Appendix C. Data Sources, Methods, and Limitations

This appendix describes the spatial data used in the MSP and other major studies completed to support the planning process. A full list of sources of information consulted for each topic is available within each section of the plan. For each type of data, this appendix includes which maps use the data, the source, methods and limitations, and references. Section 4.2.2 of the MSP outlines an ongoing process to update data, prioritize science and research needs, and fill data gaps.

Contents

Summary of data limitations

While the MSP maps provide important baseline data useful for planning-scale purposes, they have limitations in their utility for detailed or fine-scale analyses. The data sets included in the MSP vary widely in how, when, and for how long the data were collected and at what frequency and scale measurements were taken. Some features represented by data sets are dynamic and can vary widely from year to year, while others remain relatively stable over time. Many data sets lack long-term monitoring efforts, which is needed to more accurately represent the full range of variability for more dynamic uses or resources. Some data sets use statistical models to fill data gaps in monitoring effort. Changing conditions may alter future patterns from those represented in current data sets. These factors mean that data provided in the MSP have limitations and different levels of data quality and accuracy.

Ecological Data: The Marine Spatial Plan provides information about the ecology of the MSP study area, including its physical, biological, chemical, and geological characteristics. Some information was acquired from existing programs or studies, while other data was collected or analyzed specifically for the MSP. These data sources and other sources of ecological information relevant to the study area are discussed in Sections 2.1, 3.1, and 3.2 of the MSP.			

Data subject	Source	Methods and Limitations	References
Shoreline Biology: Kelp, Seagrass, Salt Marshes (Map 4)	DNR	ShoreZone Inventory files were provided by DNR's Nearshore Habitat Program. Program staff compiled these maps from comprehensive aerial photography and videography surveys completed during low tides between 1994 and 2000. Surveys incorporated the observations of a geomorphologist and a marine ecologist and were conducted from a helicopter traveling at approximately 60 knots and 300 feet (approx. 90 meters) above the ground. The inventory divides the shoreline into homogenous physical segments, with an average linear segment length of 0.5 miles. While annual kelp data showing extent (rather than just presence or absence) is available from DNR, these data were not provided in the plan due to a high amount of annual variability. Detailed methods are provided in the Washington State ShoreZone Inventory User's Manual. The manual also includes a full description of data limitations and usage guidelines (p. 15 – 16). The inventory is a regional characterization and screening tool. It is not site specific, and it should not replace site-specific surveys. However, it can complement site-specific surveys by providing a regional context.	For more information: http://www.dnr.wa.gov/programs-and-services/aquatics/aquatic-science/nearshore-habitat-inventory Nearshore Habitat Program. 2001. The Washington State ShoreZone Inventory. Washington State Department of Natural Resources, Olympia, WA. Data user manual: Berry, H.D., J.R. Harper, T.F. Mumford, Jr., B.E. Bookheim, A.T. Sewell, and L.J. Tamayo. 2001. The Washington State ShoreZone Inventory User's Manual. Nearshore Habitat Program, Washington State Department of Natural Resources, Olympia, WA. http://file.dnr.wa.gov/publications/aqr_nrsh_szusermanual.pdf
Forage Fish Surveys (Map 6)	WDFW	Over two years (October 2012 – October 2014), WDFW performed surveys, in collaboration with staff from four tribal governments to: • Identify possible spawning habitat sites in six zones throughout the MSP study area; • Collect monthly sediment samples from the upper third of the intertidal range of sites, following a protocol used previously in Puget Sound spawning surveys. (Some modifications were made to accommodate differences in scale and features between study area sites and Puget Sound sites.); • Process samples to remove substrate material and assess the presence/absence of Surf Smelt (Hypomesus pretiosus), Night Smelt (Spirinchus starksi), or Pacific Sand Lance (Ammodytes hexapterus) eggs; and • Geo-reference results to provide a map of spawning survey sites and results. When zero eggs or only a single egg were detected at a location, processing was repeated with an additional sample from that location. Maps provided in the plan illustrate the 40 sites where 2 or more eggs (live or dead) were identified in a sample. Surf Smelt and Night Smelt eggs cannot be distinguished without genetic analysis, but eggs were retained for possible future analysis. Poor weather conditions and the remote nature of select sites limited sampling efforts at some locations. Detailed methods, including field protocols and sampling frequency in specific areas, are described in WDFW's report .	Langness, M, P Dionne, D Masello, and D Lowry. Summary of coastal intertidal forage fish spawning surveys: October 2012 – October 2014. Report to the Washington Department of Natural Resources. Washington Department of Fish and Wildlife, 2015. Available at: http://msp.wa.gov/wp-content/uploads/2014/02/ForageFishReport.pdf
Herring Spawning Areas (Map 68)	WDFW	This data provides the known distribution for pacific herring (*culpa harengus pallasi*) spawning areas. Blank areas either have none of this resource or have not been inventoried for it. Generally, information in this database is highly variable regarding source: some of it is based on field surveys, while others are based on	WDFW GeoLib Database. To request data layers, contact WDFW.

		"best professional judgement" of the biologist involved. This information has been generalized for release to the general public. Polygons in Puget Sound showing locations of documented Pacific Herring (*culpa harengus pallasi*) spawning areas through 1991. The polygons were later edited by Kurt Stick, and digitized by Dale Gombert, both WDFW, 12/2003. Polygons show documented pacific herring spawning areas at specific sites throughout Puget Sound and Washington coastal areas and bays. Along the Washington coast, small populations spawn in Willapa Bay and Grays Harbor, and some spawning has been reported in the Columbia River estuary (Monaco et al. 1990). Larval and juvenile herring have also been found in Grays Harbor (Monaco et al. 1990). Herring deposit their eggs on marine vegetation: eelgrass and various algae, in the shallow subtidal and intertidal zone generally at tidal elevations from +3 feet to -20 feet Mean Low Low Waterline (MLLW).	
Catalog of Washington's Seabird Colonies (Map 11)	WDFW	This map is based on the catalog originally published by Steven Speich and Terrence Wahl in 1989. WDFW staff: • Created a spatial database from the catalog • Entered and updated information about colony locations collected between the original publication date and 2015. Data collection methods for the catalog include a combination of aerial photography, boat-based surveys, colony counts, and estimates. The database includes data ranging from the late 1800s to 2015. Species of birds surveyed include: black oystercatcher (*Haematopus bachmani*), Brandt's cormorant (*Phalacrocorax penicillatus*), Caspian tern (*Hydroprogne caspia*), Cassin's auklet (*Ptychoramphus aleuticus*), common murre (*Uria aalge*), double-crested cormorant (*Phalacrocorax auritus*), fork-tailed storm petrel (*Oceanodroma furcata*), glaucous-winged gull (*Larus glaucescens*), Leach's storm petrel (*Oceanodroma leucorhoa*), pelagic cormorant (*Phalacrocorax pelagicus*), pigeon guillemot (*Cepphus columba*), rhinoceros auklet (Cerorhinca monocerata), ring-billed gull (*Larus delawarensis*), and tufted puffin (*Fratercula cirrhata*). Additional details on methods are available in WDFW's report, Coastal Washington Marine Mammal and Bird Geodatabases.	Speich, S.M., and T.R. Wahl. 1989. Catalog of Washington seabird colonies. U.S. Fish and Wildlife Service Biological Report. 88(6). Duff, A, J. Jenkerson, L. Salzer, S. Jeffries, and S. Pearson. 2014. Coastal Washington marine mammal and bird geodatabases. Washington Department of Fish and Wildlife. Available at: http://www.msp.wa.gov/wp-content/uploads/2015/03/WDFW_BirdMammalReport.pdf
Pinniped Haulouts and Sea Otter Concentrations (Map 10)	WDFW	WDFW conducted 11 aerial surveys to identify seal and sea lion haulouts and sea otter areas. These flights were 3.1 – 7.6 hours in duration and occurred between April 2014 and March 2015. WDFW staff: • Surveyed and counted different species depending on season • Steller sea lions and California sea lions: summer, fall, and winter • Sea otters: fall and winter • Harbor seals: pupping season (summer) • Used sighting results to create a map of generalized concentration and haul out areas. Additional details on are available in WDFW's report, Aerial Surveys for Pinnipeds and Sea Otters on the Washington Coast and in the WDFW Seal and Sea Lion Haulout Atlas.	Jeffries S, J Oliver and L Salzer. 2015. Aerial Surveys for Pinnipeds and Sea Otters on the Washington Coast. Final report to the Washington Department of Natural Resources. Washington Department of Fish and Wildlife, Olympia, Washington, USA. 9pp. http://www.msp.wa.gov/wp-content/uploads/2015/03/WDFW_SeaOtterSurveyReport.pdf Seal and Sea lion Haulout Atlas http://wdfw.wa.gov/publications/00427/wdfw00427.pdf
Critical habitat for Green sturgeon (Map 7)	NOAA Fisheries	These data identify (in general) the areas where critical habitat for the green sturgeon (*Acipenser medirostris*) occurs. In 2006, NOAA listed green sturgeon as a threatened and designated critical habitat in 2009. Critical habitat is a federal designation defined by the Endangered Species Act; these data layers were acquired from NOAA Fisheries. More information about critical habitat designation processes and the data presented in the MSP is available from NOAA's Office of Protected Resources.	For more information on critical habitat designation please see: http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm http://www.westcoast.fisheries.noaa.gov/protected_species/green_sturgeon/grn_sturg_critical_habitat.html

