SECTION 905(b) ANALYSIS

GENERAL INVESTIGATION RECONNAISSANCE STUDY

Puyallup/White River Watershed, Washington
December 31, 2002

US Army Corps
of Engineers®
Seattle District

EXPEDITED RECONNAISSANCE STUDY

Section 905(b) (WRDA 86) Analysis

Puyallup/White River Basin, WA

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1. **STUDY AUTHORITY**: The Puyallup/White River project was initiated as a Corps of Engineers Civil Title I General Investigation (GI) study. The study resolution states: "That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Upper Puyallup River, Washington, dated 1936, as referenced in the Flood Control Act of 1936 (P.L. 74-738), the Puget Sound and Adjacent Waters Study, authorized by Section 209 of the Rivers and Harbors Act of 1962 (P.L. 87-874) and other pertinent reports to determine whether modifications to the recommendations contained therein are advisable, with references toward providing improvements in the interest of water resource and watershed issues affecting Lake Tapps and the White River Watershed downstream of Mud Mountain Dam, Washington". The referenced 1936 investigation included the entire Puyallup watershed, including the Puyallup River and tributaries such as the White and Carbon Rivers. As such, the scope of this investigation will include the White River as well as the broader Puyallup watershed and estuary.

The study resolution and funding were obtained through efforts by Pierce County. Additionally the Seattle District received a letter dated April 12, 2001 from the Puyallup Tribe of Indians (Appendix A) requesting assistance from the Corps through the GI Program to investigate opportunities related to flood damage reduction and ecosystem restoration.

GI funds are used for the collection and study of basic information pertaining to rivers and harbors, flood control, shore protection and related projects, restudy of authorized projects, miscellaneous investigations, and when authorized by laws, surveys, and detailed studies and plans and specifications of projects prior to construction.

In Fiscal Year 2002, funding was appropriated to initiate work on a 905(b) Report and Project Management Plan. Completion of the Project Management Plan (PMP) is expected in February 2003. The total amount budgeted for the reconnaissance phase is $100,000.

2. **STUDY PURPOSE**: This report is a preliminary analysis in accordance with the guidelines of Section 905(b) of the Water Resources Act (WRDA) of 1986. The purpose of the report is to determine if there is a Federal (Corps) interest in pursuing further studies related to ecosystem restoration and flood damage reduction in the Puyallup/White River Basin. This reconnaissance-phase study seeks to identify ecosystem restoration and flood damage reduction needs and opportunities, develops conceptual measures to address the identified problems and opportunities, and work with local governments to determine which measures and/or projects warrant further study effort in the feasibility phase. For those potential projects, a PMP will be developed to conduct further feasibility-level studies and a Feasibility Cost-Sharing Agreement (FCSA) will be coordinated with a local sponsor. Once the non-Federal sponsor and the Corps sign the FCSA, feasibility studies will be initiated.

The report finds that there is a Federal interest in pursuing more-detailed feasibility studies in order to address local basin needs for ecosystem restoration and flood damage reduction projects. To date, approximately 120 projects have been identified throughout the basin which are

consistent with Corps of Engineers high-priority mission areas in ecosystem restoration and flood damage reduction that warrant further investigation. These projects have been identified through a collaborative effort between the Corps of Engineers, Pierce and King County, the Puyallup Tribe, and various municipal, non-profit, and Federal entities. More-detailed information on these projects can be found in Section 5 of this report and Appendix C. Pierce County has been identified as the primary non-Federal sponsor. Other partners and stakeholders in the project include King County; the Puyallup Tribe of Indians; numerous municipal jurisdictions including the cities of Tacoma, Federal Way, Puyallup, and Auburn; the Muckleshoot Indian Tribe; Port of Tacoma; Washington Department of Fish and Wildlife; and other state and Federal agencies. Letters of support from several of these jurisdictions can be found in Appendix A.

3. LOCATION OF PROJECT/CONGRESSIONAL DISTRICT: The Puyallup River Watershed and its major tributaries (the Carbon and the White Rivers) are located almost entirely in Pierce County, Washington, with the exception of a small portion north of the mainstem White River which is located in King County. The Puyallup River flows in a northwesterly direction for about 50 miles before discharging into Commencement Bay. The project area resides in the 6th, 8th and 9th Congressional Districts. The basin encompasses numerous small towns and cities as well as Tacoma, the state's third largest city. Maps of the watershed are included in Appendix B; Figure 1 shows the entire watershed, and Figure 2 shows the focus area for the investigation. The Puyallup Indian Tribe resides close to the mouth of the Puyallup River, and the Muckleshoot Indian Tribe Reservation lies within the White River Basin. The tribe also operates a hatchery on the White River.

