3 PROPOSED ACTION

The Corps proposes to deepen the authorized federal navigation channel in the Columbia River from RM 3.0 to RM 106.5 and to implement the ecosystem restoration features identified in Section 1. The nonfederal sponsors for the proposed action are the Ports of Portland and St. Helens in Oregon and the Ports of Longview, Kalama, Woodland, and Vancouver in Washington. The proposed action will deepen the existing 40-foot-deep channel to the newly authorized depth of 43 feet and maintain the existing channel alignment.

Contractors will be selected by the Corps to perform the channel improvements work. Once the channel improvements are made, the Corps will maintain the 43-foot Columbia River channel as they have the current 40-foot channel. To ensure a passable channel at all times, the Corps will continue to practice the strategy for advanced maintenance with an over-dredge of up to 5 feet in specific areas. The width of the navigation channel will be 600 feet with additional width in the turns, which is the same as the existing channel. In areas where there is a potential for high recurrence of shoaling, overwidth dredging of up to 100 feet is routinely performed. As noted previously, the Project will not require dredging the entire stretch of the navigation channel from Portland to the river mouth because significant stretches are already at or deeper than 43 feet. Specific dredging locations are discussed further in Section 3.2.

Both construction and maintenance of the 43-foot channel will be conducted using a combination of dredging methods, primarily hopper and pipeline dredges. Depending on shoaling, primary depths for dredging in the navigation channel, the turning basins, and berths associated with the Project, will be between approximately 40 and 48 feet. Construction of the proposed 43-foot channel is anticipated to require removing approximately 19 mcy of dredged material, as well as 76,000 cubic yards of basalt rock and 240,000 cubic yards of cemented sand, gravel, and boulders. To complete the construction dredging for the 43-foot channel expeditiously and economically, the Corps will construct the project continuously over a 2-year period. Once the improvements are completed, the channel will require annual maintenance dredging. Over the first 20 years, annual maintenance dredging is expected to decline from around 8 mcy to about 3 mcy of sand as the new channel reaches equilibrium. Annual maintenance will then continue at an average of about 3 mcy of sand per year for the remaining 30-year life of the project. Rock, boulders, and gravel are generally not expected to be encountered or removed during maintenance operations.

Environmental mitigation features have been proposed to offset wetland and riparian losses resulting from upland disposal. These features will be developed on a total of 740 acres of land located at the Martin Island (RM 80), Woodland Bottoms (RM 81), and Webb (RM 47) mitigation sites. The Woodland Bottoms and Webb mitigation sites are located behind flood control dikes and are not connected to the Columbia River except through pump stations and tidegates. The actions to implement those features will occur behind existing dikes that have created a barrier between the sites and the listed species and their habitat. Accordingly, these actions will not affect the indicators or pathways in the conceptual model and are not anticipated to adversely modify critical habitat.

Maintenance dredging in the existing 40-foot channel has been unrestricted by in-water work periods because the dredging is done at depths and in locations where salmonids are not generally present. Maintenance dredging on the Columbia River normally occurs annually from May to October. Pile dikes are used on both shorelines to protect disposal sites and reduce maintenance dredging needs for the 40-foot channel. Pile dikes will be maintained throughout the life of the 43-foot channel. Pile dike maintenance methods that will be used for the 43-foot channel are the same as those described in the 1996 Corps BA for maintenance of selected pile dike fields. Maintenance includes periodically replacing pilings and spreader bars that have worn out or broken.

There are 12 side channels below Bonneville Dam that are also maintained (at varying frequencies) by the Corps. No changes to these side channels are proposed as part of this consultation. Side channels are located at Baker Bay West Channel (40,000 to 50,000 cubic yards every 3 to 4 years) at RM 2.5; Chinook Channel (150,000 to 200,000 cubic yards every 1 to 2 years) at RM 5; Hammond Boat Basin (infrequently) at RM 7; Skipanon Channel (20,000 to 50,000 cubic yards every 1 to 3 years) at RM 10; Tongue Point (not maintained) at RM 17; Skamokawa (infrequently) at RM 33.6; Elochoman (infrequently) at RM 37; Westport Slough (infrequently) at RM 43; Cowlitz River Old Mouth (10,000 to 20,000 cubic yards a year) at RM 67; St. Helens Cross Channel (infrequently) at RM 87; Oregon Slough (50,000 cubic yards every 3 to 5 years) at RM 102; and Government Island (infrequently) at RM 116 (Corps, 1999a).

Methods to be used for the dredging and disposal associated with the proposed Project and maintenance of the 43-foot channel are described in this section. Channel construction and maintenance will encompass a variety of dredging and dredged material disposal activities, as well as associated conservation measures. The description includes impact minimization and best management practices (BMPs) associated with each of the anticipated activities. Additional proposed conservation measures not associated with BMPs for the respective dredging/disposal activities are described in Section 8.

Typical locations for dredging or disposal activities, both construction and maintenance, are also discussed in this section. For those disposal activities that will occur in a known location (e.g., upland disposal), specific information about the location is provided.

As part of the authorized Project, ecosystem restoration features will include the use of a combined pump/gravity water supply for restoring wetland and riparian habitat at Shillapoo Lake (RM 91). Tidegate retrofits with fish slides for salmonid passage will be installed at selected locations along the lower Columbia River. Connecting channels will be constructed at the upstream end of Walker-Lord and Hump-Fisher Islands to improve fish access to embayments and rearing habitat for juvenile salmonids.

As a result of the informal consultation, additional ecosystem restoration features have been included. These features will be constructed using several different means. Lois Island embayment and Miller-Pillar intertidal and/or subtidal habitat restoration efforts will be constructed via placement of dredged material to attain target depths at each location. Miller-Pillar will also require construction of a pile dike field (five pile dikes) to hold material in place. Bachelor Slough restoration will entail deepening an existing side channel via dredging and disposal of material either upland or in or adjacent to the navigation channel. Upland disposal of Bachelor Slough sediments will allow for the development of riparian forest habitat with the ESA Critical Habitat zone for Snake River salmonids. Purple loosestrife control will entail use of an integrated pest management approach, e.g., introduction of biological control agents, use of herbicides, and/or mechanical pulling of this exotic plant.

The interim restoration action at Tenasillahe Island will encompass improvements to existing tidegates and possible placement of water control structures at inlets to interior sloughs to improve fish accessibility and water circulation through the sloughs. Over the long-term, improvements at Tenasillahe

Island may entail breaching of exterior dikes to return tidal circulation to 1,778 acres. The long-term action is contingent upon delisting of Columbia white-tailed deer and Congressional authorization to change the purpose and objectives of these refuge lands. The last restoration proposal pertains to the translocation of Columbia white-tailed deer to Cottonwood-Howard Island near Longview, Washington. No habitat restoration is required for this latter action. Additional information regarding disposal sites is included in Appendix C.

