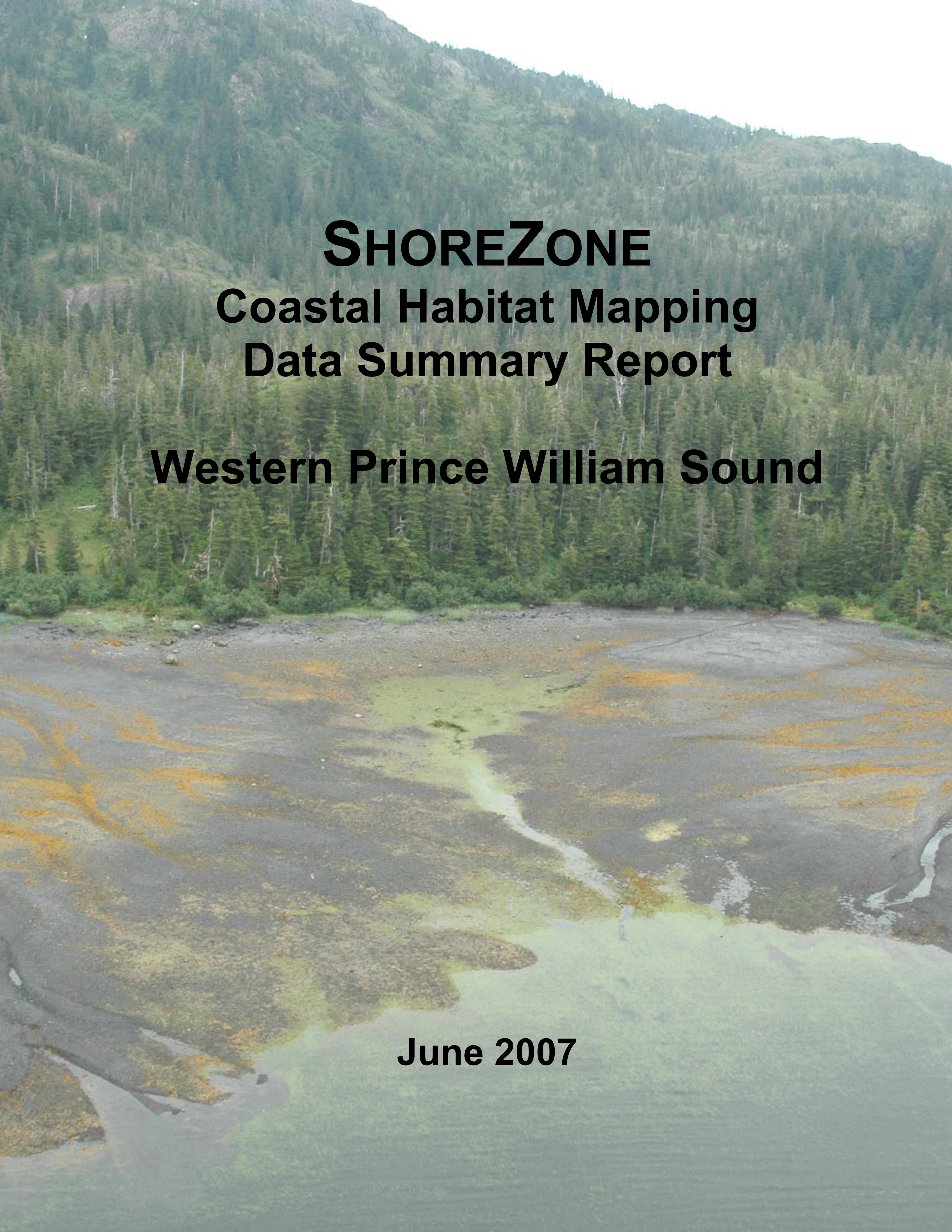

SHOREZONE
Coastal Habitat Mapping Data Summary Report

Western Prince William Sound

June 2007

CORI Project: 06-06 30 June 2007

ShoreZone Mapping Data Summary
Western Prince William Sound
(2004 Imagery)

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1 INTRODUCTION

1.1 ShoreZone Coastal Habitat Mapping

The ShoreZone Coastal Mapping Program is a partnership of scientists, GIS specialists, internet specialists, non-profit organizations, and governmental agencies. Field programs, data management and processing, and product deliveries are coordinated and executed primarily by coastal geologists John Harper and Jodi Harney of Coastal and Ocean Resources Inc. (Sidney BC, Canada) and biologist Mary Morris of Archipelago Marine Research Ltd. (Victoria BC). The processing, mapping, integration, and analysis of physical and biological data takes place in both organizations by mapping specialists who possess advanced academic and technical degrees. More information on techniques, methodology, and applications is included in the ShoreZone Protocol for the Gulf of Alaska available on the Coastal and Ocean Resources website (www.coastalandoceans.com).

ShoreZone is a coastal habitat mapping and classification system in which georeferenced aerial imagery is collected specifically for the interpretation and integration of geological and biological features of the intertidal zone and nearshore environment. Oblique low-altitude aerial video and digital still imagery of the coastal zone is collected during summer low tides (zero tide level or lower), usually from a helicopter flying at <100 m altitude. The flight trackline is recorded at 1-second intervals using Fugawi electronic navigation software and is continuously monitored in-flight to ensure all shorelines have been imaged. Video and still images are georeferenced and time-synchronized. Video imagery is accompanied by continuous, simultaneous commentary by a geologist and a biologist aboard the aircraft.

The mapping system provides a spatial framework for coastal habitat assessment on local and regional scales. Imagery exists for more than 28,000 km of coastline in the Gulf of Alaska and Southeast, and the summer 2007 field season is expected to add 12,000 km of imagery to the Alaska program (Figure 1.1). In the Pacific Northwest, the ShoreZone Coastal Mapping Program also includes more than 45,000 km of coastline in British Columbia and Washington state (from the Columbia River to the Alaska/BC border).

Research and practical applications of ShoreZone coastal mapping data and imagery include:

- linking habitat use and life-history strategy of nearshore fish and other intertidal organisms;
- habitat capability modeling (for example, to predict the spread of invasive species or the distribution of beaches appropriate for spawning fish);
- ground-truthing of aerial data on smaller spatial scales;
- natural resource planning and environmental hazard mitigation; and
- public use for recreation, education, outreach, and conservation.

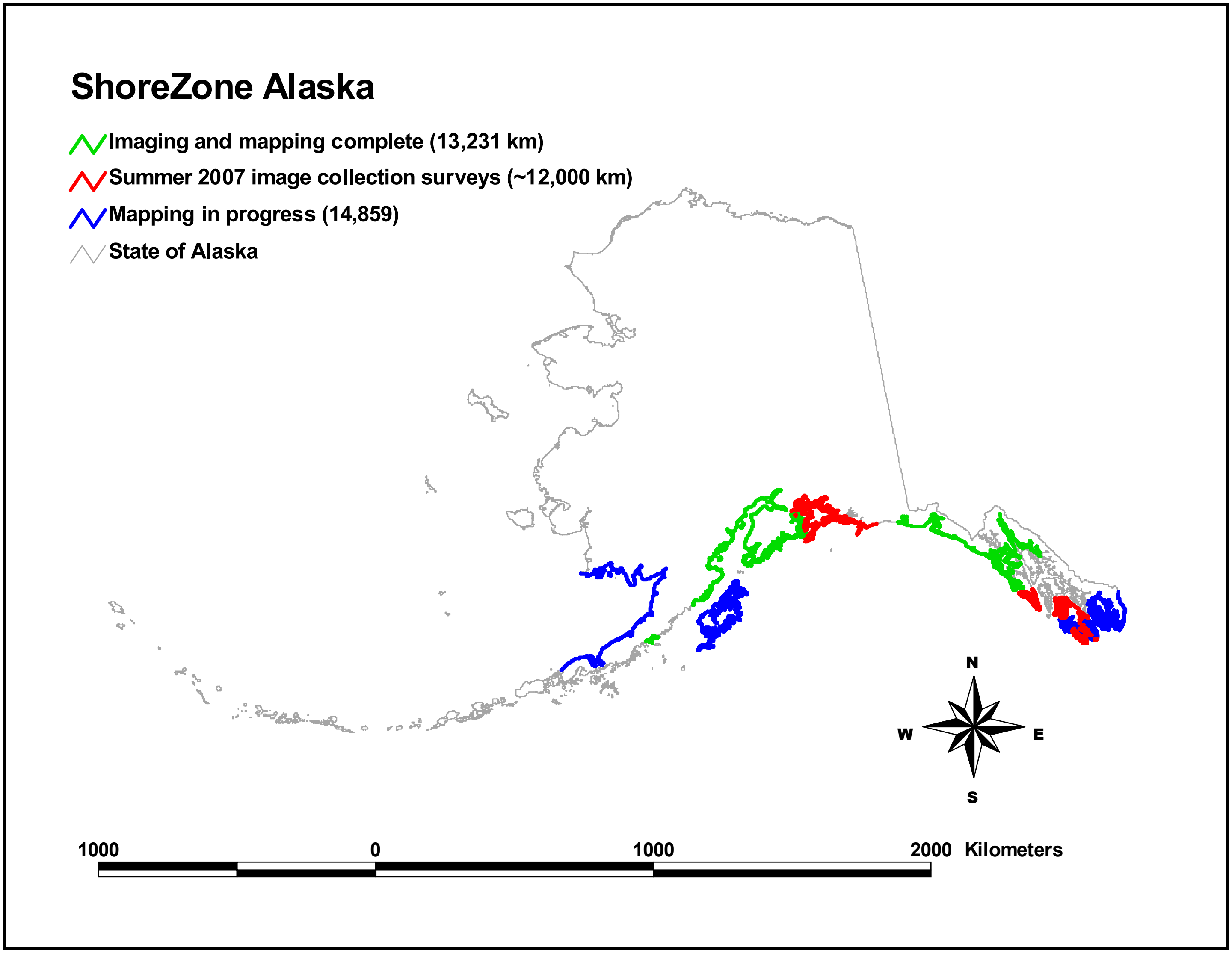


Figure 1.1. Extent of ShoreZone imagery and coastal habitat mapping in the State of Alaska.

The imagery and commentary are used in the definition of discrete along-shore coastal habitat **units** and the "mapping" of observed physical, geomorphic, sedimentary, and biological across-shore **components** within those units (Figure 1.2). Units are digitized as shoreline segments in ArcView or ArcGIS, then integrated with the along-shore and across-shore geological and biological data housed in a Microsoft Access database. Mapped habitat features include degree of wave exposure, substrate type, sediment texture, intertidal flora and fauna, subtidal algae, and some subtidal fauna. Data and imagery are posted on regional websites (such as www.coastalaska.net and www.fakr.noaa.gov/maps/szintro.htm for SE Alaska and www.shim.bc.ca/gulfislands/atlas.htm for the Gulf Islands in British Columbia, Canada).

Mapping data (in GIS and Access database formats) is in the form of **line** segments and **point** features. Line segments are the principal spatial features, representing along-shore units, each with a unique physical identifier (PHY_IDENT) that links the data to the digital shoreline in GIS. Point features (also called "variants") are small features such as streams that are better represented as a point rather than a line. Such point features are also mapped as "forms" within the unit that contains them.

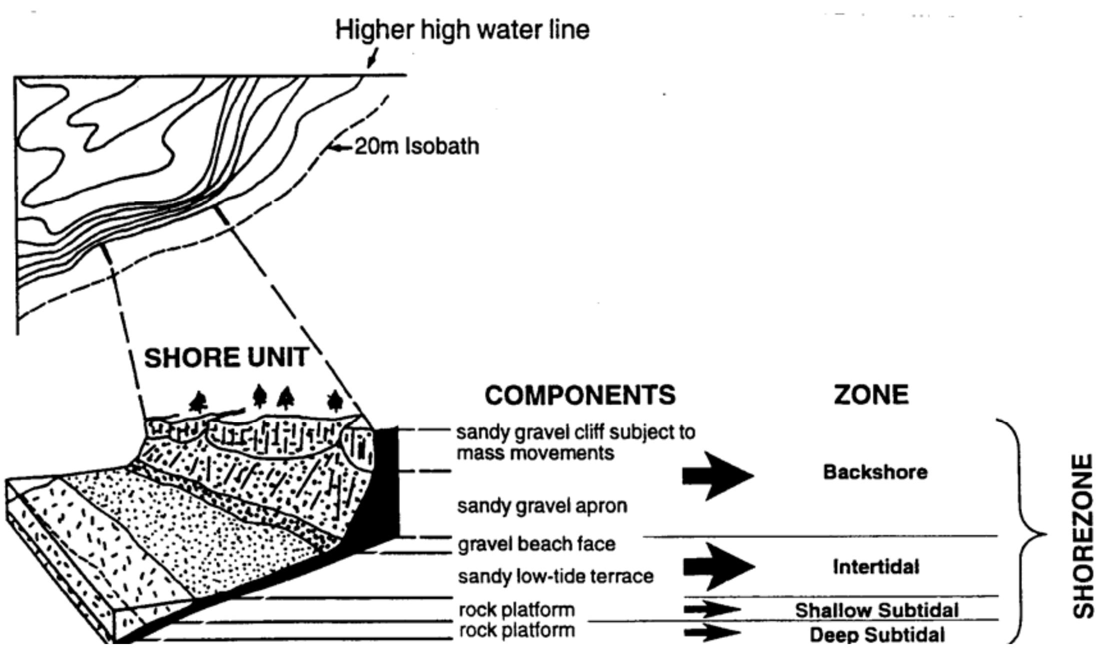


Figure 1.2. Schematic to illustrate how digital shorelines are segmented into alongshore units and across-shore components in the ShoreZone mapping system.

1.2 ShoreZone in Prince William Sound

Field surveys in western Prince William Sound in 2004 collected 1,543 km of aerial video and digital still photographs of the coastal and nearshore zone at zero-tide and lower. The imagery was used to map the geological and biological features of the shoreline from Whittier south to Latouche Island (Figure 1.3). The purpose of this report is to provide a summary of the data for these shorelines of the western Sound that were imaged in 2004.

In 2007, more than 4,000 km of imagery was collected in the northern and eastern Sound. The data presented here will be joined to that collected in 2007 to complete the ShoreZone mapping in Prince William Sound.

