ADDENDUM TO SUMMARY OF SCIENCE REPORT

Bainbridge Island

Prepared for

City of Bainbridge Island
Planning & Community Development
280 Madison Avenue North
Bainbridge Island, Washington 98110-1812

Prepared by

Herrera Environmental Consultants
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206.441.9080

January 26, 2011

Contents

1.0 Introduction 1

1.1 Purpose and Scope 1

2.0 Nearshore Areas of Bainbridge Island 5

2.1 Physical Environment 5
2.1.1 Climate 5
2.1.2 Waves and Currents 6
2.1.3 Geology 6
2.2 Nearshore Classification System 7
2.3 Nearshore Geomorphic Systems 8
2.3.1 Rocky Coasts 8
2.3.2 Beaches 10
Bluffs 10
Barriers 10
2.3.3 Embayments 13

3.0 Nearshore Biological Resources 15

3.1 Selected Vegetation Communities 15
3.1.1 Marine Riparian Zones 15
3.1.2 Eelgrass Meadows 15
Bainbridge Island Occurrence 15
Habitat 15
Threats 16
3.1.3 Kelp Forests 16
Bainbridge Island Occurrence 17
Habitat 17
Threats 18
3.2 Selected Benthic Macroinvertebrates 18
3.2.1 Olympia Oyster 19
Bainbridge Island Occurrence 19
Habitat 19
Threats 20
3.2.2 Pandalid Shrimp 20
Bainbridge Island Occurrence 20
Habitat 20
Threats 21
3.3 Fishes 21
3.3.1 Forage Fish 21
Bainbridge Island Occurrence 21
Habitat 22
Prey and Foraging 22

Threats 22
3.3.2 Salmonids 23
Bainbridge Island Occurrence 24
Habitat 25
Prey and Foraging 25
Threats 26
3.3.3 Rockfish 26
Bocaccio 28
Bainbridge Island Occurrence 28
Habitat 28
Prey and Foraging 28
Canary Rockfish 28
Bainbridge Island Occurrence 28
Habitat 29
Prey and Foraging 29
Yelloweye Rockfish 29
Habitat 30
Prey and Foraging 30
Threats to Rockfish as a Group 30
3.4 Marine Birds 32
3.4.1 Surf Scoter 33
Bainbridge Island Occurrence 33
Habitat 33
Threats 34
3.4.2 Black Oystercatchers 35
Bainbridge Island Occurrence 35
Habitat 35
Threats 35
3.4.3 Dunlin 35
Bainbridge Island Occurrence 35
Habitat 35
Threats 36
3.5 Marine Mammals 36
3.5.1 Steller Sea Lion 36
Bainbridge Island Occurrence 37
Habitat 37
Prey and Foraging 37
Threats 38
3.5.2 Orca or Killer Whale 38
Bainbridge Island Occurrence 38
Habitat 39
Prey and Foraging 39
Threats 39
3.5.3 Gray Whale 40
Bainbridge Island Occurrence 40

Habitat 40
Prey and Foraging 40
Threats 41
3.5.4 Humpback Whale 41
Bainbridge Island Occurrence 41
Habitat 42
Prey and Foraging 42
Threats 42
4.0 No Net Loss 45
4.1 Conservation Banking 50
5.0 Effects of Nearshore Modifications 51
5.1 Shoreline Stabilization Structures 51
5.1.1 Physical Impacts and Ecological Ramifications 52
Sediment Supply 53
Encroachment 53
Active Erosion 54
Passive Erosion 55
Shoreline Simplification 55
Marine Riparian Vegetation 55
Chemical Contamination 55
5.1.2 Shoreline Stabilization Measures and No Net Loss Recommendations 56
5.2 Marine Riparian Vegetation Modifications 58
5.2.1 Physical Impacts and Ecological Ramifications 58
Shading and Temperature 59
Shoreline Stability 59
Allochthonous Input 60
Groundwater-Surface Water Exchange 60
Habitat Structure and Complexity 61
5.2.2 Marine Riparian Vegetation Modifications and No Net Loss Recommendations 61
5.3 Residential Development within the Nearshore Zone 62
5.3.1 Physical Impacts and Ecological Ramifications 62
Stormwater 62
Trampling 63
5.3.2 Residential Development within the Nearshore Zone and No Net Loss Recommendations 64
5.3.3 Over-water and In-water Structures 65
Marinas 66
Boat Launches 67
Mooring Buoys 67
Over-water and In-water Structures and No Net Loss Recommendations 68
5.4 Recent Research on Buffer Width Requirements 69
5.4.1 Water Quality 73

