EXHIBIT C
FISH AND WILDLIFE COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon State Office
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266
(503) 231-6179 FAX: (503) 231-6195

Reply To: 7363.004
File Name: CRCDTRN.WPD

June 8, 1999

Colonel Robert T. Slusar, District Engineer
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

Dear Colonel Slusar:

The final Coordination Act Report on the impacts of the proposed Columbia River Channel Deepening Project on fish and wildlife resources is attached for inclusion in the Feasibility Report/Environmental Impact Statement for this project.

Sincerely yours,

for Russell D. Peterson
State Supervisor

cc:
NMFS, Meyer
EPA, Malek
ODFW, Robart
DEQ
WDFW, Mohoric, Vigue, Leigh
WDOE, Vining
RO, Weaver
Refuges, Clark, Stenvall, Melanson

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon State Office
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266
(503) 231-6179 FAX: (503) 231-6195

Reply To: 7363.004
File Name: Col. Riv. Channel Deepening-CAR
xref 8330.4323 (98), 8330.0741 (97)

June 8, 1999

Colonel Robert T. Slusar, District Engineer
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

Dear Colonel Slusar:

This letter expresses the position of the Fish and Wildlife Service on the proposed Columbia River Channel Deepening Project based on its impacts to fish and wildlife resources. This statement and the attached detailed report constitute our Fish and Wildlife Coordination Act Report (CAR) as required under Section 2 (b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and are consistent with the intent of the National Environmental Policy Act. This report is intended for inclusion with your Feasibility Report authorized under General Investigations, HD 452, 87th Congress, 2nd Session.

This report has been coordinated with and has the concurrence of the Oregon Department of Fish and Wildlife (ODFW) as indicated in the attached letter dated April 30, 1999 from Mr. Greg Robart. The Washington Department of Fish and Wildlife (WDFW) has provided a letter of comment (attached) dated May 17, 1999 from Mr. Lee Van Tussenbrook. This letter recommends the inclusion of several additional mitigation measures in the CAR. Most of these measures have been incorporated as written; however, some of the recommendations made are for impacts beyond the scope of the channel deepening project, e.g. mitigation for dredging at the mouth of the Columbia River, a separately authorized project outside the boundaries of the proposed project, and mitigation for O&M dredging activities for which the Corps maintains it is not legally bound to mitigate. The National Marine Fisheries Service (NMFS) has also concurred in the report as indicated in the letter from Mr. Michael Tehan dated May 10, 1999. The Columbia River Inter-Tribal Fish Commission has reviewed the CAR and provided comments in a letter (attached) dated May 26, 1999 from Mr. Donald Sampson.

The project study area and assumed area of influence is the Willamette River from river mile (RM) 11 downstream to its confluence with the Columbia River and from RM 105.5 in the Columbia River downstream to RM 3 which includes the major portion of the Columbia River Estuary. The project area of influence (in terms of dredged material disposal activity) also encompasses the Pacific Ocean offshore of the estuary. Except for the Habitat Evaluation Procedures (HEP) study, the period of analysis is 20 years which is consistent with the Corps' planning time frame for this project.

The Columbia River is the second largest river in North America, draining about 258,000 square miles. The Columbia River Estuary is a drowned river valley but, unlike most estuaries, it is primarily freshwater in nature due to the tremendous influence of river flows. Flows in the Columbia River average 273,000 cubic feet per second (cfs), with a former unregulated minimum of 79,000 cfs and maximum flood flows of over 1 million cfs. Peak flows occur during winter storm events. Spring freshets, once a major source of flooding, are now controlled by upriver dams and occur for longer periods with a lower peak. Late summer and fall flows are generally higher and slower due to regulation, and river water is a few degrees warmer.

The estuarine shoreline in both states consists of rocky forested cliffs and low wet floodplain areas which have been diked. A number of minor creeks and rivers with small drainage basins enter the estuary from both shores, but, because of their small size, they do not have much influence on the river. The topography of the riverine portion of the proposed project does not vary significantly. The river's shoreline and adjacent lands have been diked and developed extensively for agricultural and industrial development as well as for commercial and residential uses.

Major industries in the estuarine area include forest products, fishing, and tourism. There is a small agricultural industry, limited primarily to commercial cranberry bogs around Baker Bay, and to raising beef and dairy cattle on diked lands (former marsh and swamp lands). Industrial use is more varied along the river, particularly in the urbanized areas around Longview, Kalama, Portland, and Vancouver.

The Julia Butler Hansen Columbian White-tailed Deer and Lewis and Clark National Wildlife Refuges are located within the estuarine boundaries. The Lewis and Clark Refuge occupies much of the eastern end of the estuary and includes the marsh islands of Cathlamet Bay. The Ridgefield National Wildlife Refuge Complex is located adjacent to the project's upstream riverine boundaries near Vancouver.

The proposed project is complex with a wide range of alternatives to be considered. The Columbia River navigation channel is presently authorized at -40 feet with a 5-foot overdraft. A 43-foot channel deepening alternative (with a 5-foot overdraft) is proposed for the area between RM 3 and RM 105.5 near the Vancouver Turning Basin. The channel deepening is also proposed to extend into the Willamette River (-43 feet with a 2-foot overdraft) for a distance of about 11 miles up to the Broadway Bridge. An estimated total of 24.4 million cubic yards (mcy), including some operation and maintenance (O&M) yardage from the -40 foot channel, would be dredged initially from the Columbia River under the 43-foot alternative. Over a 20-year period, about 82 mcy of material would be removed by maintenance dredging activities. This amounts to a total project dredging quantity (new work construction plus O&M dredging) for the Columbia River of about 106 mcy. Initial construction work in the Willamette River would total about 1 mcy with all disposal material being placed inwater. About half this material would go into the Willamette River (at RM 4.5 and 9.6) and half would be placed in the Columbia River just downstream of the Willamette-Columbia Rivers confluence near Morgan's Bar. Maintenance dredging projected over a 20-year period estimates removal of an additional 3 mcy from the Willamette River channel. This material would also be disposed of inwater at an approved site. Although the average annual maintenance dredging for the project beyond the initial 20-year period is difficult to forecast with certainty, the best estimate of O&M dredging for years 21-50 is about 2-3 mcy per year.

Under the government's least cost disposal plan (Government Plan), a major portion of the estimated 106 mcy of dredged material from the Columbia River (15 mcy from new construction and an O&M total of 56 mcy over 20 years) would be disposed of at 31 upland locations covering 1,897 acres. Several other locations would also receive disposal materials from new work dredging and O&M activities over a 20-year dredging period. These include offshore (11 mcy); flowlane/inwater (27 mcy, including 4 mcy from the Willamette River); and NMFS-approved beach nourishment (1 mcy) sites. About 220,000 cy of basalt rock and approximately 450,000 cy of cemented sand, gravel, and boulders would also be removed from the Columbia and Willamette Rivers under the 43-foot channel alternative. What cannot be removed by mechanical means would require removal by blasting methods.

Thirteen mitigation sites were identified early on in the study process. These 13 sites have been reduced to five sites under the Government Plan. A portion of the disposal sites and all the mitigation sites would be managed for fish and wildlife species. The disposal and mitigation sites were analyzed using the Service's Habitat Evaluation Procedures (HEP).

The Corps, through a series of workshops with federal and state resource agencies and the public, has also developed four proposed ecosystem restoration actions under its Ecosystem Restoration Authority. These actions include levee breaching to restore water to the former Shillapoo Lake near Vancouver, Washington; tide gate retrofits for salmon passage; improved side-channel flow at various islands in the river; and restoration of shallow sub-tidal habitat between Miller Sands and Pillar Rock Islands using a dike field. These restoration actions are being developed as part of the channel deepening project, but are considered separate and distinct from any mitigation activities associated with the project.

In conjunction with the disposal alternatives, the Corps also looked at making dredged material available for beneficial uses, i.e., for borrow material, development of county or state parks, industrial development, erosion control, and/or environmental enhancement. Beneficial use sites are to be considered by the Corps when a site is available, dredging is necessary and in close proximity to the site, and the beneficial use site would save capacity in other proposed disposal sites.

Several other alternatives to the proposed -43-foot channel deepening have been considered: 1) a non-structural alternative which focuses on upgrading LOADMAX, the river stage forecasting system, thus enabling ships to determine navigable channel depths based on projected future and real-time tide and river stage information; 2) development of single-stop and topping-off regional ports at Astoria and Longview; 3) channel configuration changes including construction of a tiered channel (deepening only one side of the channel to allow for loaded deep-draft vessel efficiency), one-way reaches, and non-uniform channel depths; and 4) a no action alternative. In addition, two channel deepening variations, -41 and -42-foot depths, in conjunction with turning basin deepening measures and development of incremental reaches to accommodate traffic at major cargo terminals, have also been considered.

An alternative disposal plan, submitted by the project sponsors and known as the "Sponsor's Preferred Disposal Alternative" (Sponsor's Plan), trades some of the disposal sites in the Government Plan that would require mitigation and substitutes more costly sites that would either provide acreage for future commercial or industrial development or would not require mitigation. Four of the sponsor's disposal sites are located on port lands at Vancouver, St. Helens, Kalama, and Longview and two are at active sand and gravel operations. Three mitigation sites have been analyzed to offset losses from the Sponsor's Plan.

Fish and Wildlife Resources

The Columbia River and Estuary form a highly complex and productive system. Primary production within this system occurs in the water column, at the substrate-water interface, and on land, with the physical conditions most influencing aquatic production being light penetration and river flow. The distribution of invertebrate populations and larval fishes in the estuary is closely connected to the physical zones and estuarine habitats (bays, slopes, flats, and channels) described by salinity, circulation, and sedimentation patterns. Fauna in the marine zones of the estuary are heavily influenced by the nearshore ocean conditions and the interaction of tidal forces and riverine flows.

Because of the influence of the Columbia River, the major portion of the phytoplankton community in the estuary is composed of freshwater species, primarily diatoms. These organisms are the main food source for the zooplankton and the benthic and epibenthic filter feeders in the estuary.

Estuarine zooplankton can be divided into marine, brackish, and freshwater groups. Very few of these organisms are strictly estuarine and most are of marine origin with a high tolerance of freshwater conditions. Larval fish and invertebrates are important food items found in the estuarine plankton and comprise a significant portion of the offshore planktonic communities, as well. Zooplankton populations in the mainstem Columbia River are dominated by only a few species: Daphinia, Bosmina, and cyclopoids. Several species of rotifers are also abundant on a seasonal basis. Fish eggs and larvae of the eulachon are the dominant zooplankton in the river in April and May.

Benthic populations offshore appear to differ significantly from estuarine populations. Sediment type and distance from shore seem to determine this difference in benthos. In addition to sediment grain size and stability, salinity is also a major factor affecting the distribution of benthic invertebrates. Corophium salmonis, an amphipod of significant importance to juvenile and adult salmonids as well as juvenile sturgeon, is prevalent in areas of relatively low salinity. C. salmonis also appears to be associated with substrates of fine silt. Other benthic groups found in abundance in the estuary include oligochaetes, polychaetes, and nemertean worms and are generally associated with organic sediments. Two clam species, Macoma balthica, and the Asian clam, Corbicula manilensis, are also present in high densities in the estuary, the former being especially prevalent in Baker Bay. Two species dominate the benthic populations in the mainstem river, i.e., the amphipod, C. salmonis and the Asian clam, C. manilensis. The latter species are found in the more protected, shallow areas of the river rather than in the main channel. Other benthic invertebrates associated with the river include oligochaetes, polychaetes, mysids, and insect larvae.

Epibenthic populations offshore are composed almost entirely of macrofauna. Crangon spp. shrimp are dominant. Dungeness crabs (Cancer magister) and the mysid, Neomysis kadiakensis, are also prevalent. Major macroepibenthic species associated with the estuary are Dungeness crab and sand shrimp (Crangon spp.). The Dungeness juveniles are the major users of the estuary, not the adults. The crayfish, Pacifastacus trowbridgii, is also found in much of the estuary.

Terrestrial and aquatic insects provide an important source of food both in the estuary and the mainstem river. The marshes and swamps in the estuary and the riparian vegetation along the river are the main sources for input into the system. The islands of Cathlamet Bay are especially important in this regard.

The Columbia River Estuary and the Pacific Ocean immediately offshore of the estuary are extremely valuable habitat areas for fish. Fish are attracted to these areas because of the high concentration of prey species. The estuary serves as a nursery for many species of marine fish as well. Adult and juvenile anadromous fish including salmon, steelhead trout, cutthroat trout, smelt, sturgeon, shad, and lamprey use the estuary as a migratory pathway. For some fish, such as the Pacific herring, the estuary is also a spawning ground. Resident species are mostly of freshwater origin although some marine species, such as shiner perch and Pacific staghorn sculpin, spend their entire life cycles in the estuary.

Adult marine fish that enter the estuary are generally confined to the deeper channels where salinity is high. Fish most often found in the deeper channels of the estuary are white sturgeon, Pacific herring, shad, and surf smelt. Green sturgeon are also seasonally abundant in the estuary. Juvenile marine fish are more tolerant of lower salinities and can be found further upriver and in the shallower areas associated with the bays.

The offshore areas of the Columbia River Estuary support valuable commercial and recreational sport fisheries. One of the major offshore fisheries is for Dungeness crab. A primary crab fishing site is located in and around the offshore disposal site, Area B. Offshore fisheries for salmon, both sport and commercial, increased from the mid-1960s through the early 1990s, but, since 1992, these numbers have fallen significantly, particularly for commercial and recreational landings of coho. Preliminary figures for total commercial and recreational chinook catch show 158,000 fish were landed in Oregon in 1997, down from a high of 588,000 chinook in 1987.

Within the estuary, there is a major fishery for sturgeon. In 1996, the non-Indian commercial catch of sturgeon (white and green) for the lower Columbia River was 9,000 fish and the sport catch for white sturgeon totaled 43,000 fish. Salmonid sport fishing within the estuary is minor except for the fishery at Buoy 10. The commercial gill-net fishery within the estuary has been severely restricted in recent years and there has been a growth in the offshore fishery for groundfish since the salmon gill-net fishery has been restricted. There are minor fisheries for warmwater fish such as crappie, perch and bass in the backwaters and sloughs of the estuary.

Columbia River smelt (eulachon) and white sturgeon are important components of the Columbia River system. Adult smelt spawn in the mainstem Columbia River as well as tributary rivers such as the Grays, Cowlitz, Kalama, Lewis, and Sandy. White sturgeon also spawn in the river at depths ranging from about 10 to 75 feet. Larvae are dispersed over a wide area after hatching. Young-of -the -year (YOY) white sturgeon seem to prefer waters deeper than 40 feet, although sub-adult and adult sturgeon sometimes feed in waters less than 40 feet. Feeding studies have shown that the amphipod, C. salmonis, is an important prey item for juvenile sturgeon.

The mainstem Columbia River and its tributaries also support a varied and economically valuable population of salmon and steelhead trout. These anadromous fish are present in the river almost year round either as juveniles or adults, although some periods of use are more important than others. As in the estuary, sub-yearling juvenile chum and fall chinook prefer shallow waters and yearling juvenile coho, spring chinook, and soekeye salmon and steelhead trout appear to prefer deeper waters.

The commercial river fishery (Indian and non-Indian) is dependent on the salmon runs in the Columbia River as is the recreational ocean and river fishery. Steelhead are taken commercially in the river by treaty Indian fisherman. The commercial gill-net fishery for salmon and sturgeon (Zones 1-5) occurs in stages in winter, late summer, and early fall. Special seasons and select fishing areas are designated for salmon, sturgeon, shad and smelt. Smelt are caught both commercially and recreationally but there is very little information on the recreational fishery for this species. The commercial catch of smelt has been in severe decline over the last few years. A sturgeon sport fishery is popular throughout the river. The recreational fishery for sturgeon has surpassed salmon fishing in recent years primarily due to low returns of salmon to the fishery.

The Columbia River system supports a wide variety of habitats as well as the amphibians, reptiles, birds and mammals dependent upon them. In the lower estuary, the dunes and sandy areas are the dominating feature of many of the islands in the estuary. European beach grass is most common to the dune areas while exotic and native grasses dominate on the remaining portions of these islands.

Sitka spruce is the climax forest species in the lower estuary but the upper estuary is dominated by western hemlock, a productive and extensive lowland conifer forest. Other trees associated with the estuary include red alder, big-leaf maple, Douglas fir, Oregon ash, and shorepine. Vegetation associated with the mainstem Columbia River is similar to that described for the estuary except that portions of the river are more developed than the estuary and the vegetation here is more scarce. The major vegetative type is the riparian habitat along the river shoreline and on the islands in the river. Major tree species include black cottonwood, Oregon ash, and Pacific willow. Understory species typical of the river's shoreline and island habitats include red-osier dogwood, Himalayan blackberry, elderberry, and common forbs and grasses. In disturbed areas, the vegetative communities include species such as scotch broom, lupine, and fireweed.

Northwestern pond turtles, painted turtles, common garter snakes, and western fence lizards are representative of the reptiles found throughout the project area. These species inhabit a variety of habitat types ranging from ponds, streams, marshes, and moist forests to woodlands, meadows, and grasslands. Amphibians in the area, including the red-legged frog, Pacific chorus frog, bullfrog, western toad, long-toed salamander, and roughskin newt, live in moist forests or forested wetlands and all require some type of waterbody such as a pond, lake, or stream for breeding.

Pelagic birds associated with the offshore habitat of the Columbia River include shearwaters, common murres, gulls, and storm-petrels. Phalaropes, fulmars, and California gulls are commonly associated with the fall coastal migration whereas the winter pelagic bird populations include murres, auklets, and kittiwakes in addition to the former species.

Many species of birds are dependent on the Columbia River Estuary for their life requisite needs, i.e., food, nesting habitat, cover, and resting. Grebes, double-crested cormorants, western gulls, loons, Caspian terns, and a variety of waterfowl and other gull species are commonly associated with the estuary. Brown pelicans occur along the Oregon Coast from April through October and forage in nearshore waters of the ocean and within the estuary itself.

Western and glaucous-winged gulls, double-crested cormorants, and Caspian terns nest within the estuary. Double-crested cormorants can be found in large nesting colonies on East Sand and Rice Islands; Caspian terns occupy a large breeding colony (about 10,000 pairs) on Rice Island. Gulls also utilize the disposal islands in the estuary as well as Cape Disappointment as nesting sites.

Great blue herons are common estuarine species. Other marsh birds such as the egret are also present in the estuary in small numbers. Great blue heron rookeries can be found in the estuary and at various points along the river. Other water birds present on the river include cormorants, western grebes, and loons. Snow geese and tundra swans also use the river and its associated wetland areas during the winter.

Shorebirds are abundant within the estuary and in upriver areas. On a seasonal basis, they can be found in intertidal marsh/mudflats, non-tidal freshwater marshes, and flooded agricultural lands along the Columbia River. Western sandpipers, sanderlings, dunlins, least sandpipers, common snipe, and red-necked phalaropes are the most abundant species present. Other birds common to wetlands and marshes associated with the river include rails, coots, and sandhill cranes. Sandhill cranes utilize the marshes and wetlands in the upper portion of the river.

Waterfowl are commonly found in the estuary during spring and fall migrations although some species overwinter. Diving ducks and dabblers are found in the lower and upper estuary, respectively. Geese are present throughout the estuary. Swans generally occur in the middle and upper reaches of the estuary. Particularly important waterfowl habitat is provided by Baker, Grays, and Cathlamet Bays, and Lewis and Clark and Julia Butler Hansen National Wildlife Refuges. Geese, cinnamon teal, mallard, and wood duck nest in the estuary. Waterfowl species using the mainstem Columbia River include mallard, northern pintail, cinnamon and green-winged teal, and Canada goose. Agricultural lands along the river offer substantial foraging habitat for waterfowl. Some nesting by Canada goose, mallard, wood duck, and cinnamon teal does occur along the river but the overall production value of the river is limited. Disposal islands have become important nesting sites for resident Canada geese and mallards. However, the river's primary value to waterfowl is as migratory, foraging, or resting habitat.

Raptors present in the estuary include bald eagles, peregrine falcons, hawks, ospreys, and owls. These species forage on the bird, fish and/or small mammal resources of the estuary. Common raptor species associated with the river include red-tailed hawk, northern harrier, bald eagle, osprey, great horned owl, and western screech owl. Many of the existing disposal areas are utilized by these species as feeding areas. Red-tailed hawks are abundant along the river with substantial nesting and wintering populations making use of island and mainland habitat. Northern harriers are present as residents, migrants, and wintering birds and are associated primarily with grasslands, marshes, and agricultural fields.

Game bird species such as grouse, quail, and pheasant are present in the estuary but in small numbers. Upland game birds such as quail and pheasant can also be found within the riverine portion of the project area. They sometimes occur in pasture lands, reed canarygrass, and large willow stands (habitat generally associated with islands in the river) but are usually found in upland vegetation. Band-tailed pigeons and ruffed grouse are found in forested uplands and mourning doves are commonly associated with riparian forest/agricultural lands in the more upriver portions of the project.

Resident and migratory passerine birds are common to the estuary. Some of the more abundant species include blackbirds, song sparrows, Swainson's thrushes, and belted kingfishers. Riparian vegetation seems to be their preferred habitat. Upland areas, including vegetated disposal sites, are used by savannah and white-crowned sparrows, horned larks, and western meadowlarks. Some of the higher marshes containing bullrushes and/or willows provide nesting habitat for common yellowthroats and song sparrows. Swallows forage over marshes, mudflats, and open water. Passerine birds are also common to the mainstem Columbia River and are present on a seasonal, migratory, or resident basis. Song sparrows, tree swallows, American robins, golden-crowned kinglets, and western meadowlarks are representative of the species using the Columbia River corridor.

Waterfowl hunting in the estuary is moderate. Duck hunting areas include Trestle Bay, East and West Sand Islands, and the marshes on the east side of the Skipanon River and Cathlamet Bay. Most hunting occurs east of Cathlamet Bay.

Northern and California sea lions are present offshore and in and around the jetties and lower estuary. The harbor seal is the most common of the pinnipeds. Haulout areas are located at Desdemona Sands and Taylor Sands and at a few sites in the upper estuary, particularly the Astoria East End Boat Basin. They feed primarily on anchovies, eulachon, and lamprey. Other marine mammals located offshore include the northern fur seal, northern elephant seal, killer whale, gray whale, and harbor porpoise. Elephant seals, harbor porpoises, and gray whales are sometimes seen in the estuary.

The Columbia River Estuary provides habitat for abundant populations of river otter, nutria, beaver, muskrat, and raccoon. Mink, once abundant, are now rarely found using the estuary. Small mammals like voles, shrews, and moles are common in the estuary and along the river. They are present in upland and marsh habitat and are often found to use disposal sites. Species which occur occasionally within the estuarine project boundaries include coyote, mink, skunk and opossum. Muskrat and nutria are common to the shoreline and riparian areas of the river. They prefer tidal marshes, Sitka spruce, and willow habitat. River otter are also present along the river but in limited numbers. Opossums, skunks, and raccoons occur along the river. Several species of bats utilize the project area from the estuary to the upriver boundaries of the project at Portland and Vancouver. There is a minor trapping effort in the estuary for nutria, muskrat, mink, and river otter.

Black bear, black-tailed deer, Roosevelt elk, and the listed Columbian white-tailed deer are the four large terrestial mammals associated with the estuary. Deer use the shoreline habitat with black-tailed deer most common in the lower estuary and Columbian white-tailed deer more prevalent in the upper estuary. Elk generally do not inhabit the developed areas along the river, but they can be found in diked marshes, i.e., the Julia Butler Hansen National Wildlife Refuge, and in coniferous forested hills adjacent to the river (but out of the project area) where they overwinter. Black bear inhabit areas similar to Roosevelt elk. Black-tailed deer, Columbian white-tailed deer, elk, and black bear are also present along the river corridor. Except for the Columbian white-tailed deer, these big game animals prefer forested, upland communities, although they can sometimes be found using the river shoreline. Low lying mainland areas and islands in and along the Columbia River from about Skamakowa, Washington (RM 33) to Port Westward, Oregon (RM 54) are the preferred habitat of the Columbian white-tailed deer.

Big game hunting within the estuary boundaries is minor. The States of Washington and Oregon, however, are sites of major hunting effort in the upper portions of the estuary and the adjoining drainages.

A number of Federally-listed wildlife species are associated with the estuary. These include the Columbian white-tailed deer and brown pelican (both endangered), bald eagle (threatened), Aleutian Canada goose (threatened), and peregrine falcon (endangered). In addition, the western snowy plover, classified as threatened, nests on Clatsop Spit. Threatened and endangered wildlife species associated with the river include Columbian white-tailed deer, bald eagle, and peregrine falcon. Listed salmonid species (under the jurisdiction of NMFS) are also associated with both the estuary and the mainstem Columbia River: Lower Columbia River steelhead trout (threatened); Upper Columbia River steelhead trout (endangered); Snake River Basin steelhead trout (threatened); Snake River sockeye salmon (endangered); Snake River fall chinook salmon (threatened); Snake River spring/summer chinook salmon (threatened); Lower Columbia River chum and chinook salmon (threatened); Middle Columbia River steelhead trout (threatened); and Upper Willamette River chinook salmon and steelhead trout (threatened). The Lower Columbia River cutthroat trout has recently been proposed for listing as threatened. Also under the jurisdiction of NMFS are a number of whale and marine turtle species which utilize the areas within the project's offshore boundaries.

Impacts to Fish and Wildlife

Over the past several years, there have been problems with mounding of the dredged material deposited in some of the offshore disposal sites. This mounding has changed wave patterns and has caused concern regarding navigation safety, particularly for crab fishermen and trawl fishermen. The mounding, however, has not been proven to have had long-term impacts on benthic, epibenthic (crab), or fish resources. The Corps is investigating means of disposing of dredged material in the offshore sites so that mounding would not occur or would be significantly reduced. One of these methods is to spread the disposal over a wide area and to alter the disposal pattern (a method similar to thin-layer disposal). Additionally, studies have been initiated to look at the impact of disposal on soft-shell crabs.

For over two and one half years, efforts have also been made to designate alternative (candidate) offshore disposal sites. These offshore sites are used primarily for disposal of dredged material from the mouth of the Columbia River (MCR) but some of the construction material and some of the O&M material from the estuarine portion of the proposed channel deepening project would also be disposed offshore. The Corps garnered input from resource agencies, fishing groups, and the general public on acceptable areas in terms of impacts to biological resources as well as economic use of those resources. Three sites were proposed for consideration as candidate offshore disposal sites: an expanded Area E and two sites known as the North and South sites. These sites are located in areas of high energy (decreasing chances for mounding), within the littoral transport zone (increasing the probability for beach nourishment along the Washington shoreline), outside tow lanes, and in areas of low benthic productivity. The configuration of these sites also attempts to avoid areas of high crab concentrations, fish rearing, and fisheries use. The North and South candidate sites do cover a large area but the size of the areas provides the opportunity to dispose of material without causing mounding or permanent losses of habitats and organisms resulting from disposal in the same area year after year. However, recent meetings of the offshore disposal site workgroup have resulted in a change in the dimensions and location of the North and South sites. A new disposal site which is more amenable to most of the offshore disposal team participants has been tentatively delineated. It is a smaller site than either the North or South site and located in deep water. Disposal at this site would most probably result in permanent losses of habitat and resources over time; monitoring of disposal activities at this site would be necessary to determine losses and possible mitigation needs.

Early on in the planning process for this project, it was thought that deepening the channel would promote greater movement of oceanic water into the estuary with resultant increases in overall salinity. As a result of this concern, an interagency workgroup was convened in 1995 to look into the effects of channel deepening on saltwater intrusion and the impacts of salinity increases, if any, on estuarine resources. The conclusions reached by consensus of the workgroup participants was that, while there was a slight increase in salinity with channel deepening, the impacts of even the maximum salinity increase (2.45 ppt in the channel areas) was well within the tolerance levels of benthic invertebrates and aquatic vascular plants and that no significant biological impact would occur from these predicted salinity changes.

Other impacts to aquatic resources from dredging would still occur, however. Nutrient input from short-term upwelling created during dredging could increase but nutrient sources in the estuary and the river should not change dramatically.

Deepening the channel could also lead to bank sloughing and losses of intertidal habitat if the channel widens. This would depend on the channel slope created during dredging, the materials of the channel slopes, and on the proximity of the channel to intertidal or shallow subtidal habitats. Establishment of a pile dike field at Miller Sands could cause changes in the tidal prism in this area, an impact that could mean losses of vegetation, reduction in nutrient input, changes in the distribution of estuarine species, and increased shoaling in areas where tidal flushing is changed.

The dredging associated with channel deepening could cause increases in the amount of turbidity generated in the estuary as well as in the river. With the channel deepening, there is the possibility that there would be new materials of varying grain size encountered in the estuary and the river and that the range of the turbidity maximum could be shifted upstream. Increased ship wake generated by larger ships traveling in the deepened channel could also lead to more erosion along the river shoreline (bank sloughing) and, possibly, to a chronic turbidity problem around these erosive sites.

Dredging and disposal activities could result in the resuspension of contaminated sediments in the water column, thus increasing the bioavailability of some contaminants to aquatic organisms, including fish. Contaminated fine materials containing low concentrations of organochlorine compounds, especially in the Willamette River, may pass screening levels and be disposed of at inwater sites in the Columbia and/or the Willamette Rivers where they could accumulate in shallow areas, tidal flats, or other depositional zones, and thus become available to aquatic organisms. Many of these organochlorine contaminants disrupt the immune or endocrine system and very low concentrations of these chemicals could adversely impact fish and wildlife during sensitive life stages. In addition, disposal of materials contaminated with organochlorine compounds into the flowlane and subsequent accumulation in biota would violate water quality standards for certain reaches of the Columbia River.

Recent studies have documented contamination of water, sediment, and fish tissue within the lower Willamette River. Anthropogenic releases of contaminants within the lower Willamette River have created conditions which clearly threaten immune and endocrine system function and long term survival of outmigrating juvenile salmonids, including listed salmon and steelhead trout.

Marine phytoplankton and marine benthic species in the estuary would not suffer long-term adverse impacts from channel deepening. Corophium, an important fresh/brackishwater amphipod upon which juvenile salmonids and sturgeon feed heavily, would not be significantly impacted by the small increases in salinity expected with the project.

Deposition of dredged material in offshore disposal sites would have an immediate adverse impact on benthic species. The long-term impacts, however, in terms of overall productivity, are not readily apparent. Studies have shown that disturbance to benthic populations in terms of disposal activity does not produce long-term reductions in benthic invertebrate densities or productivity, i.e., these areas recover within six months to one year. However, continual disposal on a specific site over a long period of time may have adverse effects on benthic species. Monitoring studies specific to these disposal sites would be necessary to determine overall losses and to assess mitigation needs or levels.

Impacts on benthic populations in the estuary and main river channel in certain areas proposed for flowlane/inwater disposal could be adverse. Two areas of the river have been designated for flowlane disposal in depths as shallow as 35 feet, i.e., RM 64 to RM 68 and RM 90 to RM 100. Flowlane disposal that would occur in depths of 35 to 65 feet could impact areas where benthic populations may be more prevalent and, thus, more susceptible to disposal impacts. It is also expected that flowlane disposal in five specific areas of the estuary and river would raise the depth of the channel bottom by 20 feet over 20 years (includes disposal estimates from initial construction and O&M activities). All disposal in these areas would be in 65 to 110 feet of water. This disposal plan could result in lowered benthic productivity and consequent losses of food availability for a variety of fish species, most importantly YOY, subadult, and adult sturgeon. If any of this flowlane disposal material were to drift into shallower areas, salmon could also be affected.

Crabs in the soft-shell stage in the offshore disposal areas could be adversely effected by disposal. However, the severity and long-term effects of such disposal on ocean crabs in the soft-shell stage are not known. Recent studies done by the Corps have been inconclusive in terms of providing a definitive answer regarding disposal impacts on soft-shell crab populations. Additional research would be needed to more accurately address impacts to adult soft-shell crabs. Riverine, epibenthic species such as the Asian clam could suffer reductions in population due to initial and maintenance dredging in the channel.

Juvenile anadromous fish are not expected to suffer adverse effects from any salinity changes associated with channel deepening. Juvenile salmonids would be more adversely impacted by the filling of shallow water habitats particularly those containing Corophium or other important food sources. Beach nourishment and pile dike construction are, therefore, more likely to impact juvenile salmon than salinity changes. Construction of pile dikes fields at Miller Sands and between Miller-Pillar Rock Islands could lead to increased foraging opportunities for piscivorous birds such as terns and cormorants with resultant increases in juvenile salmon mortalities. However, if the pilings were constructed so as to minimize bird use, i.e., using metal cones or caps, wires, nails, etc., such mortalities could be significantly reduced.

Several estuarine islands created by disposal of dredged materials (Rice Island, Miller Sands, etc.) have become productive habitat sites for colonial nesting birds such as Caspian terns, cormorants, and gulls. These bird populations, particularly the tern populations, have increased significantly in the last several years. Research on the foraging activities of these birds has shown that juvenile salmon mortality from avian predators has ranged from 10 to 30 million fish. An interagency group has been working to reduce salmon mortality by relocating birds to other island sites where juvenile salmon would not be as susceptible to predation and by making the presently used sites less hospitable to bird use. Further disposal on these islands, including future use of these sites for channel deepening disposal, needs to be conducted in a manner that minimizes harm to colonial bird colonies as well as juvenile salmon.

Because smelt larvae are ubiquitous within the water column after spawning occurs, they are very susceptible to entrainment during dredging operations. The WDFW is concerned about the low number of Columbia River smelt returns in recent years and has added smelt to a State list of species of recreational, commercial, and/or tribal concern. Further losses associated with dredging would not be acceptable and must be avoided.

White sturgeon populations in the Columbia River would be impacted the most by flowlane disposal of dredged materials, particularly if benthic invertebrate food sources in the channel are disturbed. The majority of larval and YOY sturgeon rear and feed in the deeper waters of the river. Flowlane disposal in areas deeper that 65 feet, as proposed by the Corps for certain areas of the Columbia River, could adversely impact larval and YOY sturgeon by reducing the suitability of these areas for rearing and covering available food sources. There is also the possibility that larval sturgeon could be buried during disposal. Flowlane disposal, which is also proposed for depths between 35 and 65 feet for two areas of the river, could result in materials settling out in off-channel areas where benthic invertebrate densities are higher. Adult and subadult sturgeon feed in these shallower waters and would be adversely effected by even a temporary loss of this food source. Sturgeon are also particularly susceptible to the bioaccumulation of toxins from contaminants in the food chain. While there should be minimal contaminant exposure from deepening the channel itself, since most of this material is clean sand, the possibility remains that the channel deepening could lead to secondary developments in areas of fine-grained materials where contaminants are more prevalent. In these cases, the sturgeon feeding in these shallow water areas could be subject to adverse effects from contaminants including direct mortality, susceptibility to disease, and reproductive dysfunction. Studies to determine the cumulative effect of dredging and disposal on sturgeon should be initiated prior to project construction. If these studies indicate significant disposal related losses of sturgeon and sturgeon habitat, flowlane disposal in waters deeper than 30 feet should be reduced or eliminated to protect sturgeon.

Secondary impacts that could result from channel deepening include increased shipping traffic and the probability of increased incidences of oil spills; increases in illegal bilge dumping coupled with an increased probability of exotic species introductions; additional losses of habitat at Howard Island, Cottonwood Island, Austin Point, and Gateway 3 disposal sites due to secondary industrial development occasioned by disposal; and increased exposure of salmonid species to contaminants.

Ocean offshore disposal of dredged material would have minor, temporary impacts on most adult fish resources. Although there would be some declines in the abundance and diversity of fish, at first, populations would be expected to recover. However, impacts on juvenile fish, particularly juvenile flatfish, may be adverse and long-term depending on how far the disposal materials spread out from the initial disposal site. Monitoring studies should be initiated to determine these impacts.

Dredging in the mainstem Columbia and Willamette Rivers could disturb the migration of anadromous fish which are present almost year-round. Dredging and flowlane/inwater disposal during peak migration periods would cause the greatest impact, possibly leading to delays in juvenile and adult salmon migrations.

Little impact on the commercial or sport salmon fishery is expected from dredging. However, inwater disposal may impact the salmon fisheries as well as commercial crabbing sites. The sport and commercial sturgeon fisheries may relocate further upstream as a result of flowlane disposal. Inwater disposal may also cause some filling of adjacent shallow bays due to the drifting of material away from the original disposal site. This could have a long-term impact on species utilizing these shallow water areas.

The proposed project involves several inwater/flowlane fills but the majority of the disposal sites are on upland areas. Although these upland sites have been screened to avoid filling wetlands and riparian habitat (ESA critical habitat for listed fish species) as much as possible, there remain some sites where filling would still involve the loss of wetland vegetation, pasture grasses, agricultural cropland, and riparian trees and shrubs. It is this loss of habitat and the resulting impacts to wildlife species which has been addressed in the HEP analysis.

Red-legged frogs, western pond turtles, roughskin newts, and long-toed salamanders would experience significant losses in breeding and rearing habitat on those sites where wetlands and riparian habitat would be impacted by disposal. On some of the sites, wetland and forested riparian areas would be covered with disposal materials over a 50-year period. Mitigation efforts would need to be comprehensive to offset these losses.

The additional filling of established disposal sites may temporarily impact colonial nesters and shorebird use of the disposal areas but management of these areas may negate this effect. Raptors, upland game birds, and passerine species would be similarly effected but with potentially more severe impacts from the filling of riparian and wetland areas. This is true of both estuarine and riverine disposal sites. This potential loss of riparian and wetland areas is why it is especially important to ensure that any proposed mitigation for such losses not only replaces but increases the amount and/or the value of such habitat.

Marine mammals could be impacted by disposal of material in and around their haulout areas. Any increases in the numbers of marine fish within the estuary resulting from a deepened channel would probably lead to some increase in the numbers of marine mammals entering the estuary. What impact this would have on estuarine fish resources is not clear, although it has been agreed to (via the salinity workshop) that any increases in salinity resulting from channel deepening would still be within normal salinity ranges and would not lead to any significant or permanent changes in prey distribution. It is expected, therefore, that any increases in marine mammal use of the estuary directly related to the channel deepening would be temporary in nature.

Furbearer impacts would be felt primarily in the freshwater areas of the estuary where most furbearers reside. Disposal in wetlands and riparian habitat within the estuary and along the river could lead to changes in the availability of food for raccoon, mink, otter, muskrat, and beaver and could also directly effect the productivity of these species. It is important that mitigation management and monitoring of upland disposal sites be effective in offsetting habitat losses for these species.

Big game species such as deer and elk would be negatively impacted by changes in vegetation associated with upland disposal. These fills would effect riparian, wetland, shrub, and forested habitat used by these species. Much of the forested habitat would be lost forever, i.e., forests, particularly riparian forests, would not recover within the project's 50-year life.

Bald eagles nesting along the lower Columbia River are not reproducing as successfully as eagles nesting in other areas of Oregon and Washington. The reproductive problems of these eagles have been associated with bioaccumulative organochlorine contaminants. Any increases in concentrations of bioaccumulative contaminants in these eagles could further impact reproduction, especially in the lower reaches of the river downstream of Cathlamet Bay. Recent studies in the lower Columbia River and mouth of the Willamette River also indicated river otters, common fish predators, were experiencing reproductive tract disorders correlated with a number of organochlorine contaminants. Some otters exhibited enlarged spleens, lack of testes, and other abnormalities associated with contaminants such as organochlorines that can disrupt the endocrine system. The highest concentrations of many organochlorines in otter livers were associated with the Portland-Vancouver area. These studies indicate chemicals present in the Columbia and Willamette Rivers already have the potential to cause abnormalities and disrupt endocrine systems in fish and wildlife.

Habitat Evaluation Procedures (HEP)

The initial siting process for upland disposal areas focused on the avoidance and minimization of impacts to wildlife habitat to the extant practicable. Avoidance was accomplished, in part, by choosing existing and previously used disposal sites with little or no wildlife habitat. Environmental screening criteria were also applied and disposal site boundaries were adjusted to avoid sites with wetland or riparian habitat as much as possible. Minimization efforts centered on stacking dredged material higher at individual sites rather than expanding a disposal site's footprint, thus reducing the overall acreage required for disposal. Not all the projected disposal amounts could be accommodated by existing or previously used disposal sites, however, and some new disposal sites were selected. These sites do support wildlife habitat, primarily agricultural lands with some inclusions of wetland and riparian habitat. These agricultural lands provide habitat for a number of wildlife species but are of particular value to wintering Canada geese and other waterfowl. It is the projected loss of these wildlife habitats on the proposed new sites (as well as the loss of reestablished riparian habitat on a few of the previously used disposal sites) that would require mitigation.

The HEP process was used to determine project impacts on terrestrial wildlife and the mitigation levels needed to offset those losses. The HEP team, consisting of representatives from the Corps of Engineers, Washington Department of Ecology (WDOE), WDFW, ODFW, the Ports, and the Service decided that the focus of the HEP should be on wildlife species most impacted by dredged material disposal, i.e., those species associated with agricultural cropland, wetland, and/or riparian habitat. The target species selected for HEP analysis were a group of pond-breeding amphibians, Canada goose, mallard, savannah sparrow, black-capped chickadee, yellow warbler, Cooper's hawk, mink, and song sparrow.

The HEP methodology uses a species/habitat approach to quantify relative habitat values of a selected site. Each of the above species has various habitat needs which are described in a Habitat Suitability Index (HSI) model. Using HEP, the habitat in a study area is compared to optimum habitat (as defined in the HSI model) for each species selected for study, and the HSI is then determined using the calculations provided in the model. The HSI is a number between 0 and 1 with 0 representing no habitat suitability and 1 representing ideal or optimum habitat suitability. The HSI is multiplied by the number of acres of a particular habitat in the study area to obtain Habitat Units (HU).

The HEP process projects future conditions for a site for with and without project scenarios to determine net losses of habitat units. The total number of habitat units for each species and each alternative is divided by the life of the project (in years) to determine average annual habitat units (AAHUs). Project-related habitat impacts were analyzed for five target years over the life of the project: TY0 (baseline year); TY1 (year project related impacts first occur); TY5; TY25; and TY50. The latter three target years represent the points in time where changes in habitat quality or quantity would occur. This methodology for documenting habitat changes is applied to both disposal and mitigation sites.

Dredged material disposal under the Government Plan would be divided among 31 upland sites; an unspecified number of flowlane/inwater areas; two beach nourishment sites (Miller Sands Spit (O23.5) and Sandy Island (O86.2)); and designated and, as yet, undesignated (candidate) ocean disposal sites. Of the 31 upland sites, 15 sites would involve disposal on agricultural cropland, wetland, and/or riparian habitat. Under the Sponsor's Plan, there are also 31 upland disposal sites of which 13 contain agricultural, riparian, or wetland habitat. It is these disposal sites, requiring mitigation, which have been analyzed using HEP. Under the Government Plan, agricultural cropland (398 acres) is the most abundant habitat type impacted by the project, followed by riparian habitat (about 66 acres) and wetland habitat (about 38 acres). Overall, about 503 acres of upland wildlife habitat within the lower Columbia River system would be impacted by disposal under the Government Plan. The Sponsor's Plan would impact 289 acres of agricultural cropland; 30 acres of wetlands; and 68 acres of riparian habitat, for a total of 387 acres. The HEP analysis shows that the proposed disposal sites are most valuable to Canada geese, mallards, Cooper's hawks, and minks. The species which experience the greatest decrease in number of habitat units over the project life are Canada goose, mallard, and savannah sparrow. This relates to the fact that the greatest proportion of impacted habitat is agricultural cropland, most (although not all) of which is buried during disposal. Although the total number of AAHUs impacted by disposal is not large for riparian and wetland-dependent species, amphibians, black-capped chickadees, yellow warblers, Cooper's hawks, minks, and song sparrows suffer the greatest overall losses of habitat, all showing "with project" AAHUs of less than 1. The greatest numerical losses of AAHUs due to disposal occur at agricultural sites such as Scappoose Dairy, Martin Island, and Puget Island while moderate to minor losses occur at existing or formerly used disposal sites with pioneering riparian vegetation (W82.0 (Martin Bar), 077.0 (Deer Island), and W70.1 (Cottonwood Island)). However, given that riparian and wetland habitats in the lower Columbia River are of greater scarcity than agricultural cropland, it is these habitats which deserve the greater attention in terms of compensatory mitigation.

Five preliminary mitigation sites have been analyzed using HEP to help offset the losses discussed above. The tentative sites are identified as Joslin Property, Sauvie 94, Woodland Bottoms, Martin Island, and Webb Property. The HEP analysis shows that the greatest gains in mitigation habitat value (HSI) over the project life are for Canada goose and savannah sparrow. These gains are in agricultural cropland and associated habitat-agricultural cropland. Cooper's hawks achieved a moderate HSI gain in TY25 for early successional riparian habitat. For amphibians and minks, there were very small HSI gains at TY5, 25, and 50. However, the mitigation analysis does show that all species regain or exceed the maximum HSI values associated with the pre-project disposal sites. The amount of mitigation acreage associated with this mitigation scenario totals approximately 1,027 acres which amounts to an overall replacement ratio of about 2:1. In terms of a replacement ratio by habitat type, however, agricultural cropland (forage) acreage is replaced at a 0.6:1 ratio; wetland acreage is replaced at about 9:1; and riparian acreage is replaced at a ratio of about 6:1.

HEP Process Errors

Late in the HEP analysis, it was discovered that there were discrepancies in how habitat suitability indices (HSIs) were determined for some of the disposal and mitigation sites, for both with and without project scenarios. Unfortunately, these misinterpretations made some of the HEP data unreliable and, by inference, the habitat units calculated to be lost and gained over the life of the project inaccurate. The issue of greatest concern relates to the HSIs associated with farmed wetlands and riparian habitat. Despite these inconsistencies with the HEP process, however, the Service maintains that the HEP analysis has provided valuable information on the amount and types of habitat and the species that would be most impacted by the project. Furthermore, given time to redo portions of the HEP, these discrepancies may balance themselves out, i.e., because the Corps was conservative in their estimate of habitat recovery rates and recovery could actually occur at a faster rate than predicted, the benefits to impacted species would occur at an earlier stage of the mitigative process. But, because of the errors in the HEP analysis, the mitigation analysis is also suspect and the appropriateness of the project mitigation plan cannot, at this stage, be adequately determined. The WDFW, WDOE, ODFW, and the Service have identified two possible options that would prevent untimely delay of the project, keep the planning process moving forward, and, at the same time, offer suitable protection of fish and wildlife resources:

1. The first option involves completing the HEP analysis by collecting data to represent all habitat types and reanalyzing current and future conditions based on changes in individual habitat parameters. This reanalysis could be completed during the preconstruction engineering and design (PED) phase of the project.

2. The second option recognizes that, because the ability to accurately quantify impacts and mitigation needs has been compromised by inaccuracies in the HEP process, it has become necessary to look at the probable impacts of dredged material disposal and opt for the mitigation plan that best offsets these impacts. Based on the upland wildlife resource impacts expected from the Sponsor's disposal plan, which appears to have less severe impacts than the Government's disposal plan, the mitigation proposal that the Service would accept as best accomplishing the above mitigation goal includes all of the following sites (or equivalent replacement sites that are acceptable to the HEP team): Martin Island, Webb, Woodland Bottoms, Sauvie, Burke Island, and Joslin.

Discussion

The proposed deepening of the Columbia River channel to -43 feet between RM 3 and RM 105.5 would have a variety of immediate, short-term, and possibly long-term impacts on the river and its resources. The same is true of the proposed deepening of the Willamette River channel. Under the least cost disposal plan (Government Plan), over 110 million cubic yards of material (including the Willamette River material) are scheduled for disposal over a twenty year project period. This includes offshore, upland, beach nourishment and flowlane/inwater disposal for new work as well as disposal of maintenance dredging materials. This amount of dredged material disposal would have a significant detrimental impact on many habitats and species within the lower Columbia River Basin.

The Sponsor's Plan calls for two fewer disposal sites requiring mitigation than the Government Plan and involves slightly less upland disposal acreage to accommodate the dredged material. In many cases, the Sponsor's Plan opts for disposal sites which are more expensive in terms of transportation costs over those sites which would have a higher environmental cost, thus minimizing acquisition costs by avoiding sites which would require mitigation. However, the Sponsor's Plan also relies heavily on the use of port lands slated for commercial/industrial development. While the Service does not, in general, object to the use of such sites for dredged material disposal, we do have reservations about some of these port sites because some of them support valuable wildlife habitat on site or are adjacent to such habitat, e.g., the Gateway 3 site, and these habitats would probably suffer losses once disposal occurs. In addition, riparian habitat losses associated with the Sponsor's Plan are not adequately mitigated. The replacement ratios for the Sponsor's Plan are not as high as for the Government Plan, particularly for riparian habitat (only about 2:1 as compared to 6:1 for the Government Plan). To be considered satisfactory, use of the proposed disposal sites under the Sponsor's Plan would require mitigative replacement of lost riparian habitat at or near the same ratio as the Government Plan. Therefore, at this time, the Government Plan replacement ratios are more acceptable, provided mitigation is accomplished prior to or at the time of construction and approved monitoring plans are in place. However, if the sponsors did provide for appropriate riparian habitat replacement, and mitigation and monitoring plans were approved prior to project construction, we would support implementation of the Sponsor's Plan.

There is a concern that dredging may have direct adverse impacts on smelt and sturgeon in the lower Columbia River and the Willamette River, primarily because of the possibility of entrainment. Such impacts could be reduced if dredging were limited to specific inwater work periods or to the use of specific types of dredging equipment. Additionally, studies to determine cumulative, long-term impacts of dredging on smelt and sturgeon populations would aid in developing methods of dredging and disposal designed to minimize such impacts.

Pile dike construction, particularly in the estuary around Miller Sands and Miller-Pillar Rock Islands, could increase foraging opportunities for piscivorous birds, resulting in increased mortalities for juvenile salmon. These impacts could be significantly reduced if the pile dikes were constructed with metal cones or caps, wires, nails, etc., which would discourage bird use.

Several estuarine islands created by disposal of dredged materials (Rice Island, Miller Sands, etc.) have become productive habitat sites for colonial nesting birds such as Caspian terns, cormorants, and gulls. These bird populations, particularly the tern populations, have increased significantly in the last several years. Research on the foraging activities of these birds has shown that juvenile salmon mortality from avian predators has ranged from 10 to 30 million fish. An interagency group has been working to reduce salmon mortality by relocating birds to other island sites where juvenile salmon would not be as susceptible to predation and by making the presently used sites less hospitable to bird use. The final resolution of these human-caused inter-species conflicts, including the issue of future use of these sites for channel deepening disposal, must be conducted in a manner that minimizes harm to both colonial nesters and juvenile salmon.

Flowlane/inwater disposal should only be considered for areas of low benthic productivity and low fish use. Shallow intertidal and subtidal areas must be avoided as well as deepwater areas below -65 feet, particularly areas of known importance to sturgeon. The Service is particularly concerned about the predicted shallowing of the channel depth by twenty feet over 20 years in certain areas as a result of flowlane disposal. This could have serious consequences for sturgeon and sturgeon habitat in terms of rearing areas and prey availability. Monitoring studies would be needed to determine long-term impacts to sturgeon, particularly YOY and juvenile sturgeon.

Preliminary results of workshops to develop new offshore disposal sites has resulted in consideration of several candidate sites. Some of these sites are in areas where little is known of the site's natural resources (Astoria Canyon site, shale pile site). In other cases, sites may impact known resources, e.g., juvenile flatfish. In the case of the latter species, little or no disposal has occurred in the area where juvenile flatfish are known to rear. Any long-term continual disposal in the same area within a newly designated offshore disposal site should be monitored to determine overall resource losses and mitigation needs.

