Attachment 6
Navigation Discipline Report

CAPITOL LAKE – DESCHUTES ESTUARY

Long-Term Management Project Environmental Impact Statement

Navigation Discipline Report

Prepared for:

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Executive Summary

This Navigation Discipline Report evaluates the potential impacts of the Capitol Lake – Deschutes Estuary Long-Term Management Project on vessel navigation. Vessel navigation includes the ability to access and berth at a dock or slip in the West Bay of Budd Inlet. Recreational vessel use of Capitol Lake is addressed in the Land Use, Shorelines, and Recreation Discipline Report.

Impacts to vessel navigation are assessed based on the potential of project alternatives to interrupt or change the number of vessels using existing vessel facilities or resources (i.e. the Port of Olympia, West Bay marinas) or in the access patterns (i.e. channels) to these facilities. This analysis examines the No Action Alternative as well as three build alternatives (Managed Lake, Estuary, and Hybrid).

Construction Impacts on Navigation

Construction would not impact vessel navigation in Budd Inlet as none of the build alternatives include construction activities north of the 5th Avenue Dam. Initial dredging and other construction activities would be conducted from staging areas; equipment would be located and maintained within the Capitol Lake Basin or in adjacent upland park spaces. As a result, there would be **no impacts** from construction on navigation under the Managed Lake, Estuary, or Hybrid Alternatives.

The No Action Alternative would not result in construction impacts on navigation because the project would not be built. Potential impacts would be related to limited, ongoing maintenance of the 5th Avenue Dam and ongoing sedimentation of the Capitol Lake – Deschutes Estuary. Ongoing existing maintenance dredging is still anticipated to be completed by the U.S. Army Corps of Engineers (USACE), Port, and West Bay marinas, but implementation of a long-term maintenance dredging program would not occur. Therefore, operational impacts on navigation would be **less than significant** for this alternative.

Operational Impacts on Navigation

The Managed Lake Alternative would not modify the general function or location of the 5th Avenue Dam, nor does it include dredging north of the dam in Budd Inlet. The study area would still observe

sediment deposition and the USACE, Port, and private marinas would still be anticipated to conduct existing maintenance dredging activities to maintain vessel access and berth use. Implementation of a long-term maintenance dredging program in Budd Inlet's West Bay would not occur under this alternative (maintenance dredging would occur only within the Capitol Lake Basin) and operational impacts on navigation under the Managed Lake Alternative would be **less than significant**.

Both the Estuary and Hybrid Alternatives would remove the 5th Avenue Dam and restore tidal hydrology to the Capitol Lake Basin. These alternatives would reestablish sediment transport and deposition patterns from the Deschutes River and Percival Creek watershed throughout the Capitol Lake Basin and Budd Inlet. The Estuary Alternative, compared to the No Action Alternative, would increase sediment deposition within Budd Inlet under high river flow events. The Hybrid Alternative would result in even higher rates of deposition within Budd Inlet compared to the Estuary Alternative.

Increased sediment deposition within West Bay would impact the ability of cargo ships to access channels and berths at the Port of Olympia, requiring long wait times due to water depth and low tide conditions. Sediment deposition would also impact the ability of smaller craft vessels to access and use West Bay marina slips due to water depth. For these reasons, the Estuary and Hybrid Alternatives include initial dredging of the Capitol Lake Basin (resulting in a 48% reduction in impacts to sedimentation) to reduce initial sediment load and long-term maintenance dredging to reduce impacts to navigation and the implementation of a long-term maintenance dredging program.

Impacts to navigation from sediment deposition are considered significant if large commercial vessels accessing the Federal Navigation Channel (FNC) and Port would be required to wait longer than four hours for channel access due to water depth and low tide conditions caused by sediment deposition; or, if over 10% of anticipated small craft vessels would not be able to access their marina slip for moorage due to water depth caused by sediment deposition. An annual sediment monitoring plan is proposed to record sediment deposition changes allowing for maintenance dredging events to be scheduled to occur prior to reaching levels of significance. The incorporation of initial dredging and an adaptable long-term maintenance dredging program, combined with the implementation of a data-driven sediment monitoring plan, could reduce **significant impacts** to less than significant under the Estuary and Hybrid Alternatives.

Maintenance dredging, as part of the long-term maintenance dredging program, is expected to occur once every six years or more under the Estuary Alternative and once every five years or more under the Hybrid Alternative, depending on sediment deposition, over the 30-year time horizon, with the location of maintenance dredging rotating throughout West Bay to address impacted areas. Not every facility would be dredged during each occurrence, only those with impacted slips or berths that exceed the significance threshold. The long-term maintenance dredging program for both alternatives will require the USACE, Port, and West Bay marinas to schedule and coordinate berth and slip use around these events. Maintenance dredging at the Port or within the FNC Entrance Channel or turning basin will require coordination of cargo vessel calls and/or call interruptions. Maintenance dredging at the West Bay marinas could require slip vacancies for temporary periods of time. In tight marina spaces, piles or floats may need to be removed during dredging and boathouses may need to be relocated.

Impacts to navigation from a long-term maintenance dredging program are considered significant if large commercial vessels accessing the FNC and Port would be required to wait longer than four hours for channel access due to maintenance dredging activities or equipment, or if over 10% of anticipated small craft vessels would not be able to access their marina slip for moorage due to maintenance dredging activities or equipment. The benefits of monitoring and regular implementation of an adaptable long-term maintenance dredging program enable careful scheduling and planning to be incorporated into a dredge event. Monitoring ensures that maintenance dredging occurs as the significance threshold is approached and not exceeded. Maintenance dredging at the Port could be phased to avoid impacting more than one berth at a time and care with scheduling could minimize the potential for cargo vessel call delays. West Bay marinas could move vessels to different slips to conduct maintenance dredging in one location, then move those vessels back to work at another dock or access area. Boathouses located in shoaled areas requiring maintenance dredging could also be temporarily relocated within the marina or nearby prior to maintenance dredging. These measures would reduce the potential for significant impacts from the long-term maintenance dredging program on vessel navigation under the Estuary and Hybrid Alternatives to **less than significant** impacts.

Under the Estuary and Hybrid Alternatives, the implementation of a long-term maintenance dredging program would address the need for regular maintenance dredging faced under these alternatives and would result in maintenance dredging being completed with regularity, which does not occur at all locations in West Bay at this time. Under the Estuary and Hybrid Alternatives, a long-term management program is incorporated into the project itself and supplemented with an annual sediment monitoring plan, which would enable sediment accumulation conditions that interrupt vessel access or berthing to be identified early. Therefore, long-term sediment management and monitoring could provide a **minor beneficial effect** on navigation under the Estuary and Hybrid Alternatives.

Operations impacts of the No Action, Managed Lake, Estuary, and Hybrid Alternatives are summarized in Table ES.1.

Table ES.1 Summary of Operations Impacts (including Benefits) and Mitigation Measures

No Action Alternative

	Impact Finding	Mitigation Proposed for Significant Adverse Impacts	Significant and Unavoidable Adverse Impact
Sediment deposition – impacts on vessel access and berthing	**Less-Than-Significant**	None	N/A

Managed Lake Alternative

	Impact Finding	Mitigation Proposed for Significant Adverse Impacts	Significant and Unavoidable Adverse Impact
Sediment deposition – impacts on vessel access and berthing	**Less-Than-Significant**	None	N/A

Estuary Alternative

	Impact Finding	Mitigation Proposed for Significant Adverse Impacts	Significant and Unavoidable Adverse Impact
Sediment deposition – impacts on vessel access and berthing	**Significant** ***Significant*** *impacts reduced to* ***less-than-significant*** *with mitigation*	Implement monitoring to document initial conditions within West Bay and monitor sediment accumulation to identify when the FNC, turning basin, Port, and marinas are nearing the threshold that triggers maintenance dredging.	No
	Minor Beneficial Effects related to a long-term maintenance dredging program		
Maintenance dredging – impacts on vessel access and berth or slip use	**Significant** ***Significant*** *impacts reduced to* ***less-than-significant*** *with mitigation*	As part of the long-term maintenance dredging program, implement scheduling and phasing to minimize impacts to existing Port and marina operations.	No

Hybrid Alternative

	Impact Finding	Mitigation Proposed for Significant Adverse Impacts	Significant and Unavoidable Adverse Impact
Sediment deposition – impacts on vessel access and berthing	**Significant** ***Significant*** *impacts reduced to* ***less-than-significant*** *with mitigation*	Implement monitoring to document initial conditions within West Bay and monitor sediment accumulation to identify when the FNC, turning basin, Port, and marinas are nearing the threshold that triggers maintenance dredging.	No
	Minor Beneficial Effects related to a long-term maintenance dredging program		
Maintenance dredging – impacts on vessel access and berth or slip use	**Significant** ***Significant*** *impacts reduced to* ***less-than-significant*** *with mitigation*	As part of the long-term maintenance dredging program, implement scheduling and phasing to minimize impacts to existing Port and marina operations.	No

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List of Acronyms and Abbreviations

Acronyms/ Abbreviations	Definition
%	percent
AIS	Automatic Identification Systems
cm	Centimeter
cm/yr	Centimeters per year
cy	Cubic yards
DMMP	Dredged Material Management Program
EIS	Environmental Impact Statement
Enterprise Services	Washington State Department of Enterprise Services
FNC	Federal Navigation Channel
ft	Feet
LOA	Length overall
LOTT	Lacey, Olympia, Tumwater, and Thurston County
m	Meter
MLLW	Mean Lower Low Water
NAVD88	North American Vertical Datum of 1988
Port	Port of Olympia
RSLR	Relative sea level rise
SLR	Sea level rise
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
VTS	Vessel Traffic Service

1.0 Introduction and Project Description

1.1 PROJECT DESCRIPTION

The Capitol Lake – Deschutes Estuary includes the 260-acre Capitol Lake Basin, located on the Washington State Capitol Campus, in Olympia, Washington. The waterbody has long been a valued community amenity. Capitol Lake was formed in 1951 following construction of a dam and provided an important recreational resource. Historically, the Deschutes Estuary was used by local tribes for subsistence and ceremonial purposes. Today, the expansive waterbody is closed to active public use. There are a number of environmental issues including the presence of invasive species, exceedances of water quality (WQ) standards, and inadequate sediment management.

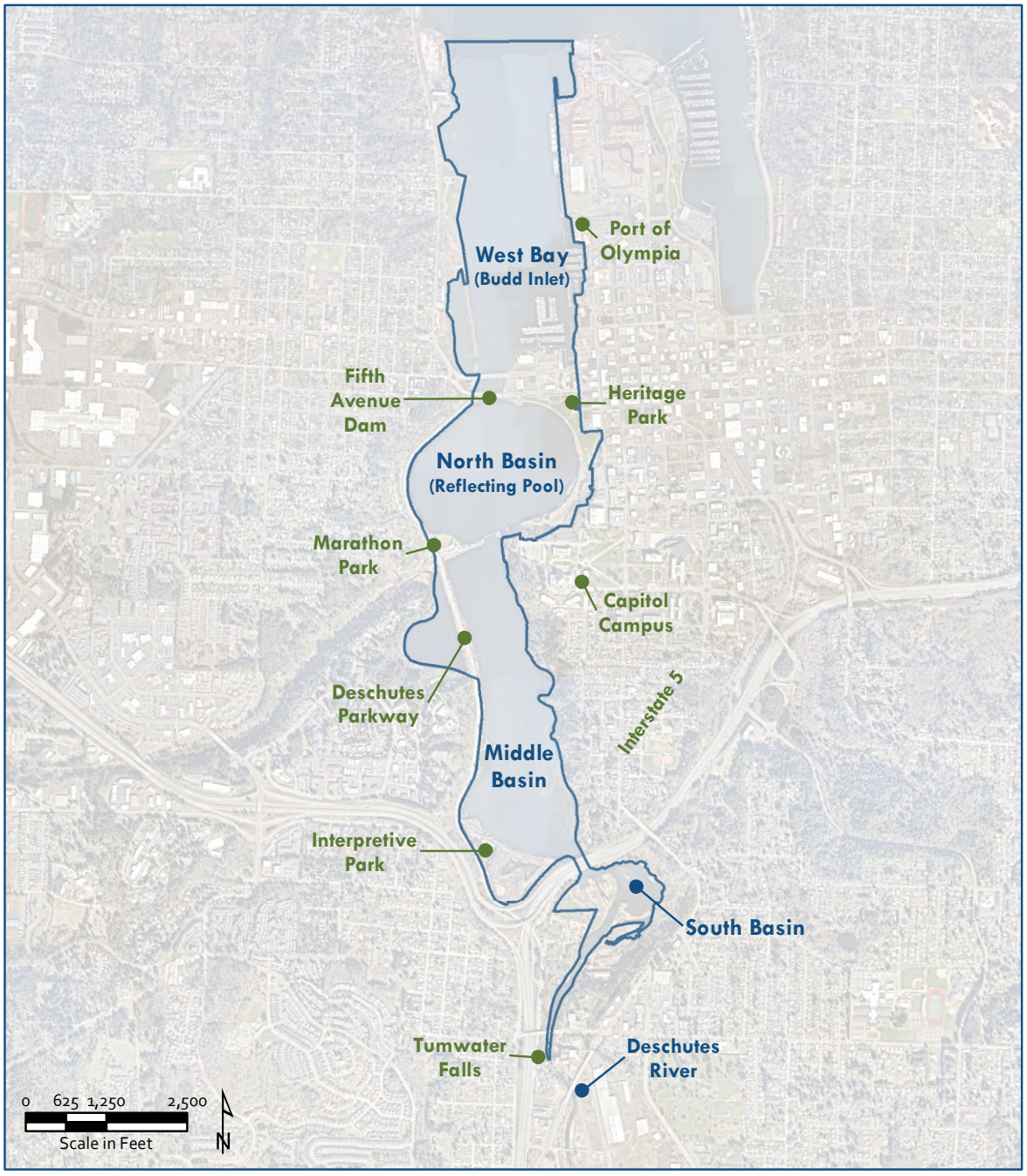
The Washington State Department of Enterprise Services (Enterprise Services) is responsible for the stewardship, preservation, operation, and maintenance of the Capitol Lake Basin. The 260-acre Capitol Lake Basin is maintained by Enterprise Services under long-term lease agreement from the Washington Department of Natural Resources.

In 2016, as part of Phase 1 of long-term planning, a diverse group of stakeholders, in collaboration with the state, identified shared goals for long-term management and agreed an Environmental Impact Statement (EIS) was needed to evaluate a range of alternatives and identify a preferred alternative. In 2018, the state began the EIS process. The EIS evaluates four alternatives, including a Managed Lake, Estuary, Hybrid, and a No Action Alternative.