The Puyallup Basin drains approximately 1,065 square miles and is fed by five glaciers at high elevations on the rugged west and north slopes of Mt. Rainier. The White River -- the Puyallup River's principal tributary -- rises on the east slope of Mt. Rainier and flows in a general northwest direction 57 miles to enter the Puyallup from the north at river mile (RM) 10.5. Mud Mountain Dam (MMD), a Federally authorized flood control project, is located at river mile 29.6 on the White River. The Carbon River enters the Puyallup at RM 17.9 and is the second major tributary to the Puyallup. The Puyallup River enters Commencement Bay in the City of Tacoma. The Puyallup River estuary is influenced primarily by the Puyallup, Hylebos, and Wapato drainages. These three drainages coexist and contribute the majority of sediments, nutrients, and flow that is needed in developing the complex ecosystem functions found within the estuarine habitat. The watershed has undergone extensive alterations to land forms, river courses, stream channels, and estuaries as a result of urban, industrial, and agricultural development. Agriculture, forestry, and rural development characterize the upper watershed. Low-level-protection flood control features and suburban development dominate the mid and lower 25 miles of the watershed. Large segments of the Puyallup, Carbon, and White Rivers have been extensively altered through levee construction, bank protection, and realignment. Construction of MMD and diversion of flows from the White River are perhaps the most significant alterations in the basin. The lower reaches are characterized by intensive commercial and industrial development. At the mouth of the Puyallup River and in the estuary several waterways, including the Hylebos Waterway, were constructed to meet the demand for greater shipping capacity and resulted in extensive channelization of the river and the tributaries flowing into the estuary. These changes significantly altered the dynamics of the estuarine habitat. The basin and especially the upper Puyallup and the Carbon Rivers have experienced significant flooding. As recently as 1995 and 1996, the basin experienced record flooding resulting in tremendous flood damages to residential and commercial property as well as to flood control structures throughout the basin. Due to significant land use changes in the watershed and flooding issues, FEMA is currently revising all flood plain mapping

in the Pierce County portion of the basin. Ecosystem restoration and flood damage reduction needs and opportunities within the basin are tremendous. One of the primary objectives will be to integrate flood damage reduction features through setback levees and restoration of side-channel and off-channel habitat for the six species of salmon and bull trout in the basin. The watershed naturally carries a tremendous amount of sediment, and the sediment transport regime has been altered by the presence of MMD and through river channel modifications. The altered sediment transport characteristics can affect channel conveyance and habitat quality. The Lower Puyallup and estuary have seen significant fill including 570 acres of mudflats and 121 acres of salt marsh. Within the historic Puyallup River Delta, opportunities to restore estuarine, nearshore, and associated habitats will be considered.

4. DISCUSSION OF PRIOR STUDIES, REPORTS, AND EXISTING WATER RESOURCE PROJECTS:

Federally Authorized Projects. There are three existing authorized projects in the Puyallup Watershed, each with a project purpose of flood damage reduction. MMD is located at RM 29.6 on the White River, 6 miles upstream and southeast of Enumclaw and 38 miles southeast of Tacoma in western Washington. The second authorized project in the watershed includes approximately 2 miles of conveyance improvements near the mouth along the Puyallup Waterway. Finally, bank protection along the upper Puyallup near the town of Orting and other critical points was also included in a 1936 authorization.

MMD. The authorized project purpose of MMD is to prevent flood damages in the lower Puyallup River valley below the mouth of the White River. Under most circumstances, the reservoir is empty except during periods of flood regulation or during periods when a pool is required for debris removal or project maintenance. Under the original authorizing documentation and water control plan, MMD was operated to control discharge in the Puyallup River at Puyallup to 50,000 cfs or less (when feasible) without restriction on MMD discharge to the White River up to a limit of 17,600 cfs. At the time of the original authorization, the channel capacity of the White River downstream of MMD was estimated to be at least 20,000 cfs. By the mid-1970s, reports from field observers indicated that damage was occurring along the White River during periods of MMD discharge as low as 12,000 cfs. Reported damage during MMD discharges of less than 17,600 cfs was attributable to multiple factors including encroachment of development along the White River channel, accretion of sediments in the channel, and limitations on channel dredging. This situation has generated significant pressure from citizens and local government (including King and Pierce County governments) to consider significantly lowering the discharge limit from MMD when feasible to protect property and infrastructure along the White River. In particular, the Corps was requested in 1993 by King County Executive Tim Hill to limit MMD discharge when feasible to a maximum of 12,000 cfs since higher discharges were documented to cause considerable damages along the White River (i.e., damages were documented to occur to the Buckley Meadows subdivision, Muckleshoot Tribe fish hatchery, Sumner sewage treatment plant, as well as at various residential areas).