Critical habitat for Bull trout (Map 7)	USFWS	These data identify (in general) the areas where critical habitat for the bull trout (*Salvelinus confluentus*) occur. In 1998, the USFWS designated bull trout as threatened, and most recently designated critical habitat in 2010. Critical habitat is a federal designation defined by the Endangered Species Act; these data layers were acquired from US Fish and Wildlife Service. More information about critical habitat designation processes and the data presented in the MSP is available from NOAA's Office of Protected Resources. The GIS files and their associated coordinates are not the legal source for determining the critical habitat boundaries of species described within this dataset. These data are to be used only in the context of the definition and purpose of critical habitat and may be used for planning and land management purposes.	For more information on critical habitat designation please see: https://ecos.fws.gov/ecp/report/table/critical-habitat.html http://www.habitat.noaa.gov/pdf/201505_15PROJECTS-FINAL.pdf
Ecological Indicators	NWFSC (NOAA)	NOAA's Northwest Fisheries Science Center (NWFSC) developed conceptual models for describing key ecological components of the Study Area and identified 110 potential ecological indicators to support marine spatial planning in Washington. This project described physical drivers, habitats, human pressures, and biological factors that are important to characterizing the ecology in the study area. The NWFSC developed the initial list of potential indicators that may provide measures of the health and status of Washington's coastal waters using the following: • the ecological models characterizing the Study Area, • a review of scientific information on indicators; and • input from scientists and managers on criteria for evaluating indicators. The NWFSC also produced a status and trends report for these potential ecological indicators where data was available to report on those indicators. This work provides a starting point for identifying helpful and scientifically-sound ecological indicators. The indicators suggested in the final report are only an initial list, which must be further assessed and refined into a shorter list to maximize their usefulness. See Section 4.2.2 of the MSP for more information on future refinement and use of the ecosystem indicators for plan implementation.	Andrews, K.S., J.M. Coyle, and C.J. Harvey. 2015. Ecological indicators for Washington State's outer coastal waters. Report to the Washington Department of Natural Resources. http://www.msp.wa.gov/wp-content/uploads/2015/03/NWFSC_EcosystemIndicatorReport.pdf
Seafloor Mapping Prioritization	NCCOS (NOAA)	The NOAA National Centers for Coastal and Ocean Science (NCCOS) led a seafloor mapping prioritization process to identify data needed to map and assess key physical and biological resources within Washington's offshore marine ecosystem. This process also captured the underlying drivers and management needs associated with the priorities. NCCOS carried out the prioritization process in four phases: 1. NCCOS compiled existing seafloor information within the area of interest into a web-based data viewer that allows users to assess the information and to support identification of mapping priorities. To improve the consistency of display and querying, the feature information collected from various data sources were translated into standardized attributes and categories. Additionally, a data was categorized by quality and age using a qualitative assessment. 2. NCCOS held a first spatial prioritization planning workshop with coastal managers at tribal, federal and state agencies to receive input on the prioritization tool and products needed to support marine planning. 3. Tribal, federal and state agency representatives completed a spatial prioritization exercise using the web-based data viewer and online spatial prioritization tool. 4. NCCOS compiled the results of the spatial prioritization exercise and held a second workshop with managers. Participants modified and consolidated results, clarified management needs in high priority areas, and developed action items for high priority areas. The results of the prioritization process encouraged NOAA to conduct new seafloor mapping in the study area in 2016 and 2017.	NCCOS. Summary Report for Spatial Prioritization Seafloor Mapping for Washington's Pacific Coast (Phase II and IV). National Oceanic and Atmospheric Administration, National Ocean Service, National Centers for Coastal Ocean Science, 2015. http://www.msp.wa.gov/wp-content/uploads/2015/03/NCCOS_SeabirdAndSeafloorEvalReport.pdf http://www.msp.wa.gov/wp-content/uploads/2015/03/NCCOS_SeafloorMappingReport.pdf https://maps.coastalscience.noaa.gov/wasp/wasp.html

Seafloor Modeling (Map 3)	TNC	As part of the Pacific Northwest Marine Ecoregional Assessment completed in 2013, the Nature Conservancy produced maps classifying marine benthic habitats in the Pacific northwest region. These data layers were produced based on three types of variables: depth, substrate, and geomorphology. These three variables were described using the following classes: • Bathymetry: inner shelf, mid-shelf, mesobenthal, and bathybenthal • Geomorphology: flats, canyon, ridge, and middle slope • Substrate: soft, mud, sand, gravel, and rock Bathymetry data was acquired from the National Ocean Services Hydrographic Database, and substrate information from the Active Tectonics and Seafloor Mapping lab at Oregon State University. Section 2.1.1 of the Ecoregional Assessment report provides additional detail on the characterization and mapping process.	Vander Schaaf, D., K. Popper, D. Kelly and J. Smith. 2013. Pacific Northwest Marine Ecoregional Assessment. The Nature Conservancy, Portland, Oregon. Available for download at: https://www.conservationgateway.org/ConservationPlanning/SettingPriorities/EcoregionalReports/Pages/ecoregional-reports.aspx https://www.conservationgateway.org/ConservationPlanning/SettingPriorities/EcoregionalReports/Documents/PNW%20Marine%20EA%20Report%202013.pdf
Seafloor Mapping and Atlas	OSU / OCNMS (NOAA)	OCNMS worked with OSU to develop a Washington State Outer Coast Seafloor Atlas based on data from 31 sidescan and multibeam sonar surveys between 2000 and 2013. OSU compiled the raw data from these surveys, re-imaged them and mosaic them as a single file, applied the existing ground-truthing data and reclassified the sediments/habitats.	Active tectonics and seafloor mapping lab. Sanctuary Seafloor Atlas Report. Corvallis, OR. Oregon State University, College of Earth, Ocean, and Atmospheric Sciences, June 30, 2015. http://www.msp.wa.gov/wp-content/uploads/2015/03/OSU_SeafloorReport.pdf https://olympiccoast.noaa.gov/science/habitatmapping/habitatmapping.html
Shallow Water Surveys	Ecology / USGS	The Washington Department of Ecology, with several partners, conducted high resolution multibeam bathymetric, single beam bathymetric, and topographic lidar mapping in the shallow intertidal and subtidal coastal areas and around river mouths on Washington's Pacific coast.	http://www.msp.wa.gov/wp-content/uploads/2013/07/ECY_NCoastNearshoreWaverunnerandBeachProfiles_FinalReport.pdf http://www.msp.wa.gov/wp-content/uploads/2013/07/ECY_SCoastNearshoreWaverunnerandBeachProfiles_FinalReport.pdf http://www.msp.wa.gov/wp-content/uploads/2013/07/ECY_MultibeamSurveys_CoastWahkiakumColumbiaMouth_FinalReport.pdf http://www.msp.wa.gov/wp-content/uploads/2013/07/ECY_NearshoreBathymetry_QuinaultQuileute.pdf
Ecologically Important Areas (additional maps provided in Section 3.2 of the MSP)	WDFW	WDFW developed maps that aimed to identify regions of relatively greater ecological importance in the study area, as represented by available data on the distribution of selected species and habitats. Input data for this analysis varied widely in format and scope, but included information from fisheries logbooks, fish and wildlife surveys, and predictive models. Data was acquired both from WDFW projects and monitoring programs, and from various external federal, state, and academic sources. For each species and habitat, WDFW used a	Washington Department of Fish and Wildlife. An Approach for Mapping Ecologically Important Areas Off the Washington Coast. Unpublished report, 2017a.