PWS04 ShoreZone Mapping
28 June 2007

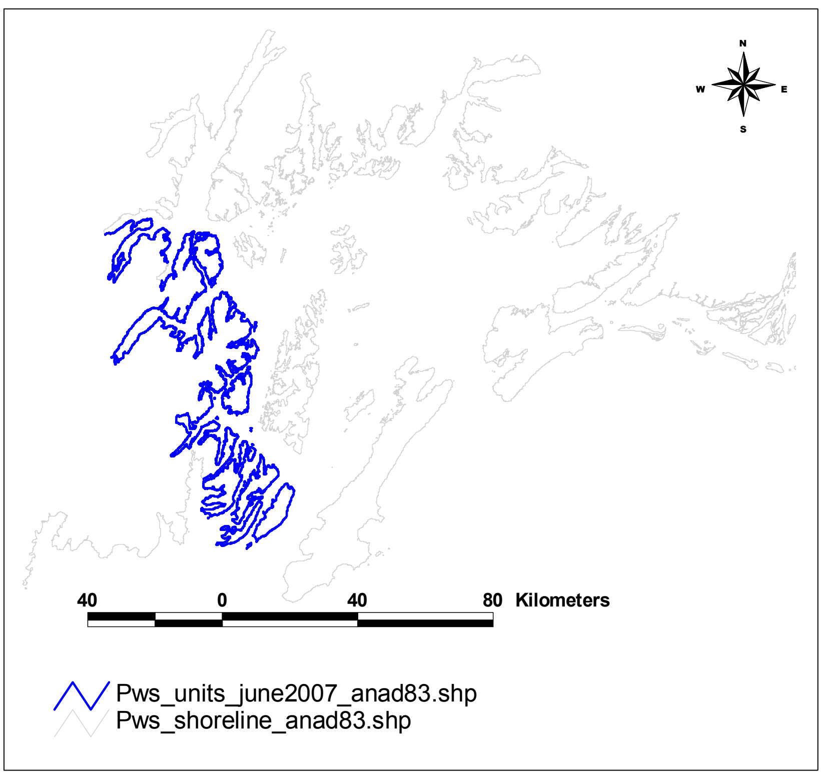


Figure 1.3. Shoreline of Western Prince William Sound mapped using the ShoreZone technique from Whittier south to Latouche Island.

2 PHYSICAL SHOREZONE DATA SUMMARY

2.1 Shore Types

The principal characteristics of each along-shore segment are used to assign an overall unit classification or “shore type” that represents the unit as a whole. ShoreZone mapping employs two unit classification systems: coastal shore types defined for British Columbia (“BC Class”) and the “Environmental Sensitivity Index” (ESI) class developed for oil-spill mitigation.

The BC Class system is used to describe alongshore coastal units as one of 34 shore types defined on the basis of the principal geomorphic features, substrates, sediment textures, across-shore width, and slope of that section of coastline (Table 2.1; Howes et al. 1994). Coastal classes that characterize units dominated by man-made features (BC Classes 32 and 33), organic material (such as marshes and estuaries), high-current channels, and glaciers are also included in the BC class system. The distribution of BC shore types in the mapped area of western Prince William Sound is summarized in Table 2.2 and Figure 2.1.

The NOAA Environmental Sensitivity Index (ESI) is a shoreline classification system developed in the mid-1970s to categorize coastal regions on the basis of their oil-spill sensitivity. The ESI system uses wave exposure and principal substrate type to assign alongshore coastal units a ranking of 1-10 to indicate the relative degree of sensitivity to oil spills (1=least sensitive, 10=most sensitive). In addition to the relative rank, each unit is also assigned one of 27 possible shore type classes (Table 2.3; Peterson et al. 2002). The ESI system has been used to map most of the coastline in the U.S., including Alaska, and is an integral component of oil-spill contingency planning, emergency response, and coastal resource management.

Table 2.1. Shore Type classification employed in the ShoreZone mapping methodology (after Howes et al. 1994 for British Columbia).

SUBSTRATE	SEDIMENT	WIDTH	SLOPE	COASTAL CLASS	NO.
ROCK	N/A	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Rock Ramp, wide	1
			FLAT (<5°)	Rock Platform, wide	2
		NARROW (<30 m)	STEEP (>20°)	Rock Cliff	3
			INCLINED (5-20°)	Rock Ramp, narrow	4
			FLAT(<5°)	Rock Platform, narrow	5
ROCK & SEDIMENT	GRAVEL	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Ramp with gravel beach, wide	6
			FLAT (<5°)	Platform with gravel beach, wide	7
		NARROW (<30 m)	STEEP (>20°)	Cliff with gravel beach	8
			INCLINED (5-20°)	Ramp with gravel beach	9
			FLAT (<5°)	Platform with gravel beach	10
	SAND & GRAVEL	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Ramp w gravel & sand beach, wide	11
			FLAT (<5°)	Platform with G&S beach, wide	12
		NARROW (<30 m)	STEEP (>20°)	Cliff with gravel/sand beach	13
			INCLINED (5-20°)	Ramp with gravel/sand beach	14
			FLAT (<5°)	Platform with gravel/sand beach	15
	SAND	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Ramp with sand beach, wide	16
			FLAT (<5°)	Platform with sand beach, wide	17
		NARROW (<30 m)	STEEP (>20°)	Cliff with sand beach	18
			INCLINED (5-20°)	Ramp with sand beach, narrow	19
			FLAT (<5°)	Platform with sand beach, narrow	20
SEDIMENT	GRAVEL	WIDE (>30 m)	FLAT (<5°)	Gravel flat, wide	21
		NARROW (<30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Gravel beach, narrow	22
			FLAT (<5°)	Gravel flat or fan	23
	SAND & GRAVEL	WIDE (>30 m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	n/a	
			FLAT (<5°)	Sand & gravel flat or fan	24
		NARROW (<30 m)	STEEP >20°)	n/a	
			INCLINED (5-20°)	Sand & gravel beach, narrow	25
			FLAT (<5°)	Sand & gravel flat or fan	26
	SAND / MUD	WIDE (>30m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Sand beach	27
			FLAT (<5°)	Sand flat	28
			FLAT (<5°)	Mudflat	29
		NARROW (<30m)	STEEP (>20°)	n/a	
			INCLINED (5-20°)	Sand beach	30
			FLAT (<5°)	n/a	n/a
	ORGANICS	n/a	n/a	Estuaries, marshes	31
ANTHRO-POGENIC	Man-made	n/a	n/a	Man-made, permeable	32
			n/a	Man-made, impermeable	33
CHANNEL	Current	n/a	n/a	Channel	34
GLACIER	Ice	n/a	n/a	Glacier	35

Table 2.2. Summary of shore types by BC Class for the 1,543 km of mapped shoreline of western Prince William Sound.

Shore Type (BC Class)	Sum of Unit Length (m)	# of Units	% Occurrence	Sum of Occur-Rence (%, km)	General Substrate Type
1	1,577	14	0.1%		
2	3,030	16	0.2%		
3	198,017	1,296	12.9%		
4	34,912	313	2.3%	**15%**	
5	1,213	15	0.1%	**239 km**	**Rock**
6	5,246	20	0.3%		
7	10,217	55	0.7%		
8	132,043	794	8.6%		
9	93,137	594	6.1%		
10	5,967	40	0.4%		
11	26,107	217	1.7%		
12	35,332	224	2.3%		
13	204,527	1,680	13.4%		
14	156,265	1,312	10.2%		
15	10,824	100	0.7%		
16	0	0	0.0%		
17	532	4	0.0%		
18	478	4	0.0%		
19	448	3	0.0%	**44%**	
20	159	2	0.0%	**681 km**	**Rock+Sediment**
21	16,343	66	1.1%		
22	32,526	146	2.1%		
23	0	0	0.0%		
24	151,184	1,347	9.9%		
25	254,334	1970	16.6%		
26	19,222	174	1.3%		
27	1,830	11	0.1%		
28	4,772	24	0.3%		
29	905	5	0.1%	**31%**	
30	915	2	0.1%	**482 km**	**Sediment**
31	117,214	736	7.7%	**8% (736 km)**	**Organics / Marsh**
32	4,517	17	0.3%		
33	466	3	0.0%	**0.3% (5 km)**	**Man-made**
34	2,184	15	0.1%	**1% (15 km)**	**Channel**
35	5,007	7	0.3%	**0.3% (7 km)**	**Glacier**

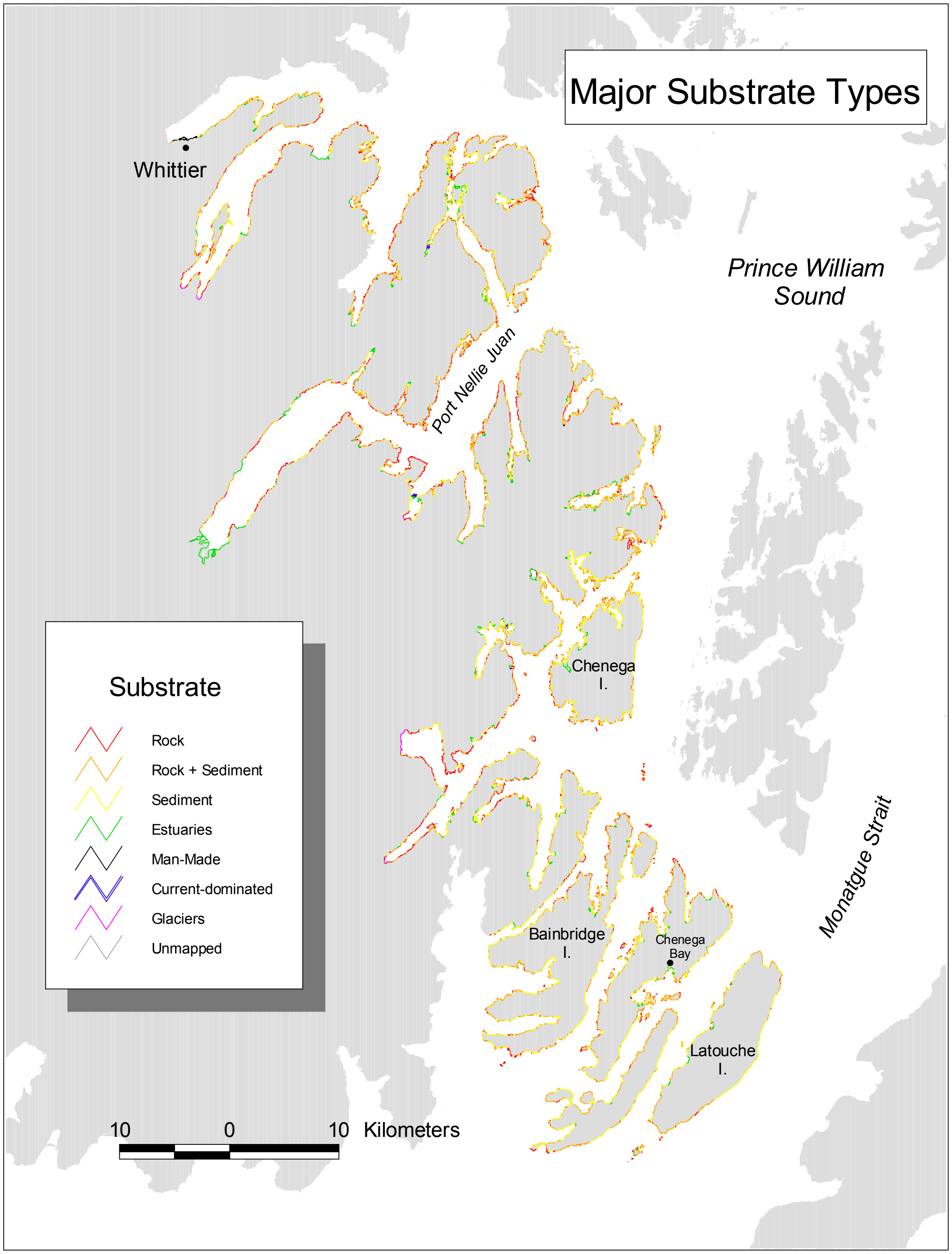


Figure 2.1. Distribution of principal substrate types (based on grouped BC Classes) in mapped areas of western Prince William Sound.

Table 2.3. Environmental Sensitivity Index ("ESI") classification (after Peterson et al 2002).

ESI Class	Description
1A	Exposed rocky shores and banks
1B	Exposed, solid, man-made structures
1C	Exposed rocky cliffs with boulder talus base
2A	Exposed wave-cut platforms in bedrock, mud, or clay
2B	Exposed scarps and steep slopes in clay
3A	Fine- to medium-grained sand beaches
3B	Scarps and steep slopes in sand
3C	Tundra cliffs
4	Coarse-grained sand beaches
5	Mixed sand and gravel beaches
6A	Gravel beaches (granules and pebbles)
6B	Gravel beaches (cobbles and boulders)
6C	Rip rap (man-made)
7	Exposed tidal flats
8A	Sheltered scarps in bedrock, mud, or clay; sheltered rocky shores (impermeable)
8B	Sheltered, solid, man-made structures; sheltered rocky shores (permeable)
8C	Sheltered riprap (man-made)
8D	Sheltered rocky rubble shores
8E	Peat shorelines
9A	Sheltered tidal flats
9B	Vegetated low banks
9C	Hypersaline tidal flats
10A	Salt- and brackish-water marshes
10B	Freshwater marshes
10C	Swamps
10D	Scrub-shrub wetlands; mangroves
10E	Inundated low-lying tundra

2.2 Physical Wave Exposure

Wave exposure is an important attribute of coastal habitats, influencing physical processes as well as the biotic character of the intertidal and nearshore zones. **Physical Exposure** is estimated by geologic mappers on the basis of incident wave energy, which is generally related to fetch distance (Table 2.4). Physical exposure is recorded as “EXP_OBSER” in the database (see data dictionary in Appendix for other database references).

Table 2.4. Definition of physical wave exposure categories employed in ShoreZone mapping.

Code	Physical Exposure	Relative Fetch
VE	Very Exposed	> 500 km
E	Exposed	> 500 km
SE	Semi-exposed	50 - 500 km
SP	Semi protected	10 - 50 km
P	Protected	< 10 km
VP	Very Protected	<1 km

Because intertidal species generally have specific energy tolerances, observations of indicator species and biotic community assemblages can be used to define **biological exposure** in each shore unit (“EXP_BIO” in the database). This measure of exposure is discussed in Section 3.

