VESSEL TRAFFIC PATTERNS
DRAFT ENVIRONMENTAL IMPACT STATEMENT

NEW WHATCOM REDEVELOPMENT

PORT OF BELLINGHAM
BELLINGHAM, WASHINGTON

Prepared for

Port of Bellingham

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1 VESSEL TRAFFIC PATTERNS

1.1 Introduction

Patterns of waterfront navigation use change in response to regional economics, waterfront land uses and demographic factors. Since initial development within the New Whatcom Area during the late 1800s, the waterfront land use has been focused on industrial activity. Waterfront navigation uses have similarly been focused on uses that support industrial land use. The types of navigation uses along the waterfront may be affected by implementation of the New Whatcom development, resulting in changes to how these navigation uses interact with public or tribal use of area shorelines.

1.2 Affected Environment – Area Navigation Uses

This section summarizes existing navigation uses within the New Whatcom Area. Historical navigation patterns are discussed to provide context for the transition occurring with land and navigation patterns along the Whatcom Waterway.

1.2.1 Historical Navigation Patterns

Historical photographs (Attachment 1) document the industrial navigation uses that have predominated along the New Whatcom waterfront since the late 1800s. During the 1800s, the New Whatcom area was developed with piers, wharves and railroad trestles. Log rafting activities took place in most harbor areas in support of local lumber mill operations.

By the early 1900s, the population of Bellingham had significantly expanded, and the waterfront areas were fully industrialized. Waterfront land uses included lumber and shingle mills, shipyards, bulk oil terminals and cargo handling. Both private and public tide-lands were used for log rafting in support of area lumber mills and related industries. The Whatcom Waterway was authorized by the Corps of Engineers, dredged and then deepened during this period. Tideland fills progressively extended the shoreline in portions of Area 1 and within Areas 2-5. Most of the development in other Site areas was constructed in over-water areas on wharves. The Bellingham Shipping Terminal was initially constructed during this period, and was later sold to the Port of Bellingham.

Between the 1930s and the 1960s, the waterfront industrial uses continued to expand. Early paper mill operations expand within Areas 2 and 3. The Port of Bellingham improved the Port terminal area and s acquired management of portions of state-owned harbor areas during the 1940s and 1950s along both sides of the Whatcom Waterway. These harbor areas were continuously leased out for log storage and log rafting. A small boat marina was located in the Log Pond between the 1930s and the 1950s and was used by the Bellingham Bay Yacht Club.

Industrial waterfront uses continued after 1963 when Georgia Pacific acquired the former holdings of Puget Sound Pulp and Timber and later the Columbia Lumber Company. GP and the Port continued supporting industrial navigation activities with their industrial waterfront facilities. Other waterfront industrial users included the Olivine Corporation, Time Oil, Chevron Products Company and other waterfront industries. Log rafting offshore of Area 1 was discontinued within a portion of the harbor areas offshore of Area 1 978 as part of the development of the ASB for improved industrial wastewater treatment. In response to increasing demand for small boat harbors, the Port converts log rafting areas into a small boat harbor just west of the project area during the 1980s. Log rafting operations continued offshore of Areas 9 and 10 through the late 1990s.

In response to changing local land use and economic factors, the Port and DNR have initiated updates to waterfront navigation planning in order to support revitalization of the waterfront. These updates include updating the boundaries of the federal navigation channel within the Whatcom Waterway, and updating state harbor lines. These changes are consistent with and support the implementation of the Waterfront Futures Group Vision and Framework Plan for the waterfront area. Specifically, these updates focus the active federal channel boundaries around the Bellingham Shipping Terminal in areas where necessary deep draft infrastructure exists and is consistent with community land use changes, targeting future funding requests from the Corps of Engineers O&M program consistent with the highly competitive nature of this program. These updates will also enable development of softened, more-natural shorelines along the Whatcom Waterway, in the event that the New Whatcom Redevelopment is implemented.

1.2.2 Existing Navigation Uses

Existing navigation uses are discussed below by area, with a discussion of how these uses compare to historical navigation uses.