Maps 5, 8, 9 12, 69		quantile approach to assign a relative importance score to each 1-square mile hexagon within the planning area. These scores allowed analysts to compare results across species and to combine multiple data layers into "hotspot" maps. Hotspots show areas that are expected to be relatively more important to a greater number of species or groups. Please see Section 3.2 of the Marine Spatial Plan for more information about the data, methods, results, and limitations associated with the EIA analyses. Table 3.3 in Section 3.2 lists all species, species groupings, and data sources for the EIA analysis. WDFW's final report also provides detailed technical and source information. Estuaries were not included in the EIA analysis owing to data availability and resolution issues, but the Marine Spatial Plan recognizes that they are known to be of high ecological importance.	http://www.msp.wa.gov/wp-content/uploads/2015/03/WDFW_EIAReport.pdf
Bird and Marine Mammal Predictive Modeling (Maps provided in Section 3.1 of the MSP) Maps 11, 12	NCCOS (NOAA)	NCCOS synthesized data from 11 existing survey programs and a wide variety of ecological datasets. The results of this analysis were a series of statistical models and maps showing areas where relatively higher abundances of 8 bird species and 6 marine mammal species would be expected, based on field observations and relevant environmental predictor variables. Model outputs were incorporated into the EIA analysis. Please see Section 3.1 of the Marine Spatial Plan for more detail on the input data (Table 3.1), methods, results and limitations associated with these models. The final report by NCCOS includes additional technical details and information on individual survey data sources.	Menza, C., J. Leirness, T. White, A. Winship, B. Kinlan, L. Kracker, J. E. Zamon, L. Ballance, E. Becker, K. A. Forney, J. Barlow, J. Adams, D. Pereksta, S. Pearson, J. Pierce, S. Jeffries, J. Calambokidis, A. Douglas, B. Hanson, S. R. Benson and L. Antrim (2016). Predictive Mapping of Seabirds, Pinnipeds and Cetaceans off the Pacific Coast of Washington. NOAA Technical Memorandum NOS NCCOS 210. Silver Spring, MD. 96 pp. http://www.msp.wa.gov/wp-content/uploads/2016/12/Final_Report_NCCOS_MarineMammals_Birds.pdf
Rocky Reefs Map 69	OSU / NOAA / BOEM	This dataset was created by the Oregon State University's Active Tectonics & Seafloor Mapping Lab, NOAA Northwest Fisheries Science Center, and the Bureau of Ocean Energy Management. Additional contributions and map products were provided by the Oregon Department of Fish and Wildlife, NOAA Biogeography Branch, The Nature Conservancy, the Seafloor Mapping Lab of California State University Monterey Bay, the Center for Habitat Studies at Moss Landing Marine Labs, and the Olympic Coast National Marine Sanctuary.	See CMECS Substrate data at: http://geo.nwifc.org/ocean/
Deep Sea Coral and Sponges (Observation points) Maps 60-64	NOAA	These data represent the observed locations of corals and sponges within the study area and were acquired from the online database maintained by NOAA's Deep Sea Coral Research and Technology Program in the Office of Habitat Conservation. NOAA's Deep-Sea Coral Research and Technology Program (DSC-RTP) is compiling a national geodatabase of the known locations of deep-sea corals and sponges in U.S. territorial waters and beyond. The database will be comprehensive, standardized, quality controlled, and networked to outside resources. The database schema accommodates both linear (trawls, transects) and point (samples, observations) data. The structure of the database is tailored to occurrence records of all the azooxanthellate corals, a subset of all corals, and all sponge species. Records shallower than 50 meters are generally excluded in order to focus on predominantly deep-water species – the mandate of the DSC-RTP. The intention is to limit the overlap with light-dependent (and mostly shallow-water) As with other compilations of data from various sources, users should be aware of the limitations of individual data records, certain data sets, and the database as a whole. Metadata are made available at the individual record and data set level to provide information on the history and quality of the information. The database does not include 'observations of absence' for corals or sponges. Few areas have been surveyed for deep-sea corals or sponges, so areas showing no observations in the database should not be interpreted as lacking these taxa.	More details available: https://deepseacoraldata.noaa.gov/ Hourigan, T. F., P. J. Etnoyer, R. P. McGuinn, C. Whitmire, D.S. Dorfman, M. Dornback, S. Cross, D. Sallis. 2015. An Introduction to NOAA's National Database for Deep-Sea Corals and Sponges. NOAA Technical Memorandum NOS NCCOS 191. 27 pp. Silver Spring, MD. http://data.nodc.noaa.gov/coris/library/NOAA/CRCP/other/other_crcp_publications/DeepSeaCoralRT/Intro_Natl_DB_for_DSCS.pdf

Remaining ecological data gaps and general limitations

Ecologically Important Areas (EIA) and species distributions: Because of the complexity of several of the analyses conducted for the MSP and the number and diversity of datasets used to represent different species and habitats, there are various limitations and uncertainties associated with modeled ecological data and results. The EIA maps provide a way to summarize available data on some key biological aspects of the study area, and show broad trends in species and habitat distribution throughout the region. However, these maps cannot fully account for other important factors such as ecological interactions or differences in ecological hotspots over different seasons and time scales. For both the EIA and species distribution analyses, each input dataset is also associated with its own challenges depending on data coverage and collection methods, and insufficient data led to an inability account for certain important species, including some which are endangered or threatened. All analysis outputs must be carefully assessed alongside other available information, including the evaluations of uncertainty provided by both studies. Please see Sections 3.1 and 3.2 of the Marine Spatial Plan for further discussion of NCCOS and EIA data gaps and limitations, and a comprehensive list of the data sources incorporated into these analyses.

Seafloor data: Collecting bathymetric and other seafloor data is often logistically challenging and costly. In some cases, modeling approaches can provide indications of where certain seafloor features or sediment types are likely to be located based on various environmental factors and known features. However, the usefulness of this kind of data can be limited without studies that can validate models using mapping technology in the field. The seafloor data prioritization process led by NCCOS identified areas that may prove particularly valuable for both marine spatial planning and other ongoing efforts to understand the physical characteristics of Washington's coastal and marine waters. These locations do not represent the only oceanographic and bathymetric data gaps in the study area. They give an indication of areas that have shared management priorities for filling data gaps and, therefore, where future mapping efforts could maximize their benefit for multiple purposes and groups.

