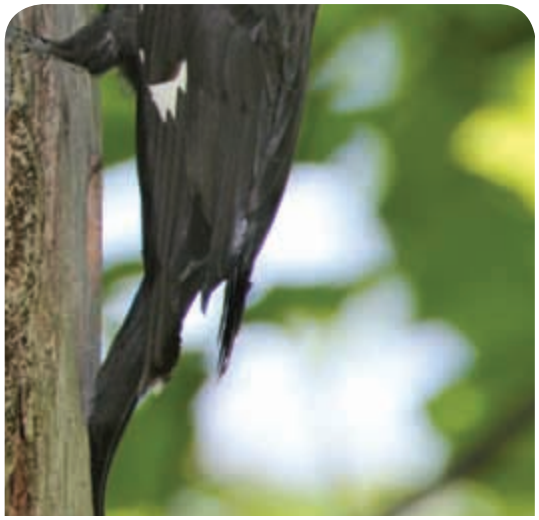
Business and Biodiversity Offsets Programme (BBOP)

BBOP Pilot Project Case Study

Bainbridge Island








CITY OF BAINBRIDGE ISLAND

BBOP
Business and Biodiversity Offsets Programme

Forest Trends, Conservation International and the Wildlife Conservation Society provided the Secretariat for BBOP during the first phase of the programme's work (2004 – 2008).

Publication Data

City of Bainbridge Island. 2009. *BBOP Pilot Project Case Study. Bainbridge Island.* Washington State, USA.

Available from: **www.forest-trends.org/biodiversityoffsetprogram/guidelines/bainbridge-case-study.pdf**

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Cover and graphic design by Rima Design.

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About this document

To help developers, conservation groups, communities, governments and financial institutions that wish to consider and develop best practice related to biodiversity offsets, the Business and Biodiversity Offsets Programme (BBOP) has prepared a set of Principles, interim guidance and resource documents[1], including pilot project case studies, of which this document[2] is one. All those involved in BBOP are grateful to the companies who volunteered pilot projects in this first phase of its work.

The ability to test methods and learn from practical experience in a set of pilot projects has played an important role in the development of the BBOP Principles on Biodiversity Offsets and supporting materials during the first phase of the programme's work (2004 – 2008). Six organisations (five companies and one city council) volunteered to undertake pilot projects during BBOP's first phase, with some joining at the outset, and some at later stages. While BBOP has offered some support and technical advice to the individual pilot projects through its Secretariat and Advisory Committee, each pilot project has been directed and managed by a team employed or contracted by the companies and city council leading the respective projects. Each of the case studies prepared by the pilot projects explains the approach taken and how close the project has come to completing the design of the biodiversity offset concerned, and sets out the developer's current thinking on the most appropriate offset. This may change as the project teams finalise their offset design and start implementation. The nature of the guidance used by the pilot projects has varied according to which drafts of the evolving BBOP Handbooks were available to them at the time. This and the individual circumstances and context of each pilot project have affected the extent to which they have used or adapted the BBOP guidance. Consequently, the case studies do not necessarily reflect the range of interim guidance currently presented in BBOP's Biodiversity Offset Design Handbook, Cost-Benefit Handbook and Implementation Handbook.

The offset activities described in this report are based on conceptual discussions for both the residential project and for the public infrastructure project and are provided as an exercise to test the BBOP biodiversity offset calculation methodology and to develop examples of possible offset options. Implementation plans for the particular offsets described in this document have not yet been developed. Any implementation plans and activities subsequently developed may be undertaken on a voluntary basis by the Upper Blakely LLC and / or the City of Bainbridge Island; no commitment or requirement for such plans and activities, which will be discussed in the coming months, should be implied from the findings and recommendations noted in this case study.

BBOP is embarking on the next phase of its work, during which we hope to collaborate with more individuals and organisations around the world, to test and develop these and other approaches to biodiversity offsets more widely geographically and in more industry sectors. BBOP is a collaborative programme, and we welcome your involvement. To learn more about the programme and how to get involved please:

See: **www.forest-trends.org/biodiversityoffsetprogram/**

Contact: **bbop@forest-trends.org**

1 The BBOP Principles, interim guidance and resource documents, including a glossary, can be found at: **www.forest-trends.org/biodiversityoffsetprogram/guidelines/**. To assist readers, a selection of terms with an entry in the BBOP Glossary has been highlighted thus: BIODIVERSITY OFFSETS. Users of the Web or CD-ROM version of this document can move their cursors over a glossary term to see the definition.

2 This case study was prepared by Marja Preston, with contributions from Upper Blakely LLC, the City of Bainbridge Island, David Parkes, Wayne White, Ray Victurine, Jonathan Ekstrom and Kerry ten Kate.

Executive Summary

In 2006, the City of Bainbridge Island agreed to participate as a pilot project in the Business and Biodiversity Offsets Programme (BBOP). The pilot project is exploring the application of a methodology for developing biodiversity offsets for a public infrastructure project and a residential project on the same property.

Biodiversity offsets are measurable CONSERVATION OUTCOMES resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate prevention and MITIGATION measures have been implemented. The goal of biodiversity offsets is to achieve NO NET LOSS, or preferably a NET GAIN, of biodiversity on the ground with respect to species composition, HABITAT STRUCTURE and ECOSYSTEM SERVICES, including LIVELIHOOD aspects. This case study provides a detailed description of the process used to develop the offset pilot project in the context of U.S. residential and infrastructure construction. It summarises the pilot project components, describes the offset development process, explains the conceptual design for the proposed offsets and makes recommendations for their implementation and long-term maintenance. The process has been complex in that the methodology used to assess impacts to biodiversity is still under development. The project is further complicated by changing budgetary and capital facilities priorities that affect the schedule for implementation of the infrastructure component of the proposal.

Rapid growth and residential development are severely impacting biodiversity on Bainbridge Island by reducing forest cover, altering intertidal habitats, fragmenting wildlife corridors and allowing invasive species to compromise native vegetation. This pilot project intends to demonstrate how sustainable developments can result in the conservation of native vegetation and preservation of ecosystem services. It is anticipated that long-term implementation of a biodiversity offset programme could result not only in additional open space preservation throughout both the urban and rural areas of the island, but also RESTORATION of degraded habitats on existing private and public open space. In order for this concept to be successfully adapted in the development context, a clear framework for implementation of biodiversity offset projects needs to be established by the local jurisdiction, to include well-defined methodologies, policy motivations for PARTICIPATION, clear guidelines and expectations for implementation, and guidance for long-term preservation of offsets. This could be achieved by:

- Simplifying the methodology to assess biodiversity impacts and offsets to encourage broader application for smaller scale projects.
- Local land use planning agencies providing incentives, or adopting a CERTIFICATION incentive system as a motivation for development projects to consider biodiversity offsets.
- Using habitat banks managed by private companies or public LAND TRUSTS to potentially facilitate the implementation of biodiversity offsets and ensure the long-term success of habitat preservation.

The City of Bainbridge Island Department of Planning and Community Development continues to explore opportunities to encourage developers to implement biodiversity offsets. Various policy incentives have been considered, including expedited permitting, flexible regulatory requirements and density bonuses for residential or commercial developments that propose offsets beyond those already required by federal, state or local regulation. It is important to note that no such incentives yet exist and that this case study involves a private landowner that is participating on an entirely voluntary basis.

The offset designs discussed in this case study have not been finalised and implementation plans for the offsets have not yet been developed. Until the biodiversity offsets discussed in this case study are implemented and then monitored over the long term it will be impossible to assess whether the goal of 'no net loss' of biodiversity has been achieved. However, it is clear that biodiversity offsets, if planned and implemented carefully, can result in CONSERVATION GAINS above and beyond those required through regulatory means.

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1. Biodiversity Offsets Concept and Approach

1.1 Overview of the biodiversity offsets concept

Biodiversity offsets are conservation activities that are intended to compensate for significant residual harm to biodiversity caused by infrastructure development, including DIRECT, INDIRECT and CUMULATIVE IMPACTS. Offsets are only considered once a development proposal has been analysed in relation to the MITIGATION HIERARCHY and it has been determined that all appropriate prevention and mitigation measures have been implemented and that no irreplaceable biodiversity features will be eliminated. Offsets are intended to complement and not substitute for traditional MITIGATION required by existing regulations.

The Business and Biodiversity Offsets Programme Offset Design Handbook (available at: **www.forest-trends.org/biodiversityoffsetprogram/guidelines/odh.pdf**) offers a number of methodologies for quantifying the loss of biodiversity caused by development projects and the gains through the offset. This case study focuses on one such approach, HABITAT HECTARES, which was originally developed in Victoria, Australia in 2002/2003, more recently adapted by BBOP and refined to the specific context of this project. This approach uses a 'BENCHMARK' to provide a reference point against which losses of biodiversity due to a project and gains through an offset can be quantified and compared consistently and transparently. The method involves quantifying impacts by first evaluating the existing biodiversity at the project site, considering the potential project impacts to biodiversity, and then developing an offset with a replacement value that directly correlates to the amount of biodiversity lost.

1.2 Applicability of biodiversity offsets within the US policy context

Voluntary biodiversity offsets present a relatively new strategy to expand the current mitigation opportunities within the United States. Offsets specifically addressing BIODIVERSITY LOSS are not commonly required by local, state or federal regulations in the US. Regulations at all levels of government require that development projects complete ENVIRONMENTAL ASSESSMENTS, detailing predicted impacts to habitat and addressing the mitigation hierarchy. Offsets are required for impacts to wetlands and the habitat of State or Federally listed species; however, offsets are rarely required for non-critical habitats and do not always consider INDIRECT IMPACTS to biodiversity. Biodiversity offsets present an opportunity to achieve greater and more specific conservation of habitats such as mature forests or intertidal habitat that are not otherwise protected by existing law. Voluntary implementation of biodiversity offsets may therefore have the potential to become a more effective means to achieving restoration and preservation of a greater range of HABITAT TYPES.

2. Project Summary

In order to demonstrate the applicability of biodiversity offsets in the urban development sector the City of Bainbridge Island has commenced a pilot programme. The Bainbridge Island / Upper Blakely LLC Biodiversity Offsets Pilot Programme is a cooperative effort between the City of Bainbridge Island and a private landowner. The landowner will voluntarily explore the potential to offset impacts resulting from a 12 home single family residential development and the City will design a conceptual offset for impacts resulting from the relocation of a shoreline road on the same property. The project is intended to provide an example of a workable offset methodology that can be applied to local ECOSYSTEMS, including Pacific Northwest coniferous forests, wetlands, marine riparian zones and intertidal habitat. The project will also demonstrate the potential for implementation of biodiversity offsets as a component of future residential or commercial developments in the jurisdiction. The City of Bainbridge Island Department of Planning and Community Development has been evaluating the potential for incentive policies to encourage biodiversity offsets as a standard practice to be incorporated into sustainable development designs and this pilot project will be the first to demonstrate how such a programme might be applied.

2.1 Puget Sound and surrounding ecoregion

The Puget Sound ECOREGION extends the length of Washington State. Nestled between the Cascade and Olympic mountains in northwest Washington, the Puget Sound basin covers more than 41,500 km^2 (16,000 square miles) of land and water within the ecoregion. The basin's surface area is roughly 80% land and 20% water. The basin supports a variety of LANDSCAPES unique in the world: the rocky shores of the San Juan Islands, the forested slopes of the Olympic Mountains, inland floodplains, and tidal mudflats.

2.2 Local ecosystem and policy context

Bainbridge Island is an urban island community measuring approximately 73 km^2, just west of the Seattle metropolitan area in the central Puget Sound Basin. The island itself supports many areas of high biodiversity, including terrestrial, marine riparian and shoreline habitats. The island currently has a population of approximately 23,180 but is required by state growth management laws to plan to accommodate a population of 28,700 by the year 2025. Rapid growth and residential development is severely impacting biodiversity on the island by reducing forest canopy, altering intertidal habitats, fragmenting wildlife corridors and allowing invasive species to compromise native vegetation.

A large portion of Bainbridge Island is forested, with approximately 70% of the land area supporting mixed coniferous and deciduous forest canopy. Forest canopy is not currently protected through local regulations, with the exception of forest areas that are located in wetlands or on steep slopes or that contain habitat for endangered or listed species. Residential development and roadways exist throughout the island, fragmenting the existing forest canopy; however, approximately 40% of the island forest is preserved in large tracts of public open space or private EASEMENTS.

The shoreline habitat surrounding the island community has been severely impacted by residential and commercial infrastructure. A 2002 study estimates that 82% of the island's shorelines are impacted or altered by development. Shoreline habitats are now protected by state law. In Washington State, the Growth Management Act requires cities to implement Shoreline Master Programs to protect nearshore and shoreline riparian habitats. The City of Bainbridge Island Shoreline Master Program has been implemented since 1992,

and protects riparian shoreline buffers and requires intensive review of environmental impacts for development of the shoreline. However, existing bulkheads, groins, docks, removal of riparian vegetation to accommodate lawns and non-native landscaping installed prior to these regulations all continue to compromise the nearshore and intertidal areas, contributing to the decline of salmon and other species that depend on this habitat.

2.3 Pilot project description

The Bainbridge Island Pilot Project was chosen to illustrate how forest canopy and shoreline habitats can be protected even as development occurs. The project encompasses a little over 16 hectares (ha) (equivalent to 40 acres) of mature forest and extends into the tidelands of Blakely Harbor.

The Upper Blakely LLC is not a typical development company. Rather, the project is owned by a family partnership with a long history in the community. The families involved in the project plan to build the infrastructure on the property in the short term and slowly, over time build homes for each of the families involved in the partnership. The families have a long term interest in preserving the natural environment on and around their property for themselves and for future generations and are, for this reason, interested in considering offsetting the biodiversity impacts resulting from the project. The potential offset for the residential project described here is an IN-KIND offset, restoring and protecting forest habitat. The City of Bainbridge Island is exploring a conceptual plan to move a shoreline road inland on the same property and offset the impacts to wetland and forest habitat by restoring a length of rock-armoured nearshore and intertidal habitat to its natural condition. The offsets for the road project are both in-kind and out-of-kind offsets. The OUT-OF-KIND offset proposes to restore intertidal habitat to offset impacts to a wetland based on the assumption that shoreline habitat is highly compromised on the island and RESTORATION of this type of habitat is a high priority in the region.

3. Motivation to Offset Biodiversity Impacts

The City of Bainbridge Island developed policies regarding preservation of biodiversity in 2007. The following policies were adopted into the Environment Element of the City's Comprehensive Plan.

GOAL 4. Encourage sustainable development that maintains diversity of healthy, functioning ecosystems that are essential for maintaining our quality of life and economic viability into the future.

> Encourage planning and land development using conservation design methods and principles such as, low impact development techniques, green building materials and mitigation that offsets impacts to biodiversity.
>
> Create a programme with effective mechanisms intended to offset development impacts to biodiversity, including developing a priority lands map that identifies areas with a high level of biodiversity and considering establishing a habitat bank on the Island.
>
> Provide incentives for developments to offset unavoidable impacts to biodiversity in areas where high-quality natural habitats exist.

The City is committed to reversing the loss of biodiversity occurring through development of infrastructure, as well as commercial and residential development. The above policies set the framework for further creation of programmes to encourage biodiversity offsets implementation by private landholders. A priority lands map has been recently developed to guide conservation planning and the adoption of an incentive programme to encourage carbon and biodiversity offsets in residential projects is anticipated in early 2009.

The City is exploring the pilot project offsets for the Country Club Road infrastructure project with an interest in further restoring habitat in Blakely Harbor, demonstrating a bulkhead removal project and working cooperatively with private landowners to ensure long-term preservation of priority nearshore ecosystems. The Upper Blakely LLC landowners are participating in this study with an interest in sustaining the natural environment where their families have lived for generations.

4. Defining the Project

The first step in developing a biodiversity offset strategy is to define the scope and assess the principal elements of the project that have the potential to impact biodiversity in the area. This step clarifies the impacts anticipated for each stage of the project and allows the project planner to begin to think about the offsets that will be required to achieve overall NO NET LOSS of biodiversity. The project and project boundaries are described below and the project elements are summarised in Table 1 on the following page.

4.1 Residential project

The residential project site is located on a hillside along the southern shoreline of Blakely Harbor. The project site extends from the shore of the harbour across a public roadway, to a forested ridgeline. The site is entirely vegetated with mixed deciduous and coniferous forest, with the exception of a private gravel access road intersecting the site from west to east. The project area is contiguous with forested land to the south and west and is bounded to the east by a roadway and existing residential development. The upland contains four forested, palustrine wetlands, two streams, and supports a diversity of birds, herptiles and small to medium sized mammals. The site is identified on the City of Bainbridge Island Open Space Study (City of Bainbridge Island 2008) as having medium to high environmental sensitivity.

The project encompasses approximately 16 ha (40 acres). The Upper Blakely LLC has secured a permit to develop twelve homes on the upper portion of the site. Approximately 12 ha (30 acres) of forested property will be preserved as permanent open space. Eight acres (3.24 ha) will be cleared to make room for homesites, an access road and stormwater facilities.

4.2 Public infrastructure project

The property held by the residential landowner extends to the shoreline of Blakely Harbor and is bisected by a public roadway along the south side of the harbour. Portions of this roadway are located very close to the water and require armouring in the form of a rock bulkhead to protect the roadbed. The structural integrity of the bulkhead is continually compromised during winter storms and requires constant repair. The bulkhead increases wave energy in the vicinity, thereby altering the substrate of the beach and

compromising nearshore and intertidal habitat. The location of the road and the bulkhead also replaces natural riparian vegetation, further compromising the potential marine riparian functions.