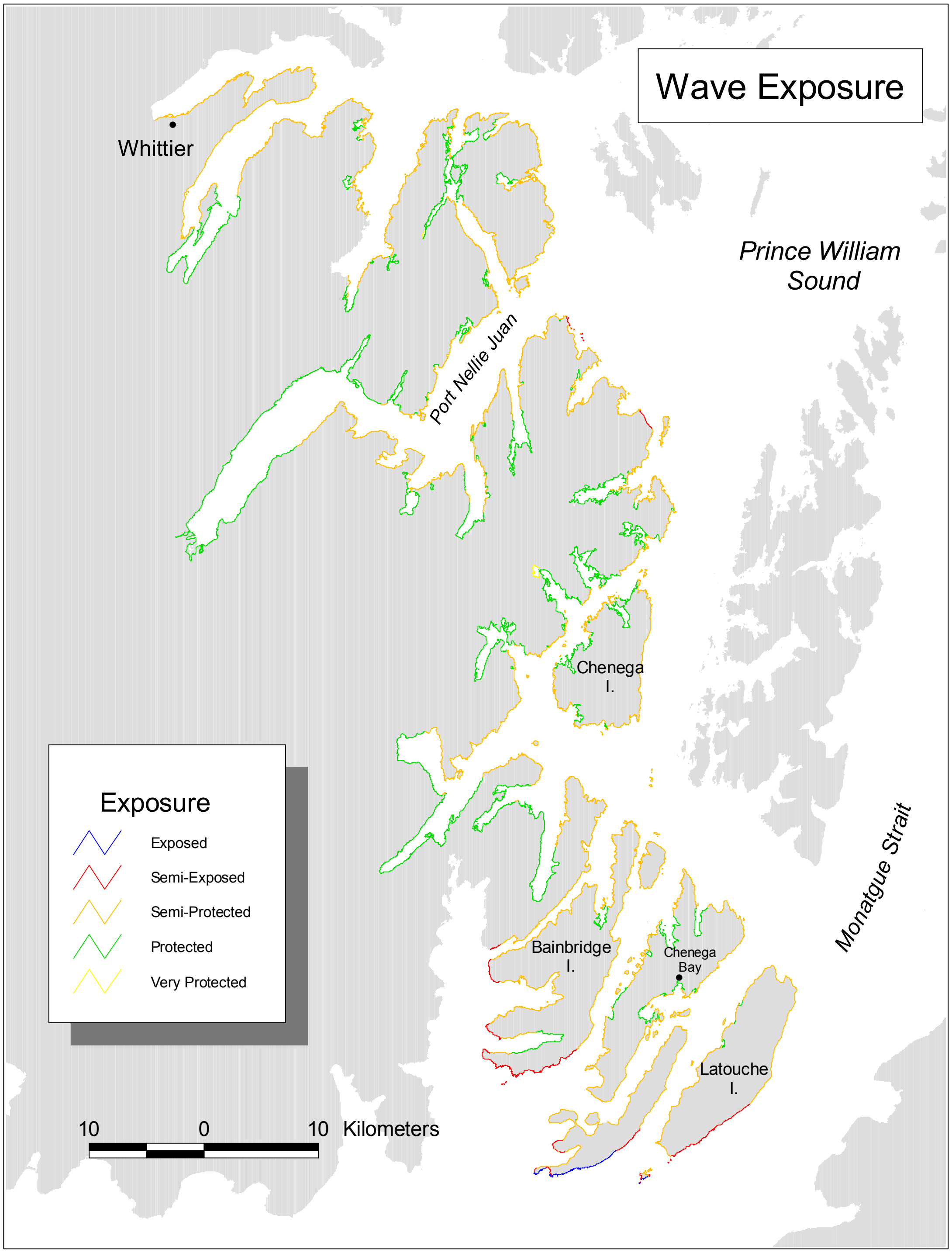


Figure 2.2. Distribution of physical wave exposure categories for mapped areas in western Prince William Sound.

2.3 Anthropogenic Shore Modifications

Shore-protection features and coastal access constructions such as seawalls, rip rap, docks, dikes, and wharves are enumerated in ShoreZone mapping data. Very few areas with shore modifications are mapped in the western Sound. Whittier and Chenega are coastal communities of the western Sound in which units are classified as man-modified (having more than 50% of the unit altered by human activities).

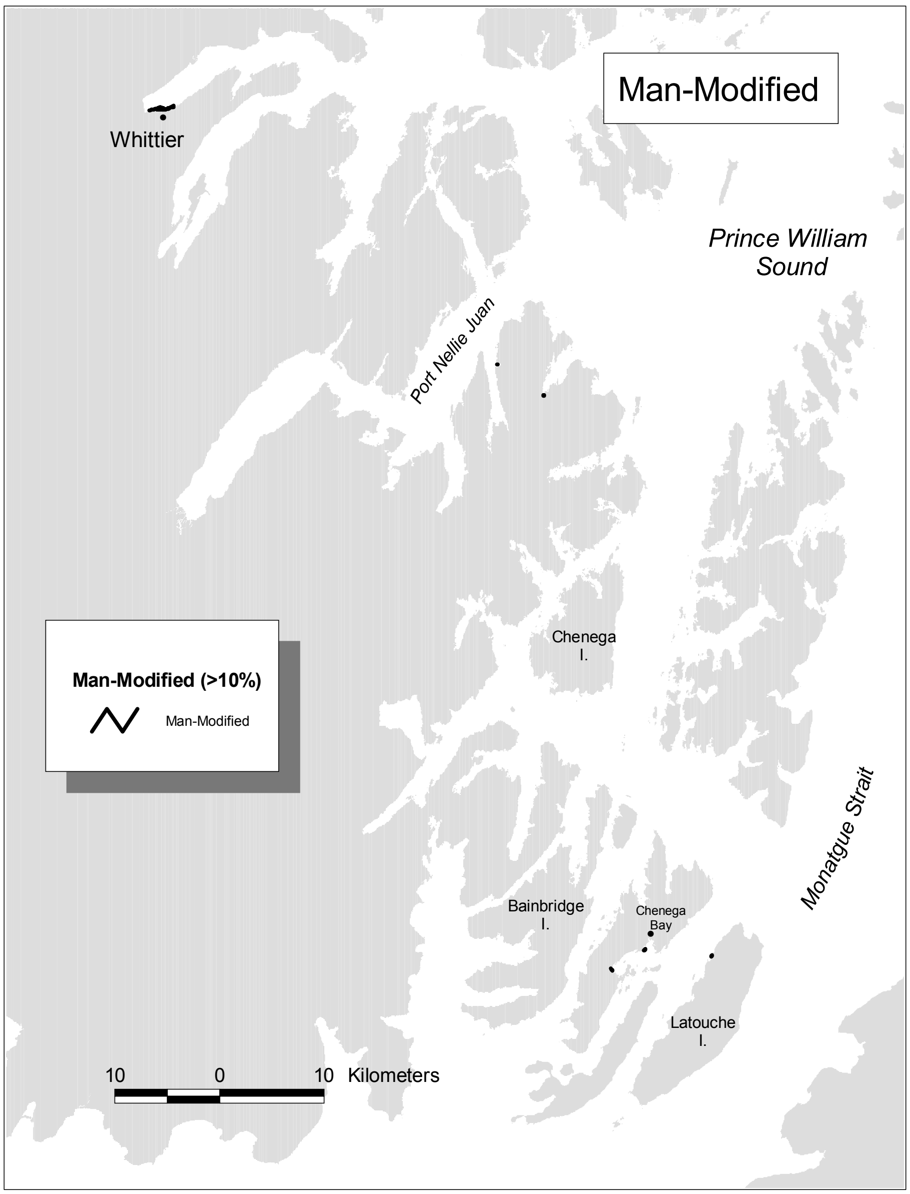


Figure 2.3. Distribution of units with more than 50% human-altered shoreline features in mapped areas of western Prince William Sound.

2.4 Oil Residence Index (ORI)

ShoreZone coastal mapping data is potentially useful for oil spill contingency planning. In addition to the imagery and biological mapping data, physical attributes of the shoreline can be used to estimate the potential oil residence time on the basis of substrate type and wave exposure level.

Substrate permeability is of principal importance in estimating the residence time of oil on the shoreline. Impermeable surfaces such as rock or sheet piling form a barrier and have shorter oil residence times. In contrast, coarse sediments are highly permeable, can trap large volumes of oil, and have lengthy oil residence periods. In general, high-energy shorelines have short oil residence times, owing to the dissipative action of waves. Low-energy shorelines have lengthy oil residence times.

The ORI is defined for each across-shore intertidal component (zone). The ORI of the unit is calculated on the basis of those defined for each zone within the unit (Tables 2.5 and 2.6).

Table 2.5. Definitions of Oil Residence Index (ORI).

Persistence	Oil Residence Index	Estimated Persistence
Short	1	Days to weeks
↓	2	**Weeks** to months
	3	Weeks to **months**
	4	**Months** to years
Long	5	Months to **years**

Table 2.6. Lookup table used to assign an Oil Residence Index (ORI) to each unit on the basis of physical exposure and sediment texture.

Substrate	VE	E	SE	SP	P	VP
Rock	1	1	1	2	3	3
Man-made, impermeable	1	1	1	2	2	2
Boulder	3	3	5	4	4	4
Cobble	2	3	5	4	4	4
Pebble	2	3	5	4	4	4
Sand w/ pebble, cobble, or boulder	1	2	3	4	5	5
Sand w/o pebble, cobble, or boulder	2	2	3	3	4	4
Mud	--	--	--	3	3	3
Organics, vegetation	--	--	--	5	5	5
Man-made, permeable	2	2	3	3	5	5

2.5 Physical Illustrations: Shore Types and Geomorphic Features

The following pages provide illustrated examples of shore types and geomorphic features mapped in western Prince William Sound.

Shore Type: Rock (BC Classes 1-5)
Shore Type: Rock and Sediment (BC Classes 6-20)
Shore Type: Sediment (BC Classes 21-30)
Shore Type: Organic Shorelines, Marshes, and Estuaries (BC Class 31)
Shore Type: Human-Altered Shorelines (BC Classes 32-33)
Shore Type: Current-Dominated Channels (BC Class 34)
Shore Type: Glaciers (BC Class 35)
Geomorphic Features: Deltas, Mudflats, and Tidal Flats
Geomorphic Features: Lagoons
Anthropogenic Features: Coastal Structures and Seawalls
Other Interesting Features: Fish Traps and Drowned Forests

Shore Type: Rock (BC Classes 1-5)

	
Rock classes represent 15% of mapped shorelines. Steep, narrow rock cliffs like the one shown (BC Class 3) are a common shore type in the western Sound, comprising 13% of the 1,543 km of mapped shoreline.	Orange, white, brown, and red anemones attached to a steep, narrow cliff in the Pleiades Islands southeast of Chenega Island in Knight Island Passage (BC Class 3).
Evans Island (Unit 02/01/5034)	Pleiades Islands (Unit 02/01/3012)
PWS04_00545.JPG	PWS04_01926.JPG

Shore Type: Rock and Sediment (BC Classes 6-20)

<table>
<tr><td></td><td></td></tr>
<tr><td>Mixed rock and sediment classes represent 44% of mapped shorelines. Shown is a low, inclined cliff with gravel beach (BC Class 8).</td><td>Cliff with gravel and sand beach (BC Class 13).</td></tr>
<tr><td>Kenai Peninsula (Unit 02/01/8253)</td><td>Port Nellie Juan (Unit 02/01/8191)</td></tr>
<tr><td>PWS04_01112.JPG</td><td>PWS04_02642.JPG</td></tr>
</table>

Shore Type: Sediment (BC Classes 21-30)

	
Sediment-dominated classes represent 31% of mapped shorelines. Shown is a wide sand flat (BC Class 28).	Wide sand and gravel fan (BC Class 24).
Deep Water Bay, Port Nellie Juan (Unit 02/02/4293)	Bainbridge Island/Port Bainbrige (Unit 02/01/6252)
PWS04_02766.JPG	PWS04_00808.JPG

Shore Type: Organic Shorelines, Marshes, and Estuaries (BC Class 31)

	
Organic shorelines comprise nearly 8% of mapped areas in the western Sound. Shown is an estuary with Forms for marsh and ponds in the supratidal and intertidal (“Mlo”), streams (“Rs”), and a delta (“Df”).	Shown is an organic shoreline (BC Class 31) with Forms for high marsh (“Mh”), streams (“Rs”), and a delta with multiple bars and channels (“Dbm”).
Kings Bay, (Unit 02/02/4484)	Crab Bay, Evans Island (Unit 02/01/057)
PWS04_02837.JPG	PWS04_00400.JPG

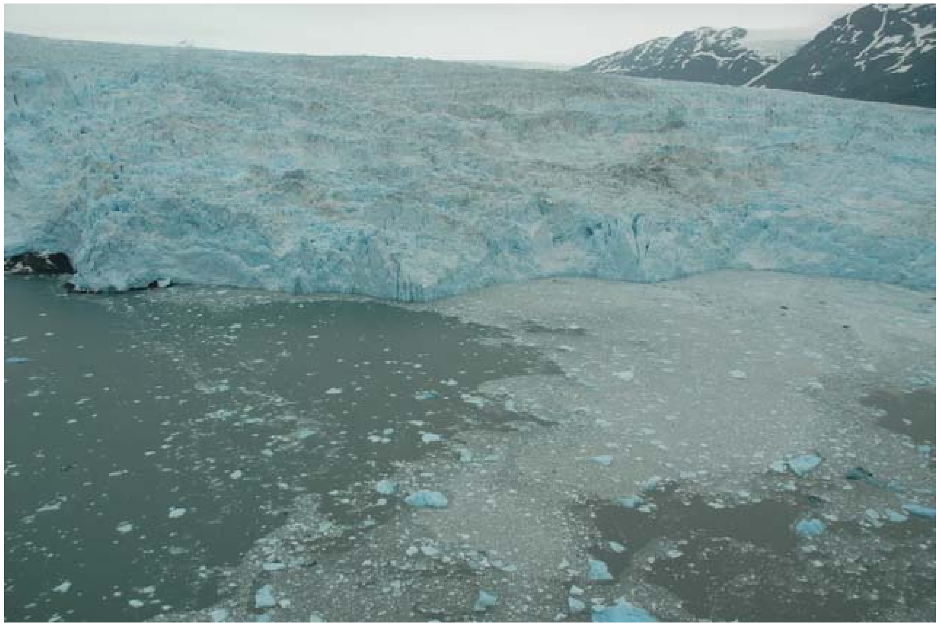
Shore Type: Human-Altered Shorelines (BC Classes 32-33)

	
Less than 1% of mapped shorelines in the western Sound are classified as entirely altered by human activities. Shown is a unit that includes Forms for port facility (“Ap”), seawall (“As”), and pilings (“Aa”), assigned a BC Class 32.	The entire unit is classified as altered by human activities (BC Class 32), including Forms for port facility (“Ap”), seawall (“As”), boat ramp (“Ar”), and tailings and fill (“At”).
Whittier (Unit 02/02/6553)	Whittier (Unit 02/02/6543)
PWS04_03692.JPG	PWS04_03688.JPG

Shore Type: Current-Dominated Channels (BC Class 34)

	
Current-dominated channels represent <1% of the length of mapped shorelines in the western Sound (BC Class 34).	
Ewan Bay (Unit 02/01/2466)	
PWS04_01724.JPG	

Shore Type: Glaciers (BC Class 35)

	
Glaciers represent <1% of the length of mapped shorelines in the Western Sound. Ice is mapped as a Form "Ig."	Blackstone Glacier
Chenega Glacier, Nassau Fjord (Unit 02/01/5481)	Blackstone Glacier, Blackstone Bay (Unit 02/02/3826)
PWS04_01386.JPG	PWS04_03607

Geomorphic Features: Deltas, Mudflats, and Tidal Flats

	
Delta fan with multiple river channels (Forms “Df” and “Rm”)	Delta (Form “Df”) and tidal flat (Form “Tt”) with multiple river channels (“Rm”)
Chenega Island (Unit 02/01/3107)	Whale Bay (Unit 02/01/8436)
PWS04_01953.JPG	PWS04_01152.JPG

Geomorphic Features: Lagoons

	
Open lagoon (Form “Lo”), marsh (Form “Ml”), and tidal flat (“Tt”)	Open lagoon (Form “Lo”), marsh (Form “Ml”), and tidal flat (“Tt”)
Masked Bay, Chenega Island (Unit 02/01/2685)	Masked Bay, Chenega Island (Unit 02/01/2686)
PWS04_01794.JPG	PWS04_01795.JPG

Anthropogenic Features: Coastal Structures and Seawalls

	
All buildings and structures are mapped as wharves (Form “Aw”); other Forms include derelict ship (“Ad”) and debris classified as fill and tailings (“At”).	Coastal road fortified with rip-rap (Form “As”).
Falls Bay (Unit 02/02/0491)	Whittier (Unit 02/02/6556)
PWS04_02386.JPG	PWS04_03694.JPG

Other Interesting Features: Fish Traps and Drowned Forests

	
Fish traps in the lower intertidal zone are mapped as Form “Ah,” which may also be used for village sites and shell middens, or as Form “As” for seawall.	Drowned forest (Form “Mf”) in a marsh with ponds (Form “Mlo”)
Ewan Bay (Unit 02/01/2470/)	Blackstone Bay (Unit 02/02/4865)
PWS04_01727.JPG	PWS04_03574.JPG

3 BIOLOGICAL SHOREZONE DATA SUMMARY

3.1 Biobands

Biological ShoreZone mapping includes both observed and interpreted data. A **bioband** is an observed assemblage of coastal biota with a characteristic color and across-shore elevation, from the high supratidal to the shallow subtidal. Biobands are named for the dominant species or group that best represents the entire band (Table 3.1). Bands are spatially distinct, with alongshore and cross-shore patterns of color and texture that are visible in aerial imagery (Figure 3.1). Some biobands are characterized by a single indicator species (such as the “Blue Mussel” band, code “BMU”), while others represent an assemblage of co-occurring species (such as the “Red Algae” band, code “RED”).