- **I&J Waterway:** Navigation uses within the I&J Waterway are currently a mix of intermediate draft industrial navigation uses. Such uses include barge and tug traffic, fishing vessel operation, operation of shallow and intermediate draft Coast Guard vessels. Small boat traffic occurs predominantly in the outer portion of the waterway and is associated with the adjacent existing marina and dry-land boat storage within Area 1. Current navigation uses within the waterway are less than during historical periods, but with a greater composition of small boat traffic entering and exiting the existing Inner Boat Basin.
- **ASB Area:** The existing ASB is used for wastewater and stormwater treatment. The ASB occupies a portion of the area historically used for log rafting from the turn of the century and the late 1970s.
- **Inner Whatcom Waterway:** Navigation uses in the Inner Waterway currently consist of a mix of intermediate draft industrial navigation uses (i.e., tugs, barges, and commercial fishing vessels) and small boat uses associated with the Colony Wharf boatyard. Industrial shoreline infrastructure including over-water wharves, bulkheads and hardened shorelines, remains located along the Whatcom Waterway.
- **Bellingham Shipping Terminal:** Under existing conditions, deep draft navigation uses will continue at the Shipping Terminal. Types of deep draft navigation uses that may be performed there include cargo operations, mooring of research vessels and/or moorage of Coast Guard or other military vessels.
- **Area 10 and Vicinity:** Under existing conditions, the area offshore of Area 10 will remain within the harbor area and will likely be used for over-water industrial uses, consistent with historical navigation patterns. The specific uses will depend on the future uses of the Area 10 properties.

1.2.3 Navigation Uses Under No Action Alternative

The No Action Alternative involves continued industrial use of the New Whatcom, waterfront properties, and development of a 600-slip marina within the ASB portion of the New Whatcom Site. Anticipated navigation uses by area are as follows:

- **I&J Waterway:** Navigation uses within the I&J Waterway will continue as a mix of intermediate draft industrial navigation uses. Such uses may include barge and tug traffic, fishing vessel operation, operation of shallow and intermediate draft Coast Guard vessels. Small boat traffic associated with the adjacent marina and dry-land boat storage will likely continue.
- **ASB Area:** Conversion of the ASB to a marina would enhance navigation opportunities for recreational, tribal, and fishing vessels. Smaller research vessels may also utilize the new moorage provided in the ASB. Industrial use of the area offshore of the ASB would likely be discontinued, reducing the footprint of navigation use from historical and existing conditions.
- **Inner Whatcom Waterway:** Navigation uses in the Inner Waterway would continue as a mix of intermediate-draft industrial navigation uses. Such uses would most likely include barge and tug traffic, fishing vessel operation. Navigation uses may also be coordinated with operations of the Bellingham Shipping Terminal, with moorage of deep draft vessels (i.e., cargo vessels) at the terminal and intermediate draft vessels (i.e., barges and tugs) within areas 2, 3 and 4. The specific uses would determine final infrastructure requirements and shoreline configurations. Shoreline infrastructure would likely remain similar to existing conditions.
- **Bellingham Shipping Terminal:** Under the No Action Alternative, deep draft navigation uses would continue at the Shipping Terminal, consistent with existing conditions. Types of deep draft navigation uses that may be performed there include cargo operations, mooring of research vessels and/or moorage of Coast Guard or other military vessels.
- **Area 10 and Vicinity:** Under the No Action Alternative, the area offshore of Area 10 will remain within the harbor area and will likely be used for over-water industrial uses, consistent with historical harbor uses. The specific uses will depend on the future uses of the Area 10 properties.

1.2.4 Navigation Uses under Redevelopment Alternatives 1 to 3

Redevelopment Alternatives 1 through 3 all involve mixed-use redevelopment of the upland New Whatcom area properties, and development of a 460-slip marina within the

ASB portion of the New Whatcom Site. The marina proposed under redevelopment Alternatives 1-3 has fewer boat slips than that proposed under the No Action Alternative, with more space within the ASB footprint devoted to public access and habitat enhancements.