Another consideration of offshore disposal should be the possibility of disposing of dredged material to contribute sand materials to the littoral drift just offshore of the mouth of the Columbia River. Past dredging and disposal practices have, over time, contributed to the severe loss of beach material along the Washington coastline. Methods of disposing of material in Area E or, if possible, in the surf zone or on Benson Beach so that it nourishes the shoreline just north of the north jetty should be investigated.

There is the possibility that, with the dredging of the 43-foot channel, the channel width would be increased, thereby increasing the amount of material dredged. This increase should be included as part of a contingency plan with the understanding that mitigation would be required for disposal of any additional material. The possibility of bank sloughing and consequent losses of intertidal habitat associated with channel deepening and widening should also be monitored. Mitigation would be required for such losses if they occurred.

In the past decade, there have been a number of safety problems associated with the shipwake from large ships on beaches along the river. The possibility of increased safety risks to boaters and shoreline recreationists from the larger ships accommodated by the project's deeper channel should be considered. With the increased shipwake, there may also be increased erosion of both the natural shoreline and of the man-made island shorelines. Such erosion could result in an increase in the amount and frequency of dredging in the channel and would probably require some method of permanent stabilization at the erosion sites. These activities could lead to loss of and further degradation of habitat in the lower Columbia River.

Another area of concern relates to the impacts of the blasting proposed for the 43-foot channel. Blasting should be planned so that impacts to fish and wildlife are kept to a minimum. Blasting procedures should be the most up-to-date, i.e., state-of-the-art at the time of construction. Primary among these conditions should be inter-agency coordination to determine appropriate timing for blasting and use of blast attenuating methodologies to assure minimal impacts. Monitoring of the blasting as a means of determining mitigation needs is imperative.

Mitigation actions should take place concurrently with or before construction to assure minimization of losses. Monitoring plans should also be developed and approved prior to construction commencement. In addition, permanent protection and long-term maintenance of mitigation sites should be addressed. In certain cases, title transfer of mitigation sites to interested resource agencies (with appropriate maintenance funding) should be considered. With regard to proposed ecosystem restoration projects, monies should be included in the authorization of the projects to implement these actions.

We have concerns about the proposed disposal at the Brown Island sites (W46.3 and W46.0). These sites support high value Columbian white-tailed deer (CWT) habitat. Brown Island also contains valuable shallow subtidal, intertidal, and riparian habitats which must be avoided during disposal.

State resource agencies have expressed concerns regarding disposal on Canada goose nesting sites. To protect these sites, no disposal should occur on known nesting areas between March 1 and June 30. The WDFW also is concerned about disposal on Martin Island. This site has not historically been used for disposal and it supports valuable waterfowl wintering and nesting habitat. Because Martin Island is designated as a significant mitigation property under the Government Plan, it may be better suited to this purpose than to disposal. The ODFW would also prefer that the Scappoose Dairy site on Sauvie Island be dropped as a disposal site and that, if possible, the Lone Star Gravel Pit be substituted for disposal. The Dairy site is managed as a Canada goose migration corridor helping to alleviate goose depredation problems by keeping the geese away from nearby agricultural areas. Disposal on this site would negate such management options. The WDFW also has concerns with the proposed disposal at the Peavey Oval site (W73.5). According to the Washington Department of Ecology, wetlands at this site are designated "waters of the state and shorelines of the state" and, therefore, "subject to protection". Mitigation would be required for any impacts to these wetlands. Because of the intricacies of past permitted filling of portions of this site, mitigation requirements, and the possibility of long-term legal actions associated with filling this site, its use as an acceptable disposal site is questionable. The option of dropping Martin Island, the Scappoose Dairy (and, possibly, substituting the Lone Star Gravel Pit), and the Peavey Oval as disposal sites should, therefore, be evaluated.

The HEP analysis has been shown to have some discrepancies which have effected the mitigation requirements for offsetting disposal impacts to wildlife resources. Two options have been offered to help resolve this issue: 1) redoing the HEP analysis during the PED phase of the project, or 2) accepting Burke Island, Martin Island, Webb, Sauvie, Joslin, and Woodland Bottoms (or equivalent replacement sites that are acceptable to the HEP team) as mitigation sites associated with each disposal plan option.

Contaminant issues must also be addressed, particularly in the Willamette River. Contaminated sites must be identified prior to construction. Avoidance of these areas would be the preferred method of dealing with contaminated sites. If avoidance is not possible and dredging is pursued in contaminated sites, then rather than capping inwater, it may be more suitable to remove the contaminated materials, place them in approved upland sites, and then cap them. Monitoring of these sites during and after dredging would be necessary. There is also concern about dioxin levels in the sediment samples taken in the Willamette River, especially at hazardous waste sites. Close inter-agency coordination would be necessary to assure that this material is handled to minimize adverse impacts.

Actions from other agencies or from private entities, as a result of the channel deepening, could cause increased dredging activity near ports, marinas, or harbors in areas containing fine-grained or contaminated sediment. The interdependent and interrelated actions due to channel deepening, such as dredging by ports and private individuals, could occur in areas with a higher degree of contaminated fine materials. Bottom materials in these areas outside the channel may not be well characterized, and depositional areas containing organic materials could be under-represented during the sampling process. These independent actions are related to channel deepening and could result in secondary impacts, i.e., resuspension of contaminants which would effect salmon, bald eagles, and other fish and wildlife.

Secondary impacts that could also result from channel deepening include increased shipping traffic and the probability of increased incidences of oil spills; increases in illegal bilge dumping coupled with an increased probability of exotic species introductions; additional losses of habitat at Howard Island, Cottonwood Island, Austin Point, and Gateway 3 disposal sites due to secondary industrial development occasioned by disposal; and increased exposure of salmonid species to contaminants. These secondary impacts must be evaluated by the Corps and appropriately mitigated, as necessary.

The Service is concerned that the screening levels used by the Corps to evaluate materials proposed for dredging and flowlane disposal are not protective of fish and wildlife in the lower Willamette and Columbia Rivers. Disturbance or (inwater) disposal of dredged materials containing organochlorines, especially dioxin-like compounds, above or below the Corps' screening levels could still result in biomagnification of contaminants through the food chain. Bioaccumulation has already been documented in bald eagles, ospreys, great blue herons, double-crested cormorants, minks, and otters along the lower Willamette and Columbia Rivers near areas proposed for dredging and disposal. In addition, existing concentrations of organochlorines and PAHs in the Willamette River already threaten smolt survival and salmon reproduction. Dredging contaminated fine materials in these areas could enhance uptake of contaminants by juvenile salmon and further threaten overall survival. Further study in the Willamette River on the impacts of dredging and disposal of contaminated materials needs to be conducted to assess probable harm to aquatic resources, particularly listed species. In addition, if the contaminant issues in the Willamette River cannot be satisfactorily resolved, then the Willamette River portion of the channel deepening project should be dropped.

The issue of fish contamination is of particular concern to the Columbia River Inter-Tribal Fish Commission (CRITFC) because of high fish consumption rates among tribal members. CRITFC's concerns regarding Willamette River dredging and disposal and impacts on tribal health are contained in their comment letter regarding the draft Portland Harbor Sediment Management Plan, enclosed with their attached comment letter to the Service. We urge the Corps to seriously consider these comments before proceeding with any planned dredging of the Willamette River.

From a fish and wildlife perspective, the no action alternative is the best alternative in terms of avoiding cumulative, long-term impacts to the lower Columbia River's natural resources. However, this report is focused on describing impacts and methods of avoiding, minimizing, and compensating for the impacts of a particular channel deepening plan. In terms of minimizing impacts, there appear to be at least two alternatives that would still provide for some increased use of the river by larger, deep-draft ships but would not have the same scope of impacts as the proposed -43 foot channel dredging coupled with the least cost disposal alternative or the sponsor's preferred disposal plan. Improving the efficiency of the LOADMAX system is the non-structural method for accommodating larger ships with the least damage to fish and wildlife species. It does not provide for the greatest amount of economic development but it does provide for some economic expansion with less cost to the environment. Another, less negatively impacting alternative is development of a tiered channel to allow for the extra depth for heavily loaded outbound ships. It may also be possible to achieve passage for larger, deep-draft ships by working with a combination of less environmentally damaging alternatives such as the 41-foot channel and LOADMAX, or a tiered channel and LOADMAX. The Service would like to see further analysis of these alternatives before a final preferred alternative is selected.

To address the above concerns associated with the 43-foot channel, avoid, minimize, or compensate for impacts, and protect fish and wildlife resources, where possible, the Service recommends that:

1. All inwater work take place within specified State and Federal resource agency time periods to protect juvenile salmonids, smelt, and sturgeon.

2. Dredging in the Columbia River downstream of the mouth of the Lewis River be limited to use of a clamshell dredge between January 1 and June 1 to minimize entrainment impacts to smelt larvae. Studies on adult smelt spawning distribution or on larval smelt production/distribution before, during, and after dredging are recommended to determine changes in mainstem spawning success and distribution related to dredging.

3. To minimize losses of juvenile salmonids, any pile dike installation, particularly in the vicinity of Miller Sands or Miller-Pillar Rock Islands, should implement design methods which prevent or deter use by piscivorous birds.

4. The final resolution of the tern predation issue, including future use of estuarine islands for channel deepening disposal, be conducted in a manner that minimizes harm to both colonial nesters as well as juvenile salmon.

5. Studies be initiated to determine the cumulative effect of dredging and disposal on sturgeon, particularly in those flowlane areas where the depth of the channel is predicted to become shallower over the next 20 years. If these studies indicate significant disposal related losses of sturgeon and sturgeon habitat, flowlane disposal in waters deeper than 30 feet should be reduced or eliminated to protect larval, YOY, and juvenile sturgeon.

6. Disposal in offshore juvenile flatfish rearing areas be avoided. In addition, any continuous long-term disposal in the same area of a newly designated offshore site should be monitored to assess mitigation needs.

7. Research studies on the impacts of disposal on soft-shell crabs be continued.

8. Offshore disposal in Area E near the north jetty be placed so as to allow for contribution to the littoral drift and nourishment of Washington Coast beaches, particularly Benson Beach.

9. Bank sloughing and consequent losses of intertidal habitat associated with channel deepening and widening be monitored. Appropriate mitigation would be required for such losses if they occurred.

10. Monitoring studies be initiated to determine recreational safety problems as well as erosion acceleration (bank sloughing) resulting from increased shipwake from larger, deep draft ships using the deepened channel. Mitigation for the loss of habitat, use, and forage for terrestial and aquatic species resulting from this erosion shall also be identified and implemented.

11. Blasting requirements as regulated by the ODFW and WDFW be incorporated into any blasting plan for the Columbia and/or Willamette Rivers with mitigation as requested.

12. All mitigation efforts be initiated concurrently with or prior to construction commencement. Monitoring plans should also be approved prior to the start of construction. In addition, permanent protection and long-term maintenance of mitigation sites should be addressed. In certain cases, title transfer of mitigation sites to interested resource agencies (with appropriate maintenance funding) may be appropriate. With regard to the proposed ecosystem restoration projects, monies to implement these actions should be included in the authorization for the projects.

13. Disposal at Brown Island avoid Columbian white-tailed deer habitat.

14. No disposal occur on known Canada goose nesting areas between March 1 and June 30.

15. The option of dropping Martin Island, Scappoose Dairy (and substituting the Lone Star Gravel Pit), and the Peavey Oval as disposal sites should be evaluated.

16. One of the two options offered for correcting the discrepancies in the baseline assumptions of the HEP analysis be selected to offset upland disposal impacts.

17. Dredging in contaminated areas be avoided, including areas with DDE, PCBs, or dioxin-like compounds above or below screening levels, particularly in the Willamette River. If this is not

possible, dredged contaminated materials should be placed in approved upland sites and capped. Monitoring of these areas for contaminant availability during dredging would be necessary.

18. Secondary impacts that could result from channel deepening such as oil spills; increases in illegal bilge dumping coupled with an increased probability of exotic species introductions; additional losses of habitat due to secondary industrial development occasioned by disposal; and increased exposure of salmonid species to contaminants be further evaluated by the Corps and appropriately mitigated, as necessary.

19. Further study in the Willamette River on the impacts of dredging and disposal of contaminated materials be conducted to assess probable harm to aquatic resources, particularly listed species. In addition, if the contaminant issues in the Willamette River cannot be satisfactorily resolved, then the Willamette River portion of the channel deepening project should be dropped.

20. CRITFC's concerns regarding Willamette River dredging and disposal and impacts on river and tribal health as contained in their comment letter regarding the draft Portland Harbor Sediment Management Plan be given serious consideration by the Corps before proceeding with any planned dredging of the Willamette River.

21. The following points be incorporated into the dredging and disposal activities for the project to avoid contaminant impacts to salmon, bald eagles, otters, and other fish and wildlife.

1) Add chemical analysis of dioxin-like compounds (individual congeners of dioxin, furan, and planar polychlorinated biphenyls) into the regular testing regimen for fine-grained sediments from the Columbia and Willamette Rivers. Develop screening levels for these compounds based on an additive or toxic equivalent (TEQ) approach, which accounts for the additive toxicity of the dioxin-like compounds. Bioassays such as the H4IIE bioassay could be applied for testing rather than a full dioxin and furan analysis to measure dioxin-like activity, but detection limits of any bioassay should be no greater than one pg/g.

2) Consider dredged material which meets the requirements for inwater/flowlane disposal as a point source discharge for any contaminants, especially bioaccumulative compounds, that are present above detection limits. This would help to quantify the cumulative low level discharges of bioaccumulative contaminants into the Columbia River. In addition, establish an easily accessible database containing this information (amount of material disposed and total contaminants in material) for all Corps projects on the Columbia and Willamette Rivers involving inwater disposal. Estimate the additional loading of DDT and metabolites, PCBs, and dioxin-like compounds (dioxins, furans, and planar PCBs) by determining the total amount of each contaminant (based on concentrations from chemical analysis on a sample from a set amount of material) within the total amount of material to be disposed. Report estimates to the appropriate State Environmental Quality personnel to determine if this additional loading would violate current water quality standards for the Columbia River.

3) Tabulate and report results of chemically analyzed fine-grained materials that are collected on a regular schedule from the Willamette and Columbia Rivers. Reports should include sampling techniques, chemicals analyzed, quality control information, and detection limits for each analyte, and should be made available to the public and other Federal Agencies. Electronic data and final reports could be made available on the Internet.

4) Prepare a detailed GIS map describing all known areas of contaminated sediments above detection limits, especially those areas containing DDT and metabolites, total PCBs, and dioxin-like compounds in the Willamette River, and overlay areas to be

dredged. The map should incorporate information recently gained from the Corps' Channel Deepening Sediment Quality Evaluation and the Portland Harbor Sediment Investigation sponsored by the Oregon Department of Environmental Quality and the U.S. Environmental Protection Agency. This map would provide critical information needed to avoid dredging contaminated areas, thus minimizing impacts to fish and wildlife.

5) Avoid dredging in areas where PCBs, DDT and metabolites, dioxins, or furans are identified in contaminant maps outlined in recommendation 4. Areas adjacent to state or Federal hazardous waste sites should not be dredged. Dredging these areas, especially areas contaminated with wood-treating chemicals, could resuspend dioxins and furans and violate the total maximum daily load for TCDD established for the Columbia River. If these areas are dredged, disposal should be in approved upland sites and monitoring for contaminant bioavailability should be conducted during the dredging process.

6) Develop a monitoring program to determine if resuspension or the availability of bioaccumulative contaminants are increased during a dredging or disposal operation involving fine materials. The monitoring program should be developed in coordination with the Service and the U.S. Geological Survey. Monitoring should address bioaccumulation, and should involve a sensitive ecological receptor or use of passive sampling devices such as semi-permeable membrane device (SPMDs), caged mussels, or other techniques.

7) Gather additional data to address how interdependent and interrelated actions associated with dredging the navigation channel could impact contaminant loading into the Willamette and Columbia Rivers. The Corps did not address this issue in their biological assessment for the Dredged Material Management Plan, and the Service recommends this issue be addressed during the channel deepening review.

Please advise us of your proposed actions regarding the above recommendations. We look forward to continued coordination with you as project planning continues.

Sincerely,

Paul Henson

for Russell D. Peterson
State Supervisor

Oregon
John A. Kitzhaber, M.D., Governor

Department of Fish and Wildlife
Northwest Region
17330 SE Evelyn Street
Clackamas, OR 97015-9514
(503) 657-2000
FAX (503) 657-2050

April 30, 1999

Russel D. Peterson
United States Department of the Interior
US Fish and Wildlife Service
Oregon State Office
2600 SE 98th Avenue, Suite 100
Portland, OR 97266

Re: US Fish and Wildlife Service Coordination Act Report: Impacts of Proposed US Army Corps of Engineers Proposed Dredging of the Columbia River Channel

Dear Mr. Peterson:

The Oregon Department of Fish and Wildlife (ODFW) has completed its review of the US Fish and Wildlife Service (USFWS) letter of April 12, 1999 with its attached Coordination Act Report (Report). The Report addresses US Army Corps of Engineers (USACOE) proposed Columbia River Channel deepening project. ODFW concurs with the Report and supports USFWS articulation of concerns and comments in the Report about the proposed project impacts to fish and wildlife. In general, the report accurately reflects comments and recommendations to protect fish and wildlife ODFW provided USACOE in previous correspondence and communications.

Specifically, ODFW would like to take this opportunity to reemphasize key issues outlined in the Report. The remainder of this letter outlines these key issues:

1. ODFW supports USFWS in urging USACOE to further study the effects of offshore dredge disposal site selection and disposal techniques on offshore marine habitats before offshore disposal is undertaken. As you know, results from early cursory studies on such habitats are inconclusive. For example, studies, to date, do not provide sufficient data on the effects of dredge disposal material on dungeness crabs because too few crabs were studied. Moreover, tested sediment particle sizes differ from those proposed to be dredged. Also, ODFW remains concerned about broadcasting dredge spoils over a broad offshore area, as proposed. In view of so much uncertainty about broadcasting dredge spoils, ODFW instead recommends to minimize risk, to bottom dwelling organisms concentrating (piling spoils) in offshore areas.

2. ODFW supports the Report recommendation to scuttling selection of the Scappoose Dairy site as a dredge disposal site. The site should not be used for disposal because Canada geese and other waterfowl which now use the site will be displaced to nearby, privately owned agricultural areas that are already suffering extensive agricultural damage by geese.

3. The Report fails to mention an apparent discrepancy in the public interest review process. Specifically, the EIS discusses the environmental impacts of dredging the Columbia River from a point three miles up the river from its mouth to a point near the Interstate (I-5) near Vancouver, WA. However, the EIS defers discussion of environmental impact of the lower three miles of the river (where USACOE will also conduct maintenance dredging) to separate National Environmental Policy Act (NEPA) documents. Yet the two projects are integrally related. One cannot exist without the other. Therefore, the Report should recommend NEPA documents be combined, reviewed and addressed jointly. The lower three miles of the Columbia River estuary is habitat for Pacific sand lance. It also supports abundant benthic and epibenthic invertebrates important to the production of herring, salmonids, flatfishes, crabs and other important demersal and pelagic fishes. Accordingly, the Report should call attention to the important connection between these two areas USACOE now administratively separates into two different NEPA documents. The Report and the EIS should discuss the importance of species found in this lower three mile river reach along with impacts the proposed project will have on aquatic biota throughout the entire estuary.

4. The Report criticizes criteria used by USACOE to ascertain impacts that would occur if contaminated Willamette River sediments are dredged and dumped in the Columbia River. ODFW concurs with this Report concern and recommends no dredging of the Willamette River channel should occur until these USACOE "thresholds of concern" criteria for sediments are revisited, and further analyzed to determine safe concentrations in dredge disposal material and exposure to fish and wildlife. For example, USFWS researchers have already noticed elevated levels of organochlorine compounds in aquatic and terrestrial organisms and avian eggs from specimens sampled along the lower Columbia and Willamette rivers near proposed dredge sites. Although the origin of these contaminants in wildlife is unknown, until there is greater certainty these pollutants do *not* derive from Willamette River sediments, dredging in the Willamette River should not be permitted under this USACOE proposed project.

We appreciate the opportunity to participate with you in drafting and reviewing the Report. Thank you for the opportunity to comment.

Sincerely,

Greg Robart

Gregory P. Robart
Habitat Conservation Biologist

c NMFS, Portland - Ben Meyer
USFWS, Portland - Kathi Larson, Ron Garst
USACOE. Portland - Laura Hicks/Jeff Dorsey
Washington Department of Fish and Wildlife, Olympia - Lauri Vigue
DEQ, NW Region, Portland - Neil Mullane

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE
2108 Grand Blvd. Vancouver, Washington 98661 o.(360)906-6729
Fax (360) 906-6776 / 906-6777

May 17, 1999

Russell D. Peterson
U.S. Fish and Wildlife Service
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266

Dear Mr. Peterson:

This letter contains comments on the final draft of the Fish and Wildlife Service's Coordination Act Report on the impacts of the proposed Columbia River Channel Deepening Project on fish and wildlife resources of the lower Columbia River.

We appreciate the USFWS incorporating most of our comments into the previous drafts of this report. The discussion and recommendations section of the report has improved with the addition of the following studies; monitoring smelt spawning distribution before, during and after dredging and disposal; the impacts of disposal on soft shell crabs; the cumulative effect of dredging and disposal on sturgeon; and erosion monitoring studies resulting from the increased shipwake of larger deep draft ships using the channel.

In order for WDFW to issue a letter of concurrence the following changes would have to occur in the final report:

In the section titled HEP process errors, under the second option, the option WDFW recommended to the resource team last fall was the following statement: based on the upland resource impacts expected from the sponsor's disposal plan, which seems to have less severe resource impacts than the Government's disposal plan, we would accept a mitigation proposal that includes **all** of the following sites or equivalent replacement sites that are acceptable to the HEP team:

- Martin Island
- Webb
- Woodland Bottoms
- Sauvie
- Burke Island
- Joslin

WDFW does not agree to the mitigation statement as written in option two of the final report.

Mitigation for cumulative effects should also be included in this final draft. The Fish and Wildlife Coordination Act requires any federally funded or federally permitted water project to include mitigation as recommended by the U.S. Fish and Wildlife Service and the relevant state fish and wildlife agencies. It is apparent that the Corps needs to complete a comprehensive cumulative effects study of the impacts to aquatic and terrestrial resources on the lower Columbia River due to all the dredging activities. The Corps mitigation plan should include measures to address impacts from ongoing maintenance and mouth of Columbia dredging.

Regarding the Peavy Oval site, our concern is now addressed by WDOE as stated in a letter to the Corps on January 26, 1999, "this site was never established as a long-term or on-going dredge disposal site for Columbia River sediment. The permits that were issued to allow fill and development of this site have been duly executed. It is Ecology's opinion that the wetlands on this site are waters of the state and shorelines of the state and subject to protection and permitting requirements of the WPCA and the SMA. Therefore, Ecology will require a full evaluation of the habitat associated with the 43 acre site known as the "Peavy Oval." Full mitigation will be required for any project impacts to wetlands at this site. Without further on-site analysis, Ecology will assume that the entire 43 acres is wetland (as defined by state and federal regulations) and will require mitigation for all impacts to site. Another option for the Corps and the sponsors is to remove the Peavy Oval from the disposal site list". It continues to be the position of WDFW that mitigation is required for the filling of additional wetland habitat at the Peavy Oval site.

Disposal in several sites may lead to secondary impacts associated with industrial development. Howard Island, Cottonwood Island, Austin Point, and POV Gateway 3 sites are examples. As stated in previous WDFW comments, reasonably anticipated secondary impacts due to subsequent industrial development must be considered in this evaluation.

In the section titled **Fish and Wildlife Resources**, page 4, it should be noted:

1. That green sturgeon are also seasonally abundant in the estuary;

2. Larval and young-of-the-year (YOY) white sturgeon utilize deepwater habitat for rearing and feeding. The impacts of flowlane disposal in areas deeper than 30 feet would have an impact on larval and YOY sturgeon by reducing rearing areas and covering available food sources, and YOY white sturgeon could well be buried in the sediments and die. To protect larval and YOY white sturgeon flowlane disposal in waters deeper than 30 feet needs to be reduced or eliminated.(page 4, paragraph 11)

3. Special seasons and select fishing areas are designated for salmon and sturgeon as well as shad and smelt.(page 5, paragraph 2).

4. In the service recommendations, number 3, there is no spawning habitat within the project area and flowlane disposal should be reduced or eliminated in areas deeper than 30 feet.

In the marine area there are two concerns that need to be addressed prior to the final EIS. The first is that WDFW feels that there needs to be mitigation for Dungeness crab impacts. This could be accomplished using proven methods as outlined in the September 1998 Revised Crab Mitigation Strategy Agreement for the Grays Harbor Navigation Improvement Project.

The second issue not adequately covered is upland disposal. WDFW feels there needs to be more discussion regarding disposal of material on Benson Beach. Disposal on Benson Beach would be a beneficial use of dredge spoils by slowing erosion and restoring the coastal shoreline.

Thank you for the opportunity to comment on this final draft of the Columbia River Channel Deepening Coordination Act Report. If you have any questions regarding the HEP comments, please call Curt Leigh at (360) 902-2422, for questions regarding ocean disposal, call Bob Burkle at (360) 249-1217, and for any questions regarding fish issues call Ken Mohoric at (360) 906-6730.

Sincerely,

Lee Van Tussenbrook
Regional Director
Southwest Region

cc: Rich Costello, WDFW - Olympia
Lauri Vigue, WDFW - Olympia
Ken Mohoric, WDFW - Vancouver
Perry Lund, WDOE - Olympia
Greg Robart, ODFW - Portland
Alan Clark, USFWS - Portland
Bob Burkle, WDFW - Montesano
Ben Meyer, NMFS - Portland
Rick Vining, DOE - Olympia
Elyse Kane, WDFW - Olympia
Larry Peck, WDFW - Olympia

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
525 NE Oregon Street
PORTLAND, OREGON 97232-2737

May 10, 1999

Mr. Russell Peterson
U.S. Fish and Wildlife Service
Attn: Ms. Kathi Larson
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266

RE: Fish and Wildlife Service's Draft Coordination Act Report on the Proposed Deepening of the Columbia River Navigation Channel

Dear Mr. Peterson:

The National Marine Fisheries Service (NMFS) has reviewed the U.S. Fish and Wildlife Service's (FWS) subject Draft Coordination Act Report which describes potential impacts resulting from the Army Corps of Engineers' (COE) proposed plan for deepening the existing 40 foot navigation channel in the Columbia River and Lower Willamette River to a maximum depth of 43 feet. We provide the following comments based on our concerns for the potential impacts of this project on marine, estuarine and anadromous fishery resources and their habitats.

The NMFS appreciates the amount of work the FWS has put into development of the report. It has been a significant task to determine and address potential issues that result from the proposed project. The FWS has done an admirable job in attempting to accomplish that. The FWS has identified the major issues that NMFS believes still need to be addressed by the COE: ocean disposal impacts; in-water disposal impacts to sturgeon; disposal on estuarine islands; impacts to estuarine fish and invertebrate species; impacts to Columbia River smelt; increased wave erosion; sediment budget for the Columbia River; contamination in the Willamette River and ecosystem restoration.

The area encompassed by the COE's proposed project will probably soon be designated as Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act. The NMFS, in their recommendations to the Pacific Fishery Management Council on EFH designations for groundfish stocks, provided the following general considerations for assessing potential impacts of proposed projects.

- The extent to which the activity would directly and indirectly affect the occurrence, abundance, health, and continued existence of fishery resources;

- The extent to which the potential for cumulative impacts exists;

- The extent to which adverse impacts can be avoided through project modification, alternative site selection or other safeguards;

- The extent to which the activity is water dependent if loss or degradation of EFH is involved; and

- The extent to which mitigation may be used to offset unavoidable loss of habitat functions and values.

The following recommendations were made for dredging and dredge material disposal:

- The cumulative impacts of past and current dredging operations on Essential Fish Habitat should be addressed.

- Environmentally sound engineering and management practices (e.g., seasonal restrictions, dredging methods, and disposal options) should be employed for all dredging and construction projects.

- Compensation for impacts to benthic environments from dredging should be provided.

- Federal agencies should identify the direct and indirect impacts such projects may have on EFH. Benthic productivity should be determined by sampling prior to any discharge of fill material. Sampling design should be developed with input from state and Federal resource agencies.

In summary, the NMFS concurs with the findings that FWS has made regarding impacts form the proposed channel deepening project and believes that the COE should undertake the following recommendations as part of any deepening of the Columbia River Navigation Channel:

- The COE should further work with the resource agencies and commercial fishermen to refine the proposed disposal sites.

- The COE should work with the resource agencies and commercial fishermen to develop and utilize appropriate methodology for dumping within the newly designated sites prior to any further disposal events.

- The COE should review the final offshore disposal management plan at least every five years and yearly for the first five years to adequately address the success or failure of the plan.

- The COE should conduct a comprehensive survey of the proposed offshore disposal sites to identify areas that are of high biological productivity, of unique substrate/habitat and to

ROJECT

›f impacts.

›urce agencies and commercial fishermen to develop
m offshore disposal.

›urce agencies to develop mitigation for impacts
›osal.

determine rates of benthic recolonization in deep
ʼer.

›urce agencies to evaluate the impact to sturgeon from

Pacific sand lance populations resulting from

ırce agencies to develop appropriate mitigation for
ained by dredging operations in the estuary.

scussions with NMFS to determine how best to
ı the estuary and what measures need to be taken to
: islands.

›erations using only a clamshell dredge form January
f the mouth of the Sandy River.

ıl for Columbia River smelt to be listed under the
ıniques and time lines accordingly.

eased wave erosion potential resulting from channel

of deepening the Willamette River until such time

; plan and conduct an analysis of juvenile usage of
nformation to evaluate the success of the

ıe Chinook River to the list of ecosystem

- The COE should further discuss the value of the tidegate on Deep River as a potential restoration project.

- The COE should further discuss the value of creation of shallow water habitat near Pillar Rock with NMFS.

The COE will need to consult pursuant to the Endangered Species Act, with NMFS on the final alternative selected. The Biological Assessment will need to address potential impacts to Snake River fall chinook salmon, Snake River spring/summer chinook salmon, Snake River sockeye salmon, Upper Columbia River steelhead, Lower Columbia River steelhead and Snake River steelhead, all listed under the Endangered Species Act. Also Lower Columbia River chinook salmon, Upper Willamette River chinook salmon, Upper Columbia River spring run chinook salmon, Columbia River chum salmon, Upper Willamette River steelhead and Middle Columbia River steelhead have been proposed for listing and should be included in the Biological Assessment.

The following should also be included in the Biological Assessment: an evaluation of the continued use of Rice Island as a dredge spoil site, its use as an avian breeding colony and impacts to salmonids; and, the impact of current pile dike fields and navigation structures on salmonids.

Questions regarding this letter should be directed to Ben Meyer at (503) 230-5425.

Sincerely,

for Michael Tehan
Chief, Oregon State Branch
for Habitat Conservation

cc: ODFW - Greg Robarts
WDFW - Ken Mahoric

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
729 N.E. Oregon, Suite 200, Portland, Oregon 97232
Telephone (503) 238-0667
Fax (503) 235-4228

May 26, 1999

Anne Badgley
Regional Director
USFWS
911 NE 11th Avenue
Portland, Oregon 97232

Dear Ms. Badgely:

The Columbia River Inter-Tribal Fish Commission (CRITFC), at the direction of the Confederated Tribes and Bands of the Yakama Indian Nation, The Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes of the Umatilla Reservation and the Nez Perce Tribe, appreciates the opportunity to comment on the USFWS final draft Coordination Act Report on the proposed Columbia River Channel Deepening Project (DCAR). We have prepared the following comments.

General Comments

CRITFC is very concerned about the potential impacts on treaty-reserved anadromous fish of the Corps of Engineers' proposed project to dredge the existing navigation channel to 43 feet. The proposed dredging project runs counter to the tribes' plan to restore the productivity of the Columbia River Estuary as expressed in our anadromous fish recovery plan, *Wy-Kan-Ush-Mi Wa-Kish-Wit* (Nez Perce et al. 1995). CRITFC provided detailed comments opposing the proposed dredging project with the Corps of Engineers on February 5, 1999 (Attachment 1). We request that these comments on the DEIS be included in the final CAR.

While CRITFC appreciates the chance to comment on the final DCAR, we are disappointed that the USFWS did not provide prior technical consultations with CRITFC or policy consultations with our member tribes during the formation of the DCAR. For other federal actions, the USFWS has typically provided these opportunities to coordinate input with the tribes.

The DCAR lacks a historical perspective of the impacts of dredging on the Columbia River ecosystem. These impacts have been well documented by Sherwood et al. (1990) and others. This perspective should be added to the final CAR.

In general, with the exception of management of Lower Willamette toxic sediments, we are concerned that despite the direct and cumulative impacts of the proposed dredging project, the DCAR appears to approve of the dredging project as long as mitigation and monitoring are accomplished. If implemented, the proposed project will only further degrade critical estuarine habitat for anadromous salmonids, Pacific lamprey and sturgeon, all resources that are seriously depressed and in many cases, listed under the Endangered Species Act. If implemented, the proposed project will be incompatible with the tribes goals of rebuilding salmon, lamprey and sturgeon.

While the DCAR did not support dredging of the Lower Willamette without further study, the DCAR did not refer to the Oregon Department of Environmental Quality's Draft Portland Harbor Sediment Management Plan (DEQ 1999). We strongly recommend that the final CAR include a discussion of that plan, including its deficiencies as specified in our comments (Attachment 2). This is critical because of the integral relationship of the plan to 1) the feasibility of dredging toxic sediments in the Lower Willamette and 2) the relationship between dredging the Lower Willamette toxic sediments and the proposed dredging of both the Lower Columbia and Lower Willamette rivers. We request that our comments on the plan be incorporated into the final CAR. CRITFC believes that the cumulative impacts of the proposed dredging project have not been adequately addressed in the DCAR. These impacts include but are not limited to the following:

- High probability of potential oil spills
- Bilge dumpages and propeller wash
- Introduction and proliferation of exotic species via ship transport that will compete with native anadromous fish
- Shoreline erosion from supertanker transit wave erosion
- Continual toxic sediment influxes into river from initial and maintenance dredging
- Loss of riparian habitat from port development and disposal of dredge spoils
- Creation of habitat favorable for avian predators from dredge spoils and ship pilings
- Impacts to coastal ocean anadromous fish habitat
- Increased probability of toxic accumulations in treaty-reserved fish consumed by tribal members from increased entrainment of toxics in the water column
- Maintenance activities on the deeper channel requiring dredging during anadromous fish migrations

The cumulative impacts of dredging on anadromous fish resources are well documented in the scientific literature. Regier et al. (1989) note that additional stress loading on a large river ecosystem may cause a synergism that intensifies the individual stressor (ie: dredging). The cumulative result is further diminishment of the ecological resource base over and above that anticipated from a discrete impact.

Specific Comments

Page 8 Increased wake from ship traffic will erode critical habitat and increase river turbidity. Studies in the Rhine River in Germany (Ward and Stanford 1989) noted that wave action caused by commercial shipping increased turbidity, stranded small fish, reduced macrophyte production and dislodged eggs and larvae. Wave action was responsible for heavy damage to fish fauna.

Page 8 We concur that chronic influx of toxic sediments will occur under the dredging proposal. These toxics will accumulate up the food chain, and tribal members who have much higher than average consumption rates of tainted fish will be at particular risk.

Page 5 Rearing juvenile salmonids will be at risk when riparian habitat is degraded from dredging spoils.

Page 9 We disagree with the DCAR statement that juvenile anadromous fish are not expected to suffer adverse effects from salinity changes from the channel deepening. Lichatowich and Cramer (1979); Reimers (1973) and CBFWA (1991) all note the importance of the freshwater- salinity interface on salmon production. The dredging will allow for more frequent and significant excursions from the existing saltwater-freshwater interface to which salmonids have adapted.

Page 10 CRITFC expects both immediate and long-term impacts on both treaty and non-treaty salmon fisheries from the dredging, whether or not there is in-water disposal. Examples of these impacts in the short and long term are provided in our comments to the DEIS and in the above comments.

Page 13 The DCAR estimates that over 110 million cubic yards of sediment will be dredged over a twenty year period under the proposed dredging project. This is a magnitude greater impact than the 19.1 million cubic yards of sediment that would be dredged in the initial activity. We concur with the USFWS that this amount of material will have a "…. significant detrimental impact on many habitats and species within the lower Columbia River basin."

Page 14 Because anadromous fish are present in the lower Columbia River at all times of the year, there is no time that dredging can occur that will not impact life histories and populations of these fish (Bottom and Jones 1990).

It is likely that the channel will be increased as the sides of the channel erode. This will encourage more dredging. Fremling et al. (1989) and Hesse et al. (1989) report that there is significant loss of off channel habitat in the Mississippi and Missouri Rivers as navigation channels have been extended and enlarged. These losses have impacted fish production.

Page 15 Blasting to enlarge the navigation channel carries considerable risks to anadromous fish.

Page 15 There is no mitigation available that will neutralize the impacts of the cumulative impacts of the proposed dredging project.

Page 15-16 According to the Draft Port of Portland Sediment Management Plan (DEQ 1999), it does not appear that dredging in the lower Willamette can occur without entraining toxic sediments. The final CAR should include a careful examination of this plan. Even if dredged toxic sediments are disposed of in an upland site, initial and maintenance dredging activities will entrain toxics into the water column. The USFWS agrees that the Lower Willamette River should not be dredged if the toxic issues cannot be resolved. The Lower Willamette River should be assigned Super Fund status and remain under jurisdiction of the Environmental Protection Agency. Dredging in the Lower Columbia should not proceed with the Lower Willamette dredging proposal unresolved.

Page 16 We concur that the Corps should improve the efficiency of the LOADMAX system by better coordination with hydrosystem operations. Please refer to our comments to the Corps DEIS on this issue (Attachment 1).

Summary

The CRITFC requests that the above comments be incorporated into the final CAR for submittal to the Corps of Engineers. Given the likely direct and cumulative impacts of the proposed dredging project on treaty trust resources that are described in our comments and in the DCAR, we strongly recommend that the USFWS position in the final CAR is the no-action alternative. Deepening the navigation channel is inconsistent with the need to significantly improve water and sustain the water quality of the Columbia and Willamette rivers and rebuild anadromous fish populations. The mix of uses of these rivers must be equitable among shared users, with priority given to the most sensitive users- the tribes and the fish on which they depend that require a high quality ecosystem.

Should you have questions regarding these comments, please contact Robert Heinith at (503) 731-1289.

Sincerely,

Donald Sampson
Executive Director

Attachments 1 and 2

cc: Russell D. Peterson, USFWS (by Fed Ex)
General R. Griffin, COE
Langdon Marsh, ODEQ
Chuck Clarke, EPA Region 10
Thomas Fitzsimmons, Ecology

References

Bottom, D.L. and K.K. Jones. 1990. Species composition, distribution, and invertebrate prey assemblages in the Columbia River Estuary. p. 243-270. *In* Columbia River:estuarine system. M.V. Angel and R.L. Smith [eds.]. Progress in Oceanography. Volume 25. Numbers 1-4.

CBFWA (Columbia Basin Fish and Wildlife Authority). 1991. The biological and technical justification for the flow proposal of the Columbia Basin Fish and Wildlife Authority. Portland, Oregon.

DEQ (Oregon Department of Environmental Quality) 1999. Draft Port of Portland Habor Sediment Management Plan. Portland, Oregon.

Lichatowich, J. and S. Cramer. 1979. Parameter selection and sample sizes in studies of anadromous salmonids. Information Report Series, Fisheries. Number 80-1. Contract DAC-W-57-77-C-0027 to the U.S. Army Corps of Engineers. By the Oregon Department of Fish and Wildlife. Portland, Oregon.

Nez Perce, Umatilla, Warm Spring and Yakama Tribes. 1995. Wy-Kan-Ush-Mi Wa-Kish-Wit. (Spirit of the Salmon). The Columbia River anadromous fish restoration plan. Volume I. Columbia River Inter-tribal Fish Commission. Portland, Oregon.

Regier, H.A., R.L. Welcomme, R.J. Steedman and H.Francis Henderson. 1989. Rehabilitation of degraded river ecosystems. P. 86-97. *In*: D.P. Dodge [ed.] Proceedings of the International Large River Symposium. Canadian Special Publication in Fisheries and Aquatic Sciences. Volume 106.

Reimers, P.E. 1973. The length of residence of juvenile chinook salmon in the Sixes River, Oregon. Fish Commission of Oregon Research Reports. 4(2):1-43.

Sherwood, C.R., D.A. Jay, R.B. Harvey and C.A. Simenstad. 1990. Historical changes in the Columbia River estuary, p. 299-352. *In* Columbia River:estuarine system. M.V. Angel and R.L. Smith [eds.]. Progress in Oceanography. Volume 25. Numbers 1-4.

Ward, J.V. and J.A. Stanford. 1989. Riverine Ecosystems: the influence of man on catchment dynamics and fish ecology. P. 56-64. *In*: D.P. Dodge [ed.] Proceedings of the International Large River Symposium. Canadian Special Publication in Fisheries and Aquatic Sciences. Volume 106.

Attachment 1

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
729 N.E. Oregon, Suite 200, Portland, Oregon 97232
Telephone (503) 238-0667
Fax (503) 235-4228

February 5, 1999

General Robert Griffin
Northwestern Division
Corps of Engineers
12565 West Center Road
Omaha, Nebraska 68144-3869

Colonel Robert T. Slusar
Portland District
Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

Dear General Griffin and Colonel Slusar:

The Columbia River Inter-Tribal Fish Commission (CRITFC), at the direction of the Confederated Tribes and Bands of the Yakama Indian Nation (YIN), the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), the Confederated Tribes of the Warm Springs Reservation of Oregon and the Nez Perce Tribe, has reviewed the Corps of Engineers' draft environmental impact statement entitled, "*Integrated Feasibility Report for Channel Improvements*" (DEIS). We have prepared the following comments.

General Comments

CRITFC has serious concerns that the DEIS failed to consider the cumulative impacts [1] resulting from implementation of the preferred alternative – the least-cost alternative of dredging and disposal of 19.1 million cubic yards of bottom sediment from the lower Willamette and Columbia Rivers to increase the navigation channel from 40 to 43 feet. The DEIS failed to adequately analyze the impact of the proposed alternative on treaty reserved resources including but not limited to Pacific salmon, sturgeon and steelhead and Pacific lamprey. For example, the DEIS fails to discuss or analyze the impacts of the proposed action if John Day and the Lower Snake

1 The Council of Environmental Quality defines "cumulative impacts" as the impact to the environment which results from the incremental impact of this action when added to other past, present and reasonably foreseeable future actions regardless of what agency, federal or non-federal or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. The DEIS failed to consider the impact of the preferred alternative to the existing degraded lower river and estuarine habitat for anadromous fish and for other river operations and conditions other than those reasonable and prudent alternatives in the NMFS 1995-1998 FCRPS Biological Opinion for Snake River Salmon and the NMFS 1998 FCRPS Biological Opinion for Columbia River Steelhead. The DEIS failed to consider the impacts of the preferred alternative on salmon recovery measures in the NWPPC Fish and Wildlife Program and in the CRITFC tribes' *Spirit of the Salmon* restoration plan.

dams are removed in the future. The DEIS fails to include any analysis of the synergistic impacts of the proposed alternative with other river operations other than the current operations, and fails to examine significant changes projected for the Willamette and Columbia River hydrographs as a result of global warming. In addition, the DEIS failed to adequately address the importance of protecting and improving the estuary. Given how so many have sought to minimize the responsibility of the FCRPS for salmon mortality by pointing fingers at potential mortality stemming from problems in the estuary and the ocean, it is somewhat ironic that activities that will adversely affect salmon migration and feeding areas in the estuary would be termed "insignificant."2

At no point during the development of this DEIS did the Corps or other federal government agencies provide a consultation for the CRITFC tribes. In fact, we could not find any mention of the impact of the preferred alternative on treaty resources anywhere in the DEIS, including the appendices. This includes consultation on the USFWS' Coordination Act Report on the DEIS alternatives. This failure to address tribal concerns must be rectified if the NEPA process for this proposed action proceeds.

Nowhere in the DEIS is there an analysis or discussion of providing alternative transportation for commodities, such as rail, to other well established ports such as Seattle or San Francisco. This failure exists despite the fact that most of the present agricultural and commodity transport from the Columbia Basin and the mid-west is now by rail and truck (55-60%). The alternative of transporting commodities by rail or truck to Astoria or even Longview was not well developed, because the capital and operations and maintenance costs of the dredging were not included in the overall costs of shipping commodities to and from Portland, thereby precluding reasonable comparison.

The DEIS failed to consider the possibility that currently depressed Asian and other world markets may never rebound to levels analyzed in the DEIS. If the proposed alternative is implemented, water quality of these rivers would surely erode. The synergistic impacts of supertanker oil spills and bilge releases3 into the Columbia and Willamette River and their impacts on the ecological food chain and critical anadromous fish habitat were not included in the DEIS analyses. The proposed designation of the Lower Willamette River as a superfund site was not mentioned in the DEIS, nor was the designation considered in analyses of DEIS alternatives. We understand that the Corps owns property on the Willamette River that is under consideration as a superfund site,4 but the Corps remains non-committal regarding cleaning up this site. While the

2 Due to the importance of the estuary in the salmon lifecycle, it is essential that any Corps activity in the estuary improve, not degrade, salmon survival.

3 The problem of exotic species being introduced into American harbors is significant, extensive, and costly. On Feb. 4, 1999, the Clinton Administration announced its proposal to almost double spending to address this problem. Scientists estimate that this problem costs the nation approximately $123 billion each year (Oregonian, 2/4/99 at A6). Without question, the Corps' environmental and economic analyses must thoroughly address the hazards from and prevention of introduction of exotic species resulting from releases of bilge water.

4 Due to the problems that are unique to the Willamette that have yet to be addressed, it is important that any dredging activities proposed for the Willamette be dealt with in a separate and subsequent analysis. These issues cannot be

DEIS states that the proposed action will likely entrain toxic sediments, such as DDT, PCBs and heavy metals in the rivers, the overall conclusion of the Corps is that the proposed action will, "...provide ecosystem restoration for fish and wildlife habitats." Entraining toxins, such as DDT PCBs, and heavy metals, onto clay sediments, which stay suspended and easily bond with organic tissue (e.g., fish), is hardly likely to "provide ecosystem restoration."

The impact of the DEIS alternatives on the life histories of salmon was not considered in the DEIS, and the DEIS and the Coordination Act Report only provide the most cursory discussion of the impacts. Species listed and proposed for listing under the Endangered Species Act include Lower Columbia chum and Willamette spring chinook. The impact from the preferred alternative on critical spawning and rearing habitat for these stocks and other listed and non-listed stocks was not adequately developed in the EIS. These serious deficiencies were noted by the Columbia River Estuary Studies Team (CREST) in recent public hearings in Astoria.

The DEIS states that the impacts of in-water disposal of dredge spoils on shallow bays that are vital juvenile rearing and adult holding habitat, "... could have a long term impact on species utilizing these shallow water areas." Yet, the DEIS preferred alternative fails to include this conclusion and instead states that no adverse impacts to fish and wildlife are expected from implementing the preferred alternative.

The DEIS failed to consider the effects of potential improvements to LOADMAX, an existing system that allows for increased shipping opportunities by forecasting river levels and tidal shifts. Contrary to the DEIS perspective, CRITFC believes that it is unlikely to improve the 5-day river forecast because of the forecast uncertainty surrounding Bonneville Dam releases, which control about 85% of the mainstem Lower Columbia flows. However, it is possible to make a 30-45 day guidance forecast, based on the CWS model runs issued by the Corps Reservoir Control Center and NWRFC, which may be beneficial to the shipping schedulers. It does not appear that the Corps considered this possibility.

The DEIS preferred alternative, creating a deeper, wider channel would lead to more ship traffic, more wave action, and more bank erosion. Widening the channel could shrink shallow-water habitat. Sub-marine slopes that would need to have an increased angle of inclination for a deeper channel would be more unstable, and hence, more maintenance dredging would be required than with the present channel conditions. The Corps O & M budget continues to shrink (Corps NWD Water Management Chief Bill Branch, 1999 pers. comm.) creating problems maintaining the existing channel, thus, the 43 foot channel may not be able to be maintained, certainly not at taxpayer expense.

The DEIS failed to examine the impacts on anadromous fish from creation of additional predatory avian habitat. For example, the creation of Rice Island in the Lower Columbia from dredge spoils has created an entire colony of Caspian terns that are consuming thousands if not millions of listed

---

adequately addressed in this EIS process.

and non-listed salmon smolts. 5
The DEIS trivializes the potential effects of underwater blasting on critical habitat and anadromous fish that are present all year in the proposed dredging area. The DEIS fails to adequately estimate the amount of submarine basalt to be blasted because of inadequate surveying.

The no-action alternative, maintaining the 40 foot navigation channel, continues to cause degradation of critical anadromous fish habitat. Given the value and precarious state of Columbia Basin anadromous fish, to provide a full range of alternatives for analysis that is required by NEPA, the Corps should provide an analysis of a no-dredging alternative.

In some ways, we are surprised that this dredging proposal is even being made. While navigation interests have prospered through the dredging and general "taming" of the Columbia River, the salmon, and the tribes that depend upon them, have suffered greatly. Many runs of salmon have been listed as threatened or endangered. Other runs have been extirpated. The tribes' treaty secured right to take fish has been constrained by the federal government's asserted need to minimize salmon mortality, yet here the federal government proposes an action that will harm salmon. The Corps anticipates significant disturbance of both river bottom and river during periods when salmon and other species are either residing or migrating. Placement of dredge spoils will cause further extensive disturbance. The extent of the potential impacts that could result from the proposed dredging is enormous. Yet to rebuild the runs, it is essential that salmon survival increase. It is likely that the sacrifices of the tribes and other fishers will be nullified, not to mention other salmon protection measures, if this dredging proposal is allowed to proceed.6

Specific Comments

Lower Columbia Channel Improvements DEIS, Appendices A-H

Appendix A, Chapter 4—Columbia River State Forecasting Analysis

Sec. 4.1 (Introduction):

The first paragraph presumes a deeper channel is preferred, without offering any alternatives.

Sec. 4.2 (Background)

The second paragraph ignores operational change made by the NWS-NWRFC over a year ago,

---

5 The Portland District, Corps of Engineers has estimated that ESA listed salmon stocks suffered between 6%-25% mortality from avian predators originating on Rice Island (Public Notice Number CENWP-EC-E-98-08 Caspian Tern Relocation, Columbia River, Clatsop County, OR; October 29, 1998).
6 The Corps must also be mindful of impacts to other aquatic species, including those that support fishers in other parts of the river and estuary. Navigation interests should not be allowed to further enrich themselves at the expense of these fishers, either.

where the twice-a-day stage forecast (e.g., 3-day forecast released by 7:30 AM and the 6-day forecast released by 1:30 PM) was replaced by the 1:30 PM six-day forecast.

Sec. 4.3 (Forecast System Limitations)

Whether the NWRFC was consulted for this analysis was not mentioned. The DEIS suggested that the study was incomplete, but we believe this is erroneous.

The third paragraph lists four limitations in the current river stage forecasting system. The Corp's Portland District's analysis indicates a lack of understanding of the DWOPER computer model used by the NWRFC to help generate harbor stage forecasts for points inclusive of Portland to Astoria.