Biological ShoreZone mapping is based on the principle that the occurrence and extent of biobands is directly related to both the degree of wave exposure and the substrate type in the coastal zone. The observed presence, absence, and distribution (mapped as “continuous” or “patchy”) of biobands within an alongshore unit are used to assign the interpreted characteristics of **biological wave exposure** and **habitat class** for the unit.

Figure 3.1. Linear “bands” of color and texture alongshore formed by biological assemblages of species in the intertidal zone. Shown is a steep, rocky shoreline in Prince of Wales Passage on Evans Island. (PWS04_00545.jpg)

Table 3.1. Biobands of Prince William Sound

Zone	Bioband Name	Database Label	Colour	Diagnostic Indicator Species	Exposure *
Supratidal	Splash Zone	**VER**	Black or bare rock	Encrusting black lichens	Width varies with exposure.
	Dune Grass	**GRA**	Pale blue-green	*Leymus mollis*	P to E
	Sedges	**SED**	Bright green to yellow-green	*Carex sp.*	VP to SP
	Marsh grasses, herbs and sedges	**PUC**	Light or bright green	*Puccinellia sp.* Other salt-tolerant herbs and grasses	VP to SE
Upper to Mid-Intertidal	Barnacle	**BAR**	Grey-white to pale yellow	*Balanus sp.* *Semibalanus sp.*	P to E
	Rockweed	**FUC**	Golden-brown	*Fucus sp.*	P to SE
	Green Algae	**ULV**	Green	*Ulva sp.* Other small green algae	P to E
	Blue Mussels	**BMU**	Black or blue-black	*Mytilus trossulus*	P to E
	Bleached Red Algae	**HAL**	Olive, golden or yellow-brown	Bleached foliose or filamentous red algae	P to SE
	Red Algae	**RED**	dark to bright red (non-corallines) or pink (corallines)	*Odonthalia sp.* *Neorhodomela sp.* *Palmaria sp.* other red algae, and other coralline algae	P to E
Lower Intertidal and Nearshore Subtidal	Surfgrass	**SUR**	Bright green	*Phyllospadix sp.*	SP to SE
	Alaria	**ALA**	Dark brown	*Alaria sp.*	SP to E
	Soft brown Kelps	**SBR**	Yellow-brown, olive brown or brown.	*Laminaria saccharina* morph	VP to SP
	Dark brown Kelps	**CHB**	Dark chocolate brown	Stalked *Laminaria sp.* *Lessoniopsis littoralis* other bladed kelps	SE to E
	Eelgrass	**ZOS**	Bright to dark green	*Zostera marina*	VP to SP
Sub-tidal	Dragon Kelp	**ALF**	Golden-brown	*Alaria fistulosa*	SP to SE
	Macrocystis **	**MAC**	Golden-brown	*Macrocystis integrifolia*	P to SE
	Bull Kelp	**NER**	Dark brown	*Nereocystis luetkeana*	SP to E

* Wave Exposure Codes: VP = Very Protected, P = Protected, SP = Semi-Protected, SE = Semi-Exposed, E = Exposed

** Macrocystis was not observed in the mapped area of the Prince William Sound 2004 aerial video survey

As the ShoreZone mapping system has been completed in different geographic areas, we have recognized differences in the species assemblages that characterize the lower intertidal biobands in different areas. These four biobands are: Bleached Red Algae (“HAL”), Red Algae (“RED”), Soft Brown Kelps (“SBR”) and Dark Brown Kelps (“CHB”). To accommodate these region-specific definitions, we define geographic **bioareas** to allow for different indicator and associated species in the four lower intertidal biobands where these regional differences are noted.

The 2004 biomapping has been assigned to one bioarea in Prince William Sound, however, as has been done in Southeast Alaska, as new areas are mapped from recently collected imagery, it is likely that additional bioareas will be defined for Prince William Sound. See Appendix A, Table A-7 for a list of other bioareas defined to date in Alaska ShoreZone mapping.

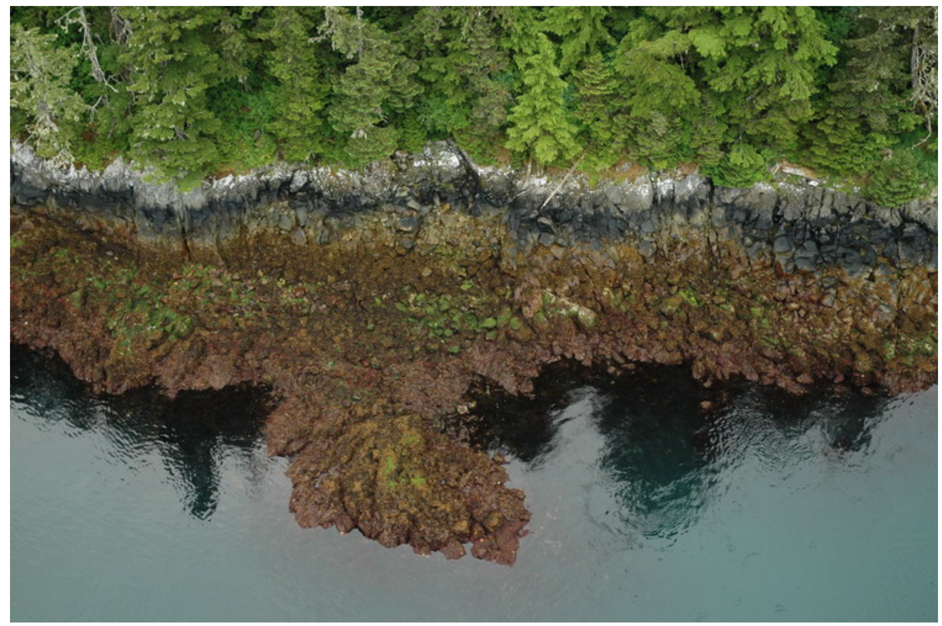
Descriptions of Prince William Sound biobands, with notes about species assemblages are listed on the following pages.

The Splash Zone (VER) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
A	**Splash Zone**	**VER**	Black or bare rock	*Verrucaria sp*. Encrusting black lichens	Visible as a dark stripe, on bare rock, marking the upper limit of the intertidal zone. This band is observed on bedrock, or on low energy boulder/cobble shorelines. Note: This band is recorded by width Narrow (N) = less than 1m Medium (M) = 1m to 5m Wide (W) = more than 5m	Width varies with exposure. N=VP-SP M=SP-SE W=SE-VE	*Littorina sp*.

There is a dark grey Splash Zone below the tree line here just north of Point Nowell in Knight Island Passage. Note the darker black blue mussel band in the mid intertidal zone.

PWS04_02146.jpg



The *Verrucaria* shows up here as a narrow black band above a mixture of lush algae on Evans Island in Prince of Wales Passage.

PWS04_00548.jpg

The Dune Grass (GRA), Sedges (SED), and Marsh grasses, herbs and sedges (PUC) Biobands

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
A	**Dune Grass**	**GRA**	Pale blue-green	*Elymus mollis*	Found in the upper intertidal zone, on dunes or beach berms. This band is often the only band present on high-energy beaches.	P-E	
A	**Sedges**	**SED**	Bright green, yellow-green to red-brown. Often appears as a mosaic of greens.	*Carex ramenskii* *Carex lynbyei* *Carex sp.* *Eleocharis sp.* *Eriophorum sp.*	Appears in wetlands around lagoons and estuaries. Usually associated with freshwater. This band can exist as a wide flat pure stand or be intermingled with dune grass. Often the PUC band forms a fringe below.	VP-SP	* species referenced for this band from Cook Inlet ground survey reports: Bennett, 1996 and Tande, 1996.
A	**Marsh grasses, herbs and sedges**	**PUC**	Light, bright, or dark green, with red-brown	*Puccinellia sp.* *Plantago maritima* *Triglochin sp.* *Honkenya peploides*	Appears in wetlands around lagoons, marshes, and estuaries. Usually associated with freshwater. Often fringing the edges of GRA and SED bands.	VP-SE	*Carex sp.*

The patch of blue-green dune grass can be readily distinguished from the other emerald green marsh grasses here in Cochrane Bay.

PWS04_03470.jpg

Dune grass, sedges, and other marsh grasses form a wetland complex in this drowned forest in Blackstone Bay.

PWS04_03574.jpg

Bennett, A.J. 1996. Physical and Biological Resource Inventory of the Lake Clark National Park - Cook Inlet Coastline, 1994-96. Unpub. Rept., US National Parks Service, Kenai, AK. 137pp.
Tande, G.F. 1996. Mapping and Classification of Coastal Marshes. Lake Clark National Park and Preserve Alaska. Unpub. Rpt.for US NPS, Lake Clark National Park & Presv., Kenai, AK. 56pp.

The Barnacle (BAR) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
upper B	**Barnacle**	**BAR**	Grey-white to pale yellow	*Balanus sp.* *Semibalanus sp.*	Visible on bedrock or large boulders. Can form an extensive band in higher exposures where algae have been grazed away.	P-E	*Endocladia muricata* *Gloiopeltis furcata* *Porphyra sp.* *Fucus sp.*

	
There is a beige barnacle band in the mid intertidal zone below the rockweed and above the red algae on this steep rocky shoreline of North Fleming Island in Knight Island Passage.	This is a close-up of barnacles mixed with *Fucus* and blue mussels on Applegate Island in Port Nellie Juan.
PWS04_01015.jpg	PWS04_03219.jpg

The Rockweed (FUC) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
upper B	**Rockweed**	**FUC**	Golden-brown	*Fucus sp.*	Appears on bedrock cliffs and boulder, cobble or gravel beaches. Commonly occurs at the same elevation as the barnacle band.	P-SE	*Balanus sp.* *Semibalanus sp.* *Ulva sp.* *Pilayella sp.*

	
There are lush bands of *Fucus* down to the waterline in Hogg Bay on Bainbridge Island.	Rockweed forms a golden band in the upper intertidal of this beach on Flemming Island in Prince of Wales Passage.
PWS04_00826.jpg	PWS04_00999.jpg

The Green Algae (ULV) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Green Algae**	**ULV**	Green	*Ulva sp.* *Monostroma sp.* *Enteromorpha sp.* *Cladophora sp.* *Acrosiphonia sp.*	Found on a variety of substrates. This band can consist of filamentous and/or foliose green algae. Filamentous species often form a low turf of dark green.	P-E	Filamentous red algae.

Green algae forms a narrow neon green band at the waterline on the south side Whale Bay.

PWS04_01188.jpg

The influence of the glacier is evident here at the Head of Icy Bay where the only biota present is a wide band of green algae.

PWS04_01334.jpg

The Blue Mussel (BMU) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Blue Mussels**	**BMU**	Black or blue-black	*Mytilus trossulus*	Visible on bedrock and on boulder, cobble or gravel beaches. Appears in dense clusters that form distinct black patches or bands, either above or below the barnacle band.	P-E	*Fucus sp.* *Semibalanus sp.* *Balanus sp.* Filamentous red algae.

Blue mussels form a narrow black band in Port Nellie Juan north of Blue Fiord. Note that the black band above the blue mussels is *Verrucaria*.

PWS04_02648.jpg

There is a fairly wide band of dusky grey, sediment-covered blue mussels on this beach in Blackstone Bay.

PWS04_03595.jpg

The Bleached Red Algae (HAL) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Bleached Red Algae**	**HAL**	Olive, golden or yellow-brown	Bleached foliose red algae *Palmaria sp.* *Odonthalia sp.*	Common on bedrock platforms, and cobble or gravel beaches. Distinguished from the RED band by colour. The bleached colour usually indicates lower wave exposure than where the RED band is observed, and may be caused by nutrient deficiency.	P-SE	*Halosaccion glandiforme* *Mazzaella sp.* Filamentous green algae

	
Bleached red algae can be seen in the lower intertidal forming a continuous band around this island off Evans Island in Latouche Passage.	There is an annual matrix of bleached red algae plastered over this lower platform creating a continuous HAL band on northern Chenega Island in Knight Island Passage.
PWS04_00411.jpg	PWS04_01971.jpg

The Red Algae (RED) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B	**Red Algae**	**RED**	Corallines: pink or white Foliose or filamentous: Dark red, bright red, or red-brown.	*Corallina sp.* *Lithothamnion sp.* *Neoptilota sp.* *Odonthalia sp.* *Neorhodomela sp.* *Palmaria sp.* *Mazzaella sp.*	Appears on most substrates except fine sediments. Lush coralline algae indicates highest exposures; diversity of foliose red algae indicates medium to high exposures, and filamentous species, often mixed with green algae, occur at medium and lower exposures.	P-E	*Pisaster sp.* *Nucella sp.* *Katharina tunicata* mixed large browns of the CHB bioband

	
There is a very distinct red algae band of *Palmaria* at the waterline on this small island off eastern Latouche Island in Latouche Passage.	Red algae forms a thick, dark brick red band in the lower intertidal of this high-energy beach on south Bainbridge Island.
PWS04_00273.jpg	PWS04_00934.jpg

The Surfgrass (SUR) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Surfgrass**	**SUR**	Bright green	*Phyllospadix sp.*	Appears in tidepools on rock platforms, often forming extensive beds. This species has a clearly defined upper exposure limit of semi-exposed and its presence in units of Exposed wave energy indicates a wide across-shore profile, where wave energy is dissipated by wave run-up across the broad intertidal zone.	SP-SE	Foliose and coralline red algae

	
This piece of semi-protected shoreline in Takanis Bay on Yakobi Island has surfgrass underwater mixed with a canopy of Macrocystis. This area acts as a good example of where surfgrass would be found at the lowest wave energy level.	The bright green surfgrass can be seen on the lower platform and extending down into the subtidal near Middle Island in Sitka Sound.
SE05_MM_1079.jpg*	SE05_MM_5135.jpg*

*Note: Although Surfgrass was observed in 2007 imagery in Prince William Sound, there were no good examples in Prince William Sound 2004 photos, and Surfgrass examples included here are from Southeast Alaska.