- **I&J Waterway:** Navigation uses within the I&J Waterway will continue as a mix of intermediate draft industrial navigation uses. Such uses may include barge and tug traffic, fishing vessel operation, operation of shallow and intermediate-draft Coast Guard vessels. Small boat traffic associated with the adjacent marina and dry-land boat storage will likely continue. Development of shoreline park and trail facilities at the head of the waterway may facilitate hand-carry boat launching (e.g., kayak and canoe launching from the park beach).
- **ASB Area:** Conversion of the ASB to a marina would enhance navigation opportunities for recreational, tribal, and fishing vessels. Smaller research or tribal vessels may also utilize the new moorage provided in the ASB. Industrial use of the area offshore of the ASB would likely be discontinued, reducing the footprint of navigation use from historical and existing conditions. The marina proposed under redevelopment Alternatives 1-3 has fewer boat slips than under the No Action Alternative, with more area within the ASB devoted to public access and habitat enhancements.
- **Inner Whatcom Waterway:** Under Redevelopment Alternatives 1-3, the navigation uses in the Inner Waterway are to be focused on small boat traffic consistent with planned marine trade activities within Area 1, and with transient moorage improvements planned for the Inner Waterway in support of mixed-use redevelopment of parcels 2-8. Navigation infrastructure will be reconfigured within the Inner Waterway to support these types of uses, with greater use of vessel floats, and lesser use of over-water industrial wharves and bulkheads.
- **Bellingham Shipping Terminal:** Under redevelopment Alternatives 1-3, deep draft navigation uses would continue at the Shipping Terminal, consistent with existing conditions and with the No Action Alternative. Types of deep draft navigation uses that may be performed there include cargo operations, mooring of research vessels and/or moorage of Coast Guard or other military vessels.
- **Area 10 and Vicinity:** Under the No Action Alternative, shoreline property within Area 10 will be devoted to park and trail uses. Industrial uses for the

areas offshore of Area 10 will likely be discontinued to avoid/minimize conflicts with shoreline park and trail uses. Some seasonal boat moorage may also be conducted in offshore harbor areas using mooring buoys. Some hand-carry boat access and uses may be associated with the park (e.g., kayak launching from the park shoreline).

1.3 Environmental Impacts and Mitigation Measures

The section summarizes impacts of future New Whatcom development activities on navigation patterns within the project and vicinity. Potential impacts and mitigation of these changes in navigation uses are discussed as appropriate.

1.3.1 Navigation Impacts of Redevelopment Alternatives 1 to 3

Redevelopment Alternatives 1 through 3 all involve mixed-use redevelopment of the upland New Whatcom area properties, and development of a marina within the ASB portion of the New Whatcom Site. This section discusses potential impacts (adverse or beneficial) associated with vessel traffic.

- **I&J Waterway – No adverse impacts:** Levels of navigation and vessel traffic within the I&J Waterway will not be significantly affected in the I&J Waterway. There may be some increase in small, hand-carry boats (e.g., kayaks) associated with the development of a shoreline park at the head of the waterway but this increase is not expected to adversely impact other public/tribal shoreline access or navigation uses.
- **ASB Marina – Beneficial impacts:** The marina is being developed within a location used historically for log rafting, industrial docks/wharves, and rail trestle operations. Under existing conditions the ASB portion of this area is used for wastewater treatment (with limited access for public or tribal use and no facilities for navigation use) and the areas offshore of the ASB are available for industrial navigation uses. Development of the marina with public access and habitat enhancements as proposed under redevelopment Alternatives 1-3 will improve navigation facilities, while simultaneously increasing public and tribal access to this area of the shoreline both inside and outside of the ASB berm. Industrial navigation uses of the harbor area offshore of the marina would be discontinued to avoid potential navigation conflicts, resulting in improved

public and tribal access to these offshore areas. Small-boat traffic may increase under these redevelopment Alternatives, but with a corresponding decrease in traffic of intermediate and large industrial vessels using the Inner Waterway and a decrease in offshore harbor-area uses (e.g., log rafting) offshore of Area 1. The number of small boats using the marina will be fewer than the number under the No Action Alternative, due to the fewer number of slips proposed under Design Concept B.