Specific points:

1. Accuracy of the Forecast. No attempt was made to list or understand the limitations. Major controlling factors: diurnal tidal cycle, Bonneville Dam releases and mainstem Willamette flow (40% regulated by 13 Corps projects). Minor controlling factor: local "side" flows from the Lewis, Cowlitz, and Clackamas Rivers. Furthermore, a skilled, but subjective, blending of the current observed stages with forecast stages is applied by the NWRFC forecaster before the forecast is released. Otherwise, unchecked model results may go out to the Corps and Port of Portland (PoP).

Diurnal tide forecasts are obtained from official NOAA- National Ocean Service Tide Prediction Tables. These tables may go out to one year in the future.

Schedulers electronically release the outflow release schedule for BON to NWRFC forecasters. The NWRFC uses the 7 am 3-day BON release schedule when modeling the Willamette River, in coordination with the COE-RCC, and the 1 pm 6-day release schedule for running the DWOPER harbor forecast program. The two release schedules often vary widely. Schedule differences of 5000 to 30,000 cfs are common, due to changes in power marketing. Represent ~85% of the mainstem flow on the Columbia.[7]

The mainstem Willamette flows are 40% controlled by regulatory operations of the COE-RCC and 60% influenced by rapidly developing weather systems- with significant impacts at times. Willamette represents about 10% of the mainstem flow on the Columbia. The Lewis, Cowlitz, and Clackamas flows represent about 5% of the mainstem flow on the Columbia.

Appendix A, Chapter 4—Columbia River Stage Forecasting Analysis

Sec. 4.3 (Forecast System Limitations)

7 One alternative that the Corps should consider would be to see whether management of Bonneville Dam could be used to maintain downstream water levels to alleviate the perceived need to dredge between Portland and Longview.

2. Inadequate Forecast Span. Since the Bonneville Dam releases control about 85% of the total volume of the lower mainstem Columbia, it is very difficult to have a reliable release schedule that goes very far into the future, given all the uncertainties and the dynamic, rapid changes associated with power marketing. Relatively good accuracy of 1-2 days into the future is the best that can be achieved given present restrictions. Thus, the greatly improved forecast system that supports the benefits of the preferred alternative is highly unlikely and the benefits will not materialize.

Appendix A, Chapter 6—Geotechnical Information

Sec. 2 (Methodology), b (Coordination):
No coordination was attempted with CRITFC or any Columbia Basin tribes.

Sec. 4 (Rock Areas and Quantities), d (Slaughters Bar):
From Col. R. Mile 63 to 67, near Longview, blasting is proposed to remove any in-place rock.

Sec. 4 (Rock Areas and Quantities), f (Morgan Bar):
Near Col. R. Mile 101 to 101, blasting is proposed to remove suspected in-place rocks.

Sec. 4 (Rock Areas and Quantities), g (Willamette River):
From Willamette R. Mile 4 to 7½, blasting is proposed to remove suspected in-place rocks.

Sec. 6 (Blasting Information), a (General):
Although blasting did occur in the channel during the 1960's and 1970's, the COE did not keep any records so as to evaluate the geophysical character of the remaining rocks in the channel.

Sec. 6 (Blasting Information), b (Rock Requiring Blasting)

In addition to the above mentioned blasting sites, the DEIS preferred alternative requires blasting at Wauna Bar, Stella Fisher Bar, and Warrior Rock. The Corps admits that they do not know the character of the rock (i.e, is the basalt fractured or massive). This is an important point because massive basaltic rock will require a substantial amount of explosive compared to fractured rock. Hence, the DEIS may easily underestimate the amount of explosives needed. Comprehensive geophysical surveying would be needed to determine the character of the proposed rock to be blasted. The DEIS fails to include the study.

Sec. 6 (Blasting Information), d (Mitigation of Blasting Effects on Fish)

The DEIS states that blast effects will be 10 psi or less, with little substantiation. If the composition of the rock material is denser than that surveyed, many more blasts will be required that will potentially harass or injure anadromous fish. The DEIS fails to include a blasting schedule, thus, whole migrations of anadromous fish could be at risk from this activity.

Appendix H, Volume I Columbia River Ocean Dredge Disposal Sites

A significant concern is the timing of the dredging and proposed disposal in the ocean and estuary on migrating anadromous fish. Because of safety concerns, it appears the best time of year to dredge is limited from May to October, with most of the work performed after July 1st, with 50 - 60 days, 24 hour a day operations (p. 13). On p. A-18, a diagram showing the periods of migrating adults clearly illustrates that summer-time dredging will have enormous impact on the adult salmon.

Exhibit C Fish and Wildlife Coordination Act Report and Impacts of the Proposed Columbia River Channel Deepening Project on Fish and Wildlife Resources

Page 20. There will likely be significant changes to the freshwater and saltwater interface if the preferred alternative is implemented, especially in low flow periods, changed river operations and if weather patterns change as a result of global warming. The DEIS failed to examine these possibilities. The result would be increased movement of the saltwater plume up the river. This will change the temperature and trophic structure of the river. Primary production areas now available for millions of juvenile salmon will be changed, forcing juvenile and adult salmon to change physiological transformations between saltwater and fresh water and cause added impacts to the existing degraded conditions (Sherwood et al. 1990; Bottom and Jones 1990). The constant impacts to estuary trophic structures from maintenance dredging has not been considered in the DEIS. Dredging is counter to the normative river paradigm expressed by the Independent Scientific Group (Williams et al. 1996).

Conclusion

The DEIS appears flawed with respect to considering a full range of alternatives as required by NEPA, including an adequate cumulative effects analysis. Another significant problem is the lack of integration of the alternatives with other significant actions occurring in the basin. These include but are not limited to, hydro-system operations, anadromous fish restoration plans and tribal and international treaties. The preferred alternative in the DEIS will likely cause direct, indirect, and cumulative impacts on treaty reserved resources. Although we do not support any dredging, if the Corps is to continue with considering additional dredging in the lower Columbia River, we strongly recommend that a full scoping for a new DEIS be initiated with full tribal consultation from the onset of scoping.

tribes and the state of Oregon.[2] The catch of chinook and steelhead has been limited due to high water conditions and low returns. Annual catches are generally less than 100. The collection of lamprey, also by agreement between the tribes and the state of Oregon, is several thousand annually.

Although the Willamette Falls fishing area is technically not part of the *U.S. v. Oregon* Columbia River Fish Management Plan,[3] there are other implications of returning Willamette fish on the plan. Under the terms of the plan, the tribes are entitled to 10,000 spring and summer chinook for ceremonial and subsistence purposes. Due to declining upriver spring chinook returns the tribes' catch has been limited and the remainder of the entitlement has come from returns to lower river hatcheries (primarily Willamette River spring chinook hatcheries). The tribal catch at Willamette Falls does count towards the 10,000 fish entitlement. The tribes also take spring chinook from hatcheries on an annual basis for consumption. In some years, the number of hatchery spring chinook taken by the tribes is several thousand.[4]

The Portland Harbor is an important migration corridor and habitat for these and several other treaty protected anadromous and resident fish species. Similarly, the Columbia River mainstem at the confluence of the Willamette River down to the estuary and Pacific Ocean provide critical habitats and migration corridors for the tribes' treaty protected Columbia River Basin fisheries. The migration and ultimate deposit of contaminated Harbor sediments and upstream sediments and pollutants into the mainstem Columbia River and estuary are of great concern to CRITFC's member tribes.

Consequently, the CRITFC tribes have a great interest in assuring that the methodologies, criteria and standards used to define the cleanup site area and the extent and level of remediation are adequate to protect the health of Columbia River tribal members who consume fish from the Willamette and Columbia Rivers or otherwise utilize the Harbor and surrounding areas as well as assure protection of the treaty fishery resource itself.

CRITFC RECOMMENDATIONS TO EPA AND DEQ

In coordination with the tribes, CRITFC provides these recommendations to protect the tribes' human health and natural resource interests, to assure that federal trust obligations to tribes are met and to preserve the tribes' rights as Natural Resource Trustees. CRITFC strongly recommends the following regarding cleanup of the Portland Harbor:

1) The U.S. Environmental Protection Agency list the Portland Harbor on the National Priorities List in accordance with the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)[5]
2) The U.S. Environmental Protection Agency be the lead Agency responsible for overseeing and enforcing site cleanup in accordance with CERCLA[6] and

---

2 Agreement for Tribal Fisheries for Willamette River Spring Chinook, Spring 1994.

3 *U.S. v. Oregon*, Civil No. 68-513-MA. D. OR. Oct. 7, 1988.

4 1996 All Species Review, Columbia River Fish Management Plan. *U.S. v. Oregon*, Technical Advisory Committee, Table 1, Spring Chinook section, August 4, 1997.

5 42 U.S.C.A. § 9605 (1980).

6 42 U.S.C.A. § 9601 to 9675 (1980)

3) The Oregon Department of Environmental Quality and the U.S. Environmental Protection Agency continue to coordinate efforts to expedite cleanup of contaminated Harbor sediments and sites in accordance with CERCLA.[7]

The following discussion supports CRITFC's recommendations. These three recommendations will not change even if the PHSMP were to meet all of EPA's requirements. CRITFC supports a federal cleanup under federal law. Furthermore, since CRITFC recommends that DEQ and EPA work cooperatively to address local and regional issues, CRITFC's specific comments on issues raised in the PHSMP are intended to apply equally to a federal cleanup process and should not be construed as CRITFC's recommendations for meeting state deferral requirements. CRITFC intends for EPA to adopt these comments in its coordination with the state to develop a cleanup strategy that is consistent with federal trust obligations, protective of tribal health and treaty protected resources and will overall, be the most protective of human health and the environment.

DISCUSSION

To justify an EPA decision to grant the state a deferral in the cleanup process, DEQ's PHSMP must address several deferral criteria as identified by EPA[8]: 1) the site area must be greater than the immediate 6 miles of the Harbor currently under site assessment the; 2) state must have the authority and resources to conduct a CERCLA level-of-protection investigation and clean up of the Harbor; 3) an enforcement strategy against responsible parties to implement clean up; 4) financial support for community involvement and; 5) preservation of the rights of Federal Natural Resource Trustees.

INDIAN TREATY RIGHTS

Regardless of these state requirements, the U.S. Constitution states that treaties with Indian tribes and the United States are like treaties with any other foreign nation and are the "Supreme law of the land,"[9] that cannot be abrogated without specific Congressional action. Furthermore, courts have concluded that the tribes' treaty right to take fish includes the right to have fish to take[10] and that the treaty right to take fish would be meaningless if the fish resource were permitted to diminish because of industrial development and pollution.[11] More specifically, the courts have

---

7 42 U.S.C.A. § 9621(f)(1980)

8 Letter from Chuck Clarke, Administrator, U.S. EPA Region 10 to Langdon Marsh, Director, Oregon DEQ, March 10, 1999.

9 United States Constitution, Art. VI, cl.2.

10 Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n, 443, 678 (1979).

11 United States v. Washington, (Phase II), 759 F.2d, 1353 at 1367,1370 (1985), where the issue of environmental right to adequate fish habitat was dismissed without prejudice). *See*, United States v. Washington (Phase I), 520 F.2d 676, 685 (9th Cir. 1975). *See also*, United States v. Winans, 198 U.S. 371 (1905); Confederated Tribes of the Umatilla Indian Reservation v. Callaway, No. 72-211 (D.Or. August 17, 1973); Confederated Tribes of the Umatilla Indian Reservation v. Alexander, 440 F.Supp. 533, 555-556, (D.Or. 1977); Muckleshoot Indian Tribe v. Hall, 698 F.Supp. 1504, 1515-1517, Wash. 1988).

affirmed that the treaty right to take fish also secured to the tribes the continued existence of those biological conditions necessary to support the fish that are the subject matter of the treaties.[12] Thus, the courts have directed federal agencies to use their authorities in such a way that will protect and not degrade treated protected fish habitat.

FEDERAL TRUST RESPONSIBILITY

As a federal agency, the U.S. EPA must use its authority in accordance with the federal trust responsibility. Originating in Cherokee Nation v. Georgia,[13] the federal trust responsibility is a special relationship between the United States and Indian tribes. In Cherokee Nation, the Supreme Court framed this relationship by describing Indian tribes as "domestic dependent nations," and further described the tribes' relation to the United States as resembling that of a "ward to his guardian."[14] This federal trust responsibility laid the foundation for federal Indian law and continues to require federal agencies to adhere to strict fiduciary standards in their relationship with Indian tribes.[15]

In situations such as the development of sediment quality criteria for water bodies that are off tribal reservations and are part of the tribes' treaty guaranteed fishery, the court in Northern Cheyenne Tribe v. Hodel[16] accurately described the federal duty by stating that, "a federal agency's trust obligation to a tribe extends to actions it takes off a reservation that uniquely impact tribal members or property on a reservation."[17] In Northern Cheyenne, the Secretary of Interior attempted to prevent its coal leasing Environmental Impact Statement from being invalidated by alleging that the Secretary did not have to consider the impacts such coal leasing would have on the tribe and that the decision to lease the coal was in the "national interest" and "vital to the nation's energy future."[18] The court further stated:

> The Secretary's conflicting responsibilities and federal actions taken in the "national interest," however, do not relieve him of his trust obligations. To the contrary, identifying and fulfilling the trust responsibility is even more important in situations such as the present case where an agency's conflicting goals and responsibilities combined

---

12 Kittitas Reclamation District v. Sunnyside Valley Irrigation District, 763 F.2d 1032 (9th cir. 1985); United States v. Adair, 723 F.2d 1394 (9th Cir. 1984).

13 30 U.S. (5 Pet.) 1 (1831).

14 *Id.* at 17.

15 *See* United States v. Creek Nation, 295 U.S. 103 (1935). *See also*, Northern Cheyenne Tribe v. Hodel, 12 Indian L. Rep. 3065, 3070-71 (D. Mont. 1985).

16 12 Indian L. Rep. 3065, (D. Mont. 1985).

17 *Id.* at 3071.

18 *Id.*

with political pressure asserted by non-Indians can lead federal agencies to compromise or ignore Indian rights.[19]

Accordingly, in developing cleanup standards, especially risk-based standards, and oversight leadership for remediation of contaminated sites in the Portland Harbor, the U.S. EPA must uphold this standard and give full consideration to Indian treaty rights and resources. For the Columbia River tribes, this equates to giving full consideration to and accounting of the tribes' treaty right to take fish and to take fish that are safe to eat. Indian tribes with treaty protected resources should be afforded the greatest protection under federal agency policies.

EPA cannot defer these trust obligations to any state. A state deferral for cleaning up the Portland Harbor will place treaty guaranteed rights and federal trust obligations at Oregon's discretionary authority. Indeed, the protection of tribal interests and treaty resources should be implemented beyond a state's general and discretionary policies regarding Indian tribes and treaty resources. The state's discretion is exemplified in the fact that the state's PHSMP does not address how tribal governments will be involved or coordinated with.

EPA has an obligation to maintain government-to-government relations with Indian tribes when implementing federal environmental laws and environmental management programs, including cleanup efforts and deferral decisions under CERCLA. In addition to federal and Constitutional law, EPA's 1984 policy states that:

> In keeping with the principle of Indian self-government, the Agency will view Tribal Governments as the appropriate non-federal parties for making decisions and carrying out program responsibilities affecting Indian reservations, their environments, and the health and welfare of the reservation populace. [20]

The CRITFC tribes are ceremonial, subsistence and commercial fishers who consume significantly more fish than the average individual.[21] Exposure to toxic chemicals from consuming contaminated fish is of specific concern to the Columbia River tribes, their environments and the health and welfare of tribal members. The development of cleanup standards requires the EPA to consult with the tribes on a government-to-government basis and to adhere to principles of treaty rights and honor its federal trust responsibility to the tribes.

---

19 *Id.* (citations omitted).

20 EPA Policy for the Administration of Environmental Programs on Indian Reservations, November 8, 1984. *See also*, President Clinton, "Memorandum on Government-to-Government Relations with Native American Tribal Governments", 59 Fed. Reg. 85 (1994).

21 A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin, CRITFC Technical Report 94-3, October 1994.

RIGHTS OF NATURAL RESOURCE TRUSTEES AND TRIBES

Responsible parties are liable to tribes for destruction of natural resources.[22] With a state deferred cleanup, the rights of Federal Natural Resource Trustees, such as tribes, becomes questionable and uncertain.[23] Whereas Federal law requires EPA to coordinate with Trustees and tribes on coordinating assessments, investigations and planning of site cleanup, the state deferral would ideally require State-trustee/tribal MOUs to assure Trustee/tribal rights are preserved. Although such MOUs with tribes should preserve tribal rights by describing the tribe's government-to-government relationship in all aspects of the site assessment and cleanup as well as assure tribal participation by providing necessary funding DEQ is not obligated to assure this. Indeed, DEQ recognizes the need for funding to support tribal participation, but is non-committal in assuring funds are available. An MOU arrangement with the state will not hold the force and effect of direct federal responsibilities to tribes.

DEFINING THE CLEANUP SITE

DEQ defines "site" as a current or future cleanup site that may extend to any other portion of the river where contaminants released from the site could come to be located.[24] Despite this and EPA's requirement, DEQ is focusing the PHSMP on only the 6 mile stretch of the Portland Harbor as the "Harbor area" or "site." "Reference areas" will include locations within the lower Willamette River from Willamette Falls (RM 26.6) to the Columbia River confluence at RM 0, excluding the Harbor area or the Columbia River itself, that are presumably unaffected by site-related contaminants. DEQ cannot presume that downstream areas are unaffected by Harbor sediments. Harbor sediments move downstream to the mainstem Columbia River, the lower estuary and the Pacific Ocean.[25]

In violation of the federal Clean Water Act and CERCLA, EPA and DEQ have allowed levels of toxic pollutants in toxic amounts into the Willamette and Columbia Rivers. The Great Lakes was an important lesson[26] and the tribes do not want the Columbia River to be next. Portland Harbor contaminants are not stationary, nor are the migratory fish species that use the Harbor. In fact, numerous state and federal studies have consistently documented unacceptably high level of dioxins, furans, heavy metals, organochlorine pesticides, PCBs, DDT and radionuclides throughout the Columbia River Basin.[27] Clearly, federal and state permitted pollution by

---

22 42 U.S.C.A. §9607 (f)(1) (1980)

23 Letter from Chuck Clarke, Administrator, U.S. EPA Region 10 to Langdon Marsh, Director, Oregon DEQ. March 10, 1999.

24 Oregon Administrative Rules (OAR) 340-122-115 (26), (34), 1997.

25 Dredging in the Portland Harbor, Portland-Vancouver Metropolitan Area. Water Resources Study, U.S. Army Corps of Engineers, Portland, Oregon, 1979. See the PHSMP, Appendix G, page G-24.

26 Kyle, Amy D., *Contaminated Catch, The Public Health Threat from Toxics in Fish*, Natural Resources Defense Council, April 1998, Table A-10, pgs. 123-150. The report identifies all of the Great Lakes as having fish consumption advisories issued for one or more of the following substances: mercury; PCBs;chlordane; DDT; dieldrin; dioxins.

27 Oregon Department of Environmental Quality. 1992. Oregon's 1992 Water Quality Status Assessment Report, 305 (b) Report. Portland, Oregon, April 1992. *See*, Tetra Tech. 1993. *Reconnaissance Survey of the Lower Columbia River. Task 6: Reconnaissance Report. Vol. 1*. *See*, U.S. Environmental Protection Agency, Region 10. (1992). *Columbia River Water Quality Summary Report*. Portland, Oregon, June 26, 1992. *See*, U.S. Environmental Protection Agency. (1992). *National Study of Chemical Residues in Fish, Volumes 1 and 2*. USEPA 823-R-92-008. Office of

industrial sources and land use practices continue to pollute the Columbia River Basin environment in violation of the Clean Water Act. In addition to the Harbor industries, other sources include stormwater and combined sewer overflow outfalls, pulp and paper mills, aluminum plants, land use practices, especially pesticide and herbicide applications and;nuclear wastes.

CRITFC requests DEQ to expand the geographic scope of the site assessment and potential cleanup to include upstream areas, including at least Willamette Falls and areas downstream of Harbor facilities, including the lower portions of the Willamette River, and the Columbia River. Additional sediment analysis should be obtained from the Columbia River at areas upstream of the confluence and downstream to the estuary and immediate portions of the Pacific Ocean. Contaminant problems in the Columbia River from Harbor pollutants would require a bi-state effort with Washington. A bi-state effort may create a less centralized more bureaucratic cleanup effort than would be experienced under EPA's centralized lead. Addressing upstream areas will assist in source identification and provide information on contaminant fate and transport.

ENVIRONMENTAL JUSTICE and TRIBAL FISH CONSUMPTION

Regarding tribal fish consumption, DEQ states that a tribal subsistence scenario is not proposed for the Portland Harbor because:

> "there are no known tribal fisheries within the Harbor area. However, should such a scenario be deemed appropriate, tribal consumption rates for the region should be estimated from a study of consumption rates among Columbia River tribes (CRITFC, 1994[28]; Harris and Harper, 1997[29]), although it is likely that these studies would greatly overestimate tribal fishing within the relatively industrialized Portland Harbor area. However, tribal consumption rates in the Pacific Northwest (CRITFC, 1994; Toy et al., 1996[30]) are similar to those of other shoreside anglers included in consumption surveys (e.g., Landolt et al., 1987[31]). Therefore, tribal fishermen would likely be protected by the subsistence exposure scenario described above."[32]

Science and Technology, USEPA, Washington, D.C., September, 1992. *See*, U.S. Geological Service. 1993. *Persistence of the DDT Pesticide in the Yakima River Basin, Washington - National Water Quality Assessment.* U.S. Government Printing Office, Washington, D.C. *See*, Washington State Department of Ecology. 1992. 1992 Statewide Water Quality Assessment. 305(b) Report. Publication #92-04.

28 CRITFC. A Fish Consumption Survey of the Umatilla, Nez Perce, Yakama, and Warm Springs Tribes of the Columbia River Basin. Columbia River Inter-Tribal Fish Commission. Portland,OR. Technical Report 94-3 (1994)

29 Harris, S. and B.L. Harper A Native American Exposure Scenario. *Risk Analysis* 17(6):789-795, 1995

30 Toy, K.A., N.L. Polissar, S. Liao, and G.D. Mittelstaedt. A Fish Consumption of the Tulalip and Squaxin Island Tribes of the Puget Sound Region, 1996.

31 Landolt, M., D. Kalman, A. Nevissi, G. van Belle, K. Van Ness, and F. Hafer, Potential Toxicant Exposure among Consumers of Recreationally Caught Fish from Urban Embayments of Puget Sound. NOAA Technical Memorandum NOS OMA 33. Rockville, MD. 1987.

32 PHSMP, Appendix G, page G-116.

CRITFC requests that the CRITFC fish consumption survey and the Harris and Harper tribal fish consumption studies be used to adequately develop a tribal consumption scenario for the purpose of developing target fish tissue levels intended to be protective of the health of tribal members. CRITFC and the tribes should be requested to provide additional information on how best to utilize these studies to further determine the geographic scope of the cleanup site and contaminants of concern.

Furthermore, CRITFC requests that determinations made regarding tribal fish consumption be wholly consistent with federal trust obligations and federal and state environmental justice policies.

The United States government has appropriately recognized widespread violations of Title VI of the Civil Rights Act of 1964[33] in the development and implementation of environmental programs. Title VI states that:

> No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.[34]

Title VI applies to state programs supported by federal funding, such as state administration of the Clean Water Act and development of sediment criteria. Title VI directly prohibits intentional discrimination but also protects against discriminatory *effects* from seemingly neutral regulations and policies.

In his 1994 Executive Order entitled, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,"[35] President Clinton highlighted the United State's commitment to upholding Title VI specifically for Federally-funded programs that affect human health or the environment. Under section 4-4 of this Executive Order, President Clinton specifically identifies the need to evaluate human health risks from subsistence consumption of contaminated fish and wildlife.[36]

Clearly, the United States has recognized EPA's obligation under Title VI and President Clinton's Executive Order to prevent discriminatory effects to subsistence fish and wildlife consumers. For the Columbia River tribes who are subsistence fishers, and who consume significantly more fish than the general population, from waters known to be overly contaminated with highly toxic pollutants, EPA has a duty under principles of tribal sovereignty, treaty rights, federal trust responsibility and the EPA's own policies to give full consideration to tribal consumption data

33. Civil Rights Act of 1964, Pub. L. No. 88-352, Title VI, Sec. 601, 78 Stat. 252 (1964).

34. *Id.*

35. Exec. Order No. 12898, 59 Fed. Reg. 7629-7633 (1994).

36. *Id.*

and to consult with the tribe on a government-to-government basis before making risk management decisions under CERCLA.

FISH IMPACTS and ENDANGERED SPECIES

Emerging evidence on the uptake of chemicals by juvenile salmon[37] and egg fry[38] as well as adverse impacts to returning adults[39] dictates continued examination of impacts to salmon from toxic substances.[40] CRITFC greatly supports further examination of impacts to juvenile salmonids from exposure to toxic contaminants and requests that DEQ keep CRITFC informed regarding the development of a technical work group to examine these type of impacts.

DEQ does not adequately address how endangered and threatened species will be protected by the state's proposed cleanup plan. Under section 7 of the Endangered Species Act,[41] EPA would have to consult with the National Marine Fisheries Service (NMFS) on the impact the cleanup would have on endangered and threatened species.

CRITFC requests that a comprehensive analysis been done to assure that endangered and threatened species are not adversely impacted. CRITFC also proposes that an EPA decision to defer cleanup to the state is a major federal action as defined under the National Environmental Policy Act (NEPA) and would require an Environmental Impact Statement.[42]

DEQ REGULATORY AUTHORITY

Regarding DEQ's authority and resources to implement a CERCLA level investigation and cleanup and the inclusion of adequate enforcement strategies, DEQ will be guided by Oregon's 1987 Environmental Cleanup Law.[43] As a general consideration, the current condition of the Portland Harbor is evidence that DEQ has not adequately implemented and enforced existing environmental and cleanup laws. The historical loading of pollutants has not been adequately addressed by DEQ. Although many sites are no longer in operation, DEQ has not pursued an aggressive clean up strategy, and in some cases, on-site stockpiles of contaminants remain. DEQ

---

37 McCain, B.B., D.C. Malins, M.M. Krahn, D.W. Brown, W.D. Gronlund, L.K. Moore, and S-L Chan, "Uptake of Aromatic and Chlorinated Hydrocarbons by Juvenile Chinook Salmon (*oncorhynchus tshawytscha*) in an Urban Estuary." Arch. Environ. Contam. Toxicol. 19, 10-16 (1990). *See*: "Proceedings of the Roundtable on Contaminant-Caused Reproductive Problems in Salmonids," edited by Michael Mac, International Joint Commission, Great Lakes Science Advisory Board's Biological Effects Subcommittee of the Ecological Committee, Windsor, Ontario, Sept. 24-25, 1990.

38 Raloff, Janet, "Those Old Dioxin Blues." Science News, Vol. 151, pgs. 306-307, May 17, 1997.

39 Arkoosh, Mary R., Demundo Casilla, Ethan Clemons and Anna N. Kagely, Robert Olson and Paul Reno, John E. Stein, "Effects of Pollution on Fish Diseases: Potential Impacts on Salmonid Populations," Journal of Aquatic Animal Health 10:182-190, 1998. Also, Damkaer, David M. and Douglas B. Dey, "Evidence of Fluoride Effects on Salmon Passage at John Day Dam, Columbia River, 1982-1986." North American journal of Fisheries Management 9:154-162, 1989.

40 Ewing, Richard D., Diminising Returns: Salmon Decline and Pesticides, Oregon Pesticide Education Network, Feb. 1999

41 16 U.S.C.A. § 7 (1973).

42 42 U.S.C.A. § 4332 (C) (1969)

43 Oregon Revised Statutes (ORS) 465-200 et. Seq.) 1987.

regulatory complacency against Harbor facilities, CRITFC points to the fact that Rhone Poulenc, a pesticide manufacturer from 1943-1990, entered into a consent order with DEQ in 1989. After eight years, Rhone Poulenc accomplished nothing as agreed. DEQ finally terminated the consent order in 1998 after eight years of regulatory complacency against a known violator.[43]

Cleanup under both CERCLA and the state's Environmental Cleanup Law are risk-based. Under CERCLA, selection of cleanup remedies is based on the National Contingency Plan (NCP)[44]. CRITFC is favorable to the federal process under the NCP, which requires that remedies meet two criteria: 1) overall protection of human health and the environment, and 2) compliance with applicable or relevant and appropriate requirements (ARARs) such as the Safe Drinking Water Act and the Clean Water Act. CRITFC recommends EPA and DEQ coordinate to assure that the risk-based standards used in the cleanup are the most protective of human health and the environment, be it a state or a federal standard or criteria.

Regarding coverage of petroleum and oil,[45] which is a prevalent contaminant in the Harbor, DEQ's stated advantage is misleading. The Oil Pollution Act of 1990,[46] which allows for remediation, compensation and liability for oil and petroleum substances, applies regardless of CERCLA's exclusion.

DREDGING

The State of Oregon has a great economic interest in and bias toward dredging. This is evident in their description of objectives for protecting the benthic community and supporting commercial activity in the Harbor:

> A healthy benthic community is a protected beneficial use. Clean sediment (i.e., those that do not restrict dredging or other commercial activities) can be identified by a lack of response in the benthic invertebrate community to contaminants in sediment. Dredging is a necessity to maintain the commercial viability of Portland Harbor. However, the presence of contaminated sediments in a working, urban harbor can greatly increase the complexity and cost of routine maintenance dredging, and may, in extreme cases, prevent dredging all together. Contaminated sediments may also adversely affect dredging for new construction or other capital improvement projects. Contaminated sediment impairs beneficial uses in the Harbor by directly impacting the benthos and by potentially placing restrictions on dredging activities, as well as adding costs to agriculture (e.g., through increased shipping charges for bulk commodities) and industry.[47]

---

[43] PHSMP. Appendix E. page E-11

[44] Comprehensive Environmental Response. Compensation and Liability Act (CERCLA). 42 U.S.C.A. § 9605 (1980).

[45] ORS 340-122-115 (30)(c) (1997).

[46] Oil Pollution Act of 1990. 33 U.S.C.A.§ 2701 to 2761 (1990).

[47] PHSMP. Appendix G. page G-35.

DEQ further states that dredging in the lower Willamette River has been a commonplace historical activity and "will be an ongoing necessity for the foreseeable future."[48] Statements such as these do not allow for much consideration of non-dredge options. Furthermore, DEQ identifies three activities that will result in increased resuspension of contaminated sediments: 1) high flows 6 months of the year (Nov.- April); 2) ship and vessel traffic, and 3) dredging. Ship and vessel traffic and dredging are commonplace occurrences in the Lower Willamette and Columbia Rivers and therefore, resuspension of contaminated sediments will likely occur on a regular basis, making those contaminants bioavailable to the aquatic environment.

It appears that DEQ is not adequately coordinating with proposed Corps dredging activities other than to assure that Corps activities are not impeded. All issues related to cleaning up the Portland Harbor must be fully addressed before any future Corps dredging activities are approved in the Harbor or in upstream/downstream areas, including the Columbia River.

CRITFC recognizes the importance of coordinating the PHSMP with the Corps of Engineers' proposed dredging activities for the lower Willamette and Columbia Rivers and incorporates by reference, CRITFC's comments on the draft EIS for that dredging project (Attachment A) and the U.S. Fish and Wildlife Service's (USFWS) draft Coordination Act Report (Attachment B). In particular, the Corps' EIS and the USFWS' draft Coordination Report do not address the environmental impacts from dredging sediments contaminated with toxics.

REMEDIAL OPTIONS

CRITFC supports remedial options that will result in long-term remediation and clean up of a site. Sediments containing hazardous substances should be properly disposed of in a permitted hazardous waste landfill. No remediated sediment should be disposed of in such a way that those sediments will re-enter the aquatic environment nor should they be "re-cycled" into other land or industrial uses. CRITFC does not support short-term options such as "capping" contaminated sediments with clean sediments. CRITFC does not support natural recovery or biodegradation options for sediments contaminated with persistent, bioaccumulative toxics or those toxics that breakdown into more persistent, bioaccumulative toxics.

To the CRITFC tribes, the state of the Willamette and Columbia Rivers is symptomatic of inadequate implementation of good environmental laws that have existed for decades, but have been hindered by economic interests and endless scientific debate. The continued emissions of persistent, bioaccumlative toxics must end and contaminated areas must be cleaned up with long-lasting solutions, not short term and "cost-effective" ones. EPA has adequate scientific evidence and authority to support these regulatory cleanup actions.

CRITFC supports a "no acceptable risk" and "zero emission" policy on bioaccumulative, persistent toxic substances, especially into fish bearing waters. Consequently, CRITFC calls upon the DEQ and EPA to implement direct regulatory action that eliminates further discharges of these substances into the Willamette and Columbia River systems. Because a CERCLA level problem exists in the Harbor, EPA and DEQ should place an immediate emission moratorium on those Harbor industries that continue to emit toxic substances into the Harbor. EPA and DEQ

---

48 PHSMP. Public Draft. page 85.

need to implement pollution prevention policies and technologies that will prevent the release of persistent, bioaccumulative toxics.

CRITFC maintains that risk assessments have no useful purpose for making regulatory decisions for persistent, bioaccumlative toxics, known carcinogens, "probable human carcinogens," and substances known to cause reproductive, developmental or neurological effects. The science is always debatable and risk assessment involves inherent uncertainties. CRITFC recognizes that for those substances that do not meet any of these effects criteria, risk assessment methodologies should be conservative and as protective of human health as possible. Thus CRITFC's comments related to risk assessment are made in context of this position. Furthermore, CRITFC disagrees with DEQ's interpretation of chemistry and bioassay results such that no further assessment will be done on those contaminants in sediment that are not bioaccumulative.[49] Impacts to the benthic community should be assessed in relation to the level of contamination. Non-bioaccumulative contaminants may have adverse effects in high concentrations.

In 1990, the Yakama Indian Nation passed a resolution calling for the elimination of organochlorine pollution by the pulp and paper industry.[50] Because tribal members are and will be one of the ultimate receivers of the environmental and biological fate and transport of persistent, bioaccumulative toxics, CRITFC urges EPA and DEQ to stop balancing human health and the environment with risk management and cleanup decisions tainted by economics and politics.

Many highly toxic chemicals, especially organochlorines, do not remain in the water column but "separate" into the sediment and bind to organic matter in the aquatic environment and are subsequently uptaken through the food chain. Therefore, EPA and DEQ must develop sediment quality guidelines and these must be protective of tribal and other sensitive populations that are exposed to those sediments in ways the general population may not be.

Multiple exposures to multiple chemicals must, at a minimum, be considered additive, and the presence of persistent bioaccumlative toxics needs to be factored in when assessing multiple chemical exposures from different or same sources. EPA should use the best science on synergistic impacts from exposure to a combination of chemicals. Sensitive sub-populations, such as the Columbia River tribes, may have significant confounding, underlying health problems that must be recognized with any synergistic assessment.

In sum, EPA must maintain government-to-government relations with Indian tribes when implementing federal environmental laws and environmental management programs, including CERCLA. CRITFC urges the EPA to adhere to principles of treaty rights and honor its federal trust responsibility to the tribes in considering its decision to defer cleanup of the Portland Harbor to the State of Oregon.

---

49 PHSMP. Appendix G. Table G-4, page G-38.

50 Yakama Tribal Council Resolution T-40-90, January 18, 1990.

CRITFC believes that the state's PHSMP does not adequately address the following criteria as required by EPA:

- Preservation of the tribes' treaty rights and federal trust obligations.
- Preservation of Federal Natural Resource Trustees.
- Protection of endangered and threatened species
- Adequate expansion of the site area beyond, upstream and down stream of the immediate 6 miles of the Harbor currently under site assessment.
- An enforcement strategy against responsible parties to implement clean up.
- Financial support for community and tribal involvement.
- Resources to conduct a CERCLA level-of-protection investigation and clean up of the Harbor.
- Coordination with Corps of Engineers dredge projects.
- Management options that do not include dredging.

For these reasons, CRITFC urges the U.S. EPA to list the Portland Harbor as a Superfund Site under CERCLA and that the U.S. EPA maintain lead jurisdiction over the cleanup, with continued coordination with DEQ. CRITFC supports a federal cleanup under federal law and intends for EPA to adopt these comments in its coordination with the state to develop a cleanup strategy that is consistent with federal trust obligations, protective of tribal health and treaty protected resources and will overall, be the most protective of human health and the environment.

Respectfully Submitted,

Donald Sampson
Executive Director

Cc: Chuck Clarke, Administrator, U.S. EPA Region 10

Enclosure

IMPACTS OF THE PROPOSED COLUMBIA RIVER CHANNEL DEEPENING PROJECT ON FISH AND WILDLIFE RESOURCES

Kathleen Larson
June 1999

Prepared for the Portland District
U.S. Army Corps of Engineers
by the
Oregon State Office
U.S. Fish and Wildlife Service

PREFACE

This is the Fish and Wildlife Service's detailed report on fish and wildlife resources affected by the proposed Columbia River Channel Deepening Project which exends from River Mile 3 to River Mile 105 on the Columbia River and for 11 miles upstream from the mouth of the Willamette River to about the Broadway Bridge. This project is being studied under General Investgation authority, House Document 452, 87th Congress, 2nd Session.

Analysis of project impacts is based on: 1) project information and engineering data received as of February, 1999; 2) an appraisal of existing resources of the area; and 3) an economic project life of 50 years. It should be noted that the proposed project may be subject to permits over which the Fish and Wildlife Service has review responsibilities. Accordingly, our comments do not preclude an additional and separate evaluation by the Service, pursuant to the Fish and Wildlife Coordination Act (16 U.S.C., et seq.), if eventual project development requires a permit from the U.S.Army Corps of Engineers under Section 10 of the River and Harbor Act of 1899 or Section 404 of the Clean Water Act. All such permits are subject to separate review by the Service under existing statutes, executive order, memorandum of agreement, and other authorities. In review of permit applications, the Fish and Wildlife Service may concur, with or without stipulations, or object to the proposed work depending on specific construction practices which may impact fish and wildlife resources. The permit applicant must also apply for and obtain any additional authorizations from other local and state public agencies prior to constructing the project.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

DESCRIPTION OF THE AREA

43-FOOT CHANNEL ALTERNATIVE

The proposed 43-foot channel alternative extends from about river mile (RM) 3 to 105 taking in the Columbia River Estuary and terminating near the Port of Vancouver. The Columbia River is the second largest river in North America, draining about 258,000 square miles. The Columbia River Estuary (Figure 1) is a drowned river valley but, unlike most estuaries, it is primarily freshwater in nature due to the tremendous influence of river flows.

The climate of the estuary is humid, marine temperate, and is characterized by wet, rainy winters and cool summers. The average rainfall for the estuary is between 80 and 120 inches, with most of the rain falling between November and February.

The Columbia Estuary is bordered by the Willapa Hills of Washington on the north. The Willapa Hills are part of the Coast Range which consists of low hills with heights up to 2,000 feet. To the south, the estuary is bounded by the Oregon Coast Range and the Clatsop Plain, a low area extending along the coast. The Pacific Ocean lies to the west with low sand dunes on the Oregon side and headlands on the Washington side.

Tidal influence extends to Bonneville Dam at RM 145, but the saltwater wedge does not go far beyond RM 20. The upriver estuarine boundary is considered to be the downstream end of Puget Island located at approximately RM 38 (Figure 1). Upstream of Puget Island, the Columbia narrows and becomes more riverine in character.

The estuarine shoreline in both states consists of rocky forested cliffs and low wet floodplain areas which have been diked. A number of minor creeks and rivers with small drainage basins enter the estuary from both shores, but, because of their small size, they do not have much influence on the river. The Columbia River flow averages 273,000 cfs, with a former unregulated minimum of 79,000 cfs and maximum flood flows of over 1 million cfs. Peak flows occur during winter storm events. Spring freshets, once a major source of flooding, are now controlled by upriver dams and occur for longer periods with a lower peak. Late summer and fall flows are generally higher and slower due to regulation and river water is a few degrees warmer.

The Columbia River plume extends northward along the Washington coast to about 49 degrees north latitude during the fall and winter and south to the California border and west to 130 degrees west longitude in the spring and summer. Surface waters of the plume are characteristic of the estuary while the bottom waters are more like the ocean.

Major industries in the estuarine area include forest products, fishing, and tourism. There is a small agricultural industry, limited primarily to commercial cranberry bogs around Baker Bay, and to raising beef and dairy cattle on diked lands (former marsh and swamp lands).

There are five ports serving the estuary: Ilwaco and Chinook in Pacific County (Washington), two port districts in Wahkiakum County (Washington), and the Port of Astoria in Clatsop County (Oregon). The largest town in the Columbia River Estuary area is Astoria with over 10,000 people. The ports of Longview, Kalama, Woodland, and Vancouver in Washington and the ports of St. Helens and Portland in Oregon serve the upriver areas. The Portland-Vancouver area is the largest metropolitan area within the project boundary.

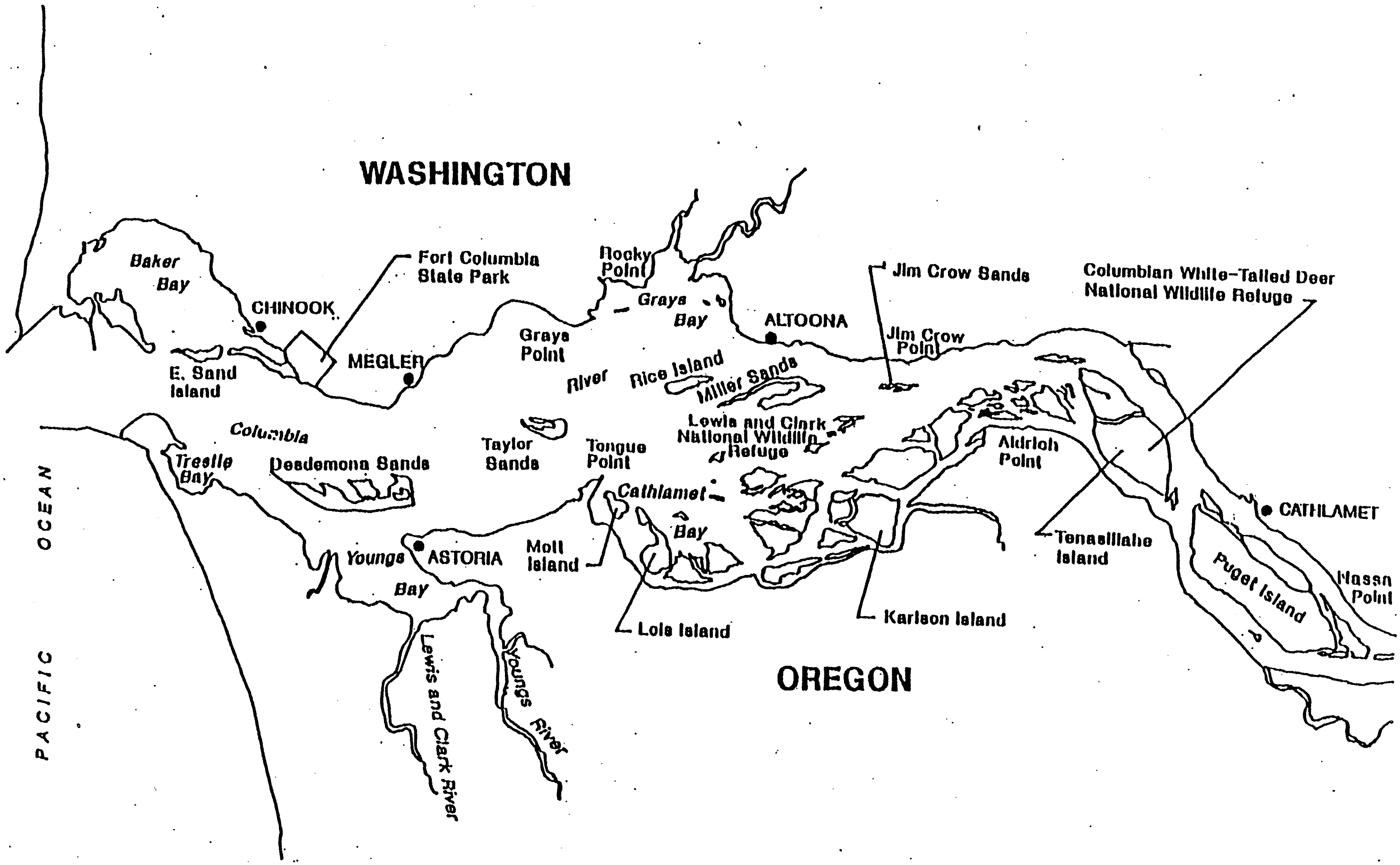


Figure 1. The Columbia River Estuary

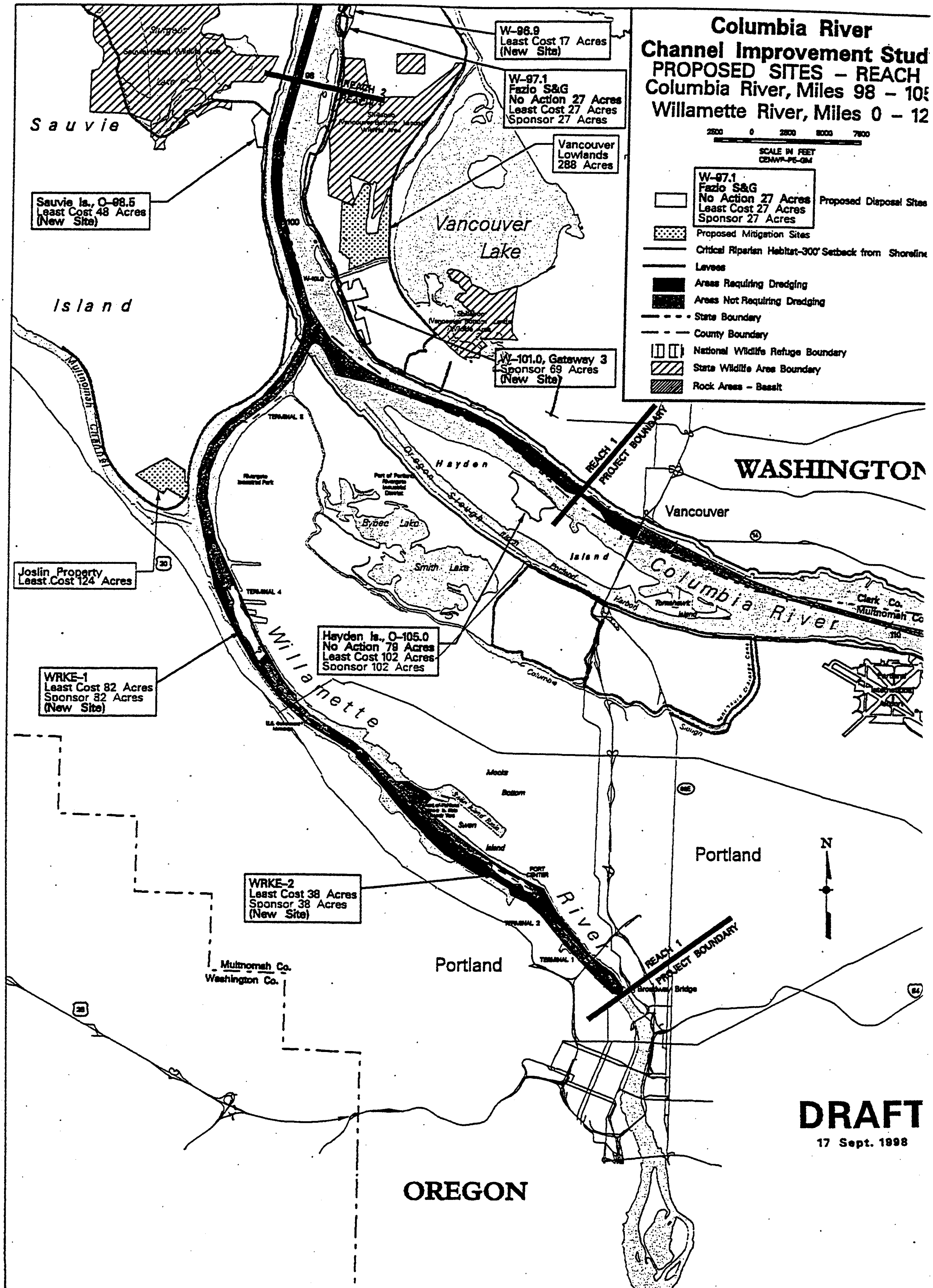
The Julia Butler Hansen Columbian White-tailed Deer and Lewis and Clark National Wildlife Refuges are located within the estuarine boundaries. The Lewis and Clark Refuge occupies much of the eastern end of the estuary and includes the marsh islands of Cathlamet Bay. The Ridgefield National Wildlife Refuge Complex is located adjacent to the project's upstream riverine boundaries. Under the Endangered Species Act, the project area lies within designated critical habitat for listed Snake River sockeye and chinook salmon. The project area also encompasses the boundaries of the lower Columbia River National Estuary Program.

The topography of the riverine portion of the proposed project does not vary significantly. The Columbia River floodplain consists of alluvial material. The river's shoreline and adjacent lands have been diked and developed extensively for agricultural and industrial development as well as for commercial and residential uses. There are 43 diking districts on the lower Columbia River located along the Oregon and Washington shorelines downstream of the Willamette River. Some of these diking districts have been added to and made part of existing refuges (including Service refuges) and wildlife management areas under State jurisdiction (Sauvie Island, e.g.). There are 49,652 acres of diked lands in Oregon and 35,128 acres in Washington for a total of 84,780 acres. Establishment and operation of these diking districts has resulted in significant habitat changes over the last century. Studies by Graves et al (1995) and by the Corps of Engineers (1996) have shown a historic loss of about 52,000 acres of wetland/marsh and about 27,000 acres of forested wetland habitat in this time period, much of it attributable to the diking of floodplains and the resultant urban development that has occurred along the lower Columbia River. The development of approximately 58,000 acres of land for agriculture has also led to the loss of fish and wildlife habitat along the lower Columbia River. This agricultural development, in conjunction with urban development, has also been occasioned by the construction of dikes. Riparian forests consisting of cottonwood and ash/broadleaf forests have declined by approximately 13,800 acres, primarily, too, as a result of floodplain conversion to agricultural and urban lands. Loss of these habitats has had a broadscale impact on fish and wildlife resources associated with the lower Columbia River. The primary impact has been a reduction in detrital export and energy flow from these habitats to the river because of the elimination of intertidal inundation and regular flooding of floodplain lands. This reduction in energy exchange has impacted waterfowl, resident neo-tropical and migrant passerines, shorebirds, raptors, small mammals, aquatic furbearers, amphibians, reptiles, and resident and anadromous fish. Tables listing the diking districts along the lower Columbia River and comparing habitat from the 1880s versus 1991 habitat acreages are contained in Appendix 1.

