

Table A-1. Ecological Function Scoring Criteria for Marine Shorelines.

Function	Scoring Criteria						Notes	Source Data
	0	1	2	3	4	5		
Physical Conditions								
Natural sediment transport patterns	> 2 jetties or groins	2 jetties or groins		1 jetty or groin		No impediment to sediment transport (no jetties or groins)	Jetties and groins are well documented to interrupt alongshore sediment transport on a variety of shoreline types, partly because that is their original design intention (Dean and Dalrymple 1992). While other activities not documented in County datasets could influence these transport patterns (e.g., dredging), work in other locations has demonstrated that structures like jetties are the dominant disruption to alongshore transport (Morang et. al. 2011). Even one jetty or groin in a reach can exert a significant effect on reach sediment transport, and it therefore scored as a 3. Following that, the distribution of scores reflects the range of conditions present in the County. For instance, there are many reaches that have one or two groins, but only a few have more than three. In this scoring, bedrock shorelines without pocket beaches are given a score of not applicable.	Jetties, groins – Pulling it All Together (PIAT) II project, Friends of the San Juans (FSJ); 2017)
Shoreline sediment input alterations: Feeder bluffs	> 50% of feeder bluffs armored	31% - 50% of feeder bluffs armored	21% to 30% of feeder bluffs armored	10% to 20% of feeder bluffs armored	< 10% of feeder bluffs armored	No shoreline alterations to sediment input from feeder bluffs	Feeder bluffs are the primary source of sediment to the nearshore in the County and even small alterations to relatively short lengths of these bluffs can have determinantal impacts to sediment supply (MacLennan et. al. 2010). Therefore, even feeder bluffs which have less than 10% armoring are still considered impacted. The level of impact becomes incrementally more significant as armoring increases and thus the percentage range is linearly variable up to 50%. Drift cells with armoring percentages greater than 50% are expected to have significant geomorphic impacts (Herrera 2011).	Feeder bluffs (Shoreforms), Armoring – Beach Strategies for Nearshore Restoration and Protection in Puget Sound, Phase 1, MacLennan et al (2017)
Shoreline sediment input alterations: Pocket beaches	> 50% of pocket beaches armored	31% - 50% of pocket beaches armored	21% to 30% of pocket beaches armored	10% to 20% of pocket beaches armored	< 10% of pocket beaches armored	No shoreline alterations to sediment input from pocket beaches	Pocket beaches are extremely important sources of sediment locally, especially in areas where sediment supply is extremely limited. There is no scientific literature that describes the incremental ecological impact of armoring of pocket beaches on western Washington nearshore ecology, but small alterations to these areas can have large impacts and the scoring reflects this sensitivity in a similar manner as feeder bluffs.	Pocket beaches (Shoreforms), Armoring – Beach Strategies for Nearshore Restoration and Protection in Puget Sound, Phase 1, MacLennan et al (2017)
Shoreline sediment input alterations: Barrier beaches	100% of barrier beaches armored	76% to 99% of barrier beaches armored	51% to 75% of barrier beaches armored	25% to 50% of barrier beaches armored	< 25% of barrier beaches armored	No shoreline alterations to sediment input from barrier beaches	Barrier beaches contribute sediment to the nearshore (Finlayson 2006), but to a lesser degree than feeder bluffs and pocket beaches. Therefore, the scoring is less sensitive to prevention of sediment flow to the shoreline. However, there is no systematic, quantitative study documenting the relative sensitivity of these shore forms to sediment loss and ultimately nearshore habitat conditions. Because of their reduced importance and sensitivity as compared to pocket beaches and feeder bluffs, scoring is linearly related to the extent of armoring.	Barrier beaches (Shoreforms), Armoring – Puget Sound Nearshore Ecosystem Restoration Project (PSNERP; 2016) and Beach Strategies for Nearshore Restoration and Protection in Puget Sound, Phase 1 (2017)