The long-term management alternatives are evaluated against the shared project goals of improving water quality; managing sediment accumulation and future deposition; improving ecological functions; and enhancing community use of the resource. Refer to Figure 1.1 for the project area for long-term management. The Final EIS will identify a preferred environmentally and economically sustainable long-term management alternative for the Capitol Lake – Deschutes Estuary.

The EIS process maintains engagement with the existing Work Groups, which include the local governments, resource agencies, and tribe. It also provides for expanded engagement opportunities for the public, such as a community sounding board. The EIS process maintains engagement with the existing Work Groups, which include the local governments, resource agencies, and the Squaxin Island Tribe. It also provides for expanded engagement opportunities for the public, such as a community sounding board.

Figure 0.1 Project Area



1.2 SUMMARY OF PROJECT ALTERNATIVES

1.2.1 Managed Lake Alternative

The Managed Lake Alternative would retain the 5th Avenue Dam in its existing configuration. The 5th Avenue Dam would be overhauled to significantly extend the serviceable life of the structure. The reflecting pool within the North Basin would be maintained, and active recreational use would be restored in this area. Sediment would be managed through initial construction dredging and recurring maintenance dredging in the North Basin only. Sediment from construction dredging would be used to create habitat areas in the Middle Basin to support improved ecological function, habitat complexity, and diversity. Sediment would continue to accumulate and over time would promote a transition to freshwater wetlands in the South and Middle Basins. Boardwalks, a 5th Avenue Pedestrian Bridge, a dock, and a boat launch would be constructed for community use.

If selected as the Preferred Alternative, adaptive management plans would be developed to maintain water quality, improve ecological functions, and manage invasive species during the design and permitting process.

1.2.2 Estuary Alternative

Under the Estuary Alternative, the 5th Avenue Dam would be removed, and an approximately 500-foot-wide (150-meter-wide) opening would be established in its place. This would reintroduce tidal hydrology to the Capitol Lake Basin, returning the area to estuarine conditions where saltwater from Budd Inlet would mix with freshwater from the Deschutes River. Sediment would be managed through initial construction dredging in the Capitol Lake Basin and recurring maintenance dredging within West Bay. Dredged materials from construction dredging would be used to create habitat areas in the Middle and North Basins to promote ecological diversity, though tideflats would be the predominant habitat type. Boardwalks, a 5th Avenue Pedestrian Bridge, a dock, and a boat launch would be constructed for community use. This alternative also includes stabilization along the entire length of Deschutes Parkway to avoid undercutting or destabilization from the tidal flow. Existing utilities and other infrastructure would be upgraded and/or protected from reintroduced tidal hydrology and saltwater conditions.

If selected as the Preferred Alternative, adaptive management plans would be developed to improve ecological functions and manage invasive species during the design and permitting process.

1.2.3 Hybrid Alternative

Under the Hybrid Alternative, the 5th Avenue Dam would be removed, and an approximately 500-foot-wide (150-meter-wide) opening would be established in its place. Tidal hydrology would be reintroduced to the western portion of the North Basin and to the Middle and South Basins. Within the North Basin, a curved and approximately 2,600-foot-long (790-meter-long) barrier wall with a walkway would be constructed to create an approximately 45-acre saltwater reflecting pool adjacent to Heritage Park. A freshwater (groundwater-fed) reflecting pool was also evaluated for this EIS. Construction and

maintenance of this smaller reflecting pool, in addition to restored estuarine conditions in part of the Capitol Lake Basin, gives this alternative its classification as a hybrid. Sediment would be managed through initial construction dredging in the Capitol Lake Basin and recurring maintenance dredging within West Bay. In the Middle and North Basins, constructed habitat areas would promote ecological diversity, though tideflats would be the predominant habitat type. Boardwalks, a 5th Avenue Pedestrian Bridge, a dock, and a boat launch would be constructed for community use. This alternative also includes stabilization along the entire length of Deschutes Parkway to avoid scour or destabilization. Existing utilities and other infrastructure would be upgraded and/or protected from reintroduced tidal hydrology and saltwater conditions.

If selected as the Preferred Alternative, adaptive management plans would be developed before operation of the alternative to improve ecological functions and manage invasive species during the design and permitting process. Adaptive management would also be needed for a freshwater reflecting pool, but not for a saltwater reflecting pool.

1.2.4 No Action Alternative

The No Action Alternative represents the most likely future expected in the absence of implementing a long-term management project. The No Action Alternative would persist if a Preferred Alternative is not identified and/or if funding is not acquired to implement the Preferred Alternative. A No Action Alternative is a required element in a SEPA EIS and provides a baseline against which the impacts of the action alternatives (Managed Lake, Estuary, Hybrid) can be evaluated and compared.

The No Action Alternative would retain the 5th Avenue Dam in its current configuration, with limited repair and maintenance activities, consistent with the scope and scale of those that have received funding and environmental approvals over the past 30 years. In the last 30 years, the repair and maintenance activities have been limited to emergency or high-priority actions, which occur sporadically as a result of need and funding appropriations.

Although Enterprise Services would not implement a long-term management project, current management activities and ongoing projects in the Capitol Lake Basin would continue. Enterprise Services would continue to implement limited nuisance and invasive species management strategies.

In the absence of a long-term management project, it is unlikely that Enterprise Services would be able to procure funding and approvals to manage sediment, improve water quality, improve ecological functions, or enhance community use. The No Action Alternative does not achieve the project goals.

1.3 CONSTRUCTION METHODS FOR THE ACTION ALTERNATIVES

This impact analysis relies on the construction method and anticipated duration for the action alternatives, which are described in detail in Chapter 2 of the EIS.

2.0 Regulatory Context

2.1 RESOURCE DESCRIPTION

This discipline report addresses vessel navigation. Vessel navigation includes the ability to access and use berths and slips within port and marina facilities. Navigation refers to marine vessel use in Lower Budd Inlet and West Bay.

2.2 RELEVANT LAWS, PLANS, AND POLICIES

Vessel navigation is regulated by a variety of federal and state laws, plans, and policies (Section 2.2.1) and local plans and policies (Section 2.2.2).

2.2.1 Federal and State

The federal and state laws, plans, and policies applicable to vessel navigation in Budd Inlet are identified and briefly described in Table 2.1 and Table 2.2. Most enforcement of the federal and state regulations fall to the U.S. Coast Guard (USCG), which supervises and enforces vessels operating in U.S. navigable waters to ensure safe navigation.

Navigable servitude entitles the federal government to exert a dominant servitude in all lands below the ordinary high water mark of navigable waters and a right to regulate navigable waterways as an extension of the Commerce Clause in Article I, Section 8 of the U. S. Constitution.

The U.S. Army Corps of Engineers (USACE), through its Civil Works Program, authorizes a number of U.S. water resources that support navigation. The USACE Section 408 process provides a mechanism for local stakeholders to modify, occupy, or alter an existing and constructed USACE Civil Works project. Projects can include navigational channels, breakwaters, basins, levees, etc. The purpose of Section 408 is to ensure that an alteration to an existing USACE Civil Works project does not adversely impact the public interest or undermine the federally authorized benefits of the USACE project.

An existing Federal Navigation Channel (FNC), affiliated federal access channels, and a turning basin are located within Budd Inlet and provide vessel access to facilities in both West and East Bay

(described in more detail in Section 4.0). Impacts on the FNC (i.e. sediment erosion/deposition rates) would be regulated under Section 408 and evaluated for effects to structural integrity, operation and maintenance, and USACE policy and criteria.

Table 2.1 Federal Laws, Plans, and Policies

Regulatory Program or Policies	Lead Agency	Description
Federal Navigable Servitude	U.S. Government	Entitles the federal government to exert a dominant servitude in all lands below the ordinary high water mark of navigable waters and a right to regulate navigable waterways.
Federal Pilotage Requirements (46 CFR 15.610 and 15.812)	USCG	Identifies the type of vessels that require a federally licensed master or mate and federal pilotage requirements for U.S.-inspected vessels on coastwise voyages.
Navigation and Navigable Waters, Subchapter E: Inland Navigation Rules (33 CFR 83 –90)	USCG	Applies to all vessels on the inland waters of the U.S. Complements the International Regulations for Preventing Collisions at Sea 1972, applicable in International Waters.
Notice to Mariners	USCG	Issues information concerning the establishment of aids to maritime navigation and the changes, discontinuances, and deficiencies, except temporary deficiencies that are easily correctable, of aids to maritime navigation maintained and operated by or under the authority of the USCG.
Port and Tanker Safety Act of 1978 (33 U.S.C. 1221 et seq.)	USCG	Grants USCG authority to supervise and control vessels, foreign and domestic, operating in U.S. navigable waters.
Ports and Waterways Safety Act of 1972 (31 U.S.C. 1221 et seq.)	USCG	Authorizes the USCG to provide for navigation and vessel safety; protect the marine environment; and protect life, property, and structures in, on, or adjacent to U.S. navigable waters.
Section 14 of the Rivers and Harbors Act of 1899 (33 USC 408), (Section 408)	USACE	Provides a mechanism for others to modify, occupy, or alter an existing USACE constructed public works project.

Table 2.2 State Plans and Policies

Regulatory Program or Policies	Lead Agency	Description
Vessel Traffic Service	USCG	The USCG Vessel Traffic Service (VTS) regulates vessel traffic and safety in Puget Sound by monitoring and directing vessel movements to maintain appropriate navigation corridors and vessel transit separation, with the coincident benefit of minimizing shipping interruptions and delays.
Washington State Pilotage Act (RCW 88.16)	USCG	Identifies requirements for compulsory pilotage provisions in certain waters of the state, including Puget Sound.

2.2.2 Local

Key local plans and policies applicable to vessel navigation in Budd Inlet are identified and briefly described Table 2.3. Other, more specific, rules may also apply at individual facilities (i.e. the Port and individual private marinas).

The Port of Olympia's primary planning document, the Comprehensive Scheme of Harbor Improvements (Port of Olympia 2017a), consists of development guidelines and a comprehensive scheme of harbor improvements. The Development Guidelines detail information on existing properties and long-range development plans within the Port's Use Districts (Port of Olympia 2017b). The Comprehensive Scheme of Harbor Improvements includes a description of anticipated future projects. The Port's Strategic Plan aims to provide organizational clarity, guide the Port, and act as a tool to communicate with staff, stakeholders, customers, and the community about the vision, role, and focus of the Port (Port of Olympia 2017c). The Port's Vision 2050 Plan includes comprehensive public engagement that helps shape long-range goals and priority actions (Port of Olympia 2019).

Table 2.3 Local Plans and Policies

Regulatory Program or Policies	Lead Agency	Description
Puget Sound Harbor Safety Plan	Puget Sound Harbor Safety Committee with USCG	Establishes a set of Standards of Care for the Puget Sound area that supplement existing federal, state, and local laws.

Regulatory Program or Policies	Lead Agency	Description
Olympia Sea Level Rise Response Plan (2019)	City of Olympia, LOTT[1] Clean Water Alliance, Port of Olympia	Provides comprehensive strategies for minimizing and preventing flooding to downtown.
Vessel Speed Limit	City of Olympia	It is unlawful for any person to operate or have control over watercraft within city waters that travels at a speed greater than 7 knots (7 nautical miles per hour) in those waters north of an east/west line transecting the tip of the Port peninsula, or which travels at a speed greater than 5 knots (5 nautical miles per hour) in waters south of said line. It is further unlawful to operate in such a manner to cause a wake that endangers or jeopardizes property or persons within the immediate vicinity.
Olympia Harbor Patrol	Operates under Swantown Marina to Port of Olympia	The Olympia Harbor Patrol is comprised of volunteers that help protect the security and safety of Swantown Marina and Boatworks, the marine terminal, Port customers, and citizens utilizing the waterfront.
Comprehensive Scheme Harbor Improvements (2017)	Port of Olympia	The Port's primary planning document.
Development Guidelines (2017)	Port of Olympia	Provides information on existing properties and long-range plans for development within the Port's Use Districts.
Strategic Plan (2017)	Port of Olympia	Aims to provide organizational clarity, guide the Port, and acts as a tool to communicate with staff, stakeholders, customers, and the community about the vision, role, and focus of the Port of Olympia.
Vision 2050 Port of Olympia (2019)	Port of Olympia	Developed through comprehensive public engagement to help shape long-range Port goals and priority actions.

[1] LOTT is a non-profit corporation that functions like a public agency and includes four partner jurisdictions – the cities of Lacey, Olympia, Tumwater, and Thurston County.