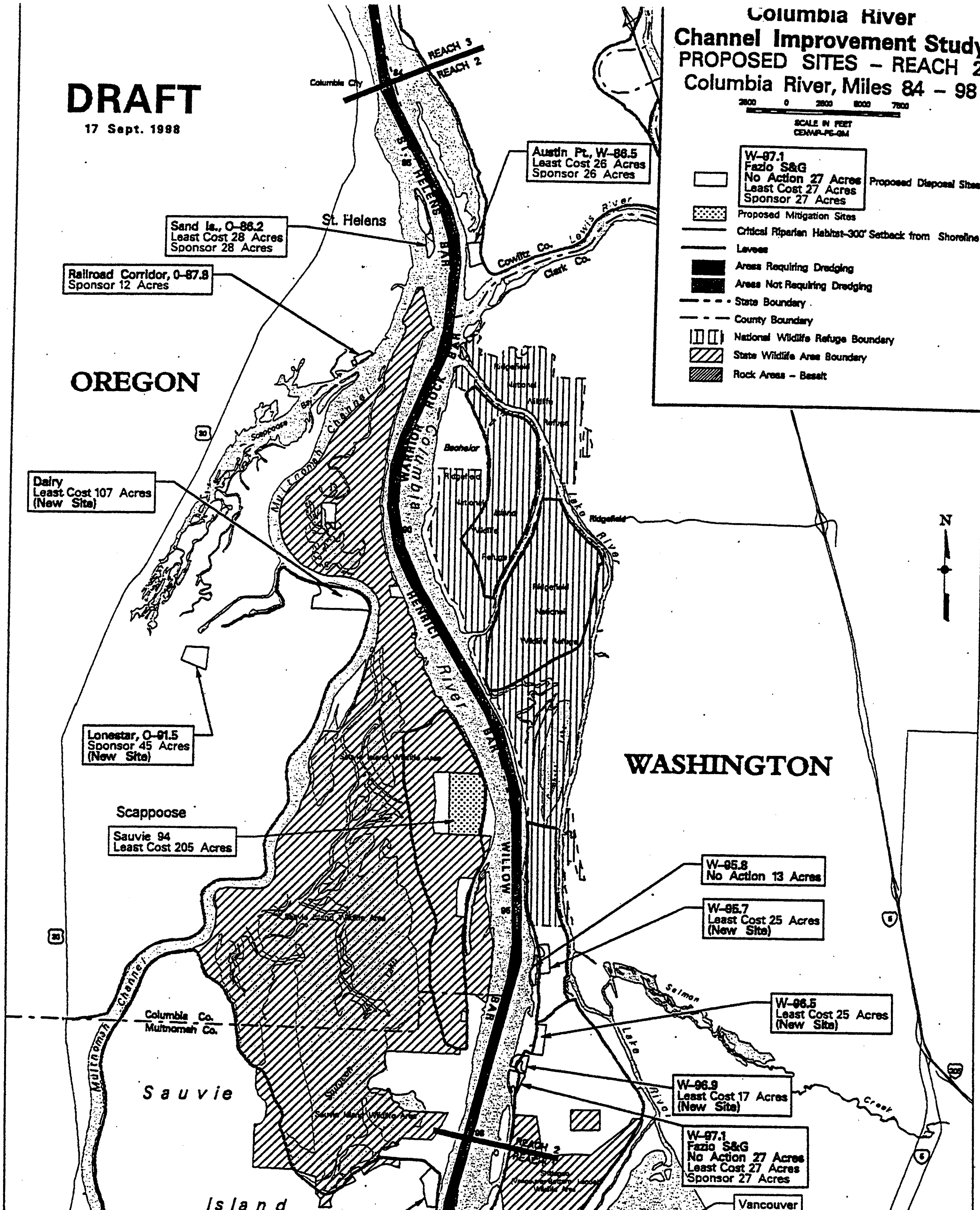
Climate in the lower section of the river is similar to that experienced in the estuarine area, i.e., mild, wet winters and cool, dry summers. Climate changes occur upstream of Longview, however, because the upstream portions of the project are also influenced by climatic changes in the Columbia Gorge. Due to this influence, the Portland-Vancouver area experiences more extremes of cold and heat than the area downstream of the Longview-Kelso area. Precipitation in the lower section (about RM 70 downstream) averages about 60 inches per year. Precipitation in the upriver sections of the project (near Portland) averages about 40 inches per year.

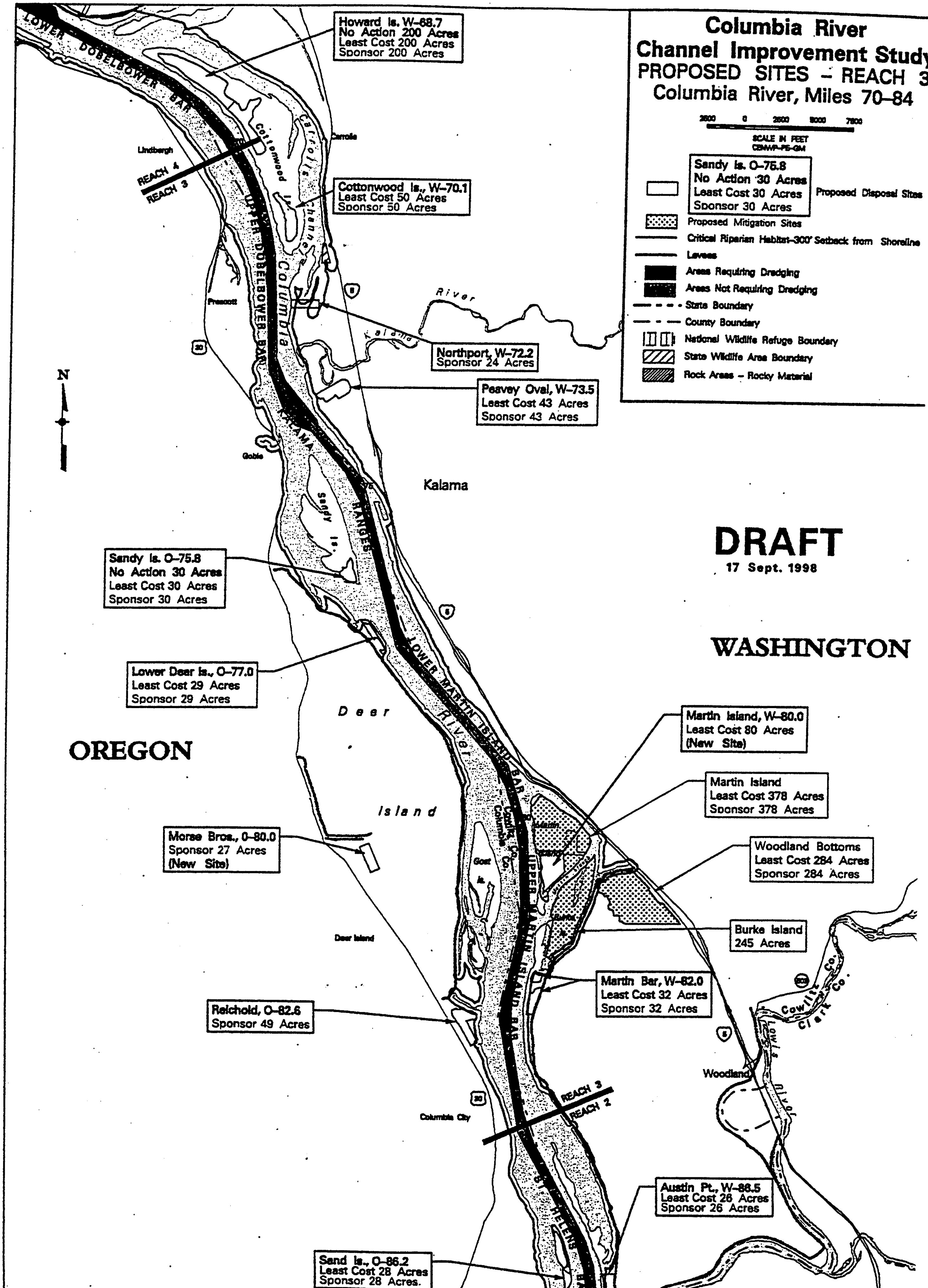
DESCRIPTION OF THE PROJECT

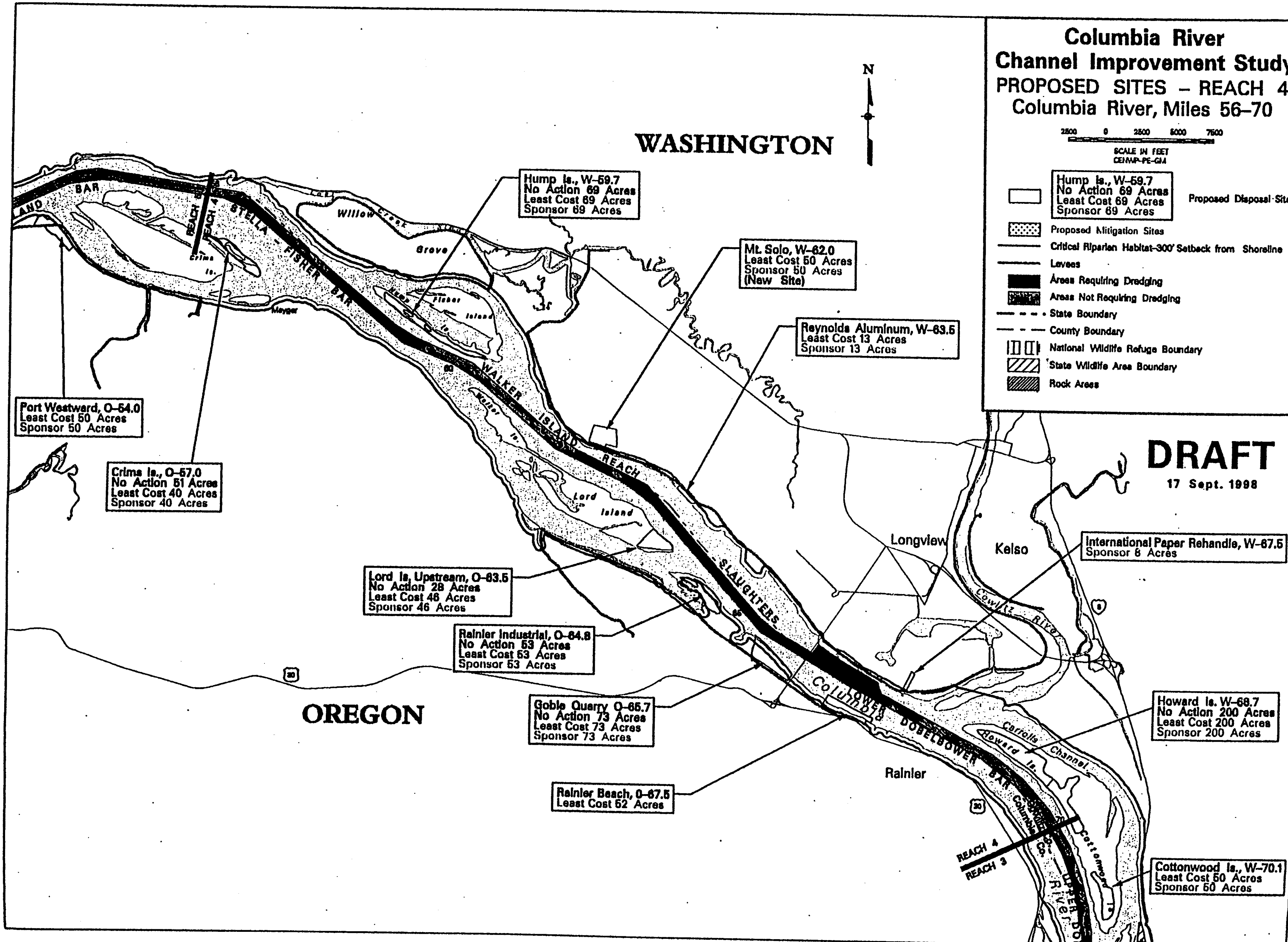
The Columbia River navigation channel is presently authorized at -40 feet with a 5-foot overdraft. A 43-foot channel deepening alternative (with a 5-foot overdraft) is proposed for the area between RM 3 and RM 105.5 near the Vancouver Turning Basin. The channel deepening is also proposed to extend into the Willamette River (-43 feet with a 2-foot overdraft) for a distance of about 11 miles up to the Broadway Bridge. An estimated total of 24.4 million cubic yards (mcy), including some operation and maintenance (O&M) yardage, would be dredged initially from the Columbia River under the 43-foot alternative. Over a 20-year period, about 82 mcy of material would be removed by O&M dredging activities. This amounts to a total project dredging quantity (new work construction plus O&M dredging) for the Columbia River of about 106 mcy. Initial construction work in the Willamette River would total about 1 mcy with all disposal material being placed inwater. About half this material would go into the Willamette River (Map Series1) at RM 4.5 and 9.6 and half would be placed in the Columbia River just



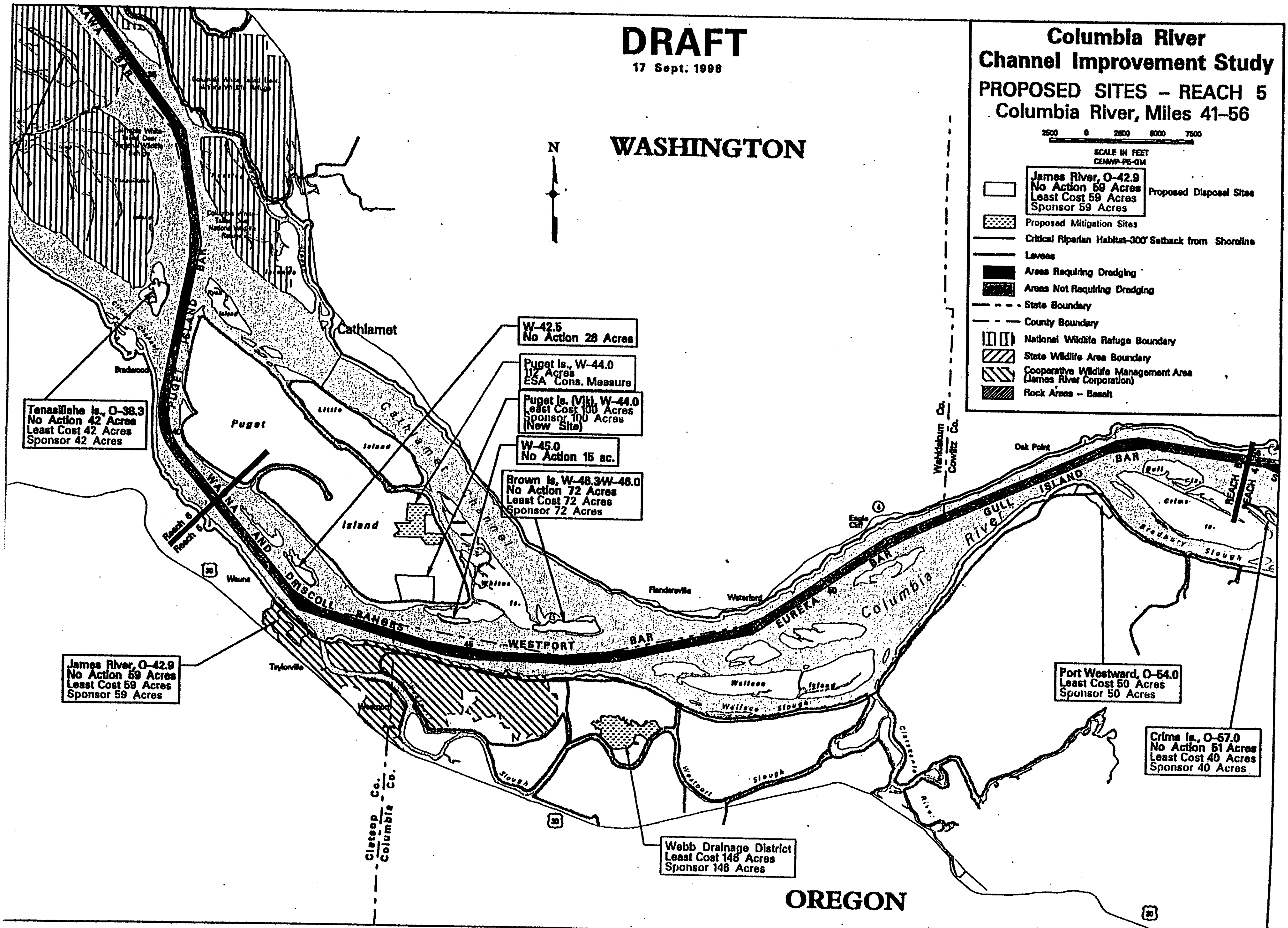
Columbia River
Channel Improvement Stud
PROPOSED SITES – REACH
Columbia River, Miles 98 – 10
Willamette River, Miles 0 – 12
SCALE IN FEET
W-97.1
Fazio S&G
No Action 27 Acres
Least Cost 27 Acres
Sponsor 27 Acres
Proposed Disposal Sites
Proposed Mitigation Sites
Critical Riparian Habitat-300' Setback from Shoreline
Levees
Areas Requiring Dredging
Areas Not Requiring Dredging
State Boundary
County Boundary
National Wildlife Refuge Boundary
State Wildlife Area Boundary
Rock Areas – Basalt
W-96.9
Least Cost 17 Acres
(New Site)
W-97.1
Fazio S&G
No Action 27 Acres
Least Cost 27 Acres
Sponsor 27 Acres
Vancouver
Lowlands
288 Acres
Sauvie Is., O-98.5
Least Cost 48 Acres
(New Site)
W-101.0, Gateway 3
Sponsor 69 Acres
(New Site)
Joslin Property
Least Cost 124 Acres
Hayden Is., O-105.0
No Action 79 Acres
Least Cost 102 Acres
Sponsor 102 Acres
WRKE-1
Least Cost 82 Acres
Sponsor 82 Acres
(New Site)
WRKE-2
Least Cost 38 Acres
Sponsor 38 Acres
(New Site)
Sauvie
Island
Vancouver
Lake
REACH 2
REACH 1
REACH 1 PROJECT BOUNDARY
WASHINGTON
Vancouver
Hayden
Island
Oregon Slough
Bybee Lake
Smith Lake
Columbia River
Clark Co.
Multnomah Co.
Columbia Slough
Willamette
River
Multnomah Channel
Mocks Bottom
Swan Island
Portland
Broadway Bridge
Multnomah Co.
Washington Co.
OREGON
N
DRAFT
17 Sept. 1998


DRAFT
17 Sept. 1998
Columbia River
Channel Improvement Study
PROPOSED SITES - REACH 2
Columbia River, Miles 84 - 98
SCALE IN FEET
W-97.1
Fazio S&G
No Action 27 Acres
Least Cost 27 Acres
Sponsor 27 Acres
Proposed Disposal Sites
Proposed Mitigation Sites
Critical Riparian Habitat-300' Setback from Shoreline
Levees
Areas Requiring Dredging
Areas Not Requiring Dredging
State Boundary
County Boundary
National Wildlife Refuge Boundary
State Wildlife Area Boundary
Rock Areas - Basalt
REACH 3
REACH 2
Columbia City
Austin Pt., W-86.5
Least Cost 26 Acres
Sponsor 26 Acres
Sand Is., O-86.2
Least Cost 28 Acres
Sponsor 28 Acres
St. Helens
Railroad Corridor, O-87.8
Sponsor 12 Acres
OREGON
ST. HELENS BAR
WARRIOR ROCK BAR
HENRICI BAR
WILLOW BAR
MORGAN BAR
Columbia River
Lewis River
Cowlitz Co.
Clark Co.
Multnomah Channel
Dairy
Least Cost 107 Acres
(New Site)
Lonestar, O-91.5
Sponsor 45 Acres
(New Site)
WASHINGTON
Scappoose
Sauvie 94
Least Cost 205 Acres
W-95.8
No Action 13 Acres
W-95.7
Least Cost 25 Acres
(New Site)
W-96.5
Least Cost 25 Acres
(New Site)
W-96.9
Least Cost 17 Acres
(New Site)
W-97.1
Fazio S&G
No Action 27 Acres
Least Cost 27 Acres
Sponsor 27 Acres
Vancouver Lowlands
288 Acres
Columbia Co.
Multnomah Co.
Sauvie
Island
Sauvie Is., O-98.5
Least Cost 48 Acres
(New Site)
Vancouver
Lake
Lake River
Salmon Creek
N

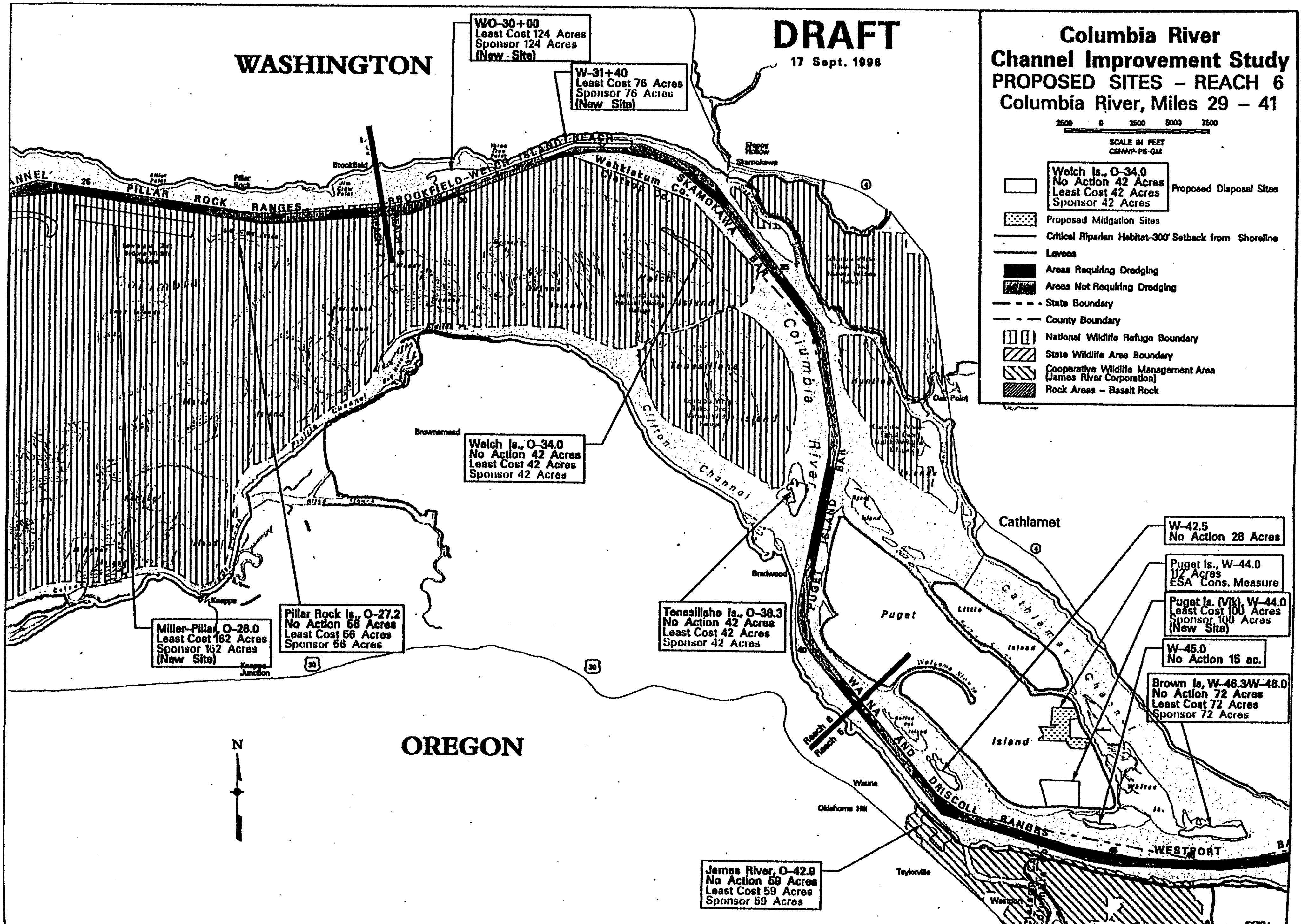

Columbia River
Channel Improvement Study
PROPOSED SITES - REACH 3
Columbia River, Miles 70-84
SCALE IN FEET
Sandy Is. O-75.8
No Action 30 Acres
Least Cost 30 Acres
Sponsor 30 Acres
Proposed Disposal Sites
Proposed Mitigation Sites
Critical Riparian Habitat-300' Setback from Shoreline
Levees
Areas Requiring Dredging
Areas Not Requiring Dredging
State Boundary
County Boundary
National Wildlife Refuge Boundary
State Wildlife Area Boundary
Rock Areas - Rocky Material
Howard Is. W-68.7
No Action 200 Acres
Least Cost 200 Acres
Sponsor 200 Acres
LOWER DOBELBOWER BAR
UPPER DOBELBOWER BAR
REACH 4
REACH 3
Lindbergh
Carrolls
Cottonwood Is.
Carrolls Channel
Cottonwood Is., W-70.1
Least Cost 50 Acres
Sponsor 50 Acres
Columbia
Prescott
River
Kalama
Northport, W-72.2
Sponsor 24 Acres
Peavey Oval, W-73.5
Least Cost 43 Acres
Sponsor 43 Acres
N
Goble
KALAMA
RANGES
Sandy Is.
Kalama
DRAFT
17 Sept. 1998
Sandy Is. O-75.8
No Action 30 Acres
Least Cost 30 Acres
Sponsor 30 Acres
WASHINGTON
LOWER MARTIN ISLAND BAR
Lower Deer Is., O-77.0
Least Cost 29 Acres
Sponsor 29 Acres
Deer
River
OREGON
Island
Martin Island, W-80.0
Least Cost 80 Acres
(New Site)
Martin Island
Least Cost 378 Acres
Sponsor 378 Acres
Cowlitz Co.
Columbia Co.
Morse Bros., O-80.0
Sponsor 27 Acres
(New Site)
Woodland Bottoms
Least Cost 284 Acres
Sponsor 284 Acres
Goat Is.
UPPER MARTIN ISLAND BAR
Burke Island
245 Acres
Deer Island
Martin Bar, W-82.0
Least Cost 32 Acres
Sponsor 32 Acres
Reichold, O-82.6
Sponsor 49 Acres
Cowlitz Co.
Clark Co.
Woodland
Lewis River
REACH 3
REACH 2
Columbia City
Austin Pt., W-86.5
Least Cost 26 Acres
Sponsor 26 Acres
Sand Is., O-86.2
Least Cost 28 Acres
Sponsor 28 Acres.
ST. HELENS BAR

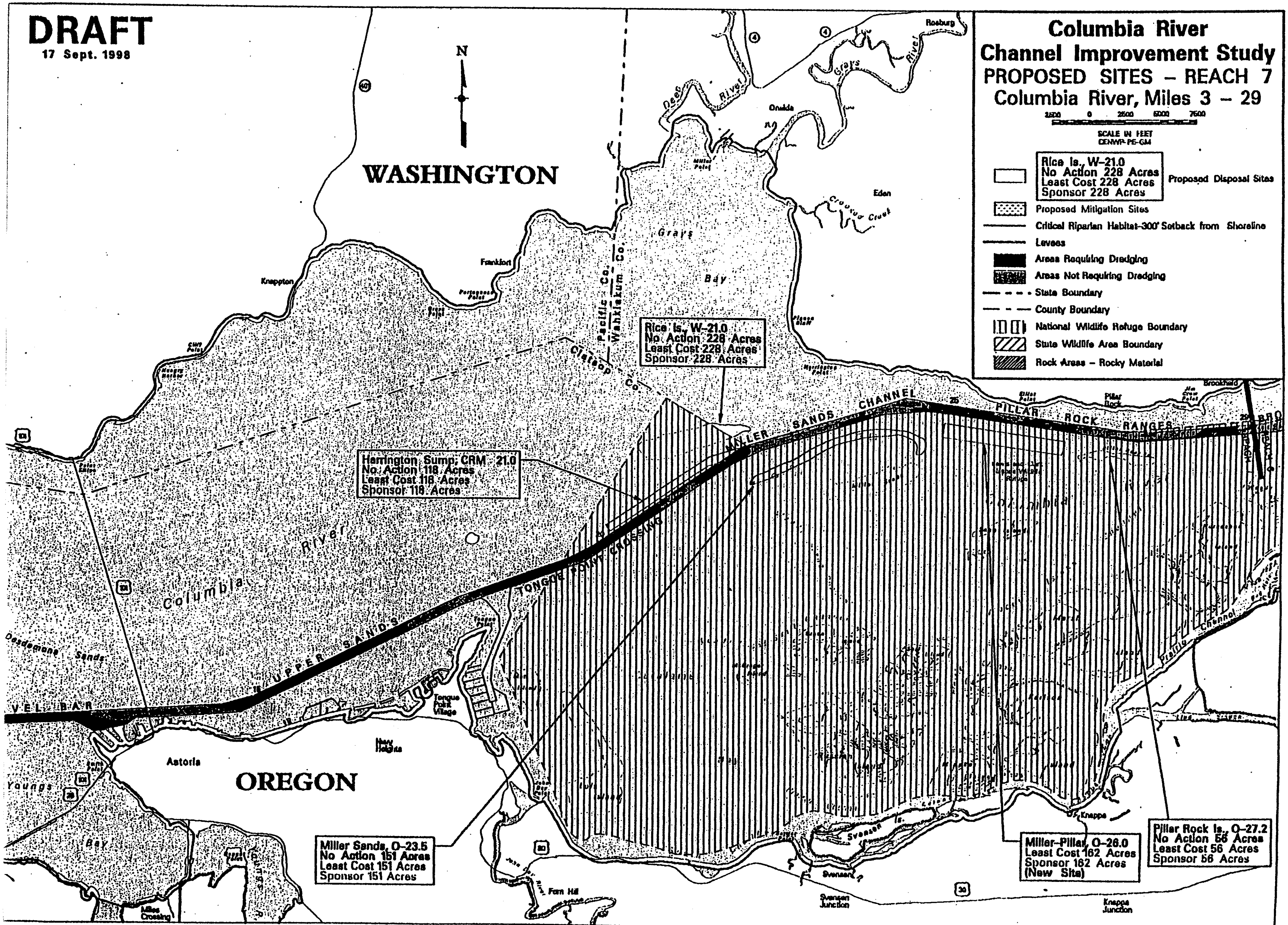


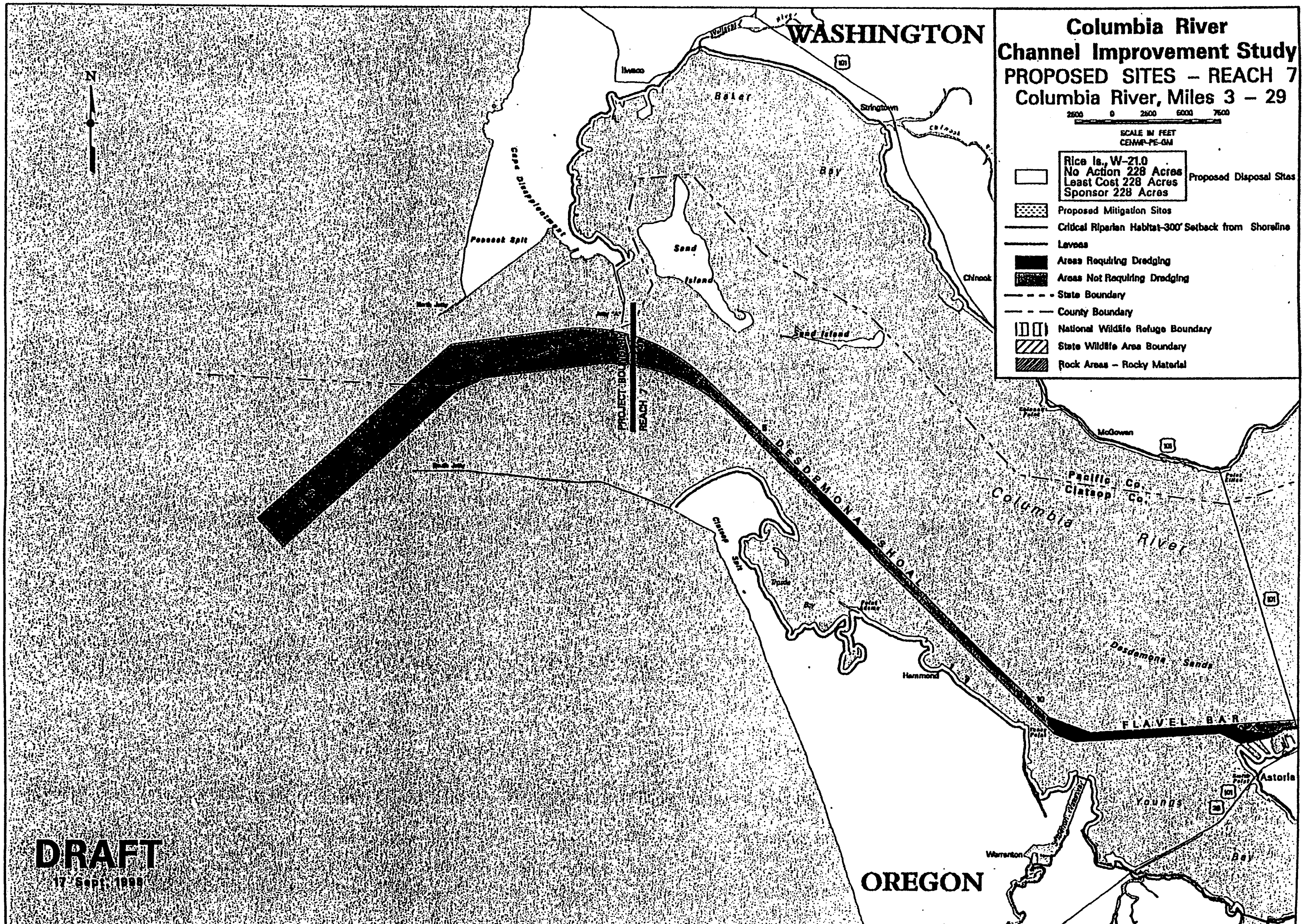
Columbia River
Channel Improvement Study
PROPOSED SITES – REACH 4
Columbia River, Miles 56–70
2500 0 2500 5000 7500
SCALE IN FEET
Hump Is., W-59.7 No Action 69 Acres Least Cost 69 Acres Sponsor 69 Acres
Proposed Disposal Sites
Proposed Mitigation Sites
Critical Riparian Habitat-300' Setback from Shoreline
Levees
Areas Requiring Dredging
Areas Not Requiring Dredging
State Boundary
County Boundary
National Wildlife Refuge Boundary
State Wildlife Area Boundary
Rock Areas
DRAFT
17 Sept. 1998
N
WASHINGTON
OREGON
Hump Is., W-59.7
No Action 69 Acres
Least Cost 69 Acres
Sponsor 69 Acres
Mt. Solo, W-62.0
Least Cost 50 Acres
Sponsor 50 Acres
(New Site)
Reynolds Aluminum, W-63.5
Least Cost 13 Acres
Sponsor 13 Acres
Port Westward, O-54.0
Least Cost 50 Acres
Sponsor 50 Acres
Crims Is., O-57.0
No Action 51 Acres
Least Cost 40 Acres
Sponsor 40 Acres
Lord Is. Upstream, O-63.5
No Action 28 Acres
Least Cost 46 Acres
Sponsor 46 Acres
Rainier Industrial, O-64.8
No Action 53 Acres
Least Cost 53 Acres
Sponsor 53 Acres
Goble Quarry O-65.7
No Action 73 Acres
Least Cost 73 Acres
Sponsor 73 Acres
Rainier Beach, O-67.5
Least Cost 52 Acres
International Paper Rehandle, W-67.5
Sponsor 8 Acres
Howard Is. W-68.7
No Action 200 Acres
Least Cost 200 Acres
Sponsor 200 Acres
Cottonwood Is., W-70.1
Least Cost 50 Acres
Sponsor 50 Acres
Longview
Kelso
Rainier
Cowlitz River
Willow Creek
Grove
Walker Is.
Lord Island
Crims Is.
Carrolls Channel
Howard Is.
Cottonwood Is.
STELLA - FISHER BAR
WALKER ISLAND REACH
SLAUGHTERS
LOWER DOBELBOWER BAR
UPPER DOB
Columbia River
REACH 4
REACH 3
REACH 5



DRAFT
17 Sept. 1998
Columbia River
Channel Improvement Study
PROPOSED SITES - REACH 5
Columbia River, Miles 41-56
SCALE IN FEET
CENWP-PE-GM
James River, O-42.9
No Action 59 Acres
Least Cost 59 Acres
Sponsor 59 Acres
Proposed Disposal Sites
Proposed Mitigation Sites
Critical Riparian Habitat-300' Setback from Shoreline
Levees
Areas Requiring Dredging
Areas Not Requiring Dredging
State Boundary
County Boundary
National Wildlife Refuge Boundary
State Wildlife Area Boundary
Cooperative Wildlife Management Area (James River Corporation)
Rock Areas - Basalt
WASHINGTON
OREGON
N
Cathlamet
W-42.5
No Action 28 Acres
Puget Is., W-44.0
112 Acres
ESA Cons. Measure
Puget Is. (Vik), W-44.0
Least Cost 100 Acres
Sponsor 100 Acres
(New Site)
W-45.0
No Action 15 ac.
Brown Is, W-46.3/W-46.0
No Action 72 Acres
Least Cost 72 Acres
Sponsor 72 Acres
Tenasillahe Is., O-38.3
No Action 42 Acres
Least Cost 42 Acres
Sponsor 42 Acres
James River, O-42.9
No Action 59 Acres
Least Cost 59 Acres
Sponsor 59 Acres
Webb Drainage District
Least Cost 146 Acres
Sponsor 146 Acres
Port Westward, O-54.0
Least Cost 50 Acres
Sponsor 50 Acres
Crims Is., O-57.0
No Action 51 Acres
Least Cost 40 Acres
Sponsor 40 Acres
Puget
Island
Little
Cathlamet Channel
PUGET ISLAND BAR
WAUNA AND DRISCOLL RANGES
WESTPORT BAR
EUREKA BAR
GULL ISLAND BAR
Columbia River
Wallace Island
Wallace Slough
Westport Slough
Clatskanie River
Bradbury Slough
Reach 6
Reach 5
REACH 4
Bradwood
Wauna
Taylorville
Westport
Flandersville
Waterford
Eagle Cliff
Oak Point
Wahkiakum Co.
Cowlitz Co.
Clatsop Co.
Columbia Co.


DRAFT
17 Sept. 1998
Columbia River
Channel Improvement Study
PROPOSED SITES – REACH 6
Columbia River, Miles 29 – 41
2500 0 2500 5000 7500
SCALE IN FEET
Welch Is., O-34.0 No Action 42 Acres Least Cost 42 Acres Sponsor 42 Acres
Proposed Disposal Sites
Proposed Mitigation Sites
Critical Riparian Habitat-300' Setback from Shoreline
Levees
Areas Requiring Dredging
Areas Not Requiring Dredging
State Boundary
County Boundary
National Wildlife Refuge Boundary
State Wildlife Area Boundary
Cooperative Wildlife Management Area (James River Corporation)
Rock Areas – Basalt Rock
WASHINGTON
OREGON
WO-30+00 Least Cost 124 Acres Sponsor 124 Acres (New Site)
W-31+40 Least Cost 76 Acres Sponsor 76 Acres (New Site)
Welch Is., O-34.0 No Action 42 Acres Least Cost 42 Acres Sponsor 42 Acres
Tenasillahe Is., O-38.3 No Action 42 Acres Least Cost 42 Acres Sponsor 42 Acres
Pillar Rock Is., O-27.2 No Action 56 Acres Least Cost 56 Acres Sponsor 56 Acres
Miller-Pillar, O-28.0 Least Cost 162 Acres Sponsor 162 Acres (New Site)
James River, O-42.9 No Action 59 Acres Least Cost 59 Acres Sponsor 59 Acres
W-42.5 No Action 28 Acres
Puget Is., W-44.0 112 Acres ESA Cons. Measure
Puget Is. (Vik), W-44.0 Least Cost 100 Acres Sponsor 100 Acres (New Site)
W-45.0 No Action 15 ac.
Brown Is, W-46.3/W-46.0 No Action 72 Acres Least Cost 72 Acres Sponsor 72 Acres
PILLAR ROCK RANGES
BROOKFIELD-WELCH ISLAND REACH
SKAMOKAWA BAR
PUGET ISLAND BAR
WAUNA AND DRISCOLL RANGES
WESTPORT
Columbia River
Clifton Channel
Cathlamet Channel
Puget Island
Little Island
Wahkiakum Co.
Brookfield
Pillar Rock
Skamokawa
Cathlamet
Oak Point
Brownsmead
Bradwood
Knappa
Knappa Junction
Wauna
Oklahoma Hill
Taylorville
Westport
Reach 6
Reach 5
N


DRAFT
17 Sept. 1998
Columbia River
Channel Improvement Study
PROPOSED SITES – REACH 7
Columbia River, Miles 3 – 29
SCALE IN FEET
CENWP-PE-GM
Rice Is. W-21.0
No Action 228 Acres
Least Cost 228 Acres
Sponsor 228 Acres
Proposed Disposal Sites
Proposed Mitigation Sites
Critical Riparian Habitat-300' Setback from Shoreline
Levees
Areas Requiring Dredging
Areas Not Requiring Dredging
State Boundary
County Boundary
National Wildlife Refuge Boundary
State Wildlife Area Boundary
Rock Areas – Rocky Material
WASHINGTON
OREGON
N
Harrington Sump, CRM 21.0
No Action 118 Acres
Least Cost 118 Acres
Sponsor 118 Acres
Miller Sands, O-23.5
No Action 151 Acres
Least Cost 151 Acres
Sponsor 151 Acres
Miller-Pillar, O-26.0
Least Cost 162 Acres
Sponsor 162 Acres
(New Site)
Pillar Rock Is. O-27.2
No Action 56 Acres
Least Cost 56 Acres
Sponsor 56 Acres
Columbia River
Grays Bay
Pacific Co.
Wahkiakum Co.
Clatsop Co.
MILLER SANDS CHANNEL
PILLAR ROCK RANGES
TONGUE POINT CROSSING
UPPER SANDS
Desdemona Sands
Knappton
Frankfort
Rosburg
Oneida
Eden
Deep River
Grays River
Crooked Creek
Brookfield
Pillar Rock
Astoria
Tongue Point Village
Navy Heights
Svensen Is.
Svensen
Svensen Junction
Knappa
Knappa Junction
Fern Hill
Miles Crossing
Youngs Bay


Columbia River
Channel Improvement Study
PROPOSED SITES – REACH 7
Columbia River, Miles 3 – 29
SCALE IN FEET
CENWP-PE-GM
Rice Is., W-21.0
No Action 228 Acres
Least Cost 228 Acres
Sponsor 228 Acres
Proposed Disposal Sites
Proposed Mitigation Sites
Critical Riparian Habitat-300' Setback from Shoreline
Levees
Areas Requiring Dredging
Areas Not Requiring Dredging
State Boundary
County Boundary
National Wildlife Refuge Boundary
State Wildlife Area Boundary
Rock Areas – Rocky Material
WASHINGTON
OREGON
N
Ilwaco
Baker
Bay
Stringtown
Chinook
Cape Disappointment
Peacock Spit
Sand Island
PROJECT BOUNDARY
REACH 7
DESDEMONA SHOAL
Desdemona Sands
FLAVEL BAR
Columbia River
Pacific Co.
Clatsop Co.
McGowan
Clatsop Spit
Hammond
Warrenton
Astoria
Youngs
DRAFT
17 Sept. 1996

downstream of the Willamette-Columbia Rivers confluence near Morgan's Bar. Maintenance dredging projected over a 20-year period estimates removal of an additional 3 million cy from the Willamette River channel. This material would also be disposed of inwater at an approved site. Although the average annual maintenance dredging for the project beyond the initial 20-year period is difficult to forecast with certainty, the best estimate of O&M dredging for years 21-50 is about 2-3 mcy per year.

Under the government's least cost disposal plan (Government Plan), a major portion of the estimated 106 mcy of dredged material from the Columbia River (15 mcy from new construction and an O&M total of 56 mcy over 20 years) would be disposed of at 31 upland locations covering 1,897 acres (Map Series 1). Several other locations would also receive disposal materials from new work dredging and O&M activities over a 20-year dredging period. These include offshore (11 mcy); flowlane/ inwater (27 mcy, including 4 mcy from the Willamette River); and NMFS-approved beach nourishment (1 mcy) sites (Map Series I). An additional 220,000 cy of basalt rock and about 450,000 cy of cemented sand, gravel, and boulders would also be removed from the Columbia and Willamette Rivers under the 43-foot channel alternative. What cannot be removed by mechanical means would require removal by blasting methods.

Site by site drawings of the proposed upland disposal sites have been produced by and are available from the Corps of Engineers. These sites are, for the most part, previously used disposal areas. However, there are eight new upland sites which have been added to the mix of disposal sites. They are: Puget Island (W44.0), Mt. Solo (W62.0), Martin Island (Map Series Reach 3), Scappoose Dairy (Map Series Reach 2), W95.7 (near Ridgefield National Wildlife Refuge), W96.5 (near Ridgefield Refuge), W96.9 (adjacent to Fazio Sand and Gravel), and O98.5 (Sauvie Island). Two of the disposal sites, Sandy Island (O75.8, near St. Helens) and Miller Sands Spit (O23.5), are designated as beach nourishment sites with some new work scheduled for Sandy Island.

Mitigation sites which were identified early in the study process included the Joslin Property (on Sauvie Island), Sauvie 94, Vancouver Lowlands, Scappoose Dairy, RN&D Development, Martin Island, Burke Island, Webb Property, Port Westward, and Puget Island (Map Series 1). Reserve mitigation sites were identified as Woodland Bottoms, Clatskanie, and Svenson Island. These 13 sites have been reduced to five sites under the least cost plan: Joslin Property, Sauvie 94, Woodland Bottoms, Martin Island, and Webb Property. A portion of the disposal sites and all the mitigation sites would be managed for fish and wildlife species. The mitigation sites are discussed further in the Habitat Evaluation Procedures (HEP) analysis at the end of this report.

The Corps, through a series of workshops with federal and state resource agencies and the public, has also developed four proposed ecosystem restoration actions under its Ecosystem Restoration Authority. These actions include restoration of water, via levee breaching, to the former Shillapoo Lake near Vancouver; tide gate retrofits for salmon passage; improved side-channel flow at Lord-Walker, Fisher-Hump, and Miller Sands Islands; and restoration of shallow sub-tidal habitat between Miller Sands and Pillar Rock Islands using a dike field. These restoration actions are being developed as part of the channel deepening project, but are considered separate and distinct from any mitigation activities associated with the project.

In conjunction with the disposal alternatives, it should be recognized that dredged material could be made available for beneficial uses. Dredged material can be used for borrow material, development of county or state parks, industrial development, erosion control, and/or environmental enhancement. Beneficial use sites are to be considered by the Corps when a site is available, dredging is necessary and in close proximity to the site, and the beneficial use site would save capacity in other proposed disposal sites; however, when a beneficial use site would not be in the best interest of the Federal government, the owner would be responsible for obtaining any necessary environmental clearances prior to the site's use for dredged material disposal. Examples of beneficial use sites include W73.5 and W72.2 at the Port of Kalama, O40.8 owned by James River Corporation near Wauna, and O46.8, the Jones Beach recreation site.

Several other alternatives to the proposed 43-foot channel deepening have been considered: 1) a non-structural alternative which focuses on upgrading the river stage forecasting system (LOADMAX), thus enabling ships to determine navigable channel depths based on projected future and real-time tide and river stage information; 2) development of single-stop and topping-off regional ports at Astoria and Longview; 3) channel configuration changes including construction of a tiered channel (deepening only one side of the channel to allow for loaded deep-draft vessel efficiency), one-way reaches, and non-uniform channel depths; and 4) a no action alternative. In addition, two channel deepening variations (-41, -42-foot depths) in conjunction with turn widening measures and development of incremental reaches to accommodate traffic at major cargo terminals have also been considered. An additional alternative submitted by the project sponsors, known as the "Sponsor's Preferred Disposal Alternative" (Sponsor's Plan), focuses on disposal site alternatives that would: 1) utilize Columbia River sand for port purposes and other beneficial uses; 2) substitute transportation costs for environmental costs; and 3) minimize acquisition costs by avoiding controversial sites that would require mitigation. The Sponsor's Plan eliminates seven of the Government Plan alternatives (Sauvie 1 (O98.5), W96.9, W96.5, W95.7, Dairy site, Martin Island, and Rainier Beach) and substitutes an additional eight sites (Gateway 3, Lonestar, Railroad Corridor, O82.6, Morse Bros., W73.5 (an area downstream of Peavey Oval), Northport (W72.2), and W67.5 (see Map Series 1 above). In total, under the Sponsor's Plan, there are slightly less acres affected by upland disposal (1,755 acres) than under the Government Plan (1,897 acres). The sponsor's alternative disposal plan trades some of the sites in the Government Plan that would require mitigation and substitutes more costly sites that would either provide acreage for future commercial or industrial development or that do not require mitigation. Four of the sponsor's disposal sites are located on port lands at Vancouver, St. Helens, Kalama, and Longview and two are at active sand and gravel operations; overall impacts to fish and wildlife habitat and species are, therefore, reduced. Several of these alternatives will be discussed in more detail later in the report.

BIOLOGICAL RESOURCES EVALUATION

AQUATIC RESOURCES

Without the Project

In the late 1970s, the aquatic portion of the Columbia River Estuary totalled about 119,000 acres. Of this amount, 58,000 acres were medium, deep water habitat below -6 feet mean lower low water (MLLW); about 45,000 acres were shallows and flats; and about 16,000 acres consisted of tidal marsh and swamp (U.S. Department of the Interior 1986). Although these acreage figures have not been updated, it is probable that there have been reductions in each habitat category since the figures were originally published; however, the estuary remains an important and significant habitat resource for fish and wildlife.

The physical processes of the Columbia River Estuary are highly complex. While considerable data exist for the main channel, these processes are not very well understood for the shallow flats and bays. The major parameters influencing the estuarine system appear to be river discharge, the daily tidal cycle, and the spring-neap tidal cycle, which, in turn, influence currents and circulation, sediment transport, and salinity. The river system itself is influenced primarily by river discharge which is controlled by dams.

River discharge effects in the estuary occur on a seasonal basis and can cause extreme variation in currents and downstream flow. Tidal oscillations cause current changes in the entire water column in the lower estuary and in the bottom waters in the upper estuary. Spring tides may cause larger variations in flow than the variations resulting from river discharge.

Tides provide the major source of energy for circulation in the estuary. Generally, circulation in the estuary is clockwise with a two layer circulation pattern, i.e., saline water flowing upstream on the bottom and freshwater flowing downstream on the top. Most of the ocean water flows in through the north channel which is connected by four major cross channels to the south channel where water flows predominately seaward. The lowest cross channel is in the vicinity of the Astoria-Megler Bridge and the most upstream cross channel rejoins the main channel at about RM 25 near Miller Sands. Salinities in the estuary range from 40 parts per thousand (ppt) to 0.5 ppt (Bottom and Jones 1990). Salinities are seasonal in nature being heavily influenced by spring freshets and low river flows during the summer and early fall. In Jones et al. (1990), the estuary is divided into three zones: the Plume and Ocean Zone (RM 0 to RM 7); the Estuarine Mixing Zone (RM 7 to RM 18); and the Tidal Fluvial Zone (upstream of RM 18). Salinity ranges within these zones are euhaline (30 to 40ppt) to mesohaline (5 to 18ppt) for the Plume and Ocean Zone; polyhaline (18 to 30ppt) to oligohaline (0.5 to 5.0ppt) for the Estuarine Mixing Zone; and oligohaline to limnetic (less than 0.5ppt) for the Tidal Fluvial Zone. The National Marine Fisheries Service (NMFS) recorded salinities of 30ppt at Tongue Point during a 24-hour salinity study conducted during the fall of 1977 and 1978 (McConnell et al. 1979) and, during a study of the Cathlamet Bay area in 1984, recorded salinities from 0.0ppt to just under 1.2ppt (Emmett et al. 1985). These data emphasize the wide variation in salinities within the estuary associated with season and river flow.

Upstream of about RM 30, the Columbia River provides the energy input to the estuary. However, between RM 18 and 32, in the Cathlamet Bay area, neither tidal nor river energy prevails and there is a distinct energy minimum.

