

# Lake Washington Ship Canal (LWSC) Pinnipeds Predation

## Sea Lions, Harbor Seals, and Deterrence Efforts

### Sea Lions

- 1981-1993, decline and functional extinction of Lake Washington steelhead.
- 1986-1996 - Active hazing of pinnipeds, variety of measures by NMFS and WDFW
- 1996 – modification to the marine mammal protection act for harassment and active removal of habitual offenders (*Frank, Larry and Bob off to Sea World*) or lethal means.
- 1993-2017 – Acoustic Deterrence Device (ADD) or Startle (ADS) at Locks below the fish ladder, non-operational after that date, NMFS no longer maintaining the system







## Harbor Seals

- Predation on salmon throughout summer months.
- Increasing use of hazing of seals (firecrackers) by fish managers found in fish ladder or adjacent areas.
- **2020** Oceans Initiative (OI) Study: Targeted Acoustic Startle Technology (**TAST**) as a non-lethal mitigation tool for reducing pinniped predation on adult salmon returning to **Ballard Locks**
- US Army Corps role was to provide real estate outgrant to allow use of Corps facilities, for the device deployment in 2020 and to complete Endangered Species Act (ESA) consultation for that season for potential effects to ESA listed species.
- Long Live the Kings (LLTK) provided support for the testing at the LWSC.
- OI Tested a single device at the fish ladder from mid-August to end of September; additional testing in Whatcom Creek after LWSC
- Reported results from OI: demonstrated a 46% increase in adult fish passage when the TAST was turned on. This translates to ~4,449 fish saved over the course of the 30-day deployment period.

TAST deployed at the Fish Ladder in 2020



# 2021 TAST Study

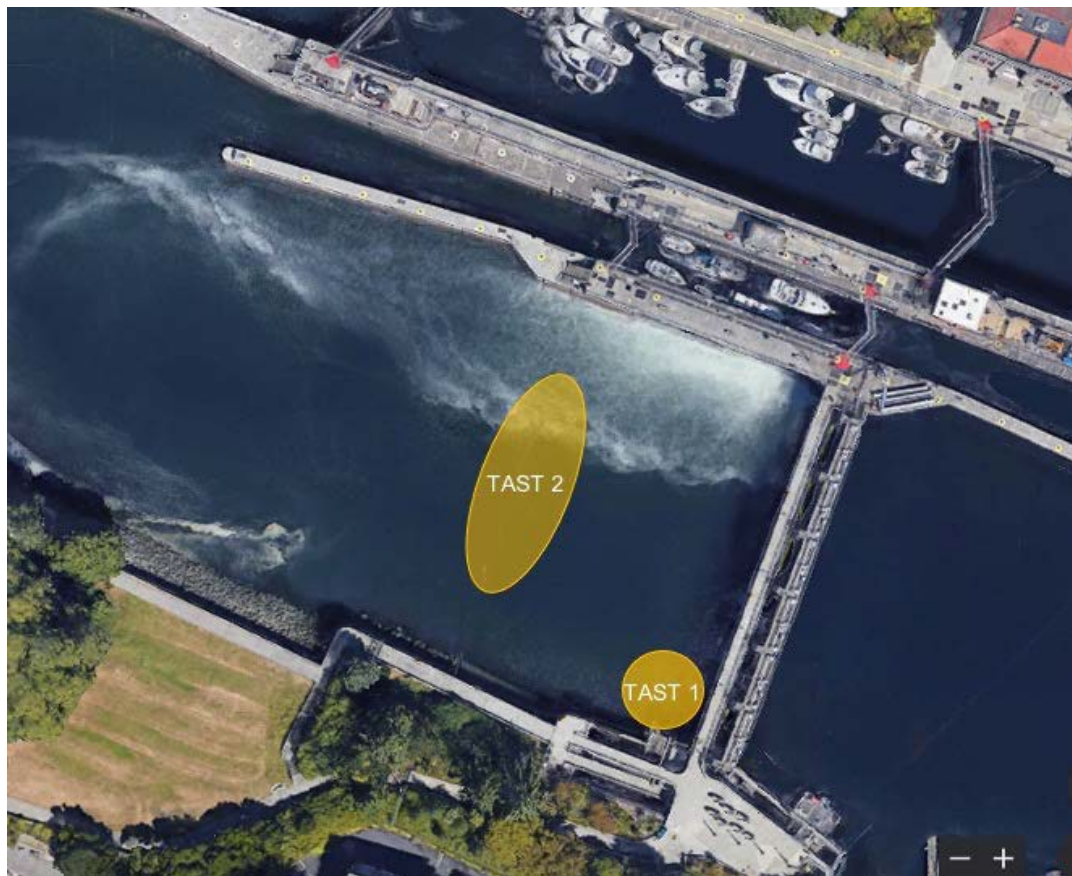
## Objectives

- 1) measure harbor seal behavioral responses to ASDs at the Locks,
- 2) assess the effectiveness of ASDs (2 units) in reducing predator presence in the area of concern (the Locks)
- 3) assess whether harbor seals demonstrate signs of habituation to the ASD.
- Conduct study throughout the summer for all species.