The *Alaria* (ALA) Bioband

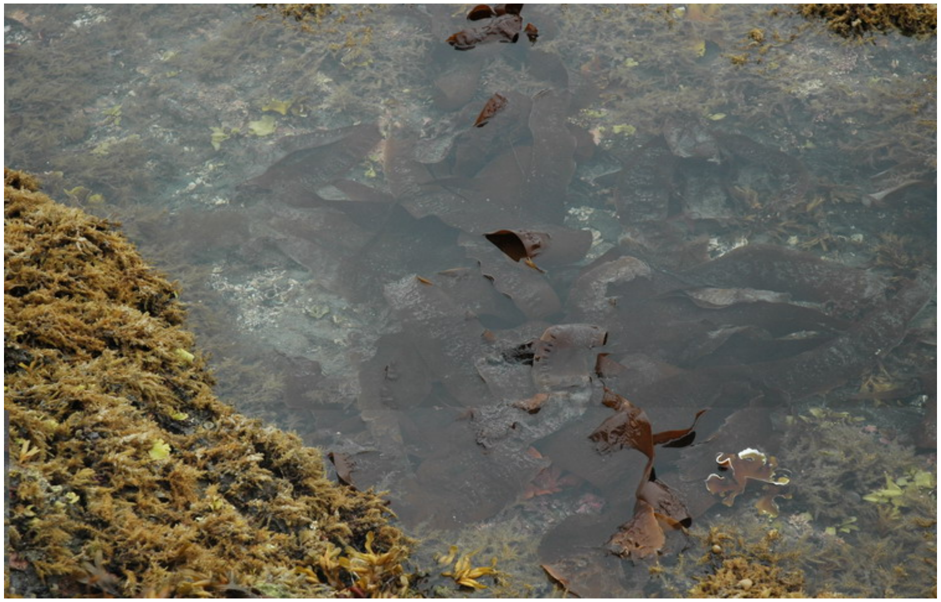
Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Alaria**	**ALA**	Dark brown or red-brown	*Alaria marginata* *Alaria sp.*	Common on bedrock cliffs and platforms, and on boulder/cobble beaches. This often single-species band has a distinct ribbon-like texture, and may appear iridescent in some imagery.	SP-E	Foliose red algae *Laminaria sp.*

	
There is a red-brown band of *Alaria* at the waterline on this steep rock cliff of Culross Island in Culross Passage.	The ALA band in Salisbury Sound, Chichagof Island, just northwest of Neva Strait, is an iridescent, deep red band in the lower intertidal. Bright orange and purple *Pisaster* sea stars cling to bedrock amidst the draped *Alaria*. Long, shiny stipes of the bull kelp are also seen in the nearshore subtidal.
PWS04_03194.jpg	SE05_MM_4991.jpg*

*Note: There were not many good example photos of *Alaria* in Prince William Sound 2004 imagery so the photo included here is from Southeast Alaska.

The Soft Brown Kelps (SBR) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Soft Brown Kelps**	**SBR**	Yellow-brown, olive brown or brown.	*Laminaria saccharina* *Cystoseira sp.*	This band is defined by non-floating large browns and can form lush bands in semi-protected areas. The kelp fronds have a ruffled appearance and can be encrusted with diatoms and bryozoans giving the blades a 'dusty' appearance.	VP-SP	*Alaria sp.* *Cymathere sp.* *Hedophyllum sessile* (bullate)

	
Soft brown kelps can be seen underwater in the nearshore subtidal of this protected beach in Jackpot Bay west of Chenega Island.	This is a close-up view of *Laminaria saccharina*.
PWS04_01658.jpg	PWS04_03223.jpg

The Dark Brown Kelps (CHB) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Dark Brown Kelps**	**CHB**	Dark chocolate brown	*Laminaria setchelli* *Laminaria bongardiana* *Laminaria yezoensis* *Lessoniopsis littoralis* *Hedophyllum sessile* (smooth)	Found at higher wave exposures, these stalked kelps grow in the lower intertidal. Blades are leathery, shiny, and smooth. A mixture of species occurs at the moderate wave exposures, while single-species stands of *Lessoniopsis.* occur at high exposures.	SE-E	*Cymathere sp.* *Pleurophycus sp.* *Costaria sp.* *Alaria sp.* *Neoptilota sp.*

Laminaria setchelli forms a dark chocolate brown band subtidally off this beach on the east edge of Erlington Island.

PWS04_00342.jpg

The stipes of the dark brown kelps can be seen poking out of the water off this reef on southwest Kruzof Island.

SE05_MM_5982.jpg*

*Note: There were not many good example photos of Dark Brown Kelps in Prince William Sound 2004 imagery so the photo included here is from Southeast Alaska.

The Eelgrass (ZOS) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
B & C	**Eelgrass**	**ZOS**	Bright to dark green	*Zostera marina*	Commonly visible in estuaries, lagoons or channels, generally in areas with fine sediments. Eelgrass can occur in sparse patches or thick dense meadows.	VP-SP	*Pilayella sp*.

	
The eelgrass shows up as a bright emerald green out of the water on the sand flats of this beach on Evans Island. It can also be seen under water forming a thick dense bed subtidally.	This small bay off Passage Canal east of Whittier is filled with lush eelgrass.
PWS04_00507.jpg	PWS04_03681.jpg

The Dragon Kelp (ALF) Bioband

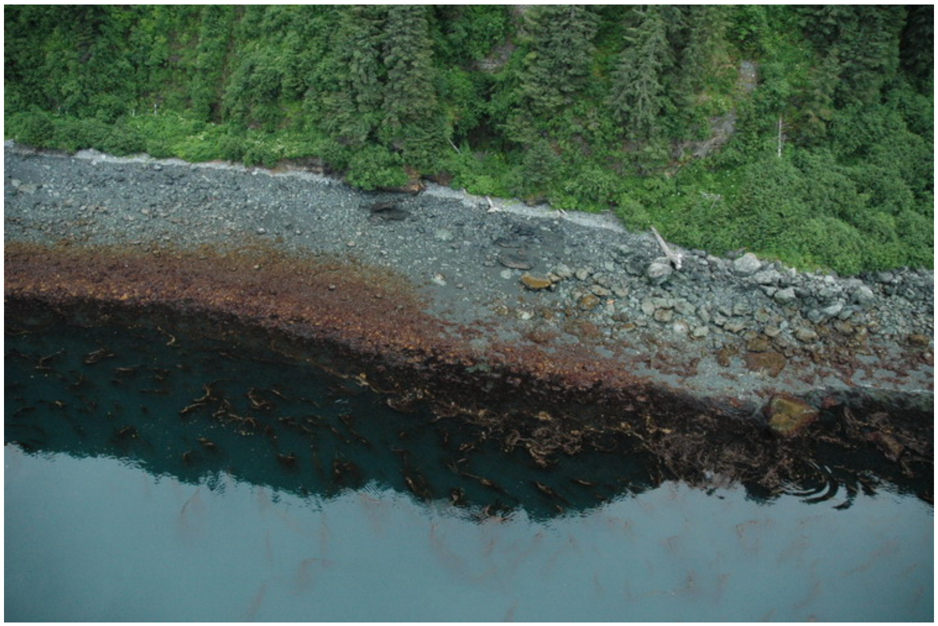
Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
C	**Dragon Kelp**	**ALF**	Golden-brown	*Alaria fistulosa*	Canopy-forming alga with very long blade and hollow floating midrib, found in nearshore habitats. If associated with NER, it occurs inshore of the bull kelp.	SP-SE	*Alaria sp.* *Nereocystis luetkeana*

	
The ALF band forms an extensive canopy in the subtidal, with NER farther offshore, at Point Gustavus in Icy Strait.	Long, narrow strands of dark brown dragon kelp can be seen in the subtidal of this boulder-cobble beach in Gilbert Bay, Port Snettisham. The kelp can be identified by its rope-like appearance imparted by hollow, floating midribs and long blades.
SE05_ML_5987.jpg*	SE05_ML_9672.jpg*

*Note: Dragon Kelp occurs in a few places in southwest Prince William Sound, but it is not common. These photo examples are from Southeast Alaska.

The Bull Kelp (NER) Bioband

Zone	Bioband Name	Database Label	Colour	Indicator Species	Physical Description	Exposure	Associate Species
C	**Bull Kelp**	**NER**	Dark brown	*Nereocystis luetkeana*	A distinctive canopy-forming kelp with many long strap-like blades growing from a single floating bulb atop a long stipe. Can form an extensive canopy in nearshore habitats, usually further offshore than *Alaria fistulosa* and *Macrocystis*. Often indicates higher current areas if observed at lower wave exposures.	SP-E	*Alaria fistulosa* *Macrocystis integrifolia*



The *Nereocystis* can be seen in the nearshore subtidal forming an extensive canopy off Bainbridge Island in Prince of Wales Passage.

PWS04_00969.jpg

Offshore bull kelp fills the subtidal along this section of shoreline in Bainbridge Passage adjacent to Port Bainbridge.

PWS04_01053.jpg

3.2 Biological Wave Exposure

Biological Wave Exposure is a summary attribute that is interpreted during biological mapping from observations of the presence and abundance of biota in each alongshore unit. It is considered the most representative index of actual wave exposure (“EXP_BIO” in the database). For this attribute, wave exposure categories ranging from Very Protected (VP) to Very Exposed (VE) are defined on the basis of a set of indicator species and a “typical” set of biobands. The six categories and codes are the same as those used in the physical ShoreZone mapping to characterize wave exposure of an alongshore unit on the basis of fetch window estimates and coastal geomorphology (“EXP_OBSER” in the database).

Energy tolerances of species assemblages are known from scientific literature and from expert knowledge, and these characteristics of coastal species are used to define wave exposure categories. Some biobands are observed in all wave exposure categories and are considered “associated species” bands (e.g. the Barnacle bioband), while other biobands are considered “indicators” because they are closely associated with particular wave exposures. For example, the Dark Brown Kelps bioband (CHB) is consistently associated with higher wave exposures. Typical indicator and associated species and biobands are summarized for each Biological Wave Exposure category from mapped areas in Prince William Sound with example illustrations in Tables 3.2 through 3.5 and in Figures 3.2 through 3.5.

A summary map of the distribution of biological wave exposure in the 2004 mapped areas of Prince William Sound is shown in Figure 3.6. Note that the “Very Exposed” category has not been applied in biological mapping of Prince William Sound but has been mapped on the Outer Kenai coast, in Kenai Fjords National Park, and on the southwest coast of Moresby Island, British Columbia.

Also note that species and biobands listed for each wave exposure category are considered “typical” but not “obligate.” That is, not all species occur in every unit classified with a particular biological wave exposure. The combination of biobands, indicator species, and interpretation by biological mappers determines the wave exposure category for each unit.

Shore station species lists are generally used to add qualitative descriptions to bioband definitions and to fill out the list of species associated with each bioband. However, in Prince William Sound, ShoreZone ground stations have not been done yet, and we have used existing data from other coastal Alaska surveys to augment the species lists for each bioband.

Table 3.2. Typical and associated species of biobands
Exposure Category: Exposed (E)**

Zone	Indicator Species	Associated Species	Bioband Name	Bioband Code
Upper Intertidal		*Leymus mollis* *	Dune Grass	GRA
	Verrucaria		Splash Zone	VER
		Balanus glandula *Semibalanus balanoides*	Barnacle	BAR
	Semibalanus carriosus		Barnacle	BAR
	Mytilus trossulus		Blue Mussel	BMU
Lower Intertidal	Coralline red algae		Red Algae	RED
	Alaria 'nana' morph		Alaria	ALA
	Lessoniopsis littoralis		Choc Brown Kelps	CHB
	Laminaria setchellii		Choc Brown Kelps	CHB
	Nereocystis luetkeana		Bull Kelp	NER

*observed in dunes on bare beaches

Figure 3.2. Exposed bedrock shoreline on southern Elrington Island. The only biobands represented here are the *Verrucaria*, barnacles, red algae, and dark brown kelps. This is the typical assemblage of bands seen at high wave exposures. Note the sea lions hauled out on the rocks. (PWS04_00334.jpg)

Table 3.3. Typical and associated species of biobands
Exposure Category: Semi-Exposed (SE)

Zone	Indicator Species	Associated Species	Bioband Name	Bioband Code
Upper Intertidal		*Leymus mollis* *	Dune Grass	GRA
	Verrucaria		Splash Zone	VER
		Balanus glandula/ Semibalanus balanoides	Barnacle	BAR
		Fucus distichus	Rockweed	FUC
	Semibalanus carriosus		Barnacle	BAR
	Mytilus trossulus		Blue Mussels	BMU
Lower Intertidal and Nearshore Subtidal	diverse mixed red algae, including *Odonthalia, Palmaria* and others.		Red Algae	RED
	Neoptilota		Red Algae	RED
	Alaria 'marginata' morph		Alaria	ALA
	Phyllospadix sp.		Surfgrass	SUR
	Laminaria setchellii		Choc Brown Kelps	CHB
	Laminaria yezoensis		Choc Brown Kelps	CHB
	Laminaria bongardiana morph		Choc Brown Kelps	CHB
	Hedophyllum smooth morph		Choc Brown Kelps	CHB
	Alaria fistulosa		Dragon Kelp	ALF
		Macrocystis integrifolia	Macrocystis	MAC
	Nereocystis luetkeana		Bull Kelp	NER

*observed in dunes on bare beaches

Figure 3.3. Boulder beach on southern Bainbridge Island with a narrow barnacle band and a continuous red algae band in the lower intertidal mixed with Alaria at the water's edge. This combination of biobands indicates a wave exposure of semi-exposed. (PWS04_00923.jpg)

Table 3.4. Typical and associated species of biobands
Exposure Category: Semi-Protected (SP)

Zone	Indicator species	Associated Species	Bioband Name	Bioband Code
Upper Intertidal		*Leymus mollis* *	Dune Grass	GRA
		Carex spp *	Sedges	SED
		Puccinellia *	Marsh grasses, herbs and sedges	PUC
		Triglochin *	Marsh grasses, herbs and sedges	PUC
		Plantago maritima *	Marsh grasses, herbs and sedges	PUC
	Verrucaria		Splash Zone	VER
Lower Intertidal and Nearshore Subtidal		*Balanus glandula* *Semibalanus balanoides*	Barnacle	BAR
		Fucus distichus	Rockweed	FUC
	Semibalanus carriosus		Barnacle	BAR
	Mytilus trossulus		Blue Mussels	BMU
		Ulva and other foliose green algae	Green Algae	ULV
	Palmeria spp (bleached)		Bleached Red Algae	HAL
	Mixed red algae including *Odonthalia*		Red Algae	RED
	Alaria 'marginata' morph		Alaria	ALA
	Zostera marina		Eelgrass	ZOS
	Cystoseira		Soft brown Kelps	SBR
	Cymathere		Soft brown Kelps	SBR
	Laminaria saccharina morph		Soft brown Kelps	SBR
	Nereocystis luetkeana		Bull Kelp	NER