The City of Bainbridge Island is investigating alternatives to continually repairing the bulkhead and has identified a conceptual plan to move the road inland, away from the shoreline. The new road alignment would impact some marine riparian area and a forested wetland. However, the relocation away from the shoreline would allow restoration of nearshore and marine riparian habitat.

The following table lists the project activities for each component of the project and describes the potential impacts anticipated for each activity.

Table 1: Project activities and elements (corresponding to Step 1 in the BBOP Biodiversity Offset Design Handbook – 'Review project scope and activities')

LIFECYCLE stage	Activity or element	Location	Impacts	Duration*
Residential development pre-construction	Land clearing	Upland forest	Habitat removal, noise	Permanent
	Road construction	Upland forest	Noise, temporary stormwater impacts	Temporary and permanent
	Utility construction and installation	Upland forest and shoreline	Habitat disruption, noise, stormwater impacts	Permanent
Road pre-construction	Land clearing	Upland forest, wetland	Habitat removal, impacts to wetland hydrology	Permanent
	Removal of existing road prism	Within existing disturbed road corridor, temporary impacts to shoreline	Possible water quality impacts	Temporary
Residential home construction	Building construction	Upland forest	Additional impervious surface, noise	Permanent
	Site landscaping	Upland forest	Additional tree canopy removal, introduction of non-native species	Permanent
Shoreline road construction	Construction of new roadbed	Upland forest, wetland	New impervious surface, water quality and stormwater runoff	Permanent
	Removal of bulkhead	Shoreline	Habitat disruption.	Temporary

* Duration relates to the activity or component, e.g. permanent (for the duration of the project) or temporary (during construction).

4.3 Review of regulatory or legal requirements for biodiversity offsets

The second step in the offset design process involves reviewing federal, state and local regulations to determine whether existing policies govern or guide the design and implementation of the offsets. In the US, this review is incorporated as part of the Environmental Impact Assessment process prior to development

permit review. The Blakely Pilot Project offset design is influenced by federal regulations such as the Federal Clean Water Act, requiring mitigation for impacts to wetlands and marine areas, by state and local regulations requiring mitigation for impacts to shoreline habitats and by local regulations protecting critical areas, including wetlands, streams and steep slopes.

Table 2: Legislative review (corresponding to Step 2 in the BBOP Biodiversity Offset Design Handbook – 'Review the legal framework and / or policy context for a biodiversity offset')

Regulation	What does the legislation say on this topic?	How does this affect your biodiversity offset design?
NEPA	NEPA requires projects with federal funding to process an EIA and an ALTERNATIVES analysis	The offset may be considered through the alternatives analysis process
Federal Clean Water Act	Requires permits and mitigation for impacts to waters of the US, i.e., wetlands and or coastal waters	US Army Corps of Engineers will issue permits and approve offsets proposed for impacts to the wetland
SEPA	State law requiring all projects to consider environmental impacts and propose mitigation. Requires public comment periods for permits	Will drive STAKEHOLDER involvement in offset discussion relating to the infrastructure process
State Shoreline Management Act	Regulates impacts within shoreline and riparian zones	Will influence design of road alignment on infrastructure project
Local Shorelines and Critical Areas Regulations	Requires mitigation for impacts to critical areas such as wetlands. Restricts development on or near steep slopes and shorelines	May restrict options for road alignment and drive mitigation for wetland impacts

4.4 Identification of stakeholders

The next step in offset design is to identify stakeholders who are affected by or can influence the outcome of the project. Stakeholders can be individuals, interest groups or government agencies. Early inclusion of stakeholders in the offset development process is important to maintain a credible and widely accepted project. The development permit process in the United States requires extensive public involvement and stakeholders are generally identified through a mandatory public comment process.

The permit approval process for the site design of the private residential development incorporated a number of opportunities for public participation, including public review of the state environmental checklist and citizen participation in a public hearing. Neighbours and citizens attended the public hearing and commented on the site design and the environmental review. Stakeholder participation with regard to the road infrastructure project has been minimal to this point as much of the project is still at a conceptual design stage. Extensive opportunities for stakeholder participation, including citizens, environmental groups, public agencies and local tribes, is anticipated as part of the required public process to design and fund the project once a feasibility study is complete.

Table 3: Stakeholder identification for Blakely Harbor pilot project (corresponding to Step 3 in the BBOP Biodiversity Offset Design Handbook – 'Initiate a stakeholder participation process')

Name of stakeholder group	Interest	Key stages for engagement	Resources required
City of Bainbridge Island Community Forestry Commission	Advocates of biodiversity offset implementation and policy development	THROUGHOUT PROCESS	Commission members' time to advise on offset development, review project and coordinate with City policies
Bainbridge Island Land Trust	Preservation of habitat through purchase / donation or conservation easements	Involved throughout project design, engagement during discussions of implementation near end of process	Land trust staff meetings with property owners and expenses to set up conservation easements
Citizens of Bainbridge Island / neighbours	Preservation of forest, shoreline, public access to shoreline. Concern regarding impacts of project in surrounding neighbourhood	Citizens and neighbours were involved during public comment for development permits. Citizens will also be involved during budget discussions and implementation of infrastructure project	City staff time required to coordinate public involvement
Puget Sound Partnership	Preservation and restoration of habitat throughout the Puget Sound	During offset design of infrastructure project	Time to coordinate with partnership
Agencies and tribes	Protection of natural resources	Both state agencies and local tribes are notified through the EIA process	City staff time to coordinate with agencies and tribes

5. Analysis of Existing Biodiversity Components and Project Impacts

Step four of the offset design process requires a comprehensive review of biodiversity components of global, national or local conservation significance. Identification of species and habitats in the project area that are of particular importance should be completed early in the project design and is usually well documented during the Environmental Impact Assessment process. The review of biodiversity components includes both the INTRINSIC values of each species or ECOSYSTEM and also the socioeconomic values of each element listed. Completion of this step requires a thorough assessment of species data, BIOTIC communities supporting those species and the ecological processes involved in the functioning of the systems.

5.1 Puget Sound ecoregion biodiversity

The Puget Sound ECOREGION is home to over 75% of Washington State's human population and contains a wide variety of habitats supporting an immense diversity of plant and animal species. Extensive development, land conversion and the establishment of non-native and invasive species has destroyed many of the terrestrial and marine ecosystems that support these species. The effects of these impacts are evident in the continued decline in eelgrass habitat, forage fish, salmon, rockfish, marine birds and orcas (killer whales). Currently, 10 animal species are listed by the state or federal government as threatened or endangered. An additional 33 marine species in Puget Sound, including three invertebrates, 22 fish, seven birds and one mammal, have been identified by state or federal governments as species of concern, meaning they are at risk (Puget Sound Action Team, 2008).

Recently, much attention has been called to the declining populations of salmon species in the region. The Puget Sound provides vital habitat for Chinook, bull trout and other salmon. However, only 22 of at least 37 historic Chinook populations remain. The remaining Chinook salmon are at best only 10% of their historic numbers, with some populations as low as 1%. Marine intertidal, nearshore, and sub-tidal areas provide critical habitat for salmon, particularly for juveniles as they migrate from freshwater systems in south and central Puget Sound watersheds to the ocean. Shallow nearshore areas are known to provide rearing habitat and shallow-water migration corridors that offer protection from predators. These critical nearshore and intertidal habitats have been severely compromised by commercial and residential development, shoreline armouring, removal of riparian vegetation and introduction of nutrients and pollutants into the water.

5.2 Biodiversity at the project site

Both the residential development and the infrastructure project are located on the south side of Blakely Harbor in the Puget Sound. Blakely Harbor was once the site of the world's largest lumber mill in the early 20th century and much of the harbour and surrounding area was heavily impacted by residential and industrial infrastructure. In contrast to its intense industrial past, Blakely Harbor is now one of the least developed waters in the Central Puget Sound. The harbour supports a properly functioning pocket estuary within approximately five miles of a natal Chinook watershed and provides significant foraging and refugia habitat for

juvenile Chinook as well as other salmonids and fishes. A number of bird species have been observed using the waters in the harbour, including common loon, Cassin's auklet and Western grebe. The area also supports larger species, such as harbour seals, orca whales and giant Pacific octopus.

The upland project area, where the residential development will occur is within the Tsugaheterophylla (Western hemlock) zone of the Puget Sound Area. The forest is representative of a typical, mature, second-growth forest and consists of Douglas fir, Western hemlock, Western red cedar, big leaf maple and young red alder trees. The project site contains four forested palustrine wetlands, two streams and supports a diversity of birds, herptiles and small to medium-sized mammals. The upland forests surrounding the harbour provide one of the few large remaining tracts of forest canopy in the area and support habitat and water quality functions that are directly connected with the coastal habitat.

A wetland measuring approximately 0.4 ha is found at the base of the slope, adjacent to the shoreline road. The wetland is forested, supporting a variety of trees and shrubs. Surface water ponding was observed in areas of the wetland during the site visit in October 2008 and it appears that much of the wetland is saturated throughout the growing season. The wetland likely supports a variety of bird and amphibian species and serves to filter runoff from the upland slopes.

The marine riparian zone is heavily impacted by a two lane road and the rock armouring structures that were built along the shoreline to protect the roadway. These rock bulkheads extend beyond the waterline and therefore prevent the establishment of large trees and other vegetation that is necessary to the functioning of an intact marine riparian buffer. Some smaller trees have established in the 3.0 – 4.5 m (10 – 15 feet) wide area between the road and the bulkheads, but the vegetation is minimal and highly compromised by impervious surfaces and invasive species.

The shoreline habitat in the vicinity of the infrastructure project consists of mostly mixed-course sediments until bare bedrock is exposed. Blakely Harbor supports significant numbers of juvenile salmon (pink, chum, & Chinook), with medium density concentrations along the southwestern shore near the project area. Surf smelt spawning, which requires a specific type of sand / gravel substrate, has been documented on the southwestern shore of the harbour (as shown on the Washington Department of Fish and Wildlife Priority Habitat and Species maps). Eelgrass has been identified along most of the southwestern shore of the harbour and eelgrass beds are known to exist directly to the west of the project site (City of Bainbridge 2002). Kelp (Laminaria & Nereocyctis spp.) is found to the east of the project site (City of Bainbridge 2001). Both of these species require certain substrate and where established, are some of the most productive and heavily utilised habitats by a wide range of species during various life stages (i.e. spawning, rearing, migration, etc.). Juvenile salmonids have been documented to have a high association with these habitats.

The table below lists the KEY BIODIVERSITY COMPONENTS found in the Blakely Harbor area and the adjacent wetland and forest habitats. The information is drawn from reports completed for the Port Blakely Mill Company in 1992 (Port Blakely Mill Company 1992) and from the Puget Sound Action Team State of the Sound report published in 2007.

Table 4: Key Biodiversity Components Matrix (corresponding to Step 4 in the BBOP Biodiversity Offset Design Handbook – 'Determine the need for an offset based on residual adverse effects')

Biodiversity component	Global significance	National / State status	Socioeconomic and CULTURAL VALUES / ECOSYSTEM FUNCTIONS AND SERVICES
Species			
Mammals			
Orca whale	IUCN LRCD	Endangered	Symbolic animal in Puget Sound area. Tourism draw
Harbour seal	IUCN LR/lc	State monitored species	
Long-legged myotis	IUCN LR/lc	State monitored species	Bat species
Long-eared myotis	IUCN LR/lc	State monitored species	Bat species
Fish			
Chinook salmon		Threatened	Local fisheries and native peoples depend on salmon as a food and income source. Culturally important to native tribes
Coho salmon		Candidate	
Coastal cutthroat trout		Species of concern	
Pacific herring		Candidate species	Forage fish are an important food source for juvenile salmonids
Surf smelt		Priority species / spawning areas listed as critical habitat	
Sand lance			
Birds			
Bald eagle		Threatened	National bird of the United States / a recovering species
Western grebe	IUCN RED LIST LC	Species of concern	
Cassin's auklet	IUCN red list LC	Species of concern	
Common loon	IUCN red list LC	Sensitive species	
Northern goshawk	IUCN red list LC	Candidate species	
Pileated woodpecker	IUCN red list LC	State monitored species	
Amphibians			
Tailed frog	IUCN red list LC	State monitored species	
Communities / habitats			
Rocky reef habitat, sand / gravel beaches, sand / mud flats, eelgrass and kelp beds		Rocky substrate sub-tidal areas are priority habitat areas. Sand / gravel beaches provide spawning habitat for forage fish, eelgrass and kelp provide refuge habitat	The nearshore / intertidal zone supports numerous fish species, providing spawning grounds, nurseries for juvenile salmonids and refuge for migrating salmon

Biodiversity component	Global significance	National / State status	Socioeconomic and CULTURAL VALUES / ECOSYSTEM FUNCTIONS AND SERVICES
Marine riparian forest		Marine riparian zones are recognised as important management areas	Riparian zones provide the following functions: water quality functions, soil stability and sediment control, wildlife habitat, shade and food source for fish, nutrient inputs, aesthetic and recreational services. These zones continue to be disturbed by ongoing residential and infrastructure development and are severely impacted on Bainbridge Island by construction of bulkheads and alteration of riparian vegetation
Forested wetland		Protected as critical habitat under federal, state and local laws	Wetlands provide numerous functions in the watershed, including water quality improvement, reduction of peak flows, groundwater recharge, habitat for invertebrates, amphibians, birds and small mammals
Conifer-mixed hardwood forest		Large tracts of intact forest near the shoreline are highly valued for their aesthetic and recreational values	Very few large tracts of undisturbed forest canopy remain in the Puget Sound basin. Although over 70% of Bainbridge Island contains forest canopy, most is fragmented by residential or infrastructure development
Whole landscapes / ecosystems			
Water quality functions		Water quality is highly compromised in the Puget Sound and is key to the maintenance of functioning habitats and of a healthy ecosystem	The forested uplands and wetlands provide water quality functions such as nutrient and sediment retention, heavy metals filtration, that have downstream impacts on water quality and habitat
Forage fish spawning habitat		Supports commercial and native fisheries, impacts salmonids	Forage fish such as Pacific herring, sand lance and surf smelt are an important food source for migrating salmon
Juvenile salmonid habitat		Supports commercial and native fisheries	The intertidal and nearshore zones are critical habitat for juvenile salmonids

6. Projected Impacts on Biodiversity Components and Mitigation Considerations

6.1 Impacts to biodiversity components

The development project includes improvements to the internal access road, clearing for homesites and construction of stormwater infrastructure, including installation of a stormwater outfall to Blakely Harbor. The majority of the impact involves removal of mature forest to accommodate the building areas. The residential development will require clearing of approximately 3.24 ha (8 acres) of forest canopy. To date, an area has been cleared to create an open meadow and new access road. Further clearing for individual building lots will occur over time as each lot is built out. Loss of forest canopy and increase in new impervious surface area will result in loss of habitat, potential for establishment of non-native plant species, and increased noise during construction and throughout the life of the project. Impacts to water quality may occur as a result of new impervious surfaces.

The infrastructure project, including clearing of public right-of-way to relocate the shoreline road, will impact approximately 766 m (2,300 linear feet) of forest canopy in the marine riparian zone on the project site. The new road alignment will likely impact a forested wetland that has formed adjacent to the existing road. An option for the road may include designing the roadway on pilings to bridge the wetland and re-establish a surface water connection that was disrupted when the road was built. The design for the road realignment is in a conceptual stage at this point; therefore, actual impact calculations are not available. However, it can be assumed that the project will result in removal of all vegetation along the new road corridor. Impervious surface will be temporarily increased during construction until the existing roadbed is restored to a natural condition. The new road alignment is slightly shorter than the existing road. Therefore, overall impervious surface will likely decrease after completion of the project, resulting in positive stormwater runoff and water quality effects.

6.2 Mitigation hierarchy

The MITIGATION HIERARCHY was addressed by the residential project developer during the local government land use development permitting process. Mitigation in the form of AVOIDANCE is designed in the clustered layout of the building sites, in the use of the existing access road to avoid clearing a new road corridor, and in the stormwater design that minimises clearing of forest canopy to install structural stormwater facilities. Other mitigation measures were explored through the ENVIRONMENTAL ASSESSMENT checklist that was reviewed with the land use development permits, including the following: all wetlands and streams were flagged and their buffers will be permanently protected. Clearing of vegetation is restricted to non-coniferous trees to ensure that roosting and nesting habitat for raptors is preserved. A mulching technique was used for clearing to ensure that all organic material is left on the site. This technique minimises erosion on the site, allows the nutrients to remain in the system and precludes the need for trucks to haul material to an off-site disposal area. Clearing and construction activities are limited to approved times to reduce noise impacts.

The mitigation hierarchy will be applied throughout the ALTERNATIVES analysis for the road project. Avoidance of impacts to the shoreline habitat will be the first priority and minimisation of impacts to the wetland habitat will be considered. Alternatives may include bridging the wetland or supporting the road with pilings to limit wetland fill and re-establish surface water flow patterns.

7. Quantification of Biodiversity Losses

7.1 Methodology

The next step in the process quantifies anticipated BIODIVERSITY LOSSES. A number of methods are available (reviewed by BBOP in the appendices to the Biodiversity Offset Design Handbook – see: **www.forest-trends.org/biodiversityoffsetprogram/guidelines/odh.pdf**). The methods used by the pilot project included an accounting approach based on the HABITAT HECTARES method developed in Australia and adapted by BBOP to include fauna as well a flora and for application in a wide variety of ecosystems worldwide. This accounting enables comparisons to be made between biodiversity loss at the IMPACT SITE and BIODIVERSITY GAINS at potential offset sites.