Function	Scoring Criteria						Notes	Source Data
	0	1	2	3	4	5		
Natural current patterns	>3 outfalls	3 outfalls	2 outfalls	1 outfall		No alteration of current patterns (no outfalls)	Available outfall data includes tide gates and culverts. All tide gates are associated with a reach, even if the gate is outside of shoreline jurisdiction. In other Pacific Northwest estuaries, tide gates and culverts are shown to exert a strong influence on both water circulation and access for key fish species (Roegner e. al. 2010), and this influence continues overtime. Because of this, even one outfall in a reach can exert a significant effect on reach current patterns, with one outlet being scored as a 3. Every additional outfall is assigned a score indicating an incrementally and cumulatively negative effect on current patterns.	Outfalls – San Juan County (2022)
Wave/current attenuation	100% armored shoreline	76% to 99% armored shoreline	51% to 75% armored shoreline	25% to 50% armored shoreline	< 25% armored shoreline	Natural shoreline (no armoring)	Armored shorelines have been shown to reflect more wave energy than unarmored shoreline (e.g., Miles et al. 2001), but these impacts are highly site specific. Detailed analysis of wave energy along County shoreline was beyond the scope of this characterization. Therefore, scoring was linearly related to the extent of armoring and included all shoreline types.	Beach Strategies for Nearshore Restoration and Protection in Puget Sound, Phase 1 (2017)
Nutrient and toxics removal	303d Category 5 – Impaired, requires TMDL		305b Category 4 – Impaired, but does not require TMDL	305b Category 2 – Waters of concern or suspected sources of water quality concern		305b Category 1 – No problems	The range corresponds to the same range prescribed by Ecology for categorizing water quality impairments.	Water quality assessment categories – WA Department of Ecology (2018)
Shade	No shade	< 10% shaded	10% to 25% shaded	25% to 50% shaded	51% to 75% shaded	75% shaded	Based on the presence of deciduous forest, evergreen forest, mixed forest, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes within 30 feet of the shoreline. The width of 30 feet is based on the ability to achieve 70 percent or greater effectiveness at providing shade, microclimate moderation, large woody debris, litterfall, and insect food sources to the nearshore (Christensen 2000; Bavins et al. 2000; Zhang et al. 2010). There is no scientific literature that describes the incremental ecological impact of shoreline vegetation removal on western Washington nearshore ecology. However, small alterations to these areas can have large impacts and the scoring reflects this sensitivity.	Tree Canopy Cover – National Land Cover Database 2019 USFS Tree Canopy Cover (CONUS; 2019)

Function	Scoring Criteria						Notes	Source Data
	0	1	2	3	4	5		
Habitat Conditions								
Total vegetation	No vegetation	<10%	10% to 25%	26% to 50%	51% to 75%	76% to 100%	Based on the presence of deciduous forest, estuarine aquatic bed, estuarine emergent wetland, evergreen forest, mixed forest, palustrine aquatic bed, palustrine emergent wetland, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes within the entire shoreline jurisdiction. Shoreline or marine riparian vegetation is an important component for maintaining critical nearshore habitat functions throughout the Puget Sound region and San Juan County (Lemieux et al 2004, Levings and Jamieson 2001). MacLennan and Johannessen (2008) conducted geographically focused research in the San Juans and found an average 25 percent loss of marine riparian forest cover on San Juan, Orcas, Lopez and Stuart islands between 1977 and 2006. At more severe levels, vegetation removal could have implications for species survival and overall habitat condition including altered shade and temperature regime, reduced bank and shoreline stability, altered organic material contributions, as well as reduced habitat complexity and increased habitat fragmentation. Incremental removal of vegetation on shorelines can have large impacts and the scoring reflects this sensitivity.	NLCD (CONUS; 2019)
Estuary habitat	No estuary habitat	<1 acre	1-2 acres	2-3 acres	3-5 acres	>5 acres	Based on the presence of estuarine emergent wetland. Nearshore habitats including estuaries and streams offer juvenile salmon and other aquatic species refuge from predation, and increased food resources. While quantitative studies remain limited, recent surveys (Wyllie-Echeverria and Barsh 2007, Beamer et al. 2008) in combination with historical and anecdotal reports (Wyllie-Echeverria 2008a, 2008b) describe salmonid use of multiple estuarine and freshwater habitats in San Juan County. There are no published studies that could be used as a basis for the size range of scores, therefore, the general presence and areas of pocket estuaries found on the County's shorelines were used as the scoring basis.	NLCD (CONUS; 2019)
Birds	No WDFW documented species present	Only a single WDFW documents species present	Presence by two WDFW documented species	Presence by three WDFW documented species	Presence by four WDFW documented species	Presence by more than four WDFW documented species	Presence. Includes alcids, cormorants, seabird colonies, bald eagle, osprey, black oystercatcher peregrine falcon, purple martin, and wild turkey. Scoring reflects the incremental value of greater species use of habitats in reach.	Birds - Priority Habitat and Species Data (PHS) - Washington Department of Fish and Wildlife (WDFW) (2006)
Haul-outs	Absent					Present	Presence	Haul-outs- PHS-WDFW (2013)
Eelgrass	Absent					Present	Presence	Eelgrass – Puget Sound Eelgrass Monitoring Data – Washington Department of Natural Resources (DNR)
Floating kelp	Absent					Present	Presence	Bullkelp – PIAT II project, FSJ (2017)