5.4.2 Sediment Control 74
5.4.3 Shade/Microclimate 74
5.4.4 Large Woody Debris 75
5.4.5 Wildlife 76
5.5 Buffer Approaches 77
5.6 Buffers Established by Other Jurisdictions 78

6.0 Literature Cited 81

Tables

Table 1. Comparison of the nearshore geomorphic classifications schemes used by Shipman (2008) and Terich (1987). 8

Table 2. Salmonids Summary of Nearshore and Estuarine Habitat Use and Spawning on Bainbridge Island.[a] 25

Table 3. Groundfish species present in Bainbridge Island (including rockfish) 27

Table 4. Likely Stressors Limiting Rockfish Populations in Puget Sound (Source Palsson et al. 2009). 31

Table 5. Sample no net loss monitoring program. 47

Table 6. Riparian buffers functions and width recommendations in the literature[a] 71

Figures

Figure 1. Nearshore geography of City of Bainbridge Island. 3

Figure 2. Coastal landforms typical of Puget Sound as identified in Shipman (2008). 9

Figure 3. Photograph of Cama Beach where a bulkhead was constructed on an accreting beach. Note upland vegetation (red alder) growing in front of the bulkhead. 12

Figure 4. Conceptual view of how to achieve no net loss (source: The Watershed Company). 48

Figure 5. Comparison of beach transects from Whidbey Island (Herrera 2009b). 54

Glossary

Accretionary shoreform – Low-lying areas along the shoreline that consist of accumulated drift. Accretionary shoreforms are common on Bainbridge Island.

Anthropogenic – Caused either directly or indirectly by human activity.

Beach face – The steep part of the beach that is generally composed of gravel, although it can contain sand or even boulders. It is the most sedimentologically active portion of the nearshore.

Beach transect – A profile of elevations perpendicular to the shoreline.

Downdrift – In the direction of dominant alongshore sediment transport.

Fetch – The distance over which the wind blows to generate a given wave field.

Low-tide terrace – A broad, flat portion of the nearshore that extends from a few feet above to a few feet below MLLW. The low-tide terrace is finer grained that the beach face above it. In Coastal Drainage Areas 2 and 3, the low-tide terraces are composed primarily of mud.

Mean higher-high water (MHHW) – The average elevation of the two high tides in each day over a tidal epoch (19 years).

Mean lower-low water (MLLW) – The average elevation of the two low tides in each day over a tidal epoch (19 years).

Nearshore – In the context of Bainbridge Island, the nearshore is the area of marine and estuarine shoreline. It generally extends from the top of shoreline bank or bluff to the depth offshore where light penetrating the water falls below a level supporting plant growth, and upstream in estuaries to the head of tidal influence. It includes bluffs, beaches, mudflats, kelp and eelgrass beds, salt marshes, gravel spits, and estuaries.

Puget Lowland – The low area between the Olympic and Cascade Mountain ranges.

Puget Sound – All marine water contained south and east of Admiralty Inlet and Deception Pass.

Salish Sea – Broadly defined as the confined body water inland from Cape Flattery, including Puget Sound, the Strait of Juan de Fuca and the Strait of Georgia.

Seattle Fault Zone – The Seattle Fault Zone is broadly defined by a series of east-west trending faults (including the Toe Jam Hill Fault and Macs Point Fault) that cross the southern end of Bainbridge Island.

Swell – Long period waves originating from distant open-ocean wind storms.