Cultural and Historical Data: The following data sources provided information about cultural and historical resources in and around the study area. For more description of these resources, please see Section 2.2 of the MSP.

Data subject	Source	Methods and Limitations	Reference
Registered historic properties (Map 14)	DAHP	This dataset is an inventory of National and/or State Register listed Historic properties with the Washington State Department of Archaeology and Historic Preservation (http://www.dahp.wa.gov) and the National Park Service (http://www.nps.gov). Sites not listed on either register are not included. These data are a work in progress and are constantly being updated. Data displayed in the plan was acquired in 2015.	Please visit http://www.dahp.wa.gov/historic-register to learn more about state and national historic registers and sites in Washington, or contact DAHP with questions about sites.
Wrecks and obstructions (Map 14)	NOAA	These data represent locations of reported wrecks and obstructions that are considered navigational hazards by NOAA's National Ocean Service in U.S. coastal waters. Data points have been reported through the Automated Wreck and Obstruction Information System (AWOIS) beginning in 1981 and this file was provided in 2013 by the Office of Coast Survey. These records emphasize known features which pose concerns for navigation and are not considered comprehensive, as these features may differ from those noted in certain navigation charts or other databases. Features which have been salvaged or disproved after reporting are not included.	Additional information and a User Guide for the AWOIS system are available from NOAA: https://www.nauticalcharts.noaa.gov/hsd/wrecks_and_obstructions.html
Cultural Risk Map (Map 58)	DAHP	To represent the presence and approximate location of cultural sites within the MSP Study Area, DAHP provided a Cultural Risk Map that shows the relative density of all cultural sites, including archaeological, historic registered, submerged/tidal, land based, and shipwreck sites within and directly adjacent to the Study Area. This map identifies areas that have a higher density of known cultural site locations, and therefore are assumed to be at a higher risk for cultural resource site disturbance from any construction activities. Each area was categorized based on the number of adjacent cells (500m x 500m) that exhibited more than 50% coverage by one or more cultural sites. • Low Density: 0-3 adjacent grid cells • Moderate Density: 4-6 adjacent grid cells • High Density: 7-9 adjacent grid cells	Additional details available: https://www.wecc.biz/_layouts/15/WopiFrame.aspx?sourcedoc=/Reliability/Cultural-Resources-Data-Sharing-Agreement.docx&action=default

		This data was not produced specifically for the Marine Spatial Planning process; however, DAHP transferred results to the 1-square mile hexagons used for the MSP. This data layer was incorporated into the Use Analysis to represent cultural uses (see Section 3.3 of the MSP). This map does not account for undiscovered sites. There is a relatively moderate potential for currently undiscovered, preserved, submerged prehistoric sites throughout the Study Area – see below (ICF International et al., 2013).	
Modeled Paleoshorelines (Map 13)	BOEM	Bureau of Ocean Energy Management (BOEM) aimed to identify the location of known and reported submerged cultural resources, potential inundated prehistoric sites, coastal properties that are listed or eligible for listing on the National Register of Historic Places (NRHP), or traditional cultural properties. To achieve this, BOEM contracted with ICF International to accomplish multiple tasks. First, ICF was directed to assess areas of the Pacific Outer Continental Shelf (POCS) for submerged prehistoric site potential, to develop a GIS-based model for where submerged prehistoric sites might be expected, and to suggest areas most likely to have survived marine transgressive processes. Second, ICF was tasked with identifying coastal properties that could be adversely impacted by alteration of the adjacent seascape. Finally, ICF was directed to identify known, reported, and potential historic shipwrecks on the POCS.	ICF International, Southeastern Archeological Research, & Davis Geoarchaeological Research. (2013). Inventory and analysis of coastal and submerged archaeological site occurrence on the Pacific Outer Continental Shelf (OCS Study BOEM 2013-0115). Bureau of Ocean Energy Management. https://www.boem.gov/ESPIS/5/5357.pdf
Probability of upland archeological features (Map 13)	DAHP	DAHP provided the results of a Statewide Archaeological Predictive Model completed in 2009 in order to aid planners and archaeologists in Washington with evaluating the potential for archaeological resources early in construction projects. This large-scale model predicts the probability of upland archaeological sites only. Historical sites and submerged archaeological sites are not included. The predictive model uses Bayesian statistical analysis to combine environmental information with information acquired from known and possible archaeological sites, Government Land Office records of cultural and natural features, and field surveys. Environmental data included information describing elevation, slope, aspect, distance to water, geology, soils, and landforms. Based on this information, the model identifies environmental conditions that are expected to coincide with archaeological sites in unsurveyed areas. The results identify locations across the state with high, moderate, low and unknown probabilities for discovering an archaeological site. These probabilities were categorized as: **Very Low / Low**: Archaeological survey contingent upon project parameters **Moderate:** Archaeological survey recommended **High / Very High:** Archaeological survey required The final report on the predictive model notes that, as with all models, the results are dependent on the limitations and assumptions associated with input data. See the 2009 Washington Statewide Archaeology Predictive Model Report for more details on input data and limitations, processing methods, or results.	Model data can be viewed on DAHP's online database, Wisaard, at: http://www.dahp.wa.gov/learn-and-research/find-a-historic-place GeoEngineers. Washington Statewide Archaeology Predictive Model Report. 2009.
Viewshed Assessment (Map 15)	UW ONRC	Some historic resources and traditional cultural properties may also be subject to various levels of visual disturbance sensitivity from new ocean uses, such as offshore wind. University of Washington's Olympic Natural Resources Center (ONRC) analyzed how far offshore different height objects would be visible from shore (Map 15) using different heights of observers (at shore) and three different heights of potential development above the surface of the water (10, 90, and 120 meters). Analyses took into account the curvature of the earth and the effects of humidity on visibility. This coarse assessment is useful to understand what may be visible from the coast, yet specific assessments for individual projects will be needed to evaluate the full potential visual impact to historic or cultural resources.	Bennett, K. Determining Line of Sight Distances: Shoreline to Offshore Power Generation Facilities. University of Washington: Olympic Natural Resources Center. http://www.msp.wa.gov/wp-content/uploads/2016/10/Viewshed_Final_Report_ONRC.pdf Map available at: http://www.msp.wa.gov/wp-content/uploads/2015/06/CoastalViewshedSummaryMap.pdf

Additional information from DAHP regarding inadvertent discovery of archaeological materials: Should archaeological materials (e.g. bones, shell, stone tools, beads, ceramics, old bottles, hearths, etc.) be observed during project activities, all work in the immediate vicinity will stop. The State Department of Archaeology and Historic Preservation (360-586-3065), the County planning office, and the affected Tribe(s) must be contacted immediately in order to help assess the situation and determine how to preserve the resource(s). Compliance with all applicable laws pertaining to archaeological resources (RCW 27.53, 27.44 and WAC 25-48) is required. Failure to comply with this requirement could result in criminal or civil penalties. If federal funds or permits are involved in the project, notification to the appropriate federal agency and the Advisory Council must occur in addition to the above-listed parties, per 36 CFR Sec. 800.12.