- **Inner Whatcom Waterway – Beneficial Impacts:** Under redevelopment Alternatives 1-3, use of the Inner Waterway by large and intermediate industrial vessels is expected to decrease, and use of the area by small boats and recreational vessels is expected to increase. Port harbor rules are expected to include no-wake requirements for vessels within the Inner Waterway and marina areas. The transitions from industrial vessel use to small boat use support community land and navigation use preferences as defined in the Waterfront Futures Group Vision and Framework Plan, while simultaneously improving public and tribal access to the area shorelines. These use transitions also reduce the requirement for navigation infrastructure requirements associated with historical industrial uses of this area, further improving public and tribal access to area shorelines.
- **Bellingham Shipping Terminal – No adverse impacts:** Under redevelopment Alternatives 1-3, deep draft navigation uses will continue at the Shipping Terminal. Types of deep draft navigation uses that may be performed there include cargo operations, mooring of research vessels and/or moorage of Coast Guard or other military vessels. The extent of vessel traffic is likely to be less than or equal to historic navigation levels in this area.
- **Area 10 and Vicinity – Beneficial Impacts:** No specific navigation improvements are planned for this area under redevelopment Alternatives 1-3. However, hand-carry boat uses are likely to increase due to the development of shoreline park facilities within Area 10. Offshore industrial uses (e.g., log rafting) of the harbor area re expected to be limited to avoid conflicts with the shoreline park uses. This will improve public and tribal access to area shorelines relative to existing conditions.

1.3.2 Impacts of No Action Alternative

The No Action Alternative involves continued industrial use of the upland New Whatcom area properties, and development of a marina within the ASB portion of the New Whatcom Site. Under these Alternatives, navigation uses would represent an extension of recent industrial trends, but with conversion of the ASB and associated harbor areas from industrial to small boat navigation uses.

- **I&J Waterway – No adverse impacts:** Levels of navigation and vessel traffic within the I&J Waterway will not be significantly affected in the I&J Waterway.
- **ASB Marina – Beneficial impacts:** The marina is being developed within a location used historically for log rafting, industrial docks/wharves, and rail trestle operations. Under existing conditions the ASB portion of this area is used for wastewater treatment (with limited access for public or tribal use and no facilities for navigation use) and the areas offshore of the ASB are available for industrial navigation uses. Development of the marina as proposed under the No Action Alternative will improve navigation facilities, while simultaneously increasing public and tribal access to this area of the waterfront. Industrial navigation uses of the area offshore of the marina would be discontinued to avoid potential navigation conflicts, resulting in improved public and tribal access to these offshore areas. Small-boat traffic may increase under the No Action Alternative, but with a corresponding decrease in industrial harbor-area uses (e.g., log rafting) offshore of Area 1.
- **Inner Whatcom Waterway – No adverse impacts:** Under the No Action Alternative, the Inner Waterway will continue to be used by industrial vessels, including tugs or barges. These uses will represent a continuation of historical uses.
- **Bellingham Shipping Terminal – No adverse impacts:** Under the No Action Alternative, deep draft navigation uses will continue at the Shipping Terminal. Types of deep draft navigation uses that may be performed there include cargo operations, mooring of research vessels and/or moorage of Coast Guard or other military vessels. The extent of vessel traffic is likely to be similar to historic navigation levels in this area.
- **Area 10 and Vicinity – No adverse impacts:** Under the No Action Alternative, the harbor areas offshore of Area 10 will continue to be used for industrial and

water dependent uses, consistent with historical land uses and harbor area designations.

1.3.3 Impacts of Separate Projects

The separate projects described in Section 2.9 include development of vessel moorage facilities at the Bellingham Shipping Terminal. These facilities are to be located within areas historically used for deep draft and intermediate draft navigation uses. These uses are consistent with historical uses in these areas and are similar to proposed uses described for the Bellingham Shipping Terminal under redevelopment Alternatives 1-3 and the No Action Alternative.

1.3.4 Summary of Mitigation Measures

No impacts requiring mitigation were defined under the redevelopment Alternatives 1-3 or under the No Action Alternative. Project impacts under the redevelopment Alternatives and under the No Action Alternatives are generally beneficial, increasing navigation opportunities while simultaneously improving public and tribal access to the area shorelines. The increases in the number of small boat vessels using the marina and Inner Waterway areas are offset by decreases in industrial navigation uses of the shoreline and associated harbor areas. Marina and waterway rules are expected to include "no wake" requirements in the marina and Inner Waterway areas. No additional requirements for mitigation measures associated with vessel traffic were identified.