The habitat hectares method uses BENCHMARKS, or reference sites to create a multi-ATTRIBUTE scoring index against which losses and gains are measured. The Bainbridge pilot project team has modified the habitat hectares quantification methodology to create benchmarks adapted to the specific conditions and vegetation communities of the Puget Sound ECOREGION. The team developed a methodology for review of terrestrial / forest and marine riparian habitat based on the Australian method. Other methods used included the Bainbridge Island Nearshore Assessment approach, which was developed in 2002 to analyse the quality of shoreline habitat and adapted here for the intertidal aspect of this offset project. Wetland habitat was assessed using structural criteria adapted from the widely used Western Washington Wetland Rating System. All of these methods are described in Appendix A.

7.2 Identification of benchmark sites

In keeping with the habitat hectares method, benchmark sites were selected for each HABITAT TYPE. The benchmark site represents an intact and fully functioning habitat that can be used as a comparison against which the impact and offset sites will be measured. Three benchmark sites have been identified for the Bainbridge project.

- The mixed-coniferous hardwood forest benchmark site against which losses and offsets to the upland forested areas at the project will be assessed is a 40 ha (100 acres) forest preserved as public open space, known as the Grand Forest in the central area of Bainbridge Island. The benchmark site is an example of a mature, mixed coniferous forest, with trees of 40 to more than 100 years in age.

- The benchmark for the wetland impacts is another publicly owned open space area known as Manzanita Park wetlands. Both of these benchmarks represent mature habitats with minimal impacts over the last 100 years.
- A benchmark site for the intertidal and marine riparian habitats was difficult to locate on Bainbridge Island. A number of different factors influence the type of shoreline habitat at the site, including location within a drift cell and geomorphic classification (e.g., high bluff, low bank, rocky shore). A benchmark site that matched the project area and was not highly impacted by development was not available on Bainbridge Island. Therefore, a benchmark site on Port Gamble Bay, north of Bainbridge Island was chosen. This site has a relatively undisturbed beach and forested marine riparian zone, with intact, mature vegetation.

7.3 Calculation of biodiversity loss for residential development

Loss of biodiversity at the impact site is calculated using a weighted attribute scoring index comparing the pre-project CONDITION to the post-impact condition at the project site, measured against the attribute scores at the benchmark sites. The index translates the numeric scores for the total impacts to each attribute into a number representing the overall 'habitat hectares' lost due to project impacts. Detailed descriptions of each of the attributes used and the WEIGHTING system developed for this project are found in Appendix A.

The Upper Blakely LLC obtained development permits in 2006 to begin development of the residential building sites. Clearing began in 2007 in an area labelled the 'meadow' and in several building lots surrounding the meadow. The existing habitat type was mixed coniferous forest, dominated by Big leaf maple, Red alder, Douglas fir, Western red cedar, sword fern, Indian plum and salal. Two acres, or 0.8 ha were cleared for the 'meadow', with large maple and conifer trees left standing throughout the area. Approximately 3.24 ha (8 acres) were cleared to accommodate a new access road and for home sites.

Field assessments of the area were completed in June 2006 prior to commencement of clearing and in October 2008, after the clearing was complete but before construction of infrastructure. The above table shows that 0.08 habitat hectares were lost in the 'meadow' area and 0.097 habitat hectares were lost in the area of the building sites. A total of 0.177 habitat hectares have been lost due to the clearing that has occurred to date.

The following table illustrates the calculation for the impacts resulting from the residential development in the upland forest.

Table 5: Habitat hectares lost at residential development site

Habitat types	Attribute	Benchmark level	Weight	Hectares of habitat type	Pre-project condition	Pre-project habitat hectares	Post -project condition	Post-project habitat hectares	Habitat hectares lost
Forest meadow **0.8 ha (= 2 acres)**	Large trees	20	0.2	0.8	12	0.096	11	0.088	0.008
	Tree canopy cover	5	0.05	0.8	5	0.04	0	0	0.04
	Lack of weeds	10	0.1	0.8	10	0.08	10	0.08	0
	Understorey life forms	10	0.1	0.8	9	0.072	7	0.056	0.016
	Snags	20	0.2	0.8	10	0.08	10	0.08	0
	Logs	20	0.2	0.8	0	0	0	0	0
	Patch size	10	0.1	0.8	10	0.08	8	0.064	0.016
	Connectivity	4	0.05	0.8	1	0.01	1	0.01	0
	Total					**0.458**		**0.378**	**0.08**
Forest building sites **3.24 ha (= 8 acres)**	Large trees	20	0.2	3.24	11	0.3564	11	0.3564	0
	Tree canopy cover	5	0.05	3.24	4	0.1296	2	0.0648	0.0648
	Lack of weeds	10	0.1	3.24	5	0.162	8	0.2592	-0.0972
	Understorey life forms	10	0.1	3.24	9	0.2916	7	0.2268	0.0648
	Snags	20	0.2	3.24	10	0.324	10	0.324	0
	Logs	20	0.2	3.24	20	0.648	20	0.648	0
	Patch size	10	0.1	3.24	10	0.324	8	0.2592	0.0648
	Connectivity	4	0.05	3.24	1	0.0405	1	0.0405	0
	Total					**2.2761**		**2.1789**	**0.0972**
							Total forest habitat hectares lost		**0.1772**

7.4 Calculation of biodiversity loss at infrastructure development site

The calculations for biodiversity loss at the infrastructure development site are based on conceptual designs and anticipated impacts to the wetland and the marine riparian zone. As the impacts have not yet occurred the post-project attribute scores are conceptual only and do not yet represent real impacts. The conceptual impacts assume clearing of the wetland and the marine riparian zone to accommodate a 10.6 m (35 feet) wide road corridor inland from the existing road corridor, although this is subject to the outcome of an alternatives analysis in a subsequent feasibility study (see *Offset Site Selection for Infrastructure Project*, below).

Table 6: Habitat hectares lost at infrastructure site

Habitat types	Attribute	Benchmark level	Weight	# Hectares of habitat type	Pre-project condition	Pre-project habitat hectares	Post -project condition	Post-project habitat hectares	Habitat hectares lost
Marine riparian zone 0.9 ha (= 2.2 acres	Large trees	10	0.17	0.9	5	0.0765	1	0.0153	0.0612
	Tree canopy cover	5	0.08	0.9	3	0.0432	3	0.0432	0
	Overhanging vegetation	20	0.17	0.9	5	0.03825	5	0.03825	0
	Understorey life forms	10	0.08	0.9	6	0.0432	6	0.0432	0
	Large woody debris	20	0.17	0.9	10	0.0765	10	0.0765	0
	Snags	10	0.08	0.9	0	0	0	0	0
	Logs	5	0.08	0.9	1	0.0144	1	0.0144	0
	Corridor width	20	0.17	0.9	0	0	0	0	0
	Total					**0.2921**		**0.2309**	**0.0612**
Forested wetland 0.23 ha (= 0.56 acres)	Vegetation structure	10	0.2	0.23	10	0.046	0	0	0.046
	Hydroperiods	15	0.2	0.23	15	0.046	15	0.046	0
	Richness of plant species	20	0.25	0.23	10	0.02875	0	0	0.02875
	Special habitat features	10	0.1	0.23	6	0.0138	0	0	0.0138
	Corridors and connections	25	0.25	0.23	25	0.0575	25	0.0575	0
	Total					**0.19205**		**0.1035**	**0.08855**
								Total habitat hectares lost	**0.14975**

8. Biodiversity Offset Design

8.1 Offset selection and design

Designing a biodiversity offset involves selecting potential sites that meet the requirements for each of the KEY BIODIVERSITY COMPONENTS, including species, ECOSYSTEMS and ECOSYSTEM FUNCTIONS that will be offset. Offset site selection must be considered within the regional planning context and should take into account each of the biodiversity components at the appropriate scale with the aim of achieving NO NET LOSS of biodiversity. Offset sites can be located within the project boundaries or within the region if suitable sites are available.

8.2 Residential impact offset site selection

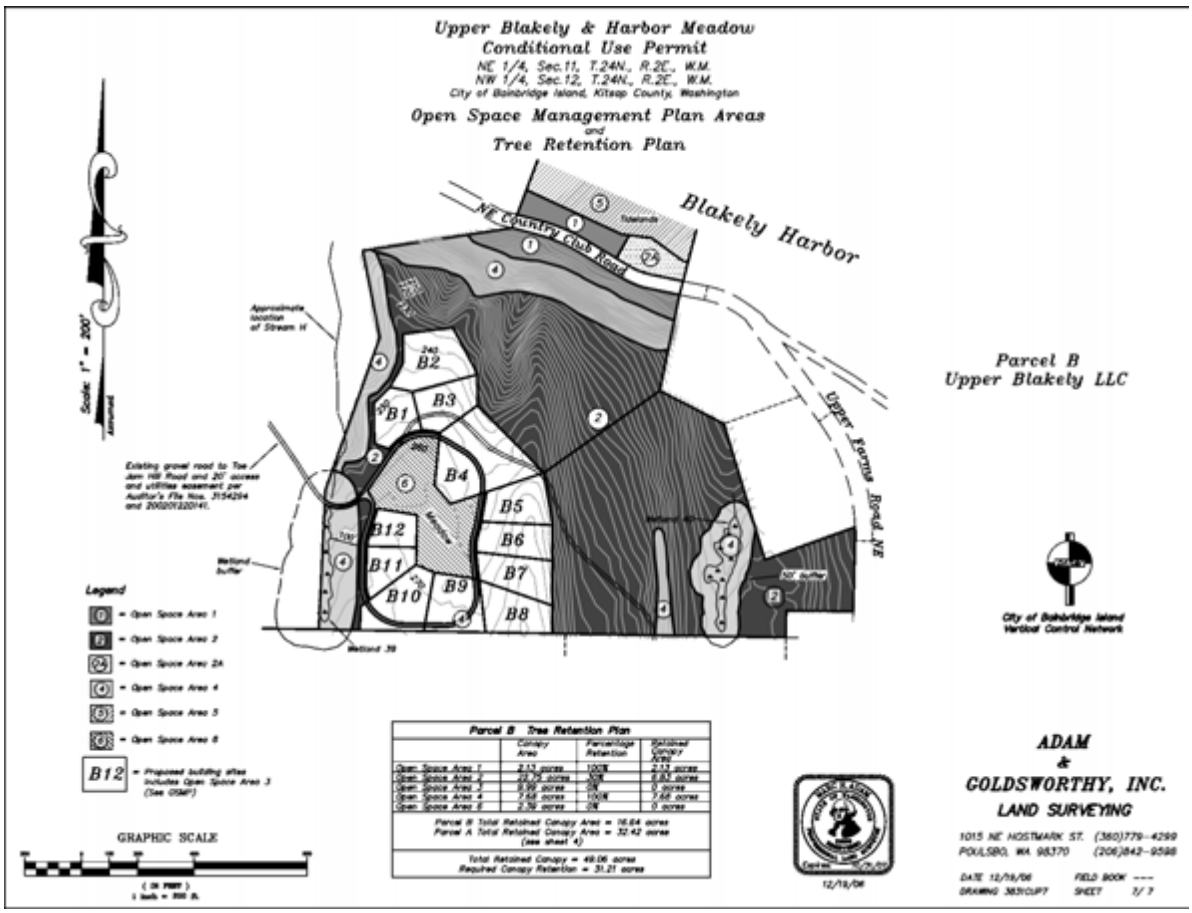
The residential pilot project proposes to offset all of the development impacts on the project site. The scale of development projects on Bainbridge Island is relatively small and the cost of land is comparatively high, therefore it is expected that most projects in the area will choose to offset their impacts within the project site or on land that is already owned by the developer. The residential development will impact mature forest and the objective of this case study is focused on offsetting the impacts to the forest habitat through AVERTED RISK and RESTORATION of remaining intact forest.

If biodiversity offsets are to be more widely applied for impacts to residential or commercial development projects on Bainbridge Island, a habitat offset bank may be considered. Offset banks have the advantage of more reliability of success and they generally can provide a larger habitat area with more connectivity. This eliminates some of the disadvantages of smaller offsets that may not be closely monitored in the long term and that are subject to encroachment and noise impacts from adjacent development.

8.3 Residential impact offset design

The residential project is designed to cluster the homesites outside of the wetlands, streams and steep slopes on the site to minimise impacts to critical habitat and preserve the maximum amount of forest canopy possible. An existing access road is used and flexible stormwater requirements are applied to minimise the need for clearing to accommodate stormwater facilities. The remaining 12.14 ha (30 acres) of land that is not developed is set aside and governed by an open space MANAGEMENT PLAN that precludes future development under the current development permits. An option for further protection of the undeveloped land might be conservation EASEMENTS established in cooperation with the local LAND TRUST.

Restoration of existing forest habitat could occur through removal of invasive species and planting of additional coniferous tree seedlings throughout the property. English ivy is severely compromising much of the existing tree community along the road, at the edge of the tree canopy. Removal of this highly destructive invasive plant would improve the health of the existing forest and allow appropriate native understory to re-establish. Native conifer species such as Douglas fir can be planted throughout the open space and between the building lots to improve the habitat potential.



8.4 Residential development quantification of biodiversity gains

BIODIVERSITY GAINS at the residential development site are calculated based on anticipated activities, including replanting mid-successional coniferous tree species, allowing native understory plants to re-establish and removing invasive species such as English ivy throughout the remaining forest.

The project owner has discussed replanting Douglas fir and other coniferous trees throughout the building sites to provide a visual buffer between homesites and to restore fringe areas impacted by clearing for the project construction. The open space area outside of the homesite and meadow impact zone will be preserved through the implementation of an Open Space Management Plan, an agreement required through the land use development process. This plan allows for maintenance of the vegetation and trimming of trees or removal of hazard trees, but generally restricts clearing of the forest canopy in the majority of the open space. Conifers would be planted throughout the open space in appropriate areas that may be dominated by early successional species such as red alder to improve the habitat, increase slope stability and add to the stormwater retention and filtering potential of the forest canopy.

The following table illustrates the anticipated biodiversity gains in habitat hectares, based on conceptual conditions at 50 years post restoration. The total habitat hectares gained is estimated at 0.85 ha. This will offset the 0.177 habitat hectares lost due to the residential development at a ratio of almost 5:1. Other offset elements are not captured in this calculation, including the averted risk where the landowner will preserve developable forestland in PERPETUITY, which may be considered an additional conservation gain (ADDITIONALITY – one of the key principles of biodiversity offsets, see below).

Table 7: Habitat hectares gained at residential development site

Habitat types	Attribute	Benchmark level	Weight	Hectares of habitat type	Pre-restoration condition	Pre-restoration habitat hectares	Conceptual post-restoration condition	Post restoration habitat hectares	Habitat hectares gained
Forest building sites **3.24 ha (= 8 acres)**	Large trees	20	0.2	3.24	11	0.3564	15	0.486	0.1296
	Tree canopy cover	5	0.05	3.24	2	0.0648	2	0.0648	0
	Lack of weeds	10	0.1	3.24	8	0.2592	10	0.324	0.0648
	Understorey life forms	10	0.1	3.24	7	0.2268	6	0.1944	-0.0324
	Snags	20	0.2	3.24	10	0.324	10	0.324	0
	Logs	20	0.2	3.24	20	0.648	20	0.648	0
	Patch size	10	0.1	3.24	8	0.2592	8	0.2592	0
	Connectivity	4	0.05	3.24	1	0.0405	1	0.0405	0
	Total					**2.1789**		**2.3409**	**0.162**
Forest open space **12 ha (= 30 acres)**	Large trees	20	0.2	12	16	1.92	20	2.4	0.48
	Tree canopy cover	5	0.05	12	5	0.6	5	0.6	0
	Lack of weeds	10	0.1	12	8	0.96	10	1.2	0.24
	Understorey life forms	10	0.1	12	10	1.2	10	1.2	0
	Snags	20	0.2	12	10	1.2	10	1.2	0
	Logs	20	0.2	12	20	2.4	20	2.4	0
	Patch size	10	0.1	12	8	0.96	8	0.96	0
	Connectivity	4	0.05	12	1	0.15	1	0.15	0
	Total					**9.3**		**10.11**	**0.72**
	Total habitat hectares gained at residential site								**0.882**

9. Offset Site Selection for Infrastructure Project

The infrastructure project is designed to relocate an existing roadbed inland away from the shoreline of Blakely Harbor. The relocation of the roadway will result in abandonment of the existing impacted roadbed and associated infrastructure. This area then becomes available for restoration and is the logical site for implementation of a biodiversity offset.

Alternatives for the road realignment will be discussed during a feasibility study that is the next step in the process. Possible alternatives include 1) continuing to repair the existing rock bulkhead, 2) moving the road inland from the existing road alignment or 3) abandoning the road altogether and creating a new connection with an existing road along the south side of the island. Moving the road inland is the preferred alternative at this time, but further geotechnical analysis of the adjacent steep slopes is necessary to determine feasibility of this option.

This case study assumes that moving the road inland is the preferred option and calculates biodiversity lost and gained based on this alternative. A conceptual design for this alternative is shown in the Shoreline Roads Erosion Management Alternatives report completed by Myers Biodynamics, Inc. for the City of Bainbridge Island and dated April 10, 2006 (City of Bainbridge Island 2006). This alternative would impact both wetland and forest habitat. The existing roadbed would be restored to marine forest riparian habitat once it is abandoned and the new road is constructed.