However, if ground disturbing activities encounter human skeletal remains, then all activity will cease that may cause further disturbance to those remains. The area of the find will be secured and protected from further disturbance. The finding of human skeletal remains will be reported to the county medical examiner/coroner and local law enforcement in the most expeditious manner possible. The remains will not be touched, moved, or further disturbed. The county medical examiner/coroner will assume jurisdiction over the human skeletal remains and make a determination of whether those remains are forensic or non-forensic. If the county medical examiner/coroner determines the remains are non-forensic, then they will report that finding to the Department of Archaeology and Historic Preservation (DAHP) who will then take jurisdiction over the remains. The DAHP will notify any appropriate cemeteries and all affected tribes of the find. The State Physical Anthropologist will make a determination of whether the remains are Indian or Non-Indian and report that finding to any appropriate cemeteries and the affected tribes. The DAHP will then handle all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains. (RCWs 68.50.645, 27.44.055, and 68.60.055)

Remaining cultural/historic data gaps and general limitations

- Data only describes known cultural/historic sites or areas that likely contain these resources within the Study Area.
- Other cultural uses or resources (e.g. cultural landscapes) may not be fully captured in this type of data. (see Section 2.2 for qualitative descriptions of cultural and historic significance of the Study Area)
- Does not include spatial data for tribal cultural resources.
- Site-specific assessments will be necessary to evaluate the visual impact to historic or cultural resources.

Economic Data: These non-spatial data sources provided information about Washington's coastal economy, the economics of existing use sectors discussed in the plan, and the potential economic impacts of some new uses. Section 2.3 of the MSP provides more information on the socioeconomics of the study area, as well as throughout discussions of various existing uses.

Data subject	Source	Methods and Limitations	Reference
Sector Analyses	Industrial Economics	In 2014, Industrial Economics produced profiles of five major sectors important to the state's marine economy and the Marine Spatial Planning process. Each profile discusses the current status of the sector, available data, relevant existing laws and policies, and issues facing the sector. General types of sources consulted by sector included: • Aquaculture • Non-tribal commercial and recreational fishing • Marine renewable energy • Recreation and tourism • Shipping Please see individual sector analysis descriptions and documents for further detail on specific sources consulted in the production of these reports.	Aquaculture: http://msp.wa.gov/wp-content/uploads/2014/03/AquacultureSectorAnalysis.pdf Fishing: http://msp.wa.gov/wp-content/uploads/2014/03/FishingSectorAnalysis.pdf Renewable Energy: http://msp.wa.gov/wp-content/uploads/2014/03/EnergySectorAnalysis.pdf Recreation and Tourism: http://msp.wa.gov/wp-content/uploads/2014/03/RecreationSectorAnalysis.pdf Shipping: http://msp.wa.gov/wp-content/uploads/2014/03/ShippingSectorAnalysis.pdf

Social and Economic Indicators	Washington Sea Grant	Washington Sea Grant economic and social scientists analyzed potential indicators of social and economic health, gathered input from coastal stakeholders on potential indicators, and provided reports summarizing the status of these indicators on Washington's Pacific coast. This work provides a starting point for identifying helpful and scientifically-sound ecosystem indicators. The indicators suggested in the final reports are only an initial list, which must be further assessed and refined into a shorter list to maximize their usefulness. See Section 4.2.2 of the MSP for more information on future refinement and use of the ecosystem indicators for plan implementation.	Social indicators: http://www.msp.wa.gov/wp-content/uploads/2015/03/SeaGrant_SocialIndicatorsReport.pdf Economic indicators: http://www.msp.wa.gov/wp-content/uploads/2015/03/SeaGrant_EconomicIndicatorReport.pdf
Economic Analysis to Support MSP in Washington	Cascade Economics	In 2015, Cascade Economics provided an analysis describing economic profiles of Washington's tribal and non-tribal coastal communities, and research efforts to complete a social impact survey. The final report also analyzes key topic areas including: • Commercial fishing (tribal and non-tribal) • Recreational fishing • Shellfish aquaculture • Recreation and tourism • Ecosystem services The report also provides qualitative assessments of the risk and vulnerability associated with these sectors, and a general qualitative assessment of the potential impacts of six types of new uses: • Marine product extraction • Offshore aquaculture • Dredge disposal (new sites) • Mining of gas hydrates • Mining of marine sand and gravel • Marine renewable energy This analysis was completed after a scoping process with the interagency team, the Washington Coastal Marine Advisory Council (WCMAC), and the MSP Science Advisory Panel. The final topic areas and methods for the analysis were developed based on part on a list of initial content suggestions from WCMAC, a public workshop, written input from WCMAC members and others, and a review by the science panel.	Taylor, M., Baker, J. R., Waters, E., Wegge, T. C., & Wellman, K. (2015). *Economic analysis to support marine spatial planning in Washington*. Prepared for the Washington Coastal Marine Advisory Council. Retrieved from http://www.msp.wa.gov/wp-content/uploads/2014/02/WMSP_2015_small.pdf

Remaining Economic Data Gaps and General Limitations

Economic data gaps and limitations are discussed throughout the plan in Section 2.3 as well as in sections describing various sectors from Sections 2.4 – 2.10. Economic models such as input-output models yield important information, but only provide a snapshot of economic impacts of various sectors. Accuracy of outputs depend on the accuracy and availability of the underlying data for that sector. In some cases, such as shellfish aquaculture, available data has known accuracy and reporting issues.

As noted in Chapter 4, economic impacts of specific projects will vary based on the location, type, and scale of the project. Therefore, these economic impacts will need to be evaluated on a case-by-case basis with updated information at the time a project is proposed.

Data subject	Source	Methods and Limitations	Reference
		Fisheries Data: The following sources provide information related to commercial and recreational fishing activity within the MSP study area. For a description of the fisheries occurring in and their importance to the communities of the MSP study area, please refer to Section 2.4 of the MSP. More details about the fisheries maps will also be provided in a separate report, which are available at msp.wa.gov.	

Fisheries Intensity Data (Maps 17 - 29)	WDFW	The fisheries use maps used in the Plan were developed by WDFW to summarize available information on areas of high importance to fisheries, as required by RCW 43.372.040(6)(c). Identifying the footprint of each fishery was the primary goal. The areas within each footprint, which represent the area where fishing has occurred or has the potential to occur, should be considered to be of potential importance to fishing. The next step—identifying areas of high importance within each footprint—is a more difficult task given limitations in the available spatial information. WDFW used three general approaches to identify areas of relatively high, medium, and low use intensities:
		
		1. *Fishery logbook data and percentile rankings*: Each hexagon was ranked based on the number of intersecting fishing sets or tows and scored using three bins:
		    a. "High"- Top 25% of hexagons
		    b. "Medium"- Middle 50% of hexagons
		    c. "Low"- Bottom 25% of hexagons
		2. *Logbook data with criteria-based intensity definitions*: Due to limited location and effort data presented in logbooks for some fisheries, each hexagon was evaluated based on available effort data and other criteria that correlates with high activity in the particular fishery (e.g. depth, distance from shore)
		3. *Interviews with fishery participants and managers*: Some fisheries have no logbook or other data recording the locations of fishing. In such cases, WDFW consulted with fishery participants and managers to determine intensity levels and footprints of select fisheries.
		
		More specific details for the methods behind producing each map can be found in WDFW 2017 (*in progress*, unpublished). WDFW considers the maps produced by all three methods as advancing public knowledge of where fisheries use the Study Area. At the same time, the maps are subject to uncertainty stemming from limitations in the source data as from variability in the fisheries themselves. Data limitations aside, fishing patterns change for a variety of reasons. Changes in regulations, the environment, economic conditions, and more can all change the level and location of fishing effort. Area of high importance may shift from one year to the next. Furthermore, as with many things, past patterns may not be reflective of future conditions.
		