3.0 Methodology

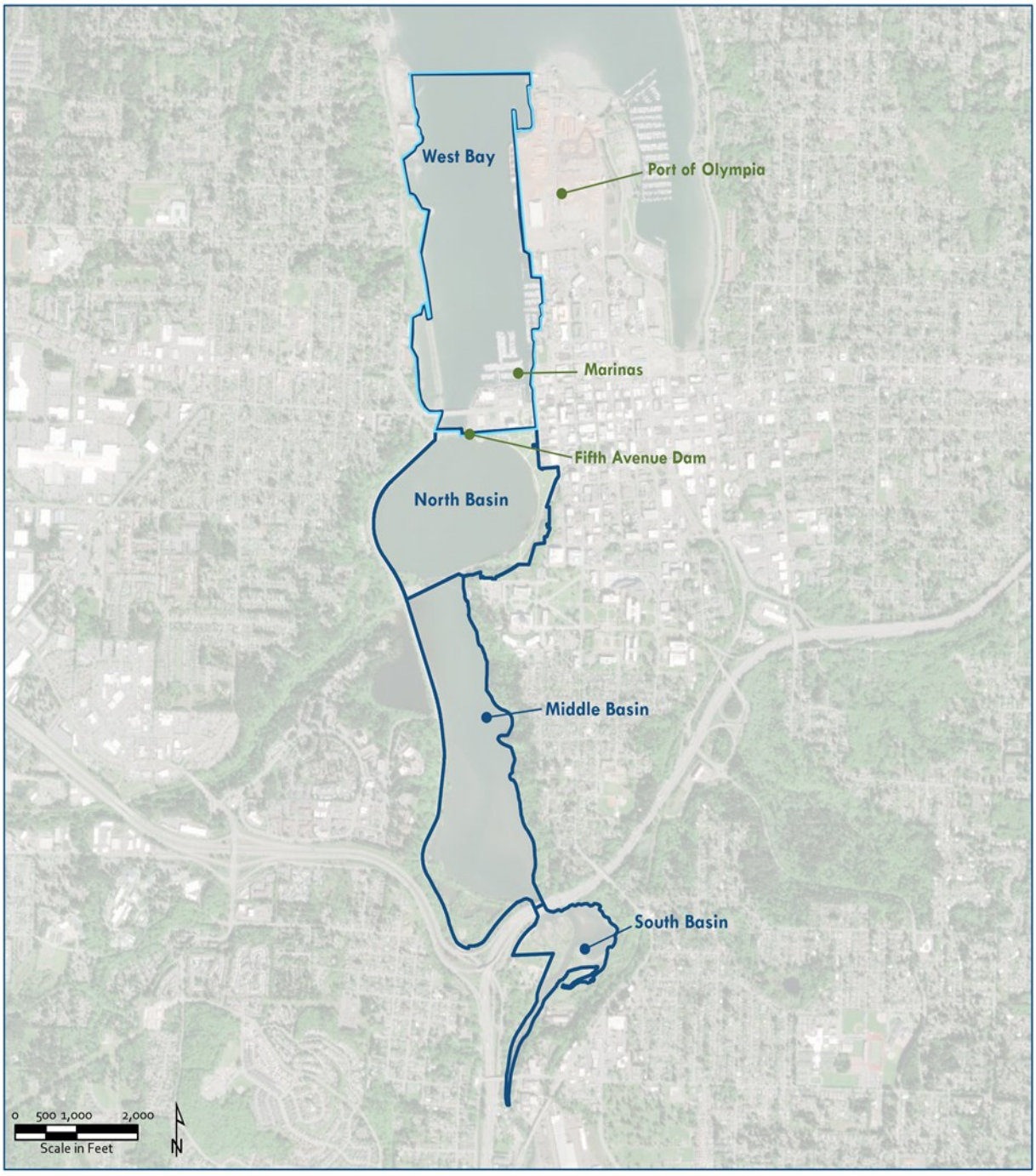
3.1 SELECTION OF THE STUDY AREA

The study area for navigation consists of areas that could be directly or indirectly affected by operation of the project and changes in sediment movement (Figure 3.1), this includes the West Bay of Budd Inlet. The southern boundary of the study area is located at 5th Avenue. The northern boundary of the study area is located at the end of the peninsula between West and East Bay, the east and west of the study area are bounded by adjacent shorelines of West Bay. The northern limit of the study area is based on:

- The hydrodynamic and sediment transport modeling (Moffatt & Nichol 2020) and the extent of sediment deposition into Budd Inlet by the build alternatives; and
- The extent of the impacts of sediment transport given the location of water-dependent businesses in West Bay.

The study area for navigation does not include Capitol Lake. Navigation in the lake is recreational and these impacts are addressed in the Land Use, Shorelines, and Recreation Discipline Report.

Figure 3.1 Study Area



3.2 DATA SOURCES AND COLLECTION

Data sources used for navigation analysis include existing navigation patterns for the study area, vessel use, depth, hydrodynamics, sediment erosion/deposition rates for the study area, and existing maintenance dredging data from the Port of Olympia, USACE, and a number of private marinas located in West Bay.

3.2.1 Navigation Patterns

Information about existing vessel navigation patterns was obtained from shipborne Automatic Identification Systems (AIS). AIS is a real-time network of transmitters and receivers that broadcast, track, and record vessel movement. AIS tracking beacons are located on ships only, not on barges that may be towed by tugs within the waterway or smaller boats. AIS devices are required for many larger commercial vessels (including cargo ships, tugboats, vessels engaged in dredging operations, and larger fishing vessels). This collected data is used to establish and evaluate the movement of larger vessels that use the FNC to access the Port of Olympia.

3.2.2 Sediment Deposition Rates

The comparison of past and present bathymetric condition surveys and hydrodynamic and sediment transport numerical modeling (Moffatt & Nichol 2020) resulted in sediment deposition rates for Budd Inlet that were then used to define the study area for navigation analysis and to develop the proposed long-term maintenance dredging program for impacted areas of West Bay.

3.2.3 Existing Maintenance Dredging

Information on existing navigational conditions was gathered by contacting the Port of Olympia, USACE, and a number of private marinas in West Bay (Fiddlehead Marina, Martin Marina, and Olympia Yacht Club). Information on the types of vessels, incidents of vessel grounding, operations, navigational constraints, sediment deposition, and long-term plans for accommodating different types of vessels was obtained from these stakeholders.

This outreach was used to evaluate existing maintenance dredging frequencies and known plans for future maintenance dredging by these different entities. Through this outreach, it was identified that, based on the federal navigational servitude doctrine and requirement of Washington State Department of Natural Resources (WDNR) lease renewals, USACE and marina-led dredging is expected to occur at these facilities within the next 10 years, prior to, or at implementation of, any of the proposed action alternatives. The anticipated dredging, completed by these entities and separate from the Project, would reach authorized depths within the FNC, Port berths, marinas, and marina access areas.

This information was then used to better understand the potential frequency of existing maintenance dredging by these entities under the No Action Alternative, and in comparison, to develop the trigger for and frequency of long-term maintenance dredging under the Estuary and Hybrid Alternatives.

3.3 ANALYSIS OF IMPACTS

Impacts of the project on vessel navigation are analyzed for the three build alternatives and the No Action Alternative. Both the Estuary and Hybrid Alternatives are designed to remove the 5th Avenue Dam, restore tidal hydrology to the Capitol Lake Basin system, and incorporate elements that manage sedimentation into Budd Inlet to maintain vessel navigation in West Bay. Impacts of the project on vessel navigation could be either adverse or beneficial.

3.3.1 Identification of Construction Impacts

The three build alternatives do not propose construction activities north of the 5th Avenue Dam in areas that could affect vessel navigation. As a result, short-term (construction) impacts are not evaluated.

3.3.2 Identification of Operational Impacts

Operational impacts could include increases in sedimentation that limit or block access or use of vessel channels, berths, and slips over time. Maintenance dredging activities may do the same and limit or block access or use of vessel channels, berths, and slips over time. Impacts analysis considers two potential impacts to vessel navigation to the facilities located within the study area:

- Impacts on vessel access and berthing due to sediment deposition; and
- Impacts on vessel access and berth or slip use due to long-term maintenance dredging.

Operational impacts could be either adverse or beneficial. Operational impacts to vessel navigation are assessed both qualitatively and quantitatively, incorporating results from hydrodynamic and sediment transport modeling (Moffatt & Nichol 2020), and data collected from the Port, USACE, and private vessel moorage facilities in West Bay.

3.3.2.1 Impacts on Navigation from Sediment Deposition

The magnitude of operational adverse impacts on vessel navigation from sediment deposition or implementation of a long-term maintenance dredging program is considered less-than-significant or significant for this analysis as follows:

- **Less-than-Significant**—Impacts are considered less than significant if the project results in no change or limited restrictions in vessel access to berthing and moorage facilities, or in the use of these facilities, in West Bay.
- **Significant**—Impacts are considered significant if vessel navigation would be so adversely affected by sediment accumulation within the study area that:
    - Large vessels accessing the FNC and Port would be required to wait longer than four (4) hours for channel access due to water depth and low tide conditions caused by sediment deposition on more than one consecutive occasion; or

- Over 10% of anticipated small craft vessels would not be able to access a slip for moorage due to water depth caused by sediment deposition.

- **Beneficial**—Impacts are considered beneficial if vessel access to berthing and moorage facilities in West Bay is improved.

3.3.2.2 Impacts on Navigation from Long-term Maintenance Dredging

The magnitude of operational adverse impacts on vessel navigation from long-term maintenance dredging are considered less than significant or significant for this analysis as follows:

- **Less than Significant**—Impacts are considered less than significant if the project results in no change or limited restrictions in vessel access to berthing and moorage facilities, or in the use of these facilities, in West Bay.
- **Significant**—Impacts are considered significant if vessel navigation would be so adversely affected by long-term maintenance dredging activities within the study area that:
    - Large vessels accessing the Port would be required to wait longer than four (4) hours for channel or berth access due to maintenance dredging equipment or activities on more than one consecutive occasion during a dredge cycle; or
    - Over 10% of anticipated small craft vessels would not be able to access a slip or boathouse for moorage due to maintenance dredging equipment or activities.
- **Beneficial**—Impacts are considered beneficial if vessel access to berthing and moorage facilities in West Bay are improved.

4.0 Affected Environment

4.1 NAVIGATION RESOURCES AND FACILITIES

The study area for navigation includes Lower Budd Inlet, which is important for both commercial and recreational vessels of varying size that support the local economy. Vessel navigation resources and facilities include the southern portion of the existing USACE FNC and adjacent turning basin, the Port's three marine terminal berths, and access to the Olympia Yacht Club, private marinas, and public moorage facilities in West Bay (Figure 4.1).

4.1.1 Federal Navigation Channel

An existing USACE FNC, affiliated federal access channels, and a turning basin are located within Budd Inlet's West and East Bays (Figure 4.2). The existing FNC and turning basin were originally authorized by the Rivers and Harbors Act of January 21, 1927 and modified in subsequent Acts (USACE 2003). The Outer Channel is authorized to 500 feet (ft) wide and 30 ft deep and branches into two channels, one to East Bay and one to West Bay. The Entrance Channel into West Bay is authorized to 300 ft wide and 30 ft deep Mean Lower Low Water (MLLW) and continues to the west side of the Port, where the turning basin provides for vessel maneuverability to the Port's adjacent berths. The turning basin is authorized to 3,350 ft long, 500 to 800 ft wide, and 30 ft deep (USACE 2003). The USACE is responsible for federal channel maintenance to authorized depths and widths.

4.1.2 Port of Olympia

The Port of Olympia is comprised of 66 acres, including three deepwater marine terminal berths with a total length of 1,750 ft and average water depth of 39 ft MLLW. Marine terminal services include cargo loading/unloading, cargo handling, storage, and other related activities. Typical vessels calling at the Port include bulk cargo ships (Port of Olympia project communications 2020). Exports include logs, livestock, and feed supplies, which are reflected in ship calls to the Port (Port of Olympia project communications, 2020). Import and export opportunity awards and losses of these types of services can increase or decrease ship calls. Present markets are volatile and not easily predictable.

4.1.3 West Bay Marinas

West Bay marinas and docking facilities closest to the 5th Avenue Dam include the Olympia Yacht Club, Fiddlehead Marina, Martin Marina, and Percival Landing (Figure 4.3). Marina access areas allow for access into these different marinas and moorage facilities, which vary in size, water depth, and services. The Olympia Yacht Club is located closest to 5th Avenue Dam and provides permanent moorage for approximately 237 vessels in 120 boathouses and 117 open slips. Approximately 250 ft of open dock space is reserved for transient vessels (Olympia Yacht Club project communications, 2020). Permanently moored vessels include both powerboats and sailboats, ranging from 24 to 73 ft long with 7 to 18-foot beams and 4 to 7-foot drafts. The Fiddlehead and Martin Marinas in West Bay are located just north of the Olympia Yacht Club and offer moorage for 80 to 90 vessels and a few houseboats and liveaboards (Fiddlehead Marina project communications, 2020; Martin Marina project communications, 2020). Draft for these facilities ranges from 2 to 7 ft, with beams of 8 to 12 ft, and a length overall (LOA) from 15 to 50 ft. The City of Olympia's Percival Landing Park is a waterfront park in downtown Olympia that offers transient moorage at Docks D and E (Figure 4.3). Percival landing can accommodate vessels up to 80 ft and offers approximately 36 slips. Moorage is offered on a first come, first served basis for short periods of time.

Marina depth is commonly about 5 to 7 ft at MLLW, which is the depth required by environmental regulations and WDNR leases. Marina depth in West Bay is estimated to average at about 7 ft MLLW based on marina outreach (Fiddlehead Marina project communications, 2020; Martin Marina project communications, 2020; Olympia Yacht Club project communications, 2020).