3.1 Project Planning and Execution

There is some uncertainty associated with the final locations and extent of the shoals to be dredged because the river's bedload movement is continuous. Therefore, surveys will also be obtained for plans and specifications as well as preconstruction surveys. In addition, because contractors will be performing the channel improvements, the method of dredging in particular areas may not be known prior to the contract being awarded. So, while the Corps' plans provide guidance for timing and locations of dredging activities, the actual construction may not follow that sequence. These planning aspects of the dredging operations are discussed below.

3.1.1 Methods

3.1.1.1 Construction

Construction dredging will include a variety of techniques for removing sand and some rock from the river bottom. The amount of dredging that will be necessary in a given location varies depending on the amount and location of shoaling. Because of this variability, bathymetric (hydrographic) surveys will be conducted prior to and after each construction dredging to identify where further dredging is needed and to quantify the amount of material removed for contractor payment.

As discussed earlier, the Corps will award contracts for project activities. The contractors will choose the specific equipment to be used. Mandating specific types of dredging within the bid process has the potential to increase the expense, exacerbate already difficult timing considerations, and eliminate the benefits gained from using the expertise of the dredge operators by precluding the use of alternative actions or methods that may be more economical or efficient. Therefore, this BA addresses all types of dredging that might be used for channel improvements or maintenance.

3.1.1.2 Maintenance

Maintenance dredging will occur using the same methods currently employed to maintain the existing 40-foot channel (Corps, 1999a). Maintenance dredging for the new channel would begin when construction of the 43-foot channel is accepted by the Corps. As a result, part of the river will be maintained at 43 feet while other portions are being deepened. Annual maintenance of the channel will continue throughout the 50-year project life. It is anticipated that hopper and pipeline dredging will be the primary dredge types used to perform annual maintenance described in Sections 3.2.1 and 3.2.3.

3.1.2 Timing

The proposed construction dredging to deepen the Columbia River Channel to 43 feet would require approximately 2 years of year-round dredging. Some activity would be occurring during the entire period. Year-round dredging is proposed at depths greater than 20 feet because salmonids generally are not present in these locations.

Maintenance dredging using a pipeline would typically occur from May through October each year. Hydrographic surveys of the channel would be updated throughout the dredging season and indicate which bars need to receive maintenance dredging. A schedule for pipeline dredging is usually developed 2 weeks in advance of mobilization to each work area and is based on the results of hydrographic surveys.

Maintenance dredging using a hopper dredge begins in the spring. For maintenance of the 43-foot channel, the Corps would likely use its dredges *Yaquina* and *Essayons*. The remainder of hopper dredging in the river would occur from May 1 through October 31 using both contract and government dredges.

In-water blasting, if necessary, would occur during the recommended in-water work period of November 1 to February 28. See Table 3-1 for additional information regarding dredging timing.

Table 3-1: Dredging Timing

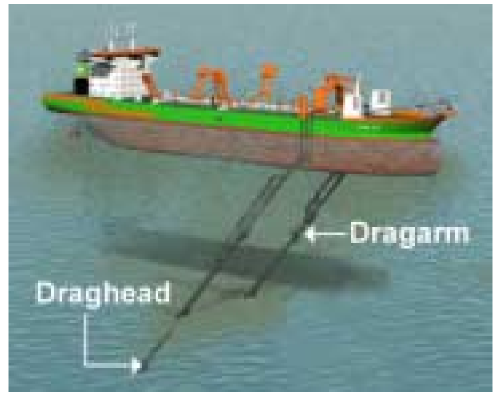
Construction Features	Type of Dredging	Timing
Navigation channel, including overdepth and overwidth dredging at depths greater than 20 feet	Hopper Pipeline Mechanical excavation	No timing windows No timing windows No timing windows
Turning basins at depths greater than 20 feet	Hopper Pipeline	No timing windows No timing windows
Rock removal with blasting	Mechanical excavation	November 1 to February 28
Rock removal at depths greater than 20 feet	Mechanical excavation	No timing windows
Berths	Mechanical excavation	November 1 to February 28
Ecosystem restoration features dredging at depths greater than 20 feet	Mechanical excavation Pipeline Hopper	No timing windows
Ecosystem restoration features dredging at depths less than 20 feet	Mechanical excavation Pipeline Hopper	November 1 to February 28

3.2 Description of Project Activities

Anticipated methods for completing the proposed project activities are described in this section. Each of the descriptions includes a general statement about the steps involved in the activity and whether they are related to construction or maintenance, followed by a brief discussion of any relevant studies performed or used by the Corps to evaluate potential adverse affects. In those instances where particular studies, general experience, or coordination with NMFS and USFWS have led to setting specific BMPs for the activities, the measures that will be used to minimize the potential impact of such activities are described. The activities and associated BMPs described in this section will be given to contractors in the bid package for all contracted dredge activities associated with project activities. Contractors will be informed that all activities must be conducted in conformance with these BMPs, and they will be mandated to provide a compliance plan.

3.2.1 Hopper Dredging

3.2.1.1 Description of Activity



Suction Hopper Dredge

Hopper dredges use a draghead at the end of dragarms located on both sides of the dredge. The dragheads are lowered to the channel bottom, and suction from the pump is used to transport material through the dragarm and into the hold of the dredge. Hopper dredges collect dredged material in the hold or "hopper" of the vessel until it is near capacity. When the hopper is filled, the dragarms are raised and the vessel moves to the disposal site. Material from hopper dredges is normally disposed of using flowlane disposal in deep areas in and adjacent to the channel. As the dredge is moving, a series of hopper doors are opened and the material is discharged at varying rates, depending on how far the hopper doors are opened. Some hopper dredges are of the "split hull" type, and some are of the "hopper door" type. In split hull hopper dredges, the hull is split open for discharging and the rate of discharge is varied by how far the hull is opened.

Hopper dredges conducting maintenance dredging currently handle about 3 mcy per year of material from the navigation channel. Hopper dredges provide flexibility for dredging operations because of their maneuverability. They are most often used on small-volume sandwave shoals in the river and on large shoals in the estuary for which pipeline dredges are less suitable. Hopper dredges are also used for maintenance dredging at the mouth of the river during the summer and fall months.

