

June 2017

# Economic Impacts of the Hiram M. Chittenden Locks

Prepared for  
Lake Washington  
Ship Canal Users Group



Prepared by  
**McDowell**  
GROUP

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[www.mcdowellgroup.net](http://www.mcdowellgroup.net)

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# Executive Summary

Among the nearly 200 marine locks sites operated nationwide by the U.S. Army Corps of Engineers (USACE), the Hiram M. Chittenden Locks in the Ballard neighborhood of Seattle are unique. The Ballard Locks, as they are more commonly known, are the only marine link between Seattle's inland lakes, Lake Washington and Lake Union, and Puget Sound. The Locks serve more individual vessels than any other locks in the nation: more than 40,000 transits in 2015, and more commercial vessels than all but 12 of the 200+ other USACE locks.



Source: USACE.

This year marks the 100<sup>th</sup> anniversary of the Locks' opening day in 1917, and as the Locks reach this important milestone, there is growing concern about making the critical infrastructure upgrades needed for the Locks to continue operating reliably and safely. This report discusses the benefits of reliable Locks operation, the potential losses in the event of a closure, and describes some of the steps needed to mitigate these risks.

## Economic Value to the Nation

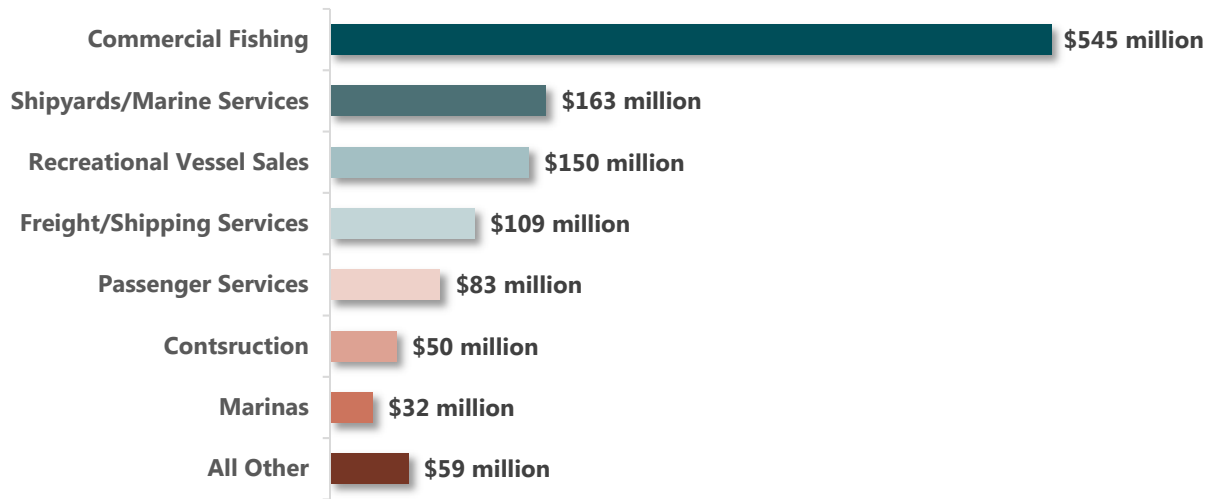
- **The Ballard Locks are the busiest in the nation in overall vessel traffic, with more than 40,000 transits annually, and the twelfth busiest in use by commercial vessels, with 7,500 commercial transits each year.** More than 1 million tons of freight moves through the Lake Washington Ship Canal and the Ballard Locks each year.
- **Moorage, marine services, and saltwater access made possible by the Locks support an estimated \$1.2 billion in gross business sales annually,** including commercial fishing companies, shipyards and marine services, vessel sales, freight and shipping services, passenger services, construction, and marinas (see chart on next page).
- **The maritime business ecosystem on the freshwater side of the Locks is unique in the Pacific Northwest and a key component of Washington State's Maritime Industry Cluster.** A group of 50 local maritime businesses identified for this report produces an estimated \$120 million in annual payroll and a full-time equivalent employment impact of approximately 3,000 jobs that depend on the Ballard Locks. At least another 150 nearby businesses benefit in more general ways from the Locks and the vessels that rely on them.
- **A unique freshwater, tide-free marine environment made accessible by the Locks reduces maintenance costs and prolongs vessel life** for an estimated 700 commercial and 4,000 recreational vessels that use the Locks for access to Puget Sound. These include vessels from nine different commercial



fishing fleets plus ocean-going freight-shippers that are relied on year-round for crucial supplies and equipment by communities throughout Alaska and elsewhere. Commercial fishing vessels that use the Locks represented an estimated \$545 million in ex-vessel earnings and contributed roughly \$785 million in seafood export value in 2015.

- **As a visitor attraction, the Locks generate approximately \$40 million in spending impacts each year,** with more than 1.25 million site visitors, including 150,000 tourists, school children and other passengers who book cruises through the Locks annually.

**Gross Sales by Businesses Dependent on the Ballard Locks, 2016**



Source: McDowell Group estimates.

## Environmental and Public Infrastructure Protection

- **The Ballard Locks control water levels in Lake Washington and Lake Union** to maintain, among other key infrastructure, the State Route 520 and Interstate Route 90 floating bridges, the water and sewer systems that serve Mercer Island's 24,000 residents, and approximately 75 miles of residential, municipal and commercial shoreline and moorage in the lakes and the Lake Washington Ship Canal.
- **The Locks are a unique access and egress point for equipment and supplies for major infrastructure projects** such as the \$4.6 billion renewal of the Route 520 floating bridge and removal of excavated material during construction of a \$430 million planned Ballard/Wallingford stormwater tunnel.
- **The Ballard Locks and its spillway and fish ladder safeguard an investment of more than \$125 million** in freshwater salmon habitat protection and restoration over the last two decades.



Source: Port of Seattle.

## Tribal Rights

- **The Ballard Locks are key to meeting federal trust responsibilities under treaties between the U.S. government and two federally recognized tribes, the Muckleshoot Indian Tribe and the Suquamish Tribe.** The Locks' fish ladder is the only access and egress point for migrating salmon that spawn in the Lake Washington, Cedar, Sammamish watershed (known as WRIA 8). The Muckleshoot Indian Tribe works with USACE at the Locks to study salmon runs, water quality, fish mortality and other factors that affect traditional and customary tribal activities under treaty protection. In addition to monitoring and research, both tribes conduct subsistence and commercial fishing activities either upstream or downstream from the Locks.

## Public Safety

- **Rapid access for public safety vessels between the lakes and Puget Sound saves money and increases effectiveness.** The Seattle Fire Department and the Seattle Harbor Patrol both keep public safety assets in the lakes and use the Locks when they respond to an emergency on the saltwater side. King County Sheriff and the U.S. Coast Guard moor vessels in saltwater, but use the Locks for maintenance and patrols.
- **A major failure of the Locks or spillway due to earthquake or uncontrolled flooding could jeopardize billions of dollars in public infrastructure and threaten human life.** USACE estimates the water level in the Lake Washington Ship Canal could drop ten feet in the first hour. Water that supports the Route 520 and Interstate 90 bridges in Lake Washington would eventually fall seven feet, which would also jeopardize the lake's function as Seattle's backup water supply. The potential for such an event and its full implications are currently under study by USACE.

## Needed Repairs

- **An additional \$30 million to \$60 million is needed to address a dozen components at the Locks identified for major repair or replacement.** These include the filling culvert valves used to empty and fill the lock chambers, the miter gates that seal each end of the Locks, and the saltwater return drain that helps prevent deterioration of water quality on the freshwater side of the Locks.
- **Operations and maintenance funding for the Locks has remained flat over the past several years, and the USACE is spending increasingly larger portions of the Locks budget to preserve the operational integrity of outdated systems.** USACE personnel and local businesses have observed more frequent service disruptions at the Locks and fear increased risk of a major malfunction.
- **An extended, unplanned closure of the Locks would have significant negative effects on nearly all the businesses that move vessels, materials or people through the Locks or serve customers that do.** Most business representatives said closures of a week or less would be manageable but that a closure of one to three months would mean layoffs and could result in great harm to their businesses.

# Study Purpose and Methodology

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The Hiram M. Chittenden Locks, known locally as the Ballard Locks and operated by the U.S. Army Corps of Engineers (USACE), is the only locks infrastructure in the U.S. that connects a large urban lake system directly to the ocean. The one-hundred-year-old Locks are the keystone of a billion-dollar-plus economic system, a critical environmental control for the vast watersheds around Seattle, a necessary tool to preserve tribal fishing rights, and a vital piece of public safety infrastructure. These economic, environmental, legal, and safety benefits of the Ballard Locks are in jeopardy because of deferred maintenance and lack of reinvestment.

## Purpose

The method prescribed by the federal government to evaluate the funding priority of the nation's various locks systems is based heavily on the gross weight of shipments through the locks. The formula therefore fails to account for most of the infrastructure value provided by the Ballard Locks, which results mainly from its role as a linchpin for several different economic and infrastructure systems in and around Ballard, the Lake Washington Ship Canal, and Seattle's inland lakes. Those systems include public safety, construction, shipbuilding and marine services, tug-and-barge companies, commercial fishing, cruise and charter vessels, and a large recreational boating community.

This report describes, and where possible quantifies, the full range of economic activity supported by the Ballard Locks. The report includes a qualitative discussion of the potential economic impacts should a major failure of the Locks occur.

## Methodology

Information for this study was obtained from the following sources:

- Interviews with representatives of more than 50 businesses, business associations, public agencies, and sovereign tribes. A list of these organizations is provided in Appendix 1.
- Interviews with USACE personnel familiar with Locks operations.
- Spending, employment, and Locks usage data provided by the firms and organizations interviewed.
- USACE data on Ballard Locks usage and operations.
- Review of past economic studies of the Ballard Locks and other locks systems and dams.
- USACE budgets, "Value to the Nation" manuals, and other reports.
- Publicly available economic and demographic data for Washington Congressional Districts 7 and 9, which encompass Lake Union, Lake Washington and South Puget Sound.
- Alaska Commercial Fisheries Entry Commission (CFEC) data on harvest levels and value for applicable Alaska fishing fleets.
- Washington Department of Fish and Wildlife data on commercial fish and crab harvests.

- National Oceanic and Atmospheric Administration Stock Assessment and Fishery Evaluation reports for federal commercial fishing harvest value, participation, and volume; and foreign trade data.
- Recreational boating data collected by the National Marine Manufacturers Association (NMMA), NMMA Canada, Washington Sea Grant, Washington Maritime Federation, City of Seattle, and others.

The economic impact methodology is described in the Economic Impact Analysis section.

## Report Sponsors

The study was administered by the Marine Exchange of Puget Sound. The following companies and organizations contributed funds towards this report.

Ballard Alliance  
 Ballard Oil Company  
 City of Kenmore  
 City of Kirkland  
 City of Seattle  
 Coastal Transportation  
 Covich-Williams  
 CSR Marine  
 Ferguson Terminal  
 Foss Maritime Company  
 Freezer Longline Coalition  
 Fremont Dock Company  
 Kane Environmental  
 King County  
 Kirby Corporation  
 Lake Union Drydock Company  
 Malone Law Group PS  
 Nautical Landing Marina  
 Nordic Heritage Museum  
 Northwest Marine Trade Association  
 Northwest Yacht Brokers Association  
 O'Hara Corporation  
 Pacific Fishermen Shipyard  
 Port of Seattle  
 Puget Sound Ports Council, Maritime Trades Department AFL-CIO  
 Seattle Marine Business Coalition  
 Stabbert Maritime  
 The American Waterways Operators  
 Trident Seafoods  
 United Catcher Boats  
 United States Seafoods  
 Vigor  
 Western Towboat



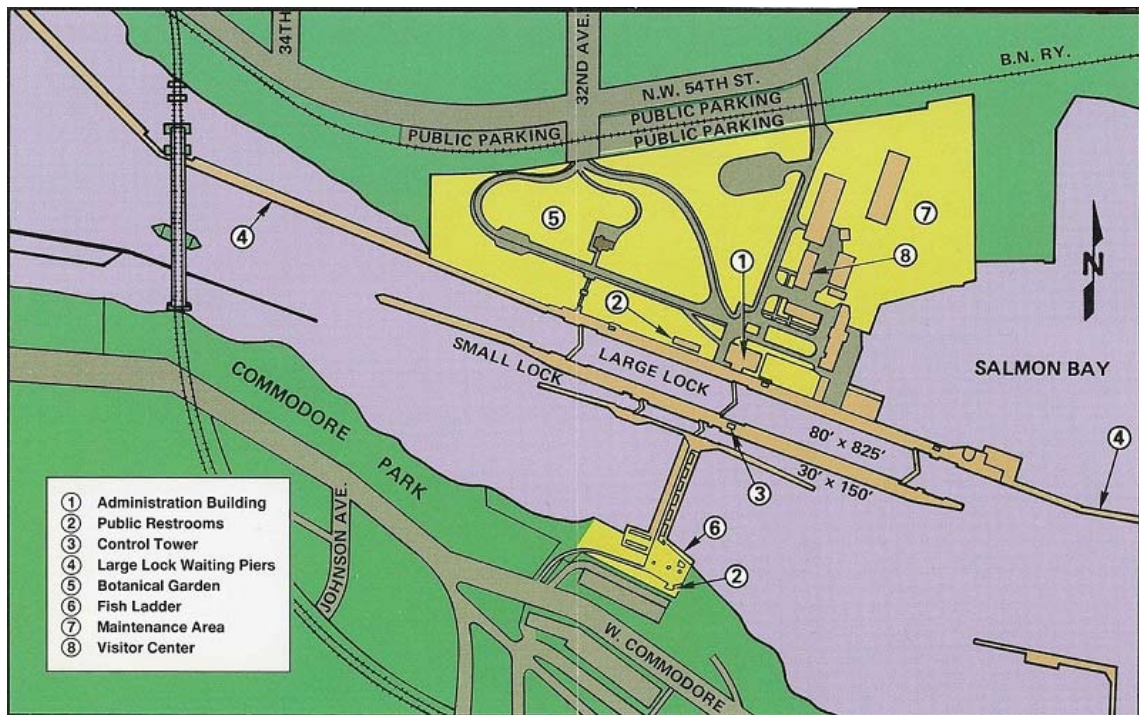
# Profile of the Ballard Locks

## Ballard Locks Facilities

The Ballard Locks site includes two sets of locks, a spillway, botanical gardens, and historical buildings that house a visitor center, administrative offices, and maintenance facilities. It is located in Salmon Bay in the Ballard neighborhood of Seattle.

The small lock is 30 feet by 150 feet and handles most of the recreational traffic. The large lock is 80 feet by 825 feet. An extra set of miter gates in the center of the large lock allows it to be divided in half to reduce the amount of water needed when vessels do not require the full length, but are still too large for the small lock. The spillway is 235 feet across and incorporates a fish ladder for salmon migration. Pathways allow pedestrians to cross both the spillway and the locks from either side of Salmon Bay and to view Locks operations.

**Figure 1. Map of Ballard Locks**



Source: USACE.

The Locks have three formal purposes, described by USACE as follows:

- To maintain the water level of the fresh water Lake Washington and Lake Union at 20 to 22 feet above sea level.
- To minimize saltwater intrusion from Puget Sound into the freshwater of the lakes.
- To move vessels from the water level of the lakes to the water level of Puget Sound and vice versa.