Figure 4.1 Resource Areas

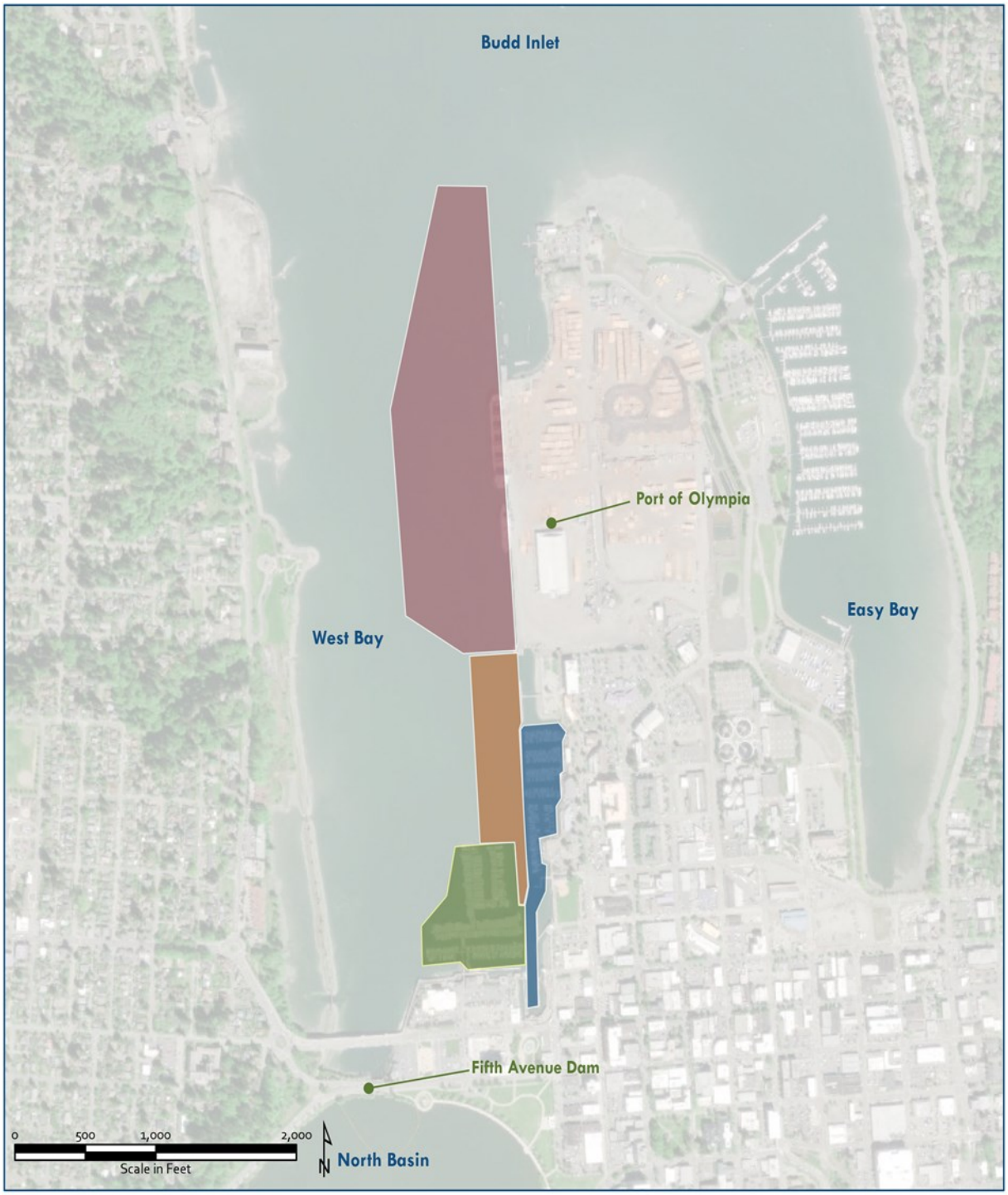


Figure 4.2 Federal Navigation Channel

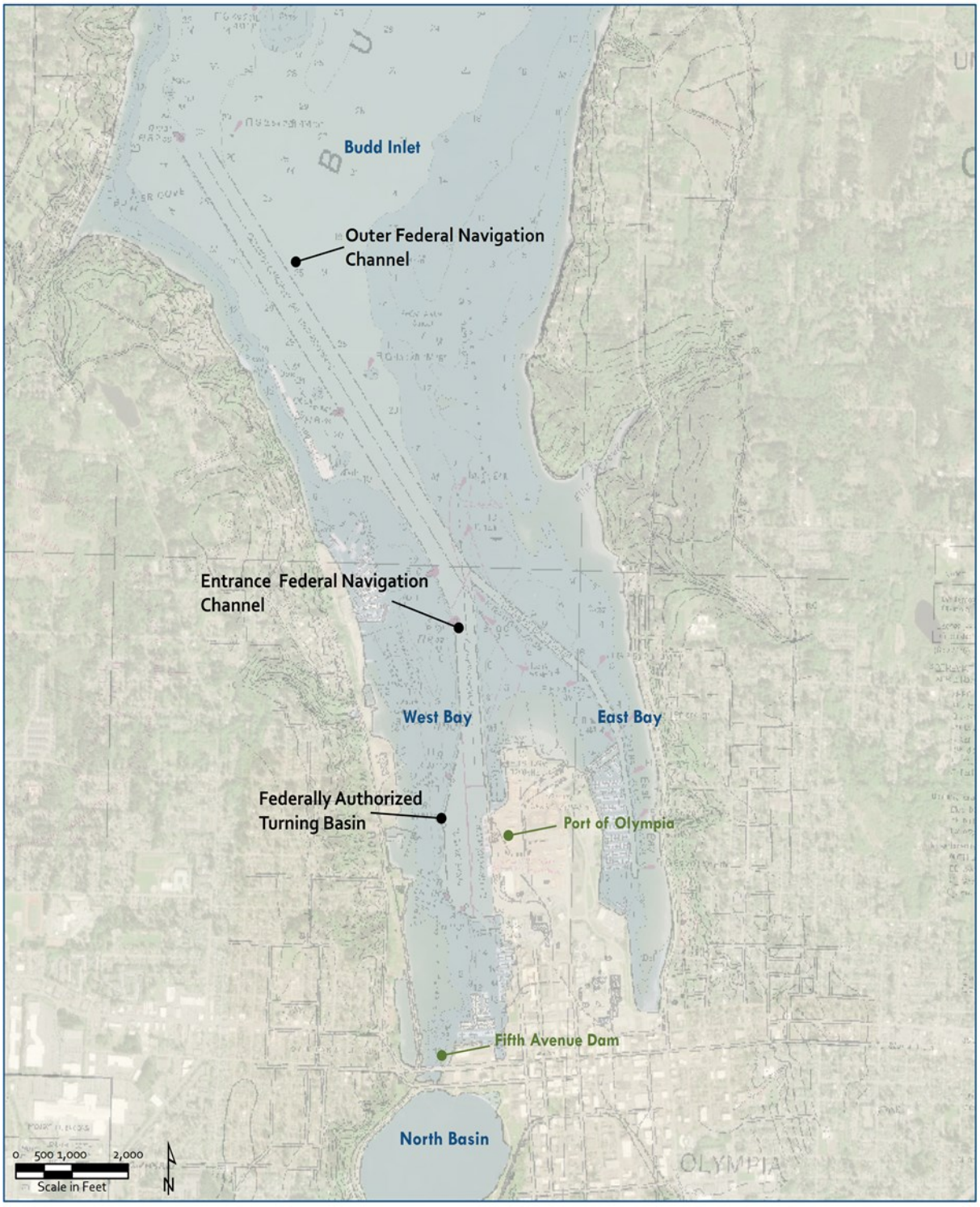


Figure 4.3 Lower West Bay Marinas

4.2 NAVIGATION PATTERNS

4.2.1 Federal Navigation Channel

The Port's cargo vessel call records are reflected accurately in the AIS data record for the 2018 to 2019 period. The AIS data includes other vessels, not calling at the Port, representing a sample of the vessel traffic for vessels where AIS reporting is optional. Figure 4.4 provides a summary representation of vessel use of Budd Inlet into West Bay. The observable patterns reflect areas where vessel traffic generally occurs. Areas not shaded may have occasional transits and should not be interpreted as indicating a complete absence of vessel traffic (areas with 5 or fewer vessel passes per year are not shaded and many recreational vessels do not have AIS that can be recorded by the system). Vessel navigation was observed to be highest within the authorized FNC and turning basin and throughout the east side of West Bay closest to the Port, local private marinas, and marina access areas along the east shore of West Bay.

4.2.2 Port of Olympia

Vessels arriving at the Port of Olympia use the FNC and turning basin. Typical vessels calling at the Port include bulk cargo ships of about 600 ft LOA and beams of around 100 ft. Given existing depths within the FNC and turning basin, cargo vessels typically sail on a rising high tide (either of the diurnal high tides) drawing around 32 ft (Port of Olympia project communications, 2020). Cargo vessels are also presently known to lighten their loads when calling at Port due to existing sediment accumulation in the FNC and turning basin. Port berth depth remains steady around 39 ft MLLW; and the Port and USACE share concerns with already impacted depth in both the FNC and turning basin, which restricts vessel size access to Port berths.

The Port has indicated they would like to welcome Panamax and Neopanamax vessels (ships designed to the dimensions necessary to pass through the Panama Canal) to their berths, which could require berth deepening and widening (not presently included in the Port's near future planning documents). This would also require coordination with the USACE as any deepening and/or widening of the FNC and turning basin would require USACE authorization.

4.2.3 West Bay Marinas

Typical vessels calling at the West Bay marinas include recreational powerboats and sailboats (Fiddlehead Marina project communications, 2020; Martin Marina project communications, 2020; Olympia Yacht Club project communications, 2020). Percival Landing Park is used for short-term moorage. There are two annual maritime-themed events that draw visitors each year: the Wooden Boat Festival on Memorial Day and the Harbor Days over Labor Day.

Figure 4.4 Budd Inlet Vessel Traffic Patterns

Legend

Number of Vessel Passes (Annual)

6 - 10	21 - 25	76 - 100
11 - 15	26 - 50	101 - 150
16 - 20	51 - 75	151 - 200

------ Limit of Federal Channel

Notes:
- AIS data was obtained from the US Coast Guard.
- Areas with 5 or fewer vessel passes per year are not shaded.
- Background nautical chart is ENC US5WA23M (April 30, 2020).

4.3 SEDIMENT DEPOSITION AND EROSION RATES

Historical and recent patterns and rates of sediment deposition within Budd Inlet were estimated by comparing available bathymetric surveys (Moffatt & Nichol 2020). The total and annual rates of erosion/deposition are presented herein in meters (m) and centimeters per year (cm/yr), respectively, unless noted otherwise.

4.3.1 Federal Navigation Channel and Port of Olympia

The USACE conducts periodic bathymetric condition surveys of the FNC and turning basin seafloor, which allow for changes in sediment deposition and erosion to be identified. Bathymetric conditions surveys are available dating back to 1998. These surveys were used to establish long-term spatial patterns of rates of sediment erosion and deposition (Moffatt & Nichol 2020). Survey comparisons show that the majority of the FNC has experienced sediment deposition ranging from 2 to 3 cm/yr between 1998 to 2020 (22 years), although some erosion has been observed over the past nine years. The turning basin has experienced sediment deposition of approximately 3 cm/yr in the 2011 to 2020 period, similar to the long-term trend observed for 1998 to 2020. Sedimentation rate studies have been carried out for the Port and Budd Inlet by others (Landau 1993, SAIC 2008, and Anchor QEA 2013); results from these studies show that the sedimentation rate is equal to approximately 0.12 to 1.1 cm/yr, which is within the range of long-term rates obtained from USACE FNC survey comparisons (-1.0 to +3.0 cm/yr). Bathymetric surveys of the FNC are shown in Figure 4.5. Based on survey comparison, the average annual sediment erosion/deposition rate within the FNC for 1998 to 2020 varies spatially and temporally between -1 to +4 cm/yr (Figure 4.6).

Figure 4.5 Bathymetric Surveys of the Federal Navigation Channel

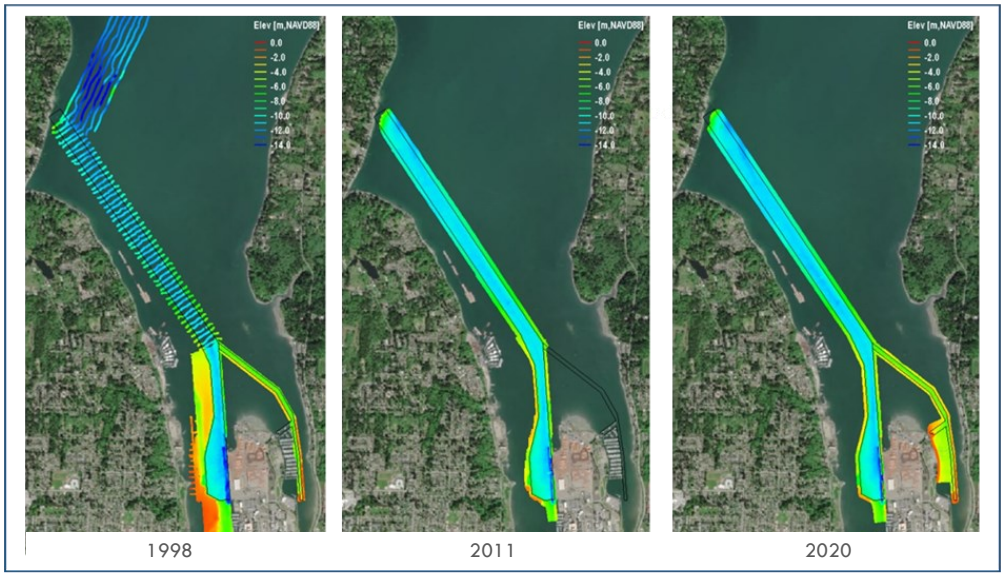
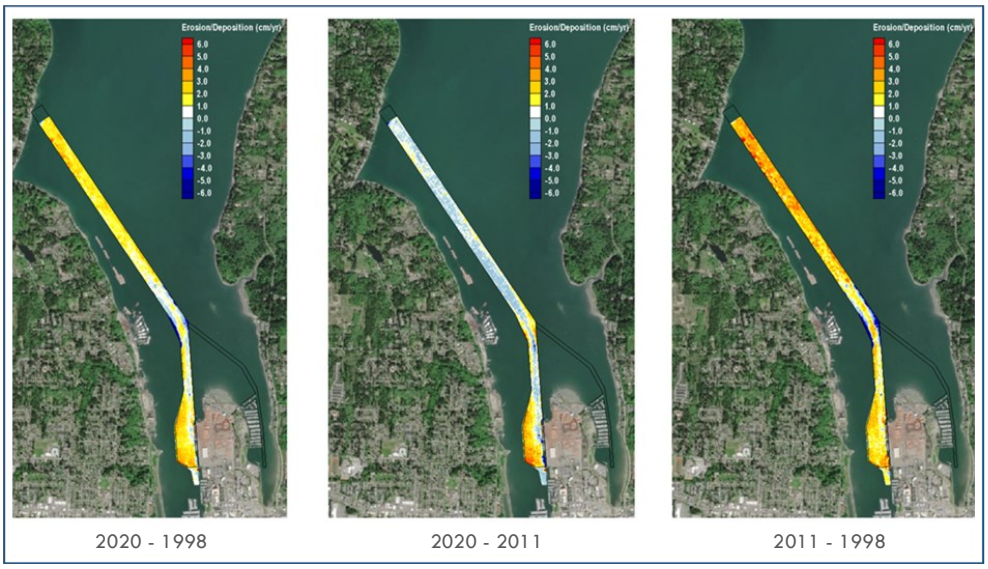


Figure 4.6 Estimated Existing Average Annual Sediment Erosion/Deposition Rates (cm/yr)



4.3.2 West Bay Marinas

Existing bathymetry information for the West Bay marinas was limited and average annual sediment deposition rates could not be obtained by comparing bathymetric surveys. However, multiple marinas report isolated areas of shoaling (Fiddlehead Marina, 2020, project communications; Martin Marina, 2020; project communications; Olympia Yacht Club, 2020, project communications). Average annual sediment erosion and deposition rates for the Olympia Yacht Club (the marina located closest to the 5th Avenue Dam) and other West Bay marinas were estimated based on the calibrated sediment transport model developed for the study area (Moffatt & Nichol, 2020) and are summarized in Table 4.1.

4.3.3 Sediment Deposition Pattern Summary for West Bay

Annual sediment deposition/erosion rates within Budd Inlet are highly dependent on river flow events with more extreme flow events depositing more sediments. However, higher sediment deposition rates generally occur on the east side of West Bay during high flow events (Moffatt & Nichol 2020). This is due to the presence of an area of shallow intertidal habitat along the remnants of an existing rail trestle on the west side of Budd Inlet's West Bay. This pattern of stronger deposition on the east side of West Bay is consistent with findings of previous U.S. Geological Survey (USGS) studies (George et al. 2006 and Stevens et al. 2008).

Table 4.1 shows that the highest sediment deposition rate occurs at the Olympia Yacht Club (closest to the 5th Avenue Dam) along with a pattern of decreasing sediment deposition with distance away from the 5th Avenue Dam northward (Moffatt & Nichol 2020). Table 4.1 includes two conditions: without relative sea level rise (RSLR) and with RSLR, which includes a 0.61 m future increase in RSLR. Deposition and erosion rates are lower for with RSLR than that without RSLR conditions. This is likely

due to the higher water levels associated with RSLR resulting in reduced flow velocities and reduced erosion of sediments in the Middle Basin, which results in reduced deposition in Budd Inlet.

