Northwest **Power** and **Conservation** Council

February 3, 2026

MEMORANDUM

TO: **Council Members**

FROM: **Stacy Horton, Washington Policy Analyst, Biologist**

SUBJECT: **Preparing for Invasive Freshwater Mussels, Assessing Hydropower and Hatchery Infrastructure**

BACKGROUND:

Presenters: James Littley, Chief Operating Officer, Okanagan Basin Water Board
Michael Stephenson, Resource Professional Leader, Idaho Power Company
Justin Bush, Aquatic Invasive Species Division Manager, Washington Department of Fish and Wildlife

Summary: Implications of a widespread establishment of zebra, quagga, or golden mussel (mussel) in the Basin includes significant risks to raw water infrastructure, resources, ecosystems and species that are closely related to the Columbia River Basin Fish and Wildlife Program (FWP) and the Federal Columbia River Power System (FCRPS). Once established at scale mussels could impact hydropower generation and fish passage facilities at dams, affect hatcheries, habitat and valuable or endangered species, and disrupt navigational locks water diversion and pumping infrastructure (including agricultural irrigation systems and associated fish screens). The Council has had numerous presentations describing anticipated economic and ecological consequences of invasive mussels. Today's presentation builds on that foundation by specifically focusing on assessing impacts to vulnerable raw water infrastructure important to the Fish and Wildlife Program and the FCRPS.

James Littley, Okanagan Basin Water Board, will present information from their mussel vulnerability guide titled '*Preparing for Invasive Mussels: Vulnerability Assessment Guide for Raw Water Infrastructure*.' First released in 2024, the Guide has been updated to include the most up-to-date information on golden mussels, with a focus on how to assess source water risk. The guide is useful for facility managers to understand risk, specific facility vulnerabilities, and treatment options.

Michael Stephenson, Idaho Power Company, will present information on the company's experience with the recent chemical treatments of the Snake River to eradicate invasive quagga mussels from the Snake River near Twin Falls. This presentation will discuss our preparations for an infestation; communication plans; challenges with access to, and staffing of facilities; and what we are doing moving forward.

Justin Bush, Washington Department of Fish and Wildlife, will present an overview of the State of Washington's comprehensive approach to invasive mussel readiness. This presentation will highlight efforts to assess fish hatchery vulnerabilities; procedures to ensure fish transport and movement do not introduce or spread invasive species; development and testing of novel containment systems to prevent mussel establishment and protect species at risk; and plans for upcoming exercises designed to enhance readiness and evaluate containment technologies.

Relevance: The Council's 2014 Columbia River Fish and Wildlife Program includes a strategy for non-native and invasive species that calls for regional coordination, preventative actions, and monitoring and management of pathways in order to preclude or limit invasive species introductions. (P. 47-48 2014 FWP)

Background: In 2010, the Councils Independent Economic Analysis Board drafted the report *Economic Risk Associated with the Potential Establishment of Zebra and Quagga Mussels in the Columbia River Basin* **,** an early look at invasive mussels in the Columbia River Basin, and considered mussel infestation scenarios and impacts on facilities, resources, ecosystems and species and (at the time) laid out the current state of knowledge about the risk of mussel introduction, establishment, growth and densities, and estimates some potential costs of infestation, avoidance, and control. The 2010 report was updated in 2013 with the report *Invasive Mussels Update, Economic Risk of Zebra and Quagga Mussels in the Columbia River Basin* which provided information suggesting that recent efforts to augment ongoing regional prevention efforts were justified economically and should be continued if not expanded.

In the Councils 2014 Columbia River Fish and Wildlife Program the Council included a strategy to 'Prevent the introduction of non-native and invasive species in the Columbia River Basin, and suppress or eradicate non-native and invasive

species', finding in the rationale that "…aquatic non-native species can invade and significantly threaten infrastructure at hydroelectric dams and fish passage facilities in the Columbia River Basin. Currently, the greatest known threat in the Columbia River Basin from aquatic invasive species is introduction into the basin of zebra or quagga mussels."

The Council continues to work with the region to maintain the efforts described in the Fish and Wildlife Program, including to evaluate potential adverse impacts, prevent establishment, monitor and control non-native species introduction and dispersal, remove and eradicate non-native species, reduce competition from non-native fish, and continue regional coordination with partners and regional stakeholders.

Given the threat of invasive mussel introductions and their impact to hydropower and hatchery infrastructure in the Columbia River Basin, the presentation today is both timely and important.

More info:

Preparing for Invasive Mussels: Vulnerability Assessment Guide for Raw Water Infrastructure

Oregon and Washington Invasive Mussel Near-Term Action Working Group Findings and Near-Term Action Recommendations

U.S. Geological Survey Zebra and Quagga Mussel Sightings Distribution Map

California Department of Fish and Wildlife Golden Mussel Survey Results in California Map

Economic Risk Associated with the Potential Establishment of Zebra and Quagga Mussels in the Columbia River Basin *(IEAB 2010-1)*

Invasive Mussels Update, Economic Risk of Zebra and Quagga Mussels in the Columbia River Basin *(IEAB 2013-2)*

2014 Columbia River Fish and Wildlife Program (Document# 2014-12)

Protect our WAters:
State of Washington Approach to Invasive Freshwater Mussel Readiness

Justin Bush (He/Him)

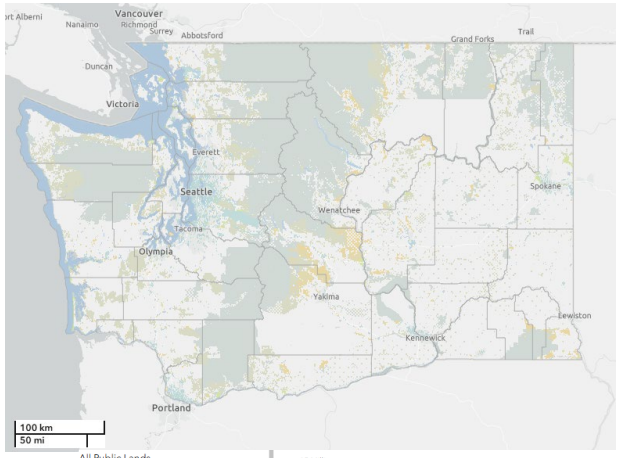
Aquatic Invasive Species (AIS)
Division Manager

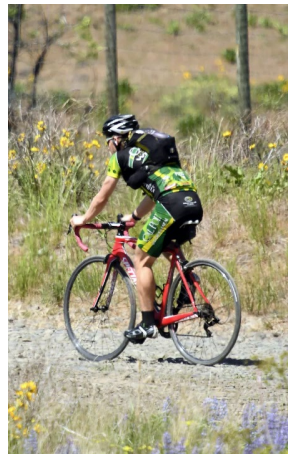
Washington Department of FISH & WILDLIFE

State of Washington

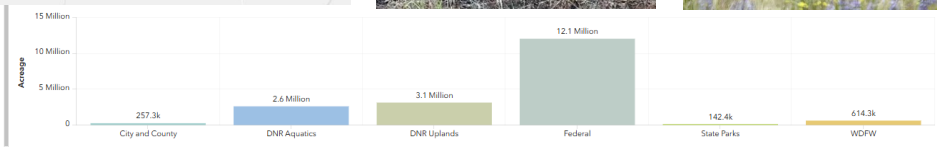
- 8.12 million residents
- 21 treaty tribes, 8 executive order tribes
- 39 counties, 281 cities and towns
- 42.6 million acres of land: 44% public
- > 8,000 lakes, 74,000 miles of streams and rivers
- > 3,000 square miles of marine estuary
- 47 species listed as endangered, threatened, or sensitive
- 75 ports, including 11 deep-draft
  - Marine Highway (M)-5 along Pacific Coast
  - M-84 pm the Columbia/Snake River system (365 miles)
  - Puget Sound and Salish Sea
- 145 federally regulated or owned dams
- Home to significant Indo-Pacific military readiness and strategic defense capabilities and logistics infrastructure

📷: WDFW





Total Acreage
18.81 Million



📖 📈: Washington Recreation and Conservation Office

📷: WDFW

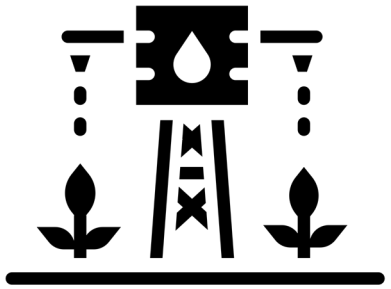
📷: Grace Thornton, WDFW

State of Washington

$31.2 billion Columbia River and $80 billion Puget Sound shipping

- Commodities and products
- Key U.S. trade gateway
  - **Leading** wheat export pathway
  - **Second** soy and corn export pathway

📈: Pacific Northwest Waterways Association, Puget Sound Pilots



$14 billion Agricultural production

$9.6 billion Irrigated agriculture

- 75% of Washington's agriculture crops irrigated
- Top 10 commodities: Apples, Cattle and Calves, Milk, Potatoes, Hay, Wheat, Eggs, Hops, Onions, Grapes

📈: Washington State Department of Agriculture

$20.5 billion Outdoor recreation and fisheries

- $5 billion in outdoor recreation involving public waters
- $1.5 billion in recreational fisheries
- $14 billion in commercial salmon fisheries

📈: Washington Recreation and Conservation Office (2020)

Invasive Freshwater Mussel Economic Risk

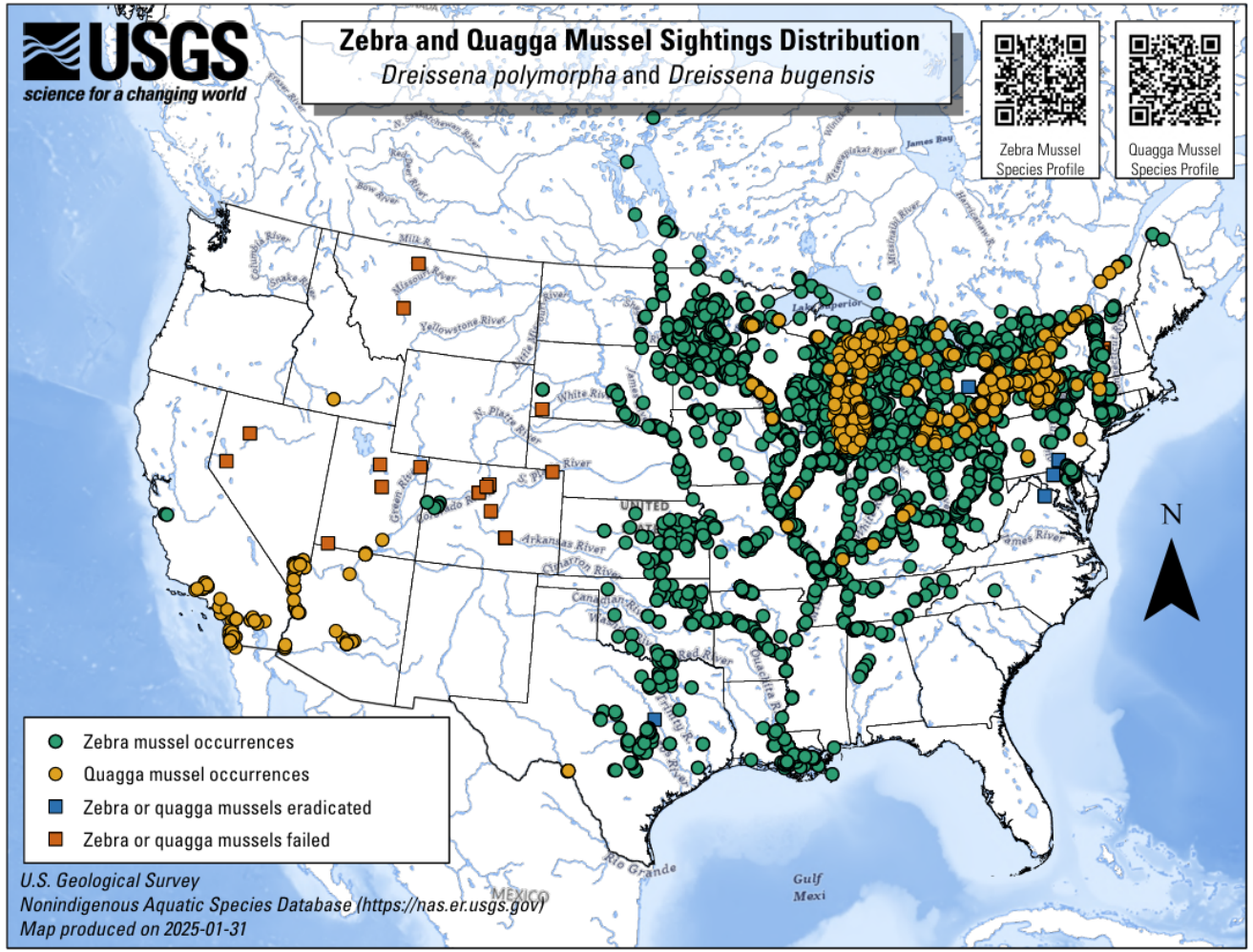
- $100 million annual hydroelectric mitigation and maintenance.

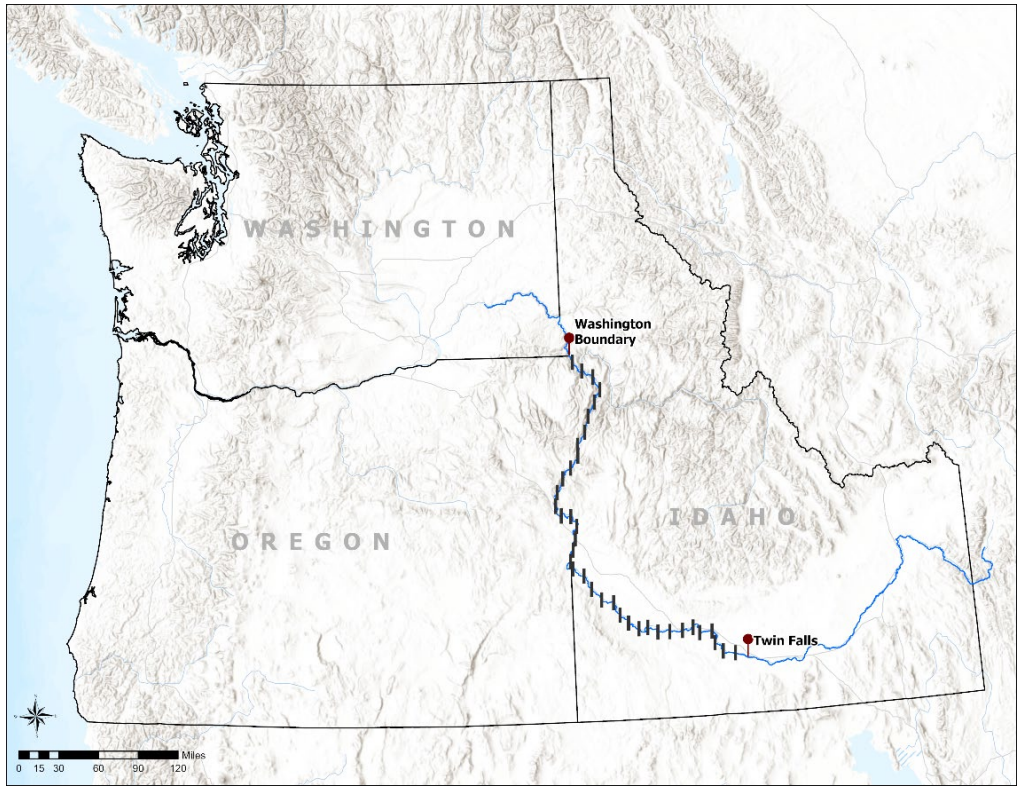
- Anticipated similar mitigation and maintenance costs for:
  - Fish Hatcheries
  - Fish Passage Infrastructure
  - Agricultural Irrigation Systems
  - Drinking and Wastewater Systems
  - Legacy Data Centers
  - Navigational Locks

Invasive mussels fouling a penstock gate at Davis Dam.
📷: U.S. Bureau of Reclamation

Dense colonies of zebra mussels can clog intake pipes.
📷: Marrone Bio Innovations

Quagga and Zebra Mussel Distribution



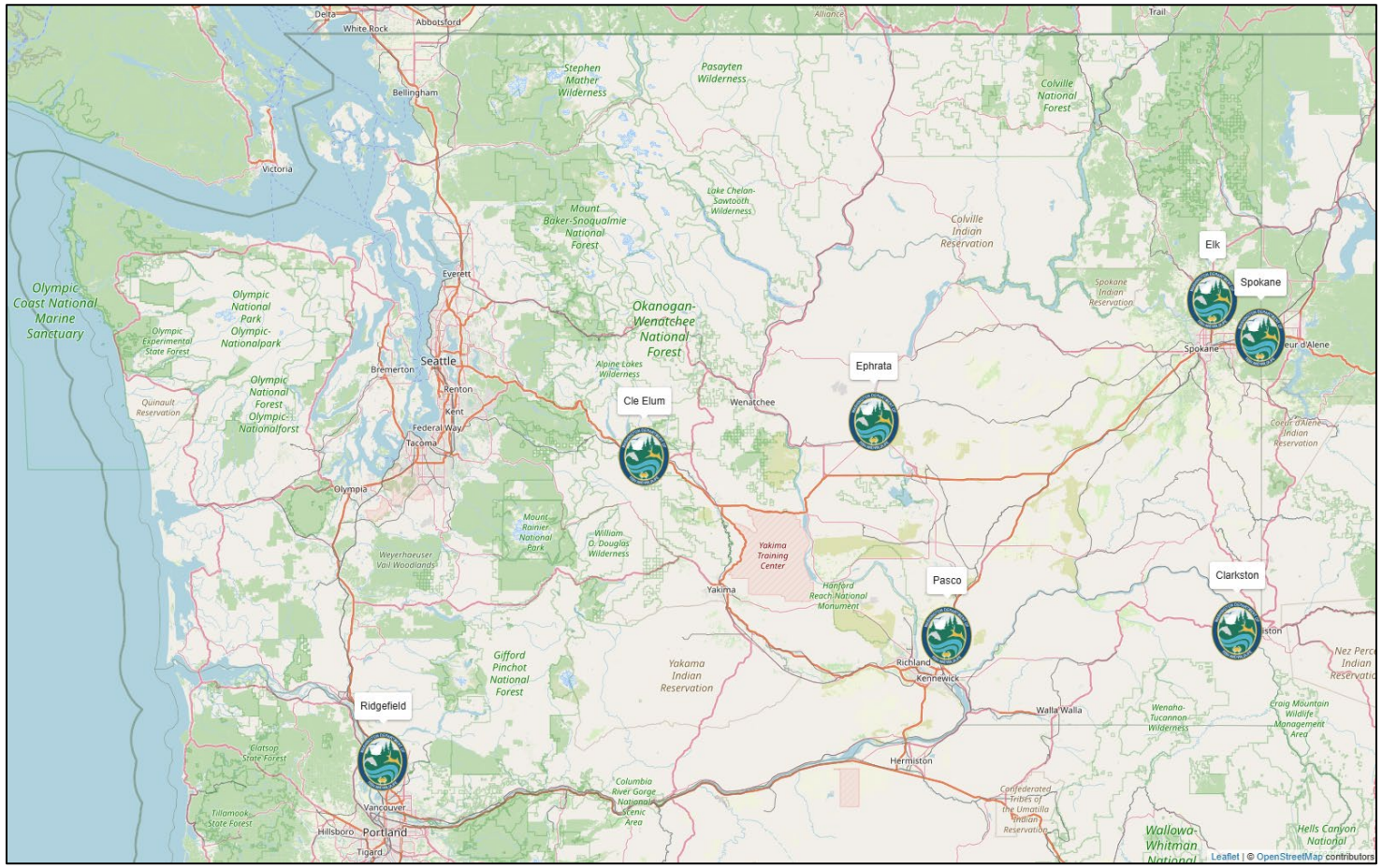


Twin Falls, Idaho is approximately 375 River Miles from Washington waters, and 175 miles from Oregon Waters.