*associated with Wetland/ Estuary areas at this wave exposure

Figure 3.4. This platform on eastern Bainbridge Island in Prince of Wales Passage has a band of fringing grasses above a medium splash zone in the supratidal. There is a thick golden band of *Fucus* in the upper intertidal and another in the lower intertidal mixed with green algae. The red algae form a continuous band at the waterline with soft brown kelps under water. This biological assemblage of species indicates that the wave exposure is semi-protected. (PWS04_00988.jpg)

Table 3.5. Typical and associated species of biobands
Exposure Category: Protected (P) and Very Protected (VP)

	Indicator species	Associated Species	Bioband Name	Bioband Code
Upper Iintertidal		*Leymus mollis* *	Dune Grass	GRA
		Carex spp *	Sedges	SED
		Puccinellia *	Marsh grasses, herbs and sedges	PUC
		Triglochin *	Marsh grasses, herbs and sedges	PUC
		Plantago maritima *	Marsh grasses, herbs and sedges	PUC
	Verrucaria		Splash Zone	VER
		Balanus glandula/ Semibalanus balanoides	Barnacle	BAR
		Fucus with epiphyte *Pilayella*	Rockweed	FUC
	Mytilus trossulus		Blue Mussels	BMU
Lower Intertidal	*Ulva/* foliose green algae		Green Algae	ULV
	Zostera marina		Eelgrass	ZOS
	Laminaria saccharina morph (not in Very Protected)		Soft brown Kelps	SBR

*associated with Wetland/ Estuary areas at this wave exposure

Figure 3.5. The combination of biobands seen in Cochrane Bay indicates that the biological wave exposure is protected. There is dune grass mixed with fringing marsh grasses in the supratidal. The *Fucus* forms a wide, continuous band across the intertidal with patchy green algae in the lower. A dense bed of bright green eelgrass fills the subtidal. (PWS04_03529.jpg)

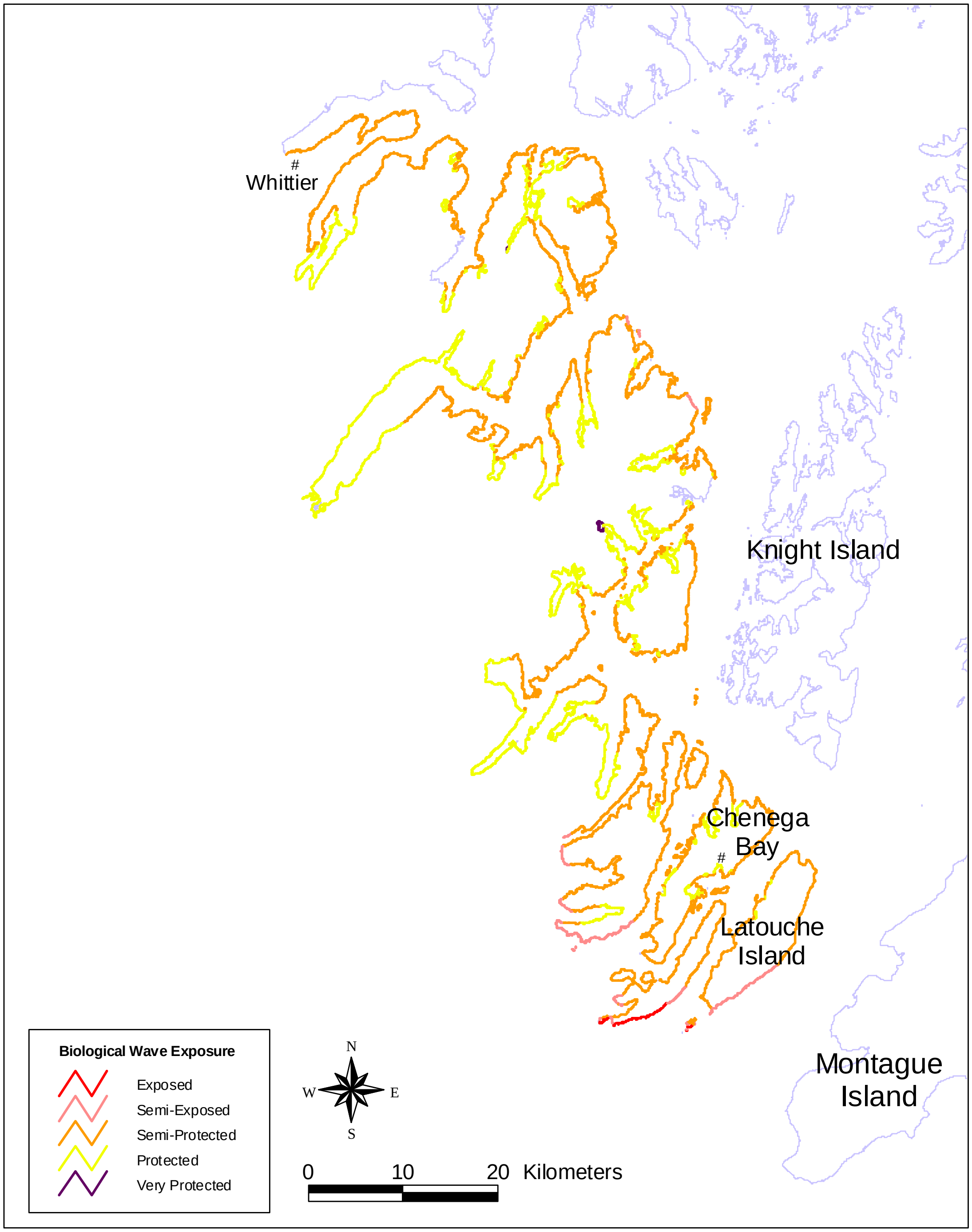


Figure 3.6. Distribution of biological wave exposures in mapped areas of western Prince William Sound.

3.3 Habitat Class

Habitat suitability for coastal species and marine organisms is determined by both physical and biological characteristics. The ShoreZone habitat mapping system considers geomorphic, energetic, and physical attributes, as well as the distribution and ecological function of organisms, to classify coastal areas and describe their habitats.

Habitat Class is a summary classification that combines both physical and biological characteristics observed for a particular shoreline unit. It is intended to provide a simplified biophysical characterization of the unit on the basis of detailed along-shore and across-shore attributes that have been mapped.

The species assemblages observed at a particular location are a reflection of both the physical characteristics of that shore segment, as well as the wave exposure. Thus, the species assemblage observed on an exposed shore with a mixture of rock and mobile sediment will be distinct from the species assemblage observed on a shore with a protected wetland complex. Further description of the Habitat Class definitions are presented in Appendix A, Table A – 8.

Where the dominant structuring process in the shore unit is wave energy, the interaction of the wave exposure and the substrate type determines the **substrate mobility.** Stability of the substrate determines the presence and abundance of attached biota. Where the substrate is stable (such as bedrock), well-developed epibenthic bioband assemblages occur. Where the substrate is mobile (such as on sandy beaches), the epibenthic community may be sparse or absent. Most shore units have habitat class determined by wave energy as the dominant structuring process.

Three classes of substrate mobility used in ShoreZone habitat characterization are:

- **Immobile or stable:** substrates such as bedrock, boulders, and cobbles (could even be pebbles on a low-exposure coast) (Figure 3.7).
- **Partially mobile:** mixed substrates such as a rock platform with a beach or sediment veneer; or units where energy varies across the beach. The partial mobility of the sediment limits the development of a full bioband assemblage that would likely occur on a stable rock shoreline (Figure 3.8).
- **Mobile:** substrates such as sandy beaches where coastal energy levels are sufficient to frequently move sediment, thereby limiting the development of epibenthic biota (Figure 3.9).

Figure 3.7. A lush assemblage of algae blankets the entirety of this **immobile** bedrock cliff on Junction Island off northern Chenega Island. (PWS04_01977.jpg)

Figure 3.8. **Partially mobile** shoreline permits the growth of biota on bedrock and other stable sediment. The example shown is on the southern side of the entrance to Port Nellie Juan. (PWS04_02512.jpg)

Figure 3.9. This is a **mobile** beach in Port Nellie Juan near the mouth of Kings Bay. The lack of biota can be attributed to the mobility of the sediment. (PWS04_02803.jpg)

Less common Habitat Classes are those determined by dominant structuring processes other than wave energy (Appendix A, Table A-8).

- **Estuary** types with wetlands and marsh vegetation along low energy sediment shores influenced by freshwater (Figure 3.10).
- **Current-Dominated** channels where high tidal currents create anomalous assemblages of biota. Usually associated with lower wave exposure conditions in adjacent shore units (Figure 3.11).
- **Glaciers** where glacial ice interacts directly with the supra-tidal, intertidal and/or subtidal area of the shoreline (Figure 3.12).
- **Anthropogenic Features** where the shoreline has been modified or disturbed. Examples include wharves or areas of rip rap or fill.

These other habitat classes tend to be rare habitats, and for Estuary or Current-dominated channels are also highly valued habitats.

A summary map of the distribution of Habitat Classes mapped in the 2004 dataset is shown in Figure 3.13.

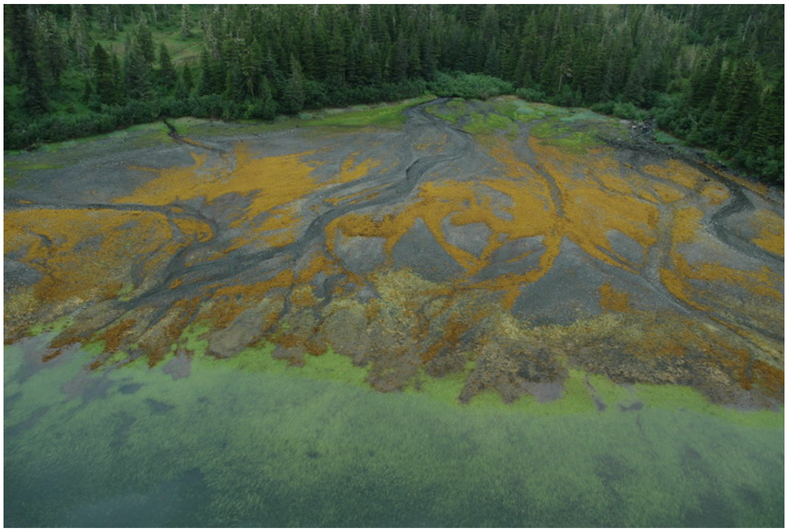


Figure 3.10. Estuary in Whale Bay with supratidal marsh grass and intertidal bands of rockweed and eelgrass. (PWS04_01152.jpg)

Figure 3.11. The head of Ewan Bay shown here has a high-current tidal falls. This **current-dominated** channel connects a ponded high-tide lagoon complex to Ewan Bay. (PWS04_01722.jpg)

Figure 3.12. Blackstone Glacier is a classic example of the **glacier** habitat where a mass of bright blue glacial ice fills the head of Blackstone Bay. (PWS04_03607.jpg)

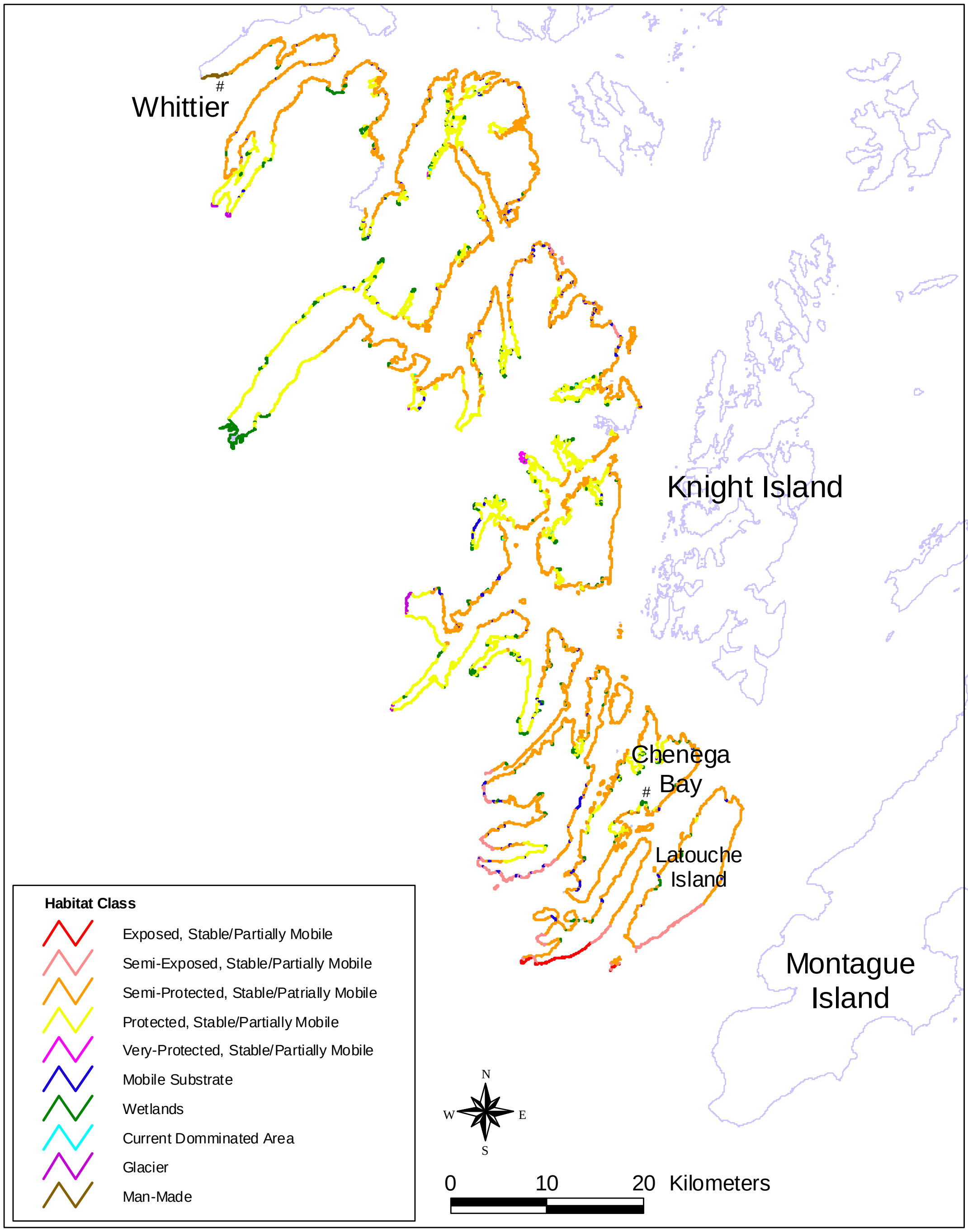


Figure 3.13. Distribution of habitat class categories mapped areas of western Prince William Sound.