Coastal summer upwelling begins in May. Colder, more dense, more saline, and nutrient rich water is brought to the surface from the ocean bottom by wind movement over the water. This process continues until the wind direction changes in the fall. This upwelling, along with low flow periods and the peaks of spring and neap tidal cycles, contributes to the saltwater influx into the estuary. During El Nino events, however, this process is essentially reversed. A change in wind patterns keeps the coastal waters warmer than usual and prevents or reduces the coastal upwelling that normally occurs in the spring. Oceanic species such as fish (including anadromous fish), seabirds, and marine mammals generally suffer losses because of the poor nutrient conditions and low prey productivity in the ocean. El Nino impacts could carry into the estuary with reductions in salinity intrusion and reduced use of the estuary by marine species. This could have detrimental impacts on some resident estuarine species because of the reduced (marine) prey base.

Saline water is carried into the estuary primarily in the north channel and leaves via the navigation channel. Salinity intrusion has been recorded as far upstream as RM 26 during low river flow and neap tides when the water column is stratified. Conversely, during high river flows and spring tides, the estuary is essentially fresh at the surface.

Nutrients enter the estuary from three sources: 1) from upriver sources in the Columbia River; 2) from tributary input, detrital breakdown, and nutrient recycling within the estuary itself; and 3) from the ocean, primarily from upwelling. Nutrient input to the Columbia River is also from upriver sources and from tributary input and detrital breakdown within the river. Of the nutrients entering the system, nitrates and nitrites appear to be limiting for phytoplankton. In the spring and summer, high uptake of these nutrients by phytoplankton in the river sometimes depletes nutrient input into the estuary.

Sediment transport is determined by sediment grain size and water velocity. Grain size and composition are also major determinants of the presence and types of benthic organisms. Transport of the finer sediments in the water column is called suspended transport. Bedload transport is movement of the heavier particles along the bottom. The river has high rates of suspended load but most of this material is flushed out to sea by the river's high flows. What remains is thought to be deposited in the estuary's bays and shallow areas.

Bedload material of river origin was formerly carried out over the bar, but human manipulations such as the construction of jetties and upriver dams and the dredging of navigation channels have changed the patterns of bedload transport. Bedload material does not move downriver much below RM 10. Also, there is some hypothetical evidence that there is a net transport of bedload material of ocean origin over the bar and into the estuary (Moritz personal communication).

Bedload transport and deposition are controlled by currents. Although the net current flow within the navigation channel is downstream, there is an upstream flowing bottom current. During strong flood tides and low river flow, upstream bedload transport occurs. North channel transport of bedload material upstream is even more pronounced. A report by Ogden Beeman (1985) estimated that 15 percent of the dredged material deposited in Area E at the tip of the North Jetty returned to the North Channel. While this percentage figure is probably not valid today, it is still true that what material does return to the channel from Area E, along with much of the material disposed of at Area D (RM 7), is transported upriver and, because of the dynamic interplay between the north and south channels, some portion of this material is expected to pass through the cross-estuary channels and be redeposited in the navigation channel. There is also evidence that material from Area D may be moving into Baker Bay (Moritz personal communication 1998). The Beeman study also estimated that about 2 million cubic yards of ocean and river sands enter and are entrained in a clockwise circulation pattern between RM 7 and RM 25. This figure has not changed significantly since the study was done.

Primary Production

Primary production occurs in the water column, at the substrate-water interface, and on land. Those physical conditions which most influence aquatic production are light penetration and river flow. Simenstad et al. (1984) estimated that phytoplankton provided 57 percent of the net annual primary production in the estuary; marshes and swamps provided 38 percent; and benthic microalgae contributed 5 percent. How much or whether these percentages have changed has not been officially determined.

The distribution of invertebrate populations and larval fishes is closely connected to the physical zones and habitats (bays, slopes, flats, and channels) discussed above which, in turn, are described by salinity, circulation, and sedimentation patterns (Simenstad et al. 1990). Fauna in the Plume and Ocean Zone and oceanward portion of the Estuarine Mixing Zone are heavily influenced by the nearshore ocean conditions and the interaction of tidal forces and riverine flows. The influx of marine organisms is, therefore, limited to the lower 13 miles of the estuary.

Seasonal changes in ocean conditions also influence the marine zooplanktonic assemblages that drift into the estuary. In the summer, ocean currents flow southward thus bringing species of northern origin such as Arcatia clausi, A. longiremis, Calanus marshallae, and Centropages abdominalis into the estuary. Conversely, organisms from the southern coastal regions such as Clausocalanus spp., Ctenocalanus vanus and Paracalanus parvus are transported via nearshore currents which flow northward and coastward during the winter into the estuary. These patterns become skewed, however, during El Nino events.

Freshwater flows heavily influence the invertebrate assemblage structure and distribution of organisms in the Tidal-Fluvial Zone. With high flows during the spring, freshwater species like Bosmina and Daphnia tend to dominate even in areas downstream of the Tidal-Fluvial Zone. During high water discharge events, the Columbia River has an overriding influence on the survival and density of mid-estuarine, freshwater-intolerant species, sometimes influencing the production capablities of species such as Eurytemora affinis for an entire year (Jones et al. 1990).

The Estuarine Mixing Zone may be critical to maintenance of invertebrate production in the estuary. It is the site where riverine sediments, nutrients, detritus, and phytoplankton populations mix with oceanic nutrients and sediments and zooplankton to form a highly productive habitat for invertebrates. Habitat differences, however, rather than physical processes, greatly influence the invertebrate populations in the Plume and Ocean Zone, more so than in either of the other two zones.

Phytoplankton: Because of the influence of the Columbia River, the major portion of the phytoplankton community in the estuary is composed of freshwater species, primarily diatoms. These organisms are the main food source for the zooplankton and the benthic and epibenthic filter feeders in the estuary.

Benthic: Microalgae, mainly diatoms, are the main source of benthic primary production in the estuary. They are found on mud flats and shallow subtidal flats. Benthic filter feeders and detritovores depend on these diatoms for food.

Emergent: The emergent marshes provide the source of material for breakdown by bacteria, and the nutrients produced are, in turn, used by phytoplankton and detritovores. The real value of these marshes, therefore, is not in their use for grazing but in their contribution to detrital export. Detrital export varies from estuary to estuary and can vary within the estuary with some portions of the estuary experiencing a large amount of detrital export and other portions little or none at all.

Seagrasses such as the surfgrass (Phyllospadis scouleri) which is found on jetties and headlands and eelgrass (Zostera marina) which prefers more protected habitat are both found in the Columbia Estuary. Eelgrass is found subtidally on the west side of Baker Bay and in low intertidal areas adjacent to the channels in the bay. Trestle Bay also has eelgrass communities but they are relatively sparse. Recent project work at Trestle Bay opened up the area to the Columbia River-ocean water interchange and it was thought that this might increase the amount of eelgrass in the area. However, eelgrass beds have declined since the breaching; but this may be due to the very high freshwater flows resulting from the recent flooding (1996/97) in the Columbia Basin (Hinton personal communication 1997).

There were over 9,200 acres of tidal marshes in the Columbia River Estuary in the early 1980s (Thomas 1983). Fringing marshes are still found in Baker, Grays, Trestle, and Youngs Bays and in Alder Cove. These marshes are tolerant of freshwater and brackish conditions and are of relatively recent origin. The mature freshwater marshes are found on the large islands in Cathlamet Bay. These marsh islands are especially important to juvenile fish, birds, and aquatic furbearers.

Invertebrates

The invertebrate populations of the estuary and the river are important food sources for higher food chain species, particularly for those species which are of value to man. The primary factors influencing these communities are salinity, freshwater flow, and water velocity (Jones et al. 1990). The distribution of larval fish and invertebrates is closely related to the the physical zones referred to above and to the habitats defined by salinity, circulation, and sediment/depositional patterns (Simenstad et al. 1990).

Zooplankton: Zooplankton can be divided into marine, brackish, and freshwater groups. Very few of these organisms are strictly estuarine and most are of marine origin with a high tolerance of freshwater conditions. Larval fish and invertebrates are important food items found in the estuarine plankton. Larval and juvenile fish comprise a significant portion of the offshore planktonic communities, as well. Smelt, tomcod, righteye flounder, and anchovy are commonly found in the offshore communities during the winter and spring. Dungeness crab megalops and zoea also form a major component of the zooplankton in the winter months. These organisms are fed upon heavily by juvenile and some adult fish.

Zooplankton populations in the mainstem Columbia River are dominated by only a few species: Daphinia, Bosmina, and cyclopoids. Several species of rotifers are also abundant on a seasonal basis. Zooplankton populations are greatest in the early fall, decrease over the winter, and then often show a late spring peak. Fish eggs and larvae of the eulachon are the dominant zooplankton in the river in April and May.

Benthic: Benthic populations offshore appear to differ significantly from estuarine populations. Sediment type and distance from shore seem to determine the difference in benthos. Also, snails and clams seem to be more prevalent in the offshore populations.

As mentioned previously, benthic infauna are very susceptible to sediment grain size and stability. Salinity is also a major factor affecting the distribution of benthic invertebrates. Corophium salmonis, an amphipod of significant importance to juvenile and adult salmonids as well as juvenile sturgeon, is prevalent in Youngs and Cathlamet Bays. Desdemona Sands is also an important area for this species.

Figure 2 indicates the density distribution for C. salmonis as well as juvenile Dungeness crab in the estuary. C. salmonis appears to be associated with substrates of fine silt. Other benthic groups found in abundance in the estuary include oligochaetes, polychaetes, and nemertean worms. These species, particularly the segmented worms, are generally associated with organic sediments. Two clam species, Macoma balthica, and the Asian clam, Corbicula manilensis, are also present in high densities in the estuary, the former being especially prevalent in Baker Bay.

Two species dominate the benthic populations in the mainstem river, i.e., the amphipod, C. salmonis and the Asian clam, Corbicula manilensis. Densities are low compared to populations in the estuary, however. The latter species are found in the more protected, shallow areas of the river rather than in the main channel. Other benthic invertebrates associated with the river include oligochaetes, polychaetes, mysids, and insect larvae. (Sandborn 1975).

Epibenthic: Epibenthic populations offshore are composed almost entirely of macrofauna. Crangon spp. shrimp are dominant. Dungeness crabs and the mysid, Neomysis kadiakensis, are also prevalent. The shrimp populations tend to be dominated by adults while the crabs are present in all life stages, i.e., megalops, small juveniles, and adults.

Major macro epibenthic species associated with the estuary are Dungeness crab (Cancer magister) and sand shrimp (Crangon spp.). The Dungeness juveniles are the major users of the estuary, not the adults (Figure 2). Juveniles move up and down the estuary depending on salinity ranges. Most crabs found in the estuary are of the 1-to 2-year class size.

Unlike the Dungeness crab, the sand shrimp spends its entire life cycle in the estuary. Adult and juveniles occupy different areas and salinities, however. The crayfish, Pacifastacus trowbridgii, is also found in much of the estuary.

Terrestrial and aquatic insects provide an important source of food both in the estuary and the mainstem river. The marshes and swamps in the estuary and the riparian vegetation along the river are the main sources for input into the system. The islands of Cathlamet Bay are especially important in this regard.

Fish (Marine/Estuarine)

The Columbia River Estuary and the Pacific Ocean immediately offshore of the estuary are extremely valuable habitat areas for fish. Fish are attracted to these areas because of the high concentration of prey species. During an 18 month survey done by NMFS in 1980, 75 species of fish were recorded using the Columbia River Estuary (Bottom and Jones 1990). Table 1 lists the 39 most abundant species collected. The summer months defined the period of most abundance in the estuary with subyearlings of starry flounder, shiner perch, English sole, longfin smelt, Pacific herring, and chinook salmon comprising the greatest portion of the survey catch.

Seventeen of the 18 most abundant fishes could be classified as resident based on their capture during all or most of the months of the year. Of these fishes, the longfin smelt, shiner perch, starry flounder, chinook salmon, Pacific staghorn sculpin, surf smelt, and threespine stickleback were collected in each of the major estuarine zones described above. Of the top 18 resident species, prickly sculpin and peamouth were the only fish that occurred primarily in the Estuarine Mixing and Tidal Fluvial Zones.

According to the NMFS study, the shallow bay habitats and Demersal Slope and Channel Bottom habitats of the Estuarine Mixing Zone between RM 7 and RM 21 support relatively high densities of fish. Maximum densities were noted in Youngs and Baker Bays. Mean densities were usually lower in the Tidal Fluvial Zone habitats upstream of RM 21.

The estuary serves as a nursery for many species of marine fish which move into the estuary to spawn. The estuary is also used as a migratory pathway for adult and juvenile anadromous fish including salmon, steelhead trout, cutthroat trout, smelt, sturgeon, shad, and lamprey. For some fish, such as the Pacific

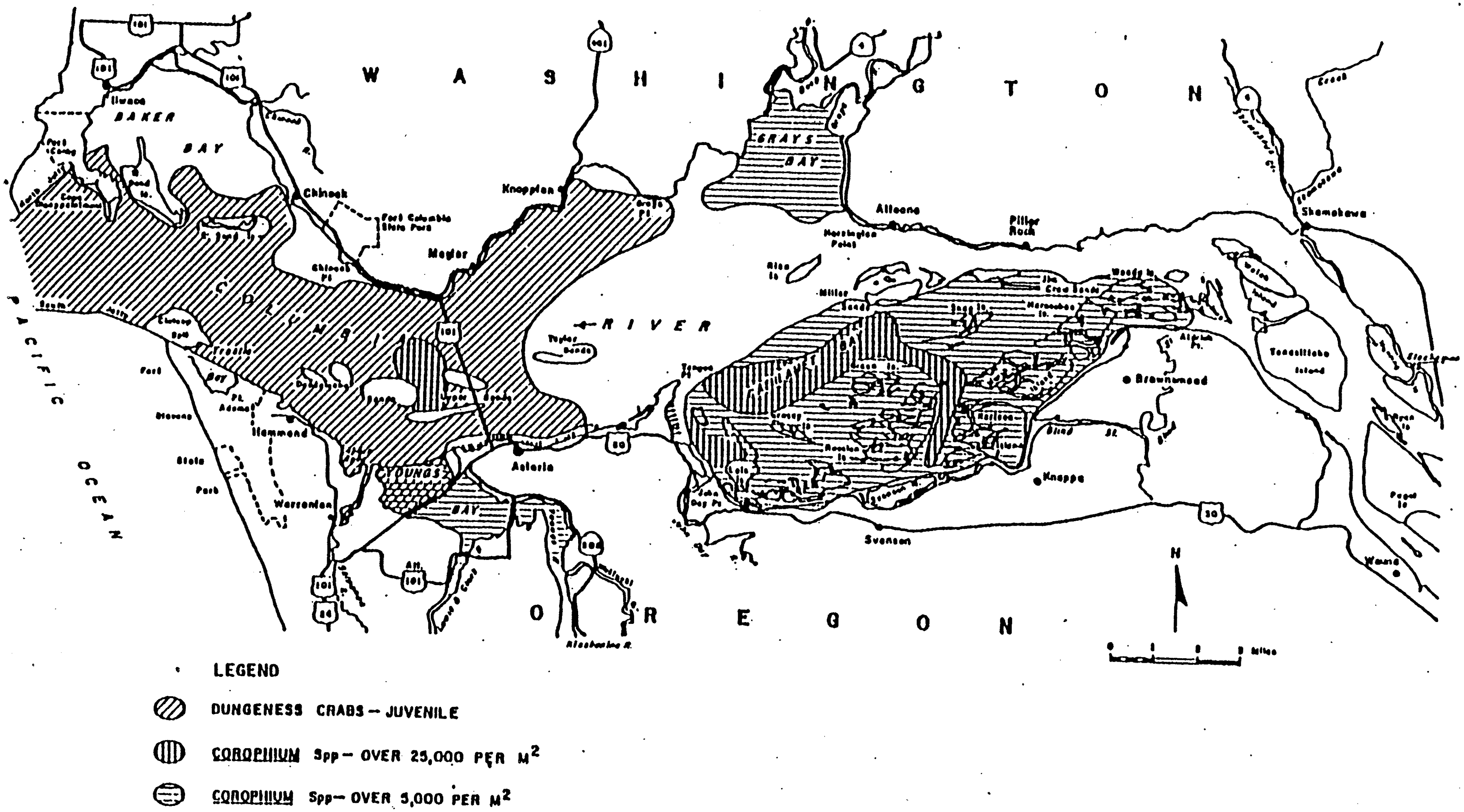


Figure 2. Distribution of Juvenile Crab and Corophium spp. in the Columbia River Estuary

Table 1. Total catch (all three gear types), seasonal occurrence, and general distribution of all species for which a minimum of 10 individuals were captured during NMFS survey of the Columbia River Estuary[1]

	Species	Total catch	Seasonal occurrence	Distribution
American shad	*Alosa sapidissima*	9,178	R	P,E,T
Big skate	*Raja binoculata*	12	R	P
Butter sole	*Isopsetta isolepis*	263	R	P,E
Chinook salmon	*Oncorhynchus tshawytscha*	11,439	R	P,E,T
Chum salmon	*Oncorhynchus keta*	31	W, Sp	P,E,T
Coho salmon	*Oncorhynchus kisutch*	2,709	W, Sp, Su	P,E,T
Common carp	*Cyprinus carpio*	20	R	P,E,T
Cutthroat trout	*Oncorhynchus clarki*	60	Sp, Su, A	P,E,T
English sole	*Parophrys vetulus*	2,243	R	P,E
Eulachon	*Thaleichthys pacificus*	1,946	W, Sp	P,E,T
Largescale sucker	*Catostomus machrocheilus*	306	R	T
Lingcod	*Ophiodon elongatus*	11	Sp, Su, A	E
Longfin smelt	*Spirinchus thaleichthys*	18,933	R	P,E,T
Northern anchovy	*Engraulis mordax*	6,907	R	P,E
Northern squawfish (pikeminnow)	*Ptychocheilus oregonensis*	13	Su, A	T
Pacific herring	*Clupea harengus pallasi*	18,490	R	P,E
Pacific lamprey	*Lampetra tridentata*	36	W, Sp, A	E,T
Pacific sand lance	*Ammodytes hexapterus*	2,290	R	P,E
Pacific staghorn sculpin	*Leptocottus armatus*	6,986	R	P,E,T
Pacific tomcod	*Microgadus proximus*	8,540	R	P,E
Peamouth	*Mylocheilus caurinus*	1,709	R	E,T
Prickly sculpin	*Cottus asper*	3,118	R	E,T
Redtail surfperch	*Amphistichus rhodoterus*	41	Sp, Su, A	P,E
River lamprey	*Lampetra ayresi*	42	Sp, Su	P,E
Saddleback gunnel	*Pholis ornata*	42	R	P,E
Sand sole	*Psettichthys melanostrictus*	310	R	P,E
Shiner perch	*Cymatogaster aggregata*	17,381	R	P,E,T
Showy snailfish	*Liparis pulchellus*	13	R	P,E
Snake prickleback	*Lumpenus sagitta*	2,088	R	P,E
Sockeye salmon	*Oncorhynchus nerka*	60	Sp, Su	P,E,T
Speckled sanddab	*Citharichthys stigmaeus*	45	R	P,E
Spiny dogfish	*Squalus acanthias*	37	Sp, Su, A	P,E
Spotfin surfperch	*Hyperprosopon anale*	41	R	P,E
Starry flounder	*Platichthys stellatus*	16,438	R	P,E,T
Steelhead	*Oncorhynchus mykiss*	895	W, Sp, Su	P,E,T
Surf smelt	*Hypomesus pretiosus*	6,401	R	P,E,T
Threespine stickleback	*Gasterosteus aculeatus*	5,494	R	P,E,T
White sturgeon	*Acipenser transmontanus*	74	R	E,T
Whitebait smelt	*Allosmerus elongatus*	3,111	R	P,E

W=Winter (Jan-Mar); Sp=Spring (Apr-Jun); Su=Summer (Jul-Sept); A=Autumn (Oct-Dec); R=Resident; P=Plume and Ocean Zone; E=Estuarine Mixing Zone; T=Tidal Fluvial Zone

[1] From Bottom and Jones 1990

herring, the estuary is also a spawning ground. Resident species are mostly of freshwater origin although some marine species, such as shiner perch and Pacific staghorn sculpin, spend their entire life cycles in the estuary.

Adult marine fish that enter the estuary are generally confined to the deeper channels where salinity is high. Juvenile marine fish, however, are more tolerant of lower salinities and can be found further upriver and in the shallower areas associated with the bays.

Substrate in the estuary's bays is generally more stable than that in the channel, providing optimum habitat for colonization by benthic and epibenthic organisms. Demersal fish are attracted to the bays for this reason. However, some high energy areas such as the shifting sands in the middle of the river, which, despite their instability, have high seasonal populations of benthic and epibenthic species, also attract demersal fish. Pelagic fish are most likely to be found in areas rich in plankton. Fish most often found in the deeper channels of the estuary are white sturgeon, Pacific herring, shad, and surf smelt.

The estuary is used extensively as a nursery and rearing area by juvenile marine and anadromous fish. Juvenile marine fish , such as Pacific tomcod, surfperch, rockfish, sanddab, smelt, and flounder are usually confined to the lower estuary. Exceptions to this rule are the starry flounder, which is found as far upriver as Portland, and English sole and Pacific staghorn sculpin which are found at Tongue Point. Juvenile chum and fall chinook salmon are found in shallow waters while steelhead and cutthroat trout; and spring chinook, coho, and sockeye salmon migrate through the estuary's deeper waters (U.S. Department of the Interior 1986). Juvenile fall chinook remain in the estuary, primarily Cathlamet and Youngs Bays, to feed for several weeks before migrating offshore. This may explain their preference for shallow areas since a primary food source, C. salmonis, is found in the shallow, intertidal areas.

Juvenile sturgeon use the upper estuary as a nursery (U. S. Department of the Interior 1986). Cathlamet Bay is used by juvenile sturgeon under 2 years while older juveniles are found further downstream.

Hatchery releases of juvenile salmonids are presented in Table 2. Not all of these fish survive to enter the estuary, however. Recent estimates by NMFS show that only about 40 to 50 million yearling spring migrants and about 60 million 0-age fall chinook smolts are projected to actually make it to the estuary in 1998 (Pollard unpublished data). The number of wild fish entering the estuary is not known, although it probably is much lower than the above estimates of hatchery juveniles. But whatever the actual numbers of juvenile salmonids entering the estuary, this figure, combined with the use of the bays and sloughs by resident fish, emphasizes the extreme importance of the estuary to fish populations both offshore and upriver.

Table 2. Summary of hatchery releases of anadromous fish in the Columbia River Basin from 1994-1996[1]

1994 Numbers	1995 Numbers	1996 Numbers	3 Year Average Numbers
167,414,052	190,443,529	169,565,831	175,807,804

[1] Data from Fish Passage Center of the Columbia Basin Fish and Wildlife Authority

Fisheries (Marine/Estuarine)

The offshore areas of the Columbia River Estuary support valuable commercial and sport fisheries. One of the major offshore fisheries is for Dungeness crab. This fishery is located between Destruction Island, Washington and Cascade Head, Oregon. A primary crabfishing site is located in and around offshore disposal site, Area B. Crabfishing season extends from December through mid-August.

Within the estuary, there is also a major fishery for sturgeon. In 1996, the non-Indian commercial catch of sturgeon (white and green) for the lower Columbia River was 9,000 fish and the sport catch of white sturgeon totaled 43,000 fish (Norman and King 1997). The area from lower Puget Island to Chinook, Washington is a popular sportfishing area for sturgeon. Some of the most popular fishing sites are located at Grays Bay, Hunting Islands, and Woody Island in Washington and at Astoria, Tongue Point, and Clifton in Oregon. Fishing from boats and bank angling are both popular methods for catching white sturgeon.

Salmonid sport fishing within the estuary is minor except for the fishery at Buoy 10. The commercial gill-net fishery within the estuary has been severely restricted in recent years.

Offshore fisheries for salmon, both sport and commercial, increased from the mid-1960s through the early 1990s. Eighty percent of the coho and 70 percent of the fall chinook returning to the Columbia River were taken in the offshore fishery in the mid-1980s (U.S. Department of the Interior 1986) but, since 1992, these numbers have fallen significantly, particularly for commercial landings of coho. In 1997, there were no commercial landings of coho in Oregon and preliminary figures indicated only 6,000 fish were caught in the recreational ocean fishery off Oregon (Pacific Fisheries Management Council 1998). Preliminary figures for total commercial and recreational chinook catch show 158,000 fish were landed in Oregon in 1997. This figure is down from a high of 588,000 chinook in 1987.

There has been a growth in the offshore fishery for groundfish since the salmon gill-net fishery has been restricted. Offshore fishing for groundfish as well as other underutilized stocks has increased since passage of the Fishery Conservation and Management Act of 1976.

There are minor fisheries for warmwater fish such as crappie, perch and bass in the backwaters and sloughs of the estuary. A minor sport fishery for red-tailed surfperch also exists on both the North and South Jetties.

Fish (Riverine)

Adult Columbia River smelt (eulachon) usually enter freshwater between mid-December through mid-April, returning to tributary rivers such as the Grays, Cowlitz, Kalama, Lewis, and Sandy. The mainstem Columbia River supports smelt spawning in the Clifton Channel between Eagle Cliff and Stella (Map Series, Reach 5 and 4), and in the reach between the Kalama River and the Lewis River (Map Series, Reach 3). Smelt also spawn in the above-mentioned tributary rivers. Spawning generally occurs in areas of moderate flow velocity over substrate consisting of fine pea-sized gravel or semi-sandy materials. Smelt eggs can be found in depths ranging from 3 inches to over 20 feet. Driven by currents, newly hatched smelt larvae immediately begin drifting downstream to the ocean. Smelt larvae can be found anywhere in the river water column as well as from bank to bank.

White sturgeon are also an important component of the Columbia River system. They are known to spawn in only three river basins on the West Coast: the Sacramento/San Joaquin Rivers, the Columbia River, and the Fraser River in Canada. Studies on sturgeon spawning in the area immediately downstream of Bonneville Dam (McCabe and Tracy 1993) determined that spawning occurs over a period of 38 to 47 days from late April or early May through late June or early July. Spawning occurs primarily in fast flowing water at depths ranging from about 10 to 75 feet over cobble and boulder substrate. Larvae are dispersed over a wide area after hatching, sometimes, in the case of the Bonneville study, as far as 109 miles from the spawning site (McCabe and Tracy 1993). Young-of -the -year (YOY) white sturgeon also seem to prefer waters deeper than 40 feet. Feeding studies conducted in 1988 (McCabe et al. 1993) in two areas of the lower Columbia River showed that the amphipod, <u>Corophium salmonis</u>, was the most important prey item for the two size classes of juvenile sturgeon studied. Other important prey species included C. spinicorne, Neomysis sp., Chironomidae larvae, eulachon eggs, and the clam, Corbicula fluminea.

The mainstem Columbia River and its tributaries also support a varied and economically valuable population of anadromous fish. Anadromous fish are present in the river almost year round either as juveniles or adults, although some periods of use are more important than others (Figure 3). As in the estuary, sub-yearling juvenile chum and fall chinook prefer shallow waters and yearling juvenile coho, spring chinook, and sockeye salmon and steelhead trout appear to prefer deeper waters (U.S. Department of the Interior 1989).

The Columbia River salmonid populations contribute significantly to the well-being of the basin. The numbers of salmon and steelhead entering the Columbia River are presented in Table 3. The figures show a serious decline in the numbers of spring and summer chinook, sockeye, coho, and chum salmon and winter steelhead trout entering the river between 1993 and 1995 but an increase in numbers for spring, summer, and fall chinook, sockeye, coho, and chum salmon and winter steelhead trout between 1995 and 1996. In total, however, the number of returning adult salmon and steelhead has fallen from 918,000 in 1993 to 857,000 in 1996.

Table 3. Minimum numbers (in thousands) of adult salmon and steelhead entering the Columbia River[1]

Year	Chinook			Sockeye	Coho	Chum	Steelhead		Total
	Spring	Summer	Fall				Winter[2]	Summer	
1993	201.1	22.0	213.9	84.2	113.9	4.5	36.4	242.8	918.0
1994	81.6	17.6	255.3	12.7	170.3	1.2	(55.2)	211.9	805.8
1995	60.4	15.0	244.7	9.2	74.1	1.5	(21.0)	(251.1)	677.0
1996	94.3	16.0	331.0	30.3	111.7	3.3	(33.4)	(237.1)	857.1

[1] From Norman and King 1997 ( ) indicates estimate
[2] Abundance index

The Columbia River supports a wide variety of warmwater gamefish such as white crappie, yellow perch, largemouth bass, and brown bullhead. Starry flounder and mountain whitefish are also found in the river. The river also provides suitable habitat for nongame fish such as peamouth, carp, and largescale sucker.

Fisheries (Riverine)

Salmon support a major portion of the ocean commercial fishery from northern California to the Gulf of Alaska. Steelhead are taken commercially in the river by treaty Indian fisherman. The commercial river fishery (Indian and non-Indian) is also dependent on the salmon runs in the Columbia River (Table 4) as is the recreational ocean and river fishery. Recreational catch statistics for the lower Columbia River are included in Table 5.

Smelt are caught both commercially and recreationally but there is very little information on the recreational fishery for this species. The commercial catch of smelt for the years 1992 to 1996 is presented in Table 4. Data for 1996 indicate that the commercial catch of smelt fell to 9,100 pounds from a 1995 catch of 440,000 pounds. What is more telling about the smelt populations in the Columbia, however, is that the 1996 landings represent a decrease of over 99% from the 1992 landings of 3.7 million pounds.

A sturgeon sport fishery is popular throughout the river (Table 5) with fishing locations near Crims Island, the Kalama River, Sandy Island, various sites between Deer Island and St. Helens, Kelly Point, and the North Portland Harbor (Mohoric personal communication). The recreational fishery for sturgeon

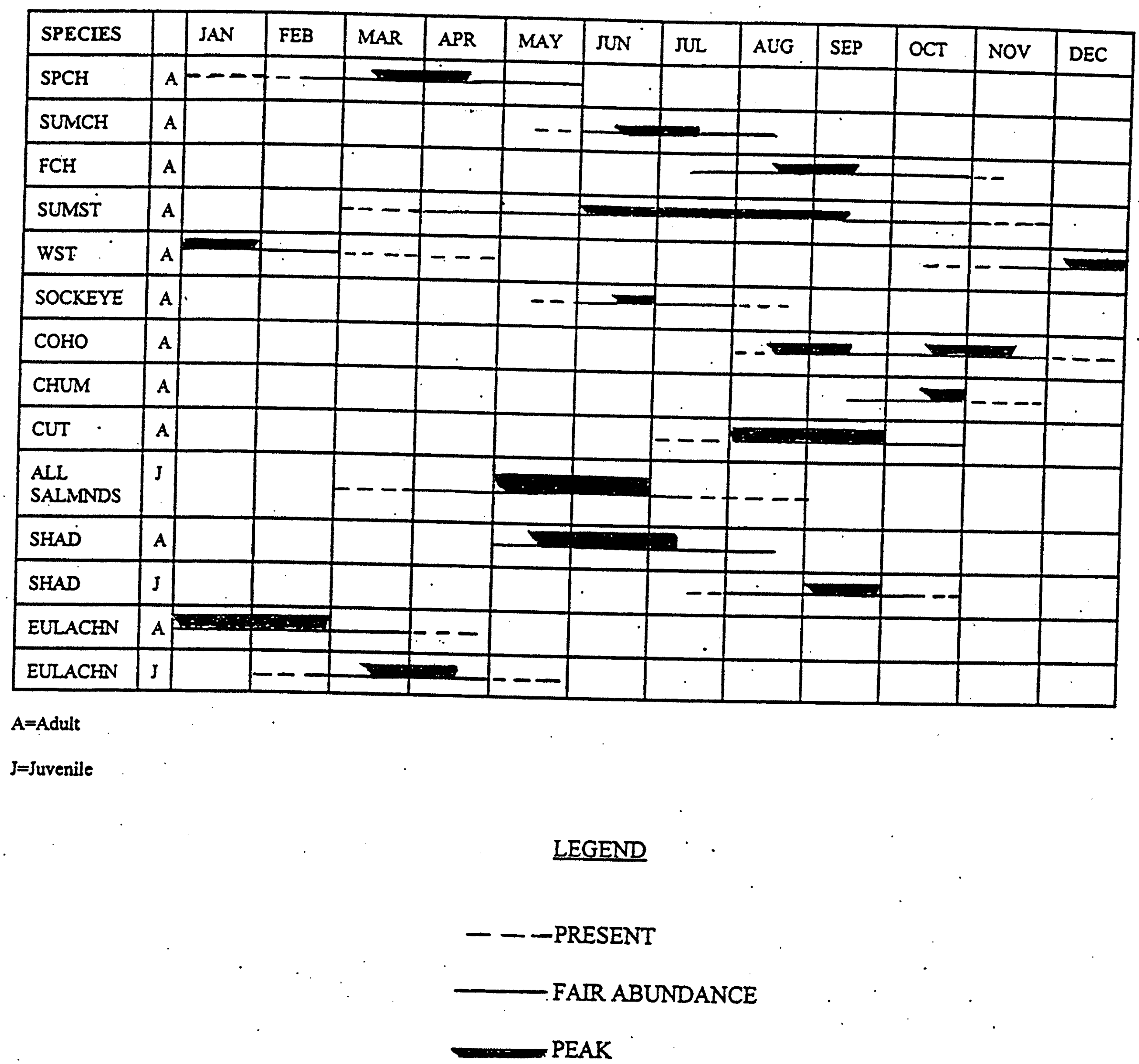


Figure 3. Relative Timing of Salmonids in the Lower Columbia River

has surpassed salmon fishing in recent years (Table 5) primarily due to low returns of salmon to the fishery.

Table 4. Lower Columbia River (below Bonneville Dam) commercial landings (thousands of pounds) and value to the fishermen (thousands of dollars) by species[1]

Year	Lbs.	Value	Lbs.	Value	Lbs.	Value	Lbs.	Value
	Chinook		Coho		Sockeye		Chum	
1992	426.6	614.4	299.0	269.1	0.0	0.0	6.9	1.7
1993	337.0	347.1	262.1	214.9	0.0	0.0	0.5	0.2
1994	64.1	122.4	496.3	411.9	0.0	0.0	0.5	0.1
1995	11.4	19.4	189.4	119.3	0.0	0.0	0.1	0.1
1996	282.8	115.9	229.6	142.4	0.0	0.0	0.3	0.1
	White Sturgeon		Green Sturgeon		Smelt			
1992	172.4	274.1	62.3	26.1	3,673.8	293.9		
1993	218.9	260.5	66.4	21.9	513.8	56.5		
1994	167.4	209.3	6.4	2.1	43.5	11.7		
1995	162.9	267.1	11.3	5.7	440.0	66.5		
1996	229.5	298.3	19.6	9.4	9.1	11.5		

[1] From Norman and King 1997

Table 5. Angler trips and catch (in thousands) in the Lower Columbia River (Bonneville to Astoria) recreational fisheries[1].

	Angler Trips			Catch				
Year	Salmonid[2]	Sturgeon	Shad	Chinook	Coho	Summer Steelhead	White Sturgeon	Shad
1993	(123.6)	187.8	20.3	5.6	0.5	9.8	37.9	111.4
1994	(85.0)	169.0	16.2	2.2	0.9	5.2	33.5	103.8
1995	(69.4)	191.4	17.8	4.6	0.2	8.1	45.1	101.4
1996	(79.1)	179.8	15.9	9.3	0.8	6.3	42.8	129.8

[1] From Norman and King 1997
[2] Numbers in parentheses indicate incomplete data

With the Project

Dredging of 110 mcy of material from the Columbia and Willamette Rivers over the next twenty years, accompanied by upland, flowlane/inwater, beach nourishment, and offshore disposal of this material, would have varying impacts on aquatic resources in the estuary and river. Aquatic impacts are discussed below.

Physical

Early on in the planning process for this project, it was thought that deepening the channel would promote greater movement of oceanic water into the estuary, possibly further upstream than RM 20 (the saltwater wedge boundary), and that saline water would be present in the estuary for longer periods. It was also thought that deepening the channel would effect the tidal circulation within the estuary, reducing the tidal flow and thus reducing the friction between the freshwater and saltwater interface. This could have lead to less vertical mixing and more stratification of the estuarine waters. Overall, there was concern that the estuary could become more saline in the channels and in some of the shallow bays.

As a result of this concern, an interagency workgroup was convened in 1995 to look into the effects of channel deepening on saltwater intrusion and the impacts of salinity increases, if any, on estuarine resources. This group met for a series of facilitated workgroup meetings in July and August 1995 and January and April of 1996. During that time, a number of different scenarios were modeled by hydraulic engineers at the Corps' Waterways Experiment Station (WES) in Mississippi. An existing model of the Columbia River Estuary was used to forecast salinity intrusion under a number of different flow and discharge conditions, including a worst-case scenario of very low freshwater outflow. Especially important was the modeling of what would occur in the backwater areas and bays under these conditions, particularly around the islands and shallow water habitats associated with Cathlamet Bay. Also available to the workgroup members was an analysis of channel deepening impacts on benthic invertebrates and estuarine vegetation done by the consulting firm of Woodward-Clyde Federal Services. The conclusions reached by concensus of the workgroup participants, utilizing existing data and tools, was that, while there was a slight increase in salinity with channel deepening, the impacts of even the maximum salinity increase (2.45 ppt in the channel areas) was well within the tolerance levels of benthic invertebrates and aquatic vascular plants and that no significant biological impact would occur from the predicted salinity changes resulting from the proposed channel deepening.

Other impacts to aquatic resources from dredging would still occur, however. Nutrient input from short-term upwelling created during dredging could increase, although nutrient sources in the estuary itself should not change dramatically.

Deepening the channel could also lead to bank sloughing and losses of intertidal habitat as the channel widens. This would depend on the channel slope created during dredging, the materials of the channel slopes, and on the proximity of the channel to intertidal or shallow subtidal habitats. Disposal associated with the creation of pile dikes (around Miller Sands Spit) and shallow subtidal habitat (at Miller-Pillar Islands) could cause changes in the tidal prism in these areas, an impact that could mean losses of vegetation, reduction in nutrient input, changes in the distribution of estuarine species, and increased shoaling in areas where tidal flushing is changed.

Disposal in the offshore areas should not have a long-term impact on nutrient levels. However, there could be impacts on sediment grain size and composition of the disposal area and a resulting adverse impact on benthic and epibenthic organisms which are susceptible to changes in sediment grain size. This impact could be avoided, however, if efforts were continued to dispose of like materials on like materials. Over the past several years, there have been problems with mounding of the material deposited in some of the offshore disposal sites. This mounding has changed wave patterns and has caused concern regarding navigation safety, particularly for crab and trawl fishermen. The mounding, however, has not been proven to have had long-term impacts on benthic, epibenthic (crab), or fish resources. The Corps is investigating means of disposing of dredged material in the offshore sites so that mounding would not occur or would be significantly reduced. One of these methods is to spread the disposal over a wide area and to alter the disposal pattern (a method similar to thin-layer disposal). Studies have been initiated to look at the impact of disposal on soft-shell crabs. Results to date have been inconclusive and additional research is needed, particularly on adult soft-shell crabs, before disposal impacts on soft-shell crabs can be accurately predicted.

For over two and one half years, efforts have also been made to designate alternative (candidate) offshore disposal sites. These offshore sites are used primarily for disposal of dredged material from the mouth of the Columbia River (MCR) but some of the construction material and some of the O&M material from the estuarine portion of the proposed channel deepening project would also be disposed offshore. The Corps garnered input from resource agencies, fishing groups, and the general public on acceptable areas in terms of impacts to biological resources as well as economic use of those resources. Three sites were proposed for consideration as candidate offshore disposal sites: an expanded Area E and two sites known as the North and South sites. These sites are located in areas of high energy (decreasing chances for mounding), within the littoral transport zone (increasing the probability for beach nourishment along the Washington shoreline), outside tow lanes, and in areas of low benthic productivity. The configuration of these sites also attempts to avoid areas of high crab concentrations, fish rearing, and fisheries use. The North and South candidate sites do cover a large area but the size of the areas provides the opportunity to dispose of material without causing mounding or permanent losses of habitats and organisms resulting from disposal in the same area year after year. However, recent meetings of the offshore disposal site workgroup have resulted in a change in the dimensions and location of the North and South sites. A new disposal site which is more amenable to most of the offshore disposal team participants has been tentatively delineated. It is a smaller site than either the North or South site and located in deep water. Disposal at this site would most probably result in permanent losses of habitat and resources over time; monitoring of disposal activities at this site would be necessary to determine losses and possible mitigation needs.

The dredging associated with channel deepening could cause increases in the amount of turbidity generated in the estuary as well as in the river. With the channel deepening, there is the possibility that there would be new materials of varying grain size encountered in the estuary and the river and that the range of the turbidity maximum could be shifted upstream. Increased ship wake generated by larger ships traveling in the deepened channel could also lead to more erosion along the river shoreline (bank sloughing) and, possibly, to a chronic turbidity problem around these erosive sites.

Contaminants

Contaminant impacts from dredging and disposal activities would be variable and difficult to pinpoint. Bioaccumulation of organochlorine compounds have been documented in various levels of the Columbia River food chain, including invertebrates (Corophium sp. and Corbicula sp.), fish, and fish-eating birds (U.S. Fish and Wildlife Service unpublished data). Several studies within the lower Columbia River have associated contaminants in the food chain to problems with reproductive success in bald eagles and reproductive tract abnormalities in otters (U.S. Fish and Wildlife Service 1998, Henny et al. 1996).

Dredging activities could result in the resuspension of sediments in the water column during both dredging and disposal of dredged material. Dredging contaminated sediments increases the bioavailability of some contaminants to aquatic organisms. Seelye et al. (1982) have shown that persistent compounds such as polychlorinated biphenyls (PCBs) and dichlorodiphenyldichloro-ethylene (DDE) can be accumulated by fish directly from exposure to resuspended sediments. Contaminated materials containing low concentrations of organochlorine compounds, especially in the Willamette River, may pass the Corps testing requirements or screening levels and be dredged and disposed of in the flowlanes of the Columbia and/or the Willamette Rivers. Once in the flowlane, fine materials containing organochlorines could accumulate in shallow areas, tidal flats, or other depositional zones, and thus become available to aquatic organisms. Low concentrations of persistent compounds such as some organochlorine pesticides, PCBs, dioxins, and furans can bioaccumulate within the food chain in these depositional areas and impair reproduction in top level predators. In addition, many of these organochlorine contaminants disrupt the immune or endocrine system (Colborn et al. 1993), and very low concentrations of these chemicals could adversely impact fish and wildlife during sensitive life stages.

Numerous fish and wildlife species in the Columbia River contain organochlorine contaminants (U.S. Fish and Wildlife Service unpublished data). Currently, the Columbia River does not meet water quality standards in certain reaches due to DDE and PCB residues in fish and wildlife (DEQ 1996). Due to elevated 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), a total maximum daily load (TMDL) has been established for the Columbia River and should not be exceeded. The lower Columbia River is considered "Water Quality Limited" due to these contaminants, and any additional loading of DDE, PCBs, or dioxin-like compounds would further degrade the water quality of the river. Disposal of materials contaminated with organochlorine compounds into the flowlane and subsequent accumulation in biota would violate water quality standards for certain reaches of the river.

Recent studies have documented polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (including dichlorodiphenyltrichloroethane (DDT) and its metabolites, DDE and tetrachlorodiphenyl-ethane (DDD)), PCBs, dioxins, and furans in water, sediment, and fish tissue within the lower Willamette River (Curtis et al. 1993, Oregon Department of Environmental Quality 1994, Harrison et al. 1995, Corp of Engineers 1998 (Columbia River Channel Deepening Sediment Quality Evaluation, handout received at public meeting). Whole water (unfiltered) samples from surface runoff into the Willamette River in Portland were found to contain up to 30 ng/kg DDT and up to 200 ng/kg total PCBs as well as DDT and its metabolites. PCBs were also detected in sediment within the lower river, ranging from 3.8 (DDE) to 100 (total PCB) μg/kg dry weight (Harrison et al. 1995). PAHs were frequently found in sediment from this reach at concentrations up to 900 mg/kg wet weight, and two PAHs were measured in one fish sample (Curtis et al. 1993, Oregon Department of Environmental Quality 1994, Harrison et al. 1995). PAH concentrations in numerous sediment samples recently collected by the Corps from the lower Willamette River exceeded screening levels, and two samples were over 1,000 ppm dry weight for total PAHs (Corp of Engineers 1998, Columbia River Channel Deepening Sediment Quality Evaluation, handout received at public meeting). Common carp (Cyprinus carpio) and northern pikeminnow (squawfish) (Ptychoceilus oregonensis) collected from the river, particularly between RM 6 and RM 8, contained median concentrations of DDT, DDD, DDE, and total PCBs which exceeded threshold values derived from U.S. Environmental Protection Agency (EPA) water quality criteria (Oregon Department of Environmental Quality 1994). Maximum values of total PCBs and three co-planar PCBs were detected in fish collected from RM 7 (Oregon Department of Environmental Quality 1994).

Dioxins and furans were also found elevated in sediment and fish from the lower Willamette River. Sediment from the Portland Harbor area near river mile seven exhibited significantly higher concentrations of dioxin (TCDD) and 2,3,7,8-tetrachlorodibenzofuran (TCDF) than upstream values (Curtis et al. 1993). Whole body northern squawfish samples exhibited significantly higher TCDD and TCDF values from this area than from upper reaches, with mean values of composite tissues exceeding 1.3 and 16 ng/kg wet weight for TCDD and TCDF, respectively (Curtis et al. 1993). Common carp collected from the Portland Harbor near RM 7 exhibited significantly more total cytochrome P450-1A1 in hepatic microsomes than in fish from upstream locations, indicating physiological evidence of exposure to aromatic hydrocarbons (Curtis et al. 1993).

Anthropogenic releases of contaminants within the lower Willamette River have created conditions which clearly threaten immune and endocrine system function and long term survival of outmigrating juvenile salmonids, including listed (spring chinook salmon, steelhead trout) and candidate species (coho salmon). Studies conducted in urban estuaries in Puget Sound, Washington have documented significant accumulation of PAHs and organochlorine compounds in outmigrating juvenile chinook salmon, and have linked this accumulation in the salmon to altered immune responses (suppression of B-cell mediated immunity and immunological memory) and elevated levels of hepatic DNA adducts (McCain et al. 1990, Arkoosh et al. 1991 and 1994, Stein et al. 1995). PAHs and organochlorine concentrations in sediment collected from the Puget Sound urban estuaries (Malins et al. 1982) were similar to concentrations observed within the lower Willamette River. Site-specific investigations of Willamette River sediment and resident fish tissue contaminant levels, in conjunction with similarities of the Willamette River sediment contamination to urban estuaries in Puget Sound, indicate that contaminant conditions in the Willamette River currently threaten the health of outmigrating juvenile anadromous fish. Dredging material contaminated with PAHs and organochlorines at concentrations above or below screening levels are likely to impact juvenile salmonids that rear in the lower Willamette and Columbia Rivers.

Primary Production

Marine phytoplankton could be shifted slightly upstream with the greater amount of oceanic water entering the estuary because of the channel deepening. However, this shift would be seasonal and temporary. There would not be a proportional decrease in the production of freshwater phytoplankton, however, since freshwater species would still be entering the estuary from upriver sources. Dredging in the estuary and the river would have some temporary impacts on phytoplankton production depending on the amount and duration of turbidity produced. Inwater disposal activities would also limit phytoplankton production for short time periods. Dredging would not impair benthic productivity to any great degree in the estuary or the mainstem river. This is due to the relatively short-term impacts associated with dredging. Most benthic colonies repopulate an area within a season (McCabe et al. 1996). Benthic productivity, however, could suffer as the result of disposal activity depending on the disposal site location, duration of disposal (how often the disposal site is used), and the number of disposal sites within the estuary and the river. This would be particularly true for inwater, flowlane, and beach nourishment sites. However, based on the above studies, changes in productivity are expected to be short-term.

Invertebrates

As with phytoplankton, the densities and diversity of zooplankton in the estuary would increase with saltwater intrusion. Certain species, i.e., copepods would probably become the most common species within the zooplankton since they are of marine origin.

Benthic: Marine benthic species distribution could shift slightly upstream in the estuary with channel deepening. Those species which are only nominally present now such as bay mussels and barnacles could become more common in the estuary over time. However, this slight shift is not expected to have long-term impacts on the ecosystem. Corophium, an important fresh/brackishwater amphipod upon which juvenile salmonids and sturgeon feed heavily, would not be significantly impacted by the small increases in salinity expected with the project.

Deposition of dredged material in offshore disposal sites would have an immediate adverse impact on benthic species. The long-term impacts, however, in terms of overall productivity, are not readily apparent. Benthic sampling in offshore areas by NMFS have shown that benthic densities vary by site but are generally moderate to high (Emmett and Hinton 1995, Hinton and Emmett 1994 1996). Studies by Siipola et al. (1993) and Richardson et al. (1977) have shown that disturbance to benthic populations in terms of disposal activity does not produce long-term reductions in benthic invertebrate densities or productivity, i.e., these areas recover within six months to one year. However, continual disposal on a specific site over a long time period may have adverse effects on benthic species. Monitoring studies specific to these disposal sites would be necessary to determine overall losses and to assess mitigation needs or levels.

Impacts on benthic populations in the estuary and main river channel in certain areas proposed for flowlane/inwater disposal would be adverse. Most flowlane disposal would occur in depths of 50 to 65 feet. However, between RM 64 and 68 and RM 90 and 100, flowlane disposal would occur in depths of 35 to 65 feet. It is expected that flowlane disposal in five specific areas of the estuary and river would raise the depth of the channel bottom by 20 feet over 20 years (includes disposal estimates from initial construction and O&M activities). These areas are from RM 5 downstream; RM 29-35; RM 39-40; RM 54-54+30; and RM 72+20 to RM 73+20. All disposal in these areas would be in 65 to 110 feet of water. This disposal plan could result in lowered benthic productivity and consequent losses of food availablity for a variety of fish species, most importantly YOY, subadult, and adult sturgeon. If any of this flowlane disposal material were to drift into shallower areas , salmon would also be affected.

Epibenthic: Crabs in the soft-shell stage in the offshore disposal areas could be adversely effected by disposal. However, the severity and long-term effects of such disposal on ocean crabs in the soft-shell stage are not known. Disposal studies recently completed by the Corps have been inconclusive. Additional work would have to be done before an answer to the question of disposal impacts on soft-shell crabs could be accurately defined.

Fish (Marine/Estuarine)

As with the lower food chain organisms, fish densities and distribution in the estuary could change with increased salinities; however, it is not expected that salinities would increase to any great degree, i.e., salinity changes would remain within normal ranges. Consequently, temporary shifts in distribution would not be considered to have a significant impact on fish in the estuarine system.

Juvenile anadromous fish could be impacted by channel deepening in terms of where they acclimate to saltwater in the estuary if there are changes in the saltwater/freshwater interface. This area may be slightly further upstream during the late summer and fall due to more saline conditions in a greater portion of the estuary. However, any changes in salinity attributable to the project are expected to be within the range of normal salinity shifts and would not cause significant impacts to smolting salmon juveniles. Juvenile salmonids would be more adversely impacted by the filling of shallow water habitats particularly those containing Corophium or other important food sources. Beach nourishment and pile dike construction are, therefore, more likely to impact juvenile salmon than the salinity changes. Construction of pile dikes could lead to increased foraging opportunities for piscivorous birds such as terns and cormorants with resultant increases in juvenile salmon mortalities. If the pilings were constructed so as to minimize bird use, i.e., using metal cones or caps, wires, nails, etc., such mortalities could be significantly reduced.