## Historical Development of the Locks

The Hiram M. Chittenden Locks and the Lake Washington Ship Canal were completed in 1917 but were first proposed more than half a century earlier, when the City of Seattle was only three years old.<sup>1</sup> The Locks and canal were originally conceived to support timber and other heavy industry on Lake Union and Lake Washington and to export coal being quarried to the east of the city. The U.S. Navy also supported the Locks because it would create strategically located freshwater moorage for military vessels. Over the next century, however, Seattle evolved into a very different city from the one its founders would have recognized. Supporting industry and providing freshwater moorage remain key benefits of the Locks, but the early visionaries could not have anticipated the complex economic and social systems that would evolve in large part because of the Ballard Locks.

While the merits of a canal linking Lake Washington to salt water were being debated, local interests constructed two small canals in the 1880s to connect Lake Washington with Lake Union. Backers of those projects understood, however, that bigger projects and outside funding would be needed if large ships were to transit between the lakes and Puget Sound. When Washington became a state in 1889, Congress agreed to conduct a feasibility study to evaluate various routes. It was completed in 1892, but it was not until 1906 that wrangling over the routes among the various interests was resolved, and focus was turned to designing a canal and lock system at the current locations.

It was during the final discussions about the particulars of the proposed canal and locks that Hiram M. Chittenden, an experienced member of the U.S. Army Corps of Engineers, arrived in Seattle. Chittenden quickly determined that although the route was acceptable, the locks envisioned for the project by the proposed builder would be inadequate. Chittenden led an effort that, in 1910, resulted in authorization from Congress for \$2.3 million in funding for the Locks (approximately \$57 million



Source: Friends of the Ballard Locks.

in 2017 dollars). King County agreed to improve the attendant waterways. Construction began in 1911, the Locks closed on July 12, 1916 to allow water in Salmon Bay to rise to 21 feet above mean sea level, and a year later, on July 4, 1917, the opening of the Hiram M. Chittenden Locks was officially celebrated.

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<sup>1</sup> Information in this section is based primarily on articles by David B. Williams, for example, Lake Washington Ship Canal (Seattle), (<http://www.historylink.org/File/1444>)

Prior to the opening of the new locks, water levels in Lake Washington varied by as much as seven feet due to seasonal differences in rain, snow-melt, and evaporation. The new locks lowered the level of Lake Washington by approximately nine feet and enabled USACE to modulate the water level there and in Lake Union, a function critical ever since to residential and commercial development along the lake and Ship Canal waterfronts.

## Locks-Dependent Watershed

The Ballard Locks is a keystone for the huge watershed that includes the Lake Washington Ship Canal, Lake Union, Portage Bay, Lake Washington, Cedar River, and Lake Sammamish, as shown at right.

A larger map at the end of this report shows additional detail, including the locations of major businesses and infrastructure within that watershed.

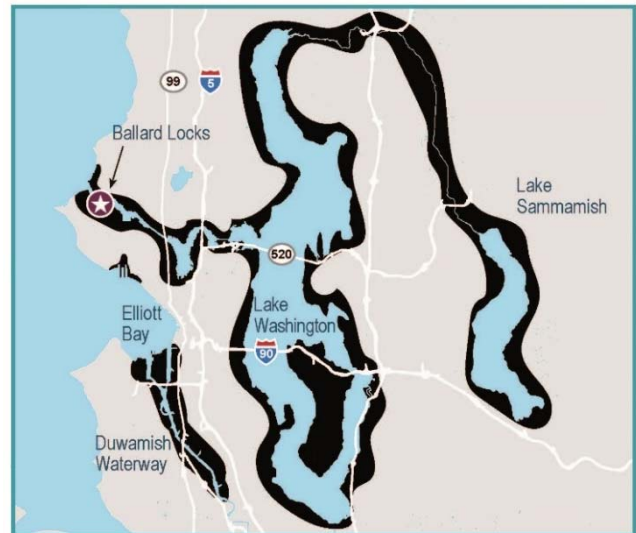
## Current Locks Operations

The Ballard Locks are the busiest in the nation in terms of the number of vessels that pass through, with more than 40,000 transits in 2015. While the large majority of those vessel transits (82 percent) are by recreational craft, there were approximately 7,500 transits by commercial vessels, including freight barges, local and ocean-going tugs, cruise passenger vessels, public safety and research vessels, and a large component of the Alaska and Washington commercial fishing fleets. The vast majority of these vessels either moor or obtain regular maintenance and repairs on the freshwater side of the Ballard Locks.

The chart at right shows the wide variety of non-recreational vessels that transited the Locks in 2015. The most common type of non-recreational vessel was towboat (46 percent), followed by commercial fishing vessels (21 percent), passenger boats/ferries (15 percent), government vessels (8 percent), and cargo vessels/crew boats (8 percent).

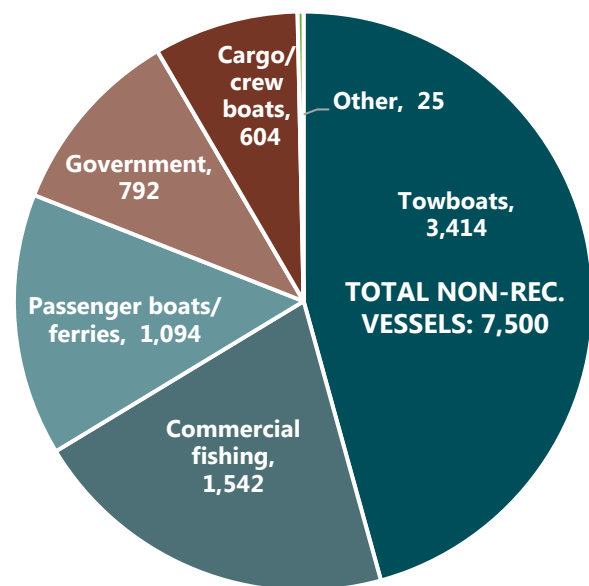
In order to obtain data at the level of detail needed for this report, Locks traffic and tonnage figures reflect data records kept at the Ballard Locks and provided by USACE personnel there. Statistics may differ slightly from those in the USACE national data system.

## LOCKS ECONOMIC IMPACT AREA



Source: Port of Seattle.

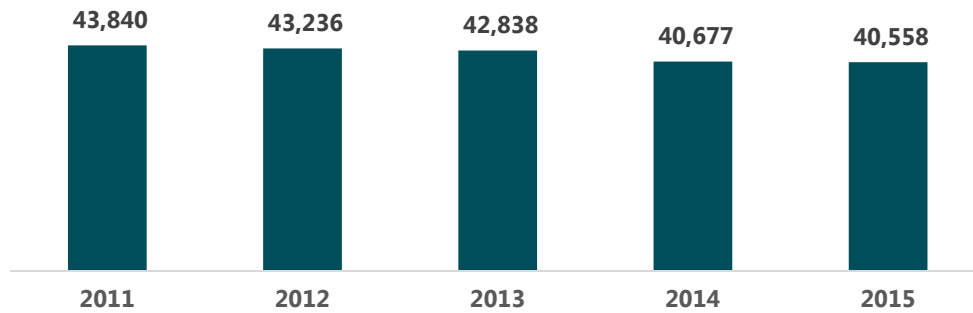
**Chart 1. Non-Recreational Vessels Using the Locks, By Vessel Type, 2015**



Source: USACE.

The chart below shows total vessel traffic over the 2011 to 2015 period, during which traffic stayed fairly steady at between 40,000 and 44,000 vessels.

**Chart 2. Annual Vessel Traffic through the Ballard Locks (both directions), 2011-2015**



Source: USACE.

The ability to transit at will between Puget Sound and the inland lakes and Ship Canal gave birth to a complex system of businesses that enjoy cost savings from access to the freshwater moorage environment and proximity to each other. The businesses include shipbuilding and repair, boat and recreational vessel sales, moorage, marine transport, commercial fishing, and a host of marine technical and professional services.

Finally, the spillway of the Ballard Locks is an important tool for managing and preserving salmon runs and for regulating water level and facilitating marine construction in Lake Washington and Lake Union, both of which improve safety and quality of life for all Seattle residents.



Source: Friends of the Ballard Locks.



## Locks-Dependent Businesses

The Northwest Marine Trade Association estimates there are 200 businesses that depend in one way or another on the Ballard Locks.

### **Marine Services and Manufacturing.**

Shipyards, marine services, marine products, construction products, and manufacturers are located along the shores of Salmon Bay, the Lake Washington Ship Canal, Lake Union, and Lake Washington. Many professional services firms, such as naval architects, attorneys, insurance brokers, and others, have located near the Locks to serve these companies.

### **Washington, Oregon and Alaska/North Pacific Fishing Fleets.**

An estimated 700 commercial fishing vessels participating in more than a dozen different fisheries depend on the Locks for access to marine services and freshwater moorage.

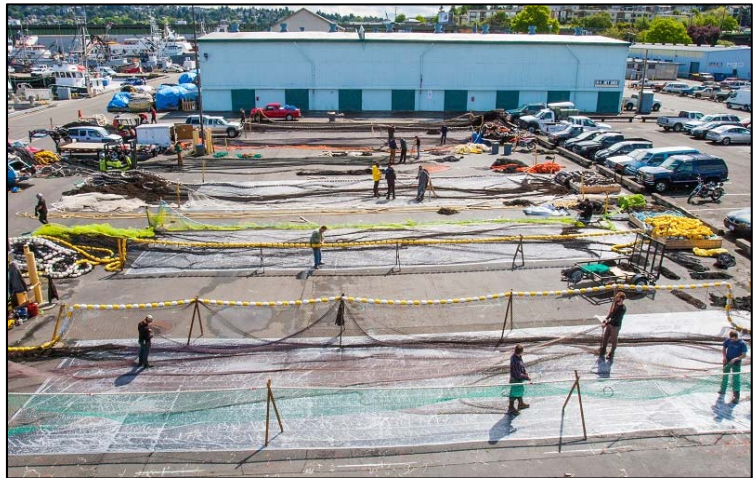
**Tribal Fisheries.** The Locks are used to control salt-water intrusion into the freshwater lake environment and to track and help manage salmon runs. Two federally recognized Native American tribes exercise traditional fishing rights at the Locks.

### **West Coast Marine Transport Companies.**

Four major shipping companies have key operations inside the Ballard Locks.

**Passenger Cruise Companies.** Ships moored and maintained on the freshwater side of the Locks carry several thousand passengers annually on tours to destinations in Alaska, Canada and Washington State.

**Recreational Vessel Sales and Marinas.** The large, protected, freshwater area accessible through the Locks gives these businesses an ideal environment that is close to population centers but with ready access to Puget Sound and beyond.



Source: Robin Pitt; Port of Seattle.



Source: Robin Pitt; Port of Seattle.



Source: UnCruise Adventures.



**Scientific Research Vessels.** Three research vessels, two owned by the University of Washington, make regular passages through the Locks from their freshwater moorage inside. The Washington Department of Fish & Wildlife also uses the Locks.



Source: University of Washington.

**Recreational Visitors.** The Locks are one of the most popular public sites in Seattle, with approximately 1,250,000 visitors each year. Approximately 150,000 visitors, residents and school children transit the Locks annually on local sightseeing cruises.

**Property Owners.** Owners of houseboats, private docks, marinas and other waterfront property depend on the Locks spillway to regulate water levels in the lakes. Without the Locks' spillway, more than 70 miles of residential, commercial and municipal shoreline would be subject to variations in water level of up to 7 feet from rain and snow run-off.



Source: Friends of the Ballard Locks.

**Recreational Boaters.** Owners and passengers of recreational vessels made 16,000 trips through the Locks in each direction in 2015 to access saltwater boating activities and cruising grounds or to obtain repairs, maintenance and other services.

**The General Public.** Several public safety agencies depend on the Locks to move vessels and equipment between the lakes and Seattle's saltwater waterfront, both for routine patrols and to respond to emergencies. The function of the Locks as a regulator of lake water level is also critical to the functioning of major public infrastructure, including the Washington Route 520 and I-90 bridges across Lake Washington and the water and sewer utilities serving Mercer Island. These bridges are critical transportation infrastructure for the area, carrying a total of 210,000 vehicles each weekday.<sup>2</sup> The Route 520 bridge, alone, represents a \$4.6 billion investment in infrastructure upgrades currently underway. Finally, the Locks facilitate movement of equipment and materials for major infrastructure projects, including barging out the equivalent of tens of thousands of truckloads of waste material from the Ballard/Wallingford stormwater tunnel scheduled for construction between 2018 and 2024.

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<sup>2</sup> Seattle Department of Transportation ([www.seattle.gov](http://www.seattle.gov)).

## USACE Civil Works Funding

For Fiscal Year 2017, the President's Budget provided for a total of \$4.62 billion in gross discretionary funding for the USACE Civil Works program as a whole. Nearly one-half (\$2.7 billion) is allocated to operations and maintenance, while one-quarter (\$1.1 billion) is allocated to construction.<sup>3</sup> The remainder is distributed among a variety of categories, as seen in the following table.

**Table 1. USACE Civil Works Program, Fiscal Year 2017 Budget**

	<b>Amount</b>
Operations and Maintenance	\$2.7 billion
Construction	\$1.1 billion
Mississippi River and Tributaries	\$222 million
Regulatory Program	\$200 million
Expenses	\$180 million
Formerly Utilized Sites Remedial Action Program (FUSRAP)	\$103 million
Investigations	\$85 million
Flood Control and Coastal Emergencies	\$30 million
Office of the Assistant Secretary of the Army for Civil Works	\$5 million
<b>Total</b>	<b>\$4.62 billion</b>

Source: USACE.

## Ballard Locks Budgets

The portion of federal funding allocated to the Ballard Locks includes routine and non-routine expenditures. The major upgrades needed by the Locks are considered non-routine maintenance. In 2015, non-routine work included phase 1 of pump plant replacement, design of the emergency closure system crane replacement, and initial design for filling culvert valve replacement. In 2016, non-routine work included completion of the emergency closure system crane design, continued design for the culvert valve replacement, dredging, and initial work to replace the dewatering pumping plant. Funding in 2017 includes \$3.9 million for non-routine maintenance to complete the new emergency closure system crane.<sup>4</sup> Three high-priority projects have been completed or are funded through FY17:

- Monolith Scour Repair (complete)
- Spillway Radial Gate Replacement (complete)
- Pumping Plant Replacement (to be completed in FY17)

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<sup>3</sup>President's Fiscal 2017 Budget for U.S. Army Corps of Engineers Civil Works released, February 9, 2016. (<http://www.usace.army.mil/Media/News-Releases/News-Release-Article-View/Article/652668/presidents-fiscal-2017-budget-for-us-army-corps-of-engineers-civil-works-releas/>)

<sup>4</sup>Civil Works FY2017 Budget Justification Information, Volume II, Operations & Maintenance with National Program O&M (<http://cdm16021.contentdm.oclc.org/cdm/compoundobject/collection/p16021coll6/id/12/rec/23>)

The terms “routine” and “non-routine” are misleading, however. Table 2 shows total routine and non-routine maintenance budgets for the Ballard Locks for the past seven years. Over that time, approximately \$12.8 million has been allocated to non-routine projects associated with outdated or unreliable Locks systems, and routine operations and maintenance budgets have remained flat at slightly more than \$8 million. This obscures the fact that the major systems that have not yet been addressed (Table 3, below) require more and more attention as time passes to keep them operational. This forces USACE to stretch the “routine” budget further and further each year, and increases the potential for a failure of one of those components. (See the chapter, “Potential Impacts of Locks Closures or Failure” for more detail.)