In response to the requests for a lower MMD discharge limit, the Seattle District Corps initiated a study in 1995 to determine the feasibility of revising the operational plan for MMD to minimize damage along the White River without significant compromise of flood control protection to the Lower Puyallup River valley. This study indicated that MMD discharge could be limited to 12,000-cfs for inflow events up to a 250-year recurrence interval without reducing the protection provided to the City of Puyallup up to a 750-year-recurrence-interval flood event. Because the

proposed change reduces flood damage along the White River and has no significant impact on the original project flood control objective, the change is considered an enhancement to project operations that can be implemented within the limits of the existing MMD water control plan. As a result, MMD has been operated in recent years with the primary objective of preventing flood damages in the lower Puyallup River valley with a secondary objective of reducing damage in the White River reach between the dam and the mouth of the White River by limiting project discharge to 12,000 cfs when feasible. The secondary objective of limiting discharge to 12,000 cfs is not intended to encourage further development in the existing White River flood plain, but instead reflects the reduced capacity of the White River channel downstream of MMD and the desire to protect existing development adjacent to the channel. Further development up to the current 12,000 cfs flood plain in this reach is not considered prudent for several reasons including uncertainty and variability in future MMD regulation and channel capacity.

The control flow in the Puyallup River at the City of Puyallup is established at 45,000 cfs with the intent of keeping discharge at the control point below the zero-damage discharge of about 50,000 cfs when feasible. MMD will be operated to limit the discharge in the Puyallup River at the control point to 45,000 cfs as long as feasible considering inflow downstream of MMD and considering that the unregulated runoff from the upper Puyallup River Watershed alone may cause the control flow to be exceeded. Since MMD controls only about 42 percent of the total drainage area in the watershed, not all potential floods can be held below the zero-damage point. Further consideration of operational changes related to MMD under this GI is not anticipated.

Commencement Bay Environmental Dredging. The Commencement Bay Environmental Dredging Project was initiated as a GI study in 2002. A 905(b) evaluation was recently completed which found no Federal interest in pursuing further studies under the Section 312 authority. The primary reasons cited included lack of a non-Federal sponsor and time limitations. Opportunities for the Corps to be involved in ecosystem restoration in the historic estuary will be pursued under the Puyallup River GI Study. Restoration opportunities could also be pursued under the Puget Sound Nearshore Investigation or the Corps Continuing Authorities Program.

Other Significant Projects. A geographic focal point in the basin is the artificially enlarged Lake Tapps. A private corporation, currently known as Puget Sound Energy, Inc. (PSE), modified Lake Tapps at the turn of the 20th century from four small natural lakes to one large lake which acts as a hydropower reservoir. Lake Tapps also serves as a major recreational area in the county. The hydropower project includes a diversion dam along the White River, an 8-mile flow line with a capacity of 2000 cfs, the Lake Tapps reservoir, forebay & penstocks, powerhouse, and fish screens at the tailrace downstream of which water is diverted back into the White River. The diversion dam is located 6 miles downstream from MMD. The Corps operates an upstream fish passage facility at the diversion dam as well. The trap-and-haul facility is used to mitigate the loss of upstream fish passage related to the construction of MMD. PSE's White River Hydropower Project on Lake Tapps is currently in a Federal Energy Regulatory Commission (FERC) licensing process. PSE in conjunction with the Cascade Water Alliance and local community organizations is concurrently investigating opportunities for Municipal and Industrial water supply and recreation opportunities related to PSE's FERC license and Lake Tapps.

Mud Mountain Dam Fish Passage. In response to Congressional requests, Seattle District is investigating and designing a long-term solution for upstream fish passage at MMD. The current upstream trap-and-haul facility is co-located with a diversion dam 6 miles downstream of MMD. The diversion dam, constructed by a private entity in the early 1900s, was originally and still is

used to divert water into Lake Tapps for the White River Hydroelectric Project and is integral to the Corps' upstream fish passage operation. The diversion dam is in need of rehabilitation or replacement. Seattle District has determined that a siting study and alternative evaluation will be the first step in identifying a plan to ensure upstream fish passage at the project. This study will include an investigation of different locations and alternatives to meet the Corps of Engineers' upstream fish passage responsibilities related to the operation of MMD. Upstream fish passage will not be considered under the GI Study.