Table 4.1 Existing Sediment Deposition in Budd Inlet (Corresponds to No the Action Alternative in Moffatt & Nichol 2020)

Location	Average Annual Sediment Deposition (cm/yr) without RSLR	Average Annual Sediment Deposition (cm/yr) with RSLR
Olympia Yacht Club	4.3	3.4
Other West Bay Marinas and Marina Access	2.1	1.7
Port/Turning Basin	2.2	1.6
FNC (excluding Turning Basin)	0.1	0.1
Rest of Budd Inlet (not within study area)	0.1	0.1

4.4 EXISTING MAINTENANCE DREDGING

4.4.1 Federal Navigation Channel and Port of Olympia

The USACE and Port of Olympia have shared that portions of the FNC and the turning basin would benefit from further maintenance dredging as cargo vessels are presently known to lighten their loads when calling at Port due to existing sediment accumulation in the FNC and turning basin (Port of Olympia project communications, 2020). Given existing available USACE and Port data, maintenance dredging at the Port of Olympia has occurred twice in the last 40 years (the USACE last conducted maintenance dredging in 2007 and the Port in 2014 at their berths). USACE maintenance dredging efforts have been delayed due to the chemical quality of the sediment, which would require the sediment to be disposed of at a permitted upland facility. Disposal at an upland facility is not consistent with federal standards that require that dredged material be disposed of using the least costly, environmentally acceptable method, when possible (e.g. in-water or beneficial re-use). However, chemical quality of the sediment is also a consideration for disposal.

Due to already impeded vessel navigation due to sediment accumulation, it is anticipated that existing maintenance dredging is likely to be conducted again by the USACE in the FNC and turning basin, and by the Port in their berths as necessary, within the next 10 years to meet existing authorized depths (-30 ft MLLW in the FNC and turning basin and -39 ft MLLW at the Port's berths). Authorized dredge depth is expected to remain consistent for 30-years, and not authorized for deepening and widening beyond these depths.

4.4.2 West Bay Marinas

The Olympia Yacht Club last completed maintenance dredging of about 11,250 cy of material within specific shallow portions of their marina in 2014; prior to this, maintenance dredging was completed in

1987. Most of the material was approved for open-water disposal, with a small quantity requiring upland disposal. Maintenance dredging at the Martin Marina last occurred in the 1980s. Shoaling and/or sediment accumulation has been observed at the northwest corner of the Olympia Yacht Club and along the east shore of West Bay near marina access ramps and the marina access channel, which connects the marinas to the Port of Olympia and FNC and turning basin.

New WDNR leases now require compliance with a shallow water policy that restricts moorage where a small craft vessel will touch the seafloor at low tide. WDNR leases now require stoppers on docks to prevent them from bottoming out, and new or renewed leases require dock upgrades to avoid bottoming out.

All three West Bay marinas already experience shoaling to some extent and have either conducted existing maintenance dredging recently or plan to complete maintenance dredging within the next 10 years to maintain navigation viability, to comply with existing or new WDNR lease requirements, and/or in parallel with dock upgrades and/or reconfiguration. Maintenance dredging is often planned around other necessary marina upgrades focused on key areas that experience shoaling.

5.0 Impacts and Mitigation Measures

5.1 OVERVIEW

This section describes the probable navigation impacts from the No Action Alternative and the build alternatives (Managed Lake, Estuary, and Hybrid Alternatives) during the project's 30-year time horizon. This section also identifies mitigation measures that could avoid, minimize, or reduce the identified impact below the level of significance.

5.2 NO ACTION ALTERNATIVE

The No Action Alternative would not result in construction impacts on navigation because the project would not be built. Potential impacts would be related to limited ongoing maintenance of the 5th Avenue Dam and ongoing sedimentation of the Capitol Lake – Deschutes Estuary, since no sediment management strategies would be implemented.

5.2.1 Sediment Deposition Rates

Annual sediment deposition/erosion rates within Budd Inlet are highly dependent on river flow events with more extreme flow events depositing more sediments. As Figure 5.1 shows, there is substantial natural variability in annual peak river flow for the Deschutes River from year to year, which surpasses the importance of settling capacity (Moffatt & Nichol 2020) (Moffatt & Nichol 2020).

Comparison of historical and recent bathymetric surveys from 1998, 2011, and 2020, as described in Section 4.3, provide us with long-term average annual sediment deposition rates and spatial patterns for the No Action Alternative. Average annual sediment deposition rates were developed by bracketing high and low flow events, and are summarized in Table 5-1 (range from 4.3 cm/yr at the Olympia Yacht Club at the southern tip of the study area to 0.1 cm/yr for the FNC at the northern most boundary of the study area).

Table 5.1 includes two conditions: without RSLR and with RSLR (includes a 0.61 m future increase in RSLR). Deposition rates are lower for with RSLR than that without RSLR conditions. As stated in

Section 4.3, this is likely contributable to the higher water levels associated with RSLR resulting in reduced flow velocities and reduced erosion of sediments in Capitol Lake's Middle Basin, which results in reduced deposition in Budd Inlet.

Figure 5.1 Deschutes River Water Flows

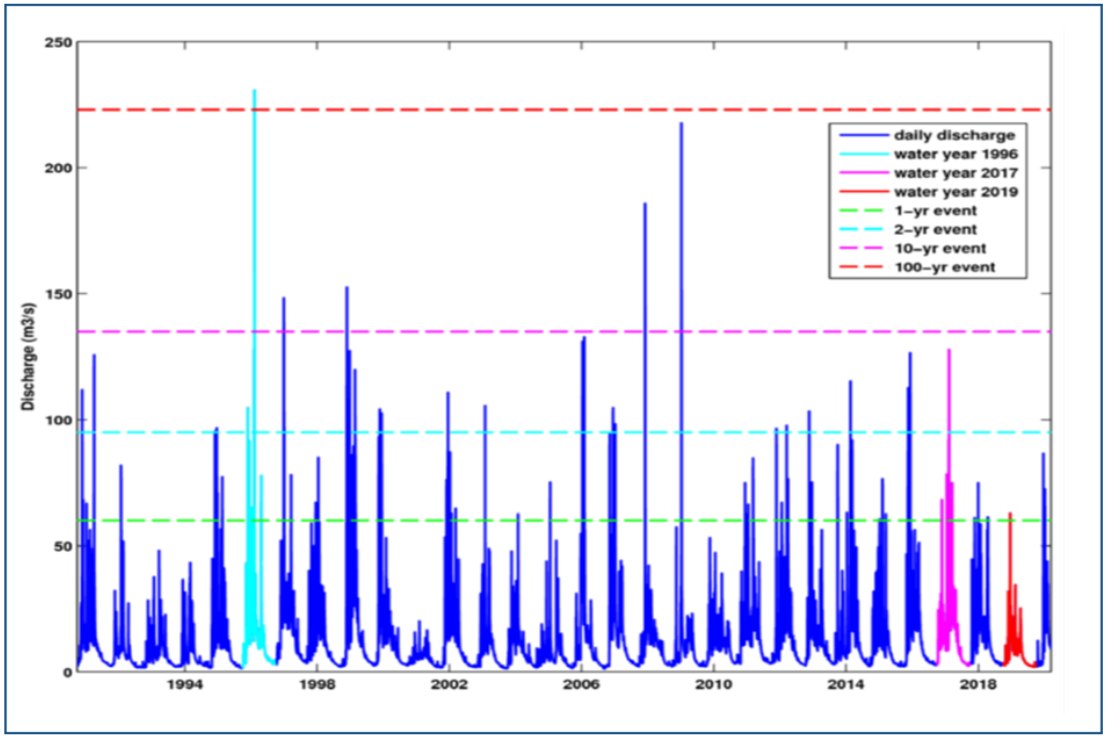


Table 5.1 Average Annual Sediment Deposition in Budd Inlet for the No Action Alternative with and without 0.61 m RSLR

Location	Average Annual Sediment Erosion/Deposition (cm/yr) w/o RSLR	Average Annual Sediment Erosion/Deposition (cm/yr) w RSLR
Olympia Yacht Club	4.3	3.4
Other West Bay Marinas and Marina Access	2.1	1.7
Port/Turning Basin	2.2	1.6
FNC (excluding Turning Basin)	0.1	0.1

Table 5.2 shows that the highest sediment deposition rate would likely occur at the Olympia Yacht Club (closest to the 5th Avenue Dam), decreasing northward throughout the east side of West Bay past the other marinas to the Port and southern end of the FNC and turning basin. Sediment deposition rates for Budd Inlet under the No Action Alternative are anticipated to increase slowly over the long-term as the settling capacity of Capitol Lake decreases over time. However, as previously stated, sediment deposition is highly dependent on naturally fluctuating annual river flows and maximum events; more

sediment is transported through the system in larger storm events, and less is transported with smaller storm years.

5.2.2 Existing Maintenance Dredging

The USACE FNC and turning basin, Port of Olympia, and West Bay marinas will continue to conduct maintenance dredging to maintain navigational and commercial viability under the No Action Alternative. Given that existing maintenance dredging is likely to be conducted by the USACE, Port, Olympia Yacht Club, and marinas within the next 10 years, impact analysis for the No Action Alternative assumes that an operable depth is obtained within this 10-year period. The next maintenance dredging event is, therefore, anticipated to be conducted at the frequencies presented in Table 5.2 for the different resource areas. For example, the Olympia Yacht Club would conduct maintenance dredging about once every 23 years or once within the 30-year project horizon, while the other marinas, USACE, and Port may not need to conduct maintenance dredging during this timeframe.

Anticipated existing maintenance dredging frequencies and quantities under the No Action Alternative were developed based on records from past dredging events, determined average sediment accumulation rates, and on quantities of sediment deposition that could be accommodated by the different facilities in the study area (Moffatt & Nichol 2020).

Table 5.2 No Action Alternative Maintenance Dredging in West Bay

Dredge Frequency (year)	Location	Amount (cy)
23	Olympia Yacht Club	21,594
47	Other Lower West Bay Marinas	15,606
42	FNC/Turning Basin/Port	247,778

For existing maintenance dredging anticipated at the Olympia Yacht Club within the 30-year project horizon, maintenance dredging would likely be completed similar to past maintenance dredging events and incorporate general maritime practices. Existing maintenance dredging would be focused on key areas of shoaling and sediment deposition, not the entire marina. This would involve planning and scheduling around this event. For example, maintenance dredging may require slip vacancies for temporary periods of time (up to a maximum of two months). In tight spaces at the marina, piles or floats may need to be removed and boathouses temporarily relocated within the marina or to a nearby location if dredging cannot be completed without moving the structure(s) prior to dredging (in some instances a small hydraulic dredge, rather than a clamshell dredge, can be used in tight spaces to minimize disturbances of existing structures). This could result in a temporary disruption to navigation if careful scheduling and phasing is not incorporated (i.e. dredge only impacted areas and phase dredging of different areas of the marina so that a smaller percentage of vessels and boathouses would need to be temporarily relocated at any one time). Marinas often include this type of scheduling and

phasing as part of their maintenance activities and plan for temporary vessel/boathouse relocation as part of their efforts to minimize disruptions and slip vacancies.

As stated above, existing maintenance dredging is generally only carried out at impacted areas, not over an entire channel or marina at one time. This enables marinas to remain operational during maintenance dredging events. Marinas will move a percentage of vessels from one dock to another to conduct maintenance dredging in one location, then move those vessels back to work at another dock or access area. Many marinas in Puget Sound are also able to complete maintenance dredging without removing piles or floats, which reduces the risk of damage to existing infrastructure and avoids complex mitigation and potential impacts on aquatic species (pile driving). Boathouses can also be relocated temporarily within or near the marina itself; towed to another slip, marina, or a temporary moorage dock installed nearby prior to dredging, if necessary.

5.2.3 Impacts from Sediment Deposition

Under the No Action Alternative, sediment deposition rates in Budd Inlet would not result in substantial changes or restrictions to vessel access, berthing, or the use of identified resources in the study area. The FNC and turning basin, Port berths, and marinas and their access channels would observe sediment deposition that would gradually increase over time, but these agencies and entities would still be anticipated to conduct existing maintenance dredging to maintain vessel access and berth use, especially if long delays were observed for cargo vessels calling at the Port (due to water depth or tide conditions), or if over 10% of small craft vessels could not access their slips or boathouses at the marinas. Therefore, operational impacts on navigation under the No Action Alternative would be **less than significant**.

5.3 IMPACTS COMMON TO ALL BUILD ALTERNATIVES

All build alternatives have in common operational impacts from sediment deposition. The extent of these impacts varies between alternatives and are described under the impacts for each alternative. The Estuary and Hybrid Alternatives also have in common impacts from the implementation of a long-term maintenance dredging program (a long-term maintenance dredging program is proposed as part of the Managed Lake Alternative but would occur in the Capitol Lake Basin, not in West Bay).

5.4 MANAGED LAKE ALTERNATIVE

5.4.1 Impacts from Construction

The Managed Lake Alternative does not include dredging or other activities north of the dam in Budd Inlet. As a result, there would be **no impacts** from construction related to navigation under the Managed Lake Alternative.

5.4.2 Impacts from Operations

5.4.2.1 Sediment Deposition Rates

Average annual sediment deposition rates for Budd Inlet under the Managed Lake Alternative would range from 4.3 cm/yr at the Olympia Yacht Club at the southern tip of the study area to 0.1 cm/yr for the FNC at the northern most boundary of the study area and are presented in Table 5.3. Similar to the No Action Alternative, deposition rates are lower for with RSLR than that without RSLR conditions, and the highest sediment deposition rate occurs at the Olympia Yacht Club, decreasing northward throughout the east side of West Bay past the other marinas to the Port and southern end of the FNC and turning basin, more noticeably during high river flow events (Moffatt & Nichol 2020).

Sediment transport modeling was completed for two different storm events (Moffatt & Nichol 2020). The Managed Lake Alternative can result in slightly reduced sediment deposition within Budd Inlet under extreme hydrologic events, such as a 100-year flood, compared to the No Action Alternative. This is likely due to deepening of the North Basin under the Managed Lake Alternative, which would create a more effective settling basin for the sediments.