: Washington Department of Fish and Wildlife

Watercraft Inspection and Decontamination

	2023	2024	2025
Watercraft Inspected	55,810	56,388	61,137
Mussel Fouled Watercraft	23	18	21
Total Decontaminations	1,116	1,320	3,374



Washington Department of Fish and Wildlife

Jan. 2025 Largest Interception on Record:
Increased Prevention and Readiness in Action

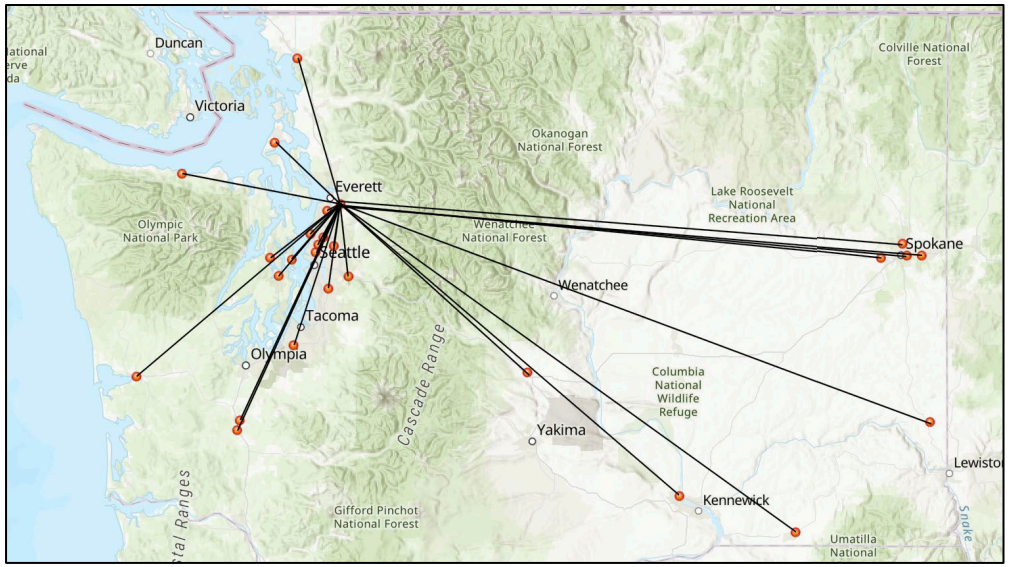
- Conveyance:
  - 2 Tugboats; 1 infested
  - 30 feet length
- Origin: Lake Michigan

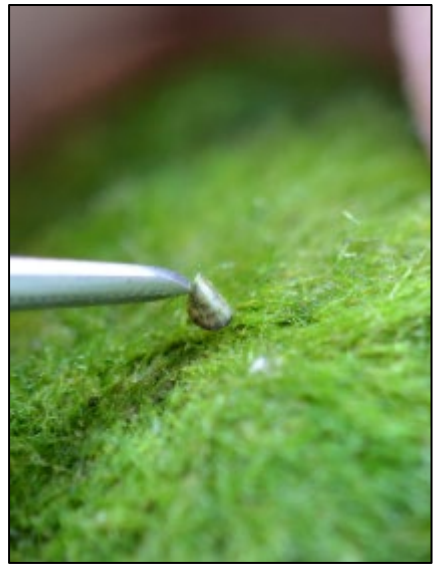
- Interception Point: Spokane (Liberty Lake)

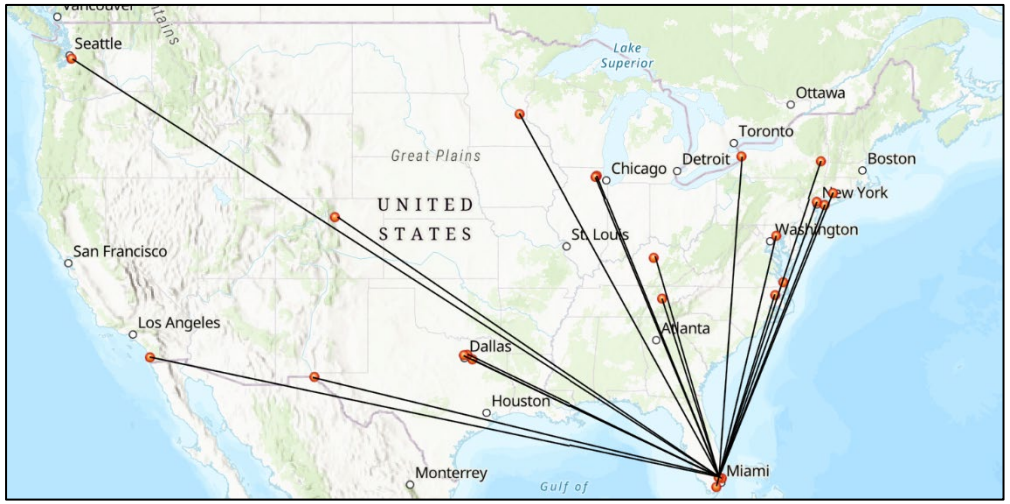
- Interception: 21 gallons of invasive mussels – analysis indicates some may have been **alive**
- Staff Time: 20 hours

📷: Washington Department of Fish and Wildlife

Marimo Moss Ball Zebra Mussel Incident (Aug. 2024)







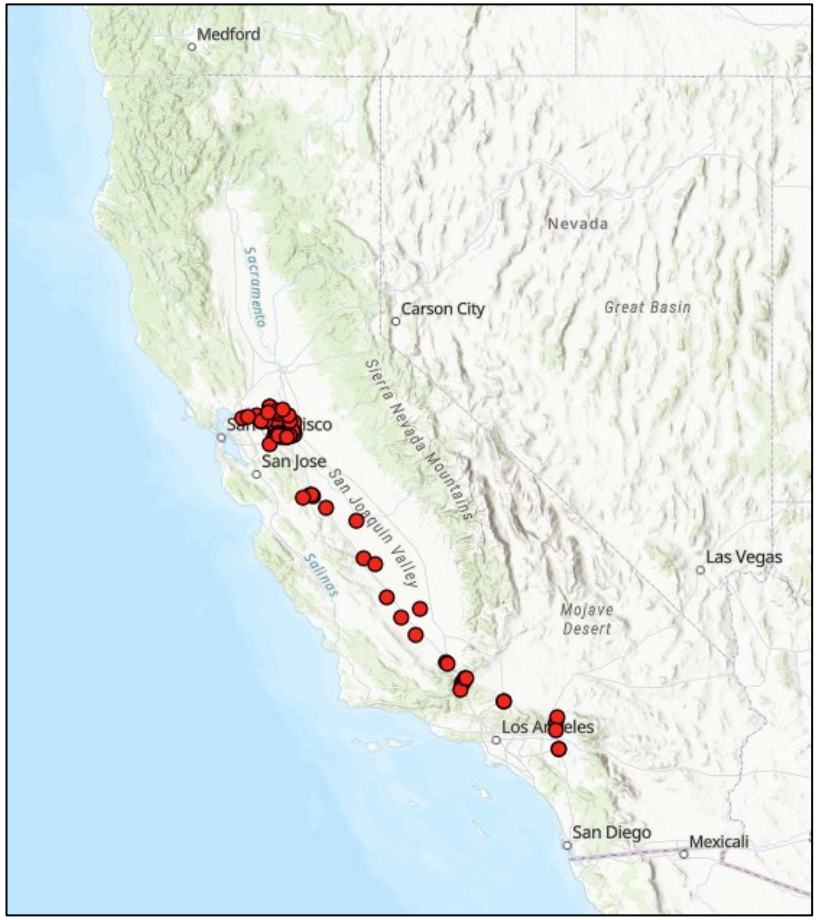
🗺️ & 📷 Washington Department of Fish and Wildlife

U.S. Marine Highway System

📘 : U.S. Department of Transportation Maritime Administration

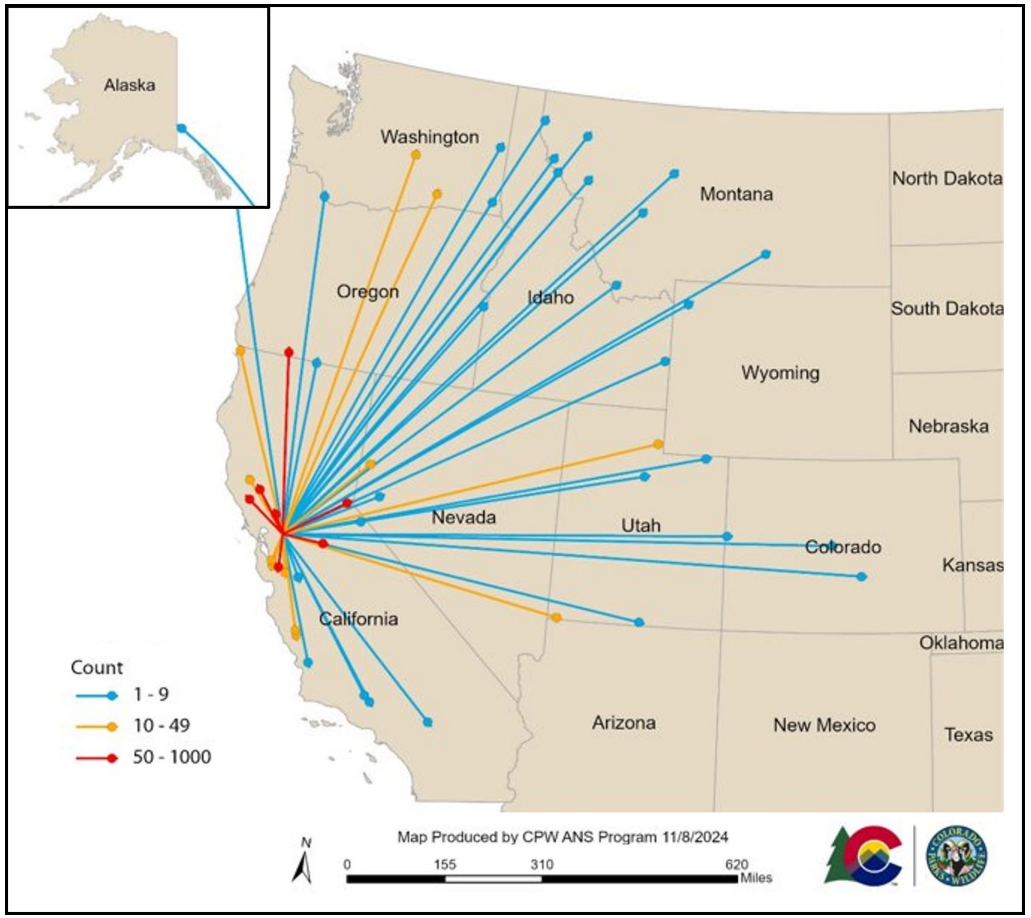
Golden Mussels in Sacramento Delta

Golden Mussel
Survey Results in California



🗺️: California Department of Fish and Wildlife

2024 Watercraft Inspections Where
“California Delta” was Last Water Visited



🗺️: Colorado Parks and Wildlife Department

Zebra Mussel Spread 1986 - 2006

U.S. Marine Highway System

🗺️: U.S. Department of Transportation Maritime Administration

1986

🗺️: U.S. Geological Survey

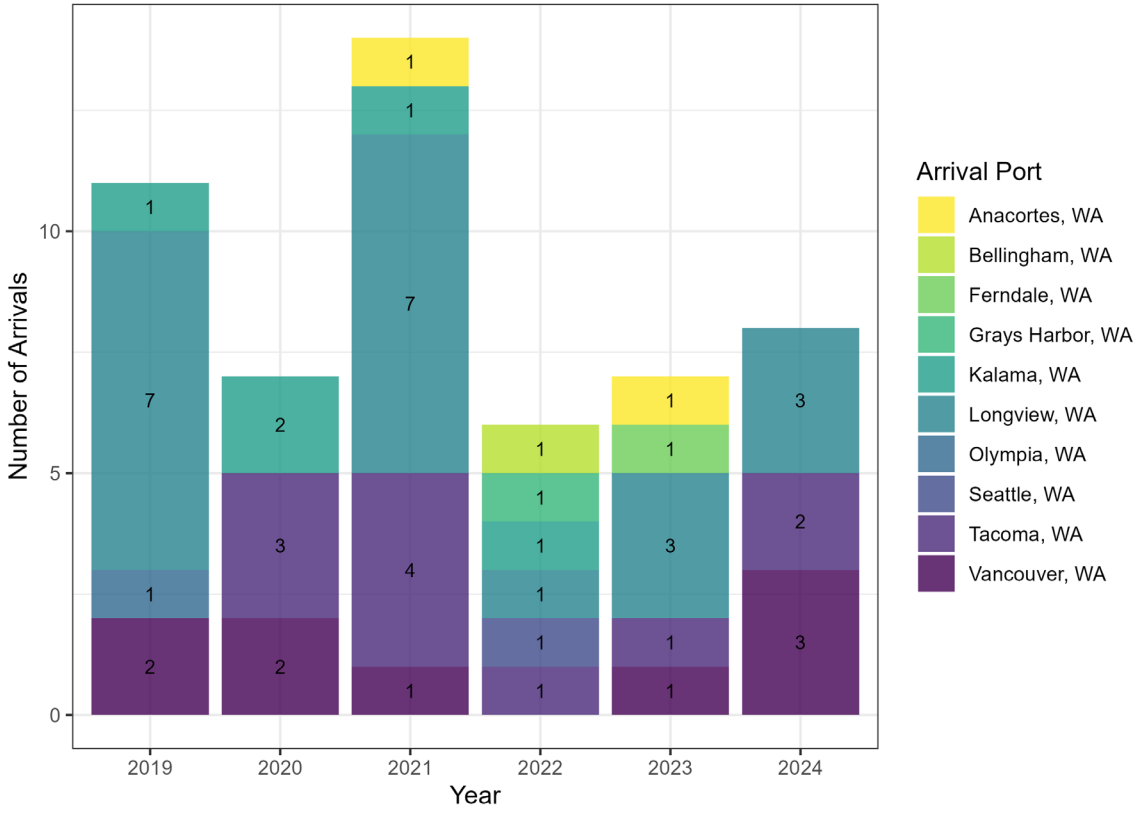
1996

🗺️: U.S. Geological Survey

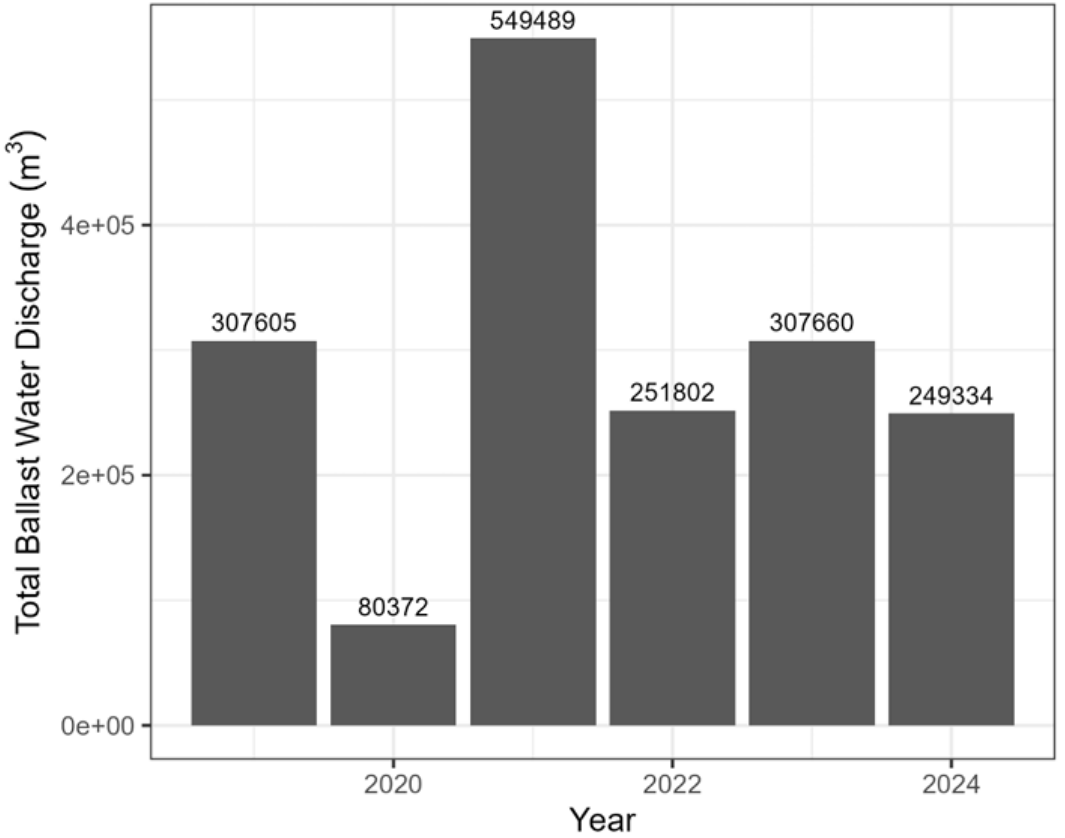
U.S. Geological Survey Non-Indigenous Aquatic Species Zebra Mussel Animated Map
https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=95

Golden Mussels Ballast Water Introduction Risk

Regulated transoceanic vessel arrivals from Stockton area, California to Washington ports 2019-2024.