3.2.1.2 Studies/Monitoring Performed for Activities

Entrainment of organisms by hopper dredging has been evaluated at the mouth of the Columbia River and in the river itself, as well as in several coastal streams (Larson and Moehl, 1992; R2 Resources Consulting, 1990). The MCR study was begun in 1985 to assess impacts to Dungeness crab populations as a result of hopper dredging. The study obtained information on fish and found that no juvenile or adult salmonids were collected during the 4 years of the study, even though other pelagic species were collected. The study concluded that because dredging occurred below the depth where salmonids migrate, no salmon were entrained. Consequently, it is believed that few, if any, salmonids are entrained during normal maintenance dredging operations in the MCR or the Columbia River.

The only documented entrainment of salmonids occurred during a study in which the dredge draghead was operated while elevated in the water column instead of on the channel bottom and while pumping (R2 Resource Consultants, 1999). No juvenile salmonids have been entrained during normal dredging operations (Larson and Moehl, 1990).

Dredging procedures call for the draghead to be buried in the sediment of the river bed during dredging operations or raised no more than 3 feet off the river bottom when the pumps are idling to further reduce the potential for fish entrainment. Adult salmonids have sufficient swimming capacity to avoid entrainment by dredging if they are present in the vicinity of dredges and if the draghead is above the river bed when operating.

Other studies on entrainment have been conducted outside of the Columbia River. Dutta and Sookachoff (1975) and Arseneault (1982) summarized the work done by Fisheries and Marine Services of Canada on entrainment of juvenile salmonids by hydraulic dredging in the Fraser River. Their results indicated that juvenile salmonids can be entrained in large numbers when dredging is done in narrow channel areas near the shore. The Fraser River study focused on an area that was narrow and constrained, and therefore, the conclusions would not be pertinent to the Columbia River because of its large cross-sectional area. Other entrainment studies, in more open areas with the dredging taking place farther from shore, have shown less entrainment. In Grays Harbor, Washington, Bengston and Brown (1977) made some limited observations of pipeline-dredged material as it was being discharged, and Tegelberg and Arthur (1977) made observations on fish entrained by both hopper and pipeline dredges. Neither study showed any salmonids entrained. Stevens (1981) collected data in Grays Harbor on fish entrained by pipeline, hopper, and clamshell dredges, and Armstrong, et al. (1982), evaluated impacts of dredging on fish as part of a Dungeness crab study in Grays Harbor. Only a single chum salmon was collected.

In 1997 and 1998, hydro-acoustic studies were done in the lower Columbia River to determine the distribution of juvenile salmonids in the navigation channel. The results show that most yearling juvenile salmonids were located along the navigation channel margins while migrating (Carlson, 2001). Because dredging would not occur in the channel margins, these fish would not be susceptible to entrainment levels exhibited in the Fraser River studies (Dutta and Sookachoff, 1975; Arseneault, 1982).

3.2.1.3 Impact Minimization Measures Applied to Activity

Hopper and pipeline dredges generally do not produce large amounts of turbidity during dredging because of the suction action of the dredge pump and the fact that the dragarm or cutter head is buried in the sediment. In addition, entrainment is not expected to occur as dredging is done at depths of more than 40 feet and salmonids generally migrate at depths of less than 15 feet. The primary impact minimization measure anticipated for hopper dredging is to require dredges to stop pumping when raising the draghead more than 3 feet from the bottom. This is normally done by the dredge operators and has been required by NMFS since the September 1999 BO for maintenance dredging of the 40-foot channel.

3.2.2 Mechanical Dredging

Mechanical dredges remove material by scooping it up with a bucket. Mechanical dredges include clamshell, dragline, and backhoe dredges. Mechanical dredges are well suited for removing cemented sands, gravels, or well-fractured rock outcrops. Accordingly, mechanical dredging is likely to be chosen by the contractor during channel construction to remove cemented conglomerates near Longview, Washington (Slaughter’s Bar), and may also be used on the rock outcropping at Warrior Rock near St. Helens, Oregon. Mechanical dredges would only be used for maintenance dredging in discrete areas where other forms of dredging may not be effective. For example, mechanical dredges are often used under bridges and in other tight areas, like the berthing areas, to remove small amounts of material.

3.2.2.1 Description of Activity

Clam Shell Dredge

Mechanical dredging is performed using a bucket operated from a crane or derrick that is mounted on a barge or operated from shore. Sediment from the bucket is usually placed on a barge for offloading and disposal to an upland or in-water site.

Because mechanical dredges are not self-propelled, they are not typically used in high traffic areas; rather, they are used in tighter spaces such as around docks and piers. Also, because they are usually situated on a barge, clamshell dredges can be used in restricted areas and shallow areas where draft restrictions may limit other choices. A clamshell dredge will be used to deepen the berths, which are restricted areas, and remove the cemented cobbles in the Slaughter's Bar area (near the Longview bridge). Mechanical dredges equipped with special buckets are often regarded as being particularly useful in silts or contaminated materials where water entrapment may be a problem. Mechanical dredges are used for side channel projects related to the Columbia River navigation channel.

3.2.2.2 Studies/Monitoring Performed for Activities

It is generally believed that clamshell dredging causes less adverse impact than other types of dredging. Stevens (1981) collected data in Grays Harbor on entrainment by pipeline, hopper, and clamshell dredges, and also evaluated the impacts of dredging on fish as part of a Dungeness crab study in Grays Harbor. The study did not show any salmon collected. Armstong, et al. (1982), in a similar study of the impacts of dredging on Dungeness crabs in Grays Harbor, reported catching one juvenile chum salmon. Both studies were conducted during the time period of early winter through late summer.

3.2.2.3 Impact Minimization Measures Applied to Activity

It is generally believed that entrainment by clamshell dredging does not occur because juvenile and adult salmonids are able to avoid entrainment by the clamshell bucket, in part because they are alerted to danger by a pressure wave created as the bucket is dropped through the water column. Based on this, clamshell dredging has not been timing restricted, even in shallow water areas.

Mechanical dredging will be used to remove rock and cemented cobbles not associated with blasting, and could conceivably be done during the in-water work period. The amount of turbidity produced by mechanical dredging depends on the type of bucket used. An open bucket dragline can produce the most amount of turbidity. A closing bucket generally produces less turbidity than the dragline type.

3.2.3 Pipeline Dredging

3.2.3.1 Description of Activity

Pipeline dredges are used for large cutline shoals and areas with multiple sandwave shoals. A pipeline dredge uses a "cutter head" on the end of an arm that is buried about 3 to 6 feet deep in the river bottom material and swings in a 250- to 300-foot arc in front of the dredge. Dredged material is sucked up through the cutter head and the pipes, then pumped to upland disposal sites or disposed of in-water, as described below.

Upland disposal sites have been identified throughout the project area. Material dredged from the channel will be pumped to these sites by pipeline dredge. Dikes will be constructed at these sites to contain the material and water. The return water will be held in settling ponds controlled by weirs.