		In addition, WDFW emphasizes that the maps' intensity rankings do not represent conflict or impact. Although impact would be expected to be proportional to fishing intensity, conflicts in areas ranked as "low" intensity could still cause unacceptable harm to a fishery. Conversely, potential conflicts in areas ranked as "high" intensity might be avoidable or otherwise mitigated. While the fisheries use maps will be helpful in assessing which fisheries may be affected by future project proposals, understanding potential conflict and impact will require consideration of all available information.
			www.msp.wa.gov
			
			https://fortress.wa.gov/dnr/managementgis/msp/default.aspx

Location of recreational shellfish beaches and hard-shell clam beaches	Washington State Department of	These data display public, recreational shellfish harvest beaches that are monitored by the Shellfish Biotoxin Program at the Washington State Department of Health (2013).	www.doh.wa.gov www.msp.wa.gov

(Map 30)	Health and Olympic National Park	Olympic National Park monitors populations of hard-shell clams on park beaches. These data represent areas where hard-shell clams may be found.	https://fortress.wa.gov/dnr/managementgis/msp/default.aspx#
Sector Analysis	Industrial Economics	In 2014, Industrial Economics produced profiles of five major sectors important to the state's marine economy and the Marine Spatial Planning process, including fisheries. The profile discusses the current status of the sector, available data, relevant existing laws and policies, and issues facing the sector.	http://msp.wa.gov/wp-content/uploads/2014/03/FishingSectorAnalysis.pdf
Economic Analysis to Support MSP in Washington	Cascade Economics	In 2015, Cascade Economics provided an analysis describing economic profiles of Washington's tribal and non-tribal coastal communities, and research efforts to complete a social impact survey. The final report also analyzes key topic areas including tribal and non-tribal commercial fishing.	Taylor, M., Baker, J. R., Waters, E., Wegge, T. C., & Wellman, K. (2015). *Economic analysis to support marine spatial planning in Washington*. Prepared for the Washington Coastal Marine Advisory Council. Retrieved from http://www.msp.wa.gov/wp-content/uploads/2014/02/WMSP_2015_small.pdf

Remaining fisheries data gaps and general limitations

Information on the location and intensity of fishing activity should be recognized as uncertain. In general, identifying the footprint of a fishery is a simpler task than accurately ranking intensity of use. Intensity information is particularly uncertain, especially at a fine spatial resolution.

Uncertainty arises from the quality of the data and from the nature of fisheries themselves. Logbook records are not available for every fishery. When available, records may be subject to inaccurate reporting, reported at an imprecise spatial resolution, available for only a few years, or associated with other uncertainties. Fisheries are also inherently variable. The location and amount of fishing effort each year will vary in response to changes in regulations, economic conditions, the marine environment, and other factors. The areas of highest importance to a fishery should be expected to vary from year to year and may shift over time. While the footprints are thought to reflect areas of fishing with reasonable accuracy, they too may vary.

WDFW emphasizes that while the maps provide valuable information about where fishing occurs, on their own they cannot be used to assess the impact or conflict that would occur from new uses in these areas. Relative intensity rankings do not equate to the amount of impact (such as economic loss) that a new use could have on a fishery. Conflict in an area identified as "low" intensity could still cause significant adverse impacts to a fishery and fishing communities. Similarly, development in a "high" intensity area could be of a type that is compatible with certain fishing methods and create no significant adverse impact. Assessment of conflict and impact would require careful study and examination of all available information on a case-by-case basis.

While information on tribal fishing activity and its economic value is provided both in the Cascade Economics study and the Marine Spatial Plan, spatial data regarding tribal fishing intensity was not available nor included in these fisheries maps. Section 2.4 of the MSP provides an overview of tribal fishing activities.

Additionally, in some cases the data used in economic analyses had confidentiality restrictions. Some datasets were also only available at a scale that can be difficult to apply to the planning area, specific communities, or segments of the commercial or recreational fishing sectors.

Aquaculture Data: Data from the following sources provides information related to aquaculture activities within the MSP study area. Currently, these operations consist of shellfish aquaculture located primarily within the Willapa Bay and Grays Harbor estuaries. For more detail on aquaculture in the study area, please refer to Section 2.5 of the MSP.

Data subject	Source	Methods and Limitations	Reference
Aquaculture districts Map 32	WDFW	These data show the aquaculture district boundaries that are used by the Washington State Department of Fish and Wildlife and farmers of commercial aquatic species for daily administration and regulation of the program. Districts were established by law (WAC 220-22-510) in 2003. This layer was created by following the text definitions and locating points from aerial imagery and/or nautical charts. Ambiguities in particular exist in Willapa Bay, where centerlines of "channels" (referred to in the text) were visually assessed from aerial imagery, and it is known that most of these lines do not match with an original WDFW map of Aquaculture Districts.	www.wdfw.wa.gov
Oyster Reserves and Oyster Tracts Map 30	DNR	Oyster Reserves are special aquatic oyster lands whose locations and permitted uses are designated by the legislature. RCW 77.60.010. Oyster Tracts are aquatic lands purchased under the Bush and Callow Acts (passed in 1895) where oysters have been planted.	www.msp.wa.gov
Commercial Shellfish Harvest Locations Map 30	DOH	This data displays locations that DOH approved for commercial shellfish harvest with a commercial harvest site certification as of 2012.	https://www.doh.wa.gov/CommunityandEnvironment/Shellfish/CommercialShellfish/HarvestSite
Commercial Growing Areas	DOH	Department of Health maps indicate the location of commercial shellfish growing areas. DOH also performs sanitary surveys in both commercial and recreational growing areas in order to classify their suitability for harvest.	Current information on shellfish growing area classifications can be found at: http://www.doh.wa.gov/CommunityandEnvironment/Shellfish/GrowingAreas
Sector Analysis	Industrial Economics	In 2014, Industrial Economics produced profiles of five major sectors important to the state's marine economy and the Marine Spatial Planning process, including aquaculture. The profile discusses the current status of the sector, available data, relevant existing laws and policies, and issues facing the sector.	http://msp.wa.gov/wp-content/uploads/2014/03/FishingSectorAnalysis.pdf
Economic Analysis to Support MSP in Washington	Cascade Economics	In 2015, Cascade Economics provided an analysis describing economic profiles of Washington's tribal and non-tribal coastal communities, and research efforts to complete a social impact survey. The final report also analyzes key topic areas including aquaculture.	Taylor, M., Baker, J. R., Waters, E., Wegge, T. C., & Wellman, K. (2015). *Economic analysis to support marine spatial planning in Washington.* Prepared for the Washington Coastal Marine Advisory Council. Retrieved from http://www.msp.wa.gov/wp-content/uploads/2014/02/WMSP_2015_small.pdf

Remaining aquaculture data gaps and general limitations

Some aquaculture datasets used in economic studies, including information from WDFW regarding shellfish farm acreage and harvest volume, have known reporting limitations and are considered to some extent incomplete and inaccurate. This makes assessing the amount of aquaculture actively occurring in the study area difficult. For this and other reasons addressed in more detail in final reports for the economic studies completed for the MSP, data on total harvest value is limited and potentially underrepresented. Additionally, some other datasets used in economic and sector analyses were only available at the statewide or local scale, rather than at the county or planning area scale.

General information is provided in Section 2.10.2 of the MSP regarding conditions that tend to be suitable for various types of offshore aquaculture, including water depth and access to shore facilities. However, limited information is available on more specific attributes that pertain to detailed site suitability for offshore aquaculture. As a result, no detailed analysis has been done to identify where in the study area these types of activities might be proposed in the future.