Ballast water discharged to Washington from 2019-2024 that contained water sourced in Stockton area.



2020 (low) = 21,232,036 gallons versus 2-8 gallons of water is retained in a wake boat

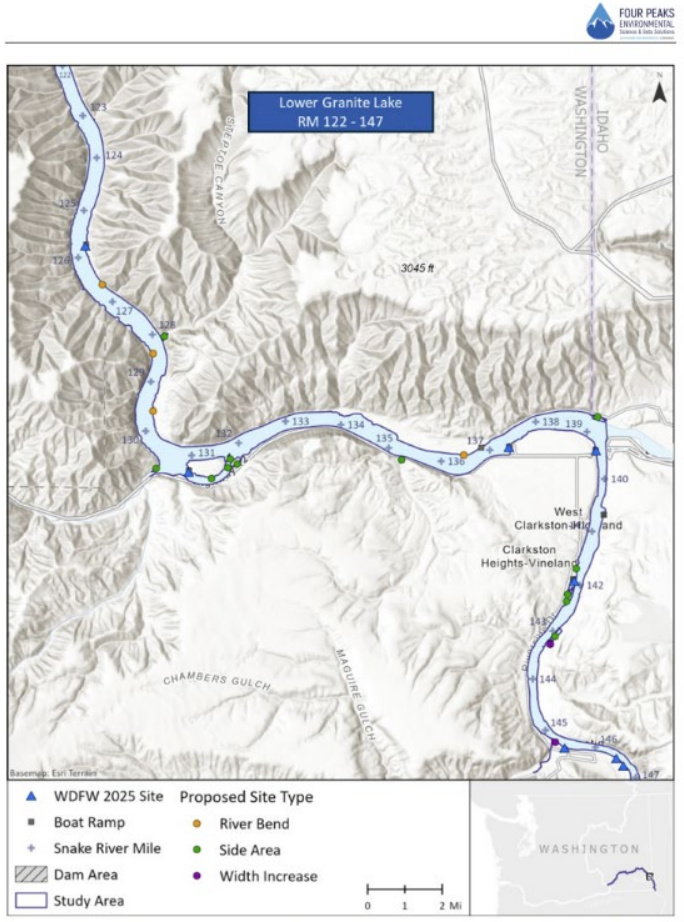
Assessing and Mitigating Infrastructure Risks

1. Understanding Downstream Spread

- Historic early detection monitoring focused on 26 criterion focused on human-mediated introduction.
  - Waterbody open to public, motorized watercraft allowed, fishing tournament, stocked with fish, etc.

- Phase 1: Spatial assessment modeling where sediments likely settle out:
  - Back and side channels.
  - Insides of river bends.
  - Locations where the cross-sectional width of the river increased.
- Identified new 74 new monitoring sites between River Mile 176 and 108.

- Phase 2: Hydraulic model using simulated veligers.



Attachment Figure A-3. Proposed and existing study sites, Lower Granite Lake between river mile 122 and river mile 147

: Four Peaks Environmental Science and Data Solutions on behalf of the Washington Department of Fish and Wildlife

2. Developing Containment Systems and Testing

🗺️: U.S. Army Corps of Engineers
Engineering Research and Development Center

- Building on 2019 field operations response exercise in November 2026 at Central Ferry Habitat Management Unit .
- Deploying and testing specifically designed containment systems.
- Bulk water exchange testing using a dye and taking readings for up to 48hours.

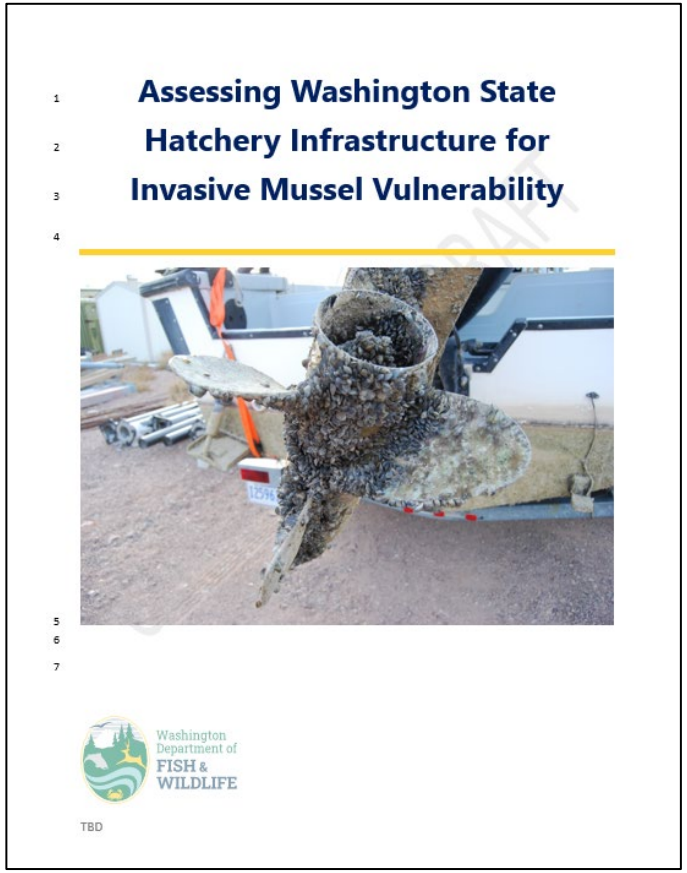
📷: Washington Department of Fish and Wildlife

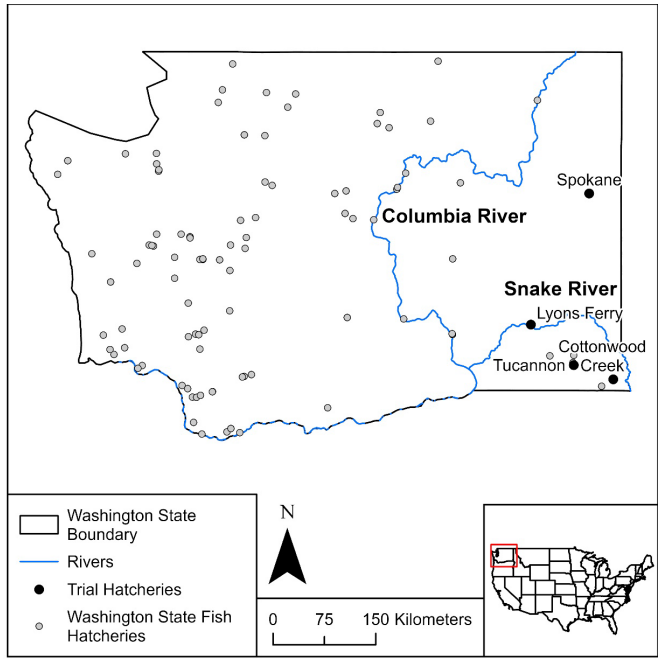
3. Understanding Fish Hatchery Vulnerabilities

Developed by U.S. Geological Survey (USGS) fish hatchery attributes such as:

- Facilities
  - Structures and materials
- Site Conditions
  - Water flow and quality
- Maintenance
  - Dewatering, freezing
- Biosecurity Practices
  - Dedicated equipment and supplies (nets, waders)

- In final stages of federal approval and unpublished





5. Exploring Engineering Solutions

Assessment of fish hatchery aquatic invasive species mitigating engineering solutions

- Proxy Species: New Zealand mud snails
- Location: Columbia Basin Fish Hatchery (Moses Lake)
- Evaluating and comparing engineering-based options to prevent the introduction, establishment, and persistence of invasive mussels and other aquatic invasive species within hatchery water systems.
- Identifies vulnerabilities within hatchery infrastructure and operations.
- Analyzes feasible technologies, and assesses their effectiveness, and operational constraints.
- Culminates in ranked recommendations and an implementation framework.

New Zealand Mud Snails

📷: WDFW

Soos Creek Fish Hatchery

📷: WDFW

6. Emergency Ballast Water Management Systems

- WDFW has convened a public/private working group to gather input on a port-based emergency ballast water treatment option for regulated vessels is desirable and feasible in Washington State.
- Working group meeting 2-3 times between February and April/May 2026.
- Potential applications within or supporting other raw water infrastructure or aquatic conveyances.

Increasing Preparedness for Raw Water Infrastructure Managers

Case Study – Skagit Hydroelectric Project (2025)

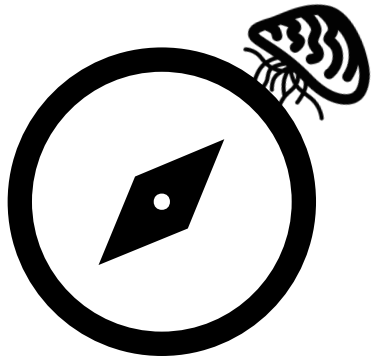
- Brought several large, portable, sectional barge platforms to the project to support in-water work
- Seattle City Light staff were trained in Watercraft Inspection and Decontamination (WID) and aware of invasive freshwater mussels and risk
- Seattle City Light staff followed protocols to inspect all equipment
- Seattle City Light staff found mussels on the portable barge platforms, alerting the state and decontaminated the equipment

: Seattle City Light

: Seattle City Light

Increasing Preparedness for Infrastructure Managers

1. Coordinate across jurisdictions and sectors; invasive mussels cross boundaries
2. Prioritize prevention; it is far less costly than long-term mitigation
3. Assess site-specific risk and vulnerabilities using standardized tools; adapt tools to identify risk and vulnerabilities of additional sectors
4. Institutionalize prevention through contracts, procurement, and operations
5. Implement monitoring, early detection, and detection notification capabilities
6. Document and promote both site and regional risks, pathways, and coordinated actions



Aquatic Invasive Species Division
ais@dfw.wa.gov
1-888-WDFW-AIS

Justin Bush
Justin.Bush@dfw.wa.gov
564-669-9486

Preparing for Invasive Mussels

Vulnerability Assessment Guide for Raw Water Infrastructure

VERSION 2.0

Implications for the Columbia Basin & Hydropower Infrastructure

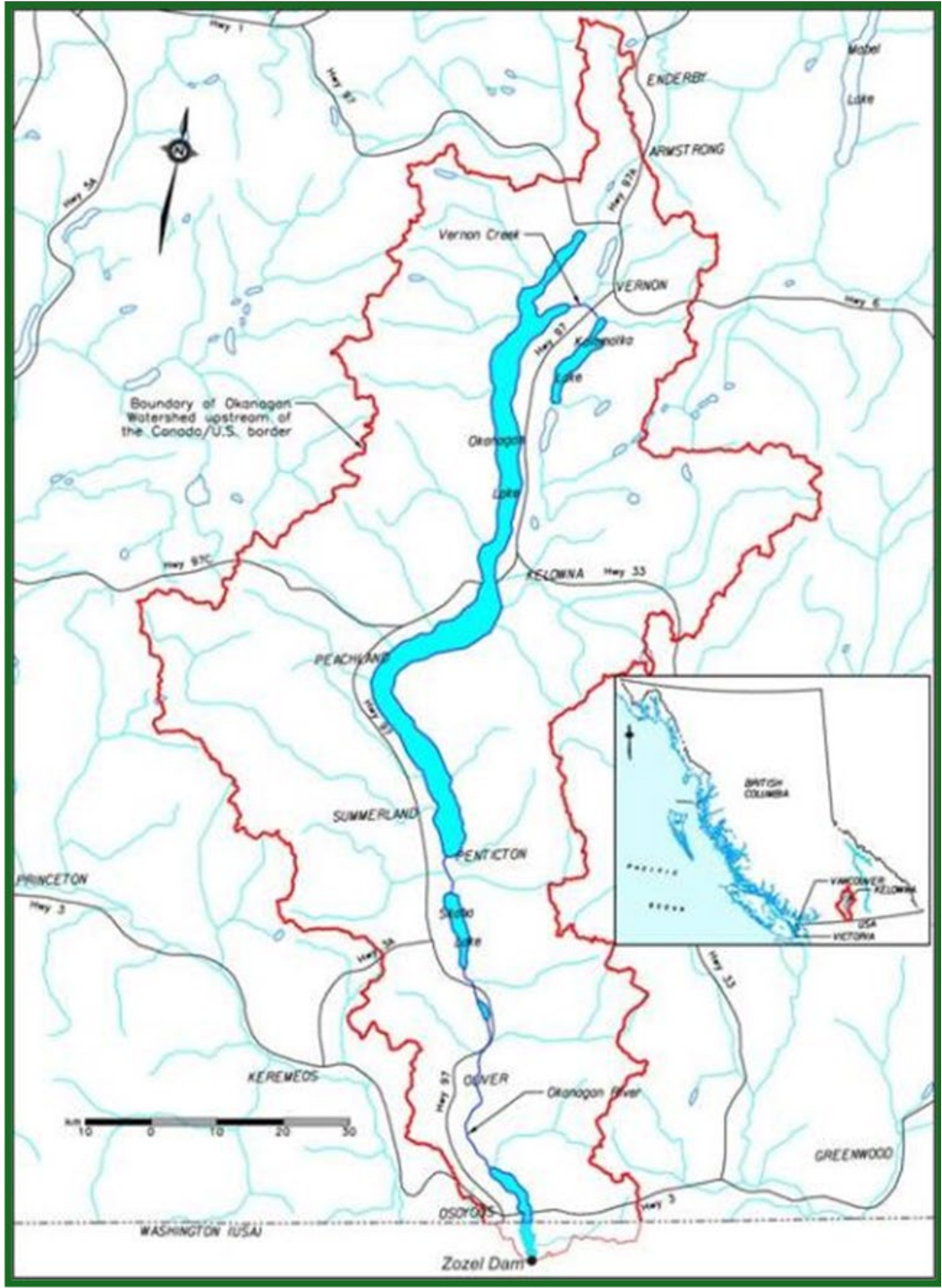
Feb 10, 2026
James Littley, Chief Operating Officer
james.littley@obwb.ca

Okanagan Basin
WATER BOARD

OBWB.CA

Who is the OBWB?

- The OBWB is a local government agency established in 1970 to address the region's most pressing water issues.
- It represents a collaborative partnership between the three Okanagan regional districts, the Okanagan Nation Alliance, the Water Supply Association of BC, and the Okanagan Water Stewardship Council.