Table 5.3 Average Annual Sediment Erosion/Deposition (cm/yr) in Budd Inlet for the Managed Lake Alternative with and without 0.61 m RSLR

Location	No Action Alternative w/o RSLR	No Action Alternative w RSLR	Managed Lake Alternative w/o RSLR	Managed Lake Alternative w RSLR
Olympia Yacht Club	4.3	3.4	4.3	3.3
Other West Bay Marinas and Marina Access	2.1	1.7	2.1	1.7
Port/Turning Basin	2.2	1.6	2.1	1.6
FNC (excluding Turning Basin)	0.1	0.1	0.1	0.1

5.4.2.2 Maintenance Dredging

A long-term maintenance dredging program for Budd Inlet is not proposed as part of the Managed Lake Alternative, but the USACE, Port of Olympia, Olympia Yacht Club, and West Bay marinas are anticipated to continue to conduct maintenance dredging in West Bay to maintain navigational viability, similar to the No Action Alternative.

5.4.2.3 Impacts from Sediment Deposition

Similar to the No Action Alternative, under the Managed Lake Alternative, sediment deposition rates in Budd Inlet would not result in substantial changes or restrictions to vessel access, berthing, or the use

of identified resources in the study area. The FNC and turning basin, Port berths, and marinas and their access channels would observe sediment deposition that would gradually increase over time, but these agencies and entities would still be anticipated to conduct maintenance dredging to maintain vessel access and berth use, especially if long delays were observed for cargo vessels calling at the Port (due to water depth or tide conditions), or if over 10% of small craft vessels could not access their slips or boathouses at the marinas. Therefore, operational impacts on navigation under the Managed Lake Alternative would be **less than significant**.

5.5 ESTUARY ALTERNATIVE

5.5.1 Impacts from Construction

The Estuary Alternative does not include dredging or other activities north of the dam in Budd Inlet. As a result, there would be **no impacts** from construction related to navigation under this alternative.

5.5.2 Impacts from Operations

5.5.2.1 Sediment Deposition Rates

Sediment deposition within Budd Inlet for the Estuary Alternative is higher than that for the No Action and Managed Lake Alternatives. Sediment transport modeling indicates that removal of the 5th Avenue Dam results in increased sediment deposition within Budd Inlet as sediments get transported farther downstream into the Capitol Lake Basin and Budd Inlet (Moffatt & Nichol, 2020). Average annual sediment deposition rates for Budd Inlet under the Estuary Alternative would range from 15.7 cm/yr at the Olympia Yacht Club at the southern tip of the study area to 0.1 cm/yr for the portion of the FNC at the northern most boundary of the study area and are presented in Table 5.4 and compared to the No Action Alternative.

Table 5.4 Average Annual Sediment Deposition (cm/yr) in Budd Inlet for the Estuary Alternative with and without 0.61 m RSLR

Location	No Action Alternative w/o RSLR	No Action Alternative w RSLR	Estuary Alternative w/o RSLR	Estuary Alternative w RSLR
Olympia Yacht Club	4.3	3.4	15.7	11.0
Other West Bay Marinas and Marina Access	2.1	1.7	8.2	6.1
Port/Turning Basin	2.2	1.6	7.8	5.3
FNC (excluding Turning Basin)	0.1	0.1	0.3	0.2

The Estuary Alternative is anticipated to result in higher increase in sediment deposition compared to the No Action Alternative under high river flow events; and could result in no changes under low flow

events. This increase in deposition rates during high flow events occurs because the river-borne sediments are transported into Budd Inlet instead of settling within the North Basin. Nor will the increase in deposition rates in Budd Inlet be uniform. Modeling shows that areas closer to the 5th Avenue Dam (e.g. Olympia Yacht Club) will experience higher sedimentation rates with relatively consistent rates observed between other nearby marinas and the Port berth and turning basin (e.g. the Port or the southern portion of the FNC).

Sediment erosion/deposition patterns were also assessed for two different flow events: a three-year simulation corresponding to a one-year flow event occurring three years in a row (Event A, representing a low flow scenario), and a three-year simulation based on a 115-year flow event occurring three times in a row (Event B, representing a high flow scenario). Sediment transport model results, in terms of deposition/erosion patterns for both events for the Estuary Alternative, are presented in Table 5.5, Figure 5.2, and Figure 5.3, which compare the Estuary Alternative to the No Action, Managed Lake, and Hybrid Alternatives (Moffatt & Nichol 2020). Annual erosion/deposition rates for Event B are generally higher than that for Event A because stronger flows associated with Event B will result in higher deposition and erosion rates compared to Event A. Model results for both events also indicate that removal of the 5th Avenue Dam increases sediment deposition within Budd Inlet as sediments are transported farther downstream and that higher deposition rates would occur on the east side of West Bay during high flow events (Moffatt & Nichol 2020) due to the presence of an area of shallow intertidal habitat along the remnants of the old trestle on the west side of West Bay.

Table 5.5 Average Annual Sediment Erosion/Deposition in cm/yr for Modeling Events A and B with 0.61 m of RSLR

Location	No Action A	No Action B	Managed Lake A	Managed Lake B	Estuary A	Estuary B	Hybrid A	Hybrid B
Olympia Yacht Club	0.0	6.7	0.1	6.4	0.3	21.7	1.1	28.6
Other West Bay Marinas and Marina Access	0.0	3.3	0.0	3.3	0.1	12.1	0.4	15.8
Port/Turning Basin	0.0	3.1	0.0	3.1	0.0	10.5	0.1	13.1
Navigation Channel (excluding Turning Basin)	0.0	0.1	0.0	0.1	0.0	0.4	0.0	0.5

Figure 5.2 Erosion/Deposition Pattern (cm/yr) for Event A with 0.61 m of RSLR

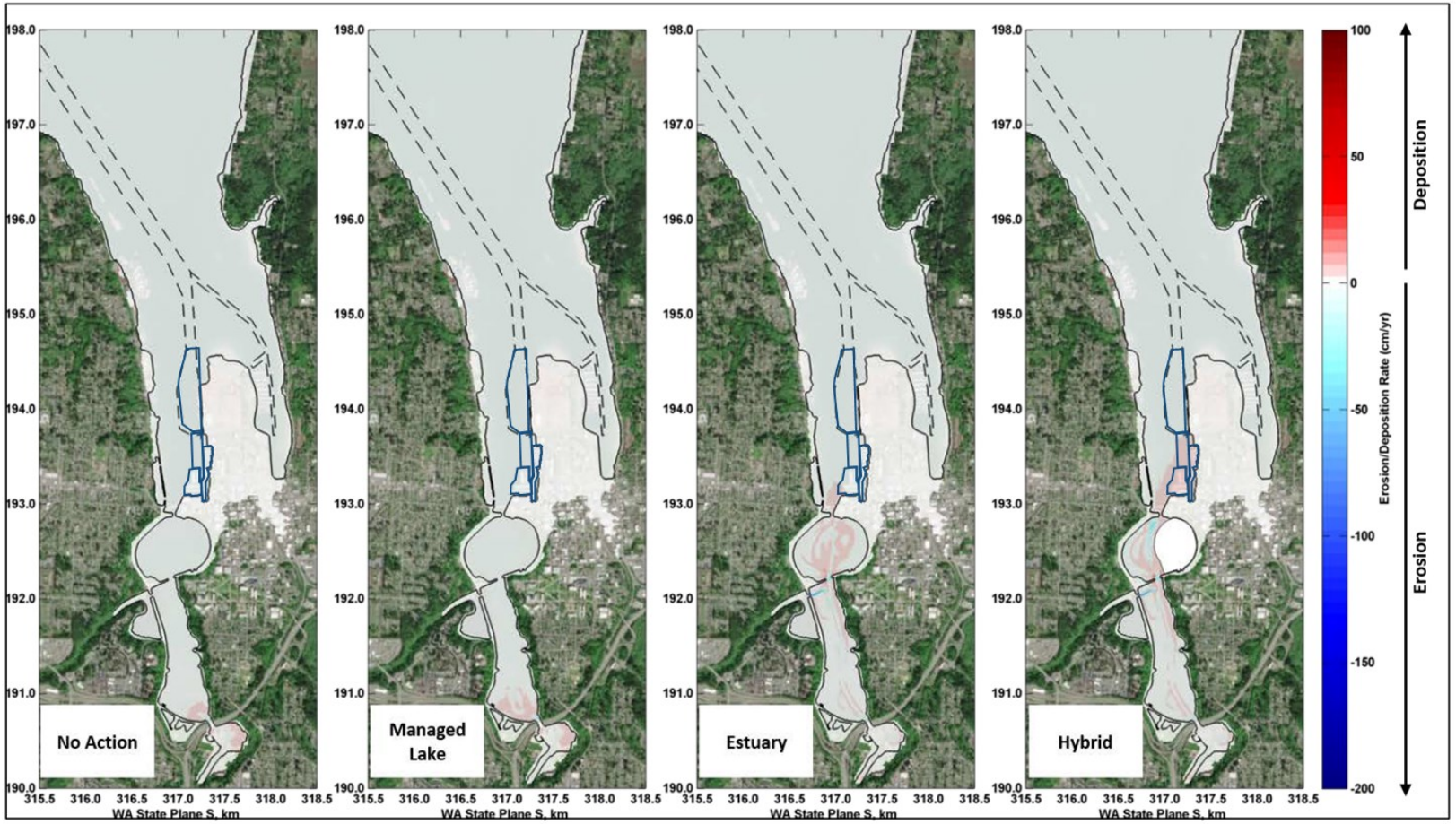
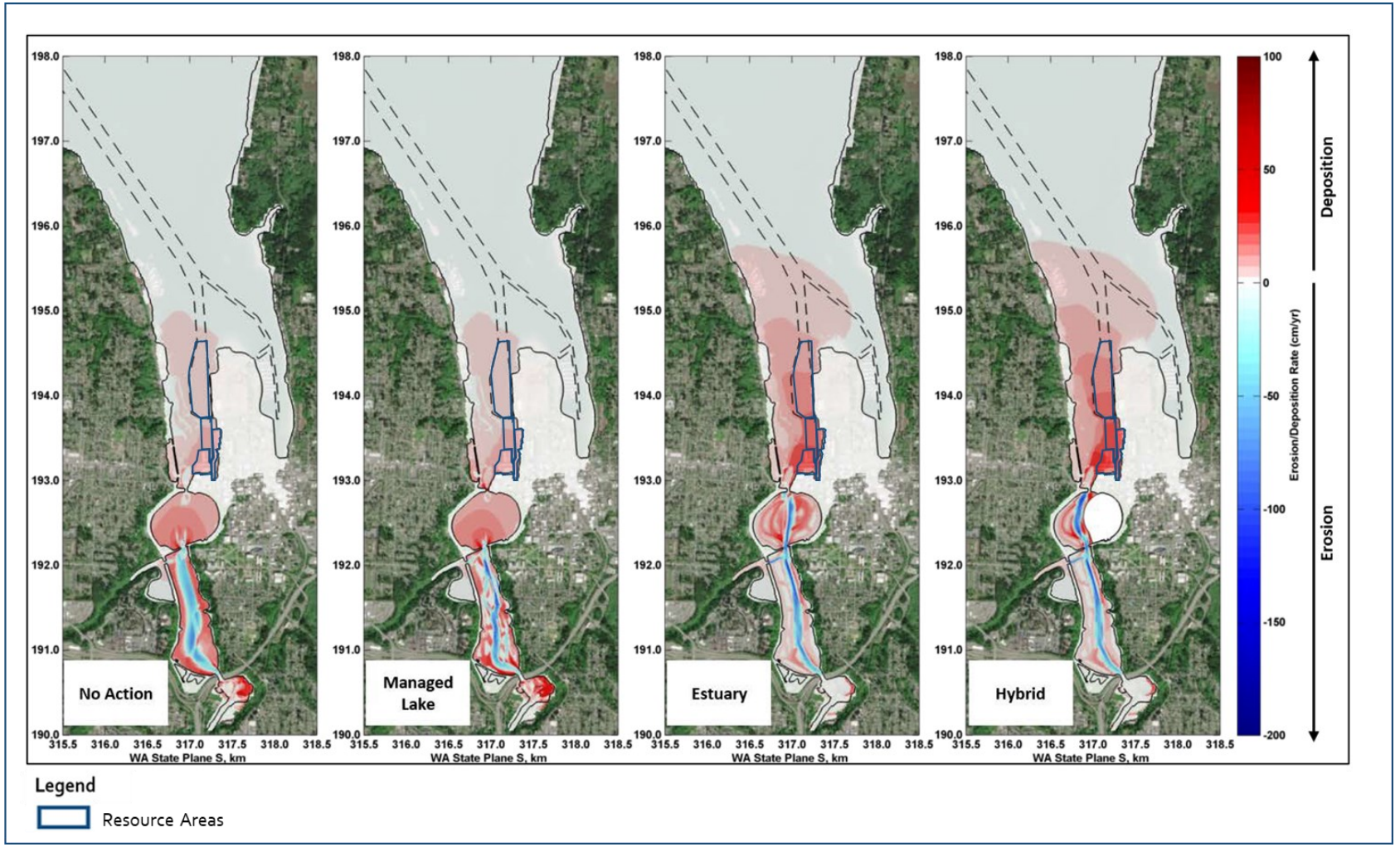


Figure 5.3. Erosion/Deposition Pattern (cm/yr) for Event B with 0.61 m or RSLR



5.5.2.2 Initial Dredging

To reduce higher sediment deposition rates within Budd Inlet associated with removal of the 5th Avenue Dam, initial dredging would be completed during construction within the North and Middle Basins as part of the Estuary Alternative. Approximately 526,000 cy of sediment would be dredged during this initial dredging event before the 5th Avenue Dam is removed. Initial dredging will remove the sediment source that will be available to the fast-moving flows during extreme hydrologic events that can be eroded from the Middle and North Basins and deposited into Budd Inlet. The goal of the initial channel dredging event is to minimize sediment deposition to downstream Budd Inlet resources north of the 5th Avenue Dam following removal. Modeling shows that initial dredging would result in a 48% reduction in impacts to sedimentation anticipated at the Olympia Yacht Club (Moffatt & Nichol 2020). Much of this dredged material would be used to construct other elements of the different build alternatives as described in Chapter 2 of the EIS (i.e. shoreline enhancement, habitat areas).

5.5.2.3 Maintenance Dredging

Removing the 5th Avenue Dam would result in increased variable sediment deposition in Budd Inlet under the Estuary Alternative (Moffatt & Nichol 2020). A long-term maintenance dredging program is proposed to manage sediment deposition in Budd Inlet. To reduce sediment deposition impacts maintenance dredging is proposed for different locations, quantities, and frequencies, as determined by sediment transport modeling (Moffatt & Nichol 2020) and data collected from local stakeholders.