Data subject	Source	Methods and Limitations	Reference
Recreational Study Map 33	Surfrider Foundation	A study by the Surfrider Foundation on ocean and coastal recreation in Washington provided data describing the economic impacts of recreational activities on Washington's coast and the geographic distribution and intensity of recreational uses in four categories: • **Diving activities**: SCUBA diving and free diving/snorkeling • **Shore-based activities**: Beachcombing, beach going, beach driving, biking & hiking, camping, hang gliding & parasailing, horseback riding, sea-life collecting & harvesting, tide pooling • **Surface water activities**: Boating & sailing, kayaking, kiteboarding, skimboarding, surfing, windsurfing, swimming & body surfing • **Wildlife viewing and sightseeing activities**: Photography, sightseeing, scenic drives, and wildlife viewing from boats or shore To provide baseline data on the extent, intensity, and economic impacts of recreation and tourism in coastal Washington, the Surfrider Foundation, in collaboration with Point 97, conducted an online survey that asked respondents to map locations where they had participated in recreational activities within the study area, and to provide information on expenditures associated with trips to coastal Washington. Two sampling approaches were used, the first of which acquired data from a random sample representing all Washington residents about their coastal recreational activities in the last 12 months. The second approach was an opt-in survey about respondents' most recent coastal trip that allowed anyone to participate, with the goal of reaching a more targeted group of coastal users. This method helped provide a complete picture of activities occurring in the study area, including some activities which are important to the region and its economy but have a smaller number of users that may not have been represented using only statewide random sampling. Spatial and statistical analyses were used to display activity results as "heat maps" showing areas of highest intensity for individual uses and groups of uses. Surfrider also provided a map showing overall use intensity based on the results (Map 33), and a final report describing important trends, popular uses, and estimations of the economic value of recreation and tourism to the coast. For the recreation study, over 17,000 data points were entered by respondents using an online mapping application. All points were included in the final analysis because even if a few individual points were associated with minor user input errors, they provide valuable information about overall trip expenditures and the total numbers of users participating in each activity. The final report by Surfrider and Point 97 provides a detailed explanation of survey and analysis methods.	Point 97, & Surfrider Foundation. (2015). An economic and spatial baseline of coastal recreation in 331 Washington. Prepared for Washington Department of Natural Resources. Retrieved from http://publicfiles.surfrider.org/P97Surfrider WACoastalRecreationReport.pdf
Public Access Map 35	Ecology	The Shoreline Public Access Project is a geographic information systems (GIS) project to identify the location, length, and degree of public access to Washington State's marine shorelines. Before the project, it was unknown how much of Washington's 3068 miles of shoreline was public. The information was scattered throughout various government agencies and the data quality was variable. Through the Shoreline Public Access Project, the best available information has been summarized into a single data set, used to answer questions about our shoreline's ownership and public accessibility. The ultimate purpose of this data is to give shoreline managers and planners another tool to assist them in making important shoreline decisions.	http://www.ecy.wa.gov/services/gis/data/oceans/beachaccess.jpg

| Recreational Vessel Density Map 34 | OCNMS (NOAA) | OCNMS compiled and processed spatial data on the location and density (vessels per square mile) of ship traffic passing through the study area in 2013 and 2014.

Types of ships and their movement through the study area were identified by analyzing satellite-derived automatic identification system (AIS or SAIS) data from exactEarth.com. AIS is a tracking system used to identify and locate vessels; the Coast Guard requires that AIS systems be carried by large commercial ships in the United States, though they are also used by some smaller and/or private vessels.

OCNMS sorted reported vessel positions into six categories, including recreational vessels. Density of positions was calculated and displayed using ArcGIS mapping software. Recreational vessel data includes personal craft like sailboats, and motorboats. Fishing vessels were not included in this data, but small personal fishing vessels were considered recreational vessels when using the study area for purposes other than fishing. The resulting maps show where AIS data indicates that vessel traffic is occurring at low, moderate, or high intensity in the study area.

Automated Identification System data is not available for all small vessels. OCNMS consulted multiple sources to identify and track recreational ship transits in the study area, but some small vessels may not be represented in this data.

Low, moderate, and high intensity of recreational vessel use were defined as follows. Values represent density in positions recorded per 1 sq-mile hexagon. | https://olympiccoast.noaa.gov/ |

Low Intensity	Moderate Intensity	High Intensity	Total # recorded positions
1 - 3	4- 9	10 – 10,361	16,325

Remaining tourism and recreation data gaps and general limitations

Surfrider results only include expenditure and activity information for Washington State residents, and additional surveys would be necessary to provide comparable information for those visitors coming to the area from out of state. However, Cascade economics was able to include estimates of spending for outdoor recreation on the Washington Coast by out-of-state visitors.

Data subject	Source	Methods and Limitations	Reference
Vessel Intensity Data Maps 36 - 39	OCNMS (NOAA)	OCNMS compiled and processed spatial data on shipping activity. This information represents the location and density (vessels per square mile) of ship traffic passing through the study area in 2013 and 2014. Types of ships and their movement through the study area were identified by analyzing satellite-derived automatic identification system (AIS or SAIS) data from exactEarth.com. AIS is a tracking system used to identify and locate vessels; the Coast Guard requires that AIS systems be carried by large commercial ships in the United States, though they are also used by some smaller and/or private vessels. OCNMS sorted reported vessel positions into six categories which include both shipping data (cargo, tanker, and tug & tow vessels) and data on other types of vessels (recreational, military, and passenger ships). Density of positions was calculated and displayed using ArcGIS mapping software. The resulting maps show where AIS data indicates that vessel traffic is occurring at low, moderate, or high intensity in the study area. Low, moderate, and high intensity of shipping use were defined as follows. Values represent density in positions recorded per 1 sq-mile hexagon. *(table below)* AIS data is not available for all small vessels. OCNMS consulted multiple sources to identify and track recreational and other small ship transits in the study area, but some small vessels may not be represented in this data.	Find the data at www.msp.wa.gov.
Towboat/Crabber Lanes Map 40	Washington Sea Grant	Coordinates for this data layer were provided by Washington Sea Grant and are the result of agreements defining navigable towboat and barge lanes through crabbing grounds between Cape Flattery, Washington and San Francisco. Lane locations were determined through discussion and negotiation between representatives of the crabbing and shipping industries, facilitated by Washington Sea Grant. The state acquired coordinates for the lanes displayed in the MSP in 2015. For information on the meetings associated with these agreements, downloadable charts, and other updates, please visit Washington Sea Grant's website.	https://wsg.washington.edu/brokering-lane-agreements-between-crabbers-and-towboat-operators/

	Low Intensity	Moderate Intensity	High Intensity	Total # recorded positions
Cargo ships	1 – 16	17 – 51	52 - 6054	27, 959
Tankers	1 – 5	6 – 15	16 – 724	13,318
Tug & tow vessels	1 – 6	7 – 23	24 – 6726	11, 564
Passenger vessels	1 - 3	4- 10	11 - 282	3,859
Recreational vessels	1 - 3	4- 9	10 – 10,361	16, 325

Shipping Sector Analysis	Industrial Economics	In 2014, Industrial Economics produced profiles of five major sectors important to the state's marine economy and the Marine Spatial Planning process. The shipping industry profile discusses the current status of the sector, available data, relevant existing laws and policies, and issues facing the sector. Types of sources consulted by analysts included: • Economic analyses of port operations completed by several individual ports in Washington and Oregon • Economic impact analyses previously conducted by various Washington counties to address specific proposed facilities such as coal and bulk terminals • Reports estimating the statewide economic impacts of the maritime industry • Reports on the significance of international trade and maritime commerce to Washington State Please see the full sector analysis for further detail on specific sources consulted for this report.	http://msp.wa.gov/wp-content/uploads/2014/03/ShippingSectorAnalysis.pdf
Economic Analysis to Support MSP	Cascade Economics	In 2015, Cascade Economics included analyses of economic impacts of shipping and ports in the Study Area.	Taylor, M., Baker, J. R., Waters, E., Wegge, T. C., & Wellman, K. (2015). *Economic analysis to support marine spatial planning in Washington*. Prepared for the Washington Coastal Marine Advisory Council. Retrieved from http://www.msp.wa.gov/wp-content/uploads/2014/02/WMSP_2015_small.pdf

Remaining shipping data gaps and general limitations

Vessel transit information is readily available for international trade and the domestic transportation of petroleum products. However, available data on the tonnage of domestic non-petroleum products being transported is more limited. It is also unknown how future shipping patterns may change in the future. Additionally, information on how shipping conditions could be impacted by potential new uses remains limited, including potential economic impacts.