BRITISH COLUMBIA
MICA
Columbia River
REVELSTOKE
Upper Arrow Lake
DUNCAN
Slocan Lake
Columbia Lake
Kootenay Lake
Lower Arrow Lake
Okanagan Lake
KEEMLEYSIDE
KOOTENAY CANAL PROJECT
Kootenay River
CANADA
UNITED STATES
HUNGRY HORSE
Hungry Horse Reservoir
LIBBY
Lake Koocanusa
ALBENI FALLS
Lake Pend Oreille
Flathead Lake
KERR DAM
Lake Chelan
WELLS
CHIEF JOSEPH
GRAND COULEE
ROCKY REACH
ROCK ISLAND
WANAPUM
PRIEST RAPIDS
LOWER GRANITE
Dworshak Reservoir
DWORSHAK
WASHINGTON
MONTANA

Preparing for Invasive Mussels:
Vulnerability Assessment Guide for Raw Water Infrastructure

Okanagan Basin WATER BOARD

RNT CONSULTING INC

Preparing for Invasive Mussels:
Vulnerability Assessment Guide for Raw Water Infrastructure

Version 2.0; 2026

Okanagan Basin WATER BOARD

RNT CONSULTING INC

The golden mussel (*Limnoperna fortunei*)

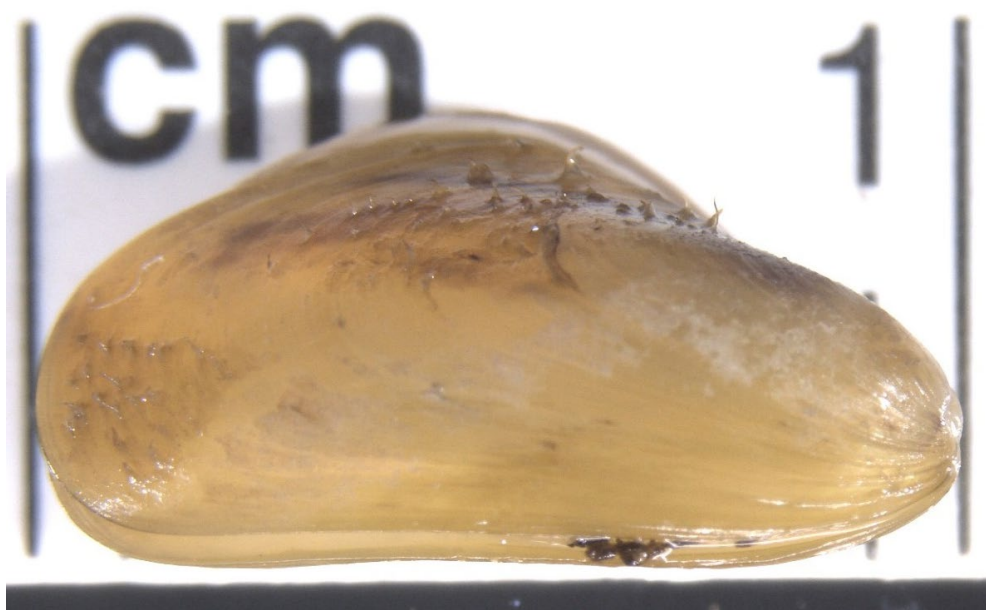
- Newly arrived in North America (California, 2024)

- Similar infrastructure/ecosystem impacts as zebra & quagga mussels

- Broader environmental tolerances → more basins now at risk

- Primary knowledge from South America and Asia

- Key uncertainties: desiccation survival, cold tolerance, treatment efficacy



Amanda Chavez (California Department of Fish and Wildlife)

California Department of Water Resources

How to use this guide:

- Applies to all facility types
- Step-by-step vulnerability assessment
- Source water analysis
- Treatment and control options
- Includes cost estimation

This means new or updated information

Section1: Invasive Mussel Effects on Infrastructure

Version 1:

- Impacts to infrastructure
  - Changes in source water
  - Magnitude of impacts
- How they infest systems
- How they alter ecosystems
- General lifecycle

Version 2:

- Similar effects expected
- Updated identification and lifecycle information
- Differ in salinity, calcium needs and temperature tolerances

Section 2: Determine Source Water Risk

At Risk, or Not at Risk? (Could invasive mussels survive in your water?)

1. Take water samples from multiple locations in your waterbody or stream, as parameters may vary spatially, especially in large systems.

2. Sample seasonally; conditions suitable for mussel introduction may occur in spring and fall even when summer or winter conditions appear unsuitable.

3. **At risk**: A source water is considered at risk if it meets the “at risk” range for **all** parameters.

4. **Not at risk**: A source water is considered not at risk if **any** parameter falls outside the “at risk” range at that site.

	Dreissenids	*Limnoperna*
PARAMETER	**AT RISK**	**AT RISK**
Calcium limits (mg/L)	>12	>1*
pH range	7.0 - 9.5	5.0 - 10.0
Salinity (ppt)	<10	<3 continuous, ~23 short-term**
Oxygen limit at 20 ºC (mg/L)	>3	>0.5 (adults); ≥5 (veligers)
Temperature limit (ºC)	0 - 33	0-35***
Breeding Temperature (ºC)	12 - 24	15- 28****

* Golden mussels require ~5 mg/L Ca for shell formation and reproduction but can survive at <2 mg/L; survival does not guarantee establishment. Calcium must be bioavailable based on other parameters.

** Golden mussels are freshwater/brackish and tolerate up to ~3 ppt continuously; some populations tolerate short-term pulses up to ~23 ppt in estuarine conditions.

*** If the entire waterbody remains below or above these limits, long-term survival is unlikely. Cold tolerance varies among populations; northern populations show increased overwintering survival down to ~0–5ºC for limited durations.

****If breeding temperature is not reached, mussels may survive but will not reproduce.

Section 3: Gather and Review Site Data

Version 1:

- Gather and Review Site Data
- Facility Walkthrough
- General Component Impacts
  - Specific component impacts and checklist e.g.: Valves, pumps and turbines, trash racks and screens etc.
- Analysis of Risk

Version 2:

- Similar effects expected

Section 4: Options to Mitigate Risks and Adapt

Version 1:

- Chemical controls
  - Chemical proactive
  - Chemical reactive
- Non-Chemical Controls
  - Non-chemical proactive
  - Non-chemical reactive

Version 2:

Many control methods in this guide were developed for zebra and quagga mussels. Their applicability to golden mussels is an active area of research. Verify species-specific efficacy, dosages, and regulatory requirements before implementation.

Step 5: Prioritize Actions for Mitigation and Adaptation

Version 1:

- Timelines for planning
- Considerations for policy
- Expected costs by facility type

Version 2:

- While detailed cost estimates for the effects of golden mussels have not been completed in North America, they are likely similar to those for zebra and quaggas. Some sources from South America also show costs associated with golden mussels.

Summary:

- Version 2 updates at-risk, not-at-risk water parameters based on “possibility” of survival at any life stage
- Golden mussels can survive in low-calcium, brackish, and even cold water at various levels and life stages
- For all mussels, calcium must be “available” based on pH
- Pockets of habitat may exist in larger systems, so test multiple sites/seasons
- Treatment and control options for golden mussels are still being researched and do not translate directly from zebra and quaggas

Questions?

James Littley, Chief Operating Officer

james.littley@obwb.ca

Quagga Mussels and Idaho Power

Snake River Quagga Mussels

Michael Stephenson

February 10,

Guide to this talk

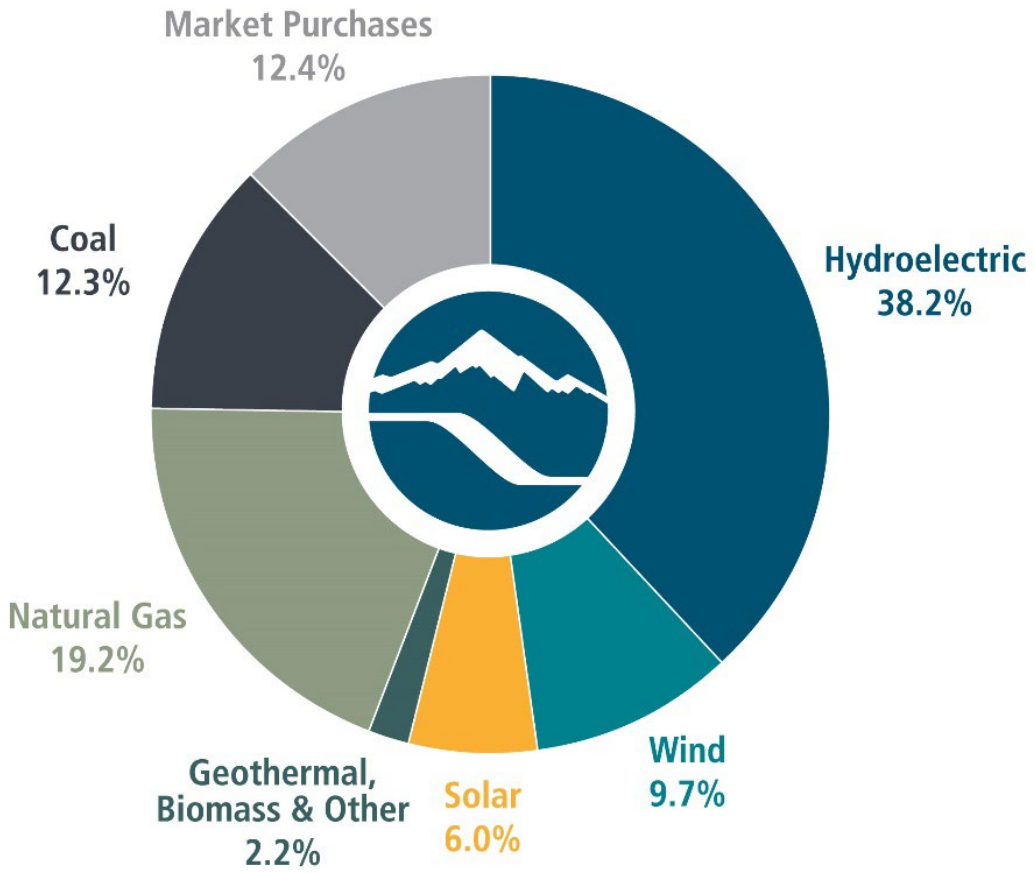
- IPC’s Invasive Species Program & Initial Preparation
- Why does Idaho Power Company care?
- What’s next for Idaho Power Company?
- How can Northwest Power and Conservation Council members help?

Dreissenid Mussels and Hydropower

Dreissenid Mussels on Trash Racks

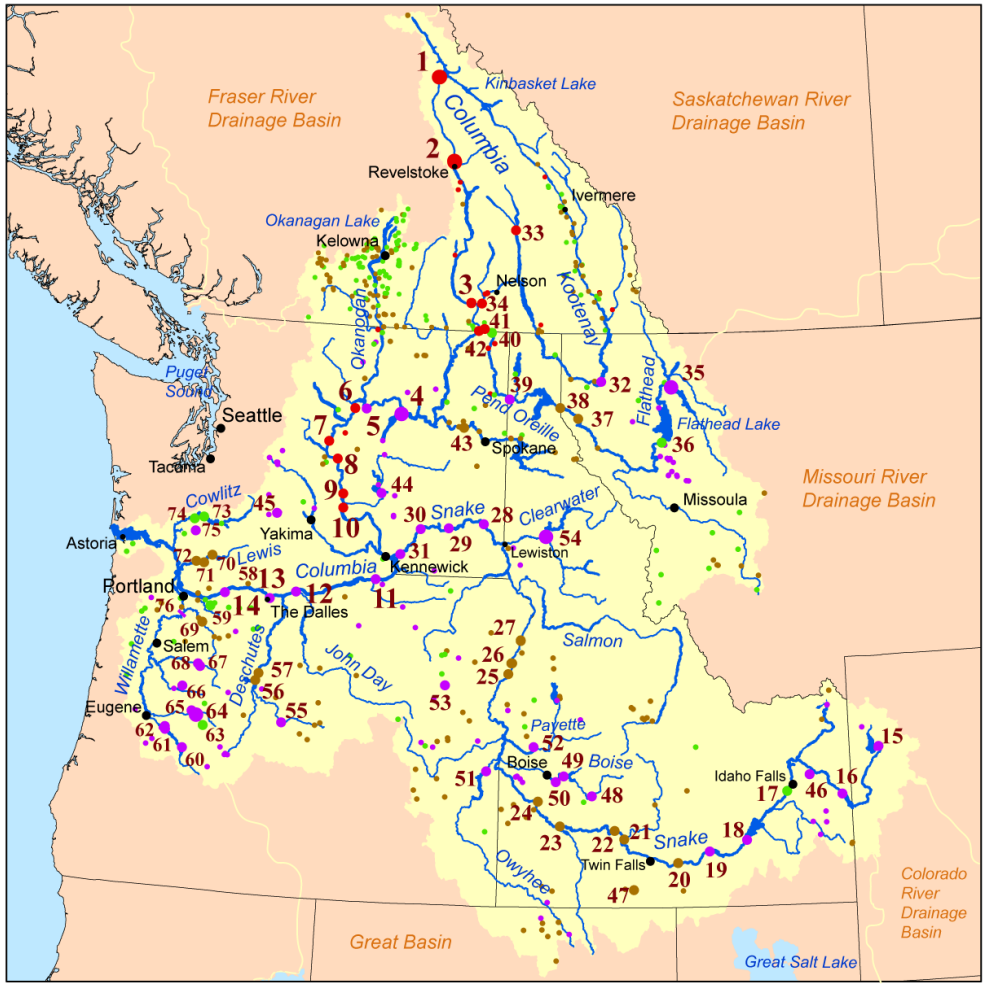
1	Hells Canyon	391,500 kW
2	Oxbow	190,000 kW
3	Brownlee	675,000 kW
4	Cascade	12,420 kW
5	Swan Falls	27,170 kW
6	C.J. Strike	82,800 kW
7	Bliss	75,038 kW
8	Lower Malad	13,500 kW
9	Upper Malad	8,270 kW
10	Lower Salmon	60,000 kW
11	Upper Salmon	34,500 kW
12	Thousand Springs	6,800 kW
13	Clear Lake	2,500 kW
14	Shoshone Falls	14,729 kW
15	Twin Falls	52,898 kW
16	Milner	59,448 kW
17	American Falls	92,340 kW

2025 Energy Mix



Data Source: U.S. Energy Information Administration.
Totals may not equal 100% due to rounding.

Hydropower in the Pacific Northwest



NWHA Website –Facilities by State

- Alaska 54
- Washington 97
- Oregon 97
- Idaho 94
- Montana 41
- California 390
- British Columbia 121
- Yukon Territory 4

898 Total

Idaho Power Company's License Compliance Concerns

Idaho Power Company Preparations

- Joined the Idaho Invasive Species Council.
- Joined regional Columbia River Basin Team.
- Joined Western Regional Panel.
- Vulnerability Assessments on IPC hydroelectric plants.
- Hosted Rapid Response Exercise in Hells Canyon 2019.