## Funding efforts to outside agencies:

- The Washington Department of Fish and Wildlife (WDFW) letter of support for funding. Governor Inslee's Southern Resident Orca Task Force report (2019) identifies decreasing pinniped predation on Puget Sound and Columbia River salmon as a priority issue for increasing available prey for orcas.
- Seattle Aquarium, letter of support for collaboration with Oceans Initiative on the education and public outreach portion of this project.
- Muckle Shoot Fisheries supports funding an additional year of data that will be valuable in demonstrating the effectiveness of TAST in reducing pinniped predation.
- LLTK Long Live the Kings (LLTK) support Oceans Initiative's (OI) proposal to continue its assessment of the TAST device to reduce the predation pressure seals and sea lions.
- NMFS letter of support for continued collaboration amongst WDFW, NMFS, USACE and support of the testing of the non-lethal TAST system.
- Corps role is again to provide real estate outgrant and ESA consultation coverage for the period from 2021-2025.

TAST locations at the Locks in 2021





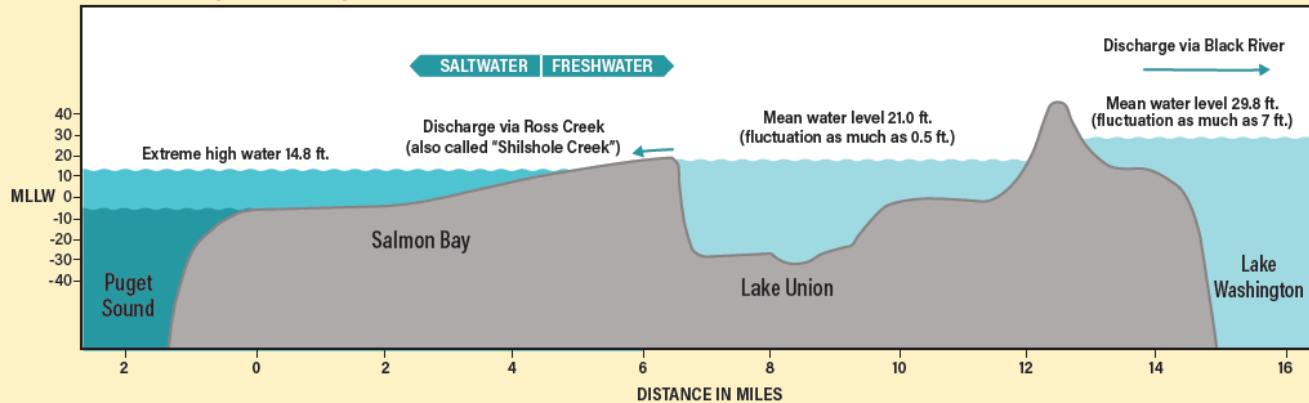


# Lake Washington Ship Canal (LWSC) Water Temperature History of Actions

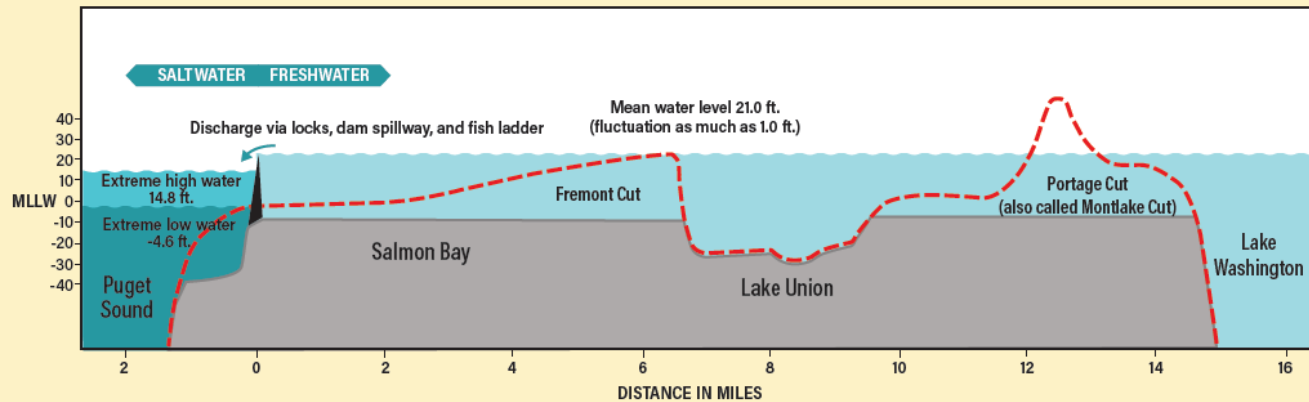
## Locks and the Ship Canal Then and Now

**Figure 3:** Schematic sections comparing historical and present day bottom configuration and elevations along route of the LWSC. All water elevations are in feet or below (-) mean lower water. Excerpt from Chrzastowski (1983).