**Table 2. Lake Washington Ship Canal/Ballard Locks Maintenance Budgets, 2011 – 2017  
(in millions of nominal dollars)**

Year	Routine Operations and Maintenance	Non-Routine Maintenance	Principal Purpose of Non-Routine Maintenance	Total Amount
2017	\$8.3	\$4.0	Replace large lock derrick crane.	\$12.3
2016	8.1	0.7	Miscellaneous drainage and building repairs	8.9
2015	8.3	4.1	Replace dewatering pump plant.	12.4
2014	8.3	1.2	Install new spillway gates and trunnions.	9.5
2013	8.0	0.6	Fabricate new spillway gates.	8.6
2012	8.4	2.2	Repair erosion below stilling basin; Replace pintle bearing sets on large lock east gates.	10.6
2011	8.3	-	None	8.3

Source: USACE Civil Works Budget and personal communication from Marian Valentine, PE, Operations Division Asset Manager, Seattle District, Corps of Engineers  
Rows may not add precisely due to rounding.

## Major Projects Needed

Table 3 shows the major systems at the Ballard Locks that still require significant attention and USACE estimates of the approximate cost of those projects. Altogether, an additional \$30 million to \$60 million is needed to address the most outdated Locks components.

**Table 3. Lake Washington Ship Canal/Ballard Locks Major Non-Routine Maintenance Needed  
(in millions of dollars)**

Major Project	Approximate Cost
Large Lock Emergency Closure System	\$4M to \$8M
Filling Culvert Valve and Machinery	\$5M to \$12M
Large Lock Gate Rehabilitation	\$6M to \$10M
Emergency Generator Connections	<\$1M
Saltwater Drain Intake System and Diffuser Well	\$5M to \$10M
Small Lock Emergency Closure	\$1M to \$5M
Electrical System	\$5M to \$7M
Small Lock Machinery	\$3M to \$5M
Saltwater Barrier Replacement	\$1M to \$2M
<b>Total Needed</b>	<b>Approximately \$30M to \$60M</b>

Source: USACE

## Role in Seattle Economic Development Planning

Seattle's latest *Community Development Plan*, adopted in October 2016, addresses the neighborhood around the Ballard Locks, which it calls the "Ballard/Interbay Northend Manufacturing & Industrial Center." The plan makes clear that the marine services hub made possible by the Locks are key to the neighborhood's future. The Community Development Plan calls for the area to be maintained as a working waterfront, with improved utilization by marine/fishing, high tech and small manufacturing businesses.



Source: Port of Seattle.

The remainder of this report describes the role and benefits of the Ballard Locks in more detail and provides estimates of the economic value of the functions for which data is available.



# Key Benefits of the Ballard Locks

This section of the report describes the key components of the economic ecosystem made possible by the Ballard Locks. Businesses and organizations that depend on the Locks are grouped by primary industry/activity, although some businesses and organizations are involved in more than one component.

The businesses and organizations referenced here are those identified as making regular use of the Locks in day-to-day operations. According to representatives of local business associations, they represent perhaps one-quarter to one-third of businesses in the area that are to some degree dependent on the Locks. Information about individual firms was compiled from a combination of personal interviews and company websites. The study team conducted a total of approximately 55 interviews with Locks users.

## Commercial Fishing Industry

### Overview and Economic Significance

Because very little fish processing occurs in the Lake Washington Ship Canal or Lake Union, the fishing fleets carry only small amounts of cargo when they transit the Locks. The Locks, however, play a key role in mooring and maintaining vessels from all the major Pacific Northwest fisheries. Commercial fishing vessels that use the Locks on a regular basis are responsible for an estimated \$545 million in harvest revenues in fisheries from Oregon to the North Pacific.

In 2016, 271 unique commercial fishing vessels over 40 feet in length made approximately 1,600 transits of the Ballard Locks. More than 200 of those vessels (80 percent) are homeported in Washington State. Approximately 40 percent of all the fishing vessels over 58 feet long that are active in the major North Pacific/Alaska commercial fisheries are moored or serviced at least once annually in the freshwater environment behind the Locks. Vessels under 58 feet, primarily gillnetters and seiners, typically moor on the freshwater side of the Locks for longer periods during the winter. Approximately 30 to 40 gillnetters and seiners moored behind the Locks engage in Washington fisheries. They transit regularly to fish in and around Puget Sound.



Source: Port of Seattle.



Fishing fleets that use the Locks regularly include the following:<sup>5</sup>

- **Amendment 80 Fleet** – The fleet consists of approximately 17 trawl catcher/processors averaging 178 feet in length and targeting yellowfin sole, Pacific Ocean perch, and other species. Twelve of the vessels used the Ballard Locks in 2016 for a total of 69 transits. Earnings for those 12 vessels in 2016 were an estimated \$162.9 million.



Source: Iquique.

- **American Fisheries Act Fleet** – The fleet harvests mainly pollock and includes catcher vessels, catcher/processors, and large floating processors. Forty-one catcher vessels and two catcher/processors used the Locks in 2016 for a total of 234 transits. The earnings by those vessels in 2016 are estimated at \$98.4 million for the catcher vessels and \$32.4 million for the catcher/processors, for a total of \$120.8 million.

- **Bering Sea Crab Fleet** – In addition to king crab and two species of tanner crab, many of these vessels also fish for cod and tender for salmon in the summer. In 2015, there were 117 active vessels, with an average length of 118 feet. In 2016, 33 crab vessels used the Locks for a total of 188 transits. Those 33 vessels earned an estimated \$75.9 million.



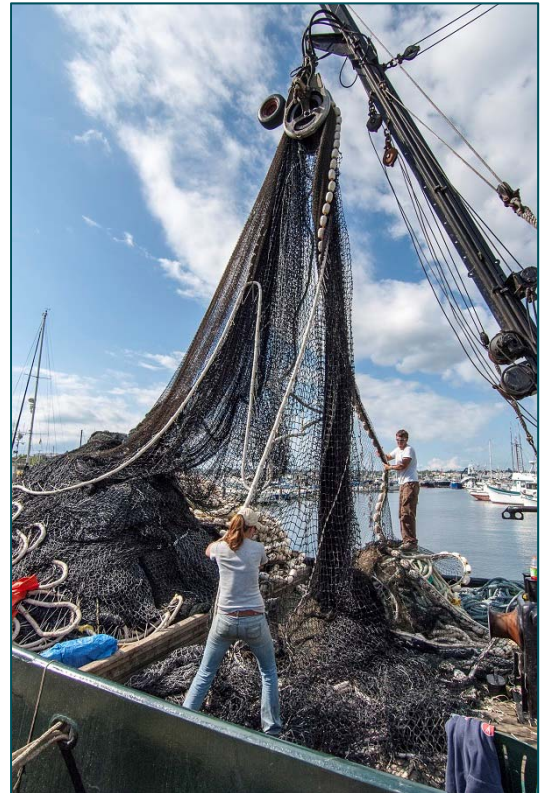
Source: Alaska Bering Sea Crabbers.

- **Freezer Longline Fleet** – The freezer longline fleet is composed of 29 vessels that harvest mainly Pacific cod in the Bering Sea and Aleutian Islands. In 2016, 16 vessels from this fleet used the Locks 71 times and earned an estimated \$94.1 million.
- **Alaska Salmon Fleet** – The salmon fleet consists of trollers, gillnetters and seiners. Trollers typically do not travel between Seattle and Alaska and therefore do not use the Locks. Gillnet vessels made 295 transits through the Locks in 2016, and purse seine vessels used the Locks 413 times. These smaller commercial vessels, typically between 35 and 58 feet in length, primarily engage in salmon fishing. Some

<sup>5</sup> Estimates of fisheries participation and earnings were developed by McDowell Group using USACE Locks transit records, Alaska Commercial Fisheries Entry Commission (CFEC) data, and National Marine Fisheries Service (NMFS) data.

of these vessels also fish in Puget Sound (see Puget Sound Fleets, below). In 2016, 47 purse seine vessels active in Alaska used the Locks 298 times. It is likely a portion of these vessels were also active in other fisheries in Puget Sound or along the coast of Washington and Oregon. Estimates of the earnings for these vessels are not readily available.

- **Halibut and Sablefish Longline Fleet** – In 2016, 19 vessels primarily targeting halibut, cod, and sablefish in Alaska, Washington, and Oregon transited the Locks 50 times. The average length of these vessels is approximately 70 feet. Several are wooden schooners more than 100 years old. It is not possible with available data to estimate earnings per vessel, due to the wide range of vessel characteristics and quota holdings. However, in 2015, Washington residents earned a total of \$51.3 million from harvest of halibut and sablefish in Alaska.
- **Puget Sound Fleet** – Commercial fishermen in Puget Sound are active in a variety of salmon, crab, and other fisheries. The number of local commercial fishing vessels that use the Locks regularly is estimated to be at least 50 based on information from Locks operators and interviews with local fishing associations. Lock transits (but not earnings) for these vessels are included in the “Alaska Salmon” totals above. Puget Sound salmon and Dungeness crab harvests typically total between \$30 million and \$40 million in earnings (ex-vessel value).
- **Federal Pacific Northwest Fleet** – In addition to being active in Alaska fisheries, many commercial fishing vessels homeported in Seattle harvest groundfish, crab, and others species in federally managed fisheries off the West Coast. In 2015, estimated landings for this region totaled nearly 500 million pounds, worth \$336.2 million. Approximately 16 percent of the Washington harvest was delivered to the Puget Sound area.<sup>6,7</sup>
- **Tribal Fishing Fleet** – A representative of the Muckleshoot Indian Tribe Fisheries Division estimates that, depending on salmon run sizes and prices, between 20 and 80 tribal fishing vessels a year use the Locks. In recent years, participation has been at the lower end of the range due to smaller runs. In addition to salmon, Washington’s tribal fishing fleet receive an allocation of the West Coast groundfish harvest. Treaty allocations of West Coast groundfish were worth \$4.4 million in 2015 for 4.1 million pounds of groundfish.<sup>8</sup> An unknown amount of tribal fishing vessels harvesting groundfish use services located on the freshwater side of the Locks.



Source: Port of Seattle.

<sup>6</sup> Pacific Fishery Management Council, Status of the Pacific Coast Groundfish Fishery, 2016, [http://www.pccouncil.org/wp-content/uploads/GroundfishSAFEtables/GF\\_SAFE\\_%201.htm](http://www.pccouncil.org/wp-content/uploads/GroundfishSAFEtables/GF_SAFE_%201.htm)

<sup>7</sup> Ibid.

<sup>8</sup> Ibid.



## Dependence on the Locks

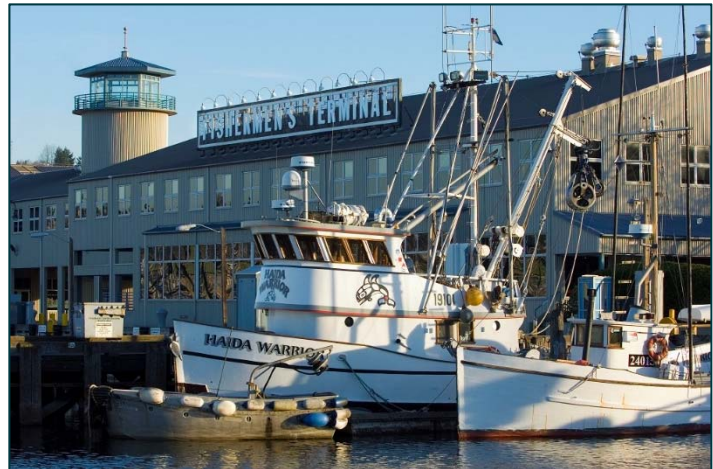
The commercial fishing fleets depend on the Locks for access to centralized goods and services. Obtaining a full range of repair, maintenance, equipment, provisioning, and other marine products and services in a single location saves money and time. Access to freshwater moorage also saves money. The less corrosive environment reduces hull and equipment maintenance and extends vessels' working lives. In addition to being in saltwater, the main commercial moorage alternative to the Ship Canal, Pier 91 on the Seattle waterfront, has limited capacity, caters to large cruise ships, and allows for only limited types of marine services.



Source: Port of Seattle.

## Key Firms and Organizations

- **Fishermen's Terminal** – Located on the freshwater side of the Locks in Salmon Bay, Fishermen's Terminal is a key piece of infrastructure for the fishing fleets and other commercial vessels as well. The terminal was built in 1914 as a center for moorage and marine services in large part because of the opportunity presented by the Locks to concentrate services in a freshwater environment. The terminal provides moorage for more than 500 vessels, all of which are primarily operated in saltwater. Tenants are mainly commercial fishing vessels, but also include eight small cruise ships, 40 tugs/workboats, and 10 charter vessels. Fishermen's Terminal collects approximately \$2 million in moorage fees annually. The terminal's FY2016 total operating budget was \$5.6 million.
- **Alaska Bering Sea Crabbers** – ABSC is a harvester association that represents 70 percent of quota shareholders in the Bering Sea Tanner and king crab fisheries. The crab fleet consists of approximately 75 vessels in an average year, and the majority either homeport in Seattle or go there periodically to access services and repairs.



Source: Port of Seattle.

- **Freezer Longline Coalition** – The Coalition represents approximately 30 active hook-and-line catcher/processor vessels between 120 and 190 feet. The majority are homeported in Seattle, but they operate year-round and spend time in port only for maintenance and repairs. They dock either at Fishermen’s Terminal or the fishing companies’ private docks. Roughly half the fleet transits the Locks annually for haul-outs or repairs.



Source: Blue North; Kevin Suver.

- **Groundfish Forum** – The Groundfish Forum represents the Amendment 80 fleet, which consists of 17 active vessels. Several of these fishing companies’ operations are based in Lake Union (US Seafoods and O’Hara Corporation, for example). Iquique and Ocean Peace are based at Pier 90/91, but use the Locks to access maintenance services.
- **Purse Seine Vessel Owners’ Association** – PSVOA is the largest commercial fishing trade organization on the West Coast. There are 400 members, with up to 40 of them homeported in Seattle at Fishermen’s Terminal.

- **Washington Trollers Association** - The WTA represents 100 vessels and 40 associate support businesses. There are about 158 salmon troll licenses altogether. The vessels homeport all over Washington, some in Oregon and California. About 60-80 homeport in Puget Sound because their owners live in Seattle. About half of the trollers have wooden boats and require shipyards that specialize in wooden vessel maintenance, several of which are located on the freshwater side of the Locks.



Source: Port of Seattle.

- **Aleutian Spray Fisheries** – The headquarters for this family-owned fish company is on the freshwater side of the Locks, and the company depends on businesses along the Ship Canal for docking space and marina services. Eight of their fishing vessels transit the Locks twice a year, and several mega-yachts transit the Locks and lease space at their docks to transfer passengers.