Contingency Planning

IDAHO POWER
An IDACORP Company

Dreissenid Mussel Management Plan

Michael Stephenson
Senior Biologist

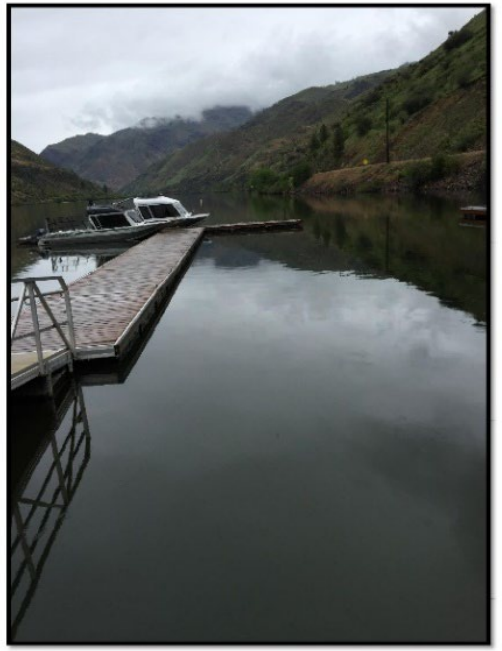
Dale Koger
Power Production Manager

Working Draft Report

August 2011

HELLS CANYON DREISSENID RAPID RESPONSE
EXERCISE SUMMARY

Copperfield, Idaho
May 20 and 21, 2019

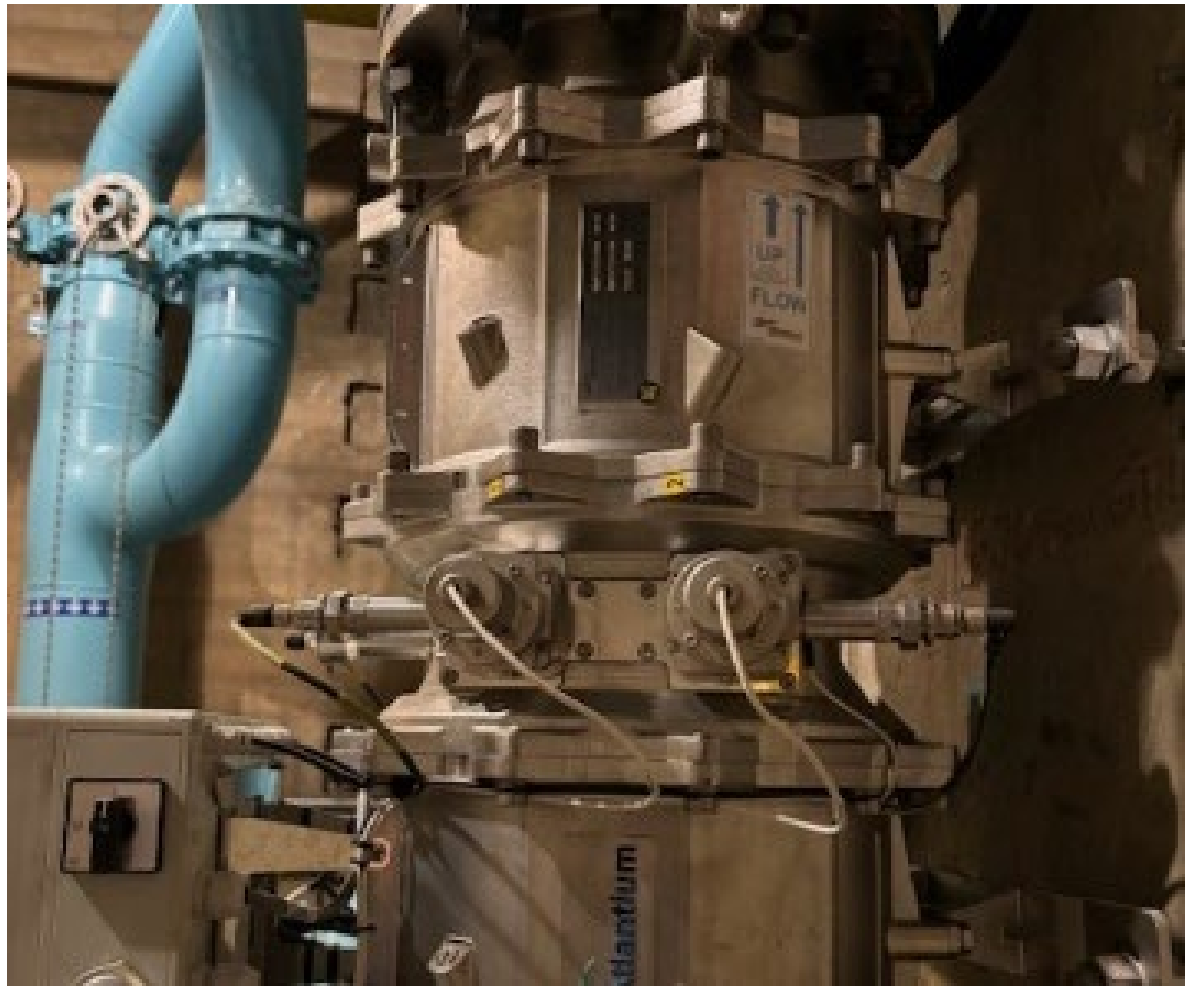


2023 Quagga Mussel Treatment

2024 IPC Hoover Dam Tour

Hoover Dam.SUPERJOSEPH / SHUTTERSTOCK

2024 Hoover Dam Tour Quagga Mussel Mitigation



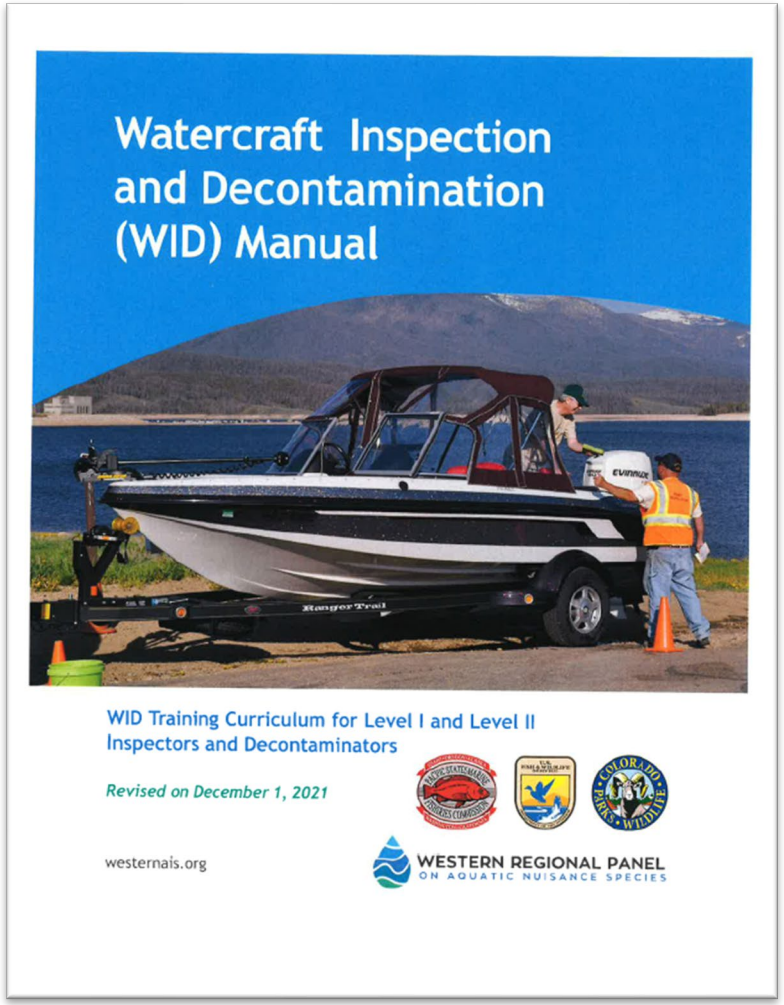
Idaho Power 2024- What did we do?

- Hosted a boat decontamination training put by Idaho State Department of Agriculture.
- Implemented mandatory decontamination of IPC boats moving between reaches of the Snake River.
- Created an internal “Lock Out” protocol to alert IPC boat operators if a boat has not been decontaminated (returning to same reach of the river).

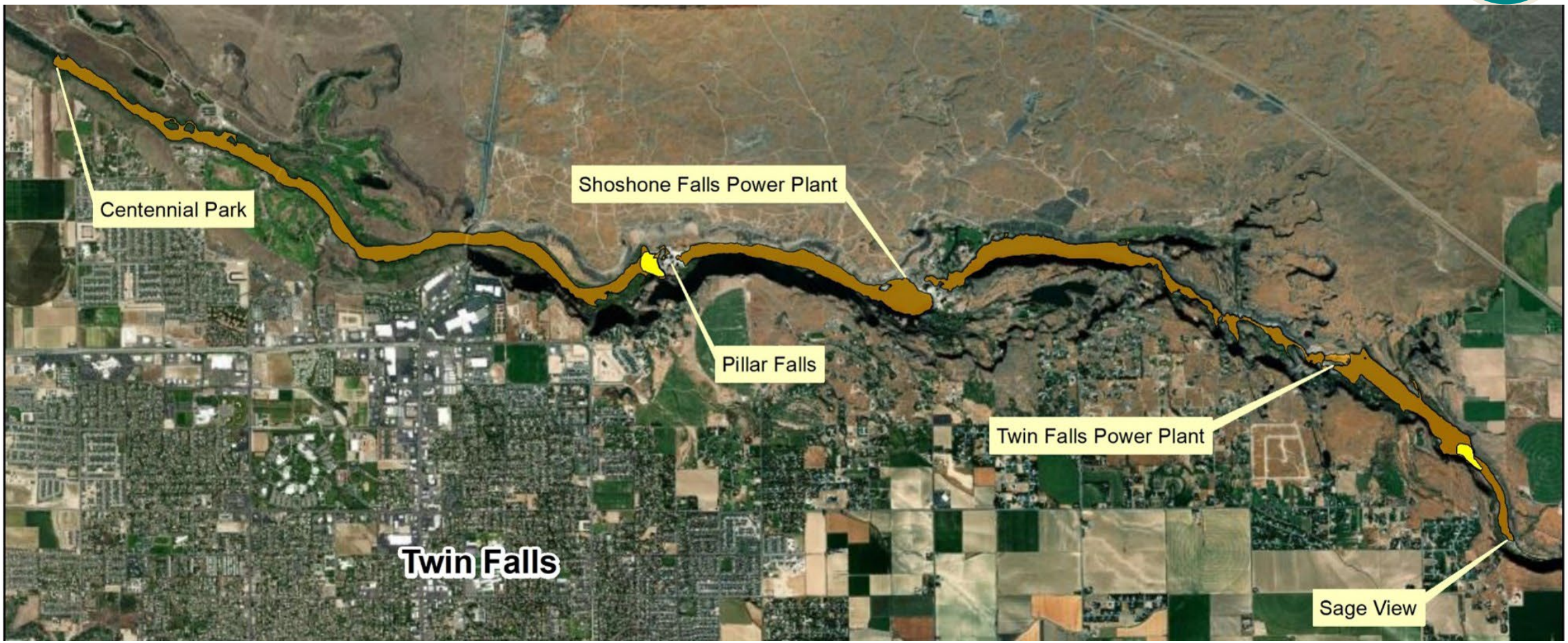
2024 Decontamination Training

2024 Decontamination Training

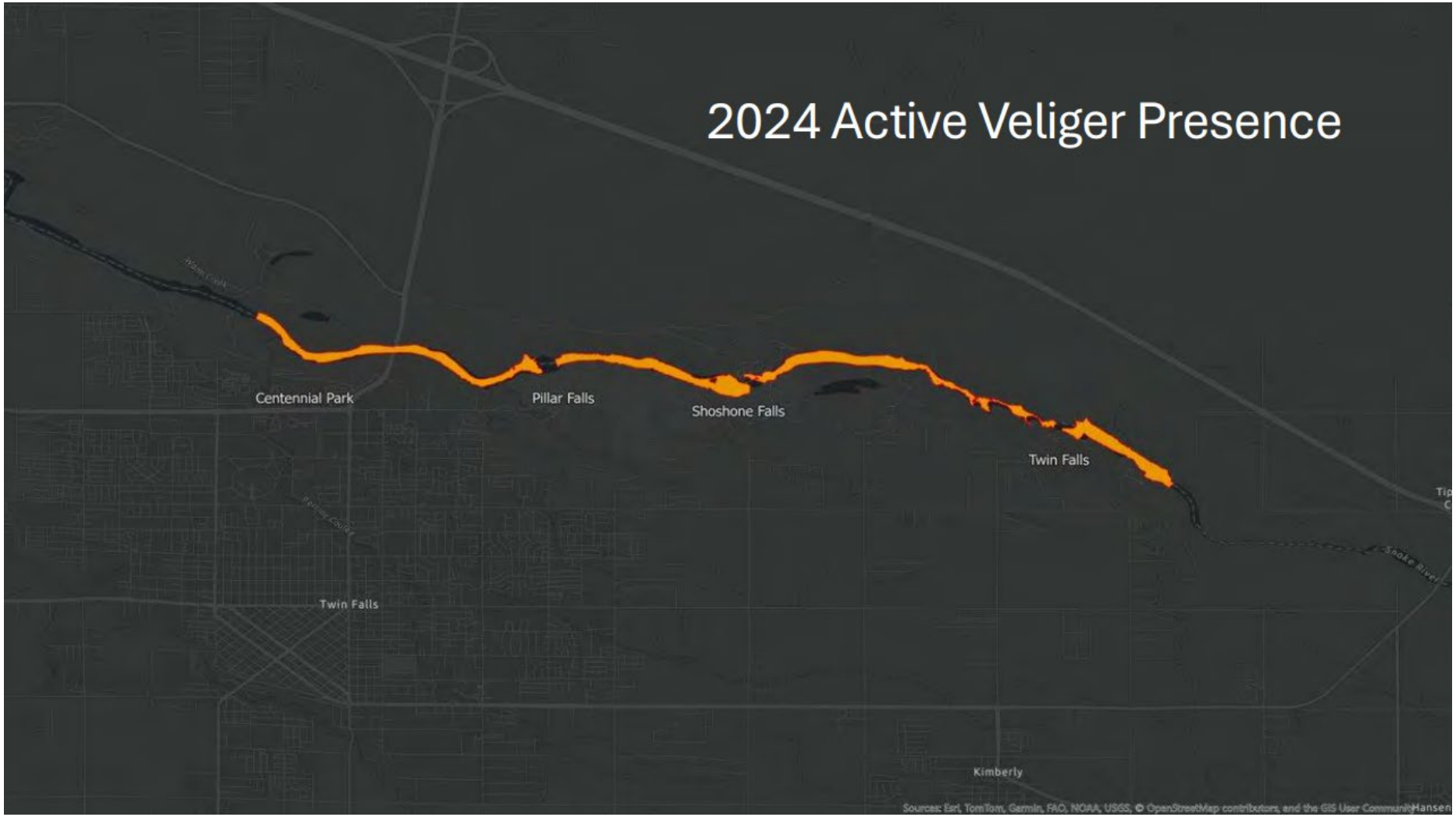
2024 Staff Decontamination Training



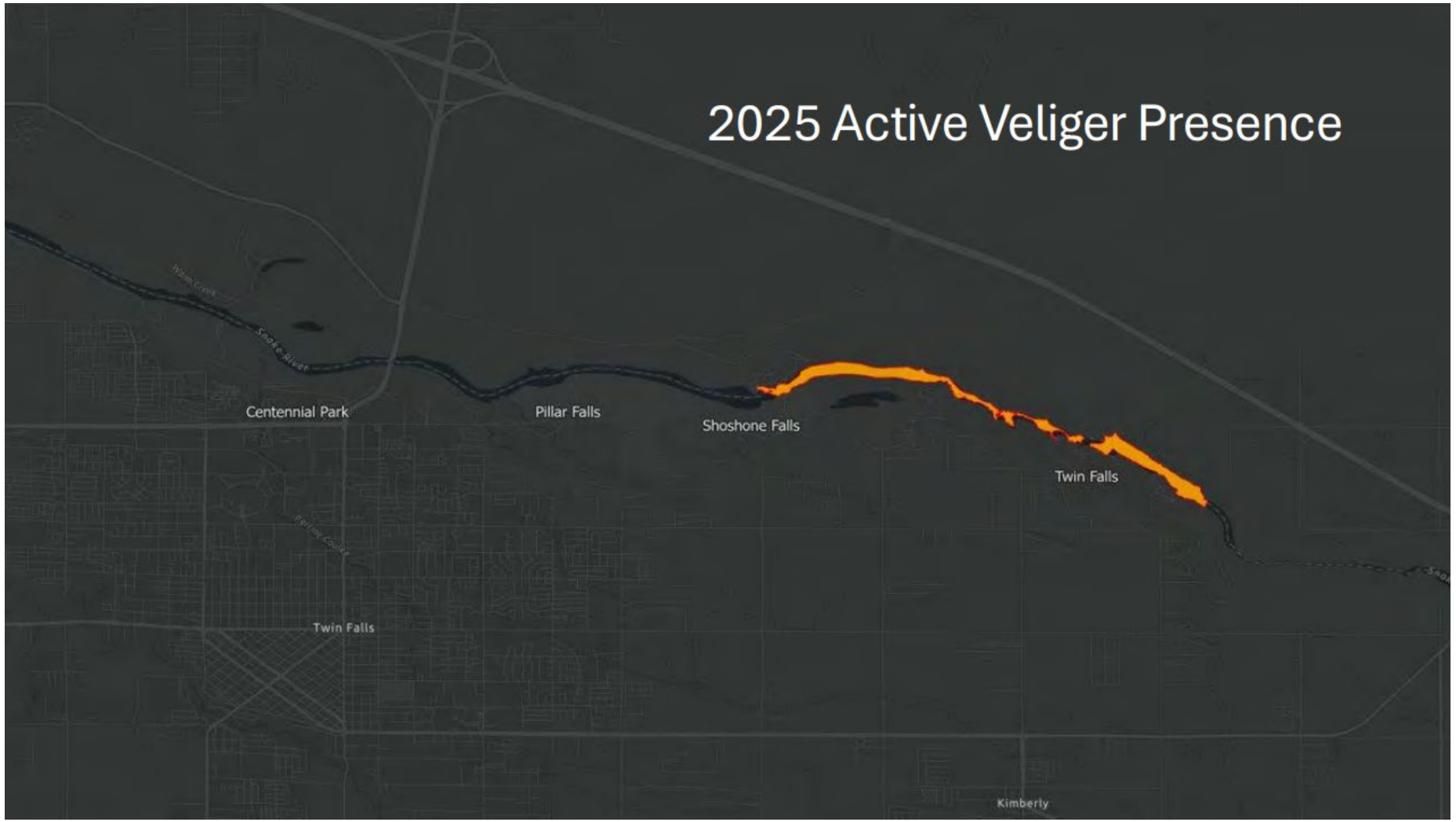
Twin Falls Treatment Area October 2024



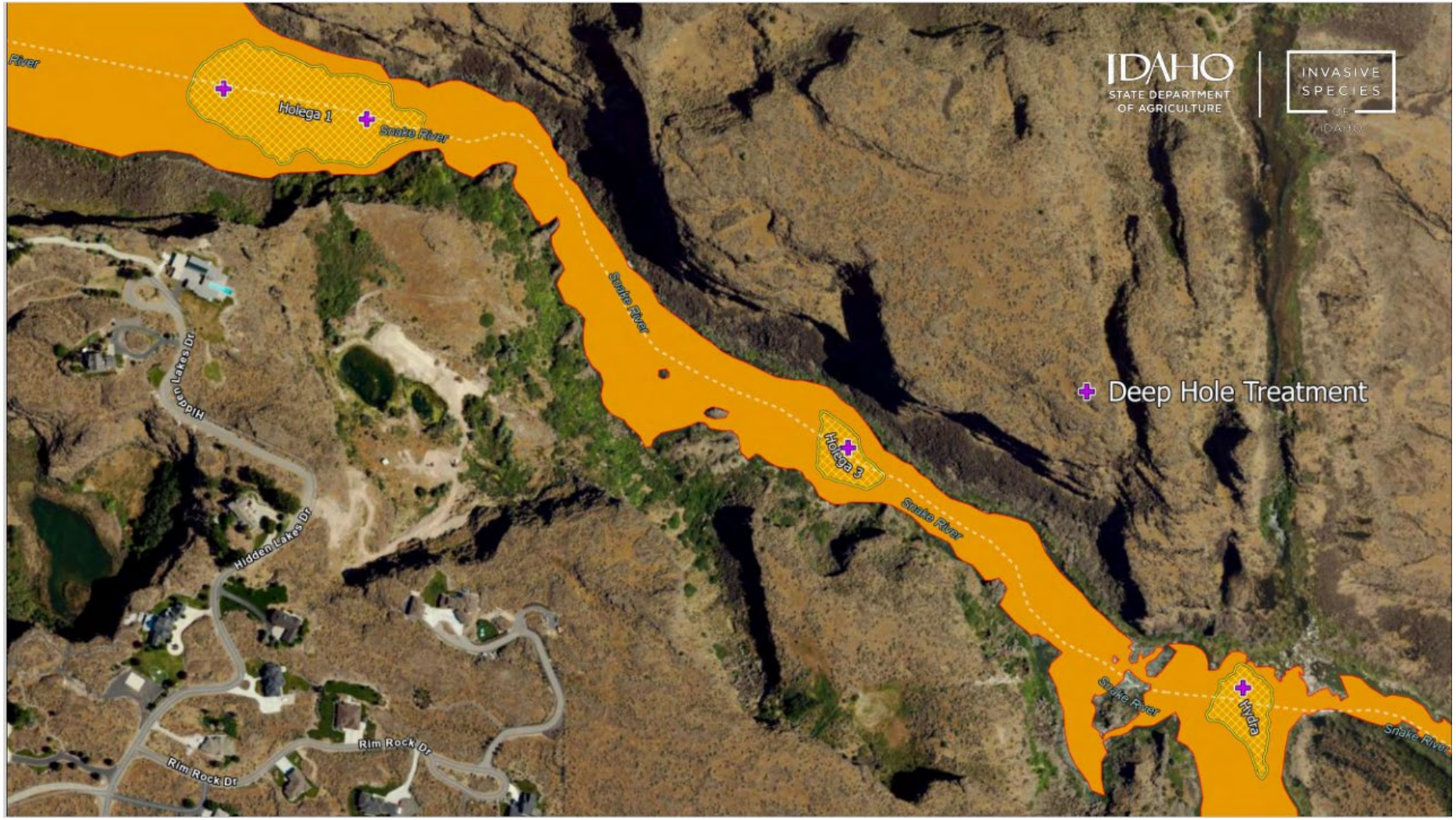
2024 Quagga Mussel Veliger Locations



2025 Quagga Mussel Veliger Locations



2025 Treatment Changes



Quagga Mussel Treatments and Idaho Power Company

- Treatments implemented by Idaho State Department of Agriculture and their contractors.
- Physical security concerns. FERC project boundaries.
- IPC safety concerns for personnel.
- Communication Planning.
- Logistics.
- Safety!