Pipeline Dredging

Future pipeline maintenance dredging is expected to be about 3 to 5 mcy per year. Maintenance dredging done by pipeline will use the Port of Portland's 30-inch dredge, the *Oregon*, from May through September. In a typical maintenance season, the *Oregon* will begin river dredging at shoals in the estuary and then progress upstream.

Flowlane disposal uses a "down pipe" with a diffuser plate at its end. The down pipe extends 20 feet below the water surface to avoid impacts to migrating juvenile salmonids. The diffuser and movement of the pipe help prevent mounds from forming on the river bottom.

3.2.3.2 Studies/Monitoring Performed for Activities

Buell (1992) studied entrainment of fish by pipeline dredging in the study area. Entrainment only occurred when the fish were in the immediate vicinity of the cutter head. Because the proposed pipeline dredging for the main navigation channel will occur at 40 feet and deeper, individuals of listed species are not expected to be near the cutter head. As mentioned in the section on hopper dredging, applicable entrainment studies found no salmonids entrained during dredging. In Grays Harbor, Washington, Bengston and Brown (1977) made some observations of pipeline-dredged material as it was being discharged, and Tegelberg and Authur (1977) made observations on fish entrained by both hopper and pipeline dredges. Neither study showed any salmonids entrained. Stevens (1981) collected data in Grays Harbor on fish entrained by pipeline, hopper, and clamshell dredges, and Armstrong, et al. (1982), evaluated impacts of dredging on fish as part of a Dungeness crab study in Grays Harbor.

3.2.3.3 Impact Minimization Measures Applied to Activity

Pipeline dredges generally do not produce large amounts of turbidity during dredging because of the suction action of the dredge pump and the fact that the cutter head is buried in the sediment. Impacts to salmonids, including entrainment, can be avoided by operating hopper dragheads and pipeline cutter heads only within 3 feet of the river bottom. Impact minimization practices and BMPs for dredging are listed in Table 3-2.

Table 3-2: Impact Minimization Practices and Best Management Practices for Dredging

Measure	Justification	Duration	Management Decision
Hopper Dredging			
Maintain dragheads in the substrate or no more than 3 feet above the bottom with the dredge pumps running.	This restriction minimizes or eliminates entrainment of juvenile salmon during normal dredging operations.	Continuous during dredging operations.	Maintain until new information becomes available that would warrant change.
Dredging in shallow water areas (less than 20 feet) only during the recommended ESA in-water work period for the Columbia River of November 1 until February 28.	Areas less than 20 feet deep are considered salmon migratory habitat. Dredging or disposal in these areas could delay migration or reduce or eliminate food sources.	Continuous during dredging and disposal operations.	Maintain until new information becomes available that would warrant change.
Pipeline Dredging			
Maintain dragheads in the substrate or no more than 3 feet above the bottom with the dredge pumps running.	This restriction minimizes or eliminates entrainment of juvenile salmon during normal dredging operations.	Continuous during dredging operations.	Maintain until new information becomes available that would warrant change.
Dredging in shallow water areas (less than 20 feet) only during the recommended ESA in-water work period for the Columbia River of November 1 until February 28.	Areas less than 20 feet deep are considered salmon migratory habitat, Dredging or disposal in these areas could delay migration or reduce or eliminate food sources.	Continuous during dredging and disposal operations.	Maintain until new information becomes available that would warrant change.
General Provisions for All Dredging			
The contractor shall not release any trash, garbage, oil, grease, chemicals, or other contaminants into the waterway.	Protection of water resources.	Life of contract or action.	If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. Contaminated ground shall be excavated and removed and the area restored as directed. Any in-water release shall be immediately reported to the nearest U.S. Coast Guard Unit for appropriate response.
The contractor, where possible, will use or propose for use materials that may be considered environmentally friendly in that waste from such materials is not regulated as a hazardous waste or is not considered harmful to the environment. If hazardous wastes are generated, disposal of this material shall be done in accordance with 40 CFR parts 260-272 and 49 CFR parts 100-177.	Disposal of hazardous waste.	Life of contract or action.	If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. Contaminated ground shall be excavated and removed and the area restored as directed. Any in-water release shall be immediately reported to the nearest U.S. Coast Guard Unit for appropriate response.

3.2.4 Berth Deepening at Lower Columbia River Ports

Three grain facilities and one container terminal on the Columbia River are identified in the Corps' FEIS (1999a) as benefiting from channel deepening. Vessel berths alongside two of these facilities – the Port of Kalama grain elevator operated by United Harvest and the Port of Portland's Terminal 6 – will require dredging to "achieve the benefits of any channel deepening alternative" (Corps, 1999a). One berth will be deepened at the United Harvest elevator, located just north of the City of Kalama. Three berths, totaling approximately 2,800 linear feet, will be deepened at Terminal 6, located at the confluence of the Columbia and Willamette Rivers.

Since the FEIS was completed in August 1999, U.S. Gypsum has opened a facility on the Columbia River at the Port of St. Helens. This facility will also require berth deepening to benefit from channel deepening. Section 6.9, of the FEIS (Corps, 1999a) Secondary Impacts, addresses "additional dredging requirements at port berthing areas," and specifies that the local ports would be required to obtain dredging permits for their facilities.

3.2.4.1 Studies/Monitoring Performed for Berth Deepening

For the purposes of evaluating the feasibility of the proposed Project and providing preliminary data for inclusion in the FEIS, a sediment characterization study was prepared for the berths to be deepened (Corps, 1999a, Appendix B). Volume I of the study is included in Appendix B of the FEIS (Corps, 1999a). Sediment core samples were taken at the United Harvest berth at Kalama, at the berths at Terminal 6 in Portland, and at the Longview grain wharf. Except for one sample at Terminal 6, which indicated a need for further evaluation to determine the appropriate disposal option, the study found that all sediments in the 42- to 45-foot dredging prism were determined to be suitable for unconfined in-water disposal, based on the Corps' Dredged Material Evaluation Framework. If testing prior to actual dredging reveals that the material is not suitable for in-water disposal, material dredged from these berths will be disposed of in such a manner that unacceptable environmental impacts will be avoided (Corps, 1999a). The same is true for the U.S. Gypsum site if that berth is deepened.