### HISTORICAL (PRE-CANAL) CONDITIONS



### PRESENT DAY CONDITIONS



Ship Canal

# Water Temperatures in Lake Washington Then and Now

## Number of days Exceeding 20 C/ 68 F

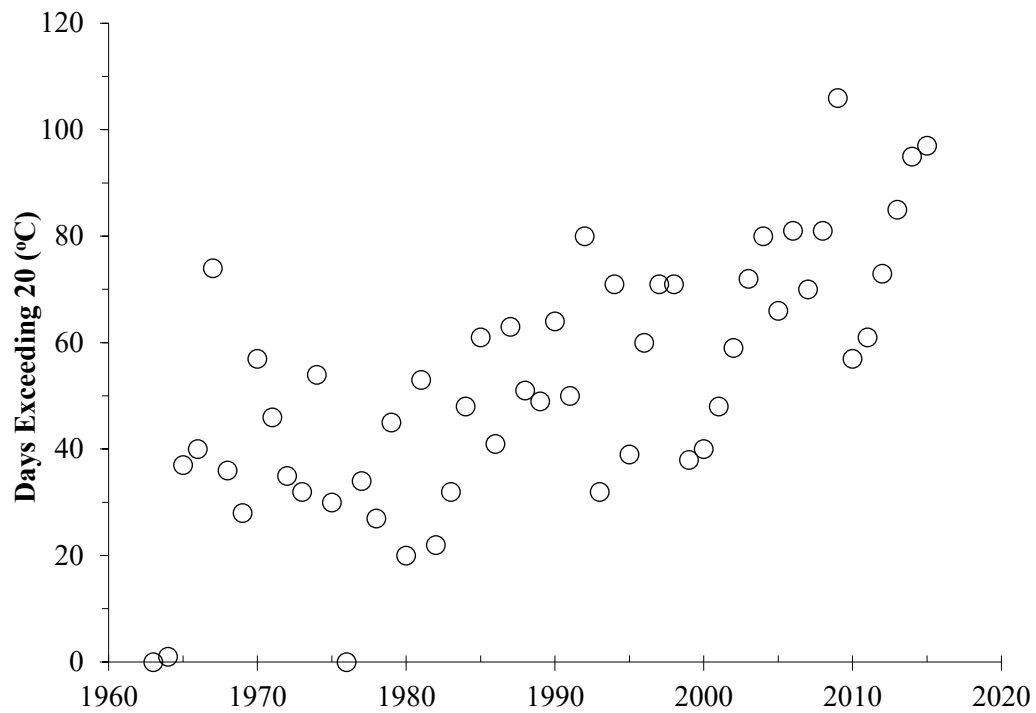
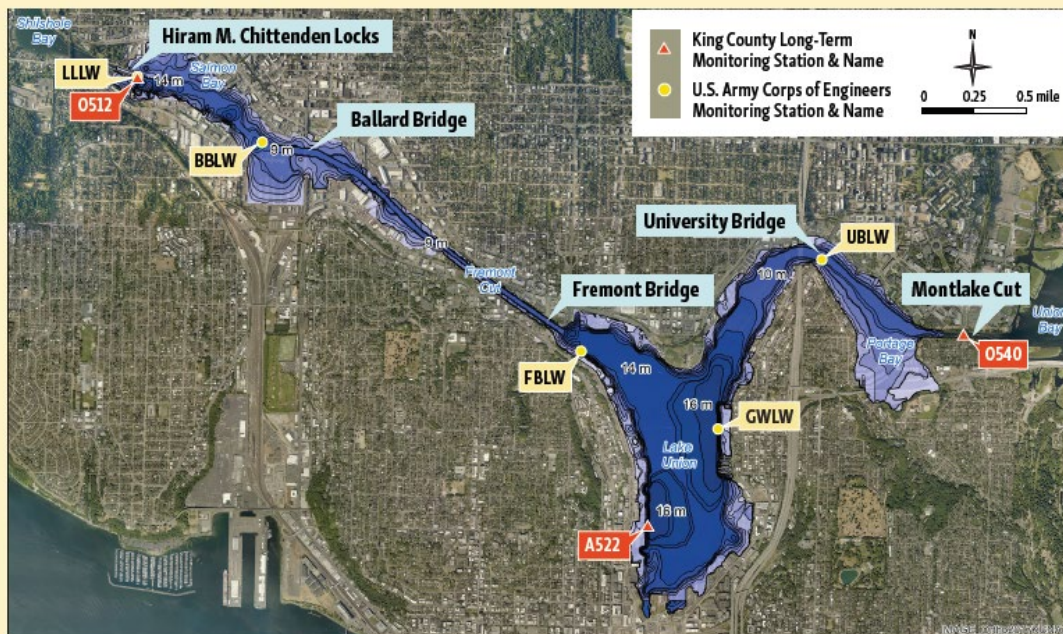


Figure. Changes in near surface water temperature in Lake Washington over 60 years.