- **Coastal Alaska Premier Seafoods** – This company is a subsidiary of one of the six Alaska Community Development Quota (CDQ) Groups, Coastal Villages Region Fund. It homeports the majority of its vessels in Lake Union at their headquarter docks.
- **Icicle Seafoods** – Icicle Seafoods, a seafood processing company, moors three 300- to 400-foot-long floating processors and a 117-foot crab/tender in Salmon Bay on Lake Union. These vessels work in Alaska most of the year but come back through the Locks for maintenance. The company's fleet of 10 trawlers operates in the Gulf of Alaska and Bering Sea but transits the Locks occasionally for repairs and maintenance. Roughly half come through the Locks in any given year, as does their 180-foot tug, Impala, which can haul 14, 40-foot containers of seafood.
- **Ferguson Terminal** – The terminal, located where 9<sup>th</sup> Avenue meets the Ship Canal, provides parking, moorage and storage for boats, cars, RVs and trucks. Icicle Seafoods, above, leases moorage there.



# Marine Freight Transportation Industry

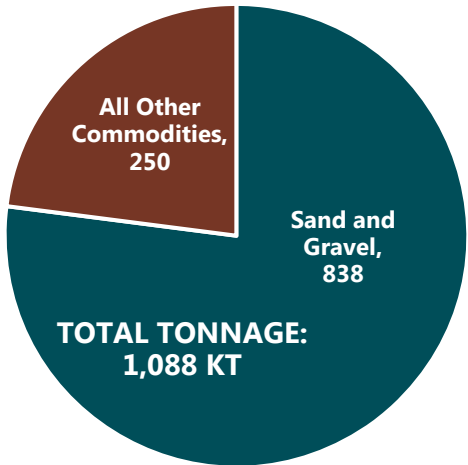
The Ballard Locks enable the work of a number of marine freight transportation companies that earned an estimated total of \$49 million in revenue associated with vessels or freight moving through the Locks.

A wide variety of products are transported through the Locks every year representing 1,088 KT (thousand tons) of cargo – mostly sand and gravel, but also fish and manufactured products (see Charts 3 and 4). While the product shipments through the Locks are significant, even more economic value is realized by Locks-dependent companies engaged in coastwise shipping in the Jones Act trade. This federal law requires commercial vessels in domestic trade to be U.S.-built, U.S.-crewed, U.S.-owned, and U.S.-flagged, and much of this Locks-dependent activity enables trade between the Pacific Northwest and Alaska. Alaska depends heavily on marine freight transportation, and many Alaskan communities could not survive without reliable service by these vessel operators. Vessel operators use the Locks to access the Ship Canal and Lake Union for moorage and services, and much of this marine freight activity is integrated with additional activity on the industrial Duwamish waterway in South Seattle.

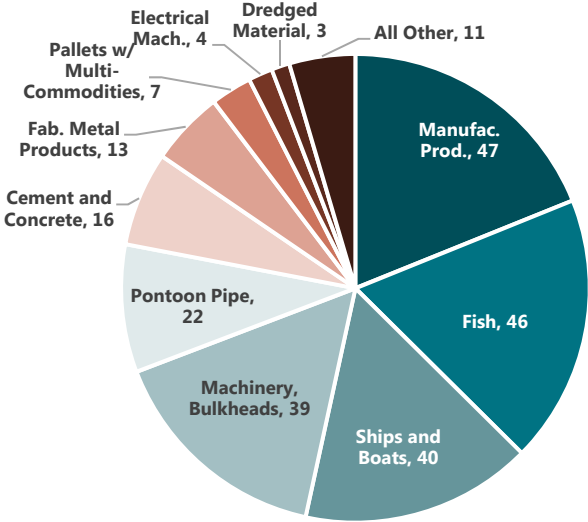
## Product Shipments

The most significant commodity in terms of weight passing through the Locks is sand and gravel, representing 77 percent of total tonnage in 2015 (838,000 tons). Other common products include 47,000 tons of manufactured products (“not otherwise specified”); 46,000 tons of fish; 40,000 tons of ships and boats (not under their own power); 39,000 tons of machinery, electrical machinery, and bulkheads; and 22,000 tons of pontoon pipe. Additional commodities include cement and concrete, fabricated metal products, pallets with multi-commodities, electrical machinery, and dredged material.

**Chart 3. Tonnage Through the Locks, 2015: Sand/Gravel vs. All Other (KT)**



**Chart 4. Tonnage Through the Locks, 2015: Commodities Other Than Sand/Gravel (KT)**

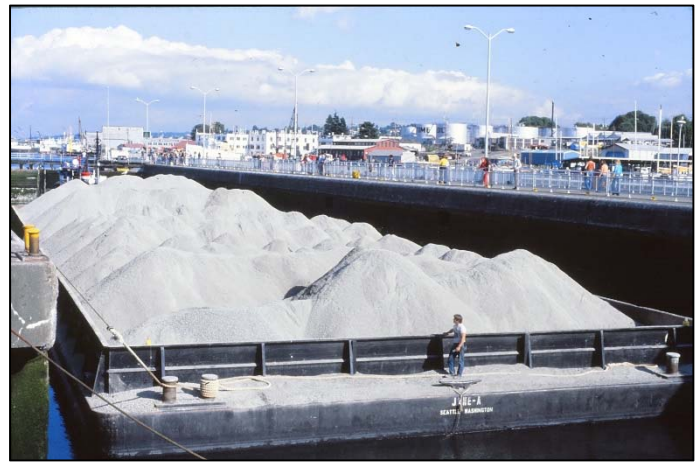


Source: USACE. Locks traffic and tonnage figures were obtained from Ballard Locks personnel. Statistics may differ slightly from those in the USACE national data system.

## Dependence on the Locks

Marine Freight Transportation Companies have direct and indirect dependence on the Ballard Locks.

Several vessel operators engage in product shipment through the Locks, moving sand, gravel, and aggregates for concrete and asphalt production. The aggregates come mainly from facilities in South Puget Sound, and some are used immediately at facilities in Salmon Bay. Some aggregate ships through the Locks to processing facilities in Kenmore, at the north end of Lake



Source: Friends of the Ballard Locks.

Washington. The sand and gravel, and aggregate cargo is tracked by the USACE and amounts to roughly 800,000 tons per year. An operator of a fleet of five small Jones Act freighters routinely carries freight through the Locks, including out-bound supplies and in-bound fish. Although the amount of construction materials that move through the Locks is not large compared to other inland waterways, the marine shipments reduce truck traffic that would contribute costs, congestion, noise, and pollution to Seattle neighborhoods.

Other Locks-dependent marine freight activities contribute significant economic value, but do not involve passing cargo through the Locks. Tugboat and barge companies do not typically carry cargo through the Locks. Many of the ocean-going barges are too large to fit through the Locks and the majority Alaska-bound freight is loaded onto barges at freight terminals on the Duwamish waterway. Towing vessels, however, are typically repaired and maintained inside the Locks, and the freshwater moorage is critical to extending vessels' working life.

Tugboats are also used to relocate drydocks and equipment at marine service companies, to move vessels through the Locks for repairs and maintenance, and to assist vessels in returning to saltwater after the work is done. Local towing activity through the Locks and within the Ship Canal and Lake Union is a necessary component of this important marine services ecosystem.

## Key Firms and Organizations

- **Western Towboat** – Western operates 23 tugboats. Their main shop, offices and yard are on the freshwater side of the Locks. They use the Locks every day, including multiple trips between Seattle and Alaska each week and biweekly trips to Hawaii. They also keep and build boats at their shipyard.
- **Foss Maritime** – The largest tug and barge company on the West Coast is headquartered in Seattle and has offices in six other cities. Foss provides harbor and ocean towing along with a wide range of other maritime services. They operate a shipyard inside the Ballard Locks (see below). The company owns 56 tugs, 8 service vessels, and 25 barges. All the vessels that use their Seattle shipyard must transit the Locks.

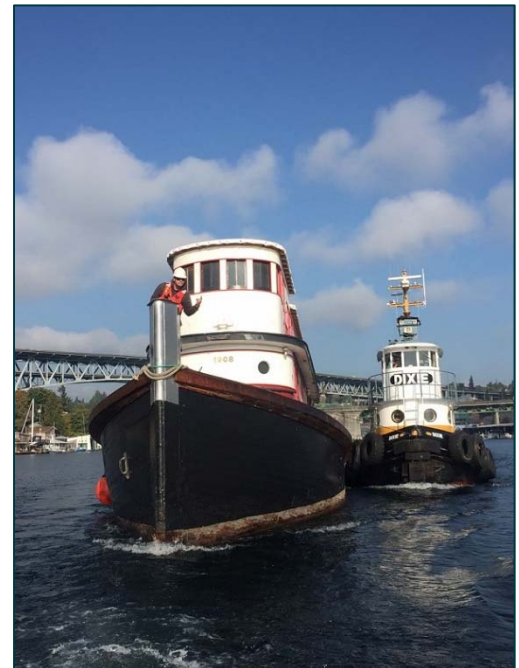
- **Coastal Transportation** – Coastal Transportation is a major carrier of freight to Southwest Alaska. Their fleet of five self-sustaining freighter vessels, ranging from 225 to 244 feet, make weekly trips from Seattle to Dutch Harbor, the Pribilof Islands, and the Aleutian Islands. Coastal is the largest carrier of break-bulk freight through the Locks. They serve a broad range of customers including municipal governments, major seafood companies, and smaller, mostly fishing-related, companies.



Source: Coastal Transportation.

- **Kirby Corp** – Kirby operates tugs and barges that primarily carry oil on offshore routes. Their Seattle facility, behind the Locks on the shore of Salmon Bay, is an operations center and a maintenance yard. They lease an office building from the Port of Seattle and dock space on the Ship Canal for tugboats getting repairs and maintenance or laying up between trips.

- **Fremont Tugboat** – The company has 11 tugboats stationed at Lake Union. They operate in Lake Union, Puget Sound, and Lake Washington. They also operate a 125-slip marina at the north end of Lake Union. The tugboats taking fishing vessels through the Locks in both directions average ten transits a month. Many of the boats that moor in their marina, which range from 15 to 75 feet long, use the Locks to sail, cruise and sightsee. The company estimates that, on average, 15-20 of the boats in their marina transit the Locks several times each month.



Source: Fremont Tugboat.

- **Island Tug** – Island Tug transports gravel for concrete production. They make frequent trips through the Locks with loaded and unloaded barges.
- **Westar Marine** – Westar Marine is a tug, barge, and water taxi company primarily engaged in marine construction support work. They moor vessels at North Lake Shipyard and use them to move materials, equipment and personnel. The Route 520 bridge project is an example of the kind of project they service.

# Shipyards and Marine Services

## Overview and Economic Significance

Including the Western Towboat and Foss Maritime yards mentioned above, there are eight shipyards and several smaller boatyards located behind the Locks. All the vessels they build or service must transit the Ballard Locks. Marine services companies have developed behind the Locks because of the shipbuilding/repairing activities there. Together the shipyards and marine services businesses form the hub of Puget Sound's boatbuilding and repair industry and play a key role in Washington State's Maritime Industry Cluster.

The companies described below estimated a total of \$150 million in Locks-dependent revenue.

## Dependence on the Locks

Locating behind the Locks offers two major advantages to these businesses: a freshwater environment that is not subject to tidal action and the efficiencies gained from access to the wide range of co-located services and expertise.

## Key Firms and Organizations

- **Northlake Shipyard** – Northlake has two drydocks with capacity for vessels up to 220 feet in length. They have a whirley crane and a 40-ton crane and do new construction as well as repairs. They work on steel, wood, glass, and aluminum, primarily commercial fishing vessels but also tugs, barges, and some cruise vessels.
- **Pacific Fishermen Shipyard** – Originally founded as a fishermen's cooperative, Pacific Fishermen services tugboats, cruise vessels, charter boats, recreational and fishing vessels up to 300 feet in length at its yard in Salmon Bay. The facility includes two marine railways and a 600-ton lift dock, as well as a general ship supply store.
- **Lake Union Drydock** – Founded in 1919, Lake Union Drydock is almost as old as the Ballard Locks. The company is a full-service yard that specializes in ship repair and conversion. It has two drydocks with capacity up to 6,000 tons. Their yard provides services to commercial and military vessels, barges, and ferries. The facility has 2,400 feet of pier-side moorage.



Source: Alaska Bering Sea Crabbers.



- **Stabbert Maritime** – Stabbert Maritime operates a shipyard on the freshwater side of the Locks that services all types of vessels, including tugs, passenger boats, private vessels, government vessels, science and sub-sea research vessels, and commercial fishing vessels. The yard is equipped with an 1,100-ton drydock as well as equipment for in-water repairs. The facility has 1,600 feet of pierside moorage and can accommodate vessels up to 450 feet.

- **Vigor Ballard** – In 2015, Vigor acquired Kvichak Marine, located on the Ship Canal. (Vigor also owns four other yards in Washington, two in Oregon, and two in Alaska.) The Ballard facility occupies 150 feet of waterfront and is dedicated to aluminum workboat fabrication.



Source: Vigor.

- **LeClercq Marine** – LeClercq owns five marinas in the Ship Canal and builds boats there as well. They specialize in construction and upgrades of large recreational vessels and also sell new and used vessels.

- **CSR Marine** – The company services mainly recreational vessels, typically from 50 to 80 feet long, at their Ballard shipyard. They also service smaller commercial vessels and manufacture fiberglass and other boat components.

- **Covich Williams** – Covich Williams is a commercial fuel dock that has been in operation behind the Locks for 50 years. They sell fuel, lube, and filters primarily to the commercial fishing fleet. They estimate they have 3,000 customers located on the freshwater side of the Ballard Locks.

- **Foss Washington Shipyard** – In addition to Foss' tug and other operations, the company owns and operates a shipyard on the freshwater side of the Locks that provides a range of repair, maintenance and new construction services in addition to maintaining company vessels.

- **Canal Boatyard** – The boatyard has a 55-ton Travelift and provides mainly haul-out services to recreational and smaller commercial vessels.

- **Ballard Oil Company** – Ballard Oil has supplied marine and aviation petroleum products and home heating oil from their location on Salmon Bay since 1937. Marine customers include commercial, private and government vessels.

- **Ballard Industrial Hardware** – In business since 1952, Ballard Industrial Hardware supplies and services a wide range of marine and other products, materials and tools from its 63,000 square foot facility on Ballard Ave. NW.

- **Jensen Motor Boat Co.** – Located on Portage Bay for the past 90 years, the company specializes in wooden boat repair, restoration, control systems, rigging, and interior joinery. It has 10,000 square feet



of covered work space, an 80-ton marine railway, a 12-ton Travel Lift, and its own machine and wood shops.

## Public Safety and Science

### Overview and Economic Significance

Four public safety organizations and three research entities use the Locks on a regular basis. The Seattle Fire Department depends on the Locks to move vessels and equipment rapidly to the site of a fire or other emergency on either side of the Locks. The Seattle Harbor Patrol uses the Locks any time it must respond to an emergency in saltwater. King County Sheriff and the U.S. Coast Guard both moor their boats in saltwater, but use the Locks for maintenance and patrols.