Other Prior and Ongoing Studies and Reports. Both Pierce and King Counties have been active in basin planning activities related to habitat restoration and flood damage reduction. Both counties have developed comprehensive flood hazard reduction plans in the early 1990s and each has active relocation programs. The Corps has also been an active participant in repair and rehabilitation of flood protective works following the 1996 flooding in the basin. More recently FEMA has a flood plain remapping project underway in the Pierce County portion of the basin. In terms of habitat restoration, King and Pierce Counties, as well as other jurisdictions in the basin, have been working on endangered species recovery planning including the most recent efforts utilizing the Environmental Diagnostic Tool (EDT) methodology to assist in prioritization of restoration actions. The Muckleshoot and Puyallup Tribes are also active in restoration activities and have numerous monitoring programs established in the basin. Restoration planning has also been extensive in the Hylebos area; these efforts have been lead by non-profit groups with strong support from municipal jurisdictions and Pierce County. Studies and reports in the historic river delta and Commencement Bay are extensive. Much of the documentation is related to the CERCLA cleanup actions but provides valuable data and identification of restoration actions relevant to the GI project.

5. PLAN FORMULATION: During a Corps of Engineers study or investigation, six planning steps set forth in the Water Resource Council's Principles and Guidelines are repeated to focus the planning effort and, eventually, to select and recommend a plan for authorization. The six planning steps are: 1) specify problems and opportunities, 2) inventory and forecast conditions, 3) formulate alternative plans, 4) evaluate effects of alternative plans, 5) compare alternative plans, and 6) select a recommended plan. The planning process is iterative and has different emphasis on the various steps depending on the study phase. In the early iterations, those conducted during the reconnaissance phase, the step of specifying problems and opportunities is emphasized. That is not to say, however, that the other steps are ignored since the initial screening of preliminary plans that results from the other steps is very important to the scoping of the follow-on feasibility-phase studies. The sub-paragraphs that follow present the results of the initial iterations of the planning steps that were conducted during the 905(b) analysis.

(A) IDENTIFIED PROBLEMS:

The reconnaissance phase has identified two significant problems in the Puyallup/White River Basin: (1) Degraded ecosystem functions and processes necessary to support critical fish and wildlife populations/habitat and to support natural flood plain function throughout the basin and estuary. (2) Need for flood damage reduction measures focused on restoring ecological processes and functions while protecting existing infrastructure.

- **ECOSYSTEM DEGRADATION**. Heavy logging, manipulation of watercourses, alteration of natural flows, flood damage reduction projects, road and railroad building, persistent flooding, and land use practices have contributed to a highly degraded ecosystem in the Puyallup/White River Watershed and the estuary. Several species of fish and wildlife have

been listed as either threatened or endangered because of the poor habitat conditions, and several physical processes have been disrupted causing further degradation with limited opportunity to recover. Ninety-eight percent of the basin's estuary has been eliminated as well as a majority of functioning riparian habitats. Identifying, prioritizing, and implementing ecosystem restoration projects throughout the basin will likely restore critical functions required for fish and wildlife species. Fish species likely to benefit from restoration efforts in the Puyallup/White Watershed are chinook, coho, chum, and pink salmon, steelhead, sea-run cutthroat trout, and bull trout. Wildlife species such as deer, elk, otters, beavers, belted kingfishers, and several species of amphibians will likely benefit as well.

- **FLOODING PROBLEMS.** The Puyallup Watershed has been plagued with significant flood problems throughout the 20th century. Flooding has adversely impacted urban development in the lower watershed and agricultural interests in the upper watershed. Major flooding occurs during the winter season from November through February. Flooding may be localized within sub-basins or widespread throughout the basin. The most recent basin-wide flooding events occurred during 1990, 1995, and 1996. Coupled with the serious flooding problems within the basin, the natural aquatic ecosystem has been degraded and populations of many fish and wildlife are in decline. Stream alterations, land uses, and construction of infrastructure have also degraded aquatic and riparian ecosystems within the basin. Federal and local jurisdictions have responded by constructing numerous flood control structures throughout the basin. Aside from MMD flood control works, flood protection measures consist largely of sporadic levees and revetments which do not provide protection from significant flood events. Today the basin's flood plain is primarily urban, residential, and agricultural -- leaving only a small fraction of the basin's natural flood plain storage capacity intact. The need to investigate additional flood damage reduction measures using an environmental approach will likely help alleviate chronic flooding in the basin.