Moving the road inland involves some impacts to a small wetland, which will trigger a regulatory requirement to offset the wetland impacts. This gives rise to an interesting situation which is likely to be increasingly common in the future: the combination of a regulatory biodiversity offset for some aspects of a project's impacts (here, the small wetland) with a broader, voluntary commitment to no net loss of the project's impacts as a whole. Regulations under the Clean Water Act require that the wetland impacts be mitigated at ratios prescribed by the federal, state and local agencies. The ratios are determined by the quality of the wetland and the functions it provides. Generally, IN-KIND mitigation is required for wetland impacts. However, in-kind options for wetland creation or restoration may not be available to satisfy the required mitigation ratio in the immediate watershed for this project. The area where the existing road will be removed may revert back to wetland conditions, but additional wetland area may still be required. The existing wetland could be expanded, but to do so would alter existing, mature upland forest and would not necessarily result in net biodiversity or ecosystem service benefits. Other offset options were therefore considered in the context of wider LANDSCAPE opportunities and regional conservation priorities. An out of kind offset that conserves higher conservation priority biodiversity is most likely to be appropriate in this case and is examined in the following section.

9.1 Considering out-of-kind offsets in the context of regional priorities

Salmon recovery and restoration of Puget Sound habitat is a top priority in the region and in Blakely Harbor in particular. In 1998 The Washington State Legislature passed the Salmon Recovery Act to create a

coordinated approach to listings of salmon runs under the federal Endangered Species Act. Restoration of salmon habitat is guided by the Puget Sound Salmon Recovery Plan (Shared Strategy for Puget Sound, 2008) and focuses on preservation and restoration of fresh water and marine habitat. The Bainbridge Island Nearshore Habitat Characterization & Assessment, Management Strategy Prioritization, and Monitoring Recommendations (Williams *et al*. 2004) were developed to address the degradation of marine and intertidal habitat around Bainbridge Island and provide a scientific BASELINE for prioritisation of restoration efforts. Both documents call for removal of shoreline armouring and restoration of degraded marine riparian zones to improve habitat for salmon.

The Salmon Recovery Act establishes guidance to create procedures for alternative mitigation and the Aquatic Resources Mitigation Act allows the state to authorise innovative mitigation for infrastructure projects that provide equal or better biological functions and values compared to traditional, in-kind mitigation. The guidance indicates that permitting agencies may make the decision that protecting high functioning, irreplaceable areas at substantially higher ratios than those required for in-kind mitigation may be the best ecological choice as long as there is no overall loss of habitat functions (State of Washington 2000).

The Bainbridge pilot project team therefore chose to focus on restoration of nearshore habitat as a potential OUT-OF-KIND offset for the impacts expected from the road infrastructure project. The relocation of the roadway will allow the City to remove the existing rock bulkhead and re-grade the beach to its natural state. The removal of the rock armouring structure will decrease the wave energy at the site, allow the natural substrate on the surface to re-establish, and result in improved habitat for forage fish and juvenile salmon. The riparian zone along the shoreline can be replanted with native vegetation that will provide overhanging vegetation, shade, habitat, nutrients and eventually a source for large woody debris on the beach, all crucial elements supporting healthy fish habitat.

The wetland and the upland forest corridor that will be impacted by the new road alignment currently provides functions such as stormwater retention, capture and filtering of contaminants, and sediment retention that directly affect the quality of the adjacent intertidal habitat. However, these functions are limited due to the location of the existing roadway between the corridor and the shoreline area. Moving the road and widening the riparian corridor along the shoreline will improve these functions and create the potential for additional marine riparian functions such as shade provided by overhanging vegetation, HABITAT STRUCTURE from large woody debris originating from the riparian zone, and nutrient inputs from organic debris (wood, leaf litter, etc.). So, although the offset for the wetland impact is technically ‘out-of-kind’, the combined marine riparian and intertidal improvements will provide enhanced functions similar to those lost through the wetland impact.

10. Calculating Infrastructure Offset Gains

In addition to the biodiversity gains at the residential development site (see above), biodiversity offset gains are anticipated to occur in the intertidal zones and marine riparian and when the existing road corridor is moved inland.

10.1 Intertidal offset gains

When the shoreline road is relocated, portions of the rock bulkheads that are currently stabilising the bank along the road will be removed. The bulkheads extend into the intertidal zone, beyond the ordinary high water mark and are compromising the available habitat. The bulkheads are located along 430 m (1,400 linear feet) of the shoreline and impact approximately 1.6 ha of intertidal and nearshore habitat. Removal of the bulkheads is anticipated to reduce the effects of wave energy at the site and allow the natural substrate on the beach to re-establish. This will improve potential habitat for migrating juvenile salmonids and provide habitat for forage fish spawning.

10.2 Marine riparian offset gains

The marine riparian corridor will increase in width from an average of 3 m (10 feet) to up to 30 m (100 feet) in some places. The new riparian corridor will be replanted with native shrubs and trees. The wider vegetation corridor will provide the following ECOSYSTEM FUNCTIONS that are currently highly compromised by the narrow riparian zone:

- Water quality: the riparian corridor will absorb and filter contaminated stormwater runoff from the road to prevent pollutants from entering the adjacent marine system.
- Sediment retention: the intact riparian corridor will increase soil stability and retain fine sediments that can adversely impact fish and invertebrates that inhabit the marine zone.
- Nutrient input and habitat structure: as the vegetation in the re-established riparian corridor matures it will contribute large woody material and organic debris to the intertidal zone. Large woody debris is a crucial component to providing habitat structure and bank stabilisation in the nearshore (Brennan and Culverwell 2004).
- Shade and temperature moderation: overhanging vegetation and tall trees in the restored riparian area will provide shade and regulate temperature. Studies show that eggs of forage fish on shaded beaches have higher survival rates than on beaches exposed to sunlight (Brennan and Culverwell 2004).

The following table summarises the anticipated HABITAT HECTARE gains for the conceptual biodiversity offset for the infrastructure project. Removing the rock bulkhead and restoring the shoreline vegetation will result in gains of 0.29 habitat hectares. Restoring the vegetation and widening the marine riparian corridor will produce gains of 0.41 habitat hectares over a 50 year RESTORATION timeframe (the issue of temporal loss – the fact that the 0.41 habitat hectares is delivered after 50 years rather than from the outset – is discussed in the next section).

Table 8: Habitat hectares gained at infrastructure project

Habitat types	Attribute	Benchmark level	Weight	Hectares of habitat type	Pre-restoration condition	Pre-restoration habitat hectares	Conceptual post - restoration condition	Post-restoration habitat hectares	Habitat hectares gained
Puget Sound nearshore 1.6 ha (= 4 acres)	Wave energy	5	0.08	1.6	4	0.1024	5	0.128	0.0256
	Light regime (natural shade)	5	0.135	1.6	1	0.0432	5	0.216	0.1728
	Light regime (artificial shade)	5	0.08	1.6	4	0.1024	4	0.1024	0
	Sediment supply	5	0.08	1.6	4	0.1024	5	0.128	0.0256
	Substrate type	5	0.08	1.6	4	0.1024	5	0.128	0.0256
	Depth or slope	5	0.135	1.6	4	0.1728	5	0.216	0.0432
	Pollution	5	0.135	1.6	4	0.1728	4	0.1728	0
	Hydrology	5	0.135	1.6	5	0.216	5	0.216	0
	Physical disturbance	5	0.135	1.6	5	0.216	5	0.216	0
	Total nearshore habitat hectares gained								**0.2928**
Marine riparian zone 0.9 ha (= 2.2 acres)	Large trees	10	0.17	0.9	1	0.0153	5	0.0765	0.0612
	Tree canopy cover	5	0.08	0.9	3	0.0432	5	0.072	0.0288
	Overhanging vegetation	20	0.17	0.9	5	0.03825	15	0.11475	0.0765
	Understorey life forms	10	0.08	0.9	6	0.0432	8	0.0576	0.0144
	Large woody debris	20	0.17	0.9	10	0.0765	20	0.153	0.0765
	Snags	10	0.08	0.9	0	0	0	0	0
	Logs	5	0.08	0.9	1	0.0144	1	0.0144	0
	Corridor width	20	0.17	0.9	0	0	10	0.0765	0.0765
	Total marine riparian habitat hectares gained								**0.3339**

10.3 Offset summary and time discounting for residential and infrastructure project

The following table summarises the anticipated BIODIVERSITY LOSSES and GAINS for each habitat type within the project. Biodiversity losses are expected within the forest meadow, the residential building sites, and in the wetland and marine riparian zone. Biodiversity gains are anticipated within the re-forested areas surrounding the building sites, throughout the forested open space, as well as in the nearshore / intertidal and marine riparian zones.

The offset project is designed to restore forested habitat in those areas where vegetation will be entirely removed. It will take time to restore the forest to a condition similar to that at which it is now functioning. The forest is currently 60 – 100 years old. If the assumption is made that within 50 years the trees and vegetation will be at such a point as to provide habitat functions roughly equivalent to those now provided by the intact forest, a simple time discounting calculation can be used to account for the ECOSYSTEM SERVICES lost during the fifty years. Using a DISCOUNT RATE of 3%, as recommended by the National Oceanic and Atmospheric Administration for the Habitat Equivalency Analysis (NOAA 2009), the following equation could be used to calculate the habitat hectares necessary to offset the present loss of habitat function:

$$PV=FV(1+i)^n$$

where PV is present value, FV is future value, i is the discount rate and n is the number of habitat function years lost

This equation indicates that biodiversity offsets that will deliver 1.43 habitat hectares in 50 years time will deliver 0.33 habitat hectares ‘now’ (i.e. enough to offset the 0.33 habitat hectares lost through the project impacts with immediate effect). The opportunity exists to provide IN-KIND offsets equivalent to 1.2 habitat hectares and to provide OUT-OF-KIND offsets equal to 0.3 habitat hectares. Overall habitat hectares proposed for both in-kind and out-of-kind offsets is 1.5 habitat hectares, which slightly exceeds the total required when taking into account the temporal loss equation. The present assumption that a 50 year period is appropriate may be reappraised as the offset project progresses, and more detailed information becomes available regarding the species to be planted.

Table 9: Summary of biodiversity offset quantification for entire project

Habitat type	Actual project area	DIRECT IMPACT	Pre-project habitat hectares	Post-project habitat hectares	Habitat hectares lost	Habitat hectares gained
Mixed coniferous forest / meadow	0.8 hectares	0.8 hectares	0.452	0.372	0.08	0
Mixed coniferous forest / building sites	3.24 hectares	3.24 hectares	2.252	2.15	0.097	0.162
Mixed coniferous forest / open space	12 hectares	No impacts	9.3	10.02	0	0.72
Puget Sound nearshore / intertidal	1.6 hectares	No impacts	1.23	1.52	0	0.293
Marine riparian zone	0.9 hectares	0.9 hectares	0.292	0.307	0.0612	0.3339
Forested wetland	0.4 hectares	0.23 hectares	0.192	0.104	0.089	0
				Total in-kind habitat hectares		**1.216**
				Total out-of-kind habitat hectares		**0.293**
				Total habitat hectares	**0.327**	**1.509**

11. Offset Implementation

11.1 Implementation of residential development offsets

The biodiversity offsets proposed for the residential component would be funded and implemented by the residential property owners. Planting of native conifer species has been underway since late 2008 and will continue throughout construction of the project. Removal of invasive species can be completed by the owners, possibly in cooperation with local STAKEHOLDERS or volunteer groups. The developable property to be set aside is governed by an Open Space Management Plan, a recorded legal document preventing further development without modification to the development permit. More permanent protection of the undeveloped land may be explored with the local land trust, through permanent conservation EASEMENTS or other such mechanisms.

11.2 Implementation of infrastructure project offsets

Implementation of the road infrastructure project is subject to public funding and priorities. The City of Bainbridge Island Capital Facilities Plan lists funding for a feasibility study for the project in 2011 – 2012. Once a feasibility study is complete, design and permitting of the project can commence. Construction of the new road alignment and shoreline restoration will be completed by the City.

12. Applying the BBOP Principles

The biodiversity offsets for the Bainbridge Island project are designed such that the outcomes will be consistent with the BBOP PRINCIPLES, as noted below.

1. **No net loss.** The offsets are designed to incorporate the concept of ADDITIONALITY in order to achieve NO NET LOSS and possibly a GAIN of biodiversity within the project area. All of the terrestrial impacts are to be offset IN-KIND. A small area of wetland impact will be offset by restoration of a much larger area of higher priority nearshore habitat with the expected result of improved habitat for endangered salmon species.

2. **Additional conservation outcomes.** Additional CONSERVATION OUTCOMES are incorporated into the offset scheme. The shoreline restoration that is planned will result in additional habitat hectares gained in the overall project, compared to the losses that are anticipated. Additional outcomes include improving the woodland surrounding the residential homes by removing invasive alien species and planting native species and also removing armouring thereby improving salmon habitat in the nearshore and marine riparian zone. Additionality may also be incorporated through AVERTED RISK in preserving developable land.

3. **Adherence to the mitigation hierarchy.** Design of the residential project incorporated the MITIGATION HIERARCHY. All critical areas, including wetlands, streams and steep slopes were avoided and preserved, the home sites are clustered to minimise clearing area and infrastructure needs. Native vegetation is being planted in all disturbed areas to stabilise slopes and minimise soil erosion. The mitigation hierarchy will be considered during a feasibility study for the infrastructure project.

4. **Limits to what can be offset.** The project does not impact species of flora or fauna that are irreplaceable or that are ENDEMIC to the area.

5. **Landscape context.** The offset in the nearshore and marine riparian zone is proposed based on knowledge of local and regional conservation priorities. Nearshore habitat is highly impacted in the Puget Sound Region and is widely recognised as a high priority for restoration to improve habitat for a number of listed marine species, including Chinook salmon and Orca whales. The terrestrial offset is planned on-site to preserve what has been identified on local maps as one of the last largely intact privately owned tracts of forest land on the island.

6. **Stakeholder participation.** Stakeholder PARTICIPATION is required through all phases of the land use development permitting process for both private and public projects in Washington State. BBOP advisory network experts as well as local forestry, shoreline and wetland scientists were consulted during the selection of BENCHMARK ATTRIBUTES and design of the offsets. Further stakeholder participation will be invited through the standard public process as the ALTERNATIVES and design for the road infrastructure and offsets are considered by local, state and federal permitting agencies.

7. **Equity.** Equity will be considered through the design and implementation of the proposed offsets. Provisions are being considered to include public access and use of the shoreline offset area once

restoration has occurred. Concerns of nearby property owners and users of the resources affected will be taken into account.

8. **Long-term outcomes.** Long-term success of the proposed offsets will be determined by the implementation plan and by the methods used to monitor and finance long-term management of the offset sites.

9. **Transparency.** Transparency is expected throughout any private or public permit process for projects such as this one. All environmental information on the project is available for public review through the city government. Decisions on offset design for the infrastructure project will involve extensive stakeholder notification and participation.

10. **Science and traditional knowledge.** The biodiversity offsets designed for this case study are based on science recommended by the BBOP Offset Design Handbook, as well as local methods, including methods developed by the City of Bainbridge Island and the Washington State Department of Ecology.

13. Next Steps

Implementation of the proposed offsets for the residential project will occur as site development progresses. Removal of non-native species and interplanting with mid-successional coniferous species will coincide with other planned site improvements. In order to ensure long-term preservation of the offset areas, further exploration of conservation easements as well as funding mechanisms for management of the land could occur in cooperation with the local land trust.

Implementation of the offset for the road project is dependent on budget priorities and potential for grant funding. The next steps include exploring grant opportunities to assist with a feasibility and design phase for the project. A feasibility study will include an analysis of geotechnical and other constraints that will determine which road alignment alternatives may be considered. Design of the roadway and the offset will follow. An implementation and long-term monitoring plan for the OFFSET ACTIVITIES should be developed once the design of the project is finalised.

14. Conclusions and Lessons Learned

14.1 Implementation of offset methodology

The offset calculation methodology used for this pilot project was developed from BBOP's adaptation of the habitat hectares methodology from Victoria, Australia. Sufficient data existed on Pacific Northwest forests to determine the appropriate ATTRIBUTES and scoring system to modify the Australian system for the local forest ECOSYSTEM. The wetland assessment methodology was based on an existing Western Washington wetland rating system. Although the attributes chosen for the wetland assessment were drawn from this document, the scoring system was modified to more closely match the HABITAT HECTARES model. Further work is likely needed to refine this methodology for wetland assessment. An extensive methodology development and data collection process was completed in 2003 for nearshore habitat on Bainbridge Island. This methodology was incorporated directly into the scoring system to calculate offset impacts. Further discussion is also warranted to determine whether this methodology has been adapted appropriately from the habitat hectares model. Further assessment and development of TIME DISCOUNTING aspects will also be necessary when considering the 60 – 80 years necessary for trees to mature and to re-establish the habitat of the Pacific Northwest forest system.

14.2 Key conclusions

This case study has provided a detailed description of the process to develop the first biodiversity offset pilot project using the BBOP Offset Design Handbook in the context of US residential and infrastructure construction. This pilot demonstrates that biodiversity offset projects with relatively small impacts can be developed using the BBOP methods. The process has been complex in that the methodology was still under development while this project was being developed. Subsequent projects should be able to build on the structure used to design this project. The implementation of this pilot project is further complicated by changing budgetary and capital facilities priorities that affect the timeline of the publicly funded components of the proposal. As the public infrastructure aspect of this project has not yet completed a feasibility study and actual impacts will not occur for some time, this case study has been able to address conceptual impacts and offsets only.

Until the biodiversity offsets discussed in this case study are implemented and then monitored over the long term it will be impossible to assess whether the goal of 'no net loss' of biodiversity has been achieved. However, it is clear that biodiversity offsets, if planned and implemented carefully, can result in CONSERVATION GAINS above and beyond those required by regulations.