Modeling demonstrates that there is not likely to be a significant initial flush of sediment; this is partly due to initial dredging that will occur during construction, resulting in a 48% reduction in sediment deposition at the Olympia Yacht Club, which would experience most of the sediment deposition (Moffatt & Nichol 2020). Rather, ongoing accumulation will occur annually and will be highly dependent on flow condition. The projected sediment transport from high and low flow conditions across 22 years (1998 to 2020) was averaged to generate the estimated annual rate of deposition and frequency of maintenance dredging within West Bay. To establish historic and projected dredging at the West Bay marinas, past dredging efforts were evaluated. The past two dredge events at Olympia Yacht Club occurred in 1987 and 2014. Based on records from these events, it is assumed that the Olympia Yacht Club dredged an average of approximately 3.25 ft of accumulated material over approximately 20% of the marina in 2014. Deeper areas of the marina basin did not require dredging at that time to maintain viable navigation. Dredge frequencies were also calculated based on the assumption that only a portion of a facility would require maintenance dredging at any one time, with a focus on shoaled areas, consistent with the approach to maintenance dredging at facilities across Puget Sound.

As assumed for the No Action Alternative, maintenance dredging is likely to be conducted by the USACE, Port, and West Bay marinas within the next 10 years, and impact analysis for the Estuary Alternative assumes that an operable depth is obtained within this 10-year period. This assumption is based on the following:

- Dredging of the FNC is expected to occur as a separate USACE-led action before sediment transport is reestablished in West Bay should the Estuary Alternative be constructed. The

USACE-led dredging is expected to include two (2) ft of advance maintenance dredging depth and one (1) ft of allowable overdredge; it is reasonable to assume that authorized depths would be reached in these areas concurrently to removal of the 5th Avenue Dam.

- West Bay marinas already experience shoaling to some extent and have either conducted maintenance dredging recently or plan to complete maintenance dredging within the next 10 years to maintain navigation and commercial viability, to comply with existing or new WDNR lease requirements and/or in parallel with dock upgrades and/or reconfiguration.

Maintenance dredging throughout the study area is proposed at the volumes and intervals described in Table 5.6 based on recently determined average sediment accumulation rates (Moffatt & Nichol 2020) and on data gathered on past maintenance dredging events at West Bay facilities. This schedule is based on the following:

- The assumption that authorized depths would be reached within 10 years, as described above;
- The anticipated sediment accumulation throughout the study area after the 5th Avenue Dam is removed; and,
- The depth of accumulation that has historically triggered the need for maintenance dredging in the past.

Table 5.6 Estuary Alternative Anticipated Maintenance Dredging in West Bay

Dredge Frequency (year)	Location	Amount (cy)	Total (cy)
6	Olympia Yacht Club	21,600	21,600
12	Olympia Yacht Club	21,600	285,000
	Other Lower West Bay Marinas	15,600	
	Port/Turning Basin	247,800	
18	Olympia Yacht Club	21,600	21,600
24	Olympia Yacht Club	21,600	350,400
	Other Lower West Bay Marinas	15,600	
	Port/Turning Basin	247,800	
	Marina Access	65,400	
30	Olympia Yacht Club	21,600	21,600
Total Dredged			700,200

Maintenance dredging would most likely be completed by mechanical means, although hydraulic dredging is not specifically precluded. Water-based heavy marine equipment, such as derricks, excavators on flat barges, and hopper barges or scows, would be used for maintenance operations.

The interagency Dredged Material Management Program (DMMP) led by USACE, Seattle District requires dredged material to meet specific marine sediment criteria prior to open-water disposal at an approved site. If dredged material does not meet criteria, material would be disposed of at an appropriate upland disposal site. Dredged material from maintenance dredging events for the Estuary Alternative is expected to be suitable for disposal at the nearby Anderson Ketron Island open water disposal site because chemical concentrations of the dredged (accumulated) material are expected to be less than the associated DMMP screening levels and invasive species are not expected to persist in these locations (Herrera Environmental Consultants, Inc. 2020). Split hull scows would be used to dispose of material at the Anderson-Ketron Island Disposal Site. Existing transloading facilities would be used if material was to be disposed of upland. Use of Port facilities for transloading dredge material would require coordination with Port operations. Dredge material could be loaded onto highway legal trucks or rail cars for transport to an upland facility.

Maintenance dredging operations are assumed to be 10 hours a day, five days a week within the applicable in-water work window (July 16 through February 15 each year). Table 5.7 presents production rates and durations for proposed maintenance dredging events. Maintenance dredging could extend into more than one in-water work window if dredging were phased to minimize impacts to operations (e.g. many marinas avoid completing maintenance during busy summer months).

Table 5.7 Maintenance Dredging Production Assumptions

Location	Dredge Volume (cy)	Production (cy/day)	Working Duration (Months)
Olympia Yacht Club	21,600	852	2
Other Lower West Bay Marinas	15,600	852	1
Port/Turning Basin	247,800	1,372	9
Marina Access	65,400	2,257	2

Maintenance dredging would be completed using best management practices. Maintenance dredging would be focused on key areas of shoaling and sediment, not an entire channel, berth, or marina. Careful planning for the scheduled maintenance dredging event, adherence to all navigation and in-water construction requirements, and avoidance of peak periods of use (i.e. summer months for the marinas) would occur. For example, maintenance dredging at the Port or within the FNC Entrance Channel or turning basin would require coordination with cargo vessel calls and/or call interruptions for periods up to about nine months during each dredge cycle (assumed to occur at a 12-year frequency in this location). Maintenance dredging at the Olympic Yacht Club and marinas could require slip vacancies for temporary periods of time (up to two months during each dredge cycle; assumed at a 6-year frequency in this location). In tight spaces at marinas, piles or floats may be required to be removed prior to dredging. Derrick barges, flat deck barges, and land equipment could be used to pull floats and piles from shoaled areas of the marinas if necessary. Boathouses located in shoaled areas requiring maintenance dredging may need to be temporarily relocated prior to maintenance dredging

(a small hydraulic dredge can be used in tight spaces to minimize the need for infrastructure relocation). Any removed floats and piles would be reinstalled following dredging activities.

5.5.2.4 Impacts from Sediment Deposition on Vessel Access and Berthing

The Estuary Alternative is anticipated to result in increases in sediment deposition compared to the No Action Alternative (Moffatt & Nichol 2020) that would impact vessel navigation in the study area. Initial dredging and implementation of a long-term maintenance dredging program is needed to minimize potential sediment deposition impacts within the study area. Shallower water depths could limit, or block, access or vessel use of channels, berths, and slips in between maintenance dredging events if not identified before impacts to navigability occurred.

A project sediment monitoring plan is proposed to document sediment accumulation within the identified resource areas in West Bay, including the southern portion of the FNC and turning basin, the Port of Olympia's three berths, and the nearby West Bay marinas. An annual sediment monitoring plan is needed given the influence of storm events on sediment load passed through the system and deposited in West Bay. The anticipated frequency of maintenance dredging (as provided in Table 5.6) is based on statistical averages, and monitoring would reduce or increase the frequency of maintenance dredging based on annual bathymetric data recorded for the West Bay resource areas. Monitoring would allow the long-term maintenance dredging program to be adapted, as necessary. For example, if the sediment monitoring observed heavy sediment deposition over a period of time as a result of high flow events, the frequency of maintenance dredging could be increased. Similarly, if a number of low flow events were observed for a period of time and low sediment deposition was observed, the frequency between maintenance dredging events could be extended. The use of the sediment monitoring plan to implement the long-term maintenance dredging program allows for a flexible and responsive approach to avoiding significant impacts to navigation from sediment deposition. Regular monitoring, combined with scheduled, but flexible maintenance dredging, provides for a management strategy that is not presently available to all stakeholders within the study area.

Impacts to navigation from sediment deposition are considered significant if navigability would be so adversely affected that large commercial vessels accessing the FNC and Port would be required to wait longer than four (4) hours for channel access due to water depth and low tide conditions caused by sediment deposition or if over 10% of anticipated small craft vessels would not be able to access their slip for moorage at an existing marina or public moorage facility due to water depth caused by sediment deposition. Initial dredging and recurring maintenance dredging plan are incorporated into this alternative to minimize impacts to navigation. Given the influence of storm events on the rate of future deposition, a sediment monitoring plan would enable adjustment of the frequency of maintenance dredging events, allowing them to be scheduled to occur prior to reaching levels of significance. With the incorporation of initial dredging and an adaptable long-term maintenance dredging program, combined with the implementation of a data-driven sediment monitoring plan, impacts on navigation in the study area under the Estuary Alternative could be reduced to less than significant levels**,** though **significant impacts** could still occur due to the variability of sediment load across and within years.

5.5.2.5 Impacts from Maintenance Dredging on Vessel Access and Berth or Slip Use

Maintenance dredging would occur at an assumed frequency of every 6 years, with the location shifting under each occurrence. This will require the USACE, Port, and West Bay marinas to schedule and coordinate berth and slip use around these events. For example, maintenance dredging at the Port or within the FNC or turning basin will require coordination of cargo vessel calls and/or call interruptions for up to nine months during each dredge cycle (assumed to occur at a 12-year frequency in this location). Maintenance dredging at the West Bay marinas could require slip vacancies for temporary periods of time (up to two months during each dredge cycle; assumed at a 12-year frequency in this location; a 6-year frequency for the Olympia Yacht Club). In tight spaces at the marinas, piles or floats may be required to be removed during dredging activities. Boathouses located in shoaled areas requiring maintenance dredging may need to be temporarily relocated prior to maintenance dredging. These types of access and slip use interruptions can be significant. General marine practices try to minimize impacts to operations when possible, and the above timeframes proposed for one maintenance dredging event are conservative.

Maintenance dredging is generally only carried out at impacted areas, not over an entire channel or marina at one time (unless combined with more extensive facility upgrades such as wharf, float, and/or pile replacements). Many ports and marinas in Puget Sound are able to remain operational during maintenance dredging activities. The number of active port berths can be temporarily reduced to accommodate dredging at one specific berth and cargo vessel calls can be rescheduled. Marinas will often move vessels to different slips to conduct maintenance dredging in one location, then move those vessels back to work at another dock or access area. Many marinas are also able to complete maintenance dredging without removing piles or floats, which reduces the risk of damage to existing infrastructure and avoids complex mitigation and potential impacts on aquatic species (pile driving). Small hydraulic dredges provide flexibility while dredging around boathouses, or they can be relocated temporarily within or near their marina. Early coordination and scheduling minimize impacts on navigation. Monitoring ensures that maintenance dredging occurs as the significance threshold is approached. In doing so, the assumed duration of dredging is not expected to exceed what is provided in Table 5.6.

All dredge vessels would be required to follow applicable regulations, as identified in Section 2.0, and to minimize impediment of vessel navigation for vessels calling at the Port with any more severity than standard maintenance dredging at ports in the Puget Sound region. Given the proposed volumes and timeframes anticipated for maintenance dredging, these limited changes in the number of vessels using these channels and areas for maintenance dredging is consistent with existing FNC and Port uses.

Impacts to navigation from maintenance dredging are considered significant if navigability would be so adversely affected that large commercial vessels accessing the FNC and Port would be required to wait longer than four (4) hours for channel access due maintenance dredging activities or equipment or if over 10% of anticipated small craft vessels would not be able to access their slip for moorage at an existing marina or public moorage facility due to maintenance dredging activities or equipment. The benefits of monitoring and regular implementation of an adaptable long-term maintenance dredging

program enables careful scheduling and planning to be incorporated into a dredge event. Maintenance dredging at the Port could phase maintenance dredging to avoid impacting more than one berth at a time, and care with scheduling could minimize the potential for cargo vessel call delays. Temporary relocation of vessels and boathouses within West Bay marinas would also minimize impacts. These measures would reduce the potential for **significant impacts** from the long-term maintenance dredging program on vessel navigation under the Estuary Alternative to less than significant impacts.

5.5.2.6 Beneficial Effects

Long-term maintenance dredging program and monitoring would ensure that impacts from sediment deposition do not reach a significant level. The need for regular maintenance dredging faced under the Estuary Alternative would be addressed and result in maintenance dredging being completed with regularity, which does not occur at all locations in West Bay at this time. Under the Estuary Alternative, a long-term management plan is incorporated into the project itself and supplemented with a sediment monitoring plan that would enable sediment accumulation conditions that interrupt vessel access or berthing to be identified early. Long-term sediment management and regular maintenance dredging and monitoring could provide a **minor beneficial effect** on navigation under the Estuary Alternative.

5.6 HYBRID ALTERNATIVE

5.6.1 Impacts from Construction

The Hybrid Alternative does not include dredging or other activities north of the dam in Budd Inlet. As a result, there would be **no impacts** from construction related to navigation under this Alternative.

5.6.2 Impacts from Operations

5.6.2.1 Sediment Deposition Rates

Sediment deposition within Budd Inlet for the Hybrid Alternative is higher than that for the No Action, Managed Lake, and Estuary Alternatives. Similar to the Estuary Alternative, sediment transport modeling indicates that removal of the 5th Avenue Dam results in increased sediment deposition within Budd Inlet as sediments get transported farther downstream into the Capitol Lake Basin and Budd Inlet (Moffatt & Nichol, 2020). Average annual sediment deposition rates for Budd Inlet under the Hybrid Alternative would range from 19.4 cm/yr at the Olympia Yacht Club at the southern tip of the study area to 0.3 cm/yr for the portion of the FNC at the northern most boundary of the study area and are presented in Table 5.8 and compared to the No Action and Estuary Alternatives.

Table 5.8 Average Annual Sediment Deposition (cm/yr) in Budd Inlet for the Hybrid and Estuary Alternatives with and without 0.61 m RSLR

Location	No Action Alternative w/o RSLR	No Action Alternative w RSLR	Estuary Alternative w/o RSLR	Estuary Alternative w RSLR	Hybrid Alternative w/o RSLR	Hybrid Alternative w RSLR
Olympia Yacht Club	4.3	3.4	15.7	11.0	19.4	14.8
Other West Bay Marinas and Marina Access	2.1	1.7	8.2	6.1	9.9	8.1
Port/Turning Basin	2.2	1.6	7.8	5.3	9.1	6.6
Navigation Channel (excluding Turning Basin)	0.1	0.1	0.3	0.2	0.3	0.3

The Hybrid Alternative is anticipated to result in higher increase in sediment deposition compared to the No Action Alternative, and even the Estuary Alternative. This is most likely due to acceleration of river flow within the North Basin as it is forced to bend around the barrier wall of the reflecting pool. This acceleration of the flow results in increased erosion within the North Basin and increased deposition within Budd Inlet compared to the Estuary Alternative.

Similar to the Estuary Alternative, deposition rates in Budd Inlet will not be uniform. Modeling shows that areas closer to the 5th Avenue Dam (e.g. Olympia Yacht Club) will experience higher sedimentation rates with relatively consistent rates observed between other nearby marinas and the Port berth and turning basin (e.g. the Port or the southern portion of the FNC).