3.2.5 Flowlane Disposal

3.2.5.1 Description of Activity

Normally, flowlane or in-water disposal distributes dredged material in sites within or adjacent to the navigation channel and downstream of the dredging area at depths greater than the channel. This is done to minimize the potential for material settling back into the channel and causing additional shoaling problems. Approximately 3 mcy of construction material will be disposed of in the flowlane, with 2.5 mcy between RM 27 and 42. Flowlane disposal for maintenance is approximately 24 mcy over 20 years. The average annual quantity of maintenance material for flowlane disposal is expected to be 2 to 4 mcy. This type of dredged material disposal is to be done throughout the Columbia River navigation channel where depths range from 35 to 65 feet, but are typically greater than 50 feet. Disposal sites are not specifically designated because they vary according to the condition of the channel and the techniques used by the contractor selected to perform the work. Flowlane disposal is dispersed along the channel to avoid creating mounds.

3.2.5.2 Studies/Monitoring Performed for Activities

In a 1997 study for the Corps by McCabe, NMFS examined fish, particularly white sturgeon, in bottom habitats in six flowlane disposal areas in the Columbia River between RM 24 and 81. The study concluded that larval and young-of-the-year white sturgeon would probably be most affected by flowlane disposal, with the impact depending on the amount of material deposited on the fish. The study concluded that laboratory research is needed to determine the mechanical impacts of flowlane disposal on white sturgeon. The study identified no impacts to salmonids.

Benthic invertebrates, which are a major food source for salmonids, are most abundant at depths of less than 20 feet. Benthic sampling in the flowlane has found low benthic invertebrate abundance (McCabe, 1997).

3.2.5.3 Impact Minimization Measures Applied to Activity

As noted in the preceding discussion, flowlane disposal is done throughout the Columbia River navigation channel. For the Project, flowlane disposal would be in depths generally ranging from 50 to 65 feet. The benthic invertebrates that provide a major food source for some fish are found at depths of less than 20 feet. Restricting the disposal of dredged materials to depths greater than 20 feet will minimize potential impacts from this activity. To avoid mounding during hopper-dredge disposal, material will be released while the dredge is in motion to disperse material over the flowlane disposal area. During disposal or placement of dredged material by pipeline dredge, the diffuser on the down pipe will be moved continually to prevent mounding on the river bottom.

3.2.6 Upland Disposal

3.2.6.1 Description of Activity

Upland disposal will be the most frequently used method for disposing of sediment associated with channel deepening construction. Disposal of sediments on designated upland sites will be done primarily with pipeline dredges. Material could also be loaded onto barges with mechanical dredges and then off-loaded at a temporary dock near the disposal site. The material would be taken to an upland site by heavy equipment. Pipeline dredges pump a water and sand slurry through pipes directly from the dredge's location on the river to the upland disposal site. Both the pipeline landfall and the offloading facility for the barge will be temporary and will only be in place until the disposal site is full or the dredging is completed. The off-loading area will be restored to predisposal conditions after use.

Most upland sites used for both channel construction and maintenance are designed as holding ponds, with earthen dikes to contain the dredged material and hold the return water while allowing sand and suspended sediment to settle (Figure 3-1). Weirs are used to regulate the return of water to the river. Once the pipeline dredge deposits the material and the water is drained, the sand is "drifted" or spread evenly around the holding area. Water returned to the river through weirs is subject to applicable water quality standards, after dilution, at an appropriate point of compliance.

Figure 3-1: Upland Disposal Site Typical Plan View

Of the 29 upland disposal sites proposed for channel construction, only five will be new sites that have not been previously used for maintenance dredging disposal: Mount Solo, Puget Island, Gateway, Fazio Adjacent, and Railroad Corridor. Because of the previous use at most of the upland disposal sites, site capacities will vary. Some sites will be used only for channel construction, some for both construction and maintenance of the new channel, and some just for maintenance. The useful life and capacity of these diked disposal sites is normally extended by building a series of "lifts," which are placed on top of the deposited sand after a specified height is reached (Figure 3-2). These upland disposal sites may accommodate one to three lifts, depending on the characteristics of the site. Section 3.3 of this BA identifies those sites and activities that result from deepening the channel and subsequent maintenance.

3.2.6.2 Studies/Monitoring Performed for Activities

A number of studies have been conducted to evaluate the suitability of potential upland disposal sites. Environmental site assessments (Phase I) have been performed for each of the potential upland disposal sites, and these are available as separate documents. Interagency Habitat Evaluation Procedure (HEP) analyses have been prepared for each site, the results of which are summarized in the (Corps, 1999a). In Oregon, follow-up habitat evaluations are being conducted in coordination with the Oregon Division of State Lands, and additional wetland evaluations have been conducted at specific disposal site locations in both states. To date, upland disposal along the Columbia River channel is not known to have had any adverse impacts on listed fish species or proposed critical habitat.

3.2.6.3 Impact Minimization Measures Applied to Activity

As indicated above, upland disposal along the Columbia River channel is not known to have had any adverse impacts on listed fish species or proposed critical habitat to date; however, several measures will minimize the potential for impact from this activity. Minimum buffer widths between disposal sites and the river are planned to protect riparian corridors where applicable (see Figure 3-1). The riparian edge along the shoreline, if present, will be avoided whenever possible, as is done with current maintenance dredging. A survey of riparian areas was made by NMFS and the Corps, and areas of significance were delineated so that they could be avoided. Proposed sites have either been located to avoid wetland impacts or, if impacted, wetlands are to be mitigated at a ratio of 1:5. In addition, many sites will be replanted and regraded after they are no longer used for dredged material disposal. Sites that have been used for past dredged material disposal were selected first. Sites from which dredged materials could be used beneficially or sold were also selected in preference to other locations.

Figure 3-2: Typical Dike Cross Section for a Hypothetical Upland Disposal Site

3.2.7 Shoreline Disposal

3.2.7.1 Description of Activity

Throughout the year, the combination of river flows, wind waves, ship wakes, and tidal effects erode sand from river beaches. In the past, many of those beach areas have been replaced with dredged material through shoreline disposal. Where shoreline disposal is used to replace the eroded areas with dredged sand, it is called "beach nourishment." Shoreline disposal is done primarily with pipeline dredges. Material dredged from the main navigation channel is pumped to a shallow water and beach area. The dredge first pumps a landing on the beach to establish a point from which further material placement occurs. Dredged material is pumped as a sand and water slurry (about 20 percent sand). As it exits the shore pipe, the sand quickly settles out on the beach while the water returns to the river. Once sand begins to accumulate, it is spread by bulldozer to match the elevation of the existing beach. A typical shoreline disposal operation occurs only once at any location during the dredging season. It takes from 5 to 15 days to fill a site, depending on the size of the site and the amount of material to be dredged. The width of the beach that is created is approximately 100 to 150 feet riverward. The process continues by adding length to the shore pipe and proceeding longitudinally along the beach. After disposal the beach is groomed to a minimum steepness of 10 to 15 percent to prevent the possibility of creating areas where fish could be stranded by wave action.