14.3 Recommendations for further applications of biodiversity offsets in the property development sector

A clear framework for implementation of biodiversity offset projects needs to be established by local jurisdictions, to include well-defined methodologies, policy motivations for participation, clear guidelines and expectations for implementation, and guidance for long-term preservation of offsets. This could be achieved by:

- Simplifying the methodology to assess biodiversity impacts and offsets in order to encourage broader application for smaller scale projects.
- Local land use planning agencies providing policy incentives as a motivation for development projects to consider biodiversity offsets.
- The use of habitat banks managed by private companies or public LAND TRUSTS to potentially facilitate the implementation of biodiversity offsets and ensure the long-term success of habitat preservation.

The City of Bainbridge Island Department of Planning and Community Development continues to explore opportunities to encourage developers to implement biodiversity offsets. Various policy incentives have been considered including expedited permitting, waiving development standards, and allowing density bonuses for residential or commercial developments that propose offsets beyond those already required by federal, state or local regulation. An innovative regulation is in the process of being developed to provide flexible development standards for residential developments that offset their biodiversity impacts. The regulation is scheduled for adoption by the City of Bainbridge Island in early 2009.

The Cascadia Green Building Council has proposed the Living Building Challenge **www.cascadiagbc.org/lbc/living-site-1.0.pdf** with a certification system for sustainable building and site design that includes a requirement to offset habitat impacts. It may be possible to explore further application of the biodiversity offsets in collaboration with this effort. However, a simplified version of the BBOP methodology should be made available if is to be widely adopted for assessing biodiversity offsets in urban development projects of the scale addressed by the City of Bainbridge Island or by the Living Building Challenge. Local jurisdictions may also need to consider setting the framework for implementation of the offsets by creating opportunities for purchase of credits from established habitat banks.

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Appendix A – Assessment Methodologies

Review of attributes for terrestrial / forest habitat

The basis for selecting attributes to measure the losses and gains in the Pacific Northwest forested ecosystem was developed from BBOP's adaptation of the habitat hectares method from Victoria, Australia. This was modified to incorporate data collected from research on the ecology of old-growth forests in the region, including *Ecological Characteristics of Old-Growth Douglas Fir Forests* (Franklin *et al*. 1981) and *Interim Definitions for Old Growth Douglas Fir and Mixed-Conifer Forests in the Pacific Northwest and California* (Franklin 1986).

Large trees. Old growth Douglas fir forests support large trees of at least 32 inches diameter at breast height (d.b.h). Large Douglas fir trees provide habitat for specialised vertebrates as well as for nitrogen-fixing lichens (Franklin *et al*. 1981).

Tree canopy cover. A deep, multi-layered canopy is an attribute of old-growth forest stands. Tree canopy is defined as those tree species in the uppermost stratum of woody vegetation reaching greater than 80% of mature height. This attribute is adapted from the habitat hectares approach.

Lack of weeds. Weeds include all introduced and non-native species. The presence of weeds compromises the health and integrity of the native vegetation. This attribute is also adapted from the habitat hectares manual (Parkes *et al*. 2003).

Understory life forms. This attribute is also adapted from the habitat hectares manual. Greater variety of understory species contributes to more varied habitat and greater biodiversity.

Snags. Large snags, or standing dead trees, are a product of mature forests. Snags are valuable habitat for wildlife, especially insects and cavity-nesting birds. Snags measured for this process are greater than 20 inches in diameter and greater than 15 feet in height (Franklin and Spies 1986).

Logs. Down dead trees and coarse woody debris decay slowly and are an important source of nutrients in the forest. Logs provide a variety of habitat functions, provide pathways along which small animals can travel and distribute seeds and fungal spores throughout the forest. Logs also serve as sites for reproduction of new tree seedlings. Large logs are greater than 24 inches in diameter and greater than or equal to 50 feet long (Franklin and Spies 1986)

Patch size. Patch size is an attribute adapted from the habitat hectares manual (Parkes *et al*. 2003). Larger patch size supports a healthier forest with less edge disturbance, and therefore greater biodiversity functions.

Connectivity. HABITAT CONNECTIVITY within a LANDSCAPE provides migratory corridors for wildlife and is important for maintaining regional population dynamics that are essential for the long-term viability of local wildlife populations.

Each BENCHMARK ATTRIBUTE was assigned a WEIGHTING factor in order to create a scoring system consistent with the habitat hectares method. The weightings of the attributes are shown below.

Forest benchmark attribute weightings

Attribute type	Benchmark attribute	Weighting
Structural	Large trees	20
	Tree canopy cover	5
	Lack of weeds	10
	Understory life forms	10
	Snags	20
	Logs	20
Landscape context	Patch size	10
	Connectivity	5

Review of attributes for marine riparian habitats

Benchmark attributes for marine riparian habitats were similar to the forest attributes described above.

Large trees. Old growth Douglas fir forests support large trees of at least 32 inches d.b.h. Large Douglas fir trees provide habitat for specialised vertebrates as well as for nitrogen-fixing lichens (Franklin *et al*. 1981).

Tree canopy cover. A deep, multi-layered canopy is an attribute of old-growth forest stands. Tree canopy is defined as those tree species in the uppermost stratum of woody vegetation reaching greater than 80% of mature height. This attribute is adapted from the habitat hectares approach.

Overhanging vegetation. Overhanging vegetation provides important habitat and structural functions in the marine riparian zone, stabilising banks, providing shade over the water, and serving as habitat for terrestrial insects that are an important prey source for juvenile salmonids.

Understory life forms. This attribute is also adapted from the habitat hectares manual (Parkes *et al*. 2003). Greater variety of understory species contributes to more varied habitat and greater biodiversity.

Snags. Large snags, or standing dead trees, are a product of mature forests. Snags are valuable habitat for wildlife, especially insects and cavity-nesting birds. Snags measured for this process are greater than 20 inches in diameter and greater than 15 feet in height (Franklin and Spies 1986).

Logs. Down dead trees and coarse woody debris decay slowly and are an important source of nutrients in the forest. Logs provide a variety of habitat functions, provide pathways along which small animals can travel and distribute seeds and fungal spores throughout the forest. Logs also serve as sites for reproduction of new tree seedlings. Large logs are greater than 24 inches in diameter and greater than or equal to 50 feet long (Franklin and Spies 1986).

Large woody debris. Large woody debris, for example, downed trees, logs, or root wads, are an important structural component in the marine riparian zone, providing habitat for feeding, refuge and reproduction for aquatic invertebrates, and refuge for fishes. Large woody debris also traps and stabilises sediments and influences sediment transport along beaches.

Corridor width. The width of the intact riparian corridor significantly influences its ability to provide adequate functions such as absorbing and filtering stormwater runoff and capturing pollutants that would otherwise be directed toward marine waters.

Each benchmark attribute was assigned a weighting in order to create a scoring system consistent with the habitat hectares method. The weightings of the attributes are summarised below.

Marine riparian benchmark attribute weightings

Attribute type	Benchmark attribute	Weighting
Structural	Large trees	20
	Tree canopy cover	5
	Overhanging vegetation	10
	Understory life forms	10
	Snags	10
	Logs	5
	Large woody debris	20
Landscape context	Corridor width	20

Review of attributes for shoreline habitat

The shoreline assessment method recommended for this pilot project and others on Bainbridge Island is based on a model developed to predict or understand natural and human-caused factors that affect the physical, biological and chemical attributes of nearshore marine habitats (Williams and Thom 2001). This model differs from the HABITAT HECTARES method, which uses BIOTIC attributes. Rather, this model assumes that anthropogenic modifications will affect an ecosystem's controlling factors, the physical processes or environmental conditions that control local HABITAT STRUCTURE and composition (e.g., vegetation, substrate), which is linked to support processes, such as shading or cover, which are in turn linked to ecological functions. Thus, impacts that affect controlling factors within an ECOSYSTEM will be reflected in changes to habitat structure, and will ultimately be manifested as changes to functions supported by the habitat (Williams and Thom 2001).

Conceptual nearshore model linking impacts to ecological functions (Williams and Thom 2001)

List of major habitat controlling factors, HABITAT STRUCTURES and functions (Williams and Thom 2001)

Controlling factors	Habitat structure	Habitat functions	Ecological functions
Depth	Density	Production	Disturbance regulation
Substrata	Biomass	Sediment flux	Prey production
Slope	Individual lengths	Nutrient flux	Reproduction
Light	Diversity	Carbon flux	Refuge
Wave energy	Patch size		Carbon Sequestration
Hydrology	Patch shape		Maintenance of biodiversity
Temperature	Landscape position		
Salinity			
Nutrients			
Water quality			

Wave energy. Wave energy refers to the reflective energy of waves, which increases depending on the composition, encroachment and vertical design of shoreline armouring structures such as bulkheads or revetments.

Light regime (loss of natural shade). Light regime or loss of natural shade measures the loss of shading from overhanging vegetation in riparian zones. Shading affects temperature and desiccation rates.

Light regime (artificial shade). Light regime with respect to artificial shade measures the shade caused by piers, docks, and other anthropogenic overwater structures. The availability of light for aquatic vegetation can be reduced by shoreline structures.

Sediment supply. Sediment supply is defined as the abundance of sediment within a reach and is affected by shoreline armouring, groins, or other stabilisation structures in the reach.

Substrate type. This attribute describes the direct modification or replacement of natural substrates with other structural materials, such as concrete, rip-rap or pilings.

Depth / slope. Depth or slope refers to the change of natural beach slope bottom depth or intertidal zone area that affects native vegetation.

Pollution (toxics, nutrients). Pollution includes toxic contaminants, faecal coliform bacteria, excessive nutrients, and altered salinity and temperature regimes.

Hydrology. This attribute refers to tidal inundation regimes or patterns of groundwater and surface water flow and how they are impacted by armouring structures.

Physical disturbance. Physical disturbance can include various recurring disturbances such as grounding of floating docks, mooring buoys and other physical disturbances such as light and noise that may impact habitat functions such as feeding, roosting, breading and rearing young.

The scoring system developed for the Bainbridge Island Nearshore Habitat Characterization and Assessment, Management Strategy Prioritization and Monitoring Recommendations (Nearshore Assessment) (Williams and Thom 2001) was modified slightly for use in the habitat hectares loss/gain calculation. For more detail on the methodology and scoring system, please refer to the full report at: **www.ci.bainbridge-isl.wa.us/nearshore_assessment.aspx**.

Review of attributes for wetland habitats

The wetland assessment methodology used for this case study is based on the existing Western Washington Wetland Rating System (Hruby 2004). The attributes chosen for the wetland assessment were drawn from the habitat functions section of the Western Washington Wetland Rating System, although the attributes were limited to five, whereas the original rating system requires measurement of nine attributes. The scoring system was also modified to more closely match the habitat hectares approach (Oliver and Parkes 2003).

Vegetation structure. This attribute analyses the number of vegetation classes present in the wetland, e.g., aquatic bed, emergent plants, scrub / shrub, forested.

Hydroperiods. This attribute measures the number of water regimes or hydroperiods present within the wetland, whether the wetland is permanently or seasonally flooded, or saturated only.

Richness of plant species. The number of plant species found in the wetland is measured through this attribute.

Special habitat features. Special habitat features contribute to the potential for the wetland to support biodiversity and include large, downed, woody debris, standing snags, undercut banks, thin-stemmed, and persistent vegetation. This attribute also includes a measurement of invasive species persistence in the wetland.

Corridors and connections. The location of the wetland within a greater LANDSCAPE CONTEXT is measured by this attribute. A high score for this attribute indicates that the wetland is part of a relatively undisturbed vegetated corridor with connections to estuaries, other wetlands or undisturbed wetlands.

Each benchmark attribute was assigned a weighting in order to create a scoring system consistent with the habitat hectares approach. The weightings of the attributes are shown below.

Wetland benchmark attribute weightings

Attribute type	Benchmark attribute	Weighting
Structural	Vegetation structure	20
	Hydroperiods	20
	Richness of plant species	25
	Special habitat features	10
Landscape context	Corridors and connections	25

Appendix B – Field Worksheets

Field studies were undertaken using *Field Assessment Sheets* (Pacific Northwest Forest 2007 and 2008); completed worksheets are reproduced below.

Assessment Sheet: Grand Forest Benchmark

Site Name/No.: Upper Blakely Pilot Project Location: Grand Forest Benchmark Date: October 2008

Assessor(s): Marja Preston Map Name/No. .....

'Site Condition Score'

Large Trees *Score*: 20

Category & Description	*% Canopy Health**		
	> 70%	*30-70%*	*< 30%*
None present	0	0	0
> 0 to 2 large trees/ha	13	12	11
> 2-4 large trees/ha	14	13	12
> 4-6 large trees/ha	16	15	14
> 6-8 large trees/ha	18	17	16
≥ the 8 large trees/ha	20	19	18

Large trees are defined as 32" diameter at breast height (dbh)[1]
* Estimate proportion of an expected healthy canopy cover that is present

Tree Canopy Cover *Score*: 5

Category & Description	*% Canopy Health **		
	> 70%	*30-70%*	*< 30%*
< 10% of benchmark cover	0	0	0
< 50% or > 150% of benchmark cover	3	2	1
≥ 50% or ≤ 150% of benchmark cover	5	4	3

Tree canopy is defined as those canopy tree species reaching ≥ 80% of mature height.

Lack of Weeds *Score*: 10

Category & Description	*'high threat' weeds**		
	None	*≤ 50%*	*> 50%*
> 50% cover of weeds	0	0	1
25 - 50% cover of weeds	2	3	4
5 - 25% cover of weeds	5	9	7
< 5% cover of weeds**	10	9	8

* proportion of weed cover due to 'high threat' weeds, e.g., English Ivy, Japanese knotweed, etc.

'High threat' weed species are defined as those introduced species (including non-indigenous 'natives') with the ability to out-compete and substantially reduce one or more indigenous life forms in the longer term assuming on-going current site characteristics and disturbance regime.

[1] Franklin, *et al.*, Ecological Growth Characteristics of Old-Growth Douglas Fir Forests. US Department of Agriculture, 1981.

Understorey Life forms

Species	# spp observed / Benchmark spp.	% cover observed / Benchmark % cover	Present (✔)	Modified (✔)
Douglas fir	/	/		
Western red cedar	/	/		
Western hemlock	/	/		
Indian plum	/	1%/		
Evergreen huckleberry	/	5%/		
Swordfern	/	100%/		
Salal	/	5%/		
Red huckleberry	/	1%/		
Oregon grape	/	1%/		
Red Elderberry	/	1%/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		

Present

For life forms with benchmark cover of < 10%, considered 'present' if
- any specimens are observed.

For life forms with benchmark cover of ≥ 10%, considered 'present' if
- the life form occupies at least 10% of benchmark cover.

Modified (apply only where life form is 'present')

For life forms with benchmark cover of <10%, then considered substantially 'modified' if the life form has either:
- < 50% of the benchmark species diversity; or
- no reproductively-mature specimens are observed.

For life forms with benchmark cover of ≥ 10%, then considered substantially 'modified' if the life form has either:
- < 50% of benchmark cover; or
- < 50% of benchmark species diversity; or
- ≥ 50% of benchmark cover due largely to immature canopy specimens but the cover of reproductively-mature specimens is < 10% of the benchmark cover.

Understorey *Score*: 10

Category & Description		
All strata and Life forms effectively absent		0
Up to 50% of life forms present		5
≥ 50% to 90% of Life forms present	• of those present, ≥ 50% substantially modified	6
	• of those present, < 50% substantially modified	7
≥ 90% of Life forms present	• of those present, ≥ 50% substantially modified	8
	• of those present, < 50% substantially modified	9
	• of those present, none substantially modified	10

Assessment Sheet: Grand Forest Benchmark [continued]

Snags *Score*: 20

Category & Description	Snags present
< 10% of benchmark per hectare	0
10-50% of benchmark per hectare	10
≥ 50% of benchmark per hectare	20

*Snags are defined as standing dead trees greater than 20-inch dbh and greater than 65 feet in height
**This benchmark site had 2 snags over 65' in height per hectare

Logs *Score*: 20

Category & Description	Large logs present*
< 10% of benchmark length	0
< 50% of benchmark length	10
≥ 50% of benchmark length	20

Large logs defined as those with diameter ≥ 0.5 of benchmark large tree dbh.
* present if large log length is ≥ 25% of EVC benchmark log length.
# absent if large log length is < 25% of EVC benchmark log length.
** This benchmark site has 4 large logs per hectare

---------- 'Landscape Context Score' ----------

Patch Size *Score*: 10

Category & Description	
< 20 ha	1
Between 20 and 40 ha	2
Between 40 and 60 ha	4
Between 60 and 80 ha	6
≥ 80 ha, but 'significantly disturbed'*	8
≥ 80 ha, but not 'significantly disturbed'*	10

Connectivity* *Score*: 4

Length of Corridor	Corridor not significantly disturbed*	Corridor significantly disturbed*
2 km	0	0
2-5 km	2	1
5-10 km	4	3
>10 km	5	4

* Is the site part of a relatively undisturbed vegetated corridor?

Final Habitat Score

	'Site Condition Score'						'Landscape Context Score'		
Component	Large Trees	Tree Canopy Cover	Lack of Weeds	Understorey	Snags	Logs	Patch Size	Connectivity	Total
									100
Score	20	5	10	10	20	20	10	4	99

Assessment Sheet: Meadow 1 (Pre-project)

Site Name/No.: Upper Blakely Pilot Project Location: Meadow 1 (center of Meadow) Date: June 15, 2007

Assessor(s): Marja Preston, Scott Shelton Map Name/No. .....