Because smelt larvae are ubiquitous within the water column after spawning occurs, they are very susceptible to entrainment during dredging operations. The WDFW is concerned about the low numbers of Columbia River smelt returns in recent years and has added smelt to a State list of species of recreational, commercial, and/or tribal concern. Further losses associated with dredging would not be acceptable and must be avoided.

White sturgeon populations in the Columbia River would be impacted the most by flowlane disposal of dredged materials, particularly if benthic invertebrate food sources in the channel are disturbed or destroyed. The majority of larval and YOY sturgeon rear and feed in the deeper waters of the river. Flowlane disposal in areas deeper that 65 feet, as proposed by the Corps for certain areas of the Columbia River, could adversely impact larval and YOY sturgeon by reducing the suitability of these areas for rearing and covering available food sources. There is also the possibility that larval sturgeon could be buried during disposal. Flowlane disposal, which is also proposed for depths between 35 and 65 feet for two areas of the river, could result in materials settling out in off-channel areas where benthic invertebrate densities are higher. Although commonly associated with deepwater habitats, adult and subadult sturgeon feed in these shallower waters and would be adversely effected by even a temporary loss of this food source. Sturgeon are also particularly susceptible to the bioaccumulation of toxins from contaminants in the food chain. While there should be minimal contaminant exposure from deepening the channel itself, since most of this material is clean sand, the possibility remains that the channel deepening could lead to secondary developments in areas of fine-grained materials where contaminants are more prevalent. In these cases, the sturgeon feeding in these shallow water areas could be subject to adverse effects from contaminants including direct mortality, susceptibility to disease, and reproductive dysfunction. Studies to determine the cumulative effect of dredging and disposal on sturgeon should be initiated prior to project construction. Studies should focus on monitoring contaminant-related changes in stock productivity (age structure, relative abundance, and total mortality), entrainment, and direct mortality. If these studies indicate significant disposal related losses of sturgeon and sturgeon habitat, flowlane disposal in waters deeper than 30 feet should be reduced or eliminated to protect sturgeon.

Ocean offshore disposal of dredged material would have minor, temporary impacts on most adult fish resources. Although there would be some declines in the abundance and diversity of fish at first, populations would be expected to recover. Impacts on juvenile fish, particularly juvenile flatfish, however, may be adverse and long-term depending on how far the disposal materials spread out from the initial disposal site. Monitoring studies should be initiated to determine these impacts.

Dredging in the mainstem Columbia and Willamette Rivers could disturb the migration of anadromous fish which are present almost year-round. Dredging during peak migration periods would have the greatest impact on salmonids possibly causing delays in juvenile and adult migrations. Depending on the timing and location of dredging, there could also be adverse effects on commercial gill netting in the Columbia River.

Inwater riverine disposal sites would most impact demersal fish which feed heavily on benthic species. Sturgeon (larval, YOY, juvenile, and adult phases) would be most impacted by flowlane disposal and possible contaminant-related effects (see above discussion for estuarine impacts). Juvenile salmonids could also be impacted by inwater disposal activities, especially in those areas where disposal would cover Corophium beds, both in and near the channel and in shallow water feeding areas (beach nourishment).

Fisheries (Estuarine/Riverine)

Little impact on the commercial or sport salmon fishery is expected from dredging. However, inwater disposal may impact the salmon fisheries as well as commercial crabbing sites. The sport and commercial sturgeon fisheries may relocate further upstream in the estuary. Inwater disposal may also cause some filling of adjacent shallow bays due to the drifting of material away from the original disposal site. This could have a long-term impact on species utilizing these shallow water areas.

WILDLIFE RESOURCES

Without the Project

The Columbia River Estuary supports a wide variety of habitats as well as the amphibians, reptiles, birds and mammals dependent upon them.

Vegetation

In the lower estuary on Clatsop Spit, Jetty A, East and West Sand Islands as well as on the man-made islands (Miller Sands, Rice Island, Lois and Mott Islands, and Jim Crow Island), the dunes and sandy areas are the dominating feature. European beach grass is most common to the dune areas while exotic and native grasses dominate on the remaining vegetated portions of these islands.

Sitka spruce is the climax forest species in the lower estuary. Other trees species include red alder, big-leaf maple, western hemlock, Douglas fir, and shorepine. The upper estuary is dominated by western hemlock, a productive and extensive lowland conifer forest. Other trees associated with this habitat type include red alder, western red cedar, big-leaf maple, Oregon ash, black cottonwood, Douglas fir, and grand fir.

Vegetation associated with the mainstem Columbia River is similar to that described for the estuary except that portions of the river are more developed than the estuary and the vegetation here is more scarce. The major vegetative type is the riparian habitat along the river shoreline and on the islands in the river. Major tree species include black cottonwood, Oregon ash, and Pacific willow. The dominant species in any mixture of these species is determined by elevation with cottonwood at the higher elevations and willow at the lower elevations. Understory species typical of the river's shoreline and island habitats include red-osier dogwood, Himalayan blackberry, and elderberry. Forbs such as stinging nettle, mosses, Equisetum spp., and cress spp. are common. The dominant grass in these communities is reed canarygrass. In disturbed areas, the vegetative communities include species such as scotch broom, mosses, lupine, fireweed, and various grasses.

Amphibians and Reptiles

Northwestern pond turtles, painted turtles, common garter snakes, western racers, western fence lizards, and western skinks are representative of the reptiles found throughout the project area. These species inhabit a variety of habitat types ranging from ponds, streams, marshes, and moist forests to woodlands, meadows, and grasslands. Amphibians in the area include the red-legged frog, Pacific chorus frog, bullfrog, western toad, Pacific giant salamander, long-toed salamander, and roughskin newt. These species live in moist forests or forested wetlands and all require some type of waterbody such as a pond, lake, or stream for breeding (Nussbaum et al. 1983, Stebbins 1985, Corkran and Thomas 1996).

Avifauna (Marine/Estuarine)

Pelagic birds associated with the offshore habitat of the Columbia River include shearwaters, common murres, gulls, and storm-petrels. Phalaropes, fulmars, and California gulls are commonly associated with the fall coastal migration whereas the winter pelagic bird populations include murres, auklets, and kittiwakes in addition to the former species (USACE 1997).

Many species of birds are dependent on the Columbia River Estuary for their life requisite needs, i.e., food, nesting habitat, cover, and resting. Five grebe species occur in the estuary (western, red-necked, eared, pied-billed, and horned) with the western grebe being the most numerous, occurring throughout the estuary, particularly in the bays during migration and winter. Double-crested cormorants, western gulls, red-throated, common, and Pacific loons, Caspian terns, and a variety of waterfowl and other gull species are common water birds associated with the estuary. Brown pelicans occur along the Oregon Coast from April through October. Concentrations of up to one thousand birds develop at the mouth of the Columbia River at the south jetty and at East Sand Island/Baker Bay. Brown pelicans forage in nearshore waters of the ocean and within the estuary itself.

Western and glaucous-winged gulls, double-crested cormorants, and Caspian terns nest within the estuary (Figure 4). Double-crested cormorants can be found in large nesting colonies on East Sand and Rice Islands; Caspian terns occupy a large breeding colony (about 10,000 pairs) on Rice Island. Gulls also utilize the disposal islands in the estuary as well as Cape Disappointment as nesting sites. Pelagic and

Brandt's cormorants nest on the cliffs at Cape Disappointment. Great blue herons are common estuarine species. Two rookeries are noted on Figure 4 and other nesting sites are thought to be on the Washington side of the estuary adjacent to Baker Bay, on Price Island (RM 35), Hunting Islands (RM 37), Ryan Island (RM 38), and in the Brown Island-White Island area (RM 45). Other marsh birds such as the egret are also present in small numbers.

Waterfowl are commonly found in the estuary during spring and fall migrations although some species overwinter. Diving ducks are more common in the lower and middle estuary while dabblers are more common in the upper estuary. Geese are present throughout the estuary. Swans are generally found in the middle and upper reaches of the estuary. Figure 4 shows the areas where waterfowl are concentrated. Particularly important waterfowl habitat is provided by Baker, Grays, and Cathlamet Bays, and Lewis and Clark and Julia Butler Hansen National Wildlife Refuges. Geese, cinnamon teal, mallard, and wood duck nest in the estuary.

Raptors present in the estuary include bald eagles, peregrine falcons, hawks, ospreys, and owls. These species forage on the bird, fish and/or small mammal resources of the estuary. Game bird species such as grouse, quail, and pheasant are also present but in small numbers.

Shorebirds are abundant within the estuary and in upriver areas. On a seasonal basis, they can be found in intertidal marsh/mudflats, non-tidal freshwater marshes, and flooded agricultural lands along the Columbia River. Western sandpipers, sanderlings, dunlins, least sandpipers, dowitchers, semipalmated plovers, common snipe, and red-necked phalaropes are the most abundant species present. Shorebird surveys have noted 10,000 to 40,000 birds in Cathlamet and/or Grays Bay and a total of 160,000 birds in the area from the Columbia River Estuary upstream to Wallace Island (RM 48) during spring migration (USACE 1997).

Resident and migratory passerine birds are common to the estuary. Some of the more abundant species include blackbirds, song sparrows, kinglets, Swainson's thrushes, rufuous hummingbirds, and belted kingfishers. Riparian vegetation seems to be their preferred habitat. Upland areas, including vegetated disposal sites, are used by savannah and white-crowned sparrows, horned larks, and western meadowlarks. Some of the higher marshes containing bullrushes and/or willows provide nesting habitat for common yellowthroats and song sparrows. Swallows forage over marshes, mudflats, and open water.

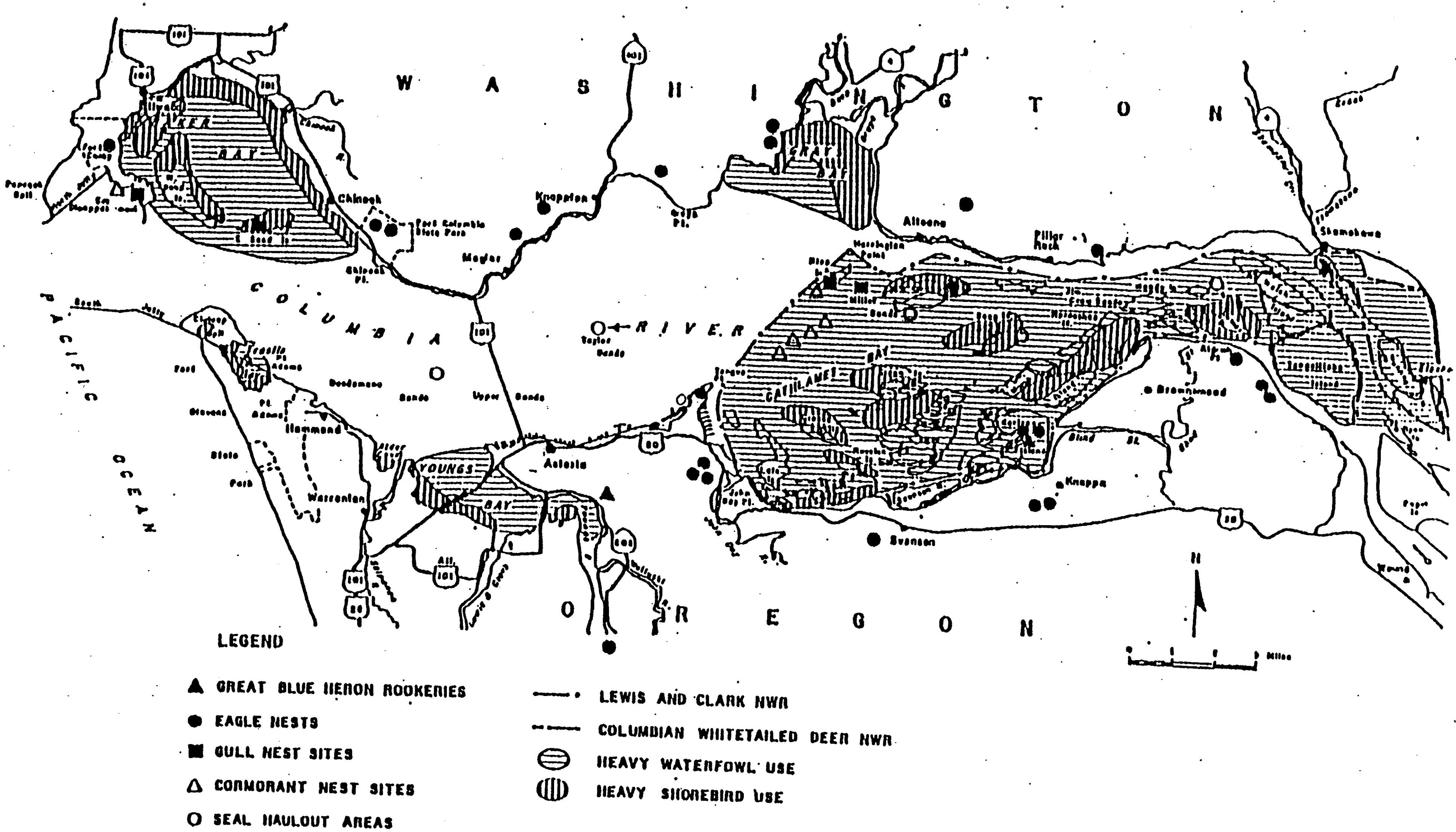


Figure 4. Major Wildlife Uses in the Columbia River Estuary

Waterfowl hunting in the estuary is moderate. Duck hunting areas include Trestle Bay, East and West Sand Islands, and the marshes on the east side of the Skipanon River and Cathlamet Bay. Most hunting occurs east of Cathlamet Bay.

Avifauna (Riverine)

Waterfowl species using the mainstem Columbia River include American wigeon, mallard, scaup, northern pintail, cinnamon and green-winged teal, and Canada goose. Woodland Bottoms, Sauvie Island, including the ODFW Wildlife Management Area, Ridgefield National Wildlife Refuge, and Vancouver Lake Lowlands provide excellent waterfowl habitat and support large concentrations of waterfowl. Agricultural lands along the river offer substantial foraging habitat for waterfowl. Some nesting by Canada goose, mallard, wood duck, and cinnamon teal does occur along the river but the overall production value of the river is limited. Disposal islands have become important nesting sites for resident Canada geese and mallards. However, the river's primary value to waterfowl is as migratory, foraging, or resting habitat.

Great blue heron rookeries can be found at various points along the river. One of the more productive sites has been on Deer Island with 91 nests observed in 1984. Additional rookeries are located at Carlson Island, Fisher Island near Willow Grove and on the Collins Estate near Cottonwood Island. Other water birds present on the river include cormorants, western grebes, and loons. Snow geese and tundra swans also use the river and its associated wetland areas during the winter.

Upland game birds such as quail and pheasant can also be found within the riverine portion of the project area. They sometimes occur in pasture lands, reed canarygrass, and large willow stands (habitat generally associated with islands in the river) but are usually found in upland vegetation. Band-tailed pigeons, ruffed grouse, and mourning doves also occur along the project length. Band-tailed pigeons and ruffed grouse are found in forested uplands and mourning doves are commonly associated with riparian forest/agricultural lands in the more upriver portions of the project.

Common raptor species associated with the river include red-tailed hawk, rough-legged hawk, bald eagle, peregrine falcon, northern harrier, osprey, kestrel, great horned owl, western screech owl, and northern saw-whet owl. Many of the existing disposal areas are utilized by these species as feeding areas. Red-tailed hawks are abundant along the river with substantial nesting and wintering populations making use of island and mainland habitat. Rough-legged hawks are present during the winter or as migrants. Northern harriers are present as residents, migrants, and wintering birds and are associated primarily with grasslands, marshes, and agricultural fields.

Other birds common to wetlands and marshes associated with the river include rails, coots, and sandhill cranes. Both Virginia and Sora's rails can be found in non-tidal marshes behind dikes while American coots are present in both saltwater and freshwater marshes as well as marshes, ponds, and lakes outside tidal influence. Sandhill cranes utilize the marshes and wetlands in the upper portion of the river and are abundant at Sauvie Island Wildlife Management Area, Ridgefield National Wildlife Refuge, Vancouver Lowlands, and on surrounding private lands.

Passerine birds are common to the Columbia River. These birds are present on a seasonal, migratory, or resident basis. Song sparrows, tree swallows, American robins, Bewick's wrens' Swainson's thrushes, golden-crowned kinglets, and western meadowlarks are representative of the species using the Columbia River corridor.

Mammals (Marine/Estuarine)

Northern and California sea lions are present offshore and in and around the jetties and lower estuary. The harbor seal is the most common of the pinnipeds. Haulout areas are located at Desdemona Sands and Taylor Sands (Figure 4), and at a few sites in the upper estuary, particularly the Astoria East End Boat Basin. Harbor seals are most abundant in the estuary during the winter and spring. They feed primarily on anchovies, eulachon, and lamprey. Other marine mammals located offshore include the northern fur seal, northern elephant seal, killer whale, pilot whale, gray whale, mink whale, harbor porpoise, and Dall porpoise. Elephant seals, harbor porpoises, and gray whales are sometimes seen in the estuary.

The Columbia River Estuary provides habitat for abundant populations of river otter, nutria, beaver, muskrat, and raccoon. Mink, once abundant, are now rarely found using the estuary (Henney et al. 1996). Small mammals like the Townsend's vole, vagrant shrew, mole, and deer mouse are also common. The latter are found in the high and mid-elevation marsh areas with steep-sided tidal channels. The muskrat and nutria depend on Lyngby sedge, sitka willow, soft-stem bulrush, and reed canarygrass/cattail communities for forage. Nutria can be found inhabiting dredged material islands, intertidal marshes, swamps, sloughs, ponds, and diked agricultural and wetland habitat. Beaver are most commonly found in wetlands and in water bodies associated with adjacent riparian forests. Beaver and raccoon feed in sitka spruce, sitka willow, and willow/dogwood communities. Species which occur occasionally within the estuarine project boundaries include coyote, mink, skunk and opossum. There is a minor trapping effort in the estuary for nutria, muskrat, and river otter.

Black bear, black-tailed deer, Roosevelt elk, and Columbian white-tailed deer are the four large terrestial mammals associated with the estuary. Deer use the shoreline habitat with black-tailed deer most common in the lower estuary and Columbian white-tailed deer more prevalent in the upper estuary. Elk generally do not inhabit the developed areas along the river, but they can be found in diked marshes, i.e., the Julia Butler Hansen National Wildlife Refuge, and in coniferous forested hills adjacent to the river (but out of the project area) where they overwinter. Black bear inhabit areas similar to Roosevelt elk.

Big game hunting within the estuary boundaries is minor. The States of Washington and Oregon, however, are sites of major hunting effort in the upper portions of the estuary and the adjoining drainages.

Mammals (Riverine)

Muskrat and nutria are common to the shoreline and riparian areas of the river. They prefer tidal marshes, Sitka spruce, and willow habitat. River otter are also present along the river but in limited numbers. Opossums, skunks, and raccoons are present although, except for the raccoon, these species prefer non-tidal habitat. Small mammals such as the Townsend's chipmunk, Townsend's vole, vagrant shrew, and Townsend's mole are present in upland and marsh habitat and are often found to use disposal sites. Several species of bats also utilize the project area from the estuary to the upriver boundaries of the project at Portland and Vancouver.

Black-tailed deer, Columbian white-tailed deer, elk, and black bear are also present along the river corridor. Except for the Columbian white-tailed deer, these big game animals prefer forested, upland communities, although they can sometimes be found using the river shoreline. Low lying mainland areas and islands in and along the Columbia River from about Skamakowa, Washington (RM 33) to Port Westward, Oregon (RM 54) are the preferred habitat of the Columbian white-tailed deer.

With the Project

Vegetation

The proposed project involves several inwater/flowlane fills but the majority of the disposal sites are on upland areas. Although these upland sites have been screened to avoid filling wetlands and riparian habitat (ESA critical habitat for listed fish species) as much as possible, there remain some sites where filling would still involve the loss of wetland vegetation, pasture grasses, agricultural cropland, and riparian trees and shrubs. It is this loss of habitat and the resulting impacts to wildlife species which has been addressed in the HEP analysis.

Amphibians and Reptiles

Red-legged frogs, western pond turtles, roughskin newts, and long-toed salamanders would experience significant losses in breeding and rearing habitat on those sites where wetlands and riparian habitat would be impacted by disposal. On some of the sites, wetland and forested riparian areas would be covered with disposal materials over a 50-year period. Mitigation efforts would need to be comprehensive to offset these losses.

Avifauna

The seabird population offshore would not be directly impacted by dredging or disposal. However, there may be some very short term disruptions in prey availability due to turbidity, prey displacement, etc. immediately following disposal in offshore sites, and a consequent minor disruption in seabird feeding activity. However, most seabird feeding activity increases around the disposal site for short periods after disposal. Also, should there be an increase in the number of marine prey species moving into the estuary on a seasonal basis as the result of dredging, the seabirds may also follow. However, such shifts in feeding locations would be transitory and should not cause any long-term impacts.

The additional filling of established disposal sites may temporarily impact colonial nesters and shorebird use of the disposal areas but management of these areas may negate this effect. Raptors, upland game birds, and passerine species would be similarly effected but with potentially more severe impacts from the filling of riparian and wetland areas. This is true of both estuarine and riverine disposal sites. This potential loss of riparian and wetland areas is why it is especially important to ensure that any proposed mitigation for such losses not only replaces but increases the amount and/or the value of such habitat.

Mammals

Marine mammals could be impacted by disposal of material in and around their haulout areas. Any increases in the numbers of marine fish within the estuary resulting from a deepened channel would probably lead to some increase in the numbers of marine mammals entering the estuary. What impact this would have on estuarine fish resources is not clear, although it has been agreed to (via the salinity workshop) that any increases in salinity resulting from channel deepening would still be within normal salinity ranges and would not lead to any significant or permanent changes in prey distribution. It is expected, therefore, that any increases in marine mammal use of the estuary directly related to the channel deepening would be temporary in nature.

Furbearer impacts would be felt primarily in the freshwater areas of the estuary where most furbearers reside. Disposal in wetlands and riparian habitat could lead to changes in the availability of food for raccoon, mink, otter, muskrat, and beaver and could also directly effect the productivity of these species. It is important that mitigation management and monitoring of upland disposal sites be effective in offsetting habitat losses for these species.

Big game species such as deer and elk would be negatively impacted by changes in vegetation associated with upland disposal. These fills would effect riparian, wetland, shrub, and forested habitat used by these species. Much of the forested habitat would be lost forever, i.e., forests, particularly riparian forests, would not recover within the project's 50-year life.

The same impacts would be felt in the riverine areas directly impacted by the project. Upland disposal would result in long-term losses to amphibian, reptile, furbearer, small mammal, and big game habitat resulting in reductions in these populations.

Contaminants

Bald eagles nesting along the lower Columbia River are not reproducinging as successfully as eagles nesting in other areas of Oregon and Washington. The reproductive problems of these eagles, which include eggshell thinning and poor productivity (number of young produced per occupied nest with known outcome), have been associated with bioaccumulative organochlorine contaminants in recent studies (Anthony et al. 1993, U.S. Fish and Wildlife Service 1998). Organochlorine contaminants including DDE and PCBs are elevated above reference values in adult eagle carcasses and blood from nestlings. Eggs from these eagles contain DDE, PCBs, dioxins, and furans at concentrations exceeding estimated no-effect levels for the species. Any increases in concentrations of bioaccumulative contaminants in these eagles could further impact reproduction, especially in the lower reaches of the river below Cathlamet.

Recent studies in the lower Columbia River and mouth of the Willamette River indicated river otters (Lutra canadensis), common fish predators, were experiencing reproductive tract disorders correlated with a number of organochlorine contaminants (Henny et al. 1996). Some otters exhibited enlarged spleens, lack of testes, and other abnormalities associated with contaminants such as organochlorines that can disrupt the endocrine system. The highest concentrations of many organochlorines in otter livers were associated with the Portland-Vancouver area. These studies indicate chemicals present in the Columbia and Willamette Rivers already have the potential to cause abnormalities and disrupt endocrine systems in fish and wildlife.

Habitat Evaluation Procedures (HEP)

The initial siting process for upland disposal areas focused on the avoidance and minimization of impacts to wildlife habitat to the extant practicable. Avoidance was accomplished, in part, by choosing existing and previously used disposal sites with little or no habitat. Environmental screening criteria were also applied and disposal site boundaries were adjusted to avoid sites with wetland or riparian habitat. Minimization efforts centered on stacking dredged material higher at individual sites rather than expanding a disposal site's footprint, thus reducing the overall acreage required for disposal. Not all the projected disposal amounts could be accommodated by existing or previously used disposal sites, however, and some new disposal sites were selected. These sites do support wildlife habitat, primarily agricultural lands with some inclusions of wetland and riparian habitat. These agricultural lands provide habitat for a number of wildlife species but are of particular value to wintering Canada geese and other waterfowl. It is the projected loss of these wildlife habitats on the proposed new sites (as well as the loss of reestablished riparian habitat on a few of the previously used disposal sites) that would require mitigation.

The HEP process was used to determine project impacts on terrestrial wildlife and the mitigation levels needed to offset those losses. The HEP team, consisting of representatives from the Corps of Engineers, Washington Department of Ecology (WDOE), WDFW, ODFW, the Ports, and the Service decided that the focus of the HEP should be on wildlife species most impacted by dredged material disposal, i.e., those species associated with agricultural cropland, wetland, and/or riparian habitat. Target species selected by the HEP team for analysis included an amphibian group of species and eight individual species which represented the habitat needs of the larger community of wintering and/or breeding wildlife species in the project area. The species analyzed in the HEP were a group of pond-breeding amphibians, Canada goose, mallard, savannah sparrow, black-capped chickadee, yellow warbler, Cooper's hawk, mink, and song sparrow.

The HEP methodology uses a species/habitat approach to quantify relative habitat values of a selected site. Each of the above species has various habitat needs which are described in a Habitat Suitability Index (HSI) model. The species models used in this HEP analysis are listed in Appendix II. The HSI model measures physical habitat variables which are used to calculate an index of habitat quality. The amphibian HSI model was developed by the Washington Department of Fish and Wildlife and written to describe the habitat needs of a variety of Columbia River Basin amphibian species, e.g., the red-legged frog, Northwestern salamander, long-toed salamander, rough-skinned newt, Pacific tree frog, spotted frog, and western toad. Copies of the selected species models used in the HEP study will be included in the appendices to the Corps' feasibility report.

The amphibian model was used to describe pond-breeding amphibians dependent on wetland, agricultural, and riparian habitats. Also included in this amphibian model is a habitat category known as associated habitat which encompasses other habitats associated with wetland/riparian habitat, including forest/shrub, grassland, and grazed and other agricultural lands all within 200 meters of a wetland edge. Canada geese, important recreational species which winter along the lower Columbia River, are associated with agricultural lands. Mallards also represent important recreationally harvested species which utilize wetlands and agricultural lands. Savannah sparrows are representative of grassland/early successional stage grass/forb communities and yellow warblers are indicative of early seral stage riparian forests. Cooper's hawks are representative of those species which use mature riparian forest habitat. Black-capped chickadees also use mature riparian forest habitat but their focus is on cavity bearing trees and/or snags. Mink were selected to represent species which are dependent on wetland and riparian habitat. Song sparrows represent edge species which also use both wetland and riparian habitat.

Using HEP, the habitat in a study area is compared to optimum habitat (as defined in the HSI model) for each species selected for study and the HSI is then determined using the calculations provided in the model. The HSI is a number between 0 and 1 with 0 representing no habitat suitability and 1 representing ideal or optimum habitat suitability. The HSI is multiplied by the number of acres of a particular habitat in the study area to obtain Habitat Units (HU):

HSI x Acres = HU and

1 Habitat Unit = 1 acre with optimum habitat suitability

The HEP process projects future conditions for a site for with and without project scenarios to determine net losses of habitat units. The total number of habitat units for each species and each alternative is divided by the life of the project (in years) to determine average annual habitat units (AAHUs). Project-related habitat impacts were analyzed for five target years over the life of the project: TY0 (baseline year); TY1 (year project related impacts first occur); TY5; TY25; and TY50. The latter three target years represent the points in time where changes in habitat quality or quantity would occur. This methodology for documenting habitat changes is applied to both disposal and mitigation sites.

A variety of sites have been selected for disposal of the estimated 110 million cy of material proposed for dredging from the Columbia and Willamette Rivers over the project life. Disposal under the Government Plan would be divided among 31 upland sites; an unspecified number of flowlane/inwater areas; two beach nourishment sites (Miller Sands Spit (O23.5) and Sandy Island (O86.2)); and designated and, as yet, undesignated (candidate) ocean disposal sites. Of the 31 upland sites, 15 sites would involve disposal on agricultural cropland, wetland, and/or riparian habitat. Under the Sponsor's Plan, there are also 31 upland disposal sites of which 13 contain agricultural, riparian, or wetland habitat. These disposal sites, requiring mitigation, have been analyzed using HEP. The habitat composition associated with each of the proposed upland disposal sites for these two alternative plans is shown in Table 6 and 6a. The majority of the upland sites consist of previously disposed dredged material amounting to over 1,500 acres for the Government Plan and 1,600 acres for the Sponsor's Plan. This material is a mix of dredged material from: 1) previous channel deepening projects (permitted prior to 1975); 2) emergency disposal activities resulting from the Mount St. Helens eruption (regulated under separate permit authorities); and 3) O&M disposal activities. These disposal areas have not been assigned any habitat value under the HEP process and, therefore, are not subject to mitigation actions.

According to Table 6, agricultural cropland (398 acres) is the most abundant habitat type impacted by the project, followed by riparian habitat (about 66 acres) and wetland habitat (about 38 acres). Overall, about 503 acres of wildlife habitat within the lower Columbia River system would be impacted by upland disposal under the Government Plan. The Sponsor's Plan would impact 289 acres of agricultural cropland; 30 acres of wetlands; and 68 acres of riparian habitat, for a total of 387 acres. Impacts to the Willamette River were not analyzed using HEP but are discussed separately below. The above habitat types are broken out further in Table 7 to give a better picture of the HSI values for each species associated with each habitat classification for both with and without project conditions. Table 7 shows

Table 6. Habitat composition and acreage for proposed disposal sites, Government Disposal Plan.

PROPOSED DISPOSAL	SITE ACREAGE	AGRICULT. CROPLAND	WETLAND	RIPARIAN	UPLAND DREDGED MATERIAL	OTHER (Roads, Barns, Houses)
REACH 1- Columbia River Miles 98-105						
O-105 – W. Hayden Island	102	0	0	0	102	0
O-98.5 – Sauvie 1	48	48	0	0	0	0
REACH 2 – Columbia River Miles 84-98						
W-97.1 - Fazio S&G	27	0	0	0	27	0
W-96.9 - Adj. Fazio S&G	17	8.2	0	0	8.8	0
W-96.5 – N. Dike Field	25	25	0	0	0	0
W-95.7	25	25	0	0	0	0
O-90.6 – Scappoose Dairy	107	99.3	7.7	0	0	0
W-86.5 - Austin Point	26	0	0	2.7	23.3	0
O-86.2 - Sand Is.	28	0	0	0	28	0
REACH 3 – Columbia River Miles 70-84						
W-82.0 - Martin Bar	32	0	0	2.9	29.1	0
W-80.0 - Martin Island	80	79.7	0	0.3	0	0
O-77.0 - Deer Island*	28.8	0	0	0	28.8	0
O-75.8 - Sandy Island*	30	0	0	0	30	0
W-73.5 - Peavy Oval	43	0	0	0	43	0
W-70.1- Cottonwood Island	50	0	0	5	45	0
REACH 4 – Columbia River Miles 56-70						
W-68.7 - Howard Is.	200	0	0	20	180	0
O-67.0 – Rainier Beach	52	0	0	0	52	0
O-65.7	73	0	0	0	73	0
O-64.8*	53	0	0	8.2	44.8	0
O-63.5*	45.9	0	0	17.5	28.4	0
W-63.5	13	0	0	0	13	0
W-62.0 - Mt. Solo	50	25	25	0	0	0
W-59.7 - Hump Island	69	0	0	7	62	0
O-57.0	51	0	0	0	51	0
REACH 5 – Columbia River Miles 41-56						
O-54.0 - Port Westward 1	50				50	0
W-46.3 & W-46.0 – Brown Is.	72	0	0	0	72	0
W-44.0 - Puget Island	100	88.2	5.4	2.6	0	3.8
O-42.9	59	0	0	0	59	0
REACH 6 – Columbia River Miles 29-41						
O-38.3 – Tenasillahe Island	42	0	0	0	42	0
O-34.0 - Welch Island	42	0	0	0	42	0

Table 6, continued.

PROPOSED DISPOSAL	SITE ACREAGE	AGRICULT. CROPLAND	WETLAND	RIPARIAN	UPLAND DREDGED MATERIAL	OTHER (Roads, Barns, Houses)
REACH 7 – Columbia River.						
O-27.2 - Pillar Rock Island	55.6	0	0	0	55.6	0
O-23.5 - Miller Sands Spit	151	0	0	0	151	0
W-21.0 - Rice Island	228	0	0	0	228	0
Totals	2075.3	398.4	38.1	66.2	1568.8	3.8

Table 6a. Habitat composition and acreage for proposed disposal sites, Sponsor Disposal Plan.

PROPOSED DISPOSAL SITE	SITE ACREAGE	AGRICULT. CROPLAND	WETLAND	RIPARIAN	UPLAND DREDGED MATERIAL	OTHER (Roads, Barns, Houses)
REACH 1- Columbia River Miles 98-105						
O-105 - Hayden Island	102	0	0	0	102	0
W-101 Gateway 3	93	93	0	0	0	0
REACH 2 – Columbia River Miles 84-98						
W-97.1 - Fazio S&G	27	0	0	0	27	0
Lonestar Gravel Pit*	113	3		2		113
Railroad Corridor	12	0	0	0	12	0
Austin Point	26	0	0	2.7	23.3	0
O-86.2-Sand Is. (Beach Nourish.)	28	0	0	0	28	0
REACH 3 – Columbia River Miles 70-84						
O-82.6 Reichold	49	0	0	0	49	0
W-82.0 - Martin Bar	32	0	0	2.9	29.1	0
Martin Island	80	79.7	0	0.3	0	0
Morse Bro. Gravel Pit	82	0	0	0	0	82
O-77.0 - Deer Island*	28.8	0	0	0	28.8	0
O-75.8 - Sandy Island*	30	0	0	0	30	0
W-73.5 (Peavy Oval)	43	0	0	0	43	0
W-72.2	50	0	0	0	50	0
W-70.1- Cottonwood Island	50	0	0	5	45	0
REACH 4 – Columbia River Miles 56-70						
W-68.7 (Howard Is.)	200	0	0	20	180	0
W-67.5	8	0	0	0	8	0
O-65.7	73	0	0	0	73	0
O-64.8*	53	0	0	8.2	44.8	0
O-63.5*	45.9	0	0	17.5	28.4	0
W-63.5	13	0	0	0	13	0
W-62.0 (Mt. Solo)	50	25	25	0	0	0
W-59.7 (Hump Island)	69	0	0	7	62	0
O-57.0	51	0	0	0	51	0
REACH 5 – Columbia River Miles 41-56						
Port Westward 1	50	0	0	0	50	0
W-46.3 & W-46.0	72	0	0	0	72	0
W-44.0 (Puget Island)	100	88.2	5.4	2.6	0	3.8
O-42.9	59	0	0	0	59	0
REACH 6 – Columbia River Miles 29-41						
O-38.3 (Tenasillahe Island)	42	0	0	0	42	0

Table 6a, continued.

O-34.0 (Welch Island)	42	0	0	0	42	0
REACH 7 – Columbia River Miles 3-29						
O-27.2 - Pillar Rock Island	55.6	0	0	0	55.6	0
O-23.5 - Miller Sands Spit	151	0	0	0	151	0
W-21.0 - Rice Island	228	0	0	0	228	0
Totals	2208.3	288.9	30.4	68.2	1627	198.8

Table 7. HSI values by species by habitat classification by target year for with and without project conditions.

		Amphibian With Project					Amphibian Without Project				
		TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	**Wetland**	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Wetland - Farmed	**Wetland - Farmed**	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
	Intertidal Emergent Wet.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian	**Riparian**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian - Degraded	**Riparian - Degraded**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian-Early	**Riparian-Early Succ.**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Riparian Assoc. Hab. - Degrad.	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
	Riparian Assoc. Hab.	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
	Riparian Assoc. Hab.-E.S.	0.12	0.12	0.12	0.24	0.36	0.12	0.12	0.12	0.24	0.36
Cropland	**Ag. Cropland**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agriculture	**Assoc. Hab. - Ag. Crop.**	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
	Ag. Cropland - Degraded - Blackberry thickets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Dredged Material	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Canada Goose With Project					**Canada Goose Without Project**				
		TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	**Wetland**	0,55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Wetland - Farmed	**Wetland - Farmed**	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
	Intertidal Emergent Wet.	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Cropland	**Ag. Cropland**	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Assoc. Hab. - Ag. Crop.	**Assoc. Hab. - Ag. Crop.**	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68

Table 7, continued.

		Mallard With Project					Mallard Without Project				
		TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	Wetland	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Wetland - Farmed	Wetland - Farmed	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
	Intertidal Emergent Wet.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Riparian	Riparian	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Riparian - Degraded	Riparian - Degraded	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Riparian-Early	Riparian-Early Succ.	0.21	0.21	0.64	0.64	0.64	0.21	0.21	0.64	0.64	0.64
	Riparian Assoc. Hab. - Degrad.	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
	Riparian Assoc. Hab.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
	Riparian Assoc. Hab.-E.S.	0.21	0.21	0.64	0.64	0.64	0.21	0.21	0.64	0.64	0.64
Cropland	Ag. Cropland	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Assoc. Hab. - Ag. Crop.	Assoc. Hab. - Ag. Crop.	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
	Ag. Cropland - Degraded - Blackberry thickets	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
		Savannah Sp. With Project					Savannah Sp. Without Project				
		TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland - Farmed	Wetland - Farmed	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Cropland	Ag. Cropland	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Assoc. Hab. - Ag. Crop.	Assoc. Hab. - Ag. Crop.	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
	Ag. Cropland - Degraded - Blackberry thickets	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
		B.C. Chickadee With Project					B.C. Chickadee Without Project				
		TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	Riparian	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Riparian - Degraded	Riparian - Degraded	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Riparian-Early	Riparian-Early Succ.	0.15	0.15	0.15	0.29	0.44	0.15	0.15	0.15	0.29	0.44
	Riparian Assoc. Hab. - Degrad.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	Riparian Assoc. Hab.	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
	Riparian Assoc. Hab.-E.S.	0.15	0.15	0.15	0.29	0.44	0.15	0.15	0.15	0.29	0.44

Table 7, continued.

		With Project					Without Project				
		Yellow Warbler					**Yellow Warbler**				
		With Project					**Without Project**				
		TY0	**TY1**	**TY5**	**TY25**	**TY50**	**TY0**	**TY1**	**TY5**	**TY25**	**TY50**
Riparian	**Riparian**	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian - Degraded	**Riparian - Degraded**	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian-Early	**Riparian-Early Succ.**	0.13	0.13	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
	Riparian Assoc. Hab. - Degrad.	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
	Riparian Assoc. Hab.	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	Riparian Assoc. Hab.-E.S.	0.13	0.13	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
		Cooper's Hawk					**Cooper's Hawk**				
		With Project					**Without Project**				
		TY0	**TY1**	**TY5**	**TY25**	**TY50**	**TY0**	**TY1**	**TY5**	**TY25**	**TY50**
Riparian	**Riparian**	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Riparian - Degraded	**Riparian - Degraded**	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Riparian-Early	**Riparian-Early Succ.**	0.26	0.26	0.26	0.77	0.77	0.26	0.26	0.26	0.77	0.77
	Riparian Assoc. Hab. - Degrad.	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
	Riparian Assoc. Hab.	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
	Riparian Assoc. Hab.-E.S.	0.26	0.26	0.26	0.77	0.77	0.26	0.26	0.26	0.77	0.77
		Mink					**Mink**				
		With Project					**Without Project**				
		TY0	**TY1**	**TY5**	**TY25**	**TY50**	**TY0**	**TY1**	**TY5**	**TY25**	**TY50**
Wetland	**Wetland**	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Wetland - Farmed	**Wetland - Farmed**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Intertidal Emergent Wet.	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Riparian	**Riparian**	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Riparian - Degraded	**Riparian - Degraded**	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Riparian-Early	**Riparian-Early Succ.**	0.22	0.22	0.22	0.45	0.67	0.22	0.22	0.22	0.45	0.67
	Riparian Assoc. Hab. - Degrad.	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
	Riparian Assoc. Hab.	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
	Riparian Assoc. Hab.-E.S.	0.22	0.22	0.22	0.45	0.67	0.22	0.22	0.22	0.45	0.67

Table 7, continued.

		Song Sparrow With Project					Song Sparrow Without Project				
		TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	**Wetland**	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Wetland - Farmed	**Wetland - Farmed**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian	**Riparian**	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian - Degraded	**Riparian - Degraded**	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian-Early	**Riparian-Early Succ.**	0.13	0.13	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
	Riparian Assoc. Hab. - Degrad.	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
	Riparian Assoc. Hab.	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	Riparian Assoc. Hab.-E.S.	0.13	0.13	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40

that the proposed disposal sites are most valuable to Canada geese, mallards, Cooper's hawks, and minks. The HSIs for these species were at least 0.55 for two or more habitat types. The average annual habitat units (AAHUs) for both disposal plans for each of the nine species for with and without project conditions are presented in Tables 8 and 8a. These tables show that all nine species would suffer habitat losses and dramatic decreases in AAHUs over a 50-year project life as the result of disposal activities on the 31 upland sites. A summary of the AAHU losses for the Government Plan is presented in Table 9. The species which experience the greatest decrease in number of habitat units are Canada goose, mallard, and savannah sparrow. This relates to the fact that the greatest proportion of impacted habitat is agricultural cropland, most (although not all) of which is buried during disposal. Table 8, however, demonstrates that, although the total number of AAHUs impacted by disposal is not large for riparian and wetland-dependent species, amphibians, black-capped chickadees, yellow warblers, Cooper's hawks, minks, and song sparrows suffer the greatest overall losses of habitat, all showing "with project" AAHUs of less than 1.

Site specific habitat losses in AAHUs for the Government Plan and the Sponsor's Plan are shown in Table 10. This table demonstrates that the greatest losses of AAHUs occurs at agricultural sites such as Scappoose Dairy, Martin Island, and Puget Island and that moderate to minor losses occur at existing or formerly used disposal sites with pioneering riparian vegetation (W82.0 (Martin Bar), 077.0 (Deer Island), and W70.1 (Cottonwood Island)). However, given that riparian and wetland habitats in the lower Columbia River are of greater scarcity than agricultural cropland, it is these habitats which deserve the greater attention in terms of compensatory mitigation.

The number of mitigation sites considered under the Government Plan has been reduced from thirteen to five. These five preliminary mitigation sites have been analyzed using HEP to help offset the losses discussed above. The tentative sites are identified as Joslin Property, Sauvie 94, Woodland Bottoms, Martin Island, and Webb Property (Table 11). The habitat suitability indices by target year, habitat, and species for these five proposed mitigation sites are presented in Table 12. The greatest gains in mitigation habitat value (HSI) over the project life are for savannah sparrows (+.41HSI), minks (+.45HSI), and Cooper's hawks (+.51HSI). These gains are in agricultural cropland and associated habitat-agricultural cropland and in early successional riparian and associated riparian habitats. For amphibians and song sparrows, there are small gains in early successional riparian-associated habitat and early successional riparian habitat at TY5, 25, and 50 in the order of +0.24 and +0.27 HSI, respectively. However, the mitigation HSI table (Table 12) does show that all species regain or exceed the maximum HSI values associated with the pre-project disposal sites.

The amount of mitigation acreage associated with the Government Plan mitigation scenario totals approximately 1,027 acres which amounts to an overall replacement ratio of about 2:1. In terms of a replacement ratio by habitat type, however, agricultural cropland (forage) acreage is replaced at a 0.6:1 ratio; wetland acreage is replaced at about 9:1; and riparian acreage is replaced at a ratio of about 6:1. A comparison of the mitigation acreages for the two alternative disposal plans is shown in Table 13. The replacement ratios for the Sponsor's Plan are not as high as for the Government Plan, particularly for riparian habitat. The Government Plan replacement ratios are more acceptable, therefore, provided mitigation is accomplished prior to or at the time of construction and approved monitoring plans are in place.

HEP Process Errors

Late in the HEP analysis, it was discovered that there were discrepancies in how habitat suitability indices (HSIs) were determined for some of the disposal and mitigation sites, for both with and without project scenarios. Unfortunately, these misinterpretations made some of the HEP data unreliable and, by inference, the habitat units calculated to be lost and gained over the life of the project inaccurate. The issue of greatest concern relates to the HSIs associated with farmed wetlands and riparian habitat. Despite these inconsistencies with the HEP process, however, the Service still believes that the HEP analysis, for the most part, has provided valuable information on the amount and types of habitat and the species that would be most impacted by the project. Furthermore, given time to redo portions of the

Table 8. AAHU calculations for the Government Disposal Plan.

Canada Goose

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Agriculture	128.38	1.40	-126.98
Cropland	113.56	1.14	-112.42
Wetland	20.96	0.21	-20.75
Farmed Wetland	17.07	0.17	-16.90
Total AAHUs	279.97	2.92	-277.05

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Assoc. Habitat Agriculture	w/o	140.28	561.14	2635.68	3082.10	6419.20
	w/	70.14	0.00	0.00	0.00	70.14
Ag. Cropland	w/o	113.56	454.24	2271.20	2839.00	5678.00
	w/	56.78	0.00	0.00	0.00	56.78
Riparian	w/o					
	w/					
Riparian Degraded	w/o					
	w/					
Riparian Early	w/o					
	w/					
Riparian Assoc. Habitat Early Succ.	w/o					
	w/					
Riparian Assoc. Habitat	w/o					
	w/					
Riparian Assoc. Habitat Degraded	w/o					
	w/					
Wetland	w/o	20.96	83.82	419.10	523.88	1047.75
	w/	10.48	0.00	0.00	0.00	10.48
Farmed Wetland	w/o	17.07	68.27	341.36	426.70	853.40
	w/	8.53	0.00	0.00	0.00	8.53

Amphibian

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Assoc. Habitat Agriculture	39.65	0.43	-39.21
Ag. Cropland	0.00	0.00	0.00
Riparian	0.00	0.00	0.00
Riparian Degraded	0.00	0.00	0.00
Riparian Early	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	3.64	0.00	-3.64
Riparian Assoc. Habitat	0.00	0.00	0.00
Riparian Assoc. Habitat Degraded	0.38	0.00	-0.38
Wetland	19.43	0.19	-19.24
Farmed Wetland	5.27	0.05	-5.22
Total AAHUs	68.37	0.68	-67.69

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Assoc. Habitat Agriculture	w/o	43.32	173.29	813.96	951.83	1982.40
	w/	21.66	0.00	0.00	0.00	21.66
Ag. Cropland	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Degraded	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Early	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	1.44	45.60	135.00	182.04
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Degraded	w/o	0.38	1.54	7.68	9.60	19.20
	w/	0.19	0.00	0.00	0.00	0.19
Wetland	w/o	19.43	77.72	388.62	485.78	971.55
	w/	9.72	0.00	0.00	0.00	9.72
Farmed Wetland	w/o	5.27	21.08	105.42	131.78	263.55
	w/	2.64	0.00	0.00	0.00	2.64

Mallard

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Assoc. Habitat Agriculture	103.84	1.13	-102.71
Ag. Cropland	91.85	0.92	-90.93
Riparian	16.45	0.16	-16.28
Riparian Degraded	1.11	0.01	-1.10
Riparian Early	36.11	0.07	-36.04
Riparian Assoc. Habitat Early Succ.	8.95	0.00	-8.95
Riparian Assoc. Habitat	0.00	0.00	0.00
Riparian Assoc. Habitat Degraded	0.67	0.01	-0.67
Wetland	25.91	0.26	-25.65
Farmed Wetland	13.81	0.14	-13.67
Total AAHUs	298.69	2.70	-295.99

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Assoc. Habitat Agriculture	w/o	113.47	453.86	2131.80	2492.88	5192.00
	w/	56.73	0.00	0.00	0.00	56.73
Ag. Cropland	w/o	91.85	367.40	1837.00	2296.25	4592.50
	w/	45.93	0.00	0.00	0.00	45.93
Riparian	w/o	16.45	65.79	328.96	411.20	822.40
	w/	8.22	0.00	0.00	0.00	8.22
Riparian Degraded	w/o	1.11	4.45	22.26	27.83	55.65
	w/	0.56	0.00	0.00	0.00	0.56
Riparian Early	w/o	6.72	65.82	716.80	1016.00	1805.34
	w/	3.36	0.00	0.00	0.00	3.36
Riparian Assoc. Habitat Early Succ.	w/o	0.00	5.96	153.60	288.00	447.56
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Degraded	w/o	0.67	2.69	13.44	16.80	33.60
	w/	0.34	0.00	0.00	0.00	0.34
Wetland	w/o	25.91	103.63	518.16	647.70	1295.40
	w/	12.95	0.00	0.00	0.00	12.95
Farmed Wetland	w/o	13.81	55.22	276.10	345.13	690.25
	w/	6.90	0.00	0.00	0.00	6.90

Savannah Sparrow

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Agriculture	73.63	0.80	-72.83
Cropland	65.13	0.65	-64.48
Farmed Wetland	9.79	0.10	-9.69
Total AAHUs	148.55	1.55	-147.00

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Assoc. Habitat Agriculture	w/o	80.46	321.83	1511.64	1767.68	3681.60
	w/	40.23	0.00	0.00	0.00	40.23
Ag. Cropland	w/o	65.13	260.52	1302.60	1628.25	3256.50
	w/	32.57	0.00	0.00	0.00	32.57
Farmed Wetland	w/o	9.79	39.16	195.78	244.73	489.45
	w/	4.89	0.00	0.00	0.00	4.89

B.C. Chickadee

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Riparian	11.31	0.11	-11.19
Riparian - Degraded	0.80	0.01	-0.79
Riparian-Early Succ.	17.12	0.05	-17.07
Riparian Assoc. Hab. - Degrad.	0.48	0.00	-0.48
Riparian Assoc. Hab.	0.00	0.00	0.00
Riparian Assoc. Hab.-E.S.	4.43	0.00	-4.43
Total AAHUs	34.14	0.17	-33.96

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs	
Riparian	w/o	11.31	45.23	226.16	282.70	565.40	
	w/	5.65	0.00	0.00	0.00	5.65	
Riparian Degraded	w/o	0.80	3.18	15.90	19.88	39.75	
	w/	0.40	0.00	0.00	0.00	0.40	
Riparian Early	w/o	4.80	22.65	252.23	576.31	856.00	120.00
	w/	2.40	0.00	0.00	0.00	2.40	
Riparian Assoc. Habitat Degraded	w/o	0.48	1.92	9.60	12.00	24.00	
	w/	0.24	0.00	0.00	0.00	0.24	
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00	
	w/	0.00	0.00	0.00	0.00	0.00	
Riparian Assoc. Habitat Early Succ.	w/o	0.00	1.80	55.60	164.25	221.65	
	w/	0.00	0.00	0.00	0.00	0.00	

Table 8, continued.