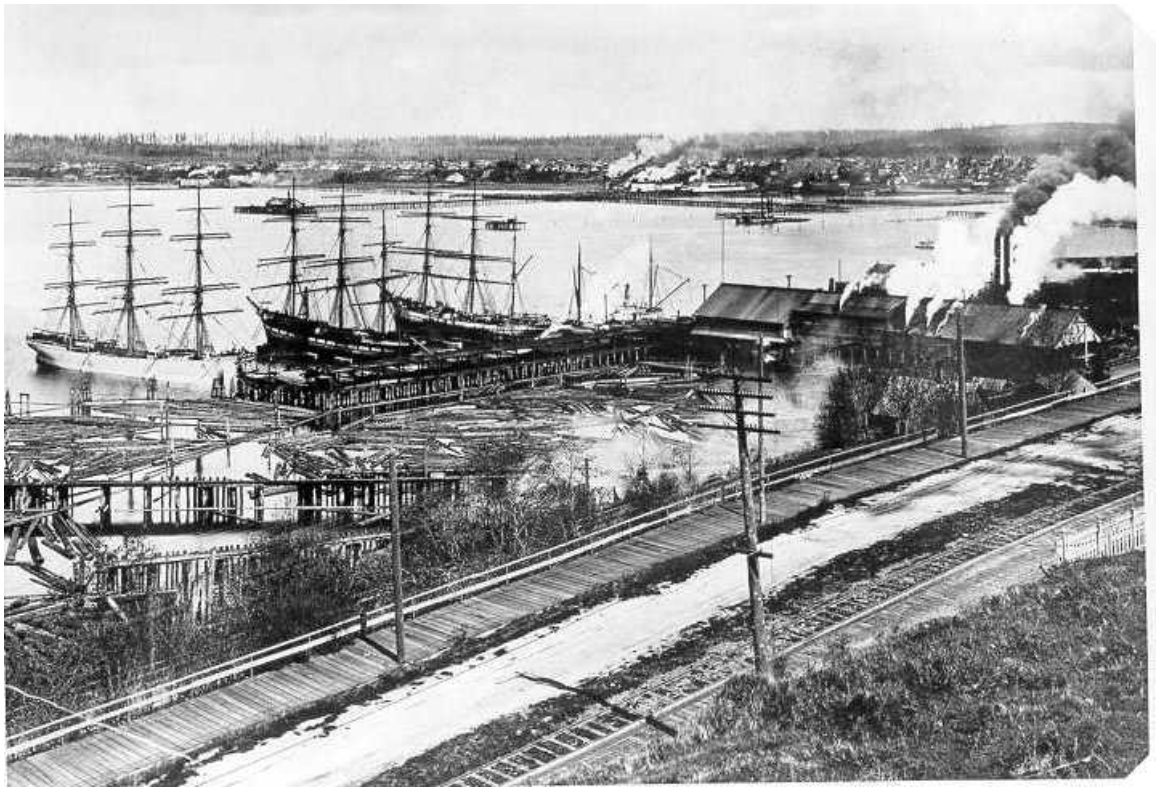
1.4 Significant Unavoidable Adverse Impacts

No adverse environmental impacts that could not be mitigated were identified under either redevelopment Alternatives 1-3, or under the No Action Alternative.

Photo 1

Date:	circa 1890
Photo Source:	Western Washington University - Center for Pacific NW Studies (Galen Biery Collection #1196)
Waterfront Uses:	Waterfront areas used for lumber mill (Morrison Mill), wharf and rail trestles (Great Northern Railway). The Whatcom Waterway had not yet been developed by the Corps of Engineers.

Photo 2



Date:	circa 1890
Photo Source:	City of Bellingham
Waterfront Uses:	Photo shows the Bellingham Bay Improvement Company Mill formerly located within Area 10. The smokestacks and log booming areas associated with the Whatcom Falls Mill Company are visible at the top of the photograph within Area 1.

Photo 3

Date:	1930
Photo Source:	Port of Bellingham (P-BBN-0353)
Waterfront Uses:	Photo shows the Pine Street trestle and the City Wharf, after purchase by the Port of Bellingham in 1925. The rail loading pier of the Chicago Miwaukee St. Paul railway is visible at the bottom of the photograph within Area 10, on what is now the Douglas Management property. Most harbor areas in the project vicinity are used for lob booming by local lumber mills, including areas offshore of Area 1, Area 10 and along the sides of the Whatcom and I&J Street waterways.