'Site Condition Score'

Large Trees *Score*: 12

Category & Description	*% Canopy Health**		
	> 70%	*30-70%*	*< 30%*
None present	0	0	0
> 0 to 2 large trees/ha	13	12	11
> 2-4 large trees/ha	14	13	12
> 4-6 large trees/ha	16	15	14
> 6-8 large trees/ha	18	17	16
≥ the 8 large trees/ha	20	19	18

Large trees are defined as 32" diameter at breast height (dbh)[1]
* Estimate proportion of an expected healthy canopy cover that is present

Tree Canopy Cover *Score*: 5

Category & Description	*% Canopy Health **		
	> 70%	*30-70%*	*< 30%*
< 10% of benchmark cover	0	0	0
< 50% or > 150% of benchmark cover	3	2	1
≥ 50% or ≤ 150% of benchmark cover	5	4	3

Tree canopy is defined as those canopy tree species reaching ≥ 80% of mature height.

Lack of Weeds *Score*: 10

Category & Description	*'high threat' weeds**		
	None	*≤ 50%*	*> 50%*
> 50% cover of weeds	0	0	1
25 - 50% cover of weeds	2	3	4
5 - 25% cover of weeds	5	9	7
< 5% cover of weeds**	10	9	8

* proportion of weed cover due to 'high threat' weeds, e.g., English Ivy, Japanese knotweed, etc.

'High threat' weed species are defined as those introduced species (including non-indigenous 'natives') with the ability to out-compete and substantially reduce one or more indigenous life forms in the longer term assuming on-going current site characteristics and disturbance regime.

[1] Franklin, *et al.*, Ecological Growth Characteristics of Old-Growth Douglas Fir Forests. US Department of Agriculture, 1981.

Understorey Life forms

Species	# spp observed / Benchmark spp.	% cover observed / Benchmark % cover	Present (✓)	Modified (✓)
Douglas fir	/	/		
Western hemlock	/	/		
Western red cedar	/	/		
White fir	/	/		
Big leaf maple	/	/		
Red alder	/	/		
Salmonberry	/	50%/0%	X	
Swordfern	/	40%/100%		X
Red huckleberry	/	1%/1%	X	
Nettle	/	1%/0%	X	
Bracken fern	/	1%/0%	X	
Oceanspray	/	1%/0%	X	
Salal	/	1%/5%		X
	/	/		
	/	/		
	/	/		

Present

For life forms with benchmark cover of < 10%, considered 'present' if
- any specimens are observed.

For life forms with benchmark cover of ≥ 10%, considered 'present' if
- the life form occupies at least 10% of benchmark cover.

Modified (apply only where life form is 'present')

For life forms with benchmark cover of <10%, then considered substantially 'modified' if the life form has either:
- < 50% of the benchmark species diversity; or
- no reproductively-mature specimens are observed.

For life forms with benchmark cover of ≥ 10%, then considered substantially 'modified' if the life form has either:
- < 50% of benchmark cover; or
- < 50% of benchmark species diversity; or
- ≥ 50% of benchmark cover due largely to immature canopy specimens but the cover of reproductively-mature specimens is < 10% of the benchmark cover.

Understorey *Score*: 9

Category & Description		
All strata and Life forms effectively absent		0
Up to 50% of life forms present		5
≥ 50% to 90% of Life forms present	• of those present, ≥ 50% substantially modified	6
	• of those present, < 50% substantially modified	7
≥ 90% of Life forms present	• of those present, ≥ 50% substantially modified	8
	• of those present, < 50% substantially modified	9
	• of those present, none substantially modified	10

Assessment Sheet: Meadow 1 (Pre-project) [continued]

Snags *Score*: 10

Category & Description	Snags present
< 10% of benchmark per hectare	0
10-50% of benchmark per hectare	10
≥ 50% of benchmark per hectare	20

Snags are defined as standing dead trees greater than 20-inch dbh and greater than 65 feet in height

Logs *Score*: 0

Category & Description	Large logs present*
< 10% of benchmark length	0
< 50% of benchmark length	10
≥ 50% of benchmark length	20

Large logs defined as those with diameter ≥ 0.5 of benchmark large tree dbh.
* present if large log length is ≥ 25% of EVC benchmark log length.
# absent if large log length is < 25% of EVC benchmark log length.

---------- 'Landscape Context Score' ----------

Patch Size *Score*: 10

Category & Description	
< 20 ha	1
Between 20 and 40 ha	2
Between 40 and 60 ha	4
Between 60 and 80 ha	6
≥ 80 ha, but 'significantly disturbed'*	8
≥ 80 ha, but not 'significantly disturbed'*	10

Connectivity* *Score*: 1

Length of Corridor	Corridor not significantly disturbed*	Corridor significantly disturbed*
2 km	0	0
2-5 km	2	1
5-10 km	4	3
>10 km	5	4

* Is the site part of a relatively undisturbed vegetated corridor?

Final Habitat Score

	'Site Condition Score'						'Landscape Context Score'		
Component	Large Trees	Tree Canopy Cover	Lack of Weeds	Understorey	Snags	Logs	Patch Size	Connectivity	Total
									100
Score	12	5	10	9	10	0	10	1	57

Assessment Sheet: Meadow 1 (Post-project)

Site Name/No.: Upper Blakely Pilot Project Location: Meadow 1 (center of Meadow) Date: October 2008

Assessor(s): Marja Preston, Scott Shelton Map Name/No. .....

'Site Condition Score'

Large Trees *Score*: 11

Category & Description	*% Canopy Health**		
	> 70%	*30-70%*	*< 30%*
None present	0	0	0
> 0 to 2 large trees/ha	13	12	11
> 2-4 large trees/ha	14	13	12
> 4-6 large trees/ha	16	15	14
> 6-8 large trees/ha	18	17	16
≥ the 8 large trees/ha	20	19	18

Large trees are defined as 32" diameter at breast height (dbh)[1]
* Estimate proportion of an expected healthy canopy cover that is present

Tree Canopy Cover *Score*: 0

Category & Description	*% Canopy Health *		
	> 70%	*30-70%*	*< 30%*
< 10% of benchmark cover	0	0	0
< 50% or > 150% of benchmark cover	3	2	1
≥ 50% or ≤ 150% of benchmark cover	5	4	3

Tree canopy is defined as those canopy tree species reaching ≥ 80% of mature height.

Lack of Weeds *Score*: 10

Category & Description	*'high threat' weeds**		
	None	*≤ 50%*	*> 50%*
> 50% cover of weeds	0	0	1
25 - 50% cover of weeds	2	3	4
5 - 25% cover of weeds	5	9	7
< 5% cover of weeds**	10	9	8

* proportion of weed cover due to 'high threat' weeds, e.g., English Ivy, Japanese knotweed, etc.

'High threat' weed species are defined as those introduced species (including non-indigenous 'natives') with the ability to out-compete and substantially reduce one or more indigenous life forms in the longer term assuming on-going current site characteristics and disturbance regime.

[1] Franklin, *et al.*, Ecological Growth Characteristics of Old-Growth Douglas Fir Forests. US Department of Agriculture, 1981.

Understorey Life forms

Species	# spp observed / Benchmark spp.	% cover observed / Benchmark % cover	Present (✓)	Modified (✓)
Douglas fir	/	/		
Western red cedar	/	/		
Indian plum	/	3%/1%	X	
Red elderberry	/	2%/1%	X	
Pacific ninebark	/	1%/0%	X	
Red huckleberry	/	3%/1%	X	
Evergreen huckleberry	/	1%/5%		X
Sword fern	/	5%/100%		X
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		

Present	For life forms with benchmark cover of < 10%, considered 'present' if • any specimens are observed. For life forms with benchmark cover of ≥ 10%, considered 'present' if • the life form occupies at least 10% of benchmark cover.
Modified (apply only where life form is 'present')	For life forms with benchmark cover of <10%, then considered substantially 'modified' if the life form has either: • < 50% of the benchmark species diversity; or • no reproductively-mature specimens are observed. For life forms with benchmark cover of ≥ 10%, then considered substantially 'modified' if the life form has either: • < 50% of benchmark cover; or • < 50% of benchmark species diversity; or • ≥ 50% of benchmark cover due largely to immature canopy specimens but the cover of reproductively-mature specimens is < 10% of the benchmark cover.

Understorey *Score*: 7

Category & Description		
All strata and Life forms effectively absent		0
Up to 50% of life forms present		5
≥ 50% to 90% of Life forms present	• of those present, ≥ 50% substantially modified	6
	• of those present, < 50% substantially modified	7
≥ 90% of Life forms present	• of those present, ≥ 50% substantially modified	8
	• of those present, < 50% substantially modified	9
	• of those present, none substantially modified	10

Assessment Sheet: Meadow 1 (Post-project) [continued]

Snags *Score*: 10

Category & Description	Snags present
< 10% of benchmark per hectare	0
10-50% of benchmark per hectare	10
≥ 50% of benchmark per hectare	20

Snags are defined as standing dead trees greater than 20-inch dbh and greater than 65 feet in height

Logs *Score*: 0

Category & Description	Large logs present*
< 10% of benchmark length	0
< 50% of benchmark length	10
≥ 50% of benchmark length	20

Large logs defined as those with diameter ≥ 0.5 of benchmark large tree dbh.
* present if large log length is ≥ 25% of EVC benchmark log length.
# absent if large log length is < 25% of EVC benchmark log length.

---------- 'Landscape Context Score' ----------

Patch Size *Score*: 8

Category & Description	
< 20 ha	1
Between 20 and 40 ha	2
Between 40 and 60 ha	4
Between 60 and 80 ha	6
≥ 80 ha, but 'significantly disturbed'*	8
≥ 80 ha, but not 'significantly disturbed'*	10

Connectivity* *Score*: 1

Length of Corridor	Corridor not significantly disturbed*	Corridor significantly disturbed*
2 km	0	0
2-5 km	2	1
5-10 km	4	3
>10 km	5	4

Is the site part of a relatively undisturbed vegetated corridor?

Final Habitat Score

	'Site Condition Score'						'Landscape Context Score'		
Component	Large Trees	Tree Canopy Cover	Lack of Weeds	Understorey	Snags	Logs	Patch Size	Connectivity	Total
									100
Score	11	0	10	7	10	0	8	1	47

Assessment Sheet: Building Sites (Pre-project)

Site Name/No.: Upper Blakely Pilot Project Location: Building Sites Date: June 15, 2007

Assessor(s): Marja Preston, Scott Shelton Map Name/No. .....

'Site Condition Score'

Large Trees *Score*: 11

Category & Description	*% Canopy Health**		
	> 70%	*30-70%*	*< 30%*
None present	0	0	0
> 0 to 2 large trees/ha	13	12	**11**
> 2-4 large trees/ha	14	13	12
> 4-6 large trees/ha	16	15	14
> 6-8 large trees/ha	18	17	16
≥ the 8 large trees/ha	20	19	18

Large trees are defined as 32" diameter at breast height (dbh)[1]
* Estimate proportion of an expected healthy canopy cover that is present

Tree Canopy Cover *Score*: 4

Category & Description	*% Canopy Health **		
	> 70%	*30-70%*	*< 30%*
< 10% of benchmark cover	0	0	0
< 50% or > 150% of benchmark cover	3	2	1
≥ 50% or ≤ 150% of benchmark cover	5	**4**	3

Tree canopy is defined as those canopy tree species reaching ≥ 80% of mature height.

Lack of Weeds *Score*: 5

Category & Description	*'high threat' weeds**		
	None	*≤ 50%*	*> 50%*
> 50% cover of weeds	0	0	1
25 - 50% cover of weeds	2	3	4
5 - 25% cover of weeds	**5**	9	7
< 5% cover of weeds**	10	9	8

* proportion of weed cover due to 'high threat' weeds, e.g., English Ivy, Japanese knotweed, etc.

'High threat' weed species are defined as those introduced species (including non-indigenous 'natives') with the ability to out-compete and substantially reduce one or more indigenous life forms in the longer term assuming on-going current site characteristics and disturbance regime.

[1] Franklin, *et al.*, Ecological Growth Characteristics of Old-Growth Douglas Fir Forests. US Department of Agriculture, 1981.

Understorey Life forms

Species	# spp observed / Benchmark spp.	% cover observed / Benchmark % cover	Present (✔)	Modified (✔)
Douglas fir	/	5%/		
Western hemlock	/	5%/		
Big leaf maple	/	60%/		
White fir	/	1%/		
Grand fir	/	1%/		
Indian plum	/	30%/1%	X	
Oregon grape	/	70%/1%	X	
Scotch broom	/	5%/0%	X	
Sword fern	/	20%/100%		X
Nootka rose	/	2%/0%	X	
Bracken fern	/	1%/0%	X	
Nettle	/	1%/0%	X	
	/	/		
	/	/		
	/	/		
	/	/		

Present

For life forms with benchmark cover of < 10%, considered 'present' if
- any specimens are observed.

For life forms with benchmark cover of ≥ 10%, considered 'present' if
- the life form occupies at least 10% of benchmark cover.

Modified (apply only where life form is 'present')

For life forms with benchmark cover of <10%, then considered substantially 'modified' if the life form has either:
- < 50% of the benchmark species diversity; or
- no reproductively-mature specimens are observed.

For life forms with benchmark cover of ≥ 10%, then considered substantially 'modified' if the life form has either:
- < 50% of benchmark cover; or
- < 50% of benchmark species diversity; or
- ≥ 50% of benchmark cover due largely to immature canopy specimens but the cover of reproductively-mature specimens is < 10% of the benchmark cover.

Understorey *Score*: 9

Category & Description		
All strata and Life forms effectively absent		0
Up to 50% of life forms present		5
≥ 50% to 90% of Life forms present	• of those present, ≥ 50% substantially modified	6
	• of those present, < 50% substantially modified	7
≥ 90% of Life forms present	• of those present, ≥ 50% substantially modified	8
	• of those present, < 50% substantially modified	9
	• of those present, none substantially modified	10

Assessment Sheet: Building Sites (Pre-project) [continued]

Snags *Score*: 10

Category & Description	Snags present
< 10% of benchmark per hectare	0
10-50% of benchmark per hectare	10
≥ 50% of benchmark per hectare	20

Snags are defined as standing dead trees greater than 20-inch dbh and greater than 65 feet in height

Logs *Score*: 20

Category & Description	Large logs present*
< 10% of benchmark length	0
< 50% of benchmark length	10
≥ 50% of benchmark length	20

Large logs defined as those with diameter ≥ 0.5 of benchmark large tree dbh.
* present if large log length is ≥ 25% of EVC benchmark log length.
# absent if large log length is < 25% of EVC benchmark log length.

---------- 'Landscape Context Score' ----------

Patch Size *Score*: 10

Category & Description	
< 20 ha	1
Between 20 and 40 ha	2
Between 40 and 60 ha	4
Between 60 and 80 ha	6
≥ 80 ha, but 'significantly disturbed'*	8
≥ 80 ha, but not 'significantly disturbed'*	10

Connectivity* *Score*: 1

Length of Corridor	Corridor not significantly disturbed*	Corridor significantly disturbed*
2 km	0	0
2-5 km	2	1
5-10 km	4	3
>10 km	5	4

* Is the site part of a relatively undisturbed vegetated corridor?

Final Habitat Score

	'Site Condition Score'						'Landscape Context Score'		
Component	Large Trees	Tree Canopy Cover	Lack of Weeds	Understorey	Snags	Logs	Patch Size	Connectivity	Total
									100
Score	11	4	5	9	10	20	10	1	70

Assessment Sheet: Building Sites (Post-project)

Site Name/No.: Upper Blakely Pilot Project Location: Building Sites Date: October 2008

Assessor(s): Marja Preston, Scott Shelton Map Name/No. .....

'Site Condition Score'

Large Trees *Score*: 11

Category & Description	*% Canopy Health**		
	> 70%	*30-70%*	*< 30%*
None present	0	0	0
> 0 to 2 large trees/ha	13	12	11
> 2-4 large trees/ha	14	13	12
> 4-6 large trees/ha	16	15	14
> 6-8 large trees/ha	18	17	16
≥ the 8 large trees/ha	20	19	18

Large trees are defined as 32" diameter at breast height (dbh)[1]
* Estimate proportion of an expected healthy canopy cover that is present

Tree Canopy Cover *Score*: 2

Category & Description	*% Canopy Health **		
	> 70%	*30-70%*	*< 30%*
< 10% of benchmark cover	0	0	0
< 50% or > 150% of benchmark cover	3	2	1
≥ 50% or ≤ 150% of benchmark cover	5	4	3

Tree canopy is defined as those canopy tree species reaching ≥ 80% of mature height.

Lack of Weeds *Score*: 8

Category & Description	*'high threat' weeds**		
	None	*≤ 50%*	*> 50%*
> 50% cover of weeds	0	0	1
25 - 50% cover of weeds	2	3	4
5 - 25% cover of weeds	5	9	7
< 5% cover of weeds**	10	9	8

* proportion of weed cover due to 'high threat' weeds, e.g., English Ivy, Japanese knotweed, etc.

'High threat' weed species are defined as those introduced species (including non-indigenous 'natives') with the ability to out-compete and substantially reduce one or more indigenous life forms in the longer term assuming on-going current site characteristics and disturbance regime.

[1] Franklin, *et al.*, Ecological Growth Characteristics of Old-Growth Douglas Fir Forests. US Department of Agriculture, 1981.

Understorey Life forms

Species	# spp observed / Benchmark spp.	% cover observed / Benchmark % cover	Present (✔)	Modified (✔)
Indian plum	/	20%/1%	X	
Oregon grape	/	30%/1%	X	
Evergreen huckleberry	/	5%/5%	X	
Sword fern	/	30%/100%		X
Salal	/	10%/5%	x	
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		

Present	For life forms with benchmark cover of < 10%, considered 'present' if • any specimens are observed. For life forms with benchmark cover of ≥ 10%, considered 'present' if • the life form occupies at least 10% of benchmark cover.
Modified (apply only where life form is 'present')	For life forms with benchmark cover of <10%, then considered substantially 'modified' if the life form has either: • < 50% of the benchmark species diversity; or • no reproductively-mature specimens are observed. For life forms with benchmark cover of ≥ 10%, then considered substantially 'modified' if the life form has either: • < 50% of benchmark cover; or • < 50% of benchmark species diversity; or • ≥ 50% of benchmark cover due largely to immature canopy specimens but the cover of reproductively-mature specimens is < 10% of the benchmark cover.