Swash – The area on the shoreline that interacts with the water surface. Swash is typified by a series of bores that propagate up and down the beach.

Updrift – In the direction opposite of dominant alongshore sediment transport.

Vashon Stade – The time period between 20,000 and 13,000 years before present of glacial inundation of the Puget Lowland at the end of the last ice age.

1.0 Introduction

1.1 Purpose and Scope

This addendum augments the City of Bainbridge Island's existing *Summary of Best Available Science* prepared by Battelle dated October 2003 in support of the City of Bainbridge Island's (the City) Shoreline Master Program (SMP). The purpose of this addendum is to provide updated information on shoreline and nearshore ecology, physical processes, habitats, and biological resources of Bainbridge Island to assist with the City's SMP update. Based on the information presented in the Battelle (2003) report, and the purpose of this addendum, other key documents were specifically included in the review for this update. These documents include:

- Bainbridge Island Nearshore Habitat Characterization & Assessment, Management Strategy Prioritization, and Monitoring Recommendations (Williams et al. 2004)
- Marine and Estuarine Shoreline Modification Issues (Williams and Thom 2001)
- Living with the shore of Puget Sound and the Georgia Strait (Terich 1987)

The addendum offers a discussion and guidance on no net loss which is the standard the City is expected to meet to be in compliance with the Shoreline Management Act, and recommends general guidance for developing and monitoring a no net loss program.[1] In addition, the addendum provides information from recent scientific studies and current thinking on four specific topics relevant to the City's land use planning and shoreline development policies and practices, three relating to types of shoreline modifications. These topics were specifically covered at the request of the City and are:

- The ecological and functional impacts of shoreline stabilization structures and no net loss
- The ecological role of riparian vegetation in the marine shoreline environments and no net loss
- The effects of development on habitat in the shoreline zone, particularly residential development

[1] No net loss is not explicitly defined in the Shoreline Management Act however, Washington State Department of Ecology defines it as follows: Over time, the existing condition of shoreline ecological functions should remain the same as when the SMP is implemented. It is a standard designed to avoid new adverse impacts to shoreline ecological functions resulting from new development. (See *http://www.ecy.wa.gov/programs/sea/shorelines/smp/handbook/Chapter4.pdf*)

- Recommendations for marine shoreline protective buffers considering geomorphic conditions and shoreline vegetation

The addendum was prepared using the most current, accurate and complete scientific and technical information, peer-reviewed research, best available science summaries, technical literature, and other scientific information related to shoreline and nearshore resources and functions. For the purpose of this document, scientific and technical information was defined according to the criteria provided by the Washington State administrative code (WAC) 173-26-201(2)(a). Information sources used in this review of science are listed in Section 6.0 *Literature Cited* of this document.

Recent science addressing the effects of the three types of nearshore modifications listed above (three first bullets) was analyzed. The approach to this analysis was primarily process-based, involving an examination of existing conditions as well as an assessment of human modifications. Physical processes lead to the formation of recognizable and classifiable geomorphic features that are then colonized by biota. Therefore scientific literature involving all aspects of shoreline processes and ecology relevant to the Puget Sound, in particular the main basin and Dyes Inlet and related passages, were examined. These shoreline processes were placed within the context of a limited set of human modifications that were identified by the City. Finally, the effects of human modifications were assessed by comparing such modifications to similar land-use practices and their related impacts to the marine nearshore environment found in the Salish Sea of Western Washington, or comparable environments elsewhere.

This review begins with a summary of science related to the physical conditions, habitats and biological resources of Bainbridge Island. It is followed by a discussion of no net loss related to effective shoreline management and general guidance for implementing a no net loss program in the City. Recent science addressing the effects of the three types of nearshore modifications listed above is discussed and suggestions for mitigation that can assist the City in achieving no net loss for associated impacts are provided. The report then summarizes recent science related to buffers recommended for protecting marine shoreline and nearshore ecological functions. Figure 1 provides a map indicating nearshore geography, streams, and locations referred to in this report.