Photo 4

Date: 1937
Photo Source: Port of Bellingham (P-BBN-0349)
Waterfront Uses: All waterfront areas were in heavy industrial use. Most harbor areas were in use for log booming in support of local lumber companies and lumber mills. The Whatcom Falls Mill Company is active within Area 1, and the Bloedell Donovan mill is active in Area 10. Portions of Areas 2-9 have been filled for industrial use, though most structures remain built on pilings over the Bay. A small boat marina is located in the Log Pond area adjacent to Areas 8 and 9.

Photo 5

Date: circa 1944
Photo Source: Port of Bellingham
Waterfront Uses: Photo shows the Bloedel Donovan cargo wharf formerly located offshore of Area 10, adjacent log booming areas and the Port terminal. A small boat marina is located within the Log Pond. Log booming areas are present offshore of Area 1.

Photo 6

Date: 1952
Photo Source: Port of Bellingham (P-BBN-0365)
Waterfront Uses: Photo shows the log rafting areas located offshore of Area 1, within the Log Pond, and offshore of Areas 9 and 10. Small boat marina (Bellingham Bay Yacht Club) is visible within the Log Pond, adjacent to the Port terminal.

Photo 7

Date:	1961
Photo Source:	Port of Bellingham (P-BBN-0002)
Waterfront Uses:	Photo shows Areas 1-9, including the Whatcom Waterway. Log rafting activities are located offshore of Area 1, within the Log Pond and offshore of Area 10. The small boat marina has been removed from the Log Pond by this time.

Photo 8

Date: 1965
Photo Source: Port of Bellingham (P-BBN-0069)
Waterfront Uses: Photo shows log booming areas offshore of Area 1. By this time most of the properties within Areas 2-8 have been acquired by Georgia Pacific Corporation. The Port terminal has been converted from over-water to filled development through fill placement.

Photo 9

Date: circa 1990
Photo Source: Port of Bellingham
Waterfront Uses: By this time the ASB has been developed within the former log rafting areas offshore of Area 1. The GP Mill and the Port Terminal are fully developed within areas 2-9. Log rafting activities continue offshore of Areas 9 and 10.

Photo 10

Date: 1993
Photo Source: Department of Ecology
Waterfront Uses: Photo shows Area 1 and portions of Areas 2-9. The ASB is visible in wastewater treatment uses. The Whatcom Waterway remains in industrial use.

Photo 11

Date: 2004
Photo Source: Ben Howard
Waterfront Uses: Photo shows the entire Site area at the time of that the Waterfront Futures Group Vision and Framework Plan was produced, documenting the community vision for revitalization of the waterfront.

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Memorandum

To: Blumen Consulting Group

From: Mark Larsen, Anchor Environmental, L.L.C.

Date: November 8, 2007

Re: Habitat and Vessel Wake Issues
Draft Environmental Impact Statement
New Whatcom Redevelopment

The shoreline substrate conditions within the project area are affected by natural wind and wave conditions within Bellingham Bay, and by the built environment. Wind and wave conditions have been analyzed as part of environmental investigation and cleanup planning activities associated with the Whatcom Waterway sediment cleanup. Examples of previous evaluations conducted within the Site as part of other work include the following:

- **Wind, Wave and Wake Conditions – Log Pond Engineering Design Report**: Wind and wave conditions applicable to the Log Pond portion of the Site were analyzed as part of the Log Pond Final Engineering Design Report (Anchor, 2000b). This analysis included a review of prop wash and vessel wake conditions applicable to the Log Pond cap. Natural wind and wave conditions were found to represent the controlling condition for sediment stability in submerged portions of the cap.
- **Wind, Wave and Wake Conditions – 2006 Supplemental RI/FS:** Wind and wave conditions applicable to the area offshore of the ASB and to the Log Pond area were analyzed as part of the 2006 Supplemental Remedial Investigation and Feasibility Study (RETEC, 2006). This analysis also included preliminary review of existing tidal surge and tsunami data applicable to the project area. Potential vessel wakes associated with a large (100-ft long) motor yacht transiting the Inner Waterway were also evaluated, using the wake analysis methods of Blaauw (1984). Evaluations for the ASB and for the Log Pond indicated that natural wave conditions produced greater wave heights than vessel wakes from motor yachts under evaluated conditions.
- **Shoreline Infrastructure Concepts:** Potential differences in shoreline infrastructure applicable to industrial and mixed-use navigation land uses were evaluated as part of