APPENDIX A DATA DICTIONARY

Table A-1. Data dictionary for UNIT table

Field Names	Type	Description
UnitRecID	N	unique numerical number for each record
PHY_IDENT	T	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers (RR/AA/UUUU/SS)
REGION	T	coastal region number
AREAS	T	coastal area number
PHY_UNIT	T	physical shore unit number; the unit is the primary alongshore subdivision during the mapping
SUBUNIT	T	subunit number: “0” for main Unit and “1,2,3…” for variants or point features
TYPE	T	a description of Unit type: a (**L**)line-type unit, or a (**P**)oint variant
BC_CLASS	N	a number indicating the BC “coastal class” or “shoreline type” (see Table A-2)
ESI	T	a number code for the ESI coastal classification system (see Table A-3)
LENGTH_M	N	the unit alongshore length in M, calculated using GIS software
GEO_MAPPER	T	last name of geology mapper
GEO_EDITOR	T	last name of individual responsible for reviewing and editing
GEO_MAP_DATE	D/T	date of original geological mapping
GEO_SOURCE	T	data sources for geological interpretation: (V)ideotape, (P)hoto-aerial, (T)opo maps, (C)harts, (O)ther
SCALE	T	scale of base maps used to delineate units
VIDEOTAPE	T	the videotape identifier number
HR	T	the “burned-in” tape time from the GPS that appears on the video image; "X" indicates no screen time was available
MIN	T	the “burned-in” tape time from the GPS that appears on the video image; "X" indicates no screen time was available
SEC	T	the “burned-in” tape time from the GPS that appears on the video image; "X" indicates no screen time was available
MAP_NO	I	page number from the DeLorme Alaska Atlas where the Unit is plotted
CHART	T	NOAA chart number(s) for the Unit
EXP_OBSER	T	an estimate of the wave exposure as observed by geomorphologist during mapping based on Table A-4
EXP_CLASS	T	a numeric code for best exposure estimate where EXP_BIO is better than ESP_OBS (see Table A-4)
ORI	I	a code indicating the potential oil residence index, see Tables A-5 and A-6
SED_SOURCE	T	a code indicating the estimated sediment source for the unit, (B)ackshore, (A)longshore, (F)luvial, (O)ffshore
SED_ABUND	T	a code indicating the relative sediment abundance within the shore-unit, (A)bundant, (M)oderate, (S)carce
SED_DIR	T	one of the eight cardinal points of the compass indicating dominant sediment transport direction
CHNG_TYPE	T	a code indicating the stability of the shore unit, (A)ccretional, (E)rosional, (S)table
CHNG_RATE	N	the rate of change of the shoreline within the unit in m/yr

Table A-1. Data dictionary for UNIT table (continued)

SHORENAME	T	the name of a prominent geographic feature near the unit; used to facilitate searches
UNIT_COMMENTS	T	a text field used for miscellaneous comments and notes during the mapping
SHORE_PROB	T	comment on nature of the shore problem, usually the difference between electronic shoreline and observed shoreline
SM1_TYPE	T	the *primary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP= sheet pile; RR = rip rap and WB = wooden bulkhead
SM%	N	the estimated % occurrence of the *primary* seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SM1_M	N	the calculated length in meters of the *primary* seawall type
SM2_TYPE	T	the *secondary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; SP = sheet pile; RR = rip rap and WB = wooden bulkhead
SM2%	N	the estimated % occurrence of the *secondary* seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SM2_ M	N	the calculated length in meters of the *secondary* seawall type
SM3_TYPE	T	the *tertiary* type of seawall occurring within the unit where: BR = boat ramp; CB = concrete bulkhead; LF = landfill; RR = rip rap and WB = wooden bulkhead
SM3%	N	the estimated % occurrence of the *tertiary* seawall type in tenths (i.e., “2” = 20% occurrence within the unit)
SM3_ M	N	the calculated length in meters of the *tertiary* seawall type
SMOD_TOTAL	N	the total % occurrence of seawall in the unit, in tenths
RAMPS	N	the number of boat ramps that occur within the shore zone of the unit or subunit. Ramps must impact some portion of the shore-zone and generally be constructed of concrete, wood or aggregate. Public boat ramps are shown as variants
PIERS_DOCK	N	the number of piers or wharves that occur within the unit. Piers or docks must extend at least 10m into the shore zone. Category does not include anchored floats
REC_SLIPS	N	the estimated number of recreational (or small) slips associated with the piers/docks of the unit based on small boat length (~<50’)
DEEPSEA_SLIP	N	the estimated number of slips for ocean-going vessels (~>100’)
ITZ	N	the sum of the across-shore width of all the intertidal components (B-Zone) within the unit

Table A-2. Shore Type classification employed in the ShoreZone mapping methodology in Alaska (after Howes et al. 1994 for British Columbia "BC Class")

SUBSTRATE	SEDIMENT	WIDTH	SLOPE	Shore Type Code & Description
ROCK	n/a	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(1) Rock Ramp, wide
			FLAT(<5°)	(2) Rock Platform, wide
		NARROW (<30m)	STEEP(>20°)	(3) Rock Cliff
			INCLINED(5-20°)	(4) Rock Ramp, narrow
			FLAT(<5°)	(5) Rock Platform, narrow
ROCK + SEDIMENT	GRAVEL	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(6) Ramp w gravel beach, wide
			FLAT(<5°)	(7) Platform w gravel beach, wide
		NARROW (<30m)	STEEP(>20°)	(8) Cliff w gravel beach
			INCLINED(5-20°)	(9) Ramp w gravel beach
			FLAT(<5°)	(10) Platform with gravel beach
	SAND & GRAVEL	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(11) Ramp w gravel & sand beach, wide
			FLAT(<5°)	(12) Platform w G&S beach, wide
		NARROW (<30m)	STEEP(>20°)	(13) Cliff w gravel/sand beach
			INCLINED(5-20°)	(14) Ramp w gravel/sand beach
			FLAT(<5°)	(15) Platform with gravel/sand beach
	SAND	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(16) Ramp w sand beach, wide
			FLAT(<5°)	(17) Platform w sand beach, wide
		NARROW (<30m)	STEEP(>20°)	(18) Cliff w sand beach
			INCLINED(5-20°)	(19) Ramp w sand beach, narrow
			FLAT(<5°)	(20) Platform w sand beach, narrow
SEDIMENT	GRAVEL	WIDE (>30m)	FLAT(<5°)	(21) Gravel flat, wide
		NARROW (<30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(22) Gravel beach, narrow
			FLAT(<5°)	(23) Gravel flat or fan
	SAND & GRAVEL	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	n/a
			FLAT(<5°)	(24) Sand & gravel flat or fan
		NARROW (<30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(25) Sand & gravel beach, narrow
			FLAT(<5°)	(26) Sand & gravel flat or fan
	SAND/MUD	WIDE (>30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(27) Sand beach
			FLAT(<5°)	(28) Sand flat
				(29) Mudflat
		NARROW (<30m)	STEEP(>20°)	n/a
			INCLINED(5-20°)	(30) Sand beach
			n/a	
	ORGANICS/FINES	n/a	n/a	(31) Organics/Fines
ANTHRO-POGENIC	MAN-MADE	n/a	n/a	(32) Man-made, permeable
				(33) Man-made, impermeable
CURRENT-DOMINATED				(34) Channel
ICE				(35) Glacial ice shoreline

Table A-3 ESI Shore Type classification (after Peterson et al 2002)

ESI No.	Description
1A	Exposed rocky shores; Exposed rocky banks
1B	Exposed, solid man-made structures
1C	Exposed rocky cliffs with boulder talus base
2A	Exposed wave-cut platforms in bedrock, mud, or clay
2B	Exposed scarps and steep slopes in clay
3A	Fine- to medium-grained sand beaches
3B	Scarps and steep slopes in sand
3C	Tundra cliffs
4	Coarse-grained sand beaches
5	Mixed sand and gravel beaches
6A	Gravel beaches; Gravel Beaches (granules and pebbles
6B	Rip rap; Gravel Beaches (cobbles and boulders)
6C	Rip rap
7	Exposed tidal flats
8A	Sheltered scarps in bedrock, mud, or clay; Sheltered rocky shores (impermeable)
8B	Sheltered, solid man-made structures; Sheltered rocky shores (permeable)
8C	Sheltered rip rap
8D	Sheltered rocky rubble shores
8E	Peat shorelines
9A	Sheltered tidal flats
9B	Vegetated low banks
9C	Hypersaline tidal flats
10A	Salt- and brackish-water marshes
10B	Freshwater marshes
10C	Swamps
10D	Scrub-shrub wetlands; Mangroves
10E	Inundated low-lying tundra

Table A-4 Exposure matrix used for estimating observed physical exposure (EXP_OBS)

Maximum Fetch (km)	Modified Effective Fetch (km)				
	<1	**1 - 10**	**10 - 50**	**50 - 500**	**>500**
<1	very protected	n/a	n/a	n/a	n/a
<10	protected	protected	n/a	n/a	n/a
10 – 50	n/a	semi-protected	semi-protected	n/a	n/a
50 – 500	n/a	semi-exposed	semi-exposed	semi-exposed	n/a
>500	n/a	n/a	semi-exposed	exposed	exposed

Codes for exposures:		
	very protected	**VP**
	protected	**P**
	semi-protected	**SP**
	semi-exposed	**SE**
	exposed	**E**
	very exposed	**VE**

Table A-5. Oil Residence Index definition and component look-up matrix

ORI Definition

Persistence	Oil Residence Index	Estimated persistence
Short	1	Days to weeks
	2	**Weeks** to months
Moderate	3	Weeks to **months**
	4	**Months** to years
Long	5	Months to **years**

ORI Look-up matrix

Substrate	VE	E	SE	SP	P	VP
rock	1	1	1	2	3	3
man-made, impermeable	1	1	1	2	2	2
boulder	2	3	5	4	4	4
cobble	2	3	5	4	4	4
pebble	2	3	5	4	4	4
sand w/ pebble, cobble, or boulder	1	2	3	4	5	5
sand w/o pebble, cobble, or boulder	2	2	3	3	4	4
mud	999	999	999	3	3	3
organics/vegetation	999	999	999	5	5	5
man-made, permeable	2	2	3	3	5	5

Table A-6. Look-up table of calculated ORI defined by shore type and exposure

Shore Type	Calculated Exposure					
CLASS	VE	E	SE	SP	P	VP
1	1	1	1	2	3	3
2	1	1	1	2	3	3
3	1	1	1	2	3	3
4	1	1	1	2	3	3
5	1	1	1	2	3	3
6	2	3	5	4	4	4
7	2	3	5	4	4	4
8	2	3	5	4	4	4
9	2	3	5	4	4	4
10	2	3	5	4	4	4
11	1	2	3	4	5	5
12	1	2	3	4	5	5
13	1	2	3	4	5	5
14	1	2	3	4	5	5
15	1	2	3	4	5	5
16	1	2	3	3	4	4
17	1	2	3	3	4	4
18	1	2	3	3	4	4
19	1	2	3	3	4	4
20	1	2	3	3	4	4
21	2	3	5	4	4	4
22	2	3	5	4	4	4
23	2	3	5	4	4	4
24	1	2	3	4	5	5
25	1	2	3	4	5	5
26	1	2	3	4	5	5
27	2	2	3	3	4	4
28	2	2	3	3	4	4
29	--	--	--	3	3	3
30	2	2	3	3	4	4
31	5	5	5	5	5	5
32	2	2	3	3	5	5
33	1	1	1	2	2	2
34	--	--	--	4	4	4

Table A-7. Data dictionary for BIOUNIT table

Field Names	Type	Description
UnitRecID	N	unique numerical number for each record
PHY_IDENT	T	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers (RR/AA/UUUU/SS)
BioArea*	T	a geographic region used to describe regional differences in biota observed in the lower intertidal biobands.
EXP_BIO	T	estimate of the exposure based on observed indicator species (see Section 3.2 for details).
HAB_CLASS	T	Habitat Classification determined by the BIO mapper that combines the EXP_BIO and the Physical features of the shoreline (see Table A-8).
HAB_OBS	N	the observed biotic assemblage from the imagery (not used in current project, kept for backward compatible with earlier AK projects)
BIO_SOURCE	T	the source that was used to interpret shore-zone biota, (V)ideotape, (S)lide, (I)nferred
HAB_CLASS2**	N	Secondary Habitat Classification determined by the BIO mapper used to denote lagoon habitat types
HC2_SOURCE	T	the source that was used to interpret the secondary lagoon habitat class, OBS(erved) as viewed from video, L(oo)KUP refering to 'Form' Code (Table A-11) Lo or Lc in Across-Shore Component Table (XSHR)
HC2_Note	T	comment field
RIPARIAN% ***	N	estimate of the percentage of alongshore length of the intertidal zone, where the shoreline is shaded by overhanging riparian vegetation, all substrate types (see additional note below)
RIPARIAN_M	N	length, in meters, of the unit shaded by overhanging riparian vegetation, all substrate types
BIO_UNIT_COMMENT	T	comment field
BIO_MAPPER	T	the last name of the biologist that provided the biological interpretation of the imagery
BIO_MAP_DATE	D/T	date of biological mapping
Photo	Y/N	marks if there is a photo (digital or slide) or a ground station associated with the unit

* Further Description of the **BIOAREA** attribute:

BIOAREA NAMES in Alaska ShoreZone Mapping To Date	BIOAREA Codes in Alaska SZ Mapping	SUFFIX Used in Database to Identify Bioarea
Southeast Alaska -- Lynn Canal	SEFJ	12
Southeast Alaska --Sitka	SESI	12
Southeast Alaska --Icy Strait	SEIC	12
Southeast Alaska --Yakutat	SEYA	12
Southeast Alaska --Misty Fjords	SEMJ	12
Southeast Alaska --Craig	SECR	12
Prince William Sound	PRWS	13
Outer Kenai	KENA	8
Cook Inlet	COOK	9
Kodiak Island	KODI	10
Katmai	KATM	11
Aniakchak	ANIA	11

Table A-7. Data dictionary for BIOUNIT table (continued)

**** Further description of the HabClass2 attribute:**

As an attribute in the BioUnit table, this category is intended to denote lagoon habitat types.

Units classified as Lagoons contain brackish or salty water that is contained within a basin that has limited drainage. They are often associated with wetlands and may include wetland biobands in the upper intertidal. Single units classified as lagoons often have the lagoon form in the A zone; however, some lagoons are large and may encompass several units when the lagoon form is mapped as the C zone.

It should be noted lagoons represent unique habitat types that differ from estuaries and other areas designated as marshland. It is an unusual coastal habitat and a prominent feature observed in the Kodiak region. It is for these reasons that it is important to employ the secondary hab class designation to highlight these areas as distinct from any other.