The University of Washington operates two research vessels that transit the Locks for virtually all their work, as does the private research vessel Kittiwake.<sup>9</sup> The Washington Department of Fish and Wildlife has a large fleet of boats and vessels that are divided between fresh and salt water. Roughly ten use the Locks annually for maintenance.

Finally, the Ballard Locks are the only point of access and egress available to salmon migrating in and out of the Lake Washington/Cedar/Sammamish watershed (known as "WRIA 8"). All salmon in the 692 square mile watershed must travel through the Locks twice in their lives, as juveniles on their way to the ocean and again as adults returning to spawn. The Locks, therefore, are key to the outcome of more than \$125 million in federal, state, local and matching or leveraged funding for habitat protection and restoration projects undertaken since 1998 in the WRIA 8 watershed.

This study did not attempt to estimate economic values for the safety and science functions related to the Locks.

### Dependence on the Locks

An important public safety role for the Locks is to allow agencies to move equipment and personnel quickly to where they are needed. To maintain the same level of service without the Locks would require duplicate assets stationed in fresh and saltwater. Both public safety and science vessels use the Locks to access the marine services available inside, and all the vessels moored behind the Locks save money because of the freshwater environment.



Source: University of Washington.

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<sup>9</sup> The University of Washington owns the 55-foot vessel Clifford A. Barnes, which is slated for replacement at a projected cost of \$13.5 million, according to the university's 2015 operating budget. The university operates the 274-foot Thomas G. Thompson under agreement with the U.S. Navy, which owns the vessel. The Thomas G. Thompson is being overhauled at a cost of \$30 million in federal funds. (<https://environment.uw.edu/news/2016/06/uws-large-research-vessel-rv-thomas-g-thompson-gets-a-midlife-overhaul/>)

Migrating salmon depend on both the fish ladder and several major Locks components to ensure their safe passage into and out of the Lake Washington Ship Canal. The Locks also help protect water quality by minimizing the intrusion of seawater into the freshwater lakes. The current filling culvert valves may hurt salmon migration by allowing for high water velocity and introducing juvenile salmon into the filling culverts where they may be injured. Pending the availability of funding in FY18 or FY19, the valves are expected to be replaced over a period of several years with hydraulically activated valves that can open more slowly, thereby slowing the velocity of water entering the culverts and injuring fewer juvenile salmon.

## Key Organizations

- **Seattle Fire Department** – The Locks are critical for marine firefighting and emergency response. Fire Department vessels transit the Locks for training and for drills or if the vessel they keep moored in Lake Union is out of service. They occasionally transit the Locks under non-emergency conditions for planned events. Currently, the department’s freshwater unit operates from an unstaffed, temporary station. The Locks allow the fire department to move equipment as needed to emergencies on both sides. In addition to firefighting, the department helps with spill mitigation and water rescues, all of which are time sensitive.
- **King County Sheriff** – King County Sheriff is responsible for a wide jurisdiction that includes rivers, lakes, Puget Sound and other large bodies of water, and encompasses the City of Seattle. They moor one vessel in Des Moines to respond to calls in saltwater. They have three vessels on Lake Washington that respond to calls and conduct patrols in Lake Washington. King County Sheriff uses the Locks intermittently to move vessels back and forth for repairs, maintenance, and special events (like Seafair) or security measures that require multiple vessels. Incorporated cities along Lake Washington that do not have police can contract with King County Sheriff for marine safety patrols.
- **Seattle Harbor Patrol** – Because of budget cuts over the years, there is no longer a harbor patrol station on the saltwater side of the Locks, so responding to saltwater emergencies requires transiting the Locks. Transits are made for emergency calls, routine patrols, and training dives.
- **United States Coast Guard** – USCG vessels are moored outside the Locks in salt water, but use the Locks to respond to incidents, conduct safety patrols, and access repair services. They are responsible for the region’s maritime transportation security and provide water-side support for a variety of emergencies.
- **University of Washington Research Vessels** – Two research vessels homeport at the University of Washington docks, located on the freshwater side of the Locks. The Thomas G. Thompson, a 274-foot research vessel, is used primarily for deep ocean research around the world. It requires the large lock. The



Source: Port of Seattle.

Clifford A. Barnes, a 55-foot vessel research vessel, is used less because at 51 years old the vessel is nearing the end of its useful life. It primarily does research in Puget Sound in both fresh water and salt water. It uses the small lock.

- **Washington Department of Fish and Wildlife** – The department does a variety of management and conservation activities in Puget Sound including fish surveys, water monitoring, sampling the fish ladder at the Ballard Locks, test fishing for crab, salmon, hydroacoustics, creel surveys of anglers, and Dungeness crab assessment. They have about 200 vessels of all sizes, and approximately 10 of them pass through the Locks annually for services.
- **Bio-Marine Enterprises** – This private company operates the Kittiwake, a research vessel owned by Charles Eaton since 1981. The Kittiwake operates exclusively in Puget Sound, and 98 percent of its work is in saltwater. The vessel transits the Locks an average of four times a month to conduct pollution and water quality sampling.

## Recreational Vessel Moorage and Sales

### Overview and Economic Significance

An estimated \$150 million in sales of new and used recreational vessels in 2016 was made possible by the Ballard Locks. University of Washington Sea Grant statistics for 2016 identify 7,625 boats sold in King County, worth \$235.7 million.<sup>10</sup> Based on an average of estimates by five industry experts, approximately 70 percent of King County boat sales, measured in dollars, occur on the freshwater side of the Ballard Locks and at least 90 percent of those sales involve vessels primarily intended for saltwater use.



Source: Port of Seattle.

### MOORAGE

There are at least 42 commercial or publicly owned marinas and yacht clubs located behind the Ballard Locks that serve primarily recreational vessels. Those facilities provide approximately 5,000 long-term slips. Occupancy rates typically exceed 80 percent, and marinas in desirable locations, especially close to saltwater, often have waiting lists. Of the 5,000 slips, an estimated 4,000 are suitable for vessels 35 feet or longer that could be used in saltwater. This figure does not include saltwater vessels moored at private docks, which could number an additional several hundred. Though not every saltwater-capable vessel uses the Locks, most are purchased and maintained at least partly because they can be used for cruising, racing, and other activities outside the Locks,

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<sup>10</sup> <https://wsg.washington.edu/community-outreach/outreach-detail-pages/boat-sales/>

according to local recreational vessel brokers. These saltwater-capable vessels accounted for the bulk of the 33,000 lock transits by recreational craft in 2016.

A detailed accounting of total fees for long-term and transient moorage by recreational craft that use the Locks to access saltwater cruising and other activities is outside the scope of this analysis. Estimates of total ownership and operating expenditures are provided below.

Finally, an unknown number of recreational vessels with long-term moorage outside the Locks, for example at Shilshole Bay Marina, or that visit Seattle from other cities or states, transit the Locks for haulouts and other services or tie up at transient moorage during visits to Seattle.

### OWNERSHIP AND OPERATING SPENDING

A study in 2011 estimated the average value of Washington-based recreational vessels between 35 and 50 feet in length at \$143,000 (2016 dollars) and the average value of vessels 50 or more feet in length at \$715,000 (2016 dollars).<sup>11</sup> The study also estimated that annual ownership and operating expenditures for vessels between 50 and 85 feet are approximately 10 percent of vessel value, or about \$70,000 per year on average. If we apply the 10 percent figure to the smaller vessels as well, we get average annual ownership and operating expenditures of approximately \$14,000 per year for Washington vessels from 35 to 50 feet long.

There are 3,200 recreational vessels between 35 and 50 feet in length, and 845 recreational vessels over 50 feet in length owned by residents of King County, Washington.<sup>12</sup> If we assume that three-quarters are moored on the freshwater side of the Locks and apply the spending estimates above, then roughly \$80 million in annual ownership and operating spending is associated with recreational vessels that depend on the Locks.

These calculations do not include so-called “mega-yachts,” which are defined as professionally crewed vessels with a waterline length of at least 24 meters (79 feet). When mega-yachts visit Seattle, they may moor in Elliott Bay, but several access moorage in the Ship Canal and Lake Union through the Locks each year. Their spending is much greater than that of typical private vessels, and several businesses in the Lake Union area cater to them. A mega-yacht visit may result in half a million dollars in local spending.<sup>13</sup>

**Table 4. Recreational Vessel Moorage and Sales Indicators, 2016**

	Indicator
Number of marinas located on the freshwater side of the Ballard Locks	~42
Number of long-term slips	~5,000
Recreational vessel sales made possible by Ballard Locks	~\$150 million
Average vessel value 35'-50'	\$143,000
Average vessel value 50'+	\$715,000
Estimated annual spending on ownership and operations for Locks-dependent vessels	\$80 million

Source: McDowell Group estimates.

<sup>11</sup> Washington Boats: Economic Impact Research, Hebert Research, 2011

<sup>12</sup> Yacht registration database for King County, BoatinfoWorld, 2/9/17

<sup>13</sup> <http://www.bizjournals.com/seattle/blog/2016/06/look-what-slipped-into-seattle-under-cover-of.html>



## Dependence on the Locks

The Locks benefits most important to recreational vessels are again access to marine services and freshwater moorage. Without the Locks, most of the saltwater-capable recreational craft currently moored on the freshwater side of the Locks would either move to a distant location or would be sold. Moving would be difficult, since there are waiting lists at all the available moorages on the saltwater side of the Seattle waterfront, according to recreational vessel brokers. The area behind the Locks is a key location for boat sales. It is home to the on-water portion of the Seattle Boat Show, many other water-based boating events, and the largest concentration of recreational vessel brokers in the state. For cruising vessels, transient moorage in Lake Union or the Ship Canal provides a very desirable location from which to visit Seattle.

## Key Firms and Organizations

Below are the major marinas and recreational vessel brokerages located inside the Ballard Locks. The Northwest Yachtbrokers' Association is the principal representative of local recreational vessel sales businesses.

### Larger commercial or municipal marinas located in Lake Washington:

Bellevue Marina	Carillon Point
Harbor Village Marina	Kenmore Marina
Kirkland Homeport Marina	Kirkland Yacht Club
Lakewood Moorage	Leschi Marina
Leschi Sailboat Moorage	Marina Park
Newport Yacht Basin	Parkshore Marina
Spinnaker Bay Marina	Yarrow Bay Marina

### Larger commercial or municipal marinas located in Lake Union, the Lake Washington Ship Canal or Portage Bay:

Affinity Marina	Ballard Mill Marina
Boatworld Marina	Commercial Marine
Fairiew Marinas	Gasworks Park
Lake Union Yacht Harbor	Nickerson Marina
Ocean Alexander Marina	Salmon Bay Marina
Tillicum Marina	AGC Marina
Boat Street Marina	Canal Marina
Ewing Street Marina	Freemont Boat Company
Harbormaster Marina	Marina Mart
Northlake Marina	Sagstad Marina
Thunderbird Marina	Westlake Landing
Seattle Yacht Club	

### Businesses specializing in mega-yacht moorage and services:

La Casse Maritime
Nautical Landings Marina
Salmon Bay Marine Center

## Recreational vessel brokerages located in Lake Union, the Lake Washington Ship Canal or Lake Washington:

Crows Nest Yachts  
Hebert Yachts  
Lake Union Sea Ray  
Northwest Yacht Sales  
Salmon Bay Marine Center  
Signature Yachts

Emerald Pacific Yachts  
Irwin Yacht Sales  
Lake Union Yacht Sales  
Premier Yachts  
Seattle Yacht Sales

## Passenger Carriers

### Overview and Economic Significance

In 2015, an estimated \$63 million in annual revenues was associated passenger vessels or products that depend on the Locks. Two companies, Anchor Bay Charters and Argosy Cruises, sell tours of the Locks and the Ship Canal to approximately 150,000 people per year. The other two passenger services moor vessels inside and must transit the Locks to conduct their cruises and charters.

### Dependence on the Locks

The ability to moor in freshwater is especially important to passenger operators with steel vessels because Coast Guard regulations are less restrictive than for saltwater moorage. One passenger carrier said the freshwater environment made accessible by the Locks reduces the number of required haulouts over a five-year period from three to just one.



Source: UnCruise Adventures.

### Key Firms and Organizations

- **Anchor Bay Charters** – The company has one vessel and provides commercial passenger charters.
- **Argosy Cruises** – Argosy Cruises operates ten vessels and sells passenger charters and scheduled cruises.
- **UnCruise Adventures** – UnCruise operates eight vessels that provide cruises to Washington, Alaska, and Canada.
- **Spirit of 76** – The Spirit of 76 is a charter vessel used for private cruises and marine education.

# Construction and Manufacturing

## Overview and Economic Significance

An estimated \$30 million in 2015 annual firm revenues was associated with construction companies that depend on the Locks. The principal firms engaged in construction and manufacturing in the area of the Ballard Locks are marine related. Two firms produce building materials from sand and gravel shipped through the Locks and distribute them primarily to construction sites on the freshwater side of the Locks. Manufacturing firms produce various types of marine machinery.

In addition to facilitating day-to-day sand and gravel shipments, the Locks allow movement of large construction components such as the pontoons used to construct the new Route 520 Bridge across Lake Washington. Beginning in 2018, the Locks will be used five-to-six days a week to barge waste material from construction of a 3-mile-long, 14-to-18-foot diameter tunnel between Ballard and the Wallingford waste transfer facility. The \$430 million project will prevent up to 60 million gallons a year of untreated sewage from flowing into the Lake Washington Ship Canal.<sup>14</sup>



Source: Salmon Bay Sand and Gravel.

## Dependence on the Locks

Much of the tonnage that passes through the Ballard Locks consists of sand, gravel or other aggregates that are shipped from Dupont in south Puget Sound and processed at facilities either in Salmon Bay or Kenmore, at the north end of Lake Washington. The Locks make that commerce possible, as there is no other cost-effective way to move those materials, according to interviews for this study.

If the Locks were to fail during construction of the tunnel described above, it would require round-the-clock trucking of waste material through residential and commercial areas to make up for the lost barge capacity.

Marine industry manufacturers operating near the Locks benefit from the proximity to their customer base, and form a vital part of the marine business ecosystem on the Lake Washington Ship Canal.

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<sup>14</sup>Seattle Public Utilities, <http://www.seattle.gov/util/EnvironmentConservation/Projects/ShipCanalWaterQuality/index.htm>.

## Key Firms and Organizations

### CONSTRUCTION PRODUCTS

- **Lakeside Industries** – The company manufactures asphalt using gravel shipped from Dupont in south Puget Sound through the Locks.
- **Salmon Bay Sand and Gravel** – The company provides concrete and other building products using sand and gravel shipped from Dupont in south Puget Sound through the Locks.

### MANUFACTURING

- **Markey Machinery** – Markey makes deck machinery such as winches that are marketed nationwide.
- **MER Equipment** – MER manufactures commercial generators for the maritime industry.
- **Hatton Marine** – Hatton Marine is a marine engine distributor and service provider for pleasure crafts, commercial fishing vessels, and tugboats.

## Visitor Industry

### Overview and Economic Significance

Approximately 1.25 million people visit the Ballard Locks every year to see the fish ladder, tour the gardens and the facility, and visit the gift shop. Visitors to the Locks arrive in three ways. Residents of nearby neighborhoods can access the Locks by footpaths from either side of the Ship Canal. They use the gardens and walkways for strolling, jogging, bicycling, and picnicking. Approximately 150,000 visitors arrive on local sightseeing cruises as described under “Passenger Carriers,” above. Other visitors arrive by car or bus.