Sediment erosion/deposition patterns were also assessed for two different flow events: Event A, representing a low flow scenario; and, Event B, representing a high flow scenario. Sediment transport model results, in terms of deposition/erosion patterns for both events are presented in Table 5.5, Figure 5.2, and Figure 5.3, which compare the Hybrid Alternative to the No Action, Managed Lake, and Estuary Alternatives (Moffatt & Nichol 2020). Annual erosion/deposition rates for Event B are generally higher than that for Event A because stronger flows associated with Event B will result in higher deposition and erosion rates compared to Event A. Model results for both events also indicate that removal of the 5th Avenue Dam increases sediment deposition within Budd Inlet as sediments are transported farther downstream and that higher deposition rates would occur on the east side of West Bay during high flow events (Moffatt & Nichol 2020) due to the presence of an area of shallow intertidal habitat along the remnants of the old trestle on the west side of West Bay.

5.6.2.2 Initial Dredging

Initial dredging for the Hybrid Alternative would occur during construction within the North Basin and Middle Basin to create both Main and Secondary Channels. Approximately 499,000 cy of sediment would be dredged during this initial dredging event for the Hybrid Alternative. Initial dredging will remove the sediment source that will be available to the fast-moving flows during extreme hydrologic events that can be eroded from the Middle and North Basins and deposited into Budd Inlet. The goal of the initial channel dredging event is to minimize sediment deposition to downstream Budd Inlet resources north of the 5th Avenue Dam following removal. Modeling shows that initial dredging would result in a 48% reduction in impacts to sedimentation anticipated at the Olympia Yacht Club (Moffatt & Nichol 2020).

5.6.2.3 Maintenance Dredging

Maintenance dredging for the Hybrid Alternative would be similar to that described for the Estuary Alternative but would vary with respect to the area and rate for accumulation. The model results for both flow events (A and B) indicate that the Hybrid Alternative results in higher rates of deposition within Budd Inlet compared to the Estuary Alternative. This is most likely due to acceleration of the flow within the North Basin as flow is forced to bend around the reflecting pool for the Hybrid Alternative. This acceleration of the flow results in increased erosion within the North Basin and increased deposition within Budd Inlet compared to the Estuary Alternative. For that reason, the frequency of maintenance dredging is increased for the Hybrid Alternative compared to the Estuary Alternative and the patterns of deposition are slightly different (Table 5.9).

Similar to the Estuary Alternative, the maintenance dredging schedule is based on the following:

- The assumption that authorized depths would be reached within 10 years;
- The anticipated sediment accumulation throughout the study area after the 5th Avenue Dam is removed; and,
- The depth of accumulation that has historically triggered the need for maintenance dredging in the past.

Table 5.9 Hybrid Alternative Anticipated Maintenance Dredging in West Bay

Dredge Frequency (year)	Location	Amount (cy)	Total (cy)
5	Olympia Yacht Club	21,600	21,600
10	Olympia Yacht Club	21,600	285,000
	Other Lower West Bay Marinas	15,600	
	Port/Turning Basin	247,800	
15	Olympia Yacht Club	21,600	21,600

Dredge Frequency (year)	Location	Amount (cy)	Total (cy)
20	Olympia Yacht Club	21,600	350,400
	Other Lower West Bay Marinas	15,600	
	Port/Turning Basin	247,800	
	Marina Access	65,400	
25	Olympia Yacht Club	21,600	21,600
30	Olympia Yacht Club	21,600	285,000
	Other Lower West Bay Marinas	15,600	
	Port/Turning Basin	247,800	
Total Dredged			985,200

Maintenance dredging would be completed similar to the methods described for the Estuary Alternative and material dredged as part of the maintenance dredging plan for the Hybrid Alternative is assumed to be suitable for open-water disposal, given the quality of the material moving downstream from the Deschutes River (Herrera Environmental Consultants, Inc., 2020).

Maintenance dredging operations are assumed to be 10 hours a day, five days a week within the applicable in-water work window (July 16 through February 15 each year). Table 5.7 presents production rates and durations for the maintenance dredging events shared between the Estuary and Hybrid Alternatives. Maintenance dredging could extend into more than one in-water work window if dredging were phased to minimize impacts to operations (e.g. many marinas avoid completing maintenance during busy summer months).

5.6.2.4 Impacts from Sediment Deposition on Vessel Access and Berthing

Similar to the Estuary Alternative, the Hybrid Alternative is anticipated to result in significant increases in sediment deposition compared to the No Action Alternative (Moffatt & Nichol 2020) that would impact vessel navigation in the study area. The Hybrid Alternative would also result in higher rates of deposition within Budd Inlet compared to the Estuary Alternative.

Initial dredging and implementation of a long-term maintenance dredging program is needed to minimize potential sediment deposition impacts within the study area. Shallower water depths could limit, or block, access or vessel use of channels, berths, and slips in between maintenance dredging events if not identified before impacts to navigability occurred.

Similar to the Estuary Alternative, a project sediment monitoring plan is proposed to document sediment accumulation within the identified resource areas in West Bay, including the southern portion of the FNC and turning basin, the Port of Olympia's three berths, and the nearby West Bay marinas. An annual sediment monitoring plan is needed given the influence of storm events on sediment load passed through the system and deposited in West Bay. The anticipated frequency of maintenance

dredging (as provided in Table 5.9) is based on statistical averages, and monitoring would reduce or increase the frequency of maintenance dredging based on annual bathymetric data recorded for the West Bay resource areas. Monitoring would allow the long-term maintenance dredging program to be adapted, as necessary. The use of the sediment monitoring plan to implement the long-term maintenance dredging program allows for a flexible and responsive approach to avoiding significant impacts to navigation from sediment deposition. Regular monitoring, combined with scheduled, but flexible maintenance dredging, provides for a management strategy that is not presently available to all stakeholders within the study area.

Impacts to navigation from sediment deposition are considered significant if navigability would be so adversely affected that large commercial vessels accessing the FNC and Port would be required to wait longer than four (4) hours for channel access due to water depth and low tide conditions caused by sediment deposition or if over 10% of anticipated small craft vessels would not be able to access their slip for moorage at an existing marina or public moorage facility due to water depth caused by sediment deposition. Initial dredging and recurring maintenance dredging plan are incorporated into this alternative to minimize impacts to navigation. Given the influence of storm events on the rate of future deposition, a sediment monitoring plan would enable adjustment of the frequency of maintenance dredging events, allowing them to be scheduled to occur prior to reaching levels of significance. With the incorporation of initial dredging and an adaptable long-term maintenance dredging program, combined with the implementation of a data-driven sediment monitoring plan, impacts on navigation in the study area under the Estuary Alternative could be reduced to less than significant levels, though **significant impacts** could still occur due to the variability of sediment load across and within years.

5.6.2.5 Impacts from Maintenance Dredging on Vessel Access and Slip or Berth Use

Maintenance dredging would occur at an assumed frequency of every 5 years, with the location shifting under each occurrence. This will require the USACE, Port, and West Bay marinas to schedule and coordinate berth and slip use around these events. For example, maintenance dredging at the Port or within the FNC or turning basin will require coordination of cargo vessel calls and/or call interruptions for up to nine months during each dredge cycle (assumed to occur at a 10-year frequency in this location). Maintenance dredging at the West Bay marinas could require slip vacancies for temporary periods of time (up to two months during each dredge cycle; assumed at a 10-year frequency in this location; a 5-year frequency for the Olympia Yacht Club). In tight spaces at the marinas, piles or floats may be required to be removed during dredging activities. Boathouses located in shoaled areas requiring maintenance dredging may need to be temporarily relocated prior to maintenance dredging. These types of access and slip use interruptions can be significant. General marine practices try to minimize impacts to operations when possible, and the above timeframes proposed for one maintenance dredging event are conservative.

Maintenance dredging is generally only carried out at impacted areas, not over an entire channel or marina at one time (unless combined with more extensive facility upgrades such as wharf, float, and/or pile replacements). Many ports and marinas in Puget Sound are able to remain operational during

maintenance dredging activities. The number of active port berths can be temporarily reduced to accommodate dredging at one specific berth and cargo vessel calls can be rescheduled. Marinas will often move vessels to different slips to conduct maintenance dredging in one location, then move those vessels back to work at another dock or access area. Many marinas are also able to complete maintenance dredging without removing piles or floats, which reduces the risk of damage to existing infrastructure and avoids complex mitigation and potential impacts on aquatic species (pile driving). Small hydraulic dredges provide flexibility while dredging around boathouses, or they can be relocated temporarily within or near their marina. Early coordination and scheduling minimize impacts on navigation. Monitoring ensures that maintenance dredging occurs as the significance threshold is approached. In doing so, the assumed duration of dredging is not expected to exceed what is provided in Table 5.9.

All dredge vessels would be required to follow applicable regulations, as identified in Section 2.0, and to minimize impediment of vessel navigation for vessels calling at the Port with any more severity than standard maintenance dredging at ports in the Puget Sound region. Given the proposed volumes and timeframes anticipated for maintenance dredging, these limited changes in the number of vessels using these channels and areas for maintenance dredging is consistent with existing FNC and Port uses.

Impacts to navigation from maintenance dredging are considered significant if navigability would be so adversely affected that large commercial vessels accessing the FNC and Port would be required to wait longer than four (4) hours for channel access due maintenance dredging activities or equipment or if over 10% of anticipated small craft vessels would not be able to access their slip for moorage at an existing marina or public moorage facility due to maintenance dredging activities or equipment. The benefits of monitoring and regular implementation of an adaptable long-term maintenance dredging program enables careful scheduling and planning to be incorporated into a dredge event. Maintenance dredging at the Port could phase maintenance dredging to avoid impacting more than one berth at a time, and care with scheduling could minimize the potential for cargo vessel call delays. Temporary relocation of vessels and boathouses within West Bay marinas would also minimize impacts. These measures would reduce the potential for significant impacts from the long-term maintenance dredging program on vessel navigation under the Hybrid Alternative to **less than significant impacts**.

5.6.2.6 Beneficial Effects

Similar to the Estuary Alternative, the implementation of long-term maintenance dredging program and monitoring would ensure that impacts from sediment deposition do not reach a significant level. The need for regular maintenance dredging faced under the Hybrid Alternative would be addressed and result in maintenance dredging being completed with regularity, which does not occur at all locations in West Bay at this time. Under the Hybrid Alternative, a long-term management plan is incorporated into the project itself and supplemented with a sediment monitoring plan that would enable sediment accumulation conditions that interrupt vessel access or berthing to be identified early. Long-term sediment management and regular maintenance dredging and monitoring could provide a **minor beneficial effect** on navigation under the Hybrid Alternative.

5.7 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

5.7.1 Common to the Estuary and Hybrid Alternatives

Two key project design features that avoid and minimize impacts to vessel navigation have been incorporated into the project under the Estuary and Hybrid Alternatives:

- Initial dredging Capitol Lake before the 5th Avenue Dam is removed is proposed for both the Estuary and Hybrid Alternatives and was shown during modeling to be effective in reducing sediment deposition in Budd Inlet. Sediment deposition at the Olympia Yacht Club, for example, reduces by approximately 48% when initial dredging is assumed. Both the Estuary and Hybrid Alternatives include initial dredging that would be completed in Capitol Lake.
- Maintenance dredging is included for both the Estuary and Hybrid Alternatives and would occur in impacted areas of West Bay. The purpose of this is to manage sediment accumulation in West Bay and minimize impacts to Port and marina facilities and access channels to less than significant levels.

In addition to the design features described above, the following mitigation measures are included:

- A sediment monitoring plan would be developed and implemented to document initial conditions at the nearby lower portion of the FNC, the Port of Olympia, and West Bay marinas to document when actual impacts are observed. A sediment monitoring plan is especially important to document high flow events (i.e. storm surges), which influence sediment load. Monitoring would be conducted annually and used to modify the long-term maintenance dredging program, as necessary. The use of the sediment monitoring plan to implement the long-term maintenance dredging program allows for an adaptive, flexible, and responsive approach to avoiding significant impacts to navigation from sediment deposition.
- As part of the long-term maintenance dredging program, scheduling and phasing would be developed in coordination with the USACE, Port, and private marinas to minimize impacts to the FNC and turning basin, Port of Olympia berths, and private marinas. Early coordination and scheduling with marina managers and vessel slip and boathouse tenants to identify the need for, and provide, temporary moorage will be provided as required (i.e. space at another marina or facility in Budd Inlet, or the installation of a temporary dock to use during maintenance dredging).

Other mitigation measures were modeled to evaluate their ability to influence sediment deposition in Budd Inlet, and reduce impacts to navigation. The modeling found that these mitigation measures would not be effective. The mitigation measures evaluated and eliminated from further review included:

- Dredging a shallow bench: Includes dredging the intertidal and subtidal bench immediately downstream of the 5th Avenue Dam on the west side of West Bay. Model results showed that this bench forces the Deschutes River flow exiting the North Basin to bend towards the east side of West Bay within Budd Inlet, which moves sediment deposition toward the Port and

marinas on the east side of West Bay. Dredging this bench could potentially result in a uniform pattern of deposition across the width of West Bay of Budd Inlet and reduced deposition at the Olympia Yacht Club and marinas.

- Sediment Control Structure: Includes constructing a control structure (e.g. a vertical wall) to the west of the Olympia Yacht Club to force the Deschutes River flow exiting the North Basin to stay on the west side of the Olympia Yacht Club and marinas, minimizing potential sediment deposition at these facilities.
- Dredging the Shallow Bench and Sediment Control Structure: Includes combining the shallow bench measure with the sediment control structure measure.
- Sediment Trap: Includes dredging a settling basin immediately downstream of the 5th Avenue Dam to create a sediment trap to capture some of the river-borne sediments before they are transported and deposited in the Budd Inlet.
- Dredged Channel: Includes dredging a channel connecting deep areas of the North Basin with the FNC to direct the fast-moving flow and contain the deposition along this channel as much as possible.

Following this evaluation, the sediment monitoring plan was determined to be the most effective measure to identify potentially impacted areas and ensure that impacts of sediment accumulation do not reach significant levels by triggering maintenance dredging as needed.

5.7.2 Measures for the Managed Lake Alternative

Mitigation measures that avoid and minimize impacts to vessel navigation are not proposed under the Managed Lake Alternative.

5.7.3 Significant Unavoidable Adverse Impacts

The project would result in no long-term change to vessel navigation under the Managed Lake, Estuary, or Hybrid Alternatives. With measures included in the project to address sediment-related impacts in West Bay, there would be no significant unavoidable adverse impacts on vessel navigation.

6.0 References

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