Yellow Warbler

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Riparian	10.28	0.10	-10.18
Riparian - Degraded	0.69	0.01	-0.68
Riparian-Early Succ.	22.56	0.04	-22.52
Riparian Assoc. Hab. - Degrad.	0.42	0.00	-0.41
Riparian Assoc. Hab.	0.00	0.00	0.00
Riparian Assoc. Hab.-E.S.	5.59	0.00	-5.59
Total AAHUs	39.54	0.16	-39.39

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs		
Riparian	w/o	10.28	41.12	205.60	257.00	514.00	205.60	257.00
	w/	5.14	0.00	0.00	0.00	5.14		
Riparian Degraded	w/o	0.69	2.76	13.78	17.23	34.45		
		0.34	0.00	0.00	0.00	0.34		
Riparian Early	w/o	4.16	41.05	448.00	635.00	1128.21		
	w/	2.08	0.00	0.00	0.00	2.08		
Riparian Assoc. Habitat Degraded	w/o	0.42	1.66	8.32	10.40	20.80		
	w/	0.21	0.00	0.00	0.00	0.21		
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00		
	w/	0.00	0.00	0.00	0.00	0.00		
Riparian Assoc. Habitat Early Succ.	w/o	0.00	3.72	96.00	180.00	279.72		
	w/	0.00	0.00	0.00	0.00	0.00		

Cooper's Hawk

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Riparian	19.79	0.20	-19.59
Riparian - Degraded	1.38	0.01	-1.36
Riparian-Early Succ.	37.36	0.08	-37.28
Riparian Assoc. Hab. - Degrad.	0.83	0.01	-0.82
Riparian Assoc. Hab.	0.00	0.00	0.00
Riparian Assoc. Hab.-E.S.	9.67	0.00	-9.67
Total AAHUs	69.03	0.30	-68.72

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Riparian	w/o	19.79	79.16	395.78	494.73	989.45
	w/	9.89	0.00	0.00	0.00	9.89
Riparian Degraded	w/o	1.38	5.51	27.56	34.45	68.90
	w/	0.69	0.00	0.00	0.00	0.69
Riparian Early	w/o	8.32	39.26	598.05	1222.38	1868.01
	w/	4.16	0.00	0.00	0.00	4.16
Riparian Assoc. Habitat Degraded	w/o	0.83	3.33	16.64	20.80	41.60
	w/	0.42	0.00	0.00	0.00	0.42
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	3.12	133.80	346.50	483.42
	w/	0.00	0.00	0.00	0.00	0.00

Mink

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Riparian	17.22	0.17	-17.05
Riparian - Degraded	1.17	0.01	-1.15
Riparian-Early Succ.	26.19	0.07	-26.12
Riparian Assoc. Hab. - Degrad.	0.70	0.01	-0.70
Riparian Assoc. Hab.	0.00	0.00	0.00
Riparian Assoc. Hab.-E.S.	6.79	0.00	-6.79
Wetland	25.91	0.26	-25.65
Wetland - Farmed	0.00	0.00	0.00
Total AAHUs	77.98	0.52	-77.46

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Riparian	w/o	17.22	68.88	344.38	430.48	860.95
	w/	8.61	0.00	0.00	0.00	8.61
Riparian Degraded	w/o	1.17	4.66	23.32	29.15	58.30
	w/	0.58	0.00	0.00	0.00	0.58
Riparian Early	w/o	7.04	33.22	384.78	884.42	1309.46
	w/	3.52	0.00	0.00	0.00	3.52
Riparian Assoc. Habitat Degraded	w/o	0.70	2.82	14.08	17.60	35.20
	w/	0.35	0.00	0.00	0.00	0.35
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	2.64	85.00	252.00	339.64
	w/	0.00	0.00	0.00	0.00	0.00
Wetland	w/o	25.91	103.63	518.16	647.70	1295.40
	w/	12.95	0.00	0.00	0.00	12.95
Wetland - Farmed	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00

Song Sparrow

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Riparian	10.28	0.10	-10.18
Riparian - Degraded	0.69	0.01	-0.68
Riparian-Early Succ.	22.56	0.04	-22.52
Riparian Assoc. Hab. - Degrad.	0.42	0.00	-0.41
Riparian Assoc. Hab.	0.00	0.00	0.00
Riparian Assoc. Hab.-E.S.	5.59	0.00	-5.59
Wetland	33.91	0.34	-33.57
Wetland - Farmed	0.00	0.00	0.00
Total AAHUs	73.45	0.49	-72.96

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Riparian	w/o	10.28	41.12	205.60	257.00	514.00
	w/	5.14	0.00	0.00	0.00	5.14
Riparian Degraded	w/o	0.69	2.76	13.78	17.23	34.45
	w/	0.34	0.00	0.00	0.00	0.34
Riparian Early	w/o	4.16	41.05	448.00	635.00	1128.21
	w/	2.08	0.00	0.00	0.00	2.08
Riparian Assoc. Habitat Degraded	w/o	0.42	1.66	8.32	10.40	20.80
	w/	0.21	0.00	0.00	0.00	0.21
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	3.72	96.00	180.00	279.72
	w/	0.00	0.00	0.00	0.00	0.00
Wetland	w/o	33.91	135.64	678.18	847.73	- 1695.45
	w/	16.95	0.00	0.00	0.00	16.95
Wetland - Farmed	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00

Table 8a. AAHU calculations for the Sponsor Disposal Plan.

Canada Goose

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Agriculture	41.79	0.87	-40.93
Cropland	36.25	0.44	-35.81
Wetland	16.72	0.17	-16.55
Farmed Wetland	0.00	0.00	0.00
Total AAHUs	94.77	1.48	-93.29

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Assoc. Habitat Agriculture	w/o	85.07	310.35	995.52	698.70	2089.64
	w/	43.28	0.00	0.00	0.00	43.28
Ag. Cropland	w/o	44.10	168.91	748.00	851.70	1812.71
	w/	22.24	0.00	0.00	0.00	22.24
Riparian	w/o					
	w/					
Riparian Degraded	w/o					
	w/					
Riparian Early	w/o					
	w/					
Riparian Assoc. Habitat Early Succ.	w/o					
	w/					
Riparian Assoc. Habitat	w/o					
	w/					
Riparian Assoc. Habitat Degraded	w/o					
	w/					
Wetland	w/o	16.72	66.88	334.40	418.00	836.00
	w/	8.36	0.00	0.00	0.00	8.36
Farmed Wetland	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00

Amphibian

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Assoc. Habitat Agriculture	12.91	0.27	-12.64
Ag. Cropland	0.00	0.00	0.00
Riparian	0.00	0.00	0.00
Riparian Degraded	0.00	0.00	0.00
Riparian Early	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	3.64	0.00	-3.64
Riparian Assoc. Habitat	0.00	0.00	0.00
Riparian Assoc. Habitat Degraded	0.35	0.00	-0.34
Wetland	15.50	0.16	-15.35
Farmed Wetland	0.00	0.00	0.00
Total AAHUs	32.40	0.43	-31.97

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Assoc. Habitat Agriculture	w/o	26.27	95.84	307.44	215.78	645.33
	w/	13.37	0.00	0.00	0.00	13.37
Ag. Cropland	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Degraded	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Early	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	1.44	45.60	135.00	182.04
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Degraded	w/o	0.35	1.39	6.96	8.70	17.40
	w/	0.17	0.00	0.00	0.00	0.17
Wetland	w/o	15.50	62.02	310.08	387.60	775.20
	w/	7.75	0.00	0.00	0.00	7.75
Farmed Wetland	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00

Mallard

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Assoc. Habitat Agriculture	33.80	0.70	-33.10
Ag. Cropland	29.32	0.36	-28.96
Riparian	20.93	0.21	-20.72
Riparian Degraded	1.11	0.01	-1.10
Riparian Early	36.11	0.07	-36.04
Riparian Assoc. Habitat Early Succ.	8.95	0.00	-8.95
Riparian Assoc. Habitat	0.00	0.00	0.00
Riparian Assoc. Habitat Degraded	0.61	0.01	-0.60
Wetland	20.67	0.21	-20.47
Farmed Wetland	0.00	0.00	0.00
Total AAHUs	151.51	1.56	-149.95

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Assoc. Habitat Agriculture	w/o	68.81	251.02	805.20	565.13	1690.15
	w/	35.01	0.00	0.00	0.00	35.01
Ag. Cropland	w/o	35.67	136.62	605.00	688.88	1466.16
	w/	17.99	0.00	0.00	0.00	17.99
Riparian	w/o	20.93	83.71	418.56	523.20	1046.40
	w/	10.46	0.00	0.00	0.00	10.46
Riparian Degraded	w/o	1.11	4.45	22.26	27.83	55.65
	w/	0.56	0.00	0.00	0.00	0.56
Riparian Early	w/o	6.72	65.82	716.80	1016.00	1805.34
	w/	3.36	0.00	0.00	0.00	3.36
Riparian Assoc. Habitat Early Succ.	w/o	0.00	5.96	153.60	288.00	447.56
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Degraded	w/o	0.61	2.44	12.18	15.23	30.45
	w/	0.30	0.00	0.00	0.00	0.30
Wetland	w/o	20.67	82.69	413.44	516.80	1033.60
	w/	10.34	0.00	0.00	0.00	10.34
Farmed Wetland	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00

Table 8a, continued.

Savannah Sparrow

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Agriculture	23.97	0.50	-23.47
Cropland	20.79	0.26	-20.54
Farmed Wetland	0.00	0.00	0.00
Total AAHUs	44.76	0.75	-44.01

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Assoc. Habitat Agriculture	w/o	48.79	178.00	570.96	400.73	1198.47
	w/	24.82	0.00	0.00	0.00	24.82
Ag. Cropland	w/o	25.29	96.88	429.00	488.48	1039.64
	w/	12.75	0.00	0.00	0.00	12.75
Farmed Wetland	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00

B.C. Chickadee

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Riparian	14.39	0.14	-14.24
Riparian - Degraded	0.80	0.01	-0.79
Riparian-Early Succ.	17.12	0.05	-17.07
Riparian Assoc. Hab. - Degrad.	0.44	0.00	-0.43
Riparian Assoc. Hab.	0.00	0.00	0.00
Riparian Assoc. Hab.-E.S.	4.43	0.00	-4.43
Total AAHUs	37.17	0.20	-36.97

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Riparian	w/o	14.39	57.55	287.76	359.70	719.40
	w/	7.19	0.00	0.00	0.00	7.19
Riparian Degraded	w/o	0.80	3.18	15.90	19.88	39.75
	w/	0.40	0.00	0.00	0.00	0.40
Riparian Early	w/o	4.80	22.55	252.23	576.31	856.00
	w/	2.40	0.00	0.00	0.00	2.40
Riparian Assoc. Habitat Degraded	w/o	0.44	1.74	8.70	10.88	21.75
	w/	0.22	0.00	0.00	0.00	0.22
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	1.80	55.60	164.25	221.65
	w/	0.00	0.00	0.00	0.00	0.00

Yellow Warbler

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Riparian	13.08	0.13	-12.95
Riparian - Degraded	0.69	0.01	-0.68
Riparian-Early Succ.	22.56	0.04	-22.52
Riparian Assoc. Hab. - Degrad.	0.38	0.00	-0.37
Riparian Assoc. Hab.	0.00	0.00	0.00
Riparian Assoc. Hab.-E.S.	5.59	0.00	-5.59
Total AAHUs	42.30	0.18	-42.12

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Riparian	w/o	13.08	52.32	261.60	327.00	654.00
	w/	6.54	0.00	0.00	0.00	6.54
Riparian Degraded	w/o	0.69	2.76	13.78	17.23	34.45
	w/	0.34	0.00	0.00	0.00	0.34
Riparian Early	w/o	4.16	41.05	448.00	635.00	1128.21
	w/	2.08	0.00	0.00	0.00	2.08
Riparian Assoc. Habitat Degraded	w/o	0.38	1.51	7.54	9.43	18.85
	w/	0.19	0.00	0.00	0.00	0.19
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	3.72	96.00	180.00	279.72
	w/	0.00	0.00	0.00	0.00	0.00

Cooper's Hawk

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Riparian	25.18	0.25	-24.93
Riparian - Degraded	1.38	0.01	-1.36
Riparian-Early Succ.	37.36	0.08	-37.28
Riparian Assoc. Hab. - Degrad.	0.75	0.01	-0.75
Riparian Assoc. Hab.	0.00	0.00	0.00
Riparian Assoc. Hab.-E.S.	9.67	0.00	-9.67
Total AAHUs	74.34	0.36	-73.98

Riparian

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Riparian	w/o	25.18	100.72	503.58	629.48	1258.95
	w/	12.59	0.00	0.00	0.00	12.59
Riparian Degraded	w/o	1.38	5.51	27.56	34.45	68.90
	w/	0.69	0.00	0.00	0.00	0.69
Riparian Early	w/o	8.32	39.26	598.05	1222.38	1868.01
	w/	4.16	0.00	0.00	0.00	4.16
Riparian Assoc. Habitat Degraded	w/o	0.75	3.02	15.08	18.85	37.70
	w/	0.38	0.00	0.00	0.00	0.38
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	3.12	133.80	346.50	483.42
	w/	0.00	0.00	0.00	0.00	0.00

Mink

Habitat	Without Project AAHUs	With Project AAHUs	Net Change
Riparian	21.91	0.22	-21.69
Riparian - Degraded	1.17	0.01	-1.15
Riparian-Early Succ.	26.19	0.07	-26.12
Riparian Assoc. Hab. - Degrad.	0.64	0.01	-0.63
Riparian Assoc. Hab.	0.00	0.00	0.00
Riparian Assoc. Hab.-E.S.	6.79	0.00	-6.79
Wetland	20.67	0.21	-20.47
Wetland - Farmed	0.00	0.00	0.00
Total AAHUs	77.37	0.51	-76.85

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Riparian	w/o	21.91	87.64	438.18	547.73	1095.45
	w/	10.95	0.00	0.00	0.00	10.95
Riparian Degraded	w/o	1.17	4.66	23.32	29.15	58.30
	w/	0.58	0.00	0.00	0.00	0.58
Riparian Early	w/o	7.04	33.22	384.78	884.42	1309.46
	w/	3.52	0.00	0.00	0.00	3.52
Riparian Assoc. Habitat Degraded	w/o	0.64	2.55	12.76	15.95	31.90
	w/	0.32	0.00	0.00	0.00	0.32
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	2.64	85.00	252.00	339.64
	w/	0.00	0.00	0.00	0.00	0.00
Wetland	w/o	20.67	82.69	413.44	516.80	1033.60
	w/	10.34	0.00	0.00	0.00	10.34
Wetland - Farmed	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00

tinued.

	Without Project AAHUs	With Project AAHUs	Net Change
	13.08	0.13	-12.95
ded	0.69	0.01	-0.68
icc.	22.56	0.04	-22.52
lab. - Degrad.	0.38	0.00	-0.37
lab.	0.00	0.00	0.00
lab.-E.S.	5.59	0.00	-5.59
	27.06	0.27	-26.79
l	0.00	0.00	0.00
	69.36	0.45	-68.91

		T0-TY1	TY1-TY5	TY5-TY25	TY25-TY50	cummulative HUs
Riparian	w/o	13.08	52.32	261.60	327.00	654.00
	w/	6.54	0.00	0.00	0.00	6.54
Riparian Degraded	w/o	0.69	2.76	13.78	17.23	34.45
	w/	0.34	0.00	0.00	0.00	0.34
Riparian Early	w/o	4.16	41.05	448.00	635.00	1128.21
	w/	2.08	0.00	0.00	0.00	2.08
Riparian Assoc. Habitat Degraded	w/o	0.38	1.51	7.54	9.43	18.85
	w/	0.19	0.00	0.00	0.00	0.19
Riparian Assoc. Habitat	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Habitat Early Succ.	w/o	0.00	3.72	96.00	180.00	279.72
	w/	0.00	0.00	0.00	0.00	0.00
Wetland	w/o	27.06	108.22	541.12	676.40	1352.80
	w/	13.53	0.00	0.00	0.00	13:53
Wetland - Farmed	w/o	0.00	0.00	0.00	0.00	0.00
	w/	0.00	0.00	0.00	0.00	0.00

Table 9. Loss in AAHUs for target species and for general habitats, Government Disposal Plan.

Target Species	HABITAT Wetland	Riparian	Agriculture	SPECIES Totals
Amphibian	-19.2	-4.0	-44.4	-67.7
Canada Goose	-20.75	0.0	-256.3	-277.1
Mallard	-25.7	-63.0	-207.3	-296.0
Savannah Sparrow	0.0	0.0	-147.0	-147.0
Black-capped Chickadee	0.0	-34.0	0.0	-34.0
Yellow Warbler	0.0	-39.4	0.0	-39.4
Cooper's Hawk	0.0	-68.7	0.0	-68.7
Mink	-25.7	-51.8	0.0	-77.5
Song Sparrow	-33.57	-39.4	0.0	-73.0
Habitat AAHU Totals	-124.9	-300.3	-655.0	-1080.2
Total Adjusted AAHU's	-99.9	-171.2	-655.0	-926.1
Adjusted AAHUs plus 5%**	-104.9	-179.7	-687.8	-972.4

* Adjustment: Wetland AAHUs x .8: Riparian AAHUs x .57.
** Plus 5%: the contingency attached to adjusted AAHUs.

Table 10. Site specific wildlife habitat losses in AAHUs for the Government and Sponsor Disposal Plans. Losses in AAHUs were mathmetically adjusted and a 5% contingency factor was added.

PROPOSED DISPOSAL SITE	Government Disposal Plan	Sponsor Disposal Plan
REACH 1- Columbia River Miles 98-105		
O-98.5 – Sauvie 1	-84.5	
W-101 Gateway 3		-28.7
REACH 2 – Columbia River Miles 84-98		
W-96.9 - Adj. Fazio S&G	-15.6	
W-96.5 – N. Dike Field	-47.6	
W-95.7	-44	
O-90.6 - Scappoose Dairy	-210.1	
W-86.5 - Austin Point	-1.8	-1.8
Lonestar Gravel Pit		-9.6
REACH 3 – Columbia River Miles 70-84		
W-82.0 - Martin Bar	-2.1	-2.1
W-80.0 - Martin Island	-136.7	
Morse Bro. Gravel Pit		-9.8
O-77.0 - Deer Island*	-26.7	-26.7
W-70.1- Cottonwood Island	-19	-19
REACH 4 – Columbia River Miles 56-70		
W-68.7 - Howard Is.	-22.9	-22.9
O-64.8*	-16.1	-16.1
O-63.5*	-40	-40
W-62.0 - Mt. Solo	-82.7	-82.7
W-59.7 - Hump Island	-49.3	-49.3
REACH 5 – Columbia River Miles 41-56		
W-44.0 - Puget Island	-173.4	-173.4
Total	[illegible]	[illegible]

Table 11. Mitigation site habitat acreages.

Habitat	Joslin	Sauvie 94	Woodland Bottoms	Martin Island	Webb	Totals	Acreage
							Wetland Total
Wetland	50.5	68.4	96.7	6.9	100	322.5	354.6
Wetland - Farmed	0	0	0	0	0	0	
Intertidal Emergent Wet.	0	0	0	32.1	0	32.1	Riparian Total
Riparian	7.3	0	0	10.8	0	18.1	424.4
Riparian - Degraded	0	0	0	0	0	0	
Riparian Early Success.	5.2	0	2.6	61.1	0	68.9	
Rip. Assoc. Hab. - Degrad.	2.7	0	0	0	0	2.7	
Riparian Assoc. Hab.	34.1	12.6	0.8	73.9	1.1	122.5	
Riparian Assoc. Hab.- E.S.	23.5	7.5	40.9	98.3	42	212.2	Agricultural Total
Ag. Cropland	0	32.1	20.7	0	0	52.8	248.4
Assoc. Hab. - Ag. Crop.	0	83.9	111.7	0	0	195.6	
Assoc. Hab. - Ag. Crop. - Degraded	0	0	0	0	0	0	
Ag. Cropland - Degraded - Blackberry thickets	0	0	0	0	0	0	Total
Other (levee, houses, bldgs)	1.1		10.8	95.2	2.5	109.6	Mitigation Acres
Total	124.4	204.5	284.2	378.3	145.6	1137	1027.4
Other:							
Martin Island - Includes 80 acre disposal site, non-managed beach and open water.							

Table 12. Mitigation habitat suitability indices by target year, habitat, and species.

	Amphibian					Amphibian				
	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Wetland - Farmed	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Intertidal Emergent Wet.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian - Degraded	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian-Early Succ.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Hab. - Degrad.	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Riparian Assoc. Hab.	0.36	0.12	0.24	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Riparian Assoc. Hab.-E.S.	0.12	0.05	0.12	0.24	0.36	0.12	0.12	0.12	0.24	0.36
Ag. Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Assoc. Hab. - Ag. Crop.	0.21	0.21	0.40	0.40	0.40	0.21	0.21	0.21	0.21	0.21
Assoc. Hab. - Ag. Crop. - Degraded	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Ag. Cropland - Degraded - Blackberry thickets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dredged Material	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	Canada Goose					Canada Goose				
	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Wetland - Farmed	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Intertidal Emergent Wet.	0.55	0.05	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Ag. Cropland	0.68	0.34	1.00	1.00	1.00	0.68	0.68	0.68	0.68	0.68
Assoc. Hab. - Ag. Crop.	0.68	0.68	1.00	1.00	1.00	0.68	0.68	0.68	0.68	0.68
Assoc. Hab. - Ag. Crop. - Degraded	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Ag. Cropland - Degraded - Blackberry thickets	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34

Table 12, continued.

	Mallard					Mallard				
	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Wetland - Farmed	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Intertidal Emergent Wet.	1.00	**0.10**	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Riparian	0.64	**0.21**	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Riparian - Degraded	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Riparian-Early Succ.	0.21	**0.10**	0.64	0.64	0.64	0.21	0.21	0.64	0.64	0.64
Riparian Assoc. Hab. - Degrad.	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Riparian Assoc. Hab.	0.64	**0.32**	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Riparian Assoc. Hab.-E.S.	0.21	**0.10**	0.64	0.64	0.64	0.21	0.21	0.64	0.64	0.64
Ag. Cropland	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Assoc. Hab. - Ag. Crop.	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Assoc. Hab. - Ag. Crop. - Degraded	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Ag. Cropland - Degraded - Blackberry thickets	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
	Savannah Sparrow					Savannah Sparrow				
	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Ag. Cropland	0.39	0.39	0.80	0.80	0.80	0.39	0.39	0.39	0.39	0.39
Assoc. Hab. - Ag. Crop.	0.39	0.39	0.80	0.80	0.80	0.39	0.39	0.39	0.39	0.39
Assoc. Hab. - Ag. Crop. - Degraded	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Ag. Cropland - Degraded - Blackberry thickets	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13

Table 12, continued.

	Black-capped Chickadee					Black-capped Chickadee				
	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.44	0.15	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Riparian - Degraded	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Riparian-Early Succ.	0.15	0.00	0.15	0.29	0.44	0.15	0.15	0.15	0.29	0.44
Riparian Assoc. Hab. - Degrad.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Riparian Assoc. Hab.	0.44	0.15	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Riparian Assoc. Hab.-E.S.	0.15	0.00	0.15	0.29	0.44	0.15	0.15	0.15	0.29	0.44
	Yellow Warbler					Yellow Warbler				
	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.40	0.00	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian - Degraded	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian-Early Succ.	0.13	0.00	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
Riparian Assoc. Hab. - Degrad.	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian Assoc. Hab.	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian Assoc. Hab.-E.S.	0.13	0.00	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
	Cooper's Hawk					Cooper's Hawk				
	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.77	0.26	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Riparian - Degraded	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Riparian-Early Succ.	0.26	0.00	0.26	0.77	0.77	0.26	0.26	0.26	0.77	0.77
Riparian Assoc. Hab. - Degrad.	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Riparian Assoc. Hab.	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Riparian Assoc. Hab.-E.S.	0.26	0.00	0.26	0.77	0.77	0.26	0.26	0.26	0.77	0.77

Table 12, continued.

			Mink					Mink		
	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.68	0.45	0.85	0.85	0.85	0.68	0.68	0.68	0.68	0.68
Wetland - Farmed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Intertidal Emergent Wet.	0.85	0.28	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Riparian	0.67	0.22	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Riparian - Degraded	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Riparian-Early Succ.	0.22	0.00	0.22	0.45	0.67	0.22	0.22	0.22	0.45	0.67
Riparian Assoc. Hab. - Degrad.	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Riparian Assoc. Hab.	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Riparian Assoc. Hab.-E.S.	0.22	0.00	0.22	0.45	0.67	0.22	0.22	0.22	0.45	0.67
		Song Sparrow					Song Sparrow			
	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.89	0.61	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Wetland - Farmed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Intertidal Emergent Wet.	0.10	0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Riparian	0.40	0.13	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian - Degraded	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian-Early Succ.	0.13	0.00	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
Riparian Assoc. Hab. - Degrad.	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian Assoc. Hab.	0.40	0.13	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian Assoc. Hab.-E.S.	0.13	0.00	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40

Table 13. Habitat acres by disposal plan and mitigation effort.

	Least Cost Disposal Plan	Mitigation Plan (Joslin, Sauvie 94, Woodland, Martin Island and Webb)	Mitigation:Disposal	Sponsor Preferred Disposal Plan	Mitigation Plan (Joslin, Sauvie 94 and Webb)	Mitigation:Disposal
Habitat Category	Acres	Acres	Ratio	Acres	Acres	Ratio
Wetland	38	355	9.3	30	219	7.3
Riparian	66	424	6.4	73	136	1.9
Agricultural	398	248	0.6	193	116	0.6
Total	502	1027	2.0	296	471	1.6
Adjusted AAHU						
Wetland	-100	571.8		-80	360.2	
Riparian	-171	639.9		-184	200.7	
Agricultural	-655	-177.8		-195	-42.7	
Total	**-926**	**1033.9**		**-459**	**518.2**	
Adjusted Total (105%)	**-972.3**			**-482.0**		

HEP, these discrepancies may balance themselves out, i.e., because the Corps was conservative in their estimate of habitat recovery rates and recovery could actually occur at a faster rate than predicted, the benefits to impacted species would occur at an earlier stage of the mitigative process. But, because of the errors in the HEP analysis, the mitigation analysis is also suspect and the appropriateness of the project mitigation plan cannot, at this stage, be adequately determined. The WDFW, WDOE, ODFW; and the Service have identified two possible options that would prevent untimely delay of the project, keep the planning process moving forward, and, at the same time, offer suitable protection of fish and wildlife resources:

1. The first option involves completing the HEP analysis by collecting data to represent all habitat types and reanalyzing current and future conditions based on changes in individual habitat parameters. This reanalysis could be completed during the preconstruction engineering and design (PED) phase of the project.

2. The second option recognizes that, because the ability to accurately quantify impacts and mitigation needs has been compromised by inaccuracies in the HEP process, it has become necessary to look at the probable impacts of dredged material disposal and opt for the mitigation plan that best offsets these impacts. Based on the upland wildlife resource impacts expected from the Sponsor's disposal plan, which appears to have less severe impacts than the Government's disposal plan, the mitigation proposal that the Service would accept as best accomplishing the above mitigation goal includes all of the following sites (or equivalent replacement sites that are acceptable to the HEP team): Martin Island, Webb, Woodland Bottoms, Sauvie, Burke Island, and Joslin.

THREATENED AND ENDANGERED SPECIES

We have attached a list (Attachment A) of threatened and endangered species that may occur within the area of the proposed Columbia River channel deepening project. The list fulfills the requirements of the Service under Section 7 (c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C., 1531 et seq.). The Corps of Engineers' (Corps) requirements under the Act are outlined in Attachment B.

The purpose of the Act is to provide a means whereby threatened and endangered species and their ecosystems on which they depend may be conserved. Under Section 7(a)(1) and 7(a)(2) of the Act and pursuant to 50 CFR 402 *et seq.*, the Corps is required to utilize its authorities to carry out programs which further species conservation and to determine whether its projects may affect threatened and endangered species and/or critical habitat. A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) which are major Federal actions significantly affecting the quality of the human environment as defined in NEPA (42 U.S.C. 4322(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to the Biological Assessment be prepared to determine whether they may affect listed and proposed species. Recommended contents of a Biological Assessment are described in Attachment B, as well as 50 CFR 40.12.

If the Corps determines, based on the Biological Assessment or evaluation, that threatened and endangered species and/or critical habitat may be affected by the project, the Corps is required to consult with the Service following the requirements of 50 CFR 402 which implement the Act.

Attachment A also includes a list of candidate species under review for listing. The list reflects changes to the candidate species list published September 19, 1997 in the Federal Register (Vol. 62, No. 182, 49398) and the addition of "species of concern". Candidate species have no protection under the Act but are included for consideration as it is possible candidates could be listed prior to project completion. Species of concern are those taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.

If a proposed project may affect candidate species or species of concern, the Corps is not required to perform a Biological Assessment or evaluation or to consult with the Service. However, the Service recommends addressing potential impacts to these species in order to prevent future conflicts. Therefore, if early evaluation of the project indicates that it is likely to adversely impact a candidate species or species of concern, the Corps may wish to request technical assistance from this office.

A number of Federally-listed wildlife species are associated with the estuary. These include the Columbian white-tailed deer and brown pelican (both endangered), bald eagle (threatened), Aleutian Canada goose (threatened), and peregrine falcon (endangered). In addition, the western snowy plover, classified as threatened, nests on Clatsop Spit. Threatened and endangered wildlife species associated with the river include Columbian white-tailed deer, bald eagle, and peregrine falcon. Listed salmonid species (under the jurisdiction of NMFS) are also associated with both the estuary and the mainstem Columbia River: Lower Columbia River steelhead trout (threatened); Upper Columbia River steelhead trout (endangered); Snake River Basin steelhead trout (threatened); Snake River sockeye salmon (endangered); Snake River fall chinook salmon (threatened); and Snake River spring/summer chinook salmon (threatened). The Lower Columbia River chinook and chum salmon; Middle Columbia River steelhead trout; Upper Willamette River chinook salmon; and Upper Willamette River steelhead trout have also been recently listed as threatened. The Lower Columbia River cutthroat trout has recently been proposed for listing as threatened. Also under the jurisdiction of NMFS are a number of whale and marine turtle species which utilize the offshore areas within the project's offshore boundaries.

Bald eagles are both resident and migratory. The lower end of Cathlamet Bay appears to be of significant importance for winter roosting and nesting (Figure 4). Bald eagles are also present at various sites along the mainstem Columbia River and, since 1990, nest sites have nearly doubled in upriver locations. Nesting activity for bald eagles occurs from January 1 through August 31. Wintering eagles occur in the lower river from October 31 through March 31. Peregrine falcons are known to nest on the Fremont Bridge within the Portland city limits.

DISCUSSION

The proposed deepening of the Columbia River channel to -43 feet between RM 3 and RM 105.5 would have a variety of immediate, short-term, and possibly long-term impacts on the river and its resources. The same is true of the proposed deepening of the Willamette River channel. Under the least cost disposal plan (Government Plan), over 110 million cubic yards of material (including the Willamette River material) are scheduled for disposal over a twenty year project period. This includes offshore, upland, beach nourishment and flowlane/inwater disposal for new work as well as disposal of maintenance dredging materials. This amount of dredged material disposal would have a significant detrimental impact on many habitats and species within the lower Columbia River Basin.

The Sponsor's Plan calls for two fewer disposal sites requiring mitigation than does the Government Plan, and involves less upland acreage overall to accommodate the dredged material. In many cases, the Sponsor's Plan opts for disposal sites which are more expensive in terms of transportation costs over those sites which would have a higher environmental cost, thus minimizing acquisition costs by avoiding disposal sites which would require mitigation. However, the Sponsor's Plan also relies heavily on the use of port lands slated for commercial/industrial development. While the Service does not, in general, object to the use of such sites for dredged material disposal, we do have reservations about some of these port sites because some of them support valuable wildlife habitat on site or are adjacent to such habitat, e.g., the Gateway 3 site, and these habitats would probably suffer losses once disposal occurs due to secondary development impacts. In addition, riparian habitat losses associated with the Sponsor's Plan are not adequately mitigated. To be considered satisfactory, use of the proposed disposal sites under the Sponsor's Plan would require mitigative replacement of lost riparian habitat at or near the same ratio as the Corps' Government Plan. However, if the sponsors did provide for appropriate riparian habitat replacement and mitigation and monitoring plans were approved prior to project construction, the Corps should give serious consideration to implementation of the Sponsor's Plan.

There is a concern that dredging may have direct adverse impacts on smelt and sturgeon in the lower Columbia River and the Willamette River, primarily because of the possibility of entrainment. Such impacts could be reduced if dredging were limited to specific inwater work periods or to the use of specific types of equipment. Additionally, studies to determine cumulative, long-term impacts of dredging on smelt and sturgeon populations would aid in developing methods of dredging and disposal designed to minimize such impacts.

Pile dike construction, particularly in the estuary around Miller Sands and Miller-Pillar Islands, could increase foraging opportunities for piscivorous birds, resulting in increased mortalities for juvenile salmon. These impacts could be significantly reduced if the pile dikes were constructed with metal cones or caps, wires, nails, etc., which would discourage bird use of the pilings.

Several estuarine islands created by disposal of dredged materials (Rice Island, Miller Sands, etc.) have become productive habitat sites for colonial nesting birds such as Caspian terns, cormorants, and gulls. These bird populations, particularly the tern populations, have increased significantly in the last several years. Research on the foraging activities of these birds has shown that juvenile salmon mortality from avian predators has ranged from 10 to 30 million fish. An interagency group has been working to reduce salmon mortality by relocating birds to other island sites where juvenile salmon would not be as susceptible to predation and by making the presently used sites less hospitable to bird use. The final resolution of these human-caused inter-species conflicts, including the issue of future use of these sites for channel deepening disposal, must be conducted in a manner that minimizes harm to both colonial nesters and juvenile salmon.

Flowlane/inwater disposal should only be considered for areas of low benthic productivity and low fish use. Shallow intertidal and subtidal areas must be avoided as well as deepwater areas below -65 feet, especially areas of known importance to sturgeon. The Service is particularly concerned about the predicted shallowing of the channel depth by twenty feet over 20 years in certain areas as a result of flowlane disposal. This could have serious consequences on sturgeon and sturgeon habitat in terms of rearing areas and prey availability. Monitoring studies would be needed to determine long-term impacts to sturgeon, particularly YOY and juvenile sturgeon.

Preliminary results of workshops to develop new offshore disposal sites has resulted in consideration of several candidate sites. Some of these sites are in areas where little is known of the site's natural resources (Astoria Canyon, shale pile site). In other cases, sites may impact known resources, e.g., juvenile flatfish. In the case of the latter species, little or no disposal has occurred in the area where juvenile flatfish are known to rear. Disposal in this area over a long-term period could be seriously detrimental to this species and should be avoided. Any long-term continual disposal in the same area within a newly designated offshore disposal site should also be monitored to determine overall losses and mitigation needs

Results from the Corps' study of disposal impacts on soft-shell crabs have been inconclusive, particularly with regard to adult soft-shell crabs. Low test numbers and the size of the test containers may have skewed the results for adult soft-shell crabs. Additional research using larger, viewable tanks with statistically valid numbers of crabs should be completed before a final decision is made regarding disposal impacts on soft-shell crabs.

Another consideration of offshore disposal should be the possibility of disposing of dredged material to contribute sand materials to the littoral drift just offshore of the mouth of the Columbia River. Past dredging and disposal practices have, over time, contributed to the severe loss of beach material along the Washington coastline. Methods of disposing of material in Area E or, if possible, in the surf zone or on Benson Beach so that it nourishes the shoreline just north of the north jetty should be investigated.

There is the possibility that, with the dredging of the 43-foot channel, the channel width would be increased, thereby increasing the amount of material dredged. This increase should be included as part of a contingency plan with the understanding that mitigation would be required for disposal of any additional material. The possibility of bank sloughing and consequent losses of intertidal habitat associated with channel deepening and widening should also be monitored. Mitigation would be required for such losses if they occurred.

In the past decade, there have been a number of safety problems associated with the shipwake from large ships on beaches along the river. The possibility of increased safety risks to boaters and shoreline recreationists from the larger ships accommodated by the project's deeper channel should be considered. With the increased shipwake, there may also be increased erosion of both the natural shoreline and of the man-made island shorelines. Such erosion could result in an increase in the amount and frequency of dredging in the channel and would probably require some method of permanent stabilization at the erosion sites. These activities could lead to loss of and further degradation of habitat in the lower Columbia River.

Another area of concern relates to the impacts of the blasting proposed for the 43-foot channel. Blasting should be planned so that impacts to fish and wildlife are kept to a minimum. Blasting procedures should be the most up-to-date, i.e., state-of-the-art at the time of construction. Primary among these conditions should be inter-agency coordination to determine appropriate timing for blasting and use of blast attenuating methodologies to assure minimal impacts. Monitoring of the blasting as a means of determining mitigation needs is imperative.

Mitigation actions should take place concurrently with or before construction to assure minimization of losses. Monitoring plans should also be developed and approved prior to construction commencement. In addition, permanent protection and long-term maintenance of mitigation sites should be addressed. In certain cases, title transfer of mitigation sites to interested resource agencies (with appropriate maintenance funding) should be considered. With regard to proposed ecosystem restoration projects, monies should be included in the authorization of the projects to implement these actions.

We have concerns about the proposed disposal at the Brown Island sites (W46.3 and W46.0). These sites support high value Columbian white-tailed deer (CWT) habitat. Brown Island also contains valuable shallow subtidal, intertidal, and riparian habitats which must be avoided during disposal.

State resource agencies have expressed concerns regarding disposal on Canada goose nesting sites. To protect these sites, no disposal should occur on known nesting areas between March 1 and June 30. The WDFW also is concerned about disposal on Martin Island. This site has not historically been used for disposal and it supports valuable waterfowl wintering and nesting habitat. Because Martin Island is designated as a significant mitigation property under the Government Plan, it may be better suited to this purpose than to disposal. The ODFW would also prefer that the Scappoose Dairy site on Sauvie Island be dropped as a disposal site and that, if possible, the Lone Star Gravel Pit be substituted for disposal. The Dairy site is managed as a Canada goose migration corridor helping to alleviate goose depredation problems by keeping the geese away from nearby agricultural areas. Disposal on this site would negate such management options. The WDFW also has concerns with the proposed disposal at the Peavey Oval site (W73.5). According to the Washington Department of Ecology, wetlands at this site are designated "waters of the state and shorelines of the state" and, therefore, "subject to protection". Mitigation would be required for any impacts to these wetlands. Because of the intricacies of past permitted filling of portions of this site, mitigation requirements, and the possibility of long-term legal actions associated with filling this site, its use as an acceptable disposal site is questionable. The option of dropping Martin Island, the Scappoose Dairy (and, possibly, substituting the Lone Star Gravel Pit), and the Peavey Oval as disposal sites should, therefore, be evaluated.

The HEP analysis has been shown to have some discrepancies which have effected the mitigation requirements for offsetting disposal impacts to wildlife resources. Two options have been offered to help resolve this issue: 1) redoing the HEP analysis during the PED phase of the project, or 2) accepting Burke Island, Martin Island, Webb, Sauvie, Joslin, and Woodland Bottoms (or equivalent replacement sites that are acceptable to the HEP team) as mitigation sites associated with each disposal plan option.

Contaminant issues must also be addressed, particularly in the Willamette River. Contaminated sites must be identified prior to construction. Avoidance of these areas would be the preferred method of dealing with these sites. If avoidance is not possible and dredging is pursued in contaminated sites, then rather than capping inwater, it may be more suitable to remove the contaminated materials, place them in approved upland sites, and then cap them. Monitoring of these sites during and after dredging would be necessary. There is also concern about dioxin levels in the sediment samples taken in the Willamette River, especially at hazardous waste sites. Close inter-agency coordination would be necessary to assure that this material is handled properly to minimize adverse impacts.

Actions from other agencies or from private entities, as a result of the channel deepening, could cause increased dredging activity near ports, marinas, or harbors in areas containing fine-grained or contaminated sediment. The interdependent and interrelated actions due to channel deepening, such as dredging by ports and private individuals, could occur in areas with a higher degree of contaminated fine materials. Bottom materials in these areas outside the channel may not be well characterized, and depositional areas containing organic materials could be under-represented during the sampling process. These independent actions are related to channel deepening and could result in secondary impacts, i.e., resuspension of contaminants which would effect salmon, bald eagles, and other fish and wildlife.

Secondary impacts that could also result from channel deepening include increased shipping traffic and the probability of increased incidences of oil spills; increases in illegal bilge dumping coupled with an increased probability of exotic species introductions; additional losses of habitat at Howard Island, Cottonwood Island, Austin Point, and Gateway 3 disposal sites due to secondary industrial development occasioned by disposal; and increased exposure of salmonid species to contaminants. These secondary impacts must be evaluated by the Corps and appropriately mitigated, as necessary.

The Service is concerned that the screening levels used by the Corps to evaluate materials proposed for dredging and flowlane disposal are not protective of fish and wildlife in the lower Willamette and Columbia Rivers. Disturbance or disposal of dredged materials containing organochlorines, especially dioxin-like compounds, above or below the Corps screening levels could still result in biomagnification of contaminants through the food chain. Bioaccumulation has already been documented in bald eagles, ospreys, great blue herons, double-crested cormorants, minks, and otters along the lower Willamette and Columbia Rivers near areas proposed for dredging and disposal. In addition, existing concentrations of organochlorines and PAHs in the Willamette River already threaten smolt survival and salmon reproduction. Dredging contaminated fine materials in these areas could enhance uptake of contaminants by juvenile salmon and further threaten overall survival. Further study in the Willamette River on the impacts of dredging and disposal of contaminated materials needs to be conducted to assess probable harm to aquatic resources, particularly listed species. In addition, if the contaminant issues in the Willamette River cannot be satisfactorily resolved, then the Willamette River portion of the channel deepening project should be dropped.

The issue of fish contamination is of particular concern to the Columbia River Inter-Tribal Fish Commission (CRITFC) because of high fish consumption rates among tribal members. CRITFC's concerns regarding Willamette River dredging and disposal and impacts on tribal health are contained in their comment letter regarding the draft Portland Harbor Sediment Management Plan, enclosed with their attached comment letter to the Service. We urge the Corps to seriously consider these comments before proceeding with any planned dredging of the Willamette River.

From a fish and wildlife perspective, the no action alternative is the best alternative in terms of avoiding cumulative, long-term impacts to the lower Columbia River's natural resources. However, this report is focused on describing impacts and methods of avoiding, minimizing, and compensating for the impacts of a particular channel deepening plan. In terms of minimizing impacts, there appear to be at least two alternatives that would still provide for some increased use of the river by larger, deep-draft ships but would not have the same scope of impacts as the proposed -43 foot channel dredging coupled with the least cost disposal alternative or the sponsor's preferred disposal plan. Improving the efficiency of the LOADMAX system is the non-structural method for accommodating larger ships with the least damage to fish and wildlife species. It does not provide for the greatest amount of economic development but it does provide for some economic expansion with less cost to the environment. Another, less negatively impacting alternative is development of a tiered channel to allow for the extra depth for heavily loaded outbound ships. It may also be possible to achieve passage for larger, deep-draft ships by working with a combination of less environmentally damaging alternatives such as the 41-foot channel and LOADMAX, or a tiered channel and LOADMAX. The Service would like to see further analysis of these alternatives before a final preferred alternative is selected.

RECOMMENDATIONS

To address the above concerns associated with the 43-foot channel, avoid, minimize or compensate for impacts, and protect fish and wildlife resources where possible, the Service recommends that:

1. All inwater work take place within specified State and Federal resource agency time periods to protect juvenile salmonids, smelt, and sturgeon.

2. Dredging in the Columbia River downstream of the mouth of the Lewis River be limited to use of a clamshell dredge between January 1 and June 1 to minimize entrainment impacts to smelt larvae. Studies on adult smelt spawning distribution or on larval smelt production/distribution before, during, and after dredging are recommended to determine changes in mainstem spawning success and distribution related to dredging.

3. To minimize losses of juvenile salmonids, any pile dike installation, particularly in the vicinity of Miller Sands or Miller-Pillar Rock Islands, should implement design methods which prevent or deter use by piscivorous birds.

4. The final resolution of the tern predation issue, including future use of estuarine islands for channel deepening disposal, be conducted in a manner that minimizes harm to both colonial nesters as well as juvenile salmon.

5. Studies be initiated to determine the cumulative effect of dredging and disposal on sturgeon, particularly in those flowlane areas where the depth of the channel is predicted to become shallower over the next 20 years. If these studies indicate significant disposal related losses of sturgeon and sturgeon habitat, flowlane disposal in waters deeper than 30 feet should be reduced or eliminated to protect larval, YOY, and juvenile sturgeon.

6. Disposal in offshore juvenile flatfish rearing areas be avoided. In addition, any continuous long-term disposal in the same area of a newly designated offshore site should be monitored to assess mitigation needs.

7. Research studies on the impacts of disposal on soft-shell crabs be continued.

8. Offshore disposal in Area E near the north jetty be placed so as to allow for contribution to the littoral drift and nourishment of Washington Coast beaches, particularly Benson Beach.

9. Bank sloughing and consequent losses of intertidal habitat associated with channel deepening and widening be monitored. Appropriate mitigation would be required for such losses if they occur.

10. Monitoring studies be initiated to determine recreational safety problems as well as erosion acceleration (bank sloughing) resulting from increased shipwake from larger, deep draft ships using the deepened channel. Mitigation for the loss of habitat, use, and forage for terrestial and aquatic species resulting from this erosion shall also be identified and implemented.

11. Blasting requirements as regulated by the ODFW and WDFW be incorporated into any blasting plan for the Columbia and/or Willamette Rivers with mitigation as requested.

12. All mitigation efforts be initiated concurrently with or prior to construction commencement. Monitoring plans should also be approved prior to the start of construction. In addition, permanent protection and long-term maintenance of mitigation sites should be addressed. In certain cases, title transfer of mitigation sites to interested resource agencies (with appropriate maintenance funding) may be appropriate. With regard to the proposed ecosystem restoration projects, monies to implement these actions should be included in the authorization for the projects.

13. Disposal at Brown Island avoid Columbian white-tailed deer habitat.

14. No disposal occur on known Canada goose nesting areas between March 1 and June 30.

15. The option of dropping Martin Island, Scappoose Dairy (and substituting the Lone Star Gravel Pit), and the Peavey Oval as disposal sites should be evaluated.

16. One of the two options offered for correcting the discrepancies in the baseline assumptions of the HEP analysis be selected to offset upland disposal impacts.

17. Dredging in contaminated areas be avoided, including areas with DDE, PCBs, or dioxin-like compounds above or below screening levels, particularly in the Willamette River. If this is not possible, dredged contaminated materials should be placed in approved upland sites and capped. Monitoring of these areas for contaminant availability during dredging would be necessary.

18. Secondary impacts that could result from channel deepening such as oil spills; increases in illegal bilge dumping coupled with an increased probability of exotic species introductions; additional losses of habitat due to secondary industrial development occasioned by disposal; and increased exposure of salmonid species to contaminants be further evaluated by the Corps and appropriately mitigated, as necessary.

19. Further study in the Willamette River on the impacts of dredging and disposal of contaminated materials be conducted to assess probable harm to aquatic resources, particularly listed species. In addition, if the contaminant issues in the Willamette River cannot be satisfactorily resolved, then the Willamette River portion of the channel deepening project should be dropped.

20. CRITFC's concerns regarding Willamette River dredging and disposal and impacts on river and tribal health as contained in their comment letter regarding the draft Portland Harbor Sediment Management Plan be given serious consideration by the Corps before proceeding with any planned dredging of the Willamette River.

21. The following points be incorporated into the dredging and disposal activities for the project to avoid contaminant impacts to salmon, bald eagles, otters, and other fish and wildlife.

    1) Add chemical analysis of dioxin-like compounds (individual congeners of dioxin, furan, and planar polychlorinated biphenyls) into the regular testing regimen for fine-grained sediments from the Columbia and Willamette Rivers. Develop screening levels for these compounds based on an additive or toxic equivalent (TEQ) approach, which accounts for the additive toxicity of the dioxin-like compounds. Bioassays such as the H4IIE bioassay could be applied for testing rather than a full dioxin and furan analysis to measure dioxin-like activity, but detection limits of any bioassay should be no greater than one pg/g.

2) Consider dredged material which meets the requirements for inwater/flowlane disposal as a point source discharge for any contaminants, especially bioaccumulative compounds, that are present above detection limits. This would help to quantify the cumulative low level discharges of bioaccumulative contaminants into the Columbia River. In addition, establish an easily accessible database containing this information (amount of material disposed and total contaminants in material) for all Corps projects on the Columbia and Willamette Rivers involving inwater disposal. Estimate the additional loading of DDT and metabolites, PCBs, and dioxin-like compounds (dioxins, furans, and planar PCBs) by determining the total amount of each contaminant (based on concentrations from chemical analysis on a sample from a set amount of material) within the total amount of material to be disposed. Report estimates to the appropriate State Environmental Quality personnel to determine if this additional loading would violate current water quality standards for the Columbia River.

3) Tabulate and report results of chemically analyzed fine-grained materials that are collected on a regular schedule from the Willamette and Columbia Rivers. Reports should include sampling techniques, chemicals analyzed, quality control information, and detection limits for each analyte, and should be made available to the public and other Federal Agencies. Electronic data and final reports could be made available on the Internet.

4) Prepare a detailed GIS map describing all known areas of contaminated sediments above detection limits, especially those areas containing DDT and metabolites, total PCBs, and dioxin-like compounds in the Willamette River, and overlay areas to be dredged. The map should incorporate information recently gained from the Corps' Channel Deepening Sediment Quality Evaluation and the Portland Harbor Sediment Investigation sponsored by the Oregon Department of Environmental Quality and the U.S. Environmental Protection Agency. This map would provide critical information needed to avoid dredging contaminated areas, thus minimizing impacts to fish and wildlife.

5) Avoid dredging in areas where PCBs, DDT and metabolites, dioxins, or furans are identified in contaminant maps outlined in recommendation 4. Areas adjacent to state or Federal hazardous waste sites should not be dredged. Dredging these areas, especially areas contaminated with wood-treating chemicals, could resuspend dioxins and furans and violate the total maximum daily load for TCDD established for the Columbia River. If these areas are dredged, disposal should be in approved upland sites and monitoring for contaminant bioavailability should be conducted during the dredging process.

6) Develop a monitoring program to determine if resuspension or the availability of bioaccumulative contaminants are increased during a dredging or disposal operation involving fine materials. The monitoring program should be developed in coordination with the Service and the U.S. Geological Survey. Monitoring should address bioaccumulation, and should involve a sensitive ecological receptor or use of passive sampling devices such as semi-permeable membrane device (SPMDs), caged mussels, or other techniques.

7) Gather additional data to address how interdependent and interrelated actions associated with dredging the navigation channel could impact contaminant loading into the Willamette and Columbia Rivers. The Corps did not address this issue in their biological assessment for the Dredged Material Management Plan, and the Service recommends this issue be addressed during the channel deepening review.

REFERENCES

Anthony, R.G., M.G. Garrett, and C.A. Schuler. 1993. Environmental contaminants in bald eagles in the Columbia River Estuary. J. Wildl. Managmnt. 57:10-19.

Arkoosh, M.R., E. Casillas, E. Clemons, B.B. McCain, and U. Varanasi. 1991. Suppression of immunological memory in juvenile chinook salmon (*Oncorhynchus tshawytscha*) from an urban estuary. Fish and Shellfish Immunol. 1:261-277.

Arkoosh, M.R., E. Clemons, M. Myers, and E. Casillas. 1994. Suppression of B-cell mediated immunity in juvenile chinook salmon (*Oncorhynchus tshawytscha*) after exposure to either polycyclic aromatic hydrocarbon or to polychlorinated biphenyls. Immunopharmacology and Immunotoxicology 16:293-314.