Number of days between first and last days when temperatures exceed 20 C.

## How do we track temperature, dissolved oxygen and salinity in the Ship Canal

**Figure 4:** Areal extent and bathymetric profile of the Lake Washington Ship Canal including U.S. Army Corps of Engineer and King County water quality monitoring stations.



### WATER QUALITY MONITORING STATION LABELS:

- LLLW (Large Locks-Lake Washington)
- BBLW (Ballard Bridge-Lake Washington)
- FBLW (Fremont Bridge-Lake Washington)
- GWLW (Gas Works-Lake Washington)
- UBLW (University Bridge-Lake Washington)
- A522/0540 (King County numbered stations)



## Seattle District (NWS) Current Water Quality Modeling and Monitoring

### Upcoming Efforts to Model Changes in Temperature and Dissolved Oxygen

- NWS will conduct model runs designed to answer questions about the potential water quality benefits in the LWSC from operations at the Ballard Locks.
- These modeled operations will be developed by NWS and will be designed to inform NWS of the relationship between operations of the Ballard Locks and LWSC water quality.
- Potential operational scenarios could include:
  - increasing flow through the Ballard Locks during the warm summer months
  - drawing down Lake Washington surface elevations to minimum levels earlier in the year, and
  - moving cool hypolimnetic waters from Lake Washington to the LWSC.
- These operational scenarios would be evaluated from a water quality standpoint to determine the flow thresholds and temperature conditions which might be required to affect water quality conditions in the LWSC.
- They would not be evaluated from the perspective of operational feasibility, demands on water supply, or cost.
- The exact operational scenarios will be developed by NWS with model runs conducted by the NWS modeler and the contractor.
- Seattle District has been funded by the ***Sustainable Rivers Program*** to update and recalibrate the existing water quality model (CE-QUAL-W2) and to perform model runs.
- NWS has also added surface temperature probes (about 5 ft depth) to Fremont and Ballard Bridge stations to provide the full temperature profile from surface to bottom.

### [Sustainable Rivers \(army.mil\)](https://www.army.mil) (SPP)

Sustainable Rivers – Collaboration between US Army Corps, Nature Conservancy and other federal, state and non-government entities. The mission of SRP is to improve the health and life of rivers by changing water infrastructure operations to restore and protect ecosystems, while maintaining or enhancing other benefits.

The founding objective of SRP is implementation of environmental flows, which are defined as the quantity, timing, and quality of water flows required to sustain ecosystems. As of 2019, SRP involved work on 66 Corps reservoirs in 16 river systems and 5,083 river miles. SRP is now the largest scale and most comprehensive program for implementing environmental flows at Corps reservoirs.

The Program recently began exploring other water infrastructure-oriented actions with potential to produce environmental benefits. Specifically, the Program is pursuing the following strategic directions: 1) expand geographically with a focus on multi-purpose reservoirs and environmental flows; 2) broaden the types of environmental actions being used to achieve sustainable management of water and ecosystems at multi-purpose reservoirs; and 3) adapt SRP methods to other infrastructure types including locks and dams, dry dams, and other structures.

## **Summary of WRIA 8 Temperature and Dissolved Oxygen Issues**

- High temperatures and low dissolved oxygen in the LWSC are critical limiting factors for salmon.
- The locks prevent cool saline water from entering the LWSC, this results in extreme temperature changes for salmon using the fish ladder.
- Experiments to induce additional marine water into the system have shown a potential for harming the freshwater environment.
- High temperatures in Lake Washington from solar heating results in higher temperatures in the LWSC.
- There are few thermal refuges for salmon in the LWSC during their upstream migration, low dissolved oxygen limits use of deeper areas.
- Many of the Chinook that hold at the Locks use a small area just above the Locks, thousands of fish utilize a small area to wait for cooler water temperatures in the LWSC.
- As temperatures continue to warm with climate change, detrimental effects of temperature and dissolved oxygen will continue to increase and further limit successful migration of juvenile and adult salmon.
- Limiting factors for salmon in LWSC have been investigated for over 20 years. Primary management actions may include adjustments to lock operations, which may improve temperature conditions primarily for adult Chinook and sockeye.
- Additional measures are yet to be investigated with limited empirical evidence to determine direct and indirect effects.