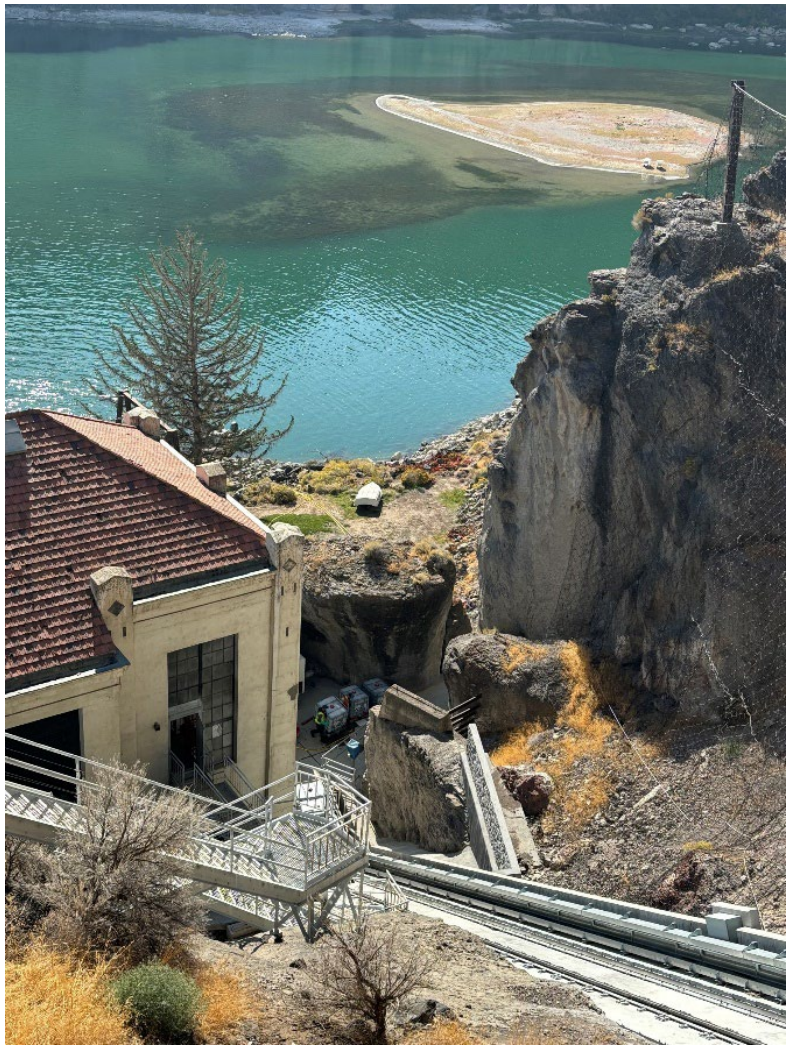
Idaho Power Company and Quagga Mussel Treatments

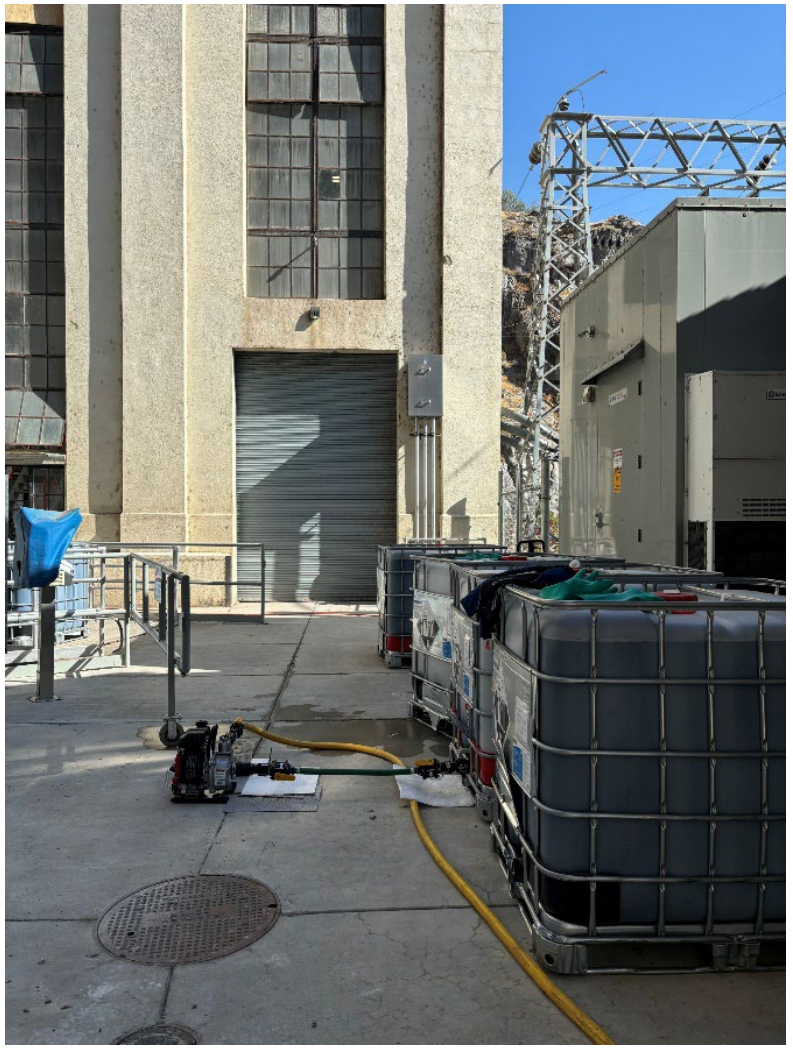
Physical security requires facilities to be staffed 24/7

1. Increased labor costs
2. Staffing concerns
3. Increased coordination with ISDA and their contractors
4. Problem solving to facilitate safe transfer of treatment chemicals
5. Trouble shooting to ensure all parts of the plants are treated

Shoshone Falls Treatment-2024

Shoshone Falls Staging and Chemical Transfer-2024





Twin Falls Intake- 2025

Idaho Power Company Recreation Facilities

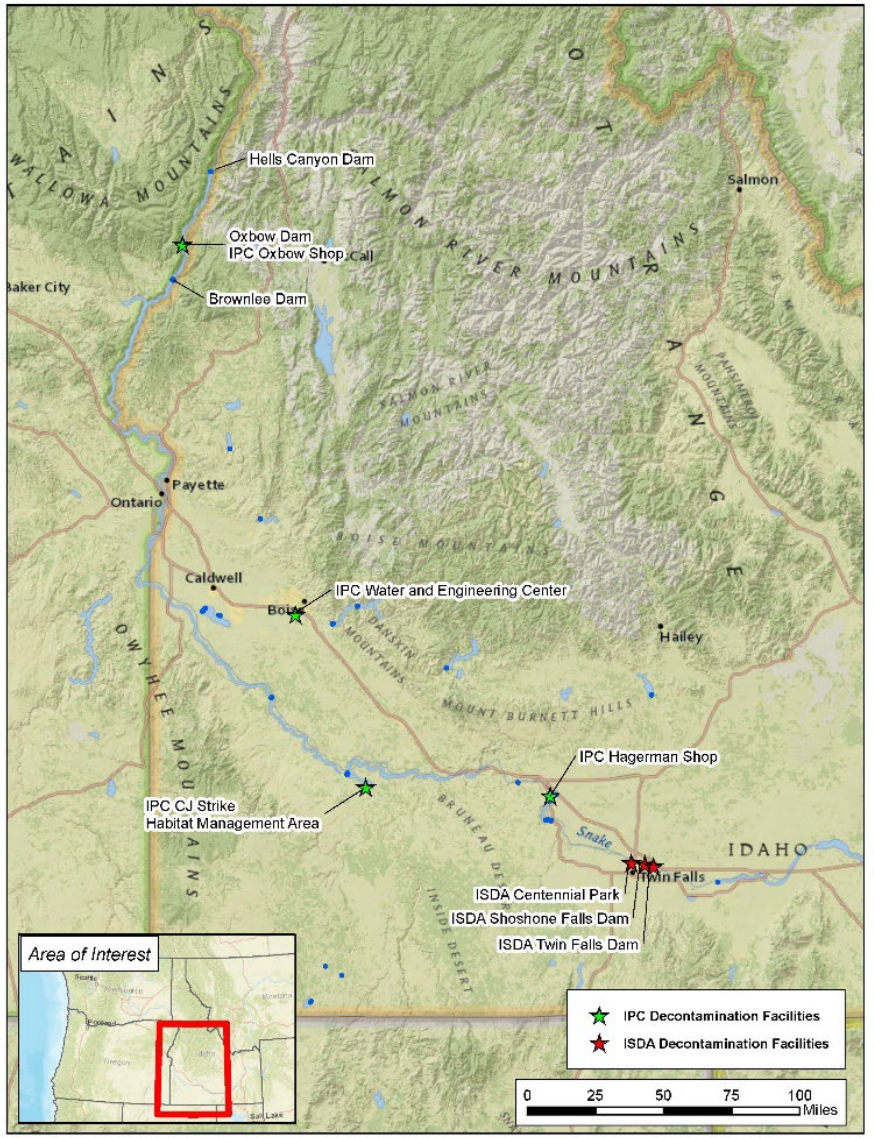
2025 Final Treatment

- ISDA potash treatment of ephemeral pools adjacent to Twin Falls and Shoshone Falls.
- Idaho Power Company focused on increased communication for safety and logistics.
- Daily check ins with ISDA crews on sampling efforts and crew's location.

Idaho Power 2025

- Presented at Northwest Hydroelectric Association meeting.
- September 2025- IPC hosted Association of Power Biologists in Hells Canyon.
- Created internal IPC training videos - how to decontaminate a boat and how to safely use a hot pressure washer.
- Power plants currently budgeting for improvements to plant infrastructure-redundant equipment and anti-fouling coatings.
- Networking with other utilities.
- Scoping UV Treatment System upgrades and filtration.

Idaho Power Decontamination Locations



What's next?

- Purchasing 3 additional hot pressure washers. Including a new location in Lewiston, ID.
- Preparing for possible future treatments.
- Contingency Planning updates.

What can Northwest Power Planning and Conservation Council members do?

Questions?

Michael Stephenson
Mstephenson@idahopower.com

Protect our WAters:
State of Washington Approach to Invasive Freshwater Mussel Readiness

Justin Bush (He/Him)

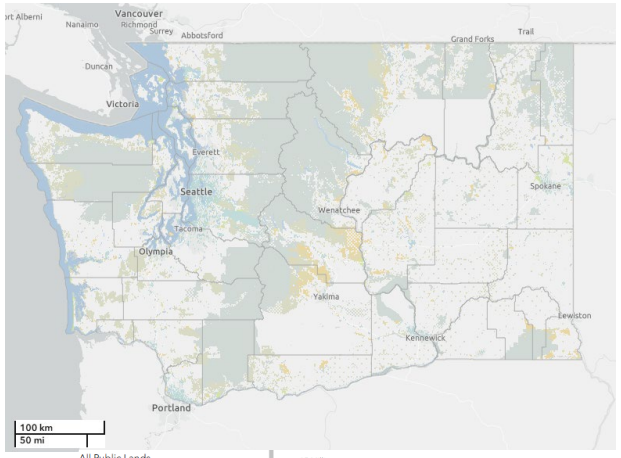
Aquatic Invasive Species (AIS)
Division Manager

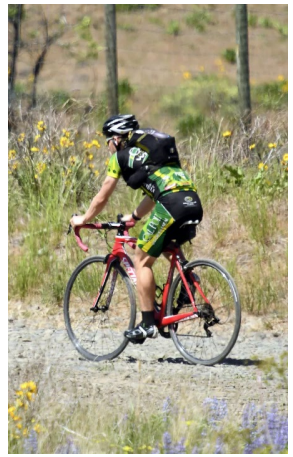
Washington Department of FISH & WILDLIFE

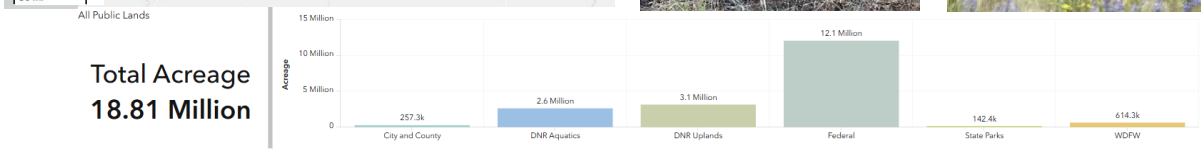
State of Washington

- 8.12 million residents
- 21 treaty tribes, 8 executive order tribes
- 39 counties, 281 cities and towns
- 42.6 million acres of land: 44% public
- > 8,000 lakes, 74,000 miles of streams and rivers
- > 3,000 square miles of marine estuary
- 47 species listed as endangered, threatened, or sensitive
- 75 ports, including 11 deep-draft
  - Marine Highway (M)-5 along Pacific Coast
  - M-84 pm the Columbia/Snake River system (365 miles)
  - Puget Sound and Salish Sea
- 145 federally regulated or owned dams
- Home to significant Indo-Pacific military readiness and strategic defense capabilities and logistics infrastructure

📷: WDFW







📖 📈: Washington Recreation and Conservation Office

📷: WDFW

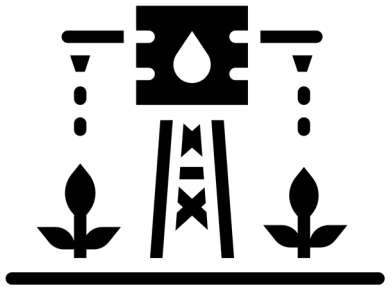
📷: Grace Thornton, WDFW

State of Washington

$31.2 billion Columbia River and $80 billion Puget Sound shipping

- Commodities and products
- Key U.S. trade gateway
  - **Leading** wheat export pathway
  - **Second** soy and corn export pathway

📈: Pacific Northwest Waterways Association, Puget Sound Pilots



$14 billion Agricultural production

$9.6 billion

Irrigated agriculture

- 75% of Washington's agriculture crops irrigated
- Top 10 commodities: Apples, Cattle and Calves, Milk, Potatoes, Hay, Wheat, Eggs, Hops, Onions, Grapes

📈: Washington State Department of Agriculture

$20.5 billion

Outdoor recreation and fisheries

- $5 billion in outdoor recreation involving public waters
- $1.5 billion in recreational fisheries
- $14 billion in commercial salmon fisheries

📈: Washington Recreation and Conservation Office (2020)

Invasive Freshwater Mussel Economic Risk

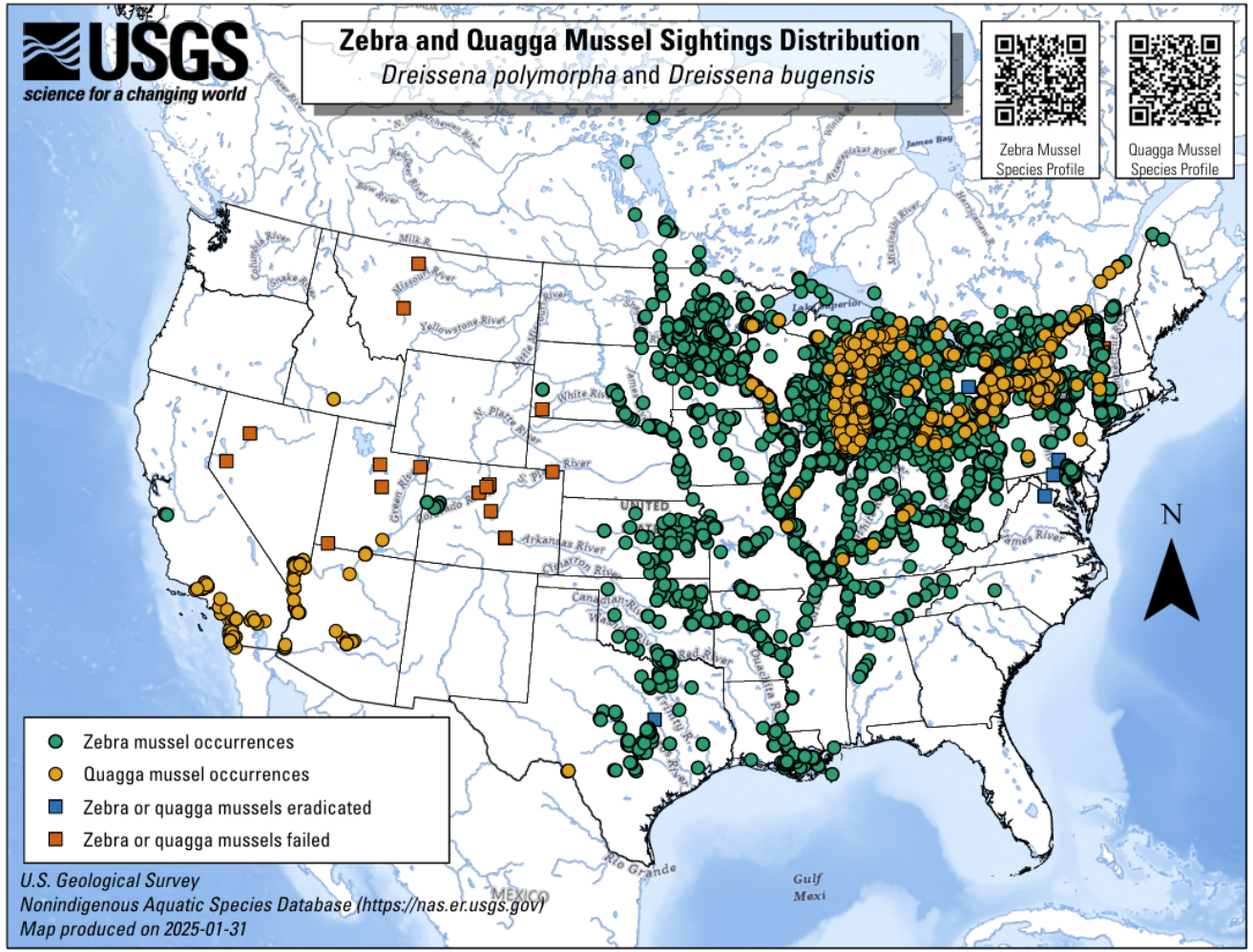
- $100 million annual hydroelectric mitigation and maintenance.