The USACE methodology for estimating Value to the Nation includes a component that measures the economic impacts of visitation. A 2013 analysis by USACE estimated visitor spending associated with the

Ballard Locks at \$38.2 million. (See Economic Impacts Analysis chapter for additional detail.)



Source: USACE.

### Dependence on the Locks

In the absence of statistical visitor research, it is difficult to estimate the precise role the Locks play in visitor itineraries and spending throughout the Seattle area. However, the popularity of the Locks as an attraction suggests they may influence visitors to remain in the area longer than they otherwise would, thereby increasing the value of the visitor experience and the amount of visitor spending. All of the revenue, employment and taxes created by local water and ground tour businesses that take visitors to or through the Locks depends entirely on the Locks operations. Those companies are described under “Passenger Carriers,” above.



## Tribal Access

Two federally recognized tribes have treaty rights associated with fish runs that migrate past the Ballard Locks by means of its fish ladder. Fish are counted each year under a co-management arrangement between the Department of Fish and Wildlife and the Muckleshoot Tribe. Average run sizes for the past several years, based on counts taken at the Locks, have been as follows:

- Coho salmon = 21,134 (average for years 2004-20014)
- Sockeye salmon = 115,175 (average for years 2006-2016)
- Chinook salmon = 11,442 (average for years 2006-2016)

In past years as many as 80 Muckleshoot tribal fishing boats have used the Locks. More recently, due to weaker runs and lower fish prices, the number has been closer to 20. The tribe also uses the Locks and fish ladder to tag and collect fish for various research purposes. The Suquamish Tribe also has treaty-protected fishing rights near the Locks.

Upgrading the Ballard Locks would benefit tribal fisheries in several ways (see also “Public Safety and Science,” above):

- Improving fish passage facilities and equipment to moderate temperature/dissolved oxygen in the Ship Canal to help ensure the future of salmon in the lake basin. This is a tribal priority.
- Replacement of the filling culvert valve machinery would facilitate slower lockages to protect salmon smolts that migrate to saltwater from the Locks from mid- April through late June or early July.

## Other Locks-Related Businesses

Many other businesses in the vicinity of the Ballard Locks do not rely specifically on vessels that transit the Locks, but are part of the marine business ecosystem that contributes to the convenience and cost-savings of Locks users. These businesses include professional firms that specialize in marine insurance, maritime law, maritime publications, naval architecture, industrial waterfront property management, and other services. Some are represented by the two main trade associations in the area:

- **North Seattle Industrial Association** – NSIA represents 44 member entities, mainly maritime, manufacturing and industrial support businesses and property owners in the area around the Locks (Lake Union, Fremont, Ballard and Interbay). NSIA is active mainly in policy, regulatory and community planning issues.
- **Northwest Marine Trade Association** – NMTA represents 700 members, mostly support-services businesses, and is the largest marine trade association in the U.S. Member businesses service everything from paddleboards to recreational vessels. In addition to working on policy and regulatory issues, NMTA coordinates the Seattle Boat Show.

## The Value of Locks Systems

USACE periodically measures and reports what it terms the “Value to the Nation” (VTN) of the Civil Works Program as a whole and each of its component sites. The purpose of the VTN reports is to summarize the economic contribution of the overall program and to help guide budget allocations among the various locks, dams and other facilities. Measurements are made in terms of National Economic Development (NED) benefits and revenues to the U.S. Treasury.<sup>15</sup> NED benefits typically include flood and environmental damage-prevention, transportation cost-savings, and recreation values. While these factors are relevant in determining the value of lock and dam facilities, they do not account for the full economic contribution of a unique asset like the Ballard Locks.

*The Locks are our business. We built our office building and marina upon the existence of the Locks. Our property would be worth a lot less if the Locks did not exist.*

*– Maritime Supply Business*

This report examines economic impacts of the Ballard Locks at several levels that are not addressed in the federal methodology. Some of those levels are quantifiable with existing data, for example vessel traffic, shipping tonnage, business sales, and commercial fishing earnings. Some are identifiable but require new data to quantify, for example business efficiencies and associated profits and taxes made possible by the Locks. Finally, some impacts, including the value of traditional and customary tribal activities, public safety impacts, and quality-of-life impacts, are beyond the scope of this analysis.



Source: Port of Seattle.

<sup>15</sup> Value to the Nation of the U.S. Army Corps of Engineers Civil Works Programs, Estimates of National Economic Development (NED) Benefits and Revenues to the U.S. Treasury for 2010. Institute for Water Resources, 2013-R-09, December 2013.

The primary purpose of virtually all other U.S. locks systems besides the Ballard Locks is to move freight long distances more efficiently than by truck or rail. For example, USACE has calculated that, on average, a gallon of fuel moves a ton of cargo 155 miles by truck, 436 miles by rail, and 576 miles by barge.<sup>16</sup> USACE applies the fuel savings to the overall tonnage moved each year throughout the nation by barge when it computes the economic contribution of its national locks system. It allocates those savings to individual locks on the basis of how much tonnage passes through each lock.<sup>17</sup>

*The Locks are critical to our research because they provide access to open water while providing a safe, convenient area for scientists to operate and prepare their research operations.*

*– Maritime Research Operations*

Fuel-cost savings are real, but they are far from the only economic development benefit created by the Ballard Locks. The U.S. Federal Highway Administration, to choose just one example, takes a broader view with respect to the value of highways. Its *Toolbox for Regional Policy Analysis Report, 2000* notes:

Economic development impacts may be measured through job creation, total or per-capita personal income, business growth and attraction, business productivity, or other means.<sup>18</sup>

The FHA goes on to list some of the primary determinants of economic benefits. In addition to the obvious measure of expenditures on transportation, the FHA lists safety improvements and accessibility, for example the travel time needed to reach suppliers, buyers, workers, etc.<sup>19</sup>

*The advantages [of the Locks] are huge, mainly because all our facilities are at Fishermen's Terminal. We would not be here if not for the Locks.*

*– Maritime Supply Business*

All the impacts cited by the FHA are relevant to the Ballard Locks.

The value of accessibility is especially key to the businesses that depend on the Locks, as described throughout

*If the Locks weren't available, it would take 1,250 truck trips to accomplish what we can do in 10 loads with barges.*

*– Construction Supply Business*

this report, especially access to highly skilled services and a large customer base. Another key benefit to Ballard Locks users is the cost savings associated with freshwater/tide-free moorage. While these benefits are much more challenging to measure than tonnage, they are nonetheless significant, and would likewise be threatened in the event of a Locks malfunction or closure.

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<sup>16</sup> Inland Waterway Navigation, Value to the Nation, USACE, 2009. These figures are provided as examples. More recent estimates may be available in other USACE publications.

<sup>17</sup> The USACE methodology includes a provision to prevent double counting the cost savings of freight that passes through more than one lock. That provision appears to under-value the Ballard Locks because none of the Ballard Locks cargo passes through any other locks.

<sup>18</sup> [https://www.fhwa.dot.gov/planning/processes/tools/toolbox/methodologies/economic\\_overview.cfm](https://www.fhwa.dot.gov/planning/processes/tools/toolbox/methodologies/economic_overview.cfm)

<sup>19</sup> Ibid

## Economic Impact Methodology

To develop a more complete profile of the economic value of the Ballard Locks, this report analyzes the following factors that are not included, or not given sufficient weight, in the USACE method.

- Local economic activity by businesses that depend on safe, reliable Locks operations and the employment and taxes generated by those businesses (quantitative estimates). Data for this analysis is drawn from the following sources:
  - Interviews with representatives of businesses that depend on the Locks
  - Spending, employment, and Locks usage data provided by the businesses
  - Publicly available economic and demographic data
- The value of additional Locks-dependent business activity consisting primarily of commercial fishing and interstate shipping by vessels that depend on the unique environment created by the Locks for a wide range of marine services and freshwater, tide-free moorage (quantitative estimates). Data for this analysis is drawn from the following sources:
  - USACE data on Ballard Locks usage, including the number of transits by different vessel types and by individual commercial vessels
  - Data on commercial fishing harvests and the ex-vessel value of those harvests from the Alaska Commercial Fisheries Entry Commission, NMFS/NOAA Stock Assessment and Fisheries Evaluation data and Foreign Trade data, and the Washington Department of Fish and Wildlife
  - Recreational boating data from NMMA, Washington Sea Grant, and other sources
  - Interviews with representatives of businesses that depend on the Locks
- The value of the Locks' role in environmental management, tribal rights, and public safety (qualitative discussion). Data for this analysis is drawn from the following sources:
  - Interviews with public, nonprofit, and tribal agencies
  - Tribal treaty documents provided by USACE
  - Municipal and state planning documents
- The potential costs of a Locks service disruption or failure (qualitative discussion). Data for this analysis is drawn from the following sources:
  - Interviews with businesses, agencies, tribes, and USACE personnel, including the USACE dam assessment team
  - USACE Locks Closure Data (see Appendix 2) and Locks repair estimates

The next section of this chapter discusses and, where data is available estimates, a range of economic impacts attributable in whole or in part to the Ballard Locks. The last section recommends an expanded VTN method more appropriate for the unique role of the Ballard Locks.



# Ballard Locks Business Contribution

## Dependent Businesses

Safe, efficient, and reliable operations of the Locks directly supports a large number of businesses located along Salmon Bay, Lake Union, Lake Washington and the waterways connecting them. Interviews with 50 key businesses, coupled with other research, indicates that core group, alone, represents approximately \$615 million in annual business sales (exclusive of commercial fishing vessel earnings) with some connection to the Locks. This includes \$482 million that is directly dependent on safe and reliable Locks operations to provide access, plus \$133 million in other sales that are not directly connected to the Locks (but earned by Locks-dependent businesses).

**Table 5. Impact of Locks-Dependent Businesses, 2015**

	Impacts
Total sales	\$615 million
Total Locks-dependent sales	\$482 million
Locks-dependent payroll	\$120 million
Locks-dependent employment	3,000 jobs

Note: Excludes commercial fishing vessel earnings.  
Source: McDowell Group estimates.

The study was able to identify approximately \$120 million in annual payroll directly tied to the Locks, with a full-time equivalent employment impact of approximately 3,000 jobs. As profiled elsewhere in this report, key Locks-dependent businesses include freight and passenger transportation providers, shipyards and other vessel-support services, and construction-related firms, along with a variety of other businesses.

Not included in these figures is the approximately \$545 million in commercial seafood harvests by fishermen who rely to varying degrees on the transportation infrastructure provided by the Locks (addressed in more detail below). Nor does the total include spending associated with recreational boat ownership and operations, estimated at perhaps \$50 million based on the assumptions discussed under "Recreational Vessel Moorage and Sales" earlier in the report. Some, but not all, of that spending is captured in the revenue of the core group of marine services businesses. Finally, the total does not include the value of interstate barge shipments by tugboats that rely on the Locks for moorage and services.

*One of the main advantages is access to freshwater, this allows our vessels to layup for a week and get a break from the saltwater. It's a maintenance advantage. The Locks also give us access to a unique terminal; for example, we have direct access to rail.*

– Seafood Company

## Profits and Tax Revenues

As noted throughout this report, the Ballard Locks creates greater profits and tax revenues in part by lowering transportation costs for the more than 1 million tons of freight that transit Locks annually. A greater contribution, however, is unique to the Ballard Locks among other locks in the nation. The Locks provide access by hundreds of commercial vessels and thousands of pleasure boats to:

- A full range of repair, maintenance, equipment, provisioning, and other marine products and services in a single location, and

- A less corrosive and tide-free freshwater environment that reduces hull and equipment maintenance and extends vessels' working lives.

Measuring these two contributions is challenging because of the diverse ways they support and enhance commercial and industrial activity. One indicator is the amount of federal tax revenue generated by Locks-dependent businesses. Based on a hypothetical average pre-tax profit rate of 10 percent of gross revenues (across all sectors), there are \$48 million in annual profits associated with the businesses that are closely connected to the Locks. Applying the average individual and business tax rate of 23.6 percent that USACE uses in its own value calculations, those profits generate \$11 million in annual federal tax revenues.<sup>20</sup>

### COMMERCIAL FISHING INDUSTRY

The profit and federal tax estimates are distributed across a broad range of industry sectors, but do not include the commercial fishing industry. Numerous commercial fishing vessel owners homeport their vessels on the freshwater side of the Locks, and many others use the Locks because service providers based inside can offer higher quality or lower cost service than can service providers outside the Locks.

The vessels in the commercial fishing fleet that use the Locks generate approximately \$545 million annually in gross revenues. While the connections between the Locks and the financial performance of the fishing fleet are complex, it is clear from interviews and the historical behavior of the fleets in choosing the area around the Locks as their home base that the concentration of services and freshwater environment result in lower costs than would otherwise be the case.

*Freshwater is great, it's better to store the boats on freshwater. But primarily it's the facilities available at fishermen's terminal: repair docks, storage off-season, expediting vehicles, and shops.*

– Commercial Fishing Company

In practice, some of the cost advantage may accrue as profit for the companies, while some may be distributed in the form of higher property rents or other expenses. Regardless of how the cost savings is distributed, however, the full value of the savings and associated taxes may be considered a national benefit created by the Locks.

**Table 6. Estimated Federal Tax Revenues (excluding commercial fish revenues)**

Impacts	
Annual profits of Locks-dependent businesses	\$48 million
Average USACE tax rate	23.6 percent
Federal tax revenue	\$11 million

Note: Excludes commercial fishing vessel earnings.

Source: McDowell Group estimates.

*The Locks allow us to operate a marine company. They are the lifeline for the company. There are not many dock spaces in Puget Sound; the Locks afford us docks and maintenance that would be otherwise difficult to find.*

– Seafood Company

**Table 7. Estimated Federal Tax Revenues Related to Commercial Fishing**

Impacts	
Gross revenues	\$545 million
Pre-tax net with Locks	\$81.8 million
Pre-tax net without Locks	\$65.4 million
Difference	\$16.4 million
Difference in federal tax revenue	\$3.9 million

Source: McDowell Group estimates.

<sup>20</sup> Federal tax rate taken from Institute for Water Resources, 2013-R-09.

A broad estimate of the federal tax benefits from commercial fishing supported by the Ballard Locks can be derived by assuming that within the fleet that uses the Locks, pretax profits would be lower in the absence of access to the facilities and services made available by the Locks. For example, where pre-tax profits might be 15 percent<sup>21</sup> of gross revenues with the efficiencies and cost savings from Locks access, a 12 percent pre-tax profit rate might be expected in the absence of the Locks. The federal tax revenue implication of that shift is about \$4 million annually.

*If the Locks were to close before the fleet could leave for the season, it would cost a whole season. Some vessels wouldn't be able to make payments.*

– Fishing Association

These calculations are intended to illustrate the relationship between safe and efficient Locks operations and the federal treasury. Given the complexity of the economic connections between the Locks and the wide range of industrial activity the Locks support, it is only possible to provide order-of-magnitude estimates within the scope of this study. Nevertheless, it is evident that the Locks add substantial tax revenue, thousands of jobs, and millions of dollars in payroll and that methods to incorporate this value into USACE's VTN calculations are warranted.