***** Further description of the Riparian% attribute:**

As an attribute in the BioUnit table, this category is intended to be an index for the potential habitat for upper beach spawning fishes.

The value recorded in the 'Riparian%' field is an estimate of the percentage of the unit's total alongshore length where riparian vegetation of trees and shrubs is shading the upper intertidal zone. Shading of the last higher high water line is a good estimate of riparian shading. Therefore, shading of wetland herbs and grasses is not included in the estimate, nor is any shading of the splashzone alone.

Shading must be visible in the upper intertidal zone, and the shading vegetation must be woody trees or shrubs. Riparian overhanging vegetation is also an indicator of lower wave exposures, where the splashzone is narrow. Shading may be on sediment-dominated or on rocky intertidal.

Table A-8. Habitat Class Codes

Habitat Class attribute is a classification of the biophysical characteristics of an entire unit, and provides a single attribute that describes the typical intertidal biota together with the geomorphology. That is, a 'typical' example of a Habitat Class would include a combination of biobands, and their associated indicator species (which determine the Biological Exposure category) and the geomorphological features of the Habitat Class.

The biomapper observes and records the biobands in the unit, if any, and determines the Biological Exposure Category. From the presence/absence of the biobands, the Exposure Category, the geomorphology and the spatial distribution of the biota within the unit, the Habitat Class is determined.

Within the database, both a numeric code and an alpha code are used. Both codes are listed in Table A-8, where the matrix includes all combinations of 'Dominant Structuring Process' on the vertical axis, and 'Biological Wave Category' on the horizontal axis.

Biological Exposure Categories

VE – Very Exposed
E – Exposed
SE – Semi-exposed
SP – Semi-protected
P – Protected
VP – Very protected

Dominant Structuring Process Categories

Wave – Immobile, Bedrock or Sediment & Bedrock, or Sediment (can have lush epibenthic biota)
– Partially mobile, Sediment or Rock and Sediment
– Mobile, Sediment (bare beach)
Other – Estuary (wetland vegetation associated with freshwater stream, often with delta form)
– Current-dominated Saltwater Channel
– Glacier Ice
– Man-made – Impermeable Substrate
– Man-made – Permeable Substrate

Table A-9. Habitat Class Definitions (shaded boxes in the Habitat Class matrix are 'Not Applicable' in most regions**)**

Dominant Structuring Process	Substrate Mobility	Coastal Type	Description	Biological Exposure Category					
				Very Exposed VE	**Exposed E**	**Semi-exposed SE**	**Semi-protected SP**	**Protected P**	**Very Protected VP**
Wave Energy	***Immobile***	***Rock or Rock & Sediment or Sediment***	The epibiota in the immobile mobility categories is influenced by the wave exposure at the site. In high wave exposures, only solid bedrock shorelines will be classified as 'immobile'. At the lowest wave exposures, even pebble/cobble beaches may show lush epibiota, indicating an immobile Habitat Class.	10 VE_I	20 E_I	30 SE_I	40 SP_I	50 P_I	60 VP_I
	Partially-mobile	***Rock & Sediment or Sediment***	These units describe the combination of sediment mobility observed. That is, a sediment beach that is bare in the upper half of the intertidal with biobands occurring on the lower beach would be classed as 'partially mobile'. This pattern is seen at moderate wave exposures. Units with immobile bedrock outcrops intermingled with bare mobile sediment beaches, as can be seen at higher wave exposures, could also be classified as 'partially mobile'.	11 VE_P	21 E_P	31 SE_P	41 SP_P	51 P_P	61 VP_P
	Mobile	***Sediment***	These categories are intended to show the 'bare sediment beaches', where no epibenthic macrobiota are observed. Very fine sediment may be mobile even at the lowest wave exposures, while at the highest wave exposures, large-sized boulders will be mobile and bare of epibiota.	12 VE_M	22 E_M	32 SE_M	42 SP_M	52 P_M	62 VP_M
Fluvial/Estuarine Processes		***Estuary/Wetland***	Units classified as the 'estuary' types always include wetland biobands in the upper intertidal, are always associated with a freshwater stream or river and often show a delta form. Estuary units are usually in lower wave exposure categories.	13 VE_E	23 E_E	33 SE_E	43 SP_E	53 P_E	63 VP_E
Current energy		***Current-dominated channel***	Species assemblages observed in salt-water channels are structured by current energy rather than by wave energy. Current-dominated sites are limited in distribution and are rare habitats.	14 VE_C	24 E_C	34 SE_C	44 SP_C	54 P_C	64 VP_C
Glacial processes		***Glacier***	In a few places in coastal Alaska, saltwater glaciers form the intertidal habitat. These Habitat Classes are rare and include a small percentage of the shoreline length.	15 VE_G	25 E_G	35 SE_G	45 SP_G	55 P_G	65 VP_G
Man-modified		***Anthropogenic – Impermeable***	Impermeable man-made Habitats are intended to specifically note units classified as Coastal Class 33.	16 VE_X	26 E_X	36 SE_X	46 SP_X	56 P_X	66 VP_X
		Anthropogenic – Permeable	Permeable man-made Habitats are intended to specifically note shore units classified as Coastal Class 32.	17 VE_Y	27 E_Y	37 SE_Y	47 SP_Y	57 P_Y	67 VP_Y

Table A-10. Data dictionary for across-shore component table (XSHR) (after Howes et al. 1994)

Field Names	Type	Description
UnitRecID	N	unique record number that relates across-shore records to a unit record
XshrRecID	N	unique record number for each across-shore record
PHY_IDENT	T20	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers (RR/AA/UUUU/SS)
CROSS_LINK	T20	unique alphanumeric identifier of component made up of: REGION, AREA, PHYS_UNIT, SUBUNIT, ZONE and COMPONENT fields
ZONE	T1	a text code indicating the across-shore position of the component: (A) supratidal, (B) intertidal or (C) subtidal zone
COMPONENT	Is	further subdivision of Zones, numbered from highest elevation in across-shore profile within Zone to lowest.
Form1	T20	describes primary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix1	T1	veneer indicator field; blank = no veneer; "v" = veneer
Mat1	T20	describes substrate associated with primary form (see Table A-12 for codes)
FormMat1Txt	T50	translation of Form and Material codes into a sentence descriptor
Form2	T20	describes secondary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix2	T1	veneer indicator field; blank = no veneer; "v" = veneer
Mat2	T20	describes substrate associated with secondary form (see Table A-12 for codes)
FormMat2Txt	T50	translation of Form and Material codes into a sentence descriptor
Form3	T20	describes tertiary physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix3	T1	veneer indicator field; blank = no veneer; "v" = veneer
Mat3	T20	describes substrate associated with tertiary form (see Table A-12 for codes)
FormMat3Txt	T50	translation of Form and Material codes into a sentence descriptor
Form4	T20	describes forth most common physical Form within each across-shore component (see Table A-11 for codes)
MatPrefix4	T1	veneer indicator field; blank = no veneer; "v" = veneer
Mat4	T20	describes substrate associated with forth-order form (see Table A-12 for codes)
FormMat4Txt	T50	translation of Form and Material codes into a sentence descriptor
WIDTH	N	the mean across-shore width of the component in meters
SLOPE	N	the estimated across-shore slope of the component in degrees; not coded in Carr Inlet
PROCESS	T4	the dominant coastal process affecting the morphology of the component (F)luvial, (M)asswasting, (W)aves, (C)urrents, (O)ther, (E)olean
COMPONENT_ORI	N	a numeric index between 1 and 5 that indicates the potential oil residency based on Table A-13

Table A-11. ‘Form’ Code Dictionary (after Howes et al. 1994)

A = Anthropogenic

a	dolphin
b	breakwater
c	log dump
d	derelict shipwreck
f	float
g	groin
h	shell midden
i	cable/ pipeline
j	jetty
k	dyke
m	marina
n	ferry terminal
o	log booms
p	port facility
q	aquaculture
r	boat ramp
s	seawall
t	landfill, tailings
w	wharf
x	outfall or intake
y	intake

B = Beach

b	berm
c	washover channel
f	face
i	inclined (no berm)
m	multiple bars&troughs
n	relic ridges, raised
p	plain
r	ridge (single intertidal bar)
s	storm ridge
t	low tide terrace
w	washover fan
v	veneer (modifier)

C = Cliff

a	eroding
p	passive
slope	
i	inclined (20to35°)
s	steep (>35°)

Cliff cont.

height	
l	low (<5m)
m	moderate (5-10m)
h	high (>10m)
modifiers	
f	fan, apron
g	surge channel
t	terraced
r	ramp

D = Delta

b	bars
f	fan
l	levee
m	multiple channels
p	plain (no delta, <5°)
s	single channel

E = Dune

b	blowouts
i	irregular
n	relic
o	ponds
r	ridge/swale
p	parabolic
v	veneer
w	vegetated

F = Reef

f	horizontal
i	irregular
r	ramp
s	smooth

I = Ice

g	glacier

L = Lagoon

o	open
c	closed

M = Marsh

f	drowned forest
h	high
l	mid to low (discontinuous)
c	tidal creek
e	levee
o	pond
s	brackish – supratidal

O = Offshore Island

b	barrier
c	chain of islets
t	table shaped
p	pillar/stack
w	whaleback
elevation	
l	low (<5m)
m	moderate (5-10m)
h	high (>10m)

P = Platform

f	horizontal
g	surge channel
h	high tide platform
i	irregular
l	low tide platform
r	ramp
t	terraced
s	smooth
p	tidepool

R = River Channel

a	perennial
t	intermittent
m	multiple channels
s	single channel

T = Tidal Flat

b	bar, ridge
c	tidal channel
e	ebb tidal delta
f	flood tidal delta
l	levee
s	multiple tidal channels
t	flats
p	tidepool
w	plunge pool

Table A-12. ‘Material’ Code Dictionary (after Howes et al. 1994)

A = Anthropogenic

a	metal (structural)
c	concrete (loose blocks)
d	debris (man-made)
f	fill, undifferentiated mixed
o	concrete (solid cement blocks)
r	rubble, rip rap
t	logs (cut trees)
w	wood (structural)

B = Biogenic

c	coarse shell
f	fine shell hash
g	grass on dunes
l	trees, fallen not cut, dead
o	organic litter
p	peat
t	trees (alive)

C = Clastic

a	blocks (angular,>25cm)
b	boulders (round, subround,>25cm)
c	cobbles
d	diamicton (poorly sorted sediment containing a range of particles in a mud matrix)
f	fines or mud (mix of silt, clay)
g	gravel (mix pebble, cobble, boulder >2mm)
k	clay
p	pebbles
r	rubble (boulders>1m)
s	sand
$	silt
x	angular fragments (mix block & rubble)
v	**sediment veneer**

R = Bedrock

rock type:

I	igneous
m	metamorphic
s	sedimentary
v	volcanic

rock structure:

1	bedding
2	jointing
3	massive

U = Undefined

DESCRIPTION OF SUBSTRATE

Simplified from Wentworth scale

GRAVELS

boulder	> 25cm
cobble	6 to 25 cm
pebble	0.5 to 6 cm
granule	0.2 to 0.5 cm

SAND

from very coarse to very fine:
all between .5mm to 2 mm

FINES (MUD)

from silt to clay:
smaller than .5mm

The ‘material’ descriptor consists of one primary term code and associated modifiers (e.g. Cash). If only one modifier is used, indicated material comprises 75% of the volume of the layer (e.g.Cs), if more than one modifier, they are ranked in order of volume. A surface layer can be described by prefix ‘v’ for veneer (e.g. vCs/R).

Table A-13. Data dictionary for the BIOBAND table

	Type	Description
UnitRecID	N	unique record number that relates across-shore records to a unit record
XshrRecID	N	unique record number for each across-shore record
PHY_IDENT	T20	unique alphanumeric identifier made up of the REGION, AREA, PHY_UNIT and SUBUNIT numbers (RR/AA/UUUU/SS)
CROSS_LINK	T20	unique alphanumeric identifier of component made up of: REGION, AREA, PHYS_UNIT, SUBUNIT, ZONE and COMPONENT fields
Note: all Biobands are coded **P**atchy (<50% cover) or **C**ontinuous (>50% cover) except the VER band, coded by width **N**arrow (<1m), **M**edium (1-5m) or **W**ide (>5m). See Table B-1 for details.		
VER	T1	bioband for 'VERrucaria' black lichen in supratidal splash zone
PUC	T1	bioband for PUCcinellia and other salt tolerant grasses and herbs
GRA	T1	bioband code for dune GRAsses of supratidal
SED	T1	bioband for mixed sedge of supratidal
BAR	T1	bioband for continuous *Balanus/Semibalanus* BARnacle in upper intertidal
FUC	T1	bioband for FUCus-/barnacle of upper intertidal
ULV	T1	bioband for mixed filamentous and foliose green algae band, mid intertidal
HAL	T1	bioband for bleached mixed filamentous and foliose red algae
BMU	T1	bioband for blue mussels (*Mytilus trossulus)* of mid-intertidal, protected areas
RED	T1	bioband for mixed filamentous and foliose RED algae of lower intertidal
ALA	T1	bioband for stand of large or small morph of *Alaria spp*.
SBR	T1	bioband for unstalked large-bladed laminarins; in the lower intertidal and nearshore subtidal
CHB	T1	bioband for stalked bladed dark chocolate-brown kelps of lower intertidal/nearshore subtidal
SUR	T1	bioband for green SURfgrass of lower intertidal
ZOS	T1	bioband for *ZOStera* (eelgrass) of sheltered areas, lower intertidal and subtidal
ALF	T1	nearshore dragon kelp bioband
MAC	T1	Nearshore canopy kelp *Macrocystis* bioband
NER	T1	bioband for nearshore subtidal *NEReocystis* bull kelp

Note: Refer to Table 6 for brief definitions of Biobands or to Appendix B, Table B-1 for full detailed and illustrated definitions of Biobands.

Table A-14. Data dictionary for the BIOSLIDE table

Field Names	Type	Description
SlideID	N	A unique numeric ID given to each slide
UnitRecID	N	unique record number that relates across-shore records to a unit record
SlideName	T50	A unique alphanumeric name assigned to each slide or photo
ImageName	T75	Full image acronym and .jpg for photolink
TapeTime	D/T	Exact time during flight when jpg collected. Used to link photo to digital trackline and position.
SlideDescription	T255	a text field used for comments made by the biomapper to describe each slide
Good Example?	Y/N	Marks good example photos of shorezone features
ImageType	T10	Media type of original image “Digital” or “Slide"
FolderName	T50	name of the folder where the images are stored - required for hyperlink to digital image
PhotoLink	Hyper-link	clicking this link will open the photos related to each unit

Table A-15. Data dictionary for the GroundStationNumber table

Field Names	Type	Description
StationID	N	A unique numeric ID given to each ground station
UnitRecID	N	The unique ID from Unit Table to link data tables
Station	T50	Unique alphanumeric name assigned to each ground station
StationDescription	T255	a text field used for comments made by the biomapper to describe each ground station
Location	T50	General location of each ground station