservoir water to cool the lower Snake River

The Corps keeps the tailwater (water just below the dam) at Lower Granite Lock and Dam at 68 degrees Fahrenheit or cooler to benefit fish passage of Endangered Species Act (ESA) listed salmonids during summer months. The Corps seasonally releases cool water from Dworshak Dam Reservoir on the North Fork of the Clearwater River. Importantly, Dworshak's cool water "stratifies" deeper in Lower Granite reservoir, the first reservoir it reaches in the lower Snake River. This deeper, cooler water subsequently becomes mixed with warmer water below Lower Granite Dam as it flows downstream.

This process of releasing cool Dworshak water to benefit fish passage in the warmer water of the Snake River is referred to as "flow augmentation." The Corps implements this program annually, beginning in early summer when water temperatures increase and ending in early fall when water temperatures begin to cool naturally.

The Temperature Differential or Thermal Blockage Problem at Lower Granite

The surface water from the forebay (water just upstream of the dam) at Lower Granite provides flow for operation of both the fish ladder and the adult fish trap built into the fish ladder. The fish trap is used to safely and efficiently collect selected adult fish for research or transportation to hatcheries.



Semi-circular cool water spray at upstream end of Lower Granite Dam adult fish ladder. U.S. Army Corps of Engineers photo.

In 2013, 2014 and 2015, when the reservoir surface water warmed significantly for a prolonged time period, a warm-water thermal blockage prevented adult fish trap operation and inhibited adult fish from entering the fish ladder.

Many salmon that had migrated upstream through Little Goose Lock and Dam, the next dam downstream, never successfully passed Lower Granite. This raised awareness throughout the regional fisheries management community of the need to find a solution for this issue.

Adult Fish Ladder Temperature Improvement

Recent thermal barriers to adult fish migration led to funding for construction of two permanent “intake chimneys” at Lower Granite to cool the adult fish ladder, plus the adult fish trap built into the fish ladder.

The permanent intake chimneys are large vertical structures bolted to the upstream face of the dam.

There are two chimneys, one on either side of the upstream end of the fish ladder where adult fish normally continue their upstream migration into the forebay in the reservoir. They both draw water from about 66 to 70 feet deep, depending on forebay elevation.

1. Supplemental Water Intake Chimney - One intake chimney covers the pipe entrance that provides supplemental water to the fish ladder at ‘Diffuser 14’ starting about 150 feet downstream from the top of the ladder. It also routes water to the adult fish trap.

2. Pump Intake Extension Chimney - A second chimney was constructed to extend an existing pump intake. This pump intake provides water to the upstream end of the fish ladder by spraying cooler water in a semi-circular pattern to cool both the immediate forebay area and the fish ladder itself.

The two intake chimneys provide a permanent way to pull cooler water from deep in the reservoir. As a result, beginning in 2016, cooler water from deep in the dam forebay will now supply both the fish ladder and the adult trap during hot summer months.

Previously, in 2014 and 2015, prior to installation of the two permanent intake chimneys completed in early 2016, the Corps temporarily used pumps during summer months to bring cooler water up from deep in the reservoir to benefit operation of both the fish ladder and the adult trap.

The Corps also modified Lower Granite powerhouse and spillway operations in 2014-2015 to enhance attraction of adult fish to the ladder. Powerhouse operational changes included changing which turbine units were operated. Spillway operational changes included closure of the spillway weir. These manipulations created a cooler water flow profile downstream of Lower Granite to best attract adult salmonids to the fish ladder entrance. This temporary 2014-2015 solution was only partially successful in eliminating the thermal barrier issue. Construction of the new permanent solution was completed in February 2016.

During 2016, monitoring of the completed permanent improvements will document the system’s effectiveness. Monitoring efforts will include use of both tagged fish and temperature sensors. The tagged fish will be monitored to confirm this improvement works as designed to help adult salmon and steelhead continue their migration upstream more expediently through the fish ladder into the reservoir above the dam.



A supplemental water intake chimney provides supplemental water starting about 150 feet down from the top of the fish ladder, plus water to the adult fish trap. U.S. Army Corps of Engineers photo.