(B) PROJECT AREA CONDITIONS: EXISTING CONDITIONS, FUTURE WITHOUT PROJECT CONDITIONS AND FUTURE WITH PROJECT CONDITIONS:

The Puyallup/White River Basin drains an area approximately 1,065 square miles in size and encompasses all or parts of more than a dozen cities and towns in Pierce and King Counties, including Tacoma, Fife, Puyallup, Sumner, Edgewood, Milton, Federal Way, Auburn, Algona, Pacific, Bonney Lake, Orting, Buckley, South Prairie, Wilkeson, Enumclaw, and Carbonado. Much of the land found at higher elevations is under Federal ownership managed by the National Park Service (Mt. Rainer National Park) and the U.S. Forest Service (Mt. Baker-Snoqualmie National Forest).

- **EXISTING CONDITIONS.** Land use within the Puyallup River Basin bears little resemblance to its historic condition. In the lower portions of the basin, extensive alterations to land forms, river courses, stream channels, and estuaries have occurred as a result of urban, industrial, and agricultural development. In Commencement Bay, the estuary historically covered an area approximately 5,800 acres in size. From 1877 to 1988, over 98 percent of the estuary was modified leaving only 187 acres of mudflat, 90 acres of subtidal and intertidal vegetated shallows, and only 57 acres of the original tidal marsh. Under existing conditions, the White River is a tributary to the Puyallup River. Prior to 1906, the flow of the White River split into distributaries near Auburn, with some flowing north toward the Green River and some in a southerly direction toward the Stuck River which then drained into the Puyallup. In 1906 flooding and human activities resulted in the entire flow of the White River

being channeled to the Stuck River. This diversion resulted in the lower 25 miles of the Puyallup River and the lower 8 miles of the White (Stuck) needing extensive flood control in the way of levees, dikes, channelization, and stream straightening. Other significant alterations in the basin include the construction of MMD by the Corps of Engineers for the purpose of flood damage reduction and the construction of a diversion dam by a private entity for hydropower generation. These projects are both along the White River. In contrast, the higher elevations found within the basin and primarily in the Mt. Rainier National Park are closer to historic conditions and are considered mostly unaltered.

In the estuary, the Hylebos and Wapato Creek drainages provide a critical link with the Puyallup River in terms of the ecological function of the estuary. In 1917, approximately 24 acres of mudflat was dredged in Hylebos Creek to provide for commercial navigation and resulted in a wider and deeper creekbed to form the Hylebos Waterway. The Hylebos Diking Commission then constructed a 1½-mile dike in order to "reclaim" the salt/brackish marsh for agricultural use. Finally, tide gates and associated ditches were installed in order to convert about 1,800 acres of previously "unusable land." These activities initiated major changes to the salt/brackish marsh habitat.

Flooding: Both the Puyallup and White Rivers originate as glacial melt from the slopes of Mt. Rainier and flow 125 and 68 miles, respectively, before emptying into Commencement Bay in Puget Sound. Major tributaries and creeks in the Puyallup/White River Basin include the Carbon, Greenwater, Clearwater, Hylebos, Boise, and Mowich Rivers. Major flooding occurs during the fall and winter seasons, typically from October through February, mainly as a result of the heavy rainfall and rain-on-snow events. Flooding may be widespread throughout the basin or localized in sub-basins depending upon the extent and uniformity of the precipitation causing the runoff. Precipitation and timing of the mainstem and tributary flows are the major factor in determining the magnitude of flooding on the rivers in the Puyallup/White River Basin.

Major flood events, peak discharge (recorded and estimated natural), and the estimated recurrence interval of natural (unregulated) discharge as measured in the lower Puyallup River at Puyallup are listed in Table 1 below:

Table 1
Major Flood Events

Year	Recorded Peak	Estimated Natural Peak	Estimate Recurrence Interval
Dec. 1933	57,000 cfs	57,000 cfs (pre MMD)	20 years
Jan. 1965	41,500 cfs	53,000 cfs	15 years
Dec. 1977	40,600 cfs	58,000 cfs	20 years
Nov. 1986	43,800 cfs	47,500 cfs	10 years
Jan. 1990	44,800 cfs	65,000 cfs	35 years
Nov. 1990	41,900 cfs	61,000 cfs	25 to 35 years
Feb. 1996	46,700 cfs	76,000 cfs	65 years