Shoreline disposal of dredged material during channel construction is anticipated to occur at Sand Island (O-82.6).[15] Sand Island, Skamokawa (W-28), and Miller Sands (O-23.5) will be used periodically for maintenance disposal.

3.2.7.2 Studies/Monitoring Performed for Activities

NMFS, under contract to the Corps, examined the quality and quantity of benthic invertebrate communities at 10 historical beach nourishment areas in the lower Columbia River (McCabe and Hinton, 1996). The goal of the study was to determine whether NMFS would allow any of these sites to be used in the future. The 10 locations were sampled quarterly between July 1994 and April 1995. The report determined that the sites were fairly productive for benthic invertebrates, including *Corophium salmonis*, an important food source for juvenile salmonids. The study also suggested that productivity levels depend on the erosive nature of the site. McCabe and Hinton found that the two highly erosive sites were significantly less productive than the other sites studied.

3.2.7.3 Impact Minimization Measures Applied to Activity

Based on the results of the 1996 McCabe and Hinton study, only sites determined to be highly erosive have been selected for use as beach nourishment areas. In addition, all grading at the sites must result in slopes from 10 to 15 percent to minimize the potential for stranding by wave and wake action. Impact minimization measures, also referred to as BMPs, for disposal are listed in Table 3-3.

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[15] Onshore locations are designated by a state code plus a river mile. For example O-82.6 is on the Oregon side of the Columbia River at RM 82.6; W-82.6 would be the corresponding point on the Washington side.

Table 3-3: Best Management Practices for Disposal

Measure	Justification	Duration	Management Decision
Flowlane Disposal			
Dispose of material in a manner that prevents mounding of the disposal material.	Spreading the material out will reduce the depth of the material on the bottom, which will reduce the impacts to fish and invertebrate populations.	Life of contract or action.	Maintain until new information becomes available that would warrant change.
Maintain discharge pipe of pipeline dredge at or below 20 feet of water depth during disposal.	This measure reduces the impact of disposal and increased suspended sediment and turbidity on migration juvenile salmonids, since they are believed to migrate principally in the upper 20 feet of the water column.	Continuous during dredging operations.	Maintain until new information becomes available that would warrant change.
Upland Disposal			
Berm upland disposal sites to maximize the settling of fines in the runoff water.	This action reduces the potential for increasing suspended sediments and turbidity in the runoff water.	Continuous during disposal operations.	Maintain until new information becomes available that would warrant change.
Maintain 300-foot habitat buffer.	This action maintains important habitat functions.	Life of contract or action.	Maintain until new information becomes available that would warrant a change.
Shoreline Disposal			
Dispose of material in shallow water areas (less than 20 feet) only during the recommended ESA in-water work period for the Columbia River of November 1 until February 28.	Areas less than 20 feet deep are considered salmon migratory habitat. Dredging or disposal in these areas could delay migration or reduce or eliminate food sources.	Continuous during dredging and disposal operations.	Maintain until new information becomes available that would warrant change.
Grade disposal site to a slope of 10 to 15 percent, with no swales, to reduce the possibility of stranding of juvenile salmonids.	Ungraded slopes can provide conditions on the beach that will create small pools or flat slopes that can strand juveniles washed up by wave action.	Continuous during dredging and disposal operations.	Maintain until new information becomes available that would warrant change.
Ocean Disposal			
Disposal of material in accordance with the site management and monitoring plan, which calls for a point dump placement of any construction material. The plan is to place any construction material in the southwest corner of the deep water site.	This action minimizes conflicts with users and impacts to ocean resources.	Continuous during dredging operations.	Maintain until new information becomes available that would warrant change.
General Provisions for All Disposal			
Disposal of hazardous waste.	The contractor, where possible, will use or propose for use materials that may be considered environmentally friendly in that waste from such materials is not regulated as a hazardous waste or is not considered harmful to the environment. If hazardous wastes are generated, disposal of this material shall be done in accordance with 40 CFR parts 260-272 and 49 CFR parts 100-177.	Life of contract or action.	If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. Contaminated ground shall be excavated and removed and the area restored as directed. Any in-water discharge shall be immediately reported to the nearest U.S. Coast Guard Unit for appropriate response.

3.2.8 Ocean Disposal

The FEIS (Corps 199a) stated that during construction of the 43-foot alternative, about 7 mcy (5 mcy new work plus 2 mcy for the 40-foot channel maintenance) of material would be disposed of in ocean disposal sites. An additional 9 mcy derived from channel maintenance would be placed in the ocean sites during the 20-year project period. The quantity is expected to be reduced because of new restoration actions described in this BA.

A new deep water site is located about 4.5 miles west of RM 1; its outer boundary is approximately 7 miles west of RM 1 (Figure 3-3). Water depths vary from 200 to 300 feet deep. Overall site dimensions are 17,000 feet by 23,000 feet and consist of an inner rectangle measuring 11,000 feet by 17,000 feet, surrounded on all sides by a 3,000-foot buffer. The site encompasses 8,980 acres. Disposal of dredged material would only be allowed within the inner dumping or target zone. The inner placement area of the site has a total area of 4,293 acres and a static disposal capacity of 225 mcy. Material placed at this site is expected to create a mound approximately 40 feet high within the target zone over the estimated 50-year life of the site. No direct disposal of dredged material would be allowed anywhere in the buffer; however, dredged material sloughing off the developing mound may extend into the buffer zone.

3.2.8.1 Studies Monitoring/Performed for Ocean Disposal

A joint Environmental Protection Agency (EPA) and Corps general approach to site designation for ocean dredged material disposal sites (ODMDS) was published in 1984. This guidance was developed to provide procedures for the identification, evaluation, and selection for final designation of ODMDS. A management plan, which includes a monitoring component, is mandatory.

For the ocean disposal site, EPA and the Corps followed these procedures and conducted and reviewed studies that include information in the areas of living resources, physical processes, geological resources, sediment quality, water quality, cultural resources, and recreational resources. In total, 143 separate studies are noted in Appendix H of the FEIS (Corps, 1999a). Two ocean dredged material disposal sites, needed for long-term use by the MCR and inner channel are proposed for designation by EPA. Additional studies will be conducted at the deeper site, particularly with regard to biological baseline studies. Monitoring will be conducted annually in accordance with the management/monitoring plan.