Bottom, D. and K.K. Jones. 1990. Species composition, distribution, and invertebrate prey of fish assemblages in the Columbia River Estuary. Prog. Oceanog. Vol. 25, pp.243-270.

Colborn, T.F., S. vom Saal, and A.M. Soto. 1993. Developmental effects of endocrine-disrupting chemicals in wildlife and humans. Environmental Health Perspectives 101(5): 378-384.

Corkran, C.C. and C. Thoms. 1996. Amphibians of Oregon, Washington, and British Columbia. Lone Pine Publishing. Vancouver, British Columbia, Canada. 175 pp.

Curtis, L.R., H.M. Carpenter, R.M. Donohoe, D.E. Williams, O.R. Hedstrom, M.L. Deinzer, M.A. Bellstein, E. Foster, and R. Gates. 1993. Sensitivity of cytochrome P450-1A1 induction in fish as a biomarker for distribution of TCDD and TCDF in the Willamette River. Oregon. Environ. Sci. Technol. 27:2149-2157.

DeHart, M. 1995, 1996, 1997. Fish Passage Center 1994, 1995, 1996 Annual Reports. Fish Passage Center of the Columbia Basin Fish and Wildlife Authority. Portland, Oregon.

Durkin, J.T. and R.L. Emmett. 1980. Benthic invertebrates, water quality, and substrate texture in Baker Bay, Youngs Bay, and adjacent areas of the Columbia River Estuary. National Marine Fisheries Service, NOAA. Seattle, Washington. 22 pp.

Emmett, R.L., G.T. McCabe, Jr., T.C. Coley, R.J. McConnell, and W.D. Muir. 1985. Benthic Sampling in Cathlamet Bay, Oregon (1984). National Marine Fisheries Service. Hammond, Oregon. 70 pp.

Emmett, R.L. and S.A. Hinton. 1995. Benthic Infauna and Sediment Characteristics Offshore from the Columbia River, July 1992. Coastal Zone and Estuarine Studies Division, NNWS, NOAA. Seattle, Washington.

Graves, J.K., J.A. Christy, P.J. Clinton, and P.L. Britz. 1995. Historic Habitats of the Lower Columbia River. Columbia River Estuary Study Task Force. Astoria, Oregon. 14 pp.

Hancock, D. 1997. A Summary of the Benthic Invertebrate Information in the Region of Existing Offshore Disposal Sites Off of the Mouth of the Columbia River. Prepared for the U.S. Army Corps of Engineers, Portland District, September, 1997. Oceanographic Institute of Oregon. Vancouver, Washington.

Harrison, H.E., C.W. Anderson, F.R. Rinella, T.M. Gasser, and T.R. Pogue, Jr. 1995. Analytical data from phases I and II of the Willamette River Basin water quality study, Oregon, 1992-1994. U.S. Geological Survey, Open-File Report 95-373. Portland, Oregon.

Henny, C.J., R.A. Grove, and O.R. Hedstrom. 1996. A field evaluation of mink and otter on the lower Columbia River and the influence of environmental contaminants. Final report to the Lower Columbia River Bi-State Water Quality Program. Portland, Oregon. 206 pp.

Hinton, S.A. and R.L. Emmett. 1994. Benthic Infauna, Sediment, and Fish Offshore from the Columbia River, July 1992. Coastal Zone and Estuarine Studies Division, NNES, NOAA. Seattle, Washington.

Hinton, S.A. and R.L. Emmett. 1996. Benthic Infauna and Sediment Characteristics Offshore from the Columbia River, August 1994. Coastal Zone and Estuarine Studies Division, NNTS, NOAA. Seattle, Washington.

Hinton, S.A. 1998. Personal Communication. National Marine Fisheries Service. Hammond, Oregon.

Jones, K.K., C.A. Simenstad, D.L. Higley, and D.L. Bottom. 1990. Community structure, distribution, and standing stock of benthos, epibenthos, and plankton in the Columbia River Estuary. Prog. Oceanog. Vol. 25, pp 211-241.

Malins, D.C., B.B. McCain, D. W. Brown, A. K. Sparks, H.O. Hodgins, and S.L. Chan. 1982. Chemical contaminants and abnormalities in fish and invertebrates from Puget Sound. NOAA Tech. Memo OMPA-19. 168 pp.

McCabe, G.T., Jr. and C.A. Tracy. 1993. Spawning characteristics and early life history of white sturgeon, *Acipenser transmontanus,* in the Lower Columbia River. In: R.C. Beamesderfer and A.A. Nigro (editors), Status and habitat requirements of the white sturgeon populations in the Columbia River downstream from McNary Dam, Volume I, pp.19-46.

McCabe, G.T., Jr., S.A. Hinton, and R.L. Emmett. 1996. Benthic invertebrates and sediment characteristics in Wahkiakum County Ferry Channel, Washington, before and after dredging. National Marine Fisheries Service. Seattle, Washington. 32 pp.

McCain, B.B., D.C. Malins, M.M. Krahn. D.W. Brown, W.D. Gronlund, L.K. Moore, and S.L. Chan. 1990. Uptake of aromatic and chlorinated hydrocarbons by juvenile chinook salmon (*Oncorhynchus tshawytscha*). Arch. Environ. Contam. Toxicol. 19:10-16.

McConnell, R.J., G.R. Snyder, J.T. Durkin, and T.H. Blahm. 1979. Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October 1977-1978. National Marine Fisheries Service, NOAA. Seattle, Washington.

McConnell, R. J. 1990. An Annotated Bibliography of Aquatic Research in the Lower Columbia River, River Mile 0-106.5. Prepared for the U.S. Army Corps of Engineers, Portland District, July, 1990. R\Mc Services. Rainier, Oregon.

Mohoric, K. 1998. Personal Communication. Washington Department of Fish and Wildlife. Vancouver, Washington.

Moritz, R. 1998. Personal Communication. U.S. Army Corps of Engineers, Portland District. Portland, Oregon.

Norman, G. and S. King. 1996. Status Report, Columbia River Fish Runs and Fisheries, 1938-1995. Washington Department of Fish and Wildlife and Oregon Department of Fish and Wildlife. Olympia, Washington and Portland, Oregon.

Nussbaum, R.A., E.D. Brodie, Jr., and R.M. Storm. 1983. Amphibians and Reptiles of the Pacific Northwest. University of Idaho Press. Moscow, Idaho. 332 pp.

Ogden Beeman and Associates, Inc. 1985. Studies to Control Shoaling of the Navigation Channel Lower Columbia River. Prepared for the U.S. Army Corps of Engineers, Portland District. Portland, Oregon. 176 pp.

Oregon Department of Environmental Quality. 1994. Willamette River toxics study 1988-1991. Water Quality Division. Portland, Oregon.

Oregon Department of Environmental Quality. 1996. Oregon Department of Environmental Quality's 1994/1996 303(d) list of water quality limited waterbodies and Oregon's criteria used for listing waterbodies. Water Quality Division. Portland, Oregon. 61 pp.

Pacific Fisheries Management Council. 1998. Review of 1997 Ocean Salmon Fisheries. Portland, Oregon.

Parsley, M.J., P.S. Anders, A.I. Miller, L.G. Beckman, and G.T. McCabe, Jr. 1993. Factors affecting white sturgeon spawning and recruitment in the Columbia River downstream from McNary Dam. In: R.C. Beamesderfer and A.A. Nigro (editors), Status and habitat requirements of the white sturgeon populations in the Columbia River downstream from McNary Dam, Volume I, pp. 61-79.

Parsley, M.J., L.G. Beckman, and G. T. McCabe, Jr. 1993. Spawning and rearing habitat use by white sturgeons in the Columbia River downstream from McNary Dam. Trans. Am. Fish Soc. 12:217-227.

Pollard, H. 1998. Unpublished data relating to juvenile salmon entering the Columbia River Estuary in 1998. National Marine Fisheries Service. Portland, Oregon.

Richardson, M.D., A.G. Carey, Jr., and W.A. Colgate. 1977. Aquatic Disposal Field Investigations, Columbia River Disposal Site, Oregon. Appendix C: The Effects of Dredged Material Disposal on Benthic Assemblages, Technical Report D-77-30. U.S Army Corps of Engineers Waterways Experiment Station. Vicksburg, Mississippi.

Sanborn, H.R. 1975. Benthic Infauna Observed at Five Sites in the Columbia River from August 1973 to July 1974. National Marine Fisheries Service. Seattle, Washington. 31 pp.

Seelye, J.G., R.J. Hesselberg, and M.J. Mac. 1982. Accummulation by fish of contaminants released from dredged sediments. Environ. Sci.Technol. 16:459-464.

Siipola, M.D., R.L. Emmett, and S.A. Hinton. 1993. Tongue Point Monitoring Program, 1989-1992. Final Report, U.S. Army Corps of Engineers. Portland, Oregon.

Simenstad, C. et al. 1984. The Dynamics of the Columbia River Estuarine Ecosystem. Vols. I and II. CREDDP. 695 pp.

Simenstad, C.A., L.F. Small, C.D. McIntire, D.A. Jay, and C.R. Sherwood. 1990. Columbia River Estuary Studies: an introduction to the estuary, a brief history, and prior studies. Progress in Oceanography, 25, 1-14.

Stebbins, R.C. 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Company. Boston, Massachusettes. 339 pp.

Stein, J.E., T. Hom, T.K. Collier, D.W. Brown, and U. Varanasi. 1995. Contaminant exposure and biochemical effects in outmigrant juvenile chinook salmon from urban and nonurban estuaries of Puget Sound, Washington. Environ. Toxicol. Chem. 14:1019-1029.

Thomas, D.W. 1983. Changes in Columbia River Estuary Habitat Types Over the Past Century. CREDDP. 55 pp.

Thomas, C.M. 1997. Environmental contaminants and breeding biology of great blue herons in the Columbia River Basin. M.S. Thesis, Oregon State University, Corvallis. 137 pp.

U.S. Army Corps of Engineers. 1996. Lower Columbia River Bi-State Water Quality Program, Fish, Wildlife, and Wetlands GIS Habitat Mapping. Portland District. Portland, Oregon.

U.S. Army Corps of Engineers. 1997. Dredged Material Management Plan and Supplemental Environmental Impact Statement. Columbia and Lower Willamette River Federal Navigation Channel. Portland District. Portland, Oregon.

U.S. Army Corps of Engineers. 1998. Columbia River Channel Deepening Sediment Quality Evaluation, handout received at public meeting. Portland District. Portland, Oregon.

U.S. Department of the Interior. Unpublished Data from the Columbia River Aquatic Food Chain Study (data collected in 1990-1991). U.S. Fish and Wildlife Service, Oregon State Office. Portland, Oregon.

U.S. Department of the Interior. 1986. Impacts of the Proposed Columbia River Coal Export Channel on Fish and Wildlife Resources. Fish and Wildlife Coordination Act Report. U.S. Fish and Wildlife Service, Oregon State Office. Portland, Oregon. 40 pp.

U.S. Department of the Interior. 1989. Columbia River Longview Anchorage. Fish and Wildlife Coordination Act Report. U.S. Fish and Wildlife Service, Oregon State Office. Portland, Oregon. 12 pp.

U.S. Department of the Interior. 1995. Impacts of organochlorine contaminants on double-crested cormorants nesting on Lewis and Clark National Wildlife Refuge. Internal Progress Report. U.S. Fish and Wildlife Service, Oregon State Office. Portland, Oregon. 11 pp.

U.S. Department of the Interior. 1998. Changes in productivity and environmental contaminants in bald eagles nesting along the lower Columbia River. Final Draft. U.S. Fish and Wildlife Service, Oregon State Office. Portland, Oregon. 40 pp.

U.S. Environmental Protection Agency. 1991. Total Maximum Daily Load (TMDL) for 2,3,7,8-TCDD in the Columbia River Basin. Decision Document, February 25, 1991. Seattle, Washington.

Woodward-Clyde Federal Services. 1996. Columbia River Channel Deepening, Report of the Interagency Workgroup on Salinity Intrusion. Prepared for the U.S. Army Corps of Engineers, Portland District, July, 1996. Woodward-Clyde Federal Services. Portland, Oregon.

APPENDIX I. Columbia River Diking Districts and Comparison of Columbia River Habitats, 1880s versus 1991.

DIKING DISTRICT	Columbia River Mile	District Acreage Oregon	Acreage Washington	
Sauvie Is. Drainage Dist.	98.5-101.5	12,000		
Clark Co. Diking Improv. Dist. No. 14	93.9-102.6		3730	
Columbia Drainage Dist. No. 1	92.9-96.8	1559		
Scappoose Drainage District	90.3-97	5530		
Lake River Delta	89.5-92.2		1565	Ridgefield NWR
Bachelor Island Area	87.9-91.4		1883	Ridgefield NWR
Lewis River Area	86.7		260	
Cowlitz Co. Consol. Diking Improv. Dist. No. 2	80.6-86.6		8070	
Deer Island Drainage District	75.8-82.3	3920		
Cowlitz Co. Consol. Diking Improv. Dist. No. 3	68.3		1825	
Rainier Drainage District	62.2-66.8	1287		
Cowlitz Co. Consol. Diking Improv. Dist. No. 1	60.3-68.3		9885	
Cowlitz Co. Diking Improv. Dist. No. 15	57.1-60.0		847	
John Drainage District	55.5-56.5	147		
Beaver Drainage District	49.7-55.4	5595		
Clatskanie Drainage District	50	325		
Magruder Drainage District	49	592		
Midland Drainage District	47.7-49.7	1330		
Webb District Improvement Co.	46.0-47.5	733		
Marshland Drainage District	45.6-47.7	1145		
Woodson Drainage District	46	355		
Westland District Improvement Co.	44.0-46.1	1090		
Clatsop Co. Diking District No. 15 (Westport)	44.0-45.0	233		
Wahkiakum Co. Consol. Diking Dist. No. 1	38.4-45.0		3865	
Wahkiakum Co. Diking Dist. No. 4	33.8-37.2		2260	
Wahkiakum Co. Diking Dist. No. 5	33.5		938	
Clatsop Co. Diking District No. 6	34.7-37.4	1778		Karlson Is.; Lewis & Clark NWR
Clatsop Co. Diking District No. 1	28.2-30.7	1358		
Clatsop Co. Diking District No. 7	28.2-30.7	982		
Clatsop Co. Diking District No. 12	28	87		Ziak Property

Clatsop Co. Diking District No. 10	27	370		Karlson Island, L&C NWR	
Svensen Island Dist. Improvement Co.	22	320			
Clatsop Co. Diking District No. 14	18	308			
Clatsop Co. Diking District No. 13		588		Youngs-Walluski Rivers	
Clatsop Co. Diking District No. 8		300		Youngs River	
Clatsop Co. Diking District No. 9		1210		Youngs Bay	
Clatsop Co. Diking District No. 2		248		Youngs Bay	
Clatsop Co. Diking District No. 5		535		Lewis & Clark River	
Clatsop Co. Diking District No. 8		1506		Lewis & Clark River	
Clatsop Co. Diking District No. 11		365			
Warrenton Diking District No. 2	10.0-11.0	996			
Warrenton Diking District No. 3	11.0-12.0	945			
Warrenton Diking District No. 1	10.0-11.0	1915			
SUBTOTAL		**49,652**	**35128**		
TOTAL		**84,780**			

Table 1. Comparison of Columbia River habitats, 1880's versus 1991, from the mouth to river mile 105.5.
Tabular information derived from Graves (1995) and U.S. Army Corps of Engineers (1996)

1880's Habitat	Acres (1880's)	1991 Habitats	Acres (1991's)	Habitat Acreage Increase/ Decrease
Sand Bank, Unvegetated	44.71	Barren Land	3,128.33	3,083
Floodplain Lake, Deep & Shallow Water	119,713.27	Open Water	138,589.29	18,876
Prairie & Pasture, Upland	17,991.62	Grassland	61.37	-17,930
Emer. Marsh (non-tidal), Flats & Shallows, Tidal Marsh	74,178.30	Wetland/Marsh	22,181.00	-51,997
	0	Shrub/Scrub	4,575.17	4,575
Oak, Fir, Ash, Savanna	201.57	Savanna-like	135.27	-66
	0	Coniferous Forest	415.5	415
Cottonwood and Ash Riparian Forest	16,051.39	Broad Leaf Forest	2,240.20	-13,811
Oak and Fir Forest	1331.8	Mixed Forest	6,972.12	6,640
	0	Agricultural	57,856.43	57,856
Urban	81.08	Urban/Developed	20,446.97	20,366
Willow Swamp (non-tidal), Tidal Swamp, Tidal Spruce Swamp, Tidal Cottonwood Swamp, Tidal Willow Swamp	37,855.42	Forested Wetland	10,851.04	-27,004
Missing Data	3.74	Missing Data	0.17	3.57
Total	267452.9		267452.86	

Appendix II. HEP Evaluation Species and Habitat Models.

Amphibian Model	WDFW Draft Habitat Suitability Index Model; May 1997
Canada Goose (wintering)	Interagency Wildlife Mitigation Team Habitat Suitability Index Model; May 1997
Mallard	Interagency Wildlife Mitigation Team Habitat Suitability Index Model; May 1997
Savannah Sparrow	Draft Habitat Suitability Index Model; June 1978
Black-capped Chickadee	USFWS Habitat Suitability Index Model; April 1983
Yellow Warbler	USFWS Habitat Suitability Index Model; July 1982
Cooper's Hawk	Review Copy Habitat Suitability Index Model; June 1980
Mink	USFWS Habitat Suitability Index Model; November 1986
Song Sparrow	Draft Habitat Suitability Index Model; June 1978

ATTACHMENT A

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES, CANDIDATE SPECIES AND SPECIES OF CONCERN THAT MAY OCCUR IN THE AREA OF THE COLUMBIA RIVER CHANNEL DEEPENING PROJECT 1-7-98-SP-368

LISTED SPECIES[1/]

Mammals		
Right whale	*Balaena glacialis*	** E
Sei whale	*Balaenoptera borealis*	** E
Blue whale	*Balaenoptera musculus*	** E
Finback whale	*Balaenoptera physalus*	** E
Humpback whale	*Megaptera navaeangliae*	** E
Sperm whale	*Physeter macrocephalus*	** E
Steller (=northern) sea lion	*Eumentopias jubatus*	** T
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	E
Birds		
Marbled murrelet	*Brachyramphus marmoratus*	CH T
Aleutian Canada goose	*Branta canadensis leucopareia*	T
Documented - Sauvie Island Wildlife Area		
Western snowy plover	*Charadrius alexandrinus nivosus*	PCH T
Peregrine falcon	*Falco peregrinus*	E
Documented - Lewis and Clark NWR		
Bald eagle	*Haliaeetus leucocephalus*	T
Brown pelican	*Pelecanus occidentalis*	E
Reptiles and Amphibians		
Loggerhead sea turtle	*Caretta caretta*	** T
Green sea turtle	*Chelonia mydas*	** T
Leatherback sea turtle	*Dermochelys coriacea*	CH ** E
Olive (=Pacific) ridley sea turtle	*Lepidochelys olivacea*	**T
Fish		
Steelhead (Lower Columbia River)[2/]	*Oncorhynchus mykiss*	** T
Steelhead (Snake River Basin)[3/]	*Oncorhynchus mykiss*	** T
Snake River Sockeye salmon	*Oncorhynchus nerka*	CH ** E
Salmon River tributary to the Snake River, Idaho.		
Snake River Chinook salmon	*Oncorhynchus tshawytscha*	CH ** T
Fall runs in the Snake River (proposed to included Deschutes River fall runs)		
Snake River Chinook salmon	*Oncorhynchus tshawytscha*	CH ** T
Spring/summer runs in the Snake River		
Chum salmon (Lower Columbia River)[5/]	*Oncorhynchus keta*	** T
Steelhead (Middle Columbia River)[6/]	*Oncorhynchus mykiss*	** T
Steelhead (Upper Willamette River)[6/]	*Oncorhynchus mykiss*	** T
Chinook salmon (Lower Columbia River)[7/]	*Oncorhynchus tshawytscha*	** T
Chinook salmon (Upper Willamette River)[7/]	*Oncorhynchus tshawytscha*	** T
Invertebrates		
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	CH T
Plants		
Golden paintbrush[4/]	*Castilleja levisecta*	T

Howellia	*Howellia aquatilis*	T
Bradshaw's lomatium	*Lomatium bradshawii*	E
Nelson's checker-mallow	*Sidalcea nelsoniana*	T
PROPOSED SPECIES		
Fish		
Coastal cutthroat trout (Lower Columbia River/SW Washington ESU)	*Oncorhynchus clarki clarki*	** PT
Plants		
Willamette daisy[8/]	*Erigeron decumbens* var. *decumbens*	PE
Kincaid's lupine[8/]	*Lupinus sulphureus* var. *kincaidii*	PT
CANDIDATE SPECIES[/]		
Fish		
Coho salmon (Lower Columbia River)[9/]	*Oncorhynchus kisutch*	** CF
SPECIES OF CONCERN		
Mammals		
White-footed vole	*Arborimus albipes*	
Pacific western big-eared bat	*Corynorhinus (=Plecotus) townsendii townsendii*	
Long-eared myotis (bat)	*Myotis evotis*	
Fringed myotis (bat)	*Myotis thysanodes*	
Long-legged myotis (bat)	*Myotis volans*	
Yuma myotis (bat)	*Myotis yumanensis*	
Birds		
Tricolored blackbird	*Agelaius tricolor*	
Olive-sided flycatcher	*Contopus cooperi (=borealis)*	
Little willow flycatcher	*Empidonax traillii brewsteri*	
Amphibians and Reptiles		
Tailed frog	*Ascaphus truei*	
Northwestern pond turtle	*Clemmys marmorata marmorata*	
Northern red-legged frog	*Rana aurora aurora*	
Fish		
Green sturgeon	*Acipenser medirostris*	
River lamprey	*Lampetra ayresi*	
Pacific lamprey	*Lampetra tridentata*	
Invertebrates		
California floater (mussel)	*Anodonta californiensis*	
Great Columbia River spire snail	*Fluminicola columbianus*	
Plants		
White top aster	*Aster curtus*	
Tall bugbane	*Cimicifuga elata*	

Pale larkspur	*Delphinium leucophaeum*
Peacock larkspur	*Delphinium pavonaceum*
Howell's montia	*Montia howlii*
Columbia Cress	*Rorippa columbiae*
Oregon sullivantia	*Sullivantia oregana*

(E) - Listed Endangered *(T) - Listed Threatened* *(CH) - Critical Habitat has been designated for this species*
(PE) - Proposed Endangered *(PT) - Proposed Threatened* *(PCH) - Critical Habitat has been proposed for this species*

Species of Concern - Taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.

(CF) - Candidate: National Marine Fisheries Service designation for any species being considered by the Secretary for listing for endangered or threatened species, but not yet the subject of a proposed rule.

*** Consultation with National Marine Fisheries Service required.*

1/ *U. S. Department of Interior, Fish and Wildlife Service, October 31, 1997, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12.*

2/ *Federal Register Vol. 63, No. 53, March 19, 1998, Final Rule-West Coast Steelhead*

3/ *Federal Register Vol. 62, No. 159, August 18, 1997, Final Rule-Snake River Steelhead*

4/ *Federal Register Vol. 62, No. 112, June 11, 1997, Final Rule-Castilleja levisecta*

5/ *Federal Register Vol. 63, No. 46, March 10, 1998, Proposed Rule - Columbia River Chum Salmon*

6/ *Federal Register Vol. 63, No. 46, March 10, 1998, Proposed Rule - Middle Columbia and Upper Willamette River Steelhead*

7/ *Federal Register Vol. 63, No. 45, March 9, 1998, Proposed Rule - West Coast Chinook Salmon*

8/ *Federal Register Vol. 63, No. 17, January 27, 1998, Proposed Rule-Erigeron decumbens var. decumbens, Lupinus sulphureus ssp. kincaidii and Fender's blue butterfly.*

9/ *Federal Register Vol. 62, No. 87, May 6, 1997, Final Rule-Coho Salmon*

ATTACHMENT B

FEDERAL AGENCIES RESPONSIBILITIES UNDER SECTION 7(a) and (c) OF THE ENDANGERED SPECIES ACT

SECTION 7(a)-Consultation/Conference

Requires:

1) Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;
2) Consultation with FWS when a Federal action may affect a listed endangered or threatened species to insure that any action authorized, funded or carried out by a Federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of Critical Habitat. The process is initiated by the Federal agency after they have determined if their action may affect (adversely or beneficially) a listed species; and
3) Conference with FWS when a Federal action is likely to jeopardize the continued existence o f a proposed species or result in destruction or adverse modification of proposed Critical Habitat.

SECTION 7(c)-Biological Assessment for Major Construction Projects[1]

– Requires Federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify and proposed and/or listed species which are/is likely to be affected by a construction project. The process is initiated by a Federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, the accuracy of the species list should be informally verified with our Service. No irreversible commitment of resources is to be made during the BA process which would foreclose reasonable and prudent alternatives to protect endangered species. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct and on-site inspection of the area to be affected by the proposal which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or for potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within FWS, National Marine Fisheries Service, State conservation departments, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures and (6) prepare a report documenting the results, including a discussion of study methods used, nay problems encountered, and other relevant information. The BA should conclude whether or not a listed species will be affected. Upon completion, the report should be forwarded to our Portland Office.

---

[1]A construction project (or other undertaking having similar physical impacts) which is a major Federal action significantly affecting the quality of the human environment as referred to in NEPA (42 U.S.C. 4332. (2)c). On projects other that construction, it is suggested that a biological evaluation similar to the biological assessment be undertaken to conserve species influenced by the Endangered Species Act.

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2946
PORTLAND, OREGON 97208-2946
July 14, 1999

Reply to
Attention of:

Engineering and Construction Division

Russell D. Peterson
State Supervisor
Oregon State Office
2600 S.E. 98th Avenue, Suite 100
Portland, OR 97266

Dear Mr. Peterson:

We have reviewed your Coordination Act Report for the Columbia River Channel Improvement Project. Our responses to your recommendations are enclosed.

If you need more information, please contact Mr. Kim Larson, (503) 808-4776.

Sincerely,

Howard B. Jones, P.E.
Chief, Engineering and Construction Division

Enclosure

U. S. Fish and Wildlife Service's Final Fish and Wildlife Coordination Act Recommendations and Portland District, U.S. Army Corps of Engineers Responses

1. **All inwater work take place within specified State and Federal resource agency time periods to protect juvenile salmonids, smelt, and sturgeon.**

Response: Construction work is currently scheduled to occur year around for two years. Maintenance dredging will occur during the normal dredging season for the Columbia River from March to November. The impacts of construction and maintenance dredging and disposal have been discussed in the EIS. Impacts to salmon are expected to be minimal. Juvenile salmon migrate principally along the channel margins and therefore would only minimally be subjected to entrainment or disposal impacts. Sturgeon occur throughout the river though they are believed to be more abundant in the deep areas. Dredging and disposal operations are expected to have some impact on sturgeon however the impacts in the main navigation channel are expected to be small since sturgeon are not considered as abundant in these areas as they primarily occur in deep areas. Flowlane disposal in the deep areas is a concern and additional studies are planned to evaluate the abundance and periods of use in these areas by all life stages of sturgeon so that disposal can be managed to minimize impacts. Impacts to smelt are also expected to be minimal since they are unlikely to be entrained by a hopper or pipeline dredge when the draghead or cutterhead is buried in the sediment.

The two dragheads of the hopper dredge *Essayons* have a combined width of about 12 feet with a zone of effect extending a few feet beyond that. The cutterheads of pipeline dredges have a similar narrow zone of effect. When operating and buried in channel sediments, their ability to entrain organisms is limited to a narrow area immediately around the draghead. The navigation channel is generally 600 feet wide throughout the project. The main river channel is about 1,500 to 2,000 feet wide. Consequently, dragheads and cutterheads influence at any one point in time about 2 to 3 percent of the navigation channel, and only a fraction of a percent of the main river channel. Further, dragheads of hopper dredges are not continuously in operation, as the vessel must periodically transit to and from disposal locations. Dredging operations are also site specific at any given point in time. Therefore, impacts are limited in geographical scope and do not encompass all of the potential travel path at any given point in time. Cutterheads and dragheads only impact a limited area at the bottom of the water column.

Juvenile smelt and sturgeon are mobile whether through active movement or passive transport by the current. Consequently, once they have moved past a dredging operation, their exposure to entrainment is generally over. Additional entrainment opportunities may arise if the dredging operation shifts downstream. As demonstrated above, their exposure in a specific section of the navigation or main river channel is minimized at the point of dredging operation.

In order to fully evaluate the impacts, however, the Corps will be participating in a WDFW study of larval smelt distribution and timing as well as the location of spawning areas in the main navigation channel. This information can be used to manage dredging and disposal operations to further reduce impacts.

2. **Dredging in the Columbia River downstream of the mouth of the Lewis River be limited to use of a clamshell dredge between January 1 and June 1 to minimize entrainment impacts to smelt larvae. Studies on adult smelt spawning distribution or on larval smelt production/distribution before, during, and after dredging are recommended to determine changes in mainstem spawning success and distribution related to dredging.**

Response: We know of no studies indicating that clamshell dredging would be less impacting to smelt than hydraulic dredging. In fact clamshell dredging may be more impacting than hydraulic dredging since each scoop of the clamshell has a chance to impact smelt in either the water column or on the bottom. The potential to entrain smelt by hydraulic dredging, however, once the cutterhead or draghead is buried in the bottom is very small. See response number 1. Consequently, we still plan on dredging with hydraulic dredges in this reach of the river during the January to June time frame. We are, however, willing to participate in a study proposed by WDFW to better identify the location of smelt spawning areas and timing and distribution of smelt larvae in the main navigation channel.

3. **To minimize losses of juvenile salmonids, any pile dike installation, particularly in the vicinity of Miller Sands or Miller-Pillar Rock Islands, should implement design methods which prevent or deter use by piscivorous birds.**

Response: The Miller-Pillar pile dike field has been eliminated from the Channel Improvement Project. The pile dike field for the Miller Sands area is not part of this project; it is part of the Dredged Material Management Plan. The Miller Sands pile dike field has been delayed until the bird issues are resolved, as is specified in the Record of Decision for the DMMP issued on 3 Nov. 1998.

4. **The final resolution of the tern predation issue, including future use of estuarine islands for channel deepening disposal, be conducted in a manner that minimizes harm to both colonial nesters as well as juvenile salmon.**

Response: Through ESA consultation, currently ongoing, the Corps will reach an agreement with NMFS regarding further disposal of dredged material on Rice, Miller Sands and Pillar Rock Islands. This agreement will include an acceptable solution to preclude tern use of the islands while allowing for the islands continued use as dredged material disposal sites. Efforts on tern management are also coordinated through the interagency Caspian Tern Working Group. Caspian tern management efforts are directed at relocation of the existing colony to other appropriate locations and reduction of the number of juvenile salmonids lost to avian predation.

5. **Studies be initiated to determine the cumulative effect of dredging and disposal on sturgeon, particularly in those flowlane areas where the depth of the channel is predicted to become shallower over the next 20 years. If these studies indicate significant disposal related losses of sturgeon and sturgeon habitat, flowlane disposal in waters deeper than 30 feet should be reduced or eliminated to protect larval, YOY, and juvenile sturgeon.**

Response: A study is currently planned for the PED phase of the project to address sturgeon and benthic invertebrate concerns with the deep water flow lane sites. The study will be done at the flow lane site between RM 30-35. Sampling will be done for all life stages of sturgeon and for benthic invertebrates four times a year for one year initially with the option to sample another year depending upon the results of the first years sampling. Results of this study will be used to manage the disposal operations in these sites to minimize impacts to sturgeon.

6. **Disposal in offshore juvenile flatfish rearing areas be avoided. In addition, any continuous long-term disposal in the same area of a newly designated offshore site should be monitored to assess mitigation needs.**

Response: The new offshore disposal site was selected to avoid the juvenile flatfish rearing areas that were mapped during the overlay process. The Corps has worked very closely with the members of the Offshore Disposal Site working group in defining these areas and in selecting the disposal site to avoid these areas. In addition the Corps conducted a series of tests to determine the impact of disposal of dredged material on juvenile flatfish. The results of these tests indicated that juvenile flatfish survived disposal at least up to 10" in depth. Consequently, the need to actively avoid these areas is unclear.

A management and monitoring plan has been developed for the two ocean sites and your agency has had a chance to review it and provide comments. In addition, the Corps has agreed to develop a taskforce to provide input to pre and post disposal assessment surveys to aid in management of the sites to further reduce impacts. Mitigation has been provided for the use of these sites by sizing them and selecting locations to minimize impacts to the extent possible.

7. **Research studies on the impacts of disposal on soft-shell crabs be continued.**

Response: Research studies on the impacts of disposal on soft shell Dungeness crabs will continue if recommended by the taskforce as needed for pre and post assessment surveys and if funds are available.

8. **Offshore disposal in Area E near the north jetty be placed so as to allow for contribution to the littoral drift and nourishment of Washington Coast beaches, particularly Benson Beach.**

Response: The Corps intends to place as much MCR dredged material in Area E as possible without causing adverse impacts to surface waves and navigation safety. This would maximize the potential for the movement of sand in the littoral system and toward the Washington beaches, particularly Benson Beach.

9. Bank sloughing and consequent losses of intertidal habitat associated with channel deepening and widening be monitored. Appropriate mitigation would be required for such losses if they occurred.

Response: Shoreline erosion is an ongoing process in the Columbia River that is only notable at old dredged material disposal sites. The river's natural shoreline is composed of erosion resistant silts and clays, or rock, and has been stable for 100's of years. At the old disposal sites, dredged material disposal has covered the river's natural banks with highly erosive sand. These sandy deposits are eroded and the sand transported downstream mainly by river currents. As the sand erodes, the slope of the riverbed remains the same and the intertidal zone simply migrates shoreward. This erosion will continue until the shoreline recedes back to the natural banks, a process that could take decades. Once all the sand has been eroded, the riverbank and intertidal areas could gradually return to the pre-disposal habitat conditions that supported Columbia River fish populations for millions of years. The proposed channel deepening would hasten the return to pre-disposal habitats, but not to an extent that would be measurable by a monitoring program. The Corps does not intend to monitor or mitigate for this restoration of natural shorelines.

10. Monitoring studies be initiated to determine recreational safety problems as well as erosion acceleration (bank sloughing) resulting from increased shipwake from larger, deep draft ships using the deepened channel. Mitigation for the loss of habitat, use, and forage for terrestrial and aquatic species resulting from this erosion shall also be identified and implemented.

Response: Large ship wakes represent a safety concern for small children and those unfamiliar with the channel, however monitoring for recreational safety is not a Corps of Engineers responsibility. The wake generated by a 43-ft draft ship would be only slightly larger (between 2-4") than that of the same ship with a 40-ft draft, assuming the ship was able to maintain the same speed.

It has been estimated that all ship wakes account for only 4 to 24 percent of the observed shoreline erosion. Given the above figures and that only about 5% of the ships that call on the Columbia River have design drafts over 40-ft, the increased erosion from deeper draft ships would be imperceptible and could not be detected by monitoring.

In considering the potential loss of habitat due to bank erosion it should be kept in mind that most of the erosion occurs at barren, sandy beaches that are the result of past disposal. As explained above, there is likely to be little change in the intertidal habitat at eroding beaches. Since no habitat losses are expected there would be no mitigation requirement.

11. **Blasting requirements as regulated by the ODFW and WDFW be incorporated into any blasting plan for the Columbia and/or Willamette Rivers with mitigation as requested.**

Response: We have coordinated the proposed blasting plan with ODFW and WDFW for the basalt areas in the Columbia and Willamette Rivers. Both agencies as well as NMFS had specific requirements for blasting, all of which were incorporated into the plan. No mitigation was requested by any agency. The Willamette portion of the project has been put on hold until contaminant issues can be resolved. We will continue to refine blasting areas in the Columbia by conducting geophysical and rock coring tests during the PED phase of the project.

12. **All mitigation efforts are initiated concurrently with or prior to construction commencement. Monitoring plans should also be approved prior to the start of construction. In addition, permanent protection and long-term maintenance of mitigation sites should be addressed. In certain cases, title transfer of mitigation sites to interested resource agencies (with appropriate maintenance funding) may be appropriate. With regard to the proposed ecosystem restoration projects, monies to implement these actions should be included in the authorization for the projects.**

Response: Mitigation efforts will be initiated concurrently with or prior to commencement of the channel improvement construction efforts. Monitoring plans will be reviewed by the interagency Wildlife Mitigation Team during the preconstruction, engineering and design (PED) phase and their approval sought. Mitigation sites will typically be acquired in fee title or else through a permanent easement. These real estate arrangements are intended to provide permanent protection of mitigation sites. The monitoring plans (Appendix G) also provided brief descriptions of maintenance actions identified for mitigation sites. The Corps continues to seek long-term funding, such as a trust fund, to cover operation and maintenance costs for wildlife mitigation sites. Mitigation sites will be title transferred to either the Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife or the U.S. Fish and Wildlife Service post-implementation of mitigation features. Ecosystem restoration has been added as a project purpose, and therefore if the project is authorized, the subsequent appropriation for project implementation will include funding to construct the ecosystem features described in the FEIS.

13. **Disposal at Brown Island avoid Columbian white-tailed deer habitat.**

Response: The Brown Island (W-46.0/46.3) location is a disposal site identified in the Columbia River Dredged Material Management Plan (DMMP) which represents the No Action Plan for this proposed project. Consultation on ESA issues for the DMMP were concluded with the U.S. Fish and Wildlife Service per the Service's letter of February 24, 1998. The Service concurred with the Corps' determination of not likely to adversely effect Columbian white-tailed deer at W-46.0/46.3 provided that the disposal area impacted was seeded in the fall with a grass/legume mixture. Use of this disposal site is no different whether for No Action Plan or Proposed Plan purposes. Therefore, the Corps will utilize this site and implement the conservation measure as set forth in the Service's February 24, 1998 letter.

14. No disposal occur on known Canada goose nesting areas between March 1 and June 30.

Response: The majority of Canada goose nesting occurs in the upper levels of the drift line along protected shorelines (non-channelward side) of dredged material islands. Most nests are hatched by the first week of May. Our intention is to not impact these drift lines, per current practices, when disposing dredged material. Avoidance of islands where Canada geese nest will occur to the extent practicable between March 1 and May 15. Given that most nests hatch prior to May 15 and that broods typically depart the nest area immediately post-hatching, we would place material at these locations after May 15.

15. The option of dropping Martin Island, Scappoose Dairy (and substituting the Lone Star Gravel Pit), and the Peavey Oval as disposal sites should be evaluated.

Response: This evaluation is presented in the EIS. Martin Island and Peavey Oval have been dropped from both the Least Cost and Proposed Disposal Plans. The Dairy site remains in the Least Cost Disposal Plan but is not included in the Proposed Disposal Plan. Lonestar Gravel Pit replaces the Scappoose Dairy in the Proposed Plan.

16. One of the two options offered for correcting the discrepancies in the baseline assumptions of the HEP analysis be selected to offset upland disposal impacts.

Response: The Corps has selected option 1. Complete the analysis by collecting data to represent all habitat types and reanalyze current and future conditions based on changes in individual habitat parameters. This reanalysis will be completed during the pre-construction engineering and design phase of the project.

17. Dredging in contaminated areas be avoided, including areas with DDE, PCBs, or dioxin-like compounds above or below screening levels, particularly in the Willamette River. If this is not possible, dredged contaminated materials should be placed in approved upland sites and capped. Monitoring of these areas for contaminant availability during dredging would be necessary.

Response: The potential for unacceptable adverse effects from the disposal of dredged material is evaluated in accordance with national and regional guidance. Proposed open water disposal is evaluated in accordance with the national guidance provided by the joint USACE/USEPA guidance manuals "Evaluating the Environmental Effects of Dredged Material Management Alternatives – A Technical Framework" (EPA 842-B-92-008), the "Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual" (EPA 503/8-91/001), and "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual" (EPA 823-B-98-004). Regional guidance is provided by the

"Dredged Material Evaluation Framework, Lower Columbia River Management Area," November 1999. These manuals draw on 25 years of experience of evaluating the effects of dredged material disposal. Material found unsuitable for unconfined open water disposal, if dredged, can be placed in either a confined aquatic disposal (CAD) area or upland in a confined (diked) disposal facility (CDF). For the Willamette River no economically available upland disposal sites have been identified for contaminated material. There is limited space for such a facility in this heavily industrialized and developed area. In addition, removing contaminated sediments from an aquatic environment and placing it upland changes the physical and chemical properties of the material and increases the likelihood for mobilization of contaminants. It also increases the available uptake pathways.

Dredged material evaluations are structured to provide information as to the potential release and exposure for a given action prior to disturbing the areas requiring dredging. Monitoring during dredging cannot be conducted in such a manner to provide timely analyses to adjust or modify the dredging operation. Therefore evaluations are conducted to determine contaminant availability before dredging. The dredging and disposal operations are then managed in an environmentally acceptable manner.

The local sponsor has requested that dredging of the Willamette River be delayed. No further CRCD studies of Willamette River sediments are anticipated at this time. Should it be determined in the future to pursue channel improvements in the Willamette River, further studies will be initiated to address the effects dredging contaminated sediments would have on the biological community. This would include the development and design of appropriate management strategies to insure the biological integrity of the system, consistent with all state and federal laws and regulations.

18. Secondary impacts that could result from channel deepening such as oil spills; increases in illegal bilge dumping coupled with an increased probability of exotic species introductions; additional losses of habitat due to secondary industrial development occasioned by disposal; and increased exposure of salmonid species to contaminants be further evaluated by the Corps and appropriately mitigated, as necessary.

Response: These issues are discussed in the Final EIS which basically states that deepening the channel would not lead to increased shipping or port development. These growths are determined by growth in commodity demand with or without a deeper channel.

Industrial development will occur at Gateway 3 and W-62.0 which represent previously unused disposal locations. Both sites are currently zoned for industrial development although their current use is for agricultural purposes. Development at these locations is not contingent upon implementation of the proposed action. The Corps will mitigate for those lands directly impacted by dredged material deposition from construction and operation and maintenance dredging actions. The Corps will not mitigate for impacts attributable to secondary development. Secondary industrial development may also occur at existing or historic disposal locations. Mitigation for habitat at these locations would only address those habitats, e.g., riparian inclusions, already identified in the mitigation plan.

19. **Further study in the Willamette River on the impacts of dredging and disposal of contaminated materials be conducted to assess probable harm to aquatic resources, particularly listed species. In addition, if the contaminant issues in the Willamette River cannot be satisfactorily resolved, then the Willamette River portion of the channel deepening project should be dropped.**

Response: The local sponsors for the channel improvement project have requested that the Willamette River dredging be delayed. If the harbor is listed as an EPA-designated Superfund site, no navigational maintenance or new work dredging can be conducted in the listed area under the Clean Water Act. If the harbor is not listed, dredging for navigation channel improvements would not preclude cleanup activities but would enhance and perhaps extend the effort. The dredging in the Willamette River would require full compliance with all laws including the Clean Water Act, Endangered Species Act, and the National Environmental Policy Act.

20. **CRITFC's concerns regarding Willamette River dredging and disposal and impacts on river and tribal health as contained in their comment letter regarding the draft Portland Harbor Sediment Management Plan be given serious consideration by the Corps before proceeding with any planned dredging of the Willamette River.**

Response: The CRITFC commented on the "Integrated Feasibility Report for Channel Improvements" regarding the Willamette River as follows:

"...The proposed designation of the Lower Willamette River as a superfund site was not mentioned in the DEIS, nor was the designation considered in analyses of DEIS alternatives. We understand that the Corps owns property on the Willamette River that is under consideration as a superfund site, but the Corps remains non-committal regarding cleaning up this site. While the DEIS states that the proposed action will likely entrain toxic sediments, such as DDT, PCBs and heavy metals in the rivers, the overall conclusion of the Corps is that the proposed action will, "...provide ecosystem restoration for fish and wildlife habitats." Entraining toxins, such as DDT PCBs, and heavy metals, onto clay sediments, which stay suspended and easily bond with organic tissue (e.g., fish), is hardly likely to "provide ecosystem restoration."

The USACE's response is as follows:

The potential listing of the Portland Harbor section of the Willamette River is a recent event but will be addressed in the final report. The property owned by the Corps in the Willamette River, the US Moorings, is not a part of the CRCD study area. The Corps has requested that DEQ include the US Moorings to the State's voluntary clean-up program and is awaiting their action on this request. The local sponsor has requested that dredging of the Willamette River be delayed as part of the initial channel deepening project. No further studies of Willamette River sediments are anticipated at this time. Further sediment quality evaluations will be required and conducted prior to any dredging and disposal activities.

21. The following points be incorporated into the dredging and disposal activities for the project to avoid contaminant impacts to salmon, bald eagles, otters, and other fish and wildlife.

1) Add chemical analysis of dioxin-like compounds (individual congeners of dioxin, furan, and planar polychlorinated biphenyls) into the regular testing regimen for fine-grained sediments from the Columbia and Willamette Rivers. Develop screening levels for these compounds based on an additive or toxic equivalent (TEQ) approach, which accounts for the additive toxicity of the dioxin-like compounds. Bioassays such as the H4IIE bioassay could be applied for testing rather than a full dioxin and furan analysis to measure dioxin-like activity, but detection limits of any bioassay should be no greater than one pg/g.

Response: Sediment quality evaluations are conducted under the guidance listed in response to Recommendation # 17, above. The list of Chemicals-of-Concern is consistent with and adopted from other sediment quality evaluation programs in the Northwest. National and regional guidelines allows for the inclusion of other chemical analyses if there is a reason-to-believe that they may be present at a particular project. Bioassays and bioaccumulation testing may be required if Tier III or higher tier testing is required. The guidance documents are living documents and are reviewed and altered to add new technology as it becomes sufficiently vigorous enough to be used as a regulatory tool.

Tests involving whole sediment determine the potential effects for bottom dwelling organisms. Tests using suspended/elutriate of dredged material are used to assess the potential effects on water column organisms. Bioaccumulation tests are required when certain chemicals of concern are detected at concentrations that may pose a potential risk to human health or ecological health in the aquatic environment.

2) Consider dredged material which meets the requirements for inwater/flowlane disposal as a point source discharge for any contaminants, especially bioaccumulative compounds, that are present above detection limits. This would help to quantify the cumulative low level discharges of bioaccumulative contaminants into the Columbia River. In addition, establish an easily accessible

database containing this information (amount of material disposed and total contaminants in material) for all Corps projects on the Columbia and Willamette Rivers involving inwater disposal. Estimate the additional loading of DDT and metabolites, PCBs, and dioxin-like compounds (dioxins, furans, and planar PCBs) by determining the total amount of each contaminant (based on concentrations from chemical analysis on a sample from a set amount of material) within the total amount of material to be disposed. Report estimates to the appropriate State Environmental Quality personnel to determine if this additional loading would violate current water quality standards for the Columbia River.

Response: Dredging and dredged material disposal is a limited transitory phenomenon. The considerations related to dredging and dredge material disposal are unrelated to the concerns associated with a continuing point source discharge and should not be treated as such. The material prior to dredging and discharge must be evaluated and found suitable for unconfined open water disposal. Because of this and the minor amount of fine-grained material dredged annually, dredging is a very short-term minor component to the transport of fine-grained material in the system.

The Corps maintains a database and records related to the sediment quality of the material it dredges or proposes to dredge. Sediment evaluation reports for projects are kept on file and may be accessed. The newer evaluations are posted on the Portland District web page. The Portland District is currently evaluating switching its database to a program called SEDQUAL which ODEQ is also adopting and which WDOE uses. It is hoped that this will eventually lead to a fully integrated system between the various agencies and be accessible through the Internet. Sediment evaluations conducted in accordance with the DMEF provide all the information necessary to determine compliance with state water quality standards.

3) **Tabulate and report results of chemically analyzed fine-grained materials that are collected on a regular schedule from the Willamette and Columbia Rivers. Reports should include sampling techniques, chemicals analyzed, quality control information, and detection limits for each analyte, and should be made available to the public and other Federal Agencies. Electronic data and final reports could be made available on the Internet.**

Response: The Portland District tabulates and reports information it gathers as part of its sediment evaluation program. Sampling and analyses are in accordance with the protocols delineated in the DMEF which can be accessed on the Internet. All information is available on request and the most recent reports have been posted on the Internet. Older information is in the process of being scanned and posted.

4) **Prepare a detailed GIS map describing all known areas of contaminated sediments above detection limits, especially those areas containing DDT and metabolites, total PCBs, and dioxin-like compounds in the Willamette River, and overlay areas to be dredged. The map should incorporate information recently gained from the Corps' Channel Deepening Sediment Quality Evaluation and the Portland Harbor Sediment Investigation sponsored by the Oregon Department of Environmental Quality and the U.S. Environmental Protection Agency. This map would provide critical information needed to avoid dredging contaminated areas, thus minimizing impacts to fish and wildlife.**

   Response: SEDQUAL is GIS compatible and information should be fully accessible through this format when conversion is completed.

5) **Avoid dredging in areas where PCBs, DDT and metabolites, dioxins, or furans are identified in contaminant maps outlined in recommendation 4. Areas adjacent to state or Federal hazardous waste sites should not be dredged. Dredging these areas, especially areas contaminated with wood-treating chemicals, could resuspend dioxins and furans and violate the total maximum daily load for TCDD established for the Columbia River. If these areas are dredged, disposal should be in approved upland sites and monitoring for contaminant bioavailability should be conducted during the dredging process.**

   Response: Dredging shall comply with all laws including the Clean Water Act, Endangered Species Act, and the National Environmental Policy Act. Also see response to Recommendation #17.

6) **Develop a monitoring program to determine if resuspension or the availability of bioaccumulative contaminants are increased during a dredging or disposal operation involving fine materials. The monitoring program should be developed in coordination with the Service and the U.S. Geological Survey. Monitoring should address bioaccumulation, and should involve a sensitive ecological receptor or use of passive sampling devices such as semi-permeable membrane device (SPMDs), caged mussels, or other techniques.**

   Response: The USACE has conducted resuspension and bioavailability of contamination during dredging research.

Information can be accessed through the USACE's Waterways Experiment Station (WES) web site. Most dredging projects are of such short duration that passive sampling devices are not useable as the exposure time is not sufficient. Passive sampling devices are designed and work well to determine long-term environmental exposures but are not sensitive enough to pinpoint local short duration events. To determine the potential for contaminants released during dredging tests such as a dredged martial elutriate test is utilized. Further, dredging techniques have been developed and have been utilized to dredge even highly contaminant sediments which minimizes resuspension and contaminant release. The local sponsor has requested that dredging of the Willamette River be delayed. No further CRCD studies of Willamette River sediments are anticipated at this time. Further studies shall be initiated to address the effects dredging contaminated sediments would have on the biological community prior to any dredging and disposal activities. This would include the development and design of appropriate management strategies to insure the biological integrity of the system, consistent with all state and federal laws and regulations.

7) **Gather additional data to address how interdependent and interrelated actions associated with dredging the navigation channel could impact contaminant loading into the Willamette and Columbia Rivers. The Corps did not address this issue in their biological assessment for the Dredged Material Management Plan, and the Service recommends this issue be addressed during the channel deepening review.**

Response: The local sponsor has requested that channel improvements for the Willamette River be delayed. No further CRCD studies of the Willamette River sediments are anticipated at this time. Should it be determined in the future to pursue channel improvements in the Willamette River, further studies will be initiated to address the effects dredging contaminated sediments would have on the biological community. Portland District would ensure compliance with all environmental regulations when or if Willamette River channel improvements are again considered.