## Total Locks-Related Business Activity

Total gross sales among businesses dependent on the Ballard Locks is estimated at \$1.19 billion for 2015. The largest components by business type include commercial fishing at \$545.0 million, shipyards/marine services at \$162.9 million, recreational vessel sales at \$150.0 million, and freight/shipping at \$108.8 million.

Revenues dependent on the existence of the Locks are estimated at \$482.4 million, while payroll dependent on the Locks is estimated at \$119.8 million.

**Table 8. Ballard Locks Business Impacts, 2015 (Millions\$)**

Sector	Gross Revenues of Locks-Related Businesses	Direct Lock-Dependent Revenue	Direct Lock-Dependent Payroll
Commercial Fishing	\$545.0		
Shipyards/Marine Services	\$162.9	\$114.5	\$51.8
Recreational Vessel Sales	\$150.0	\$150.0	\$15.0
Freight/Shipping Services	\$108.8	\$49.0	\$10.4
Passenger Services	\$83.0	\$62.7	\$21.2
Construction	\$50.0	\$30.2	\$4.1
Marinas*	\$32.2	\$32.2	\$6.4
All Other	\$58.7	\$43.9	\$10.9
<b>Total</b>	<b>\$1,190.5</b>	<b>\$482.4</b>	<b>\$119.8</b>
Locks-Related Profit (@ 10%)		\$48.2	
Locks-Related Federal Tax Revenue (@ 23.5%)		\$11.4	

Source: McDowell Group estimates.

\* Marina revenue estimate is based on the average cost of moorage. It does not include other sources of marina revenue, such as pump-outs, electricity, and other boating services.

<sup>21</sup> This higher profit rate than other sectors reflects the risk premium inherent in commercial fishing.

Table 9 summarizes overall business income, payroll, jobs and tax revenues associated with the Ballard Locks based on the information gathered for this report. Estimates for individual revenue components are based on a variety of sources and, in some cases, incomplete data, and some revenue is counted more than once. For example, a portion of the revenue attributed to shipyards and marine services originates as revenue earned by commercial fishing companies, and this means it is counted under both headings. Nevertheless, this analysis provides a measure of economic activity across the broad range of industries dependent on the Locks.

**Table 9. Summary of Locks-Related Business Impacts**

	Impacts
<b>Total annual gross revenues connected to the Locks</b>	<b>\$1.19 billion</b>
Direct Locks-dependent gross revenue	\$482.4 million
Other revenue earned by Locks-dependent businesses	\$163.2 million
Gross earnings of the Locks-supported fishing fleet	\$545 million
<b>Direct Locks-dependent annual payroll*</b>	<b>\$119.8 million</b>
<b>Direct Locks-dependent jobs*</b>	<b>3,000</b>
<b>Locks-related annual Federal tax revenues</b>	<b>\$15.3 million</b>
Commercial fishing	\$3.9 million
All other businesses	\$11.4 million

Source: McDowell Group estimates. \*Does not include commercial fishing employment or wages.

## Locks-Related Export Value

A variety of products produced by Locks-dependent businesses are exported, including machinery and new vessels. Detailed information is not available to estimate the value of most exports. Below, however, is a broad estimate of the export value of commercial seafood associated with vessels that depend on the Ballard Locks.

It is not possible to estimate precisely what portion of the catch made by each commercial fishing vessel associated with the Locks is exported. However, based on the total value of seafood exports for five major fisheries and the percentage of vessels for each fishery that uses the Ballard Locks, the Locks contributed to nearly \$800 million worth of seafood exports in 2015.

**Table 10. Approximate Commercial Seafood Exports Associated with the Ballard Locks, 2015**

Sector	Primary Harvest Species	Total 2015 Export Value	% of Harvest Associated with the Locks	Approximate Locks-Related Export Value
Amendment 80 Trawl	Yellowfin and other types of sole, ocean perch, Atka mackerel	\$360 million	60%	\$216 million
American Fisheries Act	Primarily pollock	\$1 billion	45%	\$470 million
Bering Sea Crab	King crab, tanner/snow crab, cod	\$140	28%	\$39 million
Freezer/Longline	Primarily Pacific cod	\$193 million	30%	\$60 million
Alaska and Washington Salmon	Chinook, coho, sockeye, chum, pink	\$1 billion	Not known	Not known
Other commercial fisheries	Halibut, sablefish, Dungeness crab, and other species	>\$300 million	Not known	Not known
<b>Totals</b>		<b>≈\$3 billion</b>		<b>\$785 million</b>



## Visitor Spending Impacts

As noted, USACE includes in its Value to the Nation NED calculations an estimate of visitor spending associated with civil works projects. The USACE method is primarily designed to address the lakes that form behind large dams, however, it is reasonably applicable to the Ballard Locks.

In 2013, USACE estimated that as a visitor attraction with such uses as sightseeing, boating, fishing, etc., the Ballard Locks generated \$38.2 million in visitor spending, \$15.7 million in business sales, and 248 jobs and \$6.1 million in labor income. Including economic multiplier effects, USACE estimated impacts including \$23.1 million in total sales, 310 total jobs, \$8.3 million in labor income, and \$14.3 million in value added (wages and salaries, payroll benefits, profits, rents, and indirect business taxes).

**Table 11. Visitor Industry Impacts of Ballard Locks**

	Impacts
<b>Direct Impacts</b>	
Visitor spending	\$38.2 million
Business sales	\$15.7 million
Employment	248 jobs
Labor income	\$6.1 million
<b>Total (Direct plus Indirect) Impacts</b>	
Total sales	\$23.1 million
Total employment	310 jobs
Total labor income	\$8.3 million
Total value-added (wages, benefits, profits, rents, indirect taxes)	\$14.3 million

Source: USACE.

There likely is some overlap between these visitor impacts and other business impacts calculated for this report, above. For example, we would expect the recreation impacts to include the ticket value paid by visitors who take sightseeing cruises through the Locks, which is also included in “Passenger Services” in Table 8. For the most part, however, the USACE visitor spending impacts may be considered in addition to the other impacts described here.

## Washington’s Maritime Industry Cluster

As described throughout this report, the Ballard Locks play an integral role in the maritime economy of Puget Sound – and, by extension, Washington State. The scale of this economic sector is immense: according to a 2017 report, the maritime industry in Washington State had the following impacts in 2015:

- \$38 billion in direct, indirect, and induced revenues
- 69,500 direct jobs; 191,100 total jobs
- \$4.7 billion in direct wages; \$12.5 billion in total wages
- \$21 billion in business revenue
- Average annual wages of \$67,000 (compared with statewide median of \$57,000)<sup>22</sup>

The Ballard Locks are essential infrastructure supporting the national and global competitiveness of Washington’s maritime services sector.

<sup>22</sup> *Washington State Maritime Cluster Economic Impact Study*, conducted by Community Attributes for Washington Maritime Federation and the Workforce Development Council of Seattle-King County, April 2017.

## Suggested Value to the Nation Method

This report examines the value of the Ballard Locks from many perspectives to identify improvements to the current methodology for calculating Value to the Nation/Net Economic Development benefits. USACE's current valuation is primarily a combination of transportation cost savings and recreation values. Analysis for this report suggests the following factors should also be considered:

- Estimation of net economic gains created by the Locks should include the cost savings for commercial and recreational vessels from access to centralized services and to freshwater moorage. Both of these gains would cease if, hypothetically, the Locks did not exist.
- In addition, while some percentage of recreational vessel sales and services could relocate if, again hypothetically, there were no Ballard Locks, some would be entirely lost because the unique juxtaposition of vessel buyers, convenient moorage, and access to Puget Sound would be irreplaceable. The value of that loss should also be included in estimates of net economic gains.

Unfortunately, measuring these other factors would be challenging, especially on an annual basis, because of the vast number of assumptions that would need to be made about how the City of Seattle might or might not be different without the Ballard Locks. It is therefore useful to revisit the purpose of the VTN calculation, which, as noted above, is first to measure the overall benefit of the USACE Civil Works Program in relation to its cost, and second to rank Locks in relation to one another as a guide to budget allocations among projects.

The issue at hand is that the Ballard Locks have performed a number of critical functions for 100 years and will need to continue to perform them for at least another 100 years. This issue does not require rethinking the entire VTN methodology. It only requires the flexibility to incorporate other measures of value for this particular situation, which all agree is unique.

As a proxy for more complex methods, the study team recommends using some methodology for estimating Locks-related profit and Locks-related taxes for businesses identified as closely dependent on continuous, reliable Locks operations. The calculations above were performed under the limitations of this study. They are not precise, but offer a guide to the general magnitude of the benefits in question. If USACE were to incorporate this approach into its assessment of the Ballard Locks, further refinement of the estimates would be possible.

There is one more set of benefits that is even harder to quantify, but potentially much larger than any so far considered, namely those associated with public safety. The study team has no recommendation for how to incorporate this last set into a specific valuation methodology, however the implications of a Locks failure should not be ignored when identifying repair and upgrading priorities. The last section of the report discusses some of the potential impacts of an extended closure or failure of the Ballard locks. Here again, the economics of what is at stake are likely much greater than for many other locks systems.

# Potential Impacts of Locks Closures or Failures

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## Cost of Service Disruption

Because the Ballard Locks serve a variety of stakeholder groups, closures of the Locks result in a range of negative impacts. The vast majority are due to unscheduled closures. Virtually all the Locks users interviewed said that adjusting to brief, scheduled maintenance or repair closures was not a problem. If they were faced with an unscheduled closure of several days to a week, some businesses, for example those in construction and ship repair, might be forced to cut back operations with an associated reduction in revenue and employment hours, if a customer were unable to access their facility when expected.

*Quite frankly, if we didn't have the facility inside the Locks, there are not many options to do business in the Seattle area.*

*– Construction Company*

A long closure would be much more serious. When asked what they would do if there was an unplanned, three-month closure of the Locks, most local businesses said they would need to severely curtail or stop operations, and a few said they would be forced to close permanently. Implications for the fleets of commercial fishing and towing vessels would depend on the timing of the closure. Vessels prevented from returning to the Ship Canal by a closure likely could find temporary moorage and services outside the Locks that would allow them to continue working. Commercial vessels trapped on the freshwater side of the Locks, however, could be forced to forego critical fishing, towing, and other work opportunities. Depending on the timing and duration of a closure, losses could reach tens of millions of dollars.

## Probability of an Unplanned Closure

The major components of the Locks and spillway are approaching 100 years of age. These include key valve machinery needed to raise and lower the Locks water level and the critical miter gates that keep the water contained in the Locks compartments and within the lakes, themselves. For most of the past century, maintenance has been conducted according to a schedule established by the original designers. As more

*The Locks are vital to the business. For example, the Locks have been closed since Monday for repairs, and they normally have 2-3 jobs a day, but have only had one since the Locks closed.*

*– Business Owner*

extensive repairs have become necessary, budget limitations have extended the time between maintenance activities and restricted purchase and installation of new parts. Rather than following the mechanic's adage "repair before failure," the guiding principal has become "wait until it breaks," according to individuals familiar with Locks operations.

It is reasonable to conclude that less maintenance increases the likelihood and potential duration of an unplanned closure, and many local businesses and organizations, including USACE, have expressed this concern. However, there is currently not enough data to calculate the mathematical probability of a Locks closure from

equipment or age-related failure. Additional information may become available when the USACE risk assessment team completes its analysis of the Locks in fall 2017 (see below).

## Repair Priorities

A USACE study in 2010 identified nine high-priority areas for repair. Two years later, one of those priority components, the large pumps used to empty the locks for periodic maintenance, were determined to be unsafe due to corrosion and were permanently shut down.<sup>23</sup> The portable pumps now in use require 30 hours to empty the large lock, compared to eight hours with the original pumps. A more critical system for which renewal is underway and due to be completed by 2020, contingent on funding, is the Large Lock Emergency Closure System, which consists of a crane and a set of steel “logs” to be used to block an uncontrolled release of water, should a major failure of the Locks occur.

*A long closure would absolutely affect us. We would have to lay off approximately 30 percent of our employees, and it would also affect our revenue by up to 40 percent since a majority of our business relies upon the Locks.*

*– Tug and Barge Company*

*Honestly, we could not afford a three-month closure. I don't think it would be viable. We are providing a critical interstate transportation service that would no longer exist.*

*– Tug and Barge Company*

A third high-priority repair is the saltwater drain intake, which protects freshwater habitat upstream of the Locks from excessive saltwater intrusion, a condition that is harmful to the ecology of the lakes. A temporary screen is in place over the intake to prevent migrating adult salmon from becoming trapped in the fish ladder's diffuser well. In addition to repairing the drain intake, the

Locks is in need of a permanent structure to replace the temporary screen.<sup>24</sup>

Finally, additional safety provisions could reduce the potential for accidents among the large number of visitors to the Locks each year. Although railings and safety procedures have been added over the years, additional steps could be taken during a major refurbishment to ensure visitor safety.

The most likely causes of an extended closure, according to USACE personnel, are the following:

- A vessel collision that damages or dislodges one or more of the miter gates (six gates in the large lock, four in the small lock).
- An inadvertent simultaneous operation of the miter gates and the filling culvert valves, which could result in a miter gate being dislodged and falling into the bottom of the locks chamber. The existing control system includes no preventive safety mechanism. The filling culvert replacement project includes a new control system to prevent this type of gate failure.

<sup>23</sup> Christopher Dunagan, Encyclopedia of Puget Sound, Puget Sound Institute, University of Washington, 2015.

<sup>24</sup> Lake Washington Ship Canal Major Project Status and Fish Passage Improvement Update for WRIA8 Salmon Recovery Council Meeting, USACE, March 17, 2016.



- A mechanical failure of filling culvert valves. (There are 10 valves altogether in both locks. Both lock chambers can function with a valve out of service, but with slower operation. A second valve out of service can lead to extended closure of a lock chamber.)
- Once the new Large Lock Emergency Closure System is in place, in the event of an extreme storm in the Lake Washington basin, it could be used as an auxiliary spillway to minimize flooding around the lakes. This maneuver would likely lead to damage to the lock chamber, including to the miter gates themselves. Without the new emergency closure system, an extreme storm in the Lake Washington basin would result in flooding around the lakes. The rising water could exceed the spillway capacity at the Locks, leading to water intrusion into machinery spaces, major damage to all electrical systems, and overtopping and damage to the miter gates.
- An earthquake. Earthquakes are considered the gravest threat to the integrity of the locks and spillway. This is the major focus of an analysis now underway by a USACE risk assessment team.

*Closure impacts would be significant, with massive layoffs. We would be responsible with finding ways to get to customers' vessels. There would not be a drydock capability.*

*– Shipyard Owner*

## Scheduled and Unscheduled Closures

The data on Locks closures over the past decade suggests that the Locks are remarkably reliable for 100-year-old infrastructure, but also that unplanned closures happen at the rate of roughly 80 per year, and that extended closures due to malfunction are possible.

During the ten-year period from January 1, 2007 through December 31, 2016, the Locks experienced 2,600 events that interrupted operations for periods of between a few minutes and, on one occasion, 18 days. Seventy percent of the interruption events were planned maintenance or, occasionally, due to staff being occupied with other duties. The longest service interruption due to hardware or equipment malfunction was 3.4 days. Service was also interrupted as a result of 11 accidents or collisions within the locks, with a maximum resulting closure of three days. All told, the total time for unplanned closures averaged 7.6 days per year. (See Appendix 2.)