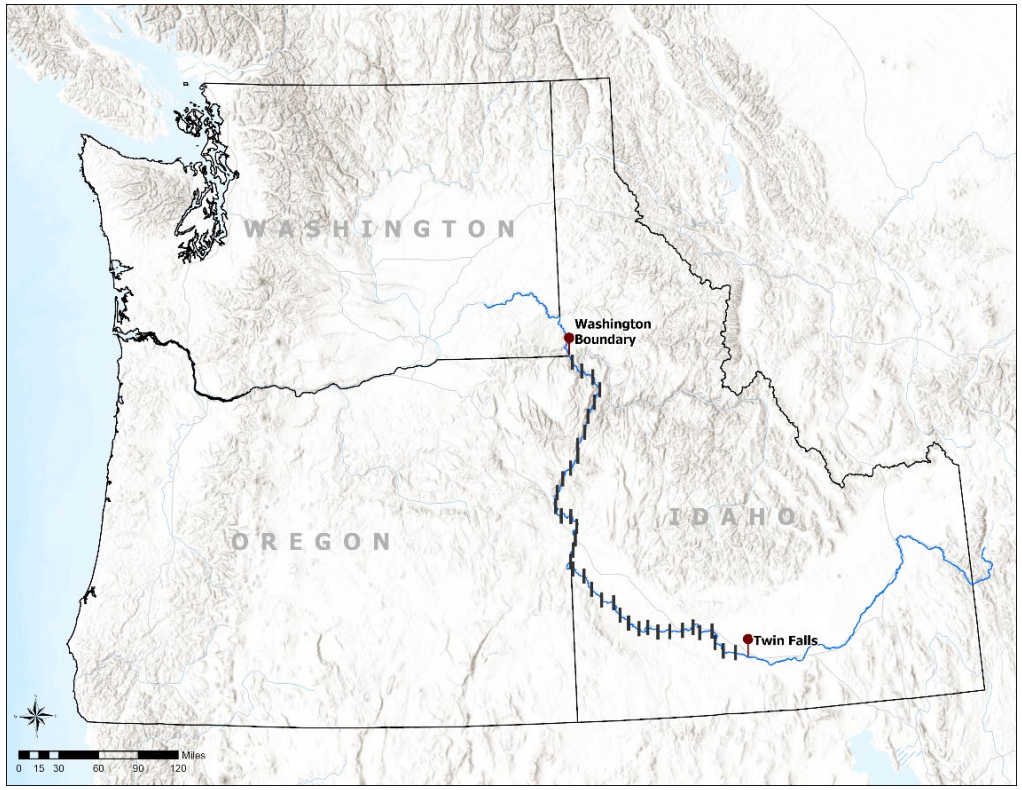
- Anticipated similar mitigation and maintenance costs for:
  - Fish Hatcheries
  - Fish Passage Infrastructure
  - Agricultural Irrigation Systems
  - Drinking and Wastewater Systems
  - Legacy Data Centers
  - Navigational Locks

Invasive mussels fouling a penstock gate at Davis Dam.
📷: U.S. Bureau of Reclamation

Dense colonies of zebra mussels can clog intake pipes.
📷: Marrone Bio Innovations

Quagga and Zebra Mussel Distribution



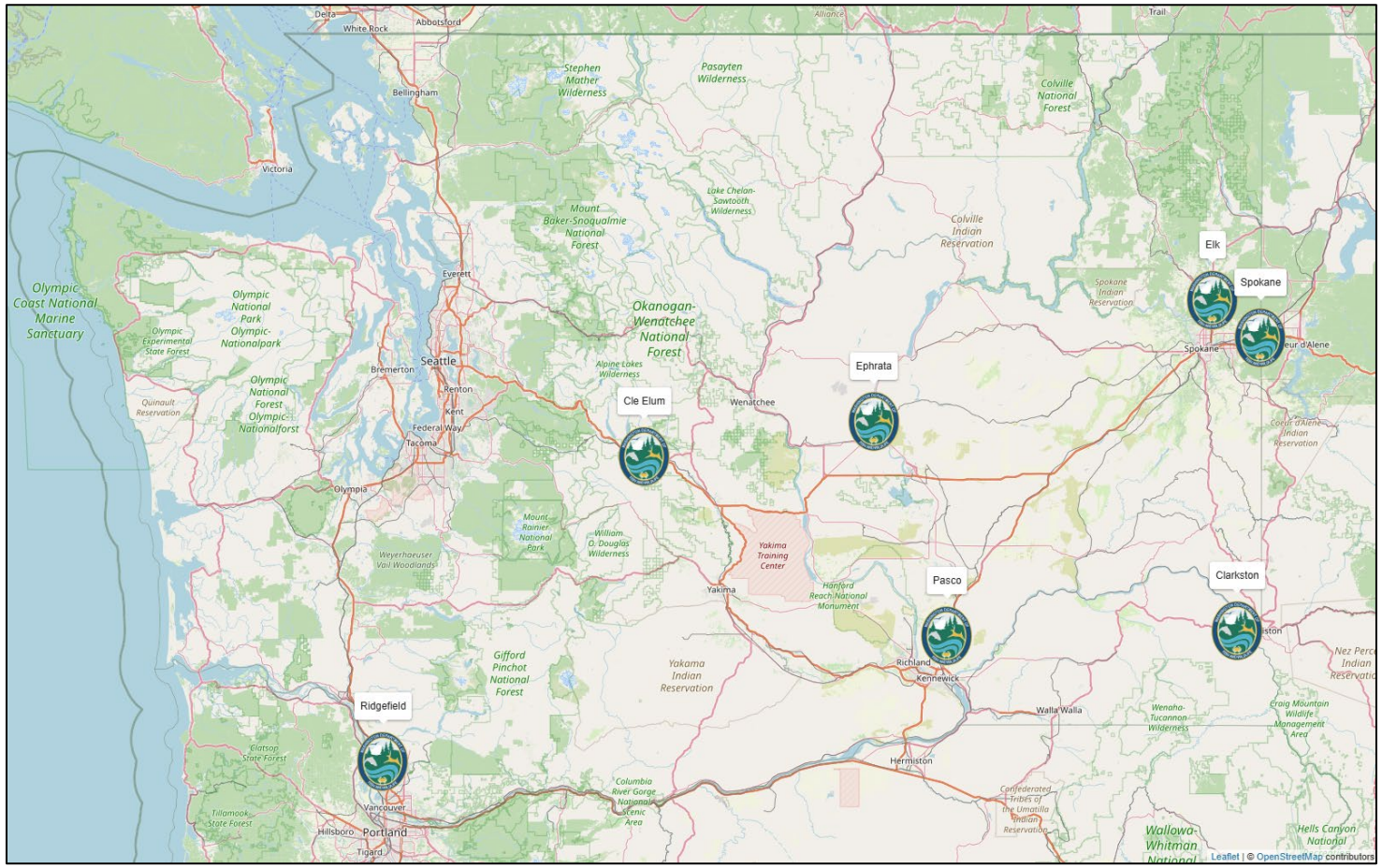


Twin Falls, Idaho is approximately 375 River Miles from Washington waters, and 175 miles from Oregon Waters.

: Washington Department of Fish and Wildlife

Watercraft Inspection and Decontamination

	2023	2024	2025
Watercraft Inspected	55,810	56,388	61,137
Mussel Fouled Watercraft	23	18	21
Total Decontaminations	1,116	1,320	3,374



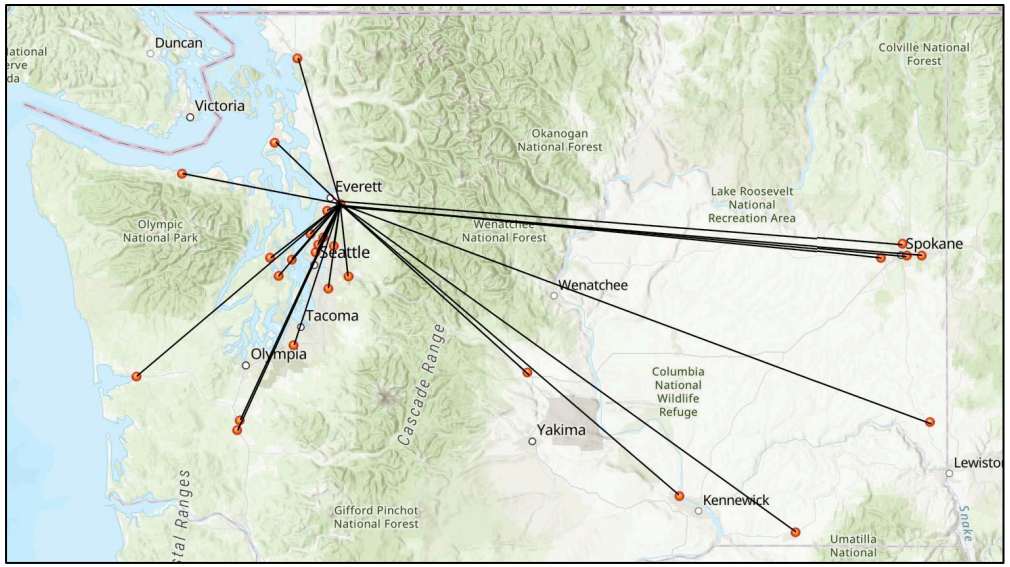
& Washington Department of Fish and Wildlife

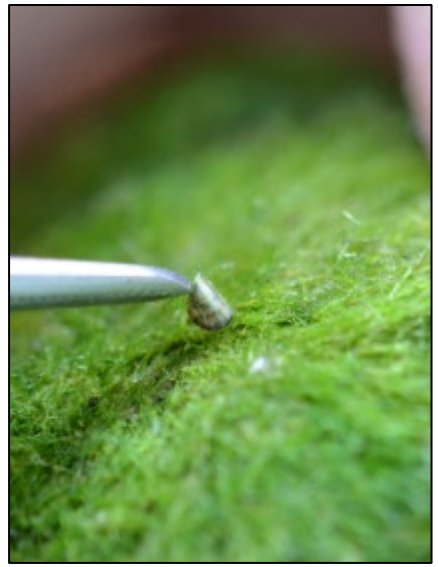
Jan. 2025 Largest Interception on Record:
Increased Prevention and Readiness in Action

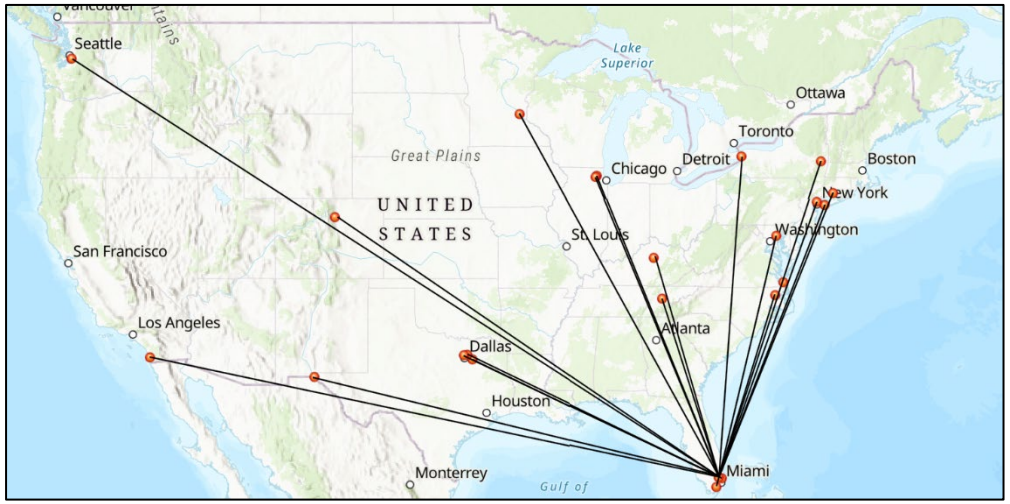
- Conveyance:
  - 2 Tugboats; 1 infested
  - 30 feet length
- Origin: Lake Michigan
- Interception Point: Spokane (Liberty Lake)
- Interception: 21 gallons of invasive mussels – analysis indicates some may have been **alive**
- Staff Time: 20 hours

📷: Washington Department of Fish and Wildlife

Marimo Moss Ball Zebra Mussel Incident (Aug. 2024)







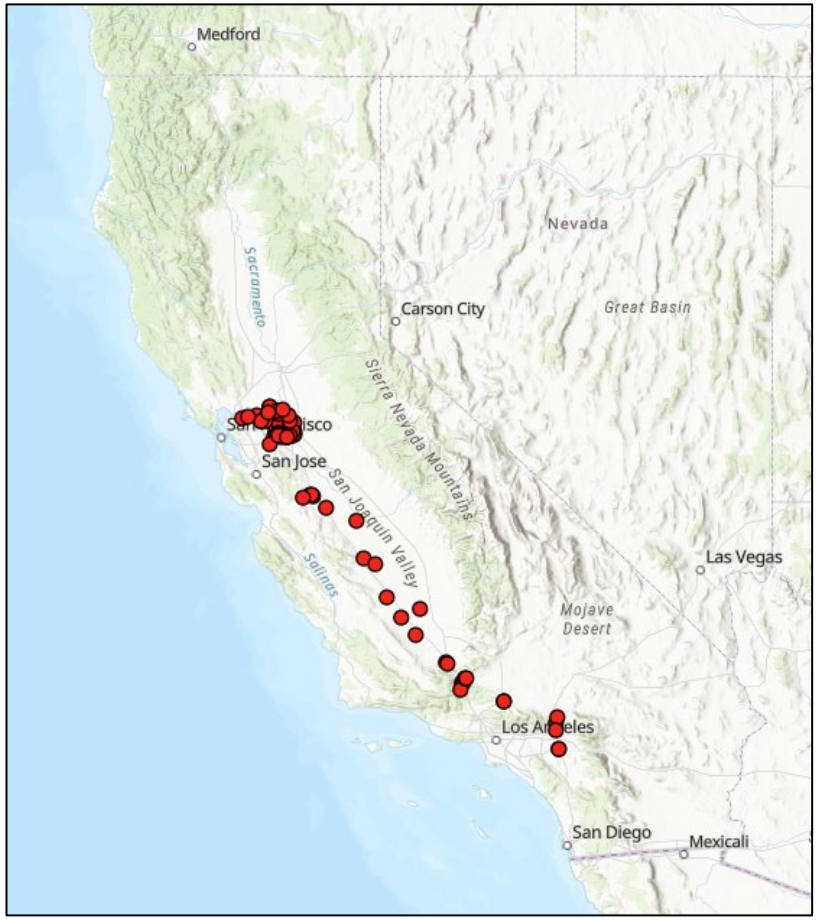
🗺️ & 📷 Washington Department of Fish and Wildlife