the Supplemental Remedial Investigation and Feasibility Study (RETEC, 2006) and the Draft Supplemental Environmental Impact Statement (Ecology, 2006). These documents considered the potential benefits of modifying the built environment by replacing vertical bulkheads with terraced, sloping shorelines incorporating habitat "benches" at intertidal and shallow subtidal elevations. These modified shorelines were specifically evaluated for the Inner Waterway, taking into account site-specific constraints anticipated for these areas . Evaluation of potential enhancements to nearshore habitat along the outside and inside of the ASB berm was also evaluated as part of the Supplemental Remedial Investigation and Feasibility Study (RETEC, 2006) and the Final Supplemental Environmental Impact Statement (Ecology, 2007a). These documents discussed methods for potential development of a "perched beach" habitat bench as part of sediment capping offshore of the ASB, and the potential to develop habitat benches along portions of the inner berm of the ASB if it is converted to a marina.

- **Cleanup Engineering Design Evaluations:** The Final Cleanup Action Plan and Consent Decree for the Whatcom Waterway site (Ecology, 2007b) anticipate completion of additional design evaluations of wind and wave effects, prop wash, tidal surge, seismic effects and other factors on the design of sediment caps and modifications to shoreline substrates. These evaluations will be conducted as part of the Engineering Design Report and will refine the design concepts developed for sediment caps and shoreline modifications as part of the Supplemental RI/FS and Final SEIS.

As discussed in the Supplemental RI/FS for the Whatcom Waterway Site (RETEC, 2006), wave heights are proportionate to wind speed and fetch. The effect of surface waves (natural or man-made) on bottom sediments is greatest in intertidal and shallow subtidal areas. The effects of waves on bottom sediments decrease rapidly with depth. Bottom sediment stability under different wave conditions can be evaluated using existing models and design manuals developed for this purpose (US Army Corps of Engineers, 1984). Generally, as wind and wave (natural or man-made) energies increase, the size of a sediment particle that can be disturbed by the wave energy also increases.

Previous analyses listed above have indicated that natural wave energies within most portions of the site are controlling on bottom sediment stability. These analyses have indicated that

waves generated by vessel wakes are significantly smaller than natural waves documented or modeled for site shoreline areas.

Vessel wakes can be additive to natural waves under certain conditions. However, this potential is limited by human behavior and navigation patterns. That is, recreational boat traffic and much commercial boat traffic are curtailed during periods of storm activity when natural waves are present at their greatest heights and wave energies. This means that recreational vessels typically do not create wave energy conditions that exceed those created under natural conditions. Some industrial and deep draft navigation vessels are unaffected by storm conditions and may produce additive wave effects. However, these types of vessels are present historically within the project area and wake effects of these vessels are included in the existing conditions. Under both the No Action Alternative and the redevelopment Alternatives 1-3, the level of deep draft vessel traffic is expected to be equal to or less than that under existing conditions. Therefore, wake effects are expected to be the same or decrease compared to existing conditions, with the controlling effects on shoreline substrate stability being predominantly the natural wind and wave characteristics of Bellingham Bay.

Previous environmental documents listed above have identified habitat enhancement concepts that can be incorporated into modified shorelines, within the evaluated constraints of the natural environment. These concepts are to be further refined as part of planned environmental design and permitting activities associated with the cleanup of the Whatcom Waterway sediments.

REFERENCES

Anchor, 2000b. Final Engineering Design Report Interim Remedial Action Log Pond Cleanup and Habitat Restoration Whatcom Waterway Site. Prepared for Georgia-Pacific West, by Anchor Environmental. July, 2000.

Blaauw, H. G., F.C.M. van der Knapp, M.T. de Groot and K.W. Pilarczyk (12984). "Design of Bank Protection of Inland Navigation Fairways." *Proceedings of the International Conference on Flexible Armoured Revetments Incorporating Geotextiles*, London, England, 29-30 March 1984.

US Army Corps of Engineers (1984). *Shore Protection Manual 4th edition*. . Prepared by the Waterways Experiment Station, Coastal Engineering Research Center, US Government Printing Office, Washington, D.C.