*A three-month closure would mean laying off half of our workforce. Any longer, we would go out of business.*

*– Shipyard Owner*

## Deferred Maintenance and the Cost of an Error

Regardless of how well designed and constructed the Ballard Locks may be, it is almost certainly less expensive to fix them before they fail than to wait until afterward because of the potential for additional damage during an unplanned or uncontrolled incident. According to USACE personnel, the reason the Locks function as well as they do is that the principle of “fix before failure” has been followed until recent years. Budget cuts and staffing shortages have restricted the amount and types of preventive maintenance performed at the Locks, however.

Deferred maintenance is particularly risky when, as with the Ballard Locks, the cost of an error is high. Interviews indicate that short, controlled closures of the Ballard Locks are not a significant problem. A long, unplanned

closure would be extremely damaging to the range of businesses and organizations that depend on the Locks. A major failure of the locks or spillway could be catastrophic.

## Potential Economic Losses from Closure

One of the clearest examples of the economic losses that could result from an extended, unplanned Locks closure is the fishing fleets. The timing of fishing activities is critical and follows year-round cycles determined by fish movements, spawning habits, weather, and a host of regulatory requirements. If a Locks closure prevents a fleet from being properly maintained and outfitted, fishing time potentially worth millions of dollars could be

*If the Locks were closed, it would significantly impact our budget. There would be an initial increase of millions to build a facility on the saltwater side, as well as an additional \$250,000 per year for staffing to run the facility in addition to our lake-side facility.*

*– Business Owner*

lost. If fishing vessels are trapped behind the Locks and prevented from fishing at all, losses could be in the tens of millions of dollars or more. As noted earlier, fishing vessels that use the Locks earned in excess of \$500 million in 2015.

The ocean transport companies typically have vessels in multiple locations and therefore have some flexibility to interchange them in the event of an extended closure.

However, they would also face large losses if vessels became trapped to the extent delivery contracts could not be fulfilled, as would cruise companies forced to cancel scheduled cruises.

Among local businesses, any long closure of the Locks would force construction/building materials firms to close, at least temporarily. Shipyards, vessel sales, marine services, and local transport companies would experience varying impacts. There would be little effect on shipbuilding and repair projects already underway, but work for vessels not already on the freshwater side of the Locks would be postponed. Recreational vessel sales would likely decline, and local transport through the Locks would cease.<sup>25</sup>

*A long-term closure would be astronomical for us. A lot of the work we do needs to happen in our yard, and we would have to go to an outside yard that would cost money that wasn't planned. Contracts would be lost. All of the shipyards would shut down. We would have to lay off workers.*

*– Tug and Barge Company*

## Public Safety and Potential Loss of Life

The Locks are a key component of public safety response for several local agencies. Further, the fact that the Locks regulate water levels in Lake Union and Lake Washington means a reduction in flood risk and potentially lower insurance costs for shoreline property. Assessment of the potential for loss of life from a failure of the Locks itself is beyond the scope of this study. The possibility is real, however, and is currently being analyzed by a USACE team that specializes in such risk assessments.

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<sup>25</sup> This information was collected in individual interviews with more than 50 business representatives.

*The Locks are critical for marine firefighting and emergency response. We transit the Locks for training and for drills, or if the Lake Union boat is out of service. We also may transit the Locks under non-emergency conditions for planned events. Without the Locks, it would significantly impact marine operations for firefighting.*

*– Seattle Fire Department*

The USACE team is examining the potential impacts of seismic, mechanical, and other possible failures of the Ballard Locks and its spillway. The analysis will focus primarily on the potential for loss of life and will examine to a more limited extent potential economic impacts. At the time of this study, the dam assessment team had reached no conclusions about either the probability or likely impacts of a major Locks failure. The team's report is expected in fall of 2017.<sup>26</sup>

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<sup>26</sup> Meeting with the assessment team, January 24, 2017.

# Appendix 1 – Interviews

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The study team conducted telephone interviews with representatives of the companies and organizations below. Multiple interviews were conducted with USACE personnel.

Alaska Bering Sea Crabbers	Aleutian Spray Fisheries
Anchor Bay Charters	Argosy Cruises
Bio-Marine Enterprises	CalPortland
Coastal Transportation	Coastal Alaska Premier Seafoods
Crow's Nest Yachts	Covich-Williams
Ferguson Terminal	CSR Marine
Freezer Longline Coalition	Foss Maritime Company (Shipyard Operations)
Groundfish Forum	Fremont Tugboat Company
Icicle Seafoods	Hatton Marine
Island Tug and Barge	Irwin Yacht Sales
Kirby Corporation	King County Police
Lake Washington/Cedar/Sammamish Steering Committee (WRIA 8)	Lake Union Drydock
LeClercq Marine Construction	Lakeside Industries
Markey Machinery	Manson Construction
Muckleshoot Tribe	MER Equipment
North Seattle Industrial Association	Nautical Landing Marina
Northwest Marine Trade Association	Northlake Shipyard, Inc.
Port of Seattle Fishermen's Terminal	Ocean Peace, Inc.
Purse Seine Vessel Owners' Association	Premier Yachts
Salmon Bay Yacht Sales	Salmon Bay Sand and Gravel
Seattle Police Department (Harbor Patrol)	Seattle Fire Department
Seattle Public Utilities	Signature Yacht Sales
Spirit of 76	Stabbert Maritime
Un-Cruise Adventures	U.S. Army Corps of Engineers (Seattle District)
United States Coast Guard (Puget Sound Sector)	University of Washington Marine Operations
Vigor Industrial (Kvichak Shipyard)	Washington Department of Fish & Wildlife
Washington State Department of Transportation	Washington Trollers Association
Westar Marine Services	Western Towboat Company

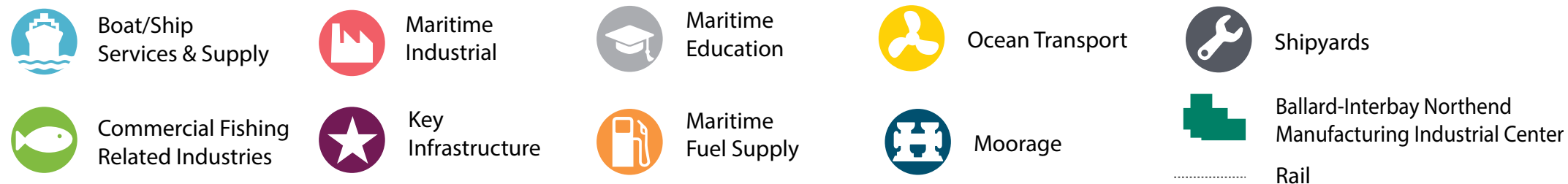
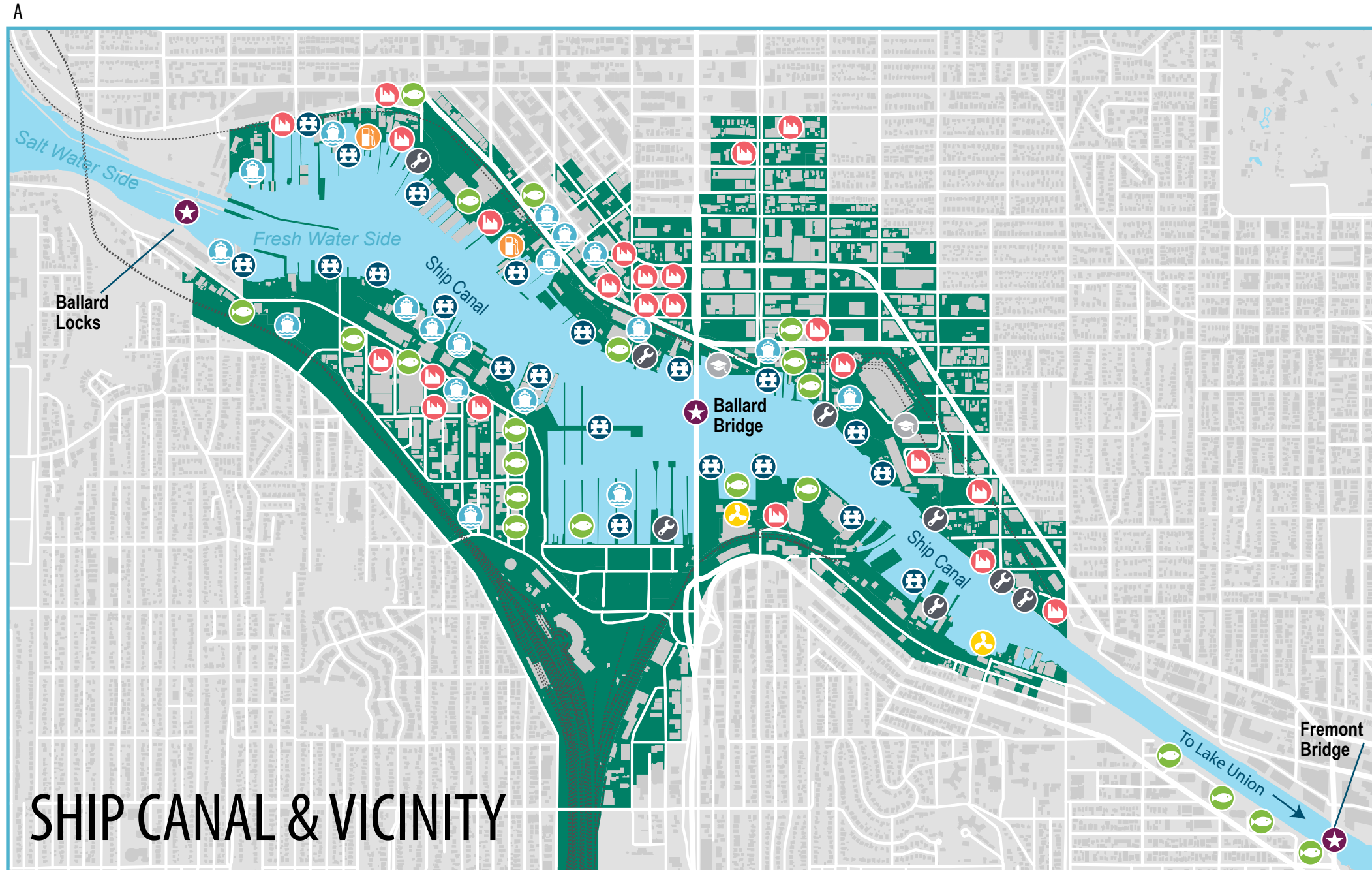


# Appendix 2 – Locks Closure Data

G3		STALL ANALYSIS REPORT								LPMS: 4	
Lock Code 01		LAKE WASHINGTON SHIP CANAL								Run Date: 01/19/2017 15:20	
HIRAM M CHITTENDEN LOCKS 01/01/2007 thru 01/01/2017											
STOPPAGE EVENTS										STALL EVENTS	
Reason Code	Code Description	Number of Events	Percent of Events	Number Scheduled	Total Time (Min)	Percent of Total Time	Average Time Stopped (Min)	Minimum Time Stopped (Min)	Maximum Time Stopped (Min)	Number of Events	Percent of Total Stall/Stoppages
A	Fog	4	0.20%	3	1,376.00	0.20%	344	30	1,181.00	0	0.00%
AA	Accident or collision in lock	11	0.40%	1	12,586.00	2.30%	1,144.20	135	4,355.00	0	0.00%
B	Rain	0	0.00%	0		0.00%				0	0.00%
BB	Closed ( unmanned shift)	0	0.00%	0		0.00%				0	0.00%
C	Sleet or Hail	0	0.00%	0		0.00%				0	0.00%
CC	Grounding	0	0.00%	0		0.00%				0	0.00%
D	Snow	0	0.00%	0		0.00%				0	0.00%
DD	Environmental (i.e. fish, animals, oil spills, hydrilla)	17	0.70%	14	4,009.00	0.70%	235.8	24	360	0	0.00%
E	Wind	0	0.00%	0		0.00%				0	0.00%
EE	Repairing lock or lock hardware	50	1.90%	30	9,242.00	1.70%	184.8	15	1,195.00	0	0.00%
F	Lightning	10	0.40%	4	629	0.10%	62.9	15	150	0	0.00%
FF	Lock Ok; unused for other reason (i.e. CG river closing etc)	1	0.00%	1	59	0.00%	59	59	59	0	0.00%
G	Low Water	0	0.00%	0		0.00%				0	0.00%
GG	Bye Time	0	0.00%	0		0.00%				0	0.00%
H	Ice on or around tow	0	0.00%	0		0.00%				0	0.00%
I	River current or Outdraft condition	0	0.00%	0		0.00%				0	0.00%
J	Flood	0	0.00%	0		0.00%				0	0.00%
K	Interference by other vessel(s)	3	0.10%	0	74	0.00%	24.7	14	37	0	0.00%
L	Tow malfunction or breakdown	3	0.10%	0	81	0.00%	27	18	38	1	0.00%
M	Tow staff occupied with other duties	3	0.10%	0	94	0.00%	31.3	24	46	0	0.00%
N	Operations (run-spill-divert water, flush seals-reserve etc)	0	0.00%	0		0.00%				0	0.00%
O	Debris	1	0.00%	0	50	0.00%	50	50	50	0	0.00%
P	Tow accident or collision	0	0.00%	0		0.00%				0	0.00%
Q	Debris in lock recess or lock chamber	6	0.20%	4	1,552.00	0.30%	258.7	19	500	0	0.00%
R	Lock hardware or equipment malfunction	77	3.00%	5	44,923.00	8.10%	583.4	10	4,929.00	0	0.00%
S	Lock staff occupied with other duties	246	9.40%	4	12,223.00	2.20%	49.7	1	285	0	0.00%
T	Maintaining lock or lock equipment	1945	74.70%	1719	450,472.00	81.50%	231.6	0	26,055.00	1	0.00%
U	Ice on lock or lock equipment	0	0.00%	0		0.00%				0	0.00%
V	Tow detained by Coast Guard or Corps	0	0.00%	0		0.00%				0	0.00%
W	Collision or Accident (not tow or not in lock; see P, AA)	0	0.00%	0		0.00%				0	0.00%
X	Bridge or other structure (i.e railway, pontoon, swing etc.)	167	6.40%	8	3,640.00	0.70%	21.8	3	160	1	0.00%
Y	Inspection or testing lock	41	1.60%	35	9,109.00	1.60%	222.2	15	2,723.00	0	0.00%
Z	Other	19	0.70%	7	2,854.00	0.50%	150.2	21	500	0	0.00%
<b>TOTALS</b>		2604	100.00%	1835	552,973.00	100.00%				3	0.10%

# BUSINESSES DEPENDENT ON THE BALLARD LOCKS

The Ballard Locks generate nearly \$1.2 billion in annual economic benefit. Areas impacted by the locks include the Lake Washington Ship Canal and adjacent properties, Lake Union, Lake Washington, Lake Sammamish and rivers and streams flowing into the lakes. The locks also have an economic nexus with the Lower Duwamish Waterway. Locations of maritime industrial activities and vital infrastructure are shown below and at right.



# LOCKS ECONOMIC IMPACT AREA