U.S. Marine Highway System

📘 : U.S. Department of Transportation Maritime Administration

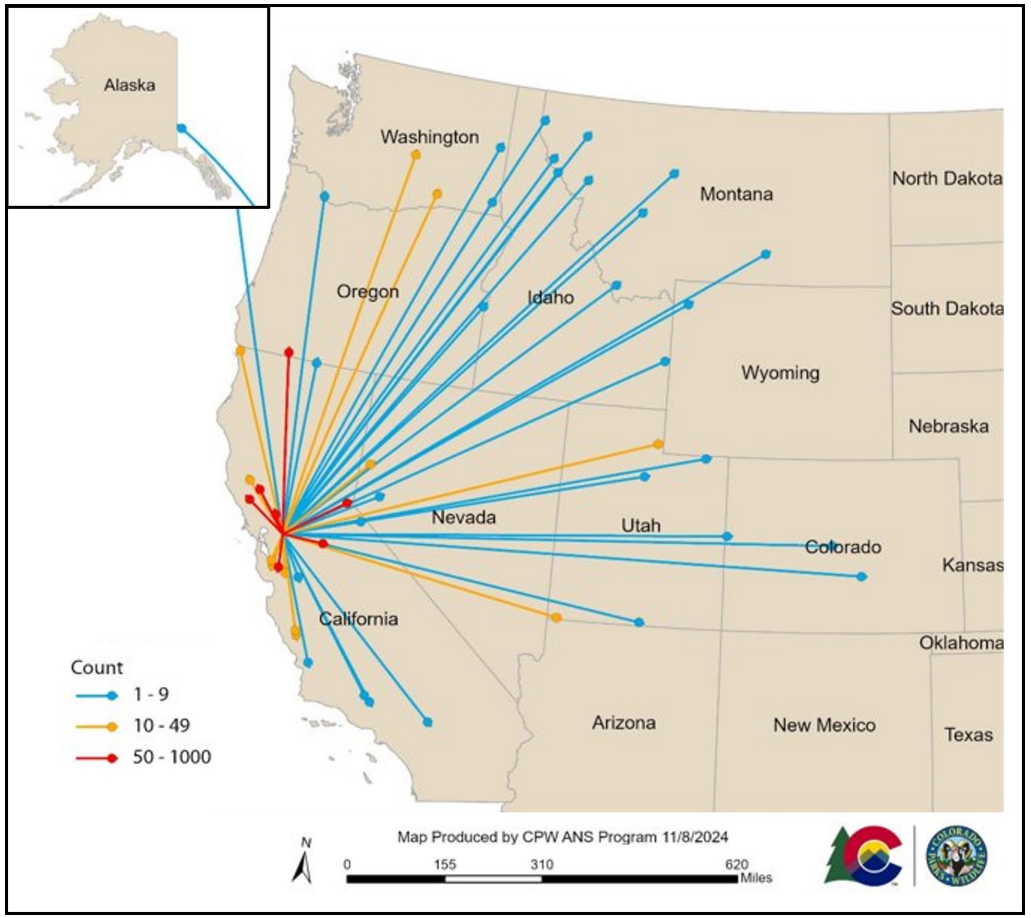
Golden Mussels in Sacramento Delta

Golden Mussel
Survey Results in California



🗺️: California Department of Fish and Wildlife

2024 Watercraft Inspections Where
“California Delta” was Last Water Visited



🗺️: Colorado Parks and Wildlife Department

Zebra Mussel Spread 1986 - 2006

U.S. Marine Highway System

🗺️: U.S. Department of Transportation Maritime Administration

1986

🗺️: U.S. Geological Survey

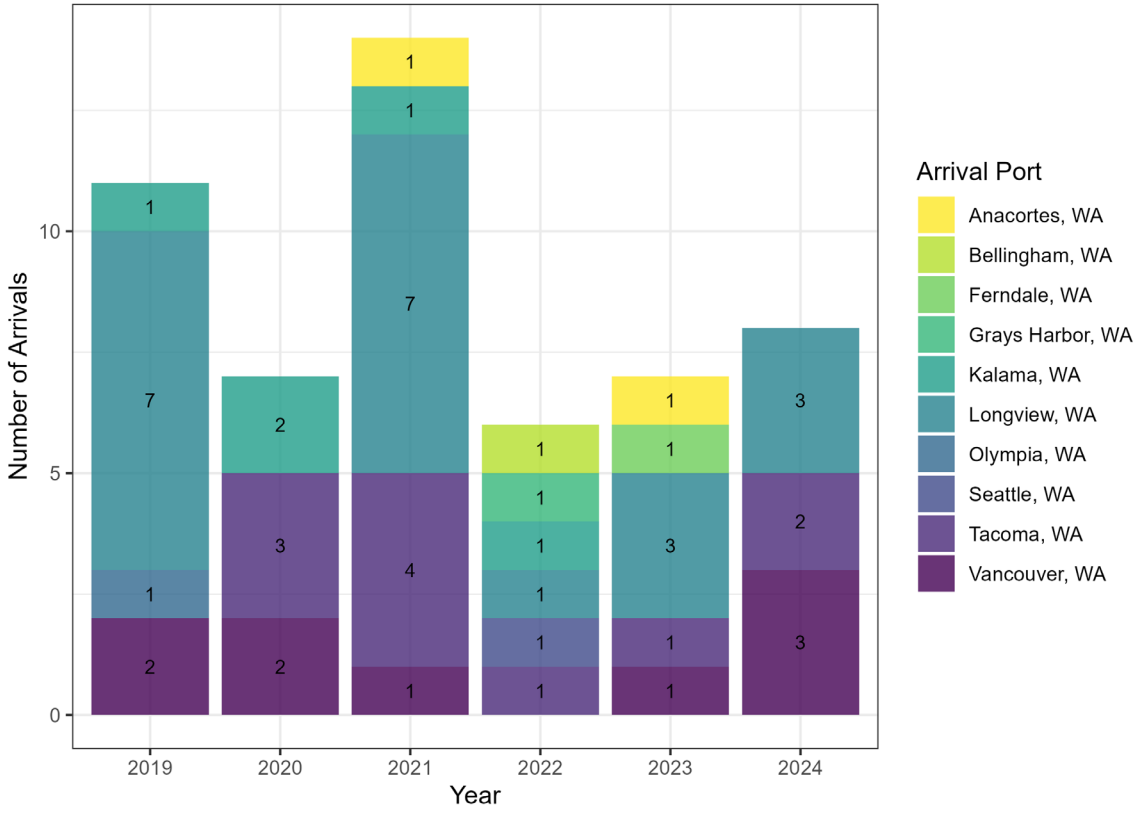
1996

🗺️: U.S. Geological Survey

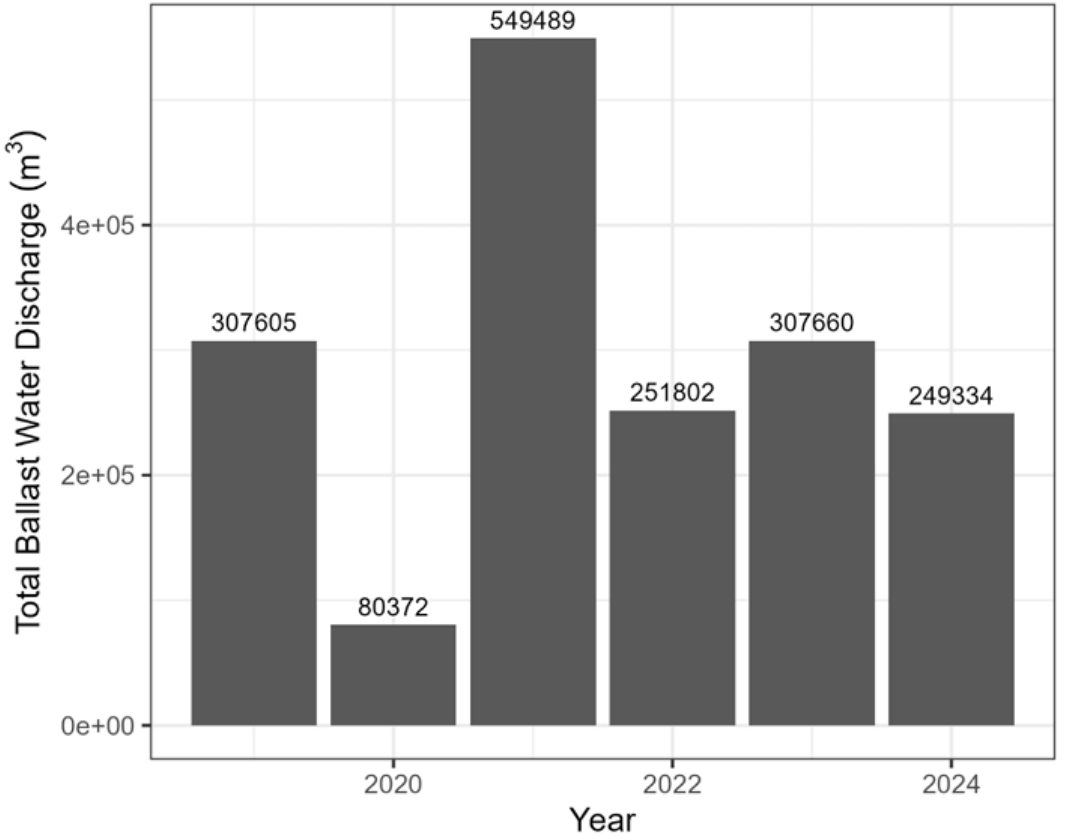
U.S. Geological Survey Non-Indigenous Aquatic Species Zebra Mussel Animated Map
https://nas.er.usgs.gov/queries/SpeciesAnimatedMap.aspx?speciesID=95

Golden Mussels Ballast Water Introduction Risk

Regulated transoceanic vessel arrivals from Stockton area, California to Washington ports 2019-2024.



Ballast water discharged to Washington from 2019-2024 that contained water sourced in Stockton area.



2020 (low) = 21,232,036 gallons versus 2-8 gallons of water is retained in a wake boat

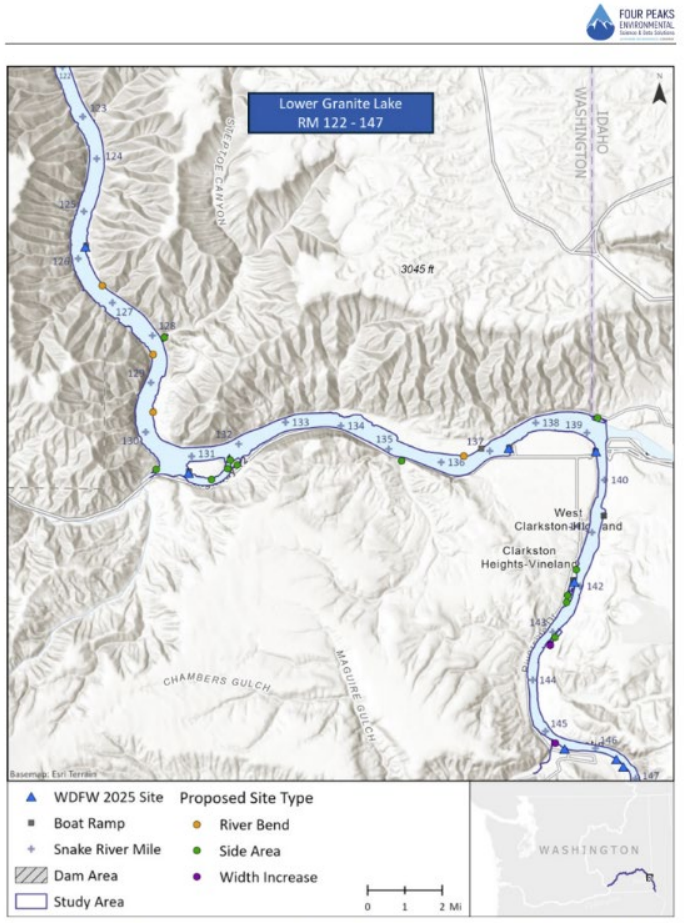
Assessing and Mitigating Infrastructure Risks

1. Understanding Downstream Spread

- Historic early detection monitoring focused on 26 criterion focused on human-mediated introduction.
  - Waterbody open to public, motorized watercraft allowed, fishing tournament, stocked with fish, etc.

- Phase 1: Spatial assessment modeling where sediments likely settle out:
  - Back and side channels.
  - Insides of river bends.
  - Locations where the cross-sectional width of the river increased.
- Identified new 74 new monitoring sites between River Mile 176 and 108.

- Phase 2: Hydraulic model using simulated veligers.



Attachment Figure A-3. Proposed and existing study sites, Lower Granite Lake between river mile 122 and river mile 147

: Four Peaks Environmental Science and Data Solutions on behalf of the Washington Department of Fish and Wildlife

2. Developing Containment Systems and Testing

🗺️: U.S. Army Corps of Engineers
Engineering Research and Development Center

- Building on 2019 field operations response exercise in November 2026 at Central Ferry Habitat Management Unit .
- Deploying and testing specifically designed containment systems.
- Bulk water exchange testing using a dye and taking readings for up to 48hours.

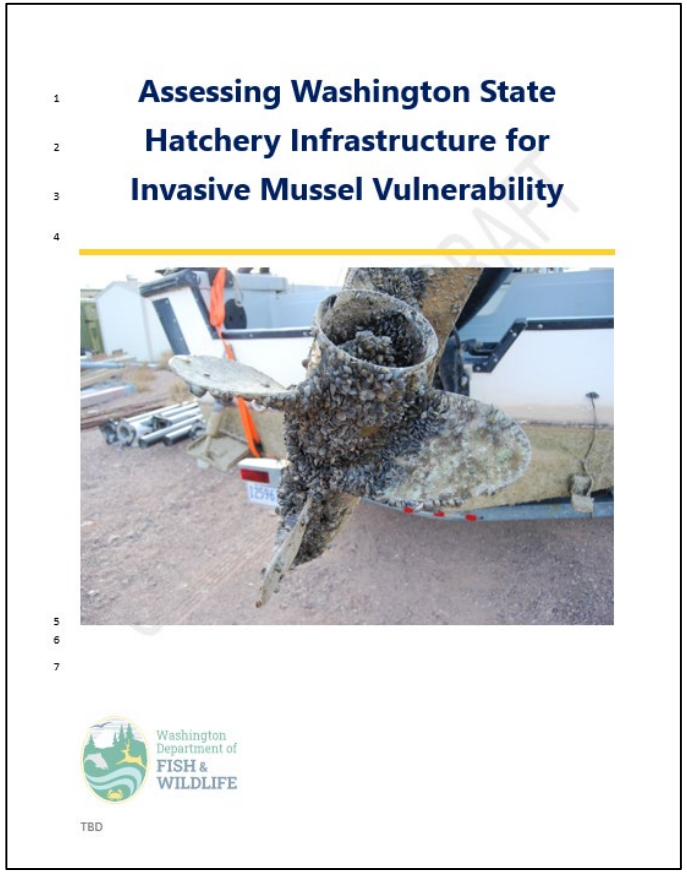
📷: Washington Department of Fish and Wildlife

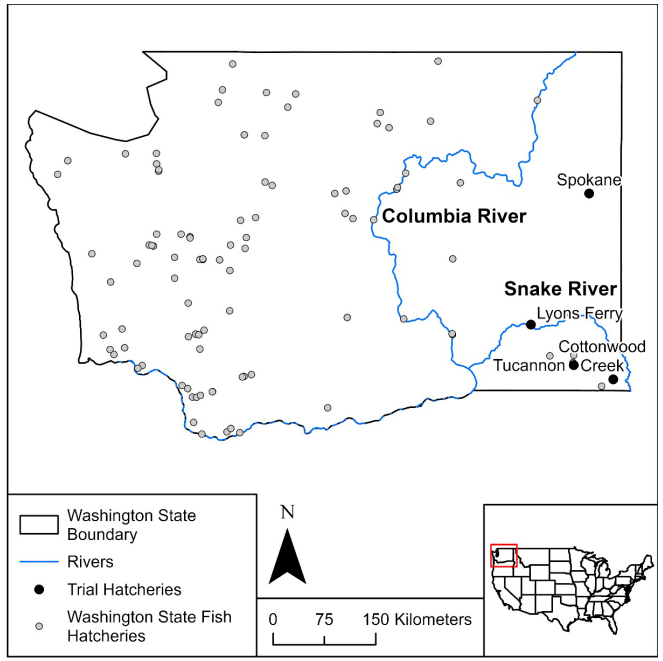
3. Understanding Fish Hatchery Vulnerabilities

Developed by U.S. Geological Survey (USGS) fish hatchery attributes such as:

- Facilities
  - Structures and materials
- Site Conditions
  - Water flow and quality
- Maintenance
  - Dewatering, freezing
- Biosecurity Practices
  - Dedicated equipment and supplies (nets, waders)

- In final stages of federal approval and unpublished





5. Exploring Engineering Solutions

Assessment of fish hatchery aquatic invasive species mitigating engineering solutions

- Proxy Species: New Zealand mud snails
- Location: Columbia Basin Fish Hatchery (Moses Lake)
- Evaluating and comparing engineering-based options to prevent the introduction, establishment, and persistence of invasive mussels and other aquatic invasive species within hatchery water systems.
- Identifies vulnerabilities within hatchery infrastructure and operations.
- Analyzes feasible technologies, and assesses their effectiveness, and operational constraints.
- Culminates in ranked recommendations and an implementation framework.

New Zealand Mud Snails

📷: WDFW

Soos Creek Fish Hatchery

📷: WDFW

6. Emergency Ballast Water Management Systems

- WDFW has convened a public/private working group to gather input on a port-based emergency ballast water treatment option for regulated vessels is desirable and feasible in Washington State.
- Working group meeting 2-3 times between February and April/May 2026.
- Potential applications within or supporting other raw water infrastructure or aquatic conveyances.

Increasing Preparedness for Raw Water Infrastructure Managers

Case Study – Skagit Hydroelectric Project (2025)

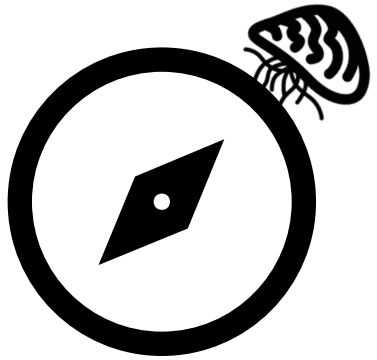
- Brought several large, portable, sectional barge platforms to the project to support in-water work
- Seattle City Light staff were trained in Watercraft Inspection and Decontamination (WID) and aware of invasive freshwater mussels and risk
- Seattle City Light staff followed protocols to inspect all equipment
- Seattle City Light staff found mussels on the portable barge platforms, alerting the state and decontaminated the equipment

: Seattle City Light

: Seattle City Light

Increasing Preparedness for Infrastructure Managers

1. Coordinate across jurisdictions and sectors; invasive mussels cross boundaries
2. Prioritize prevention; it is far less costly than long-term mitigation
3. Assess site-specific risk and vulnerabilities using standardized tools; adapt tools to identify risk and vulnerabilities of additional sectors
4. Institutionalize prevention through contracts, procurement, and operations
5. Implement monitoring, early detection, and detection notification capabilities
6. Document and promote both site and regional risks, pathways, and coordinated actions



Aquatic Invasive Species Division
ais@dfw.wa.gov
1-888-WDFW-AIS

Justin Bush
Justin.Bush@dfw.wa.gov
564-669-9486