Understorey *Score*: 7

Category & Description		
All strata and Life forms effectively absent		0
Up to 50% of life forms present		5
≥ 50% to 90% of Life forms present	• of those present, ≥ 50% substantially modified	6
	• of those present, < 50% substantially modified	7
≥ 90% of Life forms present	• of those present, ≥ 50% substantially modified	8
	• of those present, < 50% substantially modified	9
	• of those present, none substantially modified	10

Assessment Sheet: Building Sites (Post-project) [continued]

Snags *Score*: 10

Category & Description	Snags present
< 10% of benchmark per hectare	0
10-50% of benchmark per hectare	10
≥ 50% of benchmark per hectare	20

Snags are defined as standing dead trees greater than 20-inch dbh and greater than 65 feet in height

Logs *Score*: 20

Category & Description	Large logs present*
< 10% of benchmark length	0
< 50% of benchmark length	10
≥ 50% of benchmark length	20

Large logs defined as those with diameter ≥ 0.5 of benchmark large tree dbh.
* present if large log length is ≥ 25% of EVC benchmark log length.
# absent if large log length is < 25% of EVC benchmark log length.

---------- 'Landscape Context Score' ----------

Patch Size *Score*: 8

Category & Description	
< 20 ha	1
Between 20 and 40 ha	2
Between 40 and 60 ha	4
Between 60 and 80 ha	6
≥ 80 ha, but 'significantly disturbed'*	8
≥ 80 ha, but not 'significantly disturbed'*	10

Connectivity* *Score*: 1

Length of Corridor	Corridor not significantly disturbed*	Corridor significantly disturbed*
2 km	0	0
2-5 km	2	1
5-10 km	4	3
>10 km	5	4

* Is the site part of a relatively undisturbed vegetated corridor?

Final Habitat Score

	'Site Condition Score'						'Landscape Context Score'		
Component	Large Trees	Tree Canopy Cover	Lack of Weeds	Understorey	Snags	Logs	Patch Size	Connectivity	Total
									100
Score	11	2	8	7	10	20	8	1	67

Assessment Sheet: Nearshore Benchmark

Site Name/No. Port Gamble Bay Nearshore Location West Side Date November 2008

Assessor(s) Marja Preston Map Name/No. .....

'Site Condition Score'

Wave Energy *Score=5-Total=5*

Score	*Description*
0	if rocky shore, marsh/lagoon or very protected
-3	If linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If concrete/smooth type is greater than rip rap/gabion type
-1	If encroachment is greater than 33%
0	Total

Sediment Supply *Score=5-Total=5*

Score	*Description*
0	If rocky shore
-3	if linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If linear armouring is greater than 0
-2	If armour is greater than 0% and feeder activity = yes
-1	If armour is greater than 0% and feeder activity = yes, but backshore source = yes
-1	If feeder and backshore = no, but alongshore=yes and groin or drift-intercepting ramps density is greater than 0/1000 ft
0	Total

Light-Natural Shade *Score=5-Total=5*

Score	*Description*
0	if rocky shore, spit/barrier/backshore
0	If overhanging veg is greater than 80%
-1	If overhanging veg greater than 60%
-2	If overhanging veg greater than 40%
-3	If overhanging veg greater than 20%
-4	If overhanging veg greater than 0%
-5	If overhanging veg is 0%
0	Total

Substrate Type *Score=5-Total=5*

Score	*Description*
0	If rocky shore
-3	If linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If linear armouring is greater than 0%
-2	If point mods density is greater than 27.9/1000 ft
-1	If point mods density is greater than 9.7/1000 ft
0	Total

Light-Artificial Shade *Score=5-Total=5*

Score	*Description*
-3	If shading structures density is greater than 18.9/1000 ft
-2	If shading structures density is greater than 5.7/1000 ft
-1	If shading structures density is greater than 0/1000 ft
-2	If marina number greater than or equal to 2 in reach
-1	If marina number is 1 in reach
0	Total

Depth-Slope *Score=5-Total=5*

Score	*Description*
-5	If dredged (e.g., urban harbour)
-3	If linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If linear armouring is greater than 0%
-2	If encroachment is greater than 66%
-1	If encroachment is greater than 33%
0	Total

Assessment Sheet: Nearshore Benchmark [continued]

Pollution *Score=5-Total=5*

Score	*Description*
-5	If shellfishing closed
-3	If riparian TIA is greater than 60%
-2	If riparian TIA is greater than 35%
-1	If riparian TIA is greater than 10%
-1	If pipe outfall density is greater than or equal to 1.9/1000 ft
-1	If marina or fish farm is present
0	Total

Hydrology *Score=5-Total=5*

Score	*Description*
0	If rocky shore
-5	If marsh/lagoon with artificial constriction (tide gate, culvert)
-2	If riparian TIA is greater than 60%
-1	if riparian TIA is greater than 35%
-2	If encroachment is greater than 66%
-1	If encroachment is greater than 66%
-1	If pipe outfall density is greater than or equal to 1.9/1000 ft
0	Total

Physical Disturbance *Score=5-Total=5*

Score	*Description*
-5	If urban waterfront (ferry, shipping activity, dry dock)
-2	If floating structures greater than 15.4/1000 ft
-1	If floating structures greater than 4.8/1000 ft
-3	If riparian forested less than 10%
-2	If riparian forested less than 25%
-1	If riparian forested less than 40%
0	Total

Final Habitat Score

	'Site Condition Score'									
Component	Wave Energy	Light-Natural Shade	Light-Artificial Shade	Sediment Supply	Substrate Type	Depth-Slope	Pollution	Hydrology	Physical Disturbance	Total
										45
Score	5	5	5	5	5	5	5	5	5	45

Assessment Sheet: Nearshore (Pre-project)

Site Name/No. Country Club Road Nearshore | Location Reach 3107 | Date November 2008

Assessor(s) Marja Preston | Map Name/No. Pre-Restoration

'Site Condition Score'

Wave Energy *Score=5-Total=4*

Score	*Description*
0	if rocky shore, marsh/lagoon or very protected
-3	If linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If concrete/smooth type is greater than rip rap/gabion type
-1	If encroachment is greater than 33%
-1	Total

Sediment Supply *Score=5-Total=4*

Score	*Description*
0	If rocky shore
-3	if linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If linear armouring is greater than 0
-2	If armour is greater than 0% and feeder activity = yes
-1	If armour is greater than 0% and feeder activity = yes, but backshore source = yes
-1	If feeder and backshore = no, but alongshore=yes and groin or drift-intercepting ramps density is greater than 0/1000 ft
-1	Total

Light-Natural Shade *Score=5-Total=1*

Score	*Description*
0	if rocky shore, spit/barrier/backshore
0	If overhanging veg is greater than 80%
-1	If overhanging veg greater than 60%
-2	If overhanging veg greater than 40%
-3	If overhanging veg greater than 20%
-4	If overhanging veg greater than 0%
-5	If overhanging veg is 0%
-4	Total

Substrate Type *Score=5-Total=4*

Score	*Description*
0	If rocky shore
-3	If linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If linear armouring is greater than 0%
-2	If point mods density is greater than 27.9/1000 ft
-1	If point mods density is greater than 9.7/1000 ft
-1	Total

Light-Artificial Shade *Score=5-Total=4*

Score	*Description*
-3	If shading structures density is greater than 18.9/1000 ft
-2	If shading structures density is greater than 5.7/1000 ft
-1	If shading structures density is greater than 0/1000 ft
-2	If marina number greater than or equal to 2 in reach
-1	If marina number is 1 in reach
-1	Total

Depth-Slope *Score=5-Total=4*

Score	*Description*
-5	If dredged (e.g., urban harbour)
-3	If linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If linear armouring is greater than 0%
-2	If encroachment is greater than 66%
-1	If encroachment is greater than 33%
-1	Total

Assessment Sheet: Nearshore (Pre-project) [continued]

Pollution *Score=5-Total = 4*

Score	*Description*
-5	If shellfishing closed
-3	If riparian TIA is greater than 60%
-2	If riparian TIA is greater than 35%
-1	If riparian TIA is greater than 10%
-1	If pipe outfall density is greater than or equal to 1.9/1000 ft
-1	If marina or fish farm is present
-1	Total

Hydrology *Score=5-Total=5*

Score	*Description*
0	If rocky shore
-5	If marsh/lagoon with artificial constriction (tide gate, culvert)
-2	If riparian TIA is greater than 60%
-1	if riparian TIA is greater than 35%
-2	If encroachment is greater than 66%
-1	If encroachment is greater than 66%
-1	If pipe outfall density is greater than or equal to 1.9/1000 ft
0	Total

Physical Disturbance *Score=5-Total=5*

Score	*Description*
-5	If urban waterfront (ferry, shipping activity, dry dock)
-2	If floating structures greater than 15.4/1000 ft
-1	If floating structures greater than 4.8/1000 ft
-3	If riparian forested less than 10%
-2	If riparian forested less than 25%
-1	If riparian forested less than 40%
0	Total

Final Habitat Score

	'Site Condition Score'									
Component	Wave Energy	Light-Natural Shade	Light-Artificial Shade	Sediment Supply	Substrate Type	Depth-Slope	Pollution	Hydrology	Physical Disturbance	Total
Score	4	1	4	4	4	4	4	5	5	35
										45

Assessment Sheet: Nearshore (Post-project)

Site Name/No. Country Club Road Location Reach 3107 Date November 2008

Assessor(s) Marja Preston Map Name/No. .....

'Site Condition Score'

Wave Energy *Score=5-Total=5*

Score	*Description*
0	if rocky shore, marsh/lagoon or very protected
-3	If linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If concrete/smooth type is greater than rip rap/gabion type
-1	If encroachment is greater than 33%
0	Total

Sediment Supply *Score=5-Total=5*

Score	*Description*
0	If rocky shore
-3	if linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If linear armouring is greater than 0
-2	If armour is greater than 0% and feeder activity = yes
-1	If armour is greater than 0% and feeder activity = yes, but backshore source = yes
-1	If feeder and backshore = no, but alongshore=yes and groin or drift-intercepting ramps density is greater than 0/1000 ft
0	Total

Light-Natural Shade *Score=5-Total=5*

Score	*Description*
0	if rocky shore, spit/barrier/backshore
0	If overhanging veg is greater than 80%
-1	If overhanging veg greater than 60%
-2	If overhanging veg greater than 40%
-3	If overhanging veg greater than 20%
-4	If overhanging veg greater than 0%
-5	If overhanging veg is 0%
0	Total

Substrate Type *Score=5-Total=5*

Score	*Description*
0	If rocky shore
-3	If linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If linear armouring is greater than 0%
-2	If point mods density is greater than 27.9/1000 ft
-1	If point mods density is greater than 9.7/1000 ft
0	Total

Light-Artificial Shade *Score=5-Total=4*

Score	*Description*
-3	If shading structures density is greater than 18.9/1000 ft
-2	If shading structures density is greater than 5.7/1000 ft
-1	If shading structures density is greater than 0/1000 ft
-2	If marina number greater than or equal to 2 in reach
-1	If marina number is 1 in reach
-1	Total

Depth-Slope *Score=5-Total=5*

Score	*Description*
-5	If dredged (e.g., urban harbour)
-3	If linear armouring is greater than 66%
-2	If linear armouring is greater than 33%
-1	If linear armouring is greater than 0%
-2	If encroachment is greater than 66%
-1	If encroachment is greater than 33%
0	Total

Assessment Sheet: Nearshore (Post-project) [continued]

Pollution *Score=5-Total=4*

Score	*Description*
-5	If shellfishing closed
-3	If riparian TIA is greater than 60%
-2	If riparian TIA is greater than 35%
-1	If riparian TIA is greater than 10%
-1	If pipe outfall density is greater than or equal to 1.9/1000 ft
-1	If marina or fish farm is present
-1	Total

Hydrology *Score=5-Total=5*

Score	*Description*
0	If rocky shore
-5	If marsh/lagoon with artificial constriction (tide gate, culvert)
-2	If riparian TIA is greater than 60%
-1	if riparian TIA is greater than 35%
-2	If encroachment is greater than 66%
-1	If encroachment is greater than 66%
-1	If pipe outfall density is greater than or equal to 1.9/1000 ft
0	Total

Physical Disturbance *Score=5-Total=5*

Score	*Description*
-5	If urban waterfront (ferry, shipping activity, dry dock)
-2	If floating structures greater than 15.4/1000 ft
-1	If floating structures greater than 4.8/1000 ft
-3	If riparian forested less than 10%
-2	If riparian forested less than 25%
-1	If riparian forested less than 40%
0	Total

Final Habitat Score

	'Site Condition Score'									
Component	Wave Energy	Light-Natural Shade	Light-Artificial Shade	Sediment Supply	Substrate Type	Depth-Slope	Pollution	Hydrology	Physical Disturbance	Total
Score	5	5	4	5	5	5	4	5	5	43
										45

Assessment Sheet: Marine Riparian Benchmark

Site Name/No.: Port Gamble Benchmark Location: South of Old Dock, Port Gamble Bay Date: November 2008

Assessor(s): Marja Preston Map Name/No. .....

'Site Condition Score'

Large Trees *Score*: 10

Category & Description	*% Canopy Health**		
	> 70%	*30-70%*	*< 30%*
None present	0	0	0
> 0 to 2 large trees/ha	3	2	1
> 2-4 large trees/ha	4	3	2
> 4-6 large trees/ha	6	5	4
> 6-8 large trees/ha	8	7	6
≥ the 8 large trees/ha	10	9	8

Large trees are defined as 32" diameter at breast height (dbh)[1]
* Estimate proportion of an expected healthy canopy cover that is present

Tree Canopy Cover *Score*: 5

Category & Description	*% Canopy Health **		
	> 70%	*30-70%*	*< 30%*
< 10% of benchmark cover	0	0	0
< 50% or > 150% of benchmark cover	3	2	1
≥ 50% or ≤ 150% of benchmark cover	5	4	3

Tree canopy is defined as those canopy tree species reaching ≥ 80% of mature height.

Overhanging Vegetation *Score*: 20

Category & Description	
> 50% cover	20
25 - 50% cover	15
5 - 25% cover	10
< 5% cover	5
<5% cover, mainly non-native	0

Overhanging vegetation is vegetation that extends waterward of the Ordinary High Water Mark.

[1] Franklin, *et al.*, Ecological Growth Characteristics of Old-Growth Douglas Fir Forests. US Department of Agriculture, 1981.

Understorey Life forms

Species	# spp observed / Benchmark spp.	% cover observed / Benchmark % cover	Present (✔)	Modified (✔)
Red alder	/	70%		
Douglas fir	/	20%		
Western red cedar	/	10%		
Thimbleberry	/	10%		
Red elderberry	/	5%		
Salmonberry	/	80%		
Willow sp.	/	5%		
Sword fern	/	10%		
Him BB	/	15%		
	/			
	/			
	/			
	/			
	/			
	/			
	/			

Present	For life forms with benchmark cover of < 10%, considered 'present' if • any specimens are observed. For life forms with benchmark cover of ≥ 10%, considered 'present' if • the life form occupies at least 10% of benchmark cover.
Modified (apply only where life form is 'present')	For life forms with benchmark cover of <10%, then considered substantially 'modified' if the life form has either: • < 50% of the benchmark species diversity; or • no reproductively-mature specimens are observed. For life forms with benchmark cover of ≥ 10%, then considered substantially 'modified' if the life form has either: • < 50% of benchmark cover; or • < 50% of benchmark species diversity; or • ≥ 50% of benchmark cover due largely to immature canopy specimens but the cover of reproductively-mature specimens is < 10% of the benchmark cover.

Understorey *Score*: 10

Category & Description		
All strata and Life forms effectively absent		0
Up to 50% of life forms present		5
≥ 50% to 90% of Life forms present	• of those present, ≥ 50% substantially modified	6
	• of those present, < 50% substantially modified	7
≥ 90% of Life forms present	• of those present, ≥ 50% substantially modified	8
	• of those present, < 50% substantially modified	9
	• of those present, none substantially modified	10

Assessment Sheet: Marine Riparian Benchmark [continued]

Snags *Score*: 10

Category & Description	Snags present
< 10% of benchmark per hectare	0
10-50% of benchmark per hectare	5
≥ 50% of benchmark per hectare	10

*Snags are defined as standing dead trees greater than 20-inch dbh and greater than 65 feet in height
**2 snags per hectare observed at this benchmark site

Logs *Score*: 5

Category & Description	Large logs present*
< 10% of benchmark	1
< 50% of benchmark	3
≥ 50% of benchmark	5

Logs are downed trees located landward of backshore area.

Large Woody Debris *Score*: 20

Category & Description	LWD present
<10% of benchmark amount	0
< 50% of benchmark amount	10
≥ 50% of benchmark amount	20

Large woody debris is generally 10" in diameter and 10' in length
**10 LWD observed per 30 meters at this benchmark site

Corridor Width *Score*: 20

Category & Description	
<5 meters	0
5-10 meters	5
10-25 meters	10
25-50 meters	15
>50 meters	20

Final Habitat Score

	'Site Condition Score'							'Landscape Context Score'	
Component	Large Trees	Tree Canopy Cover	Overhanging Vegetation	Understorey	Snags	Logs	Large Woody Debris	Corridor Width	Total
									100
Score	10	5	20	10	10	5	20	20	100

Assessment Sheet: Marine Riparian (Pre-project)

Site Name/No.: Country Club Road Location: West End Pre-Impact Date: October 2008

Assessor(s): Marja Preston Map Name/No. .....