Function	Scoring Criteria						Notes	Source Data
	0	1	2	3	4	5		
Understory kelp	Absent					Present	Presence	Non-floating kelp – Department of Natural Resources (DNR; 2000)
Forage fish priority spawning habitat	No spawning of priority species documents			Documented spawning by a single priority species		Documented spawning by multiple priority species	Includes documented priority fish spawning habitat for sand lance, surf smelt, and rocksole. Scoring reflects the incremental value of more species spawning within a reach.	Forage fish priority spawning habitat – PHS – WDFW (2019); PIAT II project, FSJ (2017); WDFW Forage Fish Spawning Data (2019)
Herring spawning habitat	Absent					Present	Presence	Herring spawning habitat – WDFW (2010)
Shellfish	No priority species documented to be present	Documented presence by a single priority species	Documented presence by two priority species	Documented presence by three priority species	Documented presence by four priority species	Documented presence by more than four priority species	Presence. Includes abalone, Dungeness crab, geoduck, hardshell clam, oyster beds, pandalid shrimp, and red sea urchin. Scoring reflects the incremental value of greater species use of habitats in reach.	Shellfish (geoduck, abalone, clam – subtidal, clam-hardshell, Dungeness crab, pandalid shrimp, urchin) – PHS – WDFW (multiple years; 1992-2016)

Table A-2. Ecological Function Scoring Criteria for Lacustrine Shorelines

Function	Scoring Criteria						Notes	Source Data
	0	1	2	3	4	5		
Physical Conditions								
Shoreline Modifications	100% armored	76% to 99% armored	51% to 75% armored	25% to 50% armored	<25% armored	No shoreline alterations	No shoreline modification data were available for lakes. Therefore, level of alteration was based on the range of conditions observed on County lake shorelines using aerial photographic analysis. Armored shorelines have been shown to reflect more wave energy than unarmored shorelines (e.g., Miles et al. 2001), but these impacts are highly site specific. Detailed analysis of wave energy along County shorelines was beyond the scope of this characterization. Therefore, scoring was linearly related to the extent of armoring and included all lake shoreline types.	Aerial photography – San Juan County (2022)
Natural current patterns	>3 outfalls	3 outfalls	2 outfalls	1 outfall		No alteration of current patterns (no outfalls)	Currents in lakes are responsible for the circulation and distribution of heat, dissolved substances, and some organisms. Outfalls can exert a strong influence on physical circulation, distribution, and access for key fish species (Reid 1961). Because of this, even one outfall in a reach can exert a significant effect on reach current patterns, thus one outlet is scored as a 3. Every additional outfall is assigned a score indicating an incrementally and cumulatively negative effect on current patterns.	Outfalls – San Juan County (2022)
Nutrient and toxics removal	303d Category 5 – Impaired, requires TMDL		305b Category 4 – Impaired, but does not require TMDL	305b Category 2 – Waters of concern <u>or</u> suspected sources of water quality concern		305b Category 1 – No problems	The range corresponds to the same range prescribed by Ecology for categorizing water quality impairments.	Water quality assessment categories – WA Department of Ecology (2018)
Shade	No shade	< 10% shaded	10% to 25% shaded	26% to 50% shaded	51% to 75% shaded	> 75% shaded	Based on the presence of deciduous forest, evergreen forest, mixed forest, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes within 30 feet of the shoreline. The width of 30 feet is based on the ability to achieve 70 percent or greater effectiveness at providing shade, microclimate moderation, large woody debris, litterfall and insect food sources to the nearshore (Christensen 2000; Bavins et al. 2000; Zhang et al. 2010). However, there is no scientific literature that describes the incremental ecological impact of shoreline vegetation removal on western Washington nearshore ecology, but small alterations to these areas can have large impacts and the scoring reflects this sensitivity.	NLCD (CONUS 2019)