Renewable Energy Data: Data from the following sources provides information relevant to potential future offshore wind, wave, and tidal energy development within the MSP study area. Data was collected about existing infrastructure relevant to renewable energy facilities, as well as the technical suitability of Washington's marine waters for energy production. For more information on renewable energy, please refer to Section 2.10.1 of the MSP.

Data subject	Source	Methods	Reference
Technical Suitability Analysis Maps 43-50	PNNL (NOAA)	The Department of Energy's Pacific Northwest National Laboratory (PNNL) modeled offshore energy suitability off the coast of Washington for three types of wind technology, four types of wave technology, and one type of tidal energy technology. Suitability was determined based on factors including available energy resources, distance to shore support and electrical transmission infrastructure, water depth, and bottom sediment type. Results were calculated and mapped in ArcGIS. For this analysis, PNNL acquired technical specifications for renewable energy devices from industry advisors and the U.S. Department of Energy's Marine and Hydrokinetic Technology Database. Various federal, state, and academic sources provided spatial datasets describing existing conditions in the study area. A full list of data sources is available in the final project report on the MSP website.

The final report provided by PNNL cites known uncertainty issues related to substrate information and data collected in shallow water, such as wave resource data. PNNL's analysis also focused only on technical requirements for development and did not incorporate detailed information related to the cost of planning, installing, or operating offshore energy facilities. | Van Cleve, F. B., Judd, C., Radil, A., Ahmann, J., & Geerlofs, S. H. (2013). *Geospatial analysis of technical and economic suitability for renewable ocean energy development on Washington's outer coast* (No. PNNL-22554). Pacific Northwest National Laboratory. Retrieved from http://www.msp.wa.gov/wp-content/uploads/2013/07/PNNL_EnergySuitability_Final-Report.pdf |
| Line of Sight Analysis | ONRC | Line of sight was calculated for 90 meter and 10 meter offshore structure heights, and from 6 ft, 25 ft, and 35 ft on-shore observer heights. The line of sight analysis used standard calculations to account for the curvature of the earth and effects of humidity on visibility of offshore structures. | http://www.onrc.washington.edu/ |
| Sector Analysis | Industrial Economics | In 2014, Industrial Economics produced profiles of five major sectors important to the state's marine economy and the Marine Spatial Planning process. The marine renewable energy profile discusses the current status of the sector, available data, relevant existing laws and policies, and issues facing the sector. Types of sources consulted by analysts included:
• Expert interviews with representatives from private industry, government, and research
• Technical suitability analyses completed by PNNL specifically for the MSP
• Other suitability studies conducted throughout the US
• Information on past research and development projects for marine renewable energy in Washington
• Studies on potential economic and employment impacts of offshore renewable energy development in the US

Please see the full sector analysis for further detail on specific sources consulted for this report. | http://msp.wa.gov/wp-content/uploads/2014/03/EnergySectorAnalysis.pdf |

Remaining renewable energy data gaps and general limitations

Marine renewable energy development is still a relatively new sector. No projects have been constructed in the Study Area to-date. As a result, while information related to the renewable energy industry is available for other locations and at broader scales, Cascade Economics' report notes that quantitative information specific to the Study Area is limited. There are also unknowns related to some of the broader market and energy policy influences that could affect where renewable energy projects may actually be of interest to developers in the future.

It is also unclear how rapidly renewable energy technology may advance in coming years, but future changes in technology will affect assessments of the technical suitability and desirability of the Study Area for both pilot- and full-scale development, as well as the potential effects of development. Information described in the MSP is based on current knowledge and technology.

Additional Designations and Boundaries

Data subject	Source	Description	Reference
Tribal U&As (Map 2)	NOAA Fisheries	These data illustrate the combined, adjudicated boundaries of the Usual and Accustomed Areas (U&As) of the Hoh, Makah, and Quileute tribes and the Quinault Indian Nation.	http://www.nmfs.noaa.gov/
Tribal Reservations (Map 2)	DNR	The Washington State Non-Department of Natural Resources Major Public Lands (NDMPL) data are used primarily to create map products for general planning and management. The NDMPL dataset contains ownership parcels for Federal, State (excluding WA DNR), County and City lands within the State of Washington. It also includes Tribal administrative boundaries. The NDMPL data layer is a polygon dataset and does not contain arc attribute information for ownership boundaries. This data is not connected to WA DNR's Cadastre layers (these data include WA DNR ownership, Public Land Survey System and other cadastral data). As updates are made to Cadastre layers, they may not be reflected in NDMPL.	http://data-wadnr.opendata.arcgis.com/
Shipping Lanes (Map 40)	NOAA (Office of Coast Survey)	Shipping zones delineate activities and regulations for marine vessel traffic. Traffic lanes define specific traffic flow, while traffic separation zones assist opposing streams of marine traffic. Precautionary areas represent areas where ships must navigate with caution, and shipping safety fairways designate where artificial structures are prohibited. Recommended routes are predetermined routes for shipping adopted for reasons of safety. Areas to be Avoided are within defined limits where navigation is particularly hazardous or it is exceptionally important to avoid casualties and should be avoided by all ships or certain classes of ships. Shipping Lanes and Regulations layer was created by extracting ENC (.000) files published by Marine Chart Division, OCS, NOAA.	https://marinecadastre.gov/data/
Federal Navigation Channels (Maps 52, 53, 55)	USACE	This layer shows coastal channels and waterways that are maintained and surveyed by the U.S. Army Corps of Engineers (USACE). These channels are necessary transportation systems that serve economic and national security interests. The possibility of silting is always present. Local authorities should be consulted for the controlling depth. NOS Charts frequently show controlling depths in a table, which is kept current by the US Coast Guard Local Notice to Mariners. These data are intended for coastal and ocean use planning.	https://marinecadastre.gov/data/
Olympic Coast National Marine Sanctuary (Map 1)	NOAA	The National Marine Sanctuary Program manages a system of sanctuaries and other managed areas around the country. These data are based on the legal definition of each national marine sanctuary as defined in the Code of Federal Regulations, at 15 C.F.R. Part 922 and the subparts for each national marine sanctuary. The GIS compatible digital boundary files for each national marine sanctuary are representations of those legal boundaries and are based on the best available data. These digital files are not intended and should not be relied upon for use in navigation or legal purposes. For legal questions relating to the data, please contact the NMSP.	https://marinecadastre.gov/data/
Olympic National Park (Map 1)	NPS	These data represent the boundaries of the Olympic National Park.	www.nps.gov
State Park Seashore Conservation Areas (Map 1)	State Parks	These data display the ocean beaches that were established in 1967 as part of the State Seashore Conservation Area. The Seashore Conservation Area is managed by the Washington State Parks and Recreation Commission to provide the public with opportunities for recreational activities, outdoor sports, observation of nature and relaxation.	www.parks.wa.gov
State DNR Conservation Areas (Map 1)	DNR	These data display the boundaries of Natural Area Preserves and Natural Resource Conservation Areas managed by the Washington State Department of Natural Resources.	www.dnr.wa.gov http://data-wadnr.opendata.arcgis.com/
National Wildlife Refuges and Acquisition Areas (Map 1)	USFWS	These data depict the boundaries of lands and waters that are designated National Wildlife Refuges or are approved for acquisition by the U.S. Fish and Wildlife Service (USFWS) in North America, U.S. Trust Territories and Possessions. The primary source for this information is the USFWS Realty program.	https://www.fws.gov/gis/data/national/index.html