'Site Condition Score'

Large Trees *Score*: 5

Category & Description	*% Canopy Health**		
	> 70%	*30-70%*	*< 30%*
None present	0	0	0
> 0 to 2 large trees/ha	3	2	1
> 2-4 large trees/ha	4	3	2
> 4-6 large trees/ha	6	5	4
> 6-8 large trees/ha	8	7	6
≥ the 8 large trees/ha	10	9	8

Large trees are defined as 32" diameter at breast height (dbh)[1]
* Estimate proportion of an expected healthy canopy cover that is present

Tree Canopy Cover *Score*: 3

Category & Description	*% Canopy Health **		
	> 70%	*30-70%*	*< 30%*
< 10% of benchmark cover	0	0	0
< 50% or > 150% of benchmark cover	3	2	1
≥ 50% or ≤ 150% of benchmark cover	5	4	3

Tree canopy is defined as those canopy tree species reaching ≥ 80% of mature height.

Overhanging Vegetation *Score*: 5

Category & Description	
> 50% cover	20
25 - 50% cover	15
5 - 25% cover	10
< 5% cover	5
<5% cover, mainly non-native	0

Overhanging vegetation is vegetation that extends waterward of the Ordinary High Water Mark.

[1] Franklin, *et al.*, Ecological Growth Characteristics of Old-Growth Douglas Fir Forests. US Department of Agriculture, 1981.

Understorey Life forms

Species	# spp observed / Benchmark spp.	% cover observed / Benchmark % cover	Present (✓)	Modified (✓)
Red alder	/	10%/70%		X
Salmonberry	/	5%/80%		X
Rosa sp.	/	2%/0%	X	
Him. BB	/	1%/15%		X
Pacific ninebark	/	4%/0%	X	
Big leaf maple	/	1%/0%	X	
Douglas fir	/	1%/20%		X
Grasses/Herbs	/	5%/0%	X	
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		

Present	For life forms with benchmark cover of < 10%, considered 'present' if • any specimens are observed. For life forms with benchmark cover of ≥ 10%, considered 'present' if • the life form occupies at least 10% of benchmark cover.
Modified (apply only where life form is 'present')	For life forms with benchmark cover of <10%, then considered substantially 'modified' if the life form has either: • < 50% of the benchmark species diversity; or • no reproductively-mature specimens are observed. For life forms with benchmark cover of ≥ 10%, then considered substantially 'modified' if the life form has either: • < 50% of benchmark cover; or • < 50% of benchmark species diversity; or • ≥ 50% of benchmark cover due largely to immature canopy specimens but the cover of reproductively-mature specimens is < 10% of the benchmark cover.

Understorey *Score*: 6

Category & Description		
All strata and Life forms effectively absent		0
Up to 50% of life forms present		5
≥ 50% to 90% of Life forms present	• of those present, ≥ 50% substantially modified	6
	• of those present, < 50% substantially modified	7
≥ 90% of Life forms present	• of those present, ≥ 50% substantially modified	8
	• of those present, < 50% substantially modified	9
	• of those present, none substantially modified	10

Assessment Sheet: Marine Riparian (Pre-project) [continued]

Snags *Score*: 0

Category & Description	Snags present
< 10% of benchmark per hectare	0
10-50% of benchmark per hectare	5
≥ 50% of benchmark per hectare	10

Snags are defined as standing dead trees greater than 20-inch dbh and greater than 65 feet in height

Logs *Score*: 1

Category & Description	Large logs present*
< 10% of benchmark	1
< 50% of benchmark	3
≥ 50% of benchmark	5

Logs are downed trees located landward of backshore area.

Large Woody Debris *Score*: 10

Category & Description	LWD present
<10% of benchmark amount	0
< 50% of benchmark amount	10
≥ 50% of benchmark amount	20

Large woody debris is generally 10" in diameter and 10' in length

Corridor Width *Score*: 0

Category & Description	
<5 meters	0
5-10 meters	5
10-25 meters	10
25-50 meters	15
> 50 meters	20

Final Habitat Score

	'Site Condition Score'							'Landscape Context Score'	
Component	Large Trees	Tree Canopy Cover	Overhanging Vegetation	Understorey	Snags	Logs	Large Woody Debris	Corridor Width	Total
									100
Score	5	3	5	6	0	1	10	0	30

Assessment Sheet: Marine Riparian (Post-project)

Site Name/No.: Country Club Road Location: West End Post-Impact Date: October 2008

Assessor(s): Marja Preston Map Name/No. .....

'Site Condition Score'

Large Trees *Score*: 1

Category & Description	*% Canopy Health**		
	> 70%	*30-70%*	*< 30%*
None present	0	0	0
> 0 to 2 large trees/ha	3	2	1
> 2-4 large trees/ha	4	3	2
> 4-6 large trees/ha	6	5	4
> 6-8 large trees/ha	8	7	6
≥ the 8 large trees/ha	10	9	8

Large trees are defined as 32" diameter at breast height (dbh)[1]
* Estimate proportion of an expected healthy canopy cover that is present

Tree Canopy Cover *Score*: 3

Category & Description	*% Canopy Health *		
	> 70%	*30-70%*	*< 30%*
< 10% of benchmark cover	0	0	0
< 50% or > 150% of benchmark cover	3	2	1
≥ 50% or ≤ 150% of benchmark cover	5	4	3

Tree canopy is defined as those canopy tree species reaching ≥ 80% of mature height.

Overhanging Vegetation *Score*: 5

Category & Description	
> 50% cover	20
25 - 50% cover	15
5 - 25% cover	10
< 5% cover	5
<5% cover, mainly non-native	0

Overhanging vegetation is vegetation that extends waterward of the Ordinary High Water Mark.

[1] Franklin, *et al.*, Ecological Growth Characteristics of Old-Growth Douglas Fir Forests. US Department of Agriculture, 1981.

Understorey Life forms

Species	# spp observed / Benchmark spp.	% cover observed / Benchmark % cover	Present (✓)	Modified (✓)
Red alder	/	10%/70%		X
Salmonberry	/	5%/80%		X
Rosa sp.	/	2%/0%	X	
Him. BB	/	1%/15%		X
Pacific ninebark	/	4%/0%	X	
Big leaf maple	/	1%/0%	X	
Douglas fir	/	1%/20%		X
Grasses/Herbs	/	5%/0%	X	
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		

Present	For life forms with benchmark cover of < 10%, considered 'present' if • any specimens are observed. For life forms with benchmark cover of ≥ 10%, considered 'present' if • the life form occupies at least 10% of benchmark cover.
Modified (apply only where life form is 'present')	For life forms with benchmark cover of <10%, then considered substantially 'modified' if the life form has either: • < 50% of the benchmark species diversity; or • no reproductively-mature specimens are observed. For life forms with benchmark cover of ≥ 10%, then considered substantially 'modified' if the life form has either: • < 50% of benchmark cover; or • < 50% of benchmark species diversity; or • ≥ 50% of benchmark cover due largely to immature canopy specimens but the cover of reproductively-mature specimens is < 10% of the benchmark cover.

Understorey *Score*: 6

Category & Description		
All strata and Life forms effectively absent		0
Up to 50% of life forms present		5
≥ 50% to 90% of Life forms present	• of those present, ≥ 50% substantially modified	6
	• of those present, < 50% substantially modified	7
≥ 90% of Life forms present	• of those present, ≥ 50% substantially modified	8
	• of those present, < 50% substantially modified	9
	• of those present, none substantially modified	10

Assessment Sheet: Marine Riparian (Post-project) [continued]

Snags *Score*: 0

Category & Description	Snags present
< 10% of benchmark per hectare	0
10-50% of benchmark per hectare	5
≥ 50% of benchmark per hectare	10

Snags are defined as standing dead trees greater than 20-inch dbh and greater than 65 feet in height

Logs *Score*: 1

Category & Description	Large logs present*
< 10% of benchmark	1
< 50% of benchmark	3
≥ 50% of benchmark	5

Logs are downed trees located landward of backshore area.

Large Woody Debris *Score*: 10

Category & Description	LWD present
<10% of benchmark amount	0
< 50% of benchmark amount	10
≥ 50% of benchmark amount	20

Large woody debris is generally 10" in diameter and 10' in length

Corridor Width *Score*: 0

Category & Description	
<5 meters	0
5-10 meters	5
10-25 meters	10
25-50 meters	15
> 50 meters	20

Final Habitat Score

	'Site Condition Score'							'Landscape Context Score'	
Component	Large Trees	Tree Canopy Cover	Overhanging Vegetation	Understorey	Snags	Logs	Large Woody Debris	Corridor Width	Total
									100
Score	1	3	5	6	0	1	10	0	26

Assessment Sheet: Wetland Benchmark

Site Name/No. Wetland Benchmark | Location Manzanita Park | Date November 2008

Assessor(s) Marja Preston | Map Name/No. .....

'Site Condition Score'

Vegetation Structure *Score* 10

Score	*Description*
20	Wetland contains 4 or more vegetation classes
15	Wetland contains 3 vegetation classes
10	Wetland contains 2 or more vegetation classes
0	Wetland contains 1 vegetation class
10	Total

Vegetation class types: 1)Aquatic bed, 2)Emergent Plants, 3)Scrub/shrub, 4)Forested areas (with >30% tree cover), add a vegetation class if forested class has 3 out of 5 strata covering 20% within forest polygon: canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover

Hydroperiods *Score* 15

Score	*Description*
20	4 or more water regimes present
15	3 water regimes present
10	2 water regimes present
0	1 water regime present
15	Total

Water regimes: 1) permanently flooded or inundated, 2) seasonally flooded or inundated, 3) occasionally flooded or inundated, 4) saturated only, 5) permanently flowing stream or river in or adjacent to the wetland, 6) seasonally flowing stream in or adjacent to the wetland, 7) lake-fringe wetland = 2 points, 8) freshwater tidal wetland = 2 points

Richness of Plant Species *Score* 20

Score	*Description*
25	>20 plant species
20	10-20 plant species
10	5-10
0	<5 plant species
20	Total

Count the number of plant species in the wetland that cover at least 10 ft^2

Special Habitat Features *Score* 10

Add the following to calculate score:

Score	*Description*
2	Downed logs present
2	Snags present
2	Undercut banks present for 6.6ft and/or overhanging vegetation extends at least 3.3ft over stream for at least 33ft
2	¼ acre of thin-stemmed persistent vegetation or woody branches in areas that are permanently or seasonally inundated
2	Invasive plants cover less than 25% of wetland area in each stratum of plants
10	Total

Corridors and Connections *Score* 25

Score	*Description*
20	Wetland is part of relatively undisturbed vegetated corridor at least 150 ft wide w/at least 30% cover of shrubs, forest or native undisturbed prairie that connects to other wetlands, estuaries, or undisturbed uplands at least 250 acres in size
10	Or, wetland is part of relatively undisturbed vegetated corridor at least 50ft wide w/at least 30% cover of shrubs or forest and connects to other wetlands, estuaries or uplands at least 25 acres in size. Or a lake-fringe wetland if it does not have an undisturbed corridor.
And.....	
5	wetland is within 5 miles of brackish water or salt water estuary
5	Or, wetland is within 3 mi of a large field or pasture >40 acres
5	Or, wetland is within 1 mi of lake greater than 20 acres
25	Total

Final Habitat Score

	Site Conditions					
Component	Vegetation Structure	Hydroperiods	Richness of Plant Species	Special Habitat Features	Corridors and Connections	Total
Score	10	15	20	10	25	80
						100

Assessment Sheet: Wetland (Pre-Impact)

Site Name/No. Country Club Wetland | Location South side of CC Road | Date November 2008

Assessor(s) Marja Preston | Map Name/No. Wetland Pre-Impact

'Site Condition Score'

Vegetation Structure *Score* 10

Score	*Description*
20	Wetland contains 4 or more vegetation classes
15	Wetland contains 3 vegetation classes
10	Wetland contains 2 or more vegetation classes
0	Wetland contains 1 vegetation class
10	Total

Vegetation class types: 1)Aquatic bed, 2)Emergent Plants, 3)Scrub/shrub, 4)Forested areas (with >30% tree cover), add a vegetation class if forested class has 3 out of 5 strata covering 20% within forest polygon: canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover

Hydroperiods *Score* 15

Score	*Description*
20	4 or more water regimes present
15	3 water regimes present
10	2 water regimes present
0	1 water regime present
15	Total

Water regimes: 1) permanently flooded or inundated, 2) seasonally flooded or inundated, 3) occasionally flooded or inundated, 4) saturated only, 5) permanently flowing stream or river in or adjacent to the wetland, 6) seasonally flowing stream in or adjacent to the wetland, 7) lake-fringe wetland = 2 points, 8) freshwater tidal wetland = 2 points

Richness of Plant Species *Score* 10

Score	*Description*
25	>20 plant species
20	10-20 plant species
10	5-10
0	<5 plant species
10	Total

Count the number of plant species in the wetland that cover at least 10 ft^2

Special Habitat Features *Score* 6

Add the following to calculate score:

Score	*Description*
2	Downed logs present
2	Snags present
2	Undercut banks present for 6.6ft and/or overhanging vegetation extends at least 3.3ft over stream for at least 33ft
2	¼ acre of thin-stemmed persistent vegetation or woody branches in areas that are permanently or seasonally inundated
2	Invasive plants cover less than 25% of wetland area in each stratum of plants
6	Total

Corridors and Connections *Score* 25

Score	*Description*
20	Wetland is part of relatively undisturbed vegetated corridor at least 150 ft wide w/at least 30% cover of shrubs, forest or native undisturbed prairie that connects to other wetlands, estuaries, or undisturbed uplands at least 250 acres in size
10	Or, wetland is part of relatively undisturbed vegetated corridor at least 50ft wide w/at least 30% cover of shrubs or forest and connects to other wetlands, estuaries or uplands at least 25 acres in size. Or a lake-fringe wetland if it does not have an undisturbed corridor.
And.....	
5	wetland is within 5 miles of brackish water or salt water estuary
5	Or, wetland is within 3 mi of a large field or pasture >40 acres
5	Or, wetland is within 1 mi of lake greater than 20 acres
25	Total

Final Habitat Score

	Site Conditions					
Component	Vegetation Structure	Hydroperiods	Richness of Plant Species	Special Habitat Features	Corridors and Connections	Total
						100
Score	10	15	10	6	25	66

Assessment Sheet: Wetland (Post-Impact)

Site Name/No. Country Club Wetland | Location South side of CC Road | Date November 2008

Assessor(s) Marja Preston | Map Name/No. Wetland Post-Impact

'Site Condition Score'

Vegetation Structure *Score* 0

Score	*Description*
20	Wetland contains 4 or more vegetation classes
15	Wetland contains 3 vegetation classes
10	Wetland contains 2 or more vegetation classes
0	Wetland contains 1 vegetation class
0	Total

Vegetation class types: 1)Aquatic bed, 2)Emergent Plants, 3)Scrub/shrub, 4)Forested areas (with >30% tree cover), add a vegetation class if forested class has 3 out of 5 strata covering 20% within forest polygon: canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover

Hydroperiods *Score* 15

Score	*Description*
20	4 or more water regimes present
15	3 water regimes present
10	2 water regimes present
0	1 water regime present
15	Total

Water regimes: 1) permanently flooded or inundated, 2) seasonally flooded or inundated, 3) occasionally flooded or inundated, 4) saturated only, 5) permanently flowing stream or river in or adjacent to the wetland, 6) seasonally flowing stream in or adjacent to the wetland, 7) lake-fringe wetland = 2 points, 8) freshwater tidal wetland = 2 points

Richness of Plant Species *Score* 0

Score	*Description*
25	>20 plant species
20	10-20 plant species
10	5-10
0	<5 plant species
0	Total

Count the number of plant species in the wetland that cover at least 10 ft^2

Special Habitat Features *Score* 0

Add the following to calculate score:

Score	*Description*
2	Downed logs present
2	Snags present
2	Undercut banks present for 6.6ft and/or overhanging vegetation extends at least 3.3ft over stream for at least 33ft
2	¼ acre of thin-stemmed persistent vegetation or woody branches in areas that are permanently or seasonally inundated
2	Invasive plants cover less than 25% of wetland area in each stratum of plants
0	Total

Corridors and Connections *Score* 25

Score	*Description*
20	Wetland is part of relatively undisturbed vegetated corridor at least 150 ft wide w/at least 30% cover of shrubs, forest or native undisturbed prairie that connects to other wetlands, estuaries, or undisturbed uplands at least 250 acres in size
10	Or, wetland is part of relatively undisturbed vegetated corridor at least 50ft wide w/at least 30% cover of shrubs or forest and connects to other wetlands, estuaries or uplands at least 25 acres in size. Or a lake-fringe wetland if it does not have an undisturbed corridor.
And.....	
5	wetland is within 5 miles of brackish water or salt water estuary
5	Or, wetland is within 3 mi of a large field or pasture >40 acres
5	Or, wetland is within 1 mi of lake greater than 20 acres
25	Total

Final Habitat Score

	Site Conditions					
Component	Vegetation Structure	Hydroperiods	Richness of Plant Species	Special Habitat Features	Corridors and Connections	Total
						100
Score	0	15	0	0	25	40

To learn more about the BBOP principles, guidelines and optional methodologies, go to:

www.forest-trends.org/biodiversityoffsetprogram/guidelines