Function	Scoring Criteria						Notes	Source Data
	0	1	2	3	4	5		
Habitat Conditions								
Total Vegetation	No vegetation	< 10%	10% to 25%	26% to 50%	51% to 75%	76% to 100%	Based on the presence of deciduous forest, evergreen forest, mixed forest, palustrine aquatic bed, palustrine emergent wetland, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes. Measurements are within the entire shoreline jurisdiction. Shoreline vegetation is an important component for maintaining critical nearshore habitat functions. The degree of impact to the aquatic environment from vegetation loss depends upon the magnitude of the removal (such as size and number of trees affected, and total area cleared of vegetation). At more severe levels, vegetation removal could have implications for species survival and overall habitat condition including a littered shade and temperature regime, reduced bank and shoreline stability, altered organic material contributions, as well as reduced habitat complexity and increased habitat fragmentation. Incremental removal of vegetation on shorelines can have large impacts and the scoring reflects this sensitivity.	NLCD (CONUS; 2019)
Wetland Habitat	No wetland habitat	<5% wetland habitat	5% to 9% wetland habitat	10% to 20% wetland habitat	21% to 50% wetland habitat	> 50% wetland habitat	The range of scores was based on the general presence and areas of wetlands associated with lake shorelines in the County. Measurements are within the entire shoreline management area.	
Birds	No WDFW documented species present	Only a single WDFW documents species present	Presence by two WDFW documented species	Presence by three WDFW documented species	Presence by four WDFW documented species	Presence by more than four WDFW documented species	Presence. Includes alcids, cormorants, seabird colonies, bald eagle, osprey, black oystercatcher peregrine falcon, purple martin, and wild turkey. Scoring reflects the incremental value of greater species use of habitats in reach.	Birds - Priority Habitat and Species Data (PHS) - Washington Department of Fish and Wildlife (WDFW) (2006)
Salmonids	No priority species documented to be present			Documented presence of one priority species		Documented presence of multiple priority species	Includes coastal cutthroat trout, chum, kokanee and coho salmon, and rainbow trout. Chinook salmon, though present in the County, are not recorded in the existing County database. Note that fish use of streams and lakes in the County is limited by stream size, seasonal water flows, and accessibility. Use is predominantly by coho, chum, and coastal cutthroat trout. Scoring reflects the incremental value of greater species use of habitats in reach.	Fish distribution - WDFW PHS