Figure 3-3: Ocean Disposal Area

3.2.8.2 Impact Minimization Measures Applied to Activity

An adaptive management approach is applied to monitoring and use of the ocean disposal site (the deep water site). This approach involves coordinating site management plans with the state resource agencies to help minimize impacts to marine resources. EPA and the Corps will be conducting pre- and post-construction assessment studies for the deep water site. These assessments will include special studies in addition to routine bathymetric surveys. EPA and the Corps acknowledge the need for biological data. The scope for the special studies will be developed and scoped during the preconstruction engineering and design phase. The special studies may include the following:

- Side scan sonar
- Sediment characterization
- Crab distribution and abundance studies
- Benthic sampling

3.2.8.3 Baseline Studies

The Marine Protection Research and Sanctuary Act Section 102(c)(3)(A) requires that the management plan include a baseline of conditions at the site.

There is only limited information on biological resources of the deep water site. Additional baseline studies will be needed to characterize this site. The scope of these baseline studies will be decided after input is received from the Corp's Ocean Disposal Taskforce.

3.2.9 Drilling and Blasting

3.2.9.1 Description of Activity

Removal of approximately 75,000 cubic yards of rock would be required at Warrior Rock (RM 87.3). This may require in-water drilling and blasting to loosen and fracture rock (basalt) so that it can be removed for construction of the 43-foot channel. Mechanical methods such as a large clamshell dredge would be tried first to see if the rock could be removed. If not, a blasting plan would be developed with state and federal agencies, indicating the location and pattern of holes to be dug for placement of the charges needed to fragment the rock. The holes would be drilled and charges set to create an implosion, rather than an explosion, for minimum impact on fish. Following the blasting of the rock, a clamshell dredge would likely be used to remove the loosened material. Such blasting would be limited to the "in-water work window" period between November through February.

Drilling and blasting will not be required for maintenance dredging in the 43-foot channel.

3.2.9.2 Studies/Monitoring Performed for Activities

Studies indicating the potential effects of blasting on Columbia River aquatic life are not available. The effects of blasting on benthic invertebrates are unknown because little work has been done regarding pressure impacts to these species. Benthic communities in the immediate vicinity of the blast (specifically those sediments or rocks removed) are likely to be destroyed. Following material excavation, however, it is expected that these communities would quickly recover to pre-blast levels.

3.2.9.3 Impact Minimization Measures Applied to Activity

Mechanical excavation of rock areas is not expected to have any more impact than the other dredging operations discussed previously. In the event that rock must be blasted, several measures would be taken to minimize impacts. The principal impact of blasting is the injury caused to fish by the pressure wave produced by the explosive. If the over-pressure (the pressure over the blast zone) exceeds several hundred pounds per square inch (psi), fish may be injured. NMFS has requested that over-pressures be kept at 10 psi or lower to prevent injury to listed salmonids. This level would also protect other species of resident and anadromous fish. The contractor would drill and fill with explosive in as many holes as possible during one 12-hour shift. Each hole would contain 100 pounds or less of explosives. Each charge would be detonated on a delay so that only 100 pounds of explosive would be detonated at one time, with the blast occurring as an implosion rather than an explosion, to reduce its area of impact. In this way over-pressures will be kept to 10 psi or less at distances of 30 to 50 feet from the blast point. Over-pressures would also be monitored to ensure that they remained below 10 psi. In addition, measures would be used to scare fish away prior to the blast (Cimmino, pers. comm., 1997).

Incorporating these measures should minimize impacts to fish during blasting to the maximum extent possible. A detailed fish-monitoring and protection plan will be developed and coordinated with the state resource agencies prior to blasting.

3.2.10 Conservation Measures

A conservation measure is any impact minimization measure, mitigation activity, or BMP that the Corps may employ to offset identified or potential adverse effects from dredging and disposal activities. BMPs and impact minimization measures associated with a specific proposed activity have been discussed within the particular subsection describing that activity. Details regarding other general impact avoidance, mitigation, or monitoring measures are discussed in Section 8 of this document.

3.3 Activities Proposed within Respective Reaches

This section presents the locations where dredging, disposal mitigation, and ecosystem restoration activities will occur during channel construction and operations and maintenance. Following is a brief description of each of the project reaches in which dredging and disposal activities will occur and identification of some of the major features within each reach, together with graphics indicating the known disposal sites.

3.3.1 River Reach A – River Mile 106.5 to 146

River Reach A is included in this BA because project activities downstream may cause incidental impacts in this reach by decreasing river water surface elevations slightly. No direct project activities will occur in this reach.

3.3.2 River Reach 1 – River Mile 98 to 106.5

The upper extent of the proposed project activity is located at RM 106.5 at the Interstate 5 Highway Bridge. The reach continues downstream to RM 98, which is located downstream of the confluence of the Willamette and Columbia Rivers adjacent to Sauvie Island. The Ports of Vancouver and Portland are in this reach. Areas where Project actions will take place within River Reach 1 include dredging areas for the navigation channel, as well as upland and flowlane dredged material disposal locations (Figure 3-4).

The Corps' dredging areas within Reach 1 are:

- Vancouver Turning Basin
- Lower Vancouver Bar
- Morgan Bar

Proposed upland disposal sites within Reach 1 are:

- West Hayden Island, O-105.0
- Gateway 3, W-101.0

Berths to be deepened in Reach 1 are:

- Terminal 6
- United Grain in Vancouver

Other actions in Reach 1 include:

- Deepening the Turning Basin at RM 105.5
- Shillapoo Lake Restoration

3.3.3 River Reach 2 – River Mile 84 to 98

The upper portion of River Reach 2 is located at RM 98, which is near the midpoint of Sauvie Island. The reach runs approximately 14 miles to RM 84, which is located just downstream from St. Helens, Oregon. The Ports of St. Helens and Woodland are in this reach. Action areas within River Reach 2 include dredging areas for the navigation channel, as well as upland and flowlane dredged material disposal locations (Figure 3-4). As noted in the discussion on dredging activities, Warrior Rock near St. Helens is a location where a clamshell dredge might be the appropriate tool. In the case of the Warrior Rock area, the presence of basalt may require the use of blasting to loosen the material for subsequent dredging. Shoreline disposal will also occur at Sand Island in St. Helens County Park. Dredged materials will be used to replace sand lost to erosion in this recreational area. This is called "beach nourishment."