Table A-2. Ecological Function Scoring Criteria for Lacustrine Shorelines

Function	Scoring Criteria						Notes	Source Data
	0	1	2	3	4	5		
Physical Conditions								
Shoreline Modifications	100% armored	76% to 99% armored	51% to 75% armored	25% to 50% armored	<25% armored	No shoreline alterations	No shoreline modification data were available for lakes. Therefore, level of alteration was based on the range of conditions observed on County lake shorelines using aerial photographic analysis. Armored shorelines have been shown to reflect more wave energy than unarmored shorelines (e.g., Miles et al. 2001), but these impacts are highly site specific. Detailed analysis of wave energy along County shorelines was beyond the scope of this characterization. Therefore, scoring was linearly related to the extent of armoring and included all lake shoreline types.	Aerial photography – San Juan County (2022)
Natural current patterns	>3 outfalls	3 outfalls	2 outfalls	1 outfall		No alteration of current patterns (no outfalls)	Currents in lakes are responsible for the circulation and distribution of heat, dissolved substances, and some organisms. Outfalls can exert a strong influence on physical circulation, distribution, and access for key fish species (Reid 1961). Because of this, even one outfall in a reach can exert a significant effect on reach current patterns, thus one outlet is scored as a 3. Every additional outfall is assigned a score indicating an incrementally and cumulatively negative effect on current patterns.	Outfalls – San Juan County (2022)
Nutrient and toxics removal	303d Category 5 – Impaired, requires TMDL		305b Category 4 – Impaired, but does not require TMDL	305b Category 2 – Waters of concern <u>or</u> suspected sources of water quality concern		305b Category 1 – No problems	The range corresponds to the same range prescribed by Ecology for categorizing water quality impairments.	Water quality assessment categories – WA Department of Ecology (2018)
Shade	No shade	< 10% shaded	10% to 25% shaded	26% to 50% shaded	51% to 75% shaded	> 75% shaded	Based on the presence of deciduous forest, evergreen forest, mixed forest, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes within 30 feet of the shoreline. The width of 30 feet is based on the ability to achieve 70 percent or greater effectiveness at providing shade, microclimate moderation, large woody debris, litterfall and insect food sources to the nearshore (Christensen 2000; Bavins et al. 2000; Zhang et al. 2010). However, there is no scientific literature that describes the incremental ecological impact of shoreline vegetation removal on western Washington nearshore ecology, but small alterations to these areas can have large impacts and the scoring reflects this sensitivity.	NLCD (CONUS 2019)

Function	Scoring Criteria						Notes	Source Data
	0	1	2	3	4	5		
Habitat Conditions								
Total Vegetation	No vegetation	< 10%	10% to 25%	26% to 50%	51% to 75%	76% to 100%	Based on the presence of deciduous forest, evergreen forest, mixed forest, palustrine aquatic bed, palustrine emergent wetland, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes. Measurements are within the entire shoreline jurisdiction. Shoreline vegetation is an important component for maintaining critical nearshore habitat functions. The degree of impact to the aquatic environment from vegetation loss depends upon the magnitude of the removal (such as size and number of trees affected, and total area cleared of vegetation). At more severe levels, vegetation removal could have implications for species survival and overall habitat condition including a littered shade and temperature regime, reduced bank and shoreline stability, altered organic material contributions, as well as reduced habitat complexity and increased habitat fragmentation. Incremental removal of vegetation on shorelines can have large impacts and the scoring reflects this sensitivity.	NLCD (CONUS; 2019)
Wetland Habitat	No wetland habitat	<5% wetland habitat	5% to 9% wetland habitat	10% to 20% wetland habitat	21% to 50% wetland habitat	> 50% wetland habitat	The range of scores was based on the general presence and areas of wetlands associated with lake shorelines in the County. Measurements are within the entire shoreline management area.	
Birds	No WDFW documented species present	Only a single WDFW documents species present	Presence by two WDFW documented species	Presence by three WDFW documented species	Presence by four WDFW documented species	Presence by more than four WDFW documented species	Presence. Includes alcids, cormorants, seabird colonies, bald eagle, osprey, black oystercatcher peregrine falcon, purple martin, and wild turkey. Scoring reflects the incremental value of greater species use of habitats in reach.	Birds - Priority Habitat and Species Data (PHS) - Washington Department of Fish and Wildlife (WDFW) (2006)
Salmonids	No priority species documented to be present			Documented presence of one priority species		Documented presence of multiple priority species	Includes coastal cutthroat trout, chum, kokanee and coho salmon, and rainbow trout. Chinook salmon, though present in the County, are not recorded in the existing County database. Note that fish use of streams and lakes in the County is limited by stream size, seasonal water flows, and accessibility. Use is predominantly by coho, chum, and coastal cutthroat trout. Scoring reflects the incremental value of greater species use of habitats in reach.	Fish distribution - WDFW PHS