The Corps' dredging areas within Reach 2 are:

- Willow Bar
- Henrici Bar
- Warrior Rock Bar (some blasting potential in this area)
- St. Helens Bar

Proposed upland disposal sites within Reach 2 are:

- Fazio Sand and Gravel (Fazio A), W-97.1
- Fazio Adjacent (Fazio B), W-96.9
- Lonestar, O-91.5
- Railroad Corridor, O-87.8
- Austin Point, W-86.5

Proposed shoreline disposal will occur at:

- Sand Island, O-86.2

Other actions in Reach 2 include:

- Bachelor Slough Restoration

Figure 3-4: Reach 1 and 2 Disposal Sites and Dredge Areas RM 84-106.5

3.3.4 River Reach 3 – River Mile 70 to 84

The upper portion of River Reach 3 is located around RM 84, just downstream from St. Helens, Oregon. The reach runs approximately 14 miles to RM 70, which is between Cottonwood and Howard Islands. The Port of Kalama is in this reach. Action areas within River Reach 3 include dredging for areas of the navigation channel, as well as upland and flowlane dredged material disposal locations (Figure 3-5).

The Corps' dredging areas within Reach 3 are:

- Upper Martin Island Bar
- Lower Martin Island Bar
- Kalama Ranges
- Upper Dobelbower Bar

Proposed upland disposal sites within Reach 3 are:

- Martin Bar, W-82.0
- Reichold, O-82.6
- Lower Deer Island, O-77.0
- Sandy Island, O-75.8
- Northport, W-71.9
- Cottonwood Island, W-70.1

Proposed shoreline disposal will occur at:

- Martin Island Lagoon

Berths to be deepened in Reach 3 are:

- Peavy Grain in Kalama
- Harvest States in Kalama

Other actions in Reach 3 include:

- Deepening the Turning Basin at 73.5
- Burris Creek Tidegate
- Deer Island Tidegate
- Howard/Cottonwood Translocation of Columbia White-tailed Deer
- Flowlane Disposal

3.3.5 River Reach 4 – River Mile 56 to 70

The upper portion of River Reach 4 is located near RM 70, which is between Cottonwood and Howard Islands. The reach runs approximately 14 miles to RM 56, which is located at Crims Island. The Port of Longview is in this reach. Slaughters Bar, a well-known feature in this reach, is a site where the use of a mechanical dredge might be required to remove cemented sands and gravels in the area. Action areas within River Reach 4 include dredging areas for the navigation channel, as well as upland and flowlane dredged material disposal sites (Figure 3-6).

The Corps' dredging areas within Reach 4 are:

- Lower Dobelbower Bar
- Slaughters Bar
- Walker Island Reach
- Stella-Fisher Bar

Figure 3-5: Reach 3 Disposal Sites and Dredge Areas RM 70-84

Figure 3-6: Reach 4 Disposal Sites and Dredge Areas RM 56-70

Proposed upland disposal sites within Reach 4 are:

- Howard Island, W-68.7
- International Paper Rehandle, W-67.5
- Rainier Beach, O-67.0
- Rainier Industrial, O-64.8 (not constructed until 2003)
- Lord Island, O-63.5
- Reynolds Aluminum, W-63.5
- Mount Solo, W-62.0
- Hump Island, W-59.7
- Crims Island, O-57.0

Berths to be deepened in Reach 4 are:

- U.S. Gypsum near Rainier

Other actions in Reach 4 include:

- Hump Fisher Restoration
- Ford Walker Restoration
- Flowlane Disposal

3.3.6 River Reach 5 – River Mile 40 to 56

The upper portion of River Reach 5 is located at Crims Island around RM 56. The reach runs approximately 15 miles to RM 41. The navigation channel runs north of the island. Action areas within River Reach 5 include dredging areas for the navigation channel, as well as upland and flowlane dredged material disposal sites (Figure 3-7).

The Corps dredging areas within Reach 5 are:

- Gull Island Bar
- Eureka Bar
- Westport Bar
- Wauna and Driscoll Ranges

Proposed upland disposal sites within Reach 5 are:

- Port Westward, O-54.0
- Brown Island, W-46.3
- Puget Island, W-44.0
- James River, O-42.9

Other actions in Reach 5 include:

- Flowlane Disposal

3.3.7 River Reach 6 – River Mile 29 to 40

The upper portion of River Reach 6 is located near RM 40, which runs through the lower end of Puget Island in the vicinity of Cathlamet. The reach runs approximately 11 miles to RM 29, where the river begins to broaden considerably. Action areas within River Reach 6 include some dredging areas for the navigation channel, as well as upland and flowlane dredged material disposal sites (Figure 3-8).

The Corps' dredging areas within Reach 6 are:

- Puget Island Bar
- Skamokawa Bar
- Brookfield-Welch Island Bar

Proposed upland disposal sites within Reach 6 are:

- Tenasillahe Island, O-38.3 (channel maintenance)
- Welch Island, O-34.0 (channel maintenance)
- Skamokawa, W-33.4 (channel maintenance)

Other actions in Reach 6 include:

- Tenasillahe Island Restoration
- Flowlane Disposal

Figure 3-7: Reach 5 Disposal Sites and Dredge Areas RM 40-56

Figure 3-8: Reach 6 Disposal Sites and Dredge Areas RM 29-40

3.3.8 River Reach 7 – River Mile 3 to 29

River Reach 7 encompasses the Columbia River estuary, which is the extreme lower end of the watershed. It extends from RM 29 to the river mouth at RM 3. The estuary, which ranges from 4 to 5 miles in width, contains two main channels. The south channel is an extension of the main river channel upstream of the estuary and carries most of the upland river discharge. The navigation channel follows the south channel through the estuary. The north channel extends upstream to about RM 20. Wide and shallow intertidal and subtidal flats separate these two deep channels. A few of the well-known features within this reach include Miller Sands Channel, Flavel Bar, and Tongue Point Crossing. Action areas within River Reach 7 will be some estuarine dredging areas for the navigation channel and upland, shoreline, and flowlane dredged material disposal sites (Figure 3-9).

The Corps' dredging areas within Reach 7 are:

- Pillar Rock Ranges
- Miller Sands Channel
- Tongue Point Crossing
- Upper Sands
- Flavel Bar
- Upper Desdemona Shoal
- Lower Desdemona Shoal

Proposed upland disposal sites within Reach 7 are:

- Pillar Rock Island, O-27.2 (channel maintenance)
- Miller Sands, O-23.5 (channel maintenance)
- Rice Island, W-21.0 (channel maintenance)

Other actions in Reach 6 include:

- Turning Basin at RM 13
- Miller-Pillar Restoration
- Lois Island Restoration
- Purple Loosestrife Control
- Flowlane Disposal

3.3.9 River Mouth – Reach B (RM 3 to the Outer Edge of the Deep Water Site)

River Reach B of the project extends into the Pacific Ocean to the western boundary of the deep water site. Proposed project activities within this reach are restricted to ocean disposal of dredged materials (see Figure 3-3). Ocean disposal is only proposed at one site of the two that are awaiting EPA designation.

Figure 3-9: Reach 7 Disposal Sites and Dredge Areas RM 3-29