The 1996 flood was the natural flood of record on the Puyallup River. Without storage at MMD, the discharge at Puyallup would have reached approximately 76,000 cfs, which would equate to approximately a 65-year event. Based on a 1988 USGS Report, the channel capacity of the Puyallup River from its mouth to the City of Puyallup is equivalent to a 100-year regulated discharge (approximately 50,000 cfs) throughout most of the reach. In the reach from the City of Puyallup to the City of Orting, the channel capacity is equivalent to a discharge with a recurrence interval of less than 100 years. The Carbon River's channel capacity is also equivalent to a discharge with a recurrence interval of less than 100 years. Based on the 1988 USGS report, the White River had a channel capacity equivalent to a discharge with a recurrence interval of less than a 100-year flood, especially in the reach located in Pierce County.

In response to flooding that occurred throughout the 1990s, Pierce and King Counties have worked to identify flooding issues and have aggressively pursued measures to reduce the impacts of flooding. In general, the extent of inundation and the associated flood damages can be related to insufficient conveyance capacity due to sediment buildup, at-risk structures in the 100-year flood plain, insufficient protection of structures in the flood plain, obstructions to flow including vegetation, and uncontrolled runoff from unregulated portions of the basin. Since the flooding in 1995 and 1996 both King and Pierce Counties have aggressively pursued acquisition of lands within the 100-year flood plain and relocation of existing structures that have been subjected to repeated flooding.

Ecosystem Restoration: In addition to the flood problems, the basin's ecosystem has been severely degraded and populations of many species of fish and wildlife are in decline. As early as 1906, Pierce County began modifying the White and Puyallup Rivers. Large woody debris (LWD) was snagged and removed. The White River was diverted into the Stuck River and then into the Puyallup River and banks were stabilized. An estimated 570 acres of mudflats and 121 acres of salt marsh were filled. Logging and road construction reduced riparian buffers and habitat. MMD was constructed resulting in a barrier to fish migration, and river gravel mining was employed to lower the riverbeds. Because of these actions, degradation of ecosystem health and many of the flooding problems in the Puyallup/White River Watershed are the result of altered natural processes in the basin. The primary limiting factors to aquatic ecosystem health in the Puyallup River Basin are physical barriers, flood plain connectivity, streambed/sediment conditions, riparian conditions, and water quality.

Physical Barriers. Physical barriers include flowage barriers/constrictors and fish passage barriers. MMD is the largest barrier in the Puyallup/White River Watershed. It currently blocks passage to all anadromous fish in the headwaters of the White River and has altered historic flows and gravel replenishment in the lower reaches. Road culverts make up the majority of the remaining barriers. In 1999 the Pierce Conservation District was involved in a comprehensive effort identifying fish passage barriers where 357 individual culverts were identified with 70% being considered partial barriers to anadromous fish both upstream and downstream. Fish passage barriers also include velocity impediments, degraded water quality conditions such as high temperatures, or low dissolved-oxygen barriers. Other barriers and flow constrictors include railroad and highway bridges, small agricultural diversions, dams, and road and highway embankments near or next to streams. While some of these structures are not necessarily a full blockage for fish, they serve as an impediment to natural flows and

can exacerbate flooding problems -- upsetting the equilibrium of natural flows, river hydrology, and sediment transport.

Flood plain Connectivity. Flood plain connectivity refers to conditions affecting overall flows of a watercourse through a flood plain. Flood plains with open connectivity are connected directly to the river at many points allowing wetlands and other off-channel areas to store floodwater and later discharge this storage back to the river during lower flows. Flood plain connectivity in the Puyallup/White Watershed has been altered from natural conditions resulting in a reduction of peak flows on the White River and increased peak flows in sub-basins affected by land use conversion and impervious surface runoff. Examples of alterations include bank hardening using riprap or dikes, channel realignments, and the existence of a high density of roads, railroads, and levees. The conversion of active channels to inaccessible ponds has occurred in several areas because of agricultural ditching and urban development. Residential, commercial, and industrial development has also filled in flood plains.

Altered and degraded flood plain connectivity in the Puyallup/White Watershed has contributed significantly to degraded aquatic ecosystems, increased flow velocities, greater bank erosion, and an adversely altered sediment transport regime. During high flows, salmonids will normally take refuge in off-channel areas, but riprap and channeled watercourses have precluded natural channel migration and the development and perpetuation of off-channel habitats. Channelization has contributed to increased bed scour which destroys spawning areas. These degraded habitat functions are impacted further by the reduced flood plain interactions resulting from severe channel incision. Overall flood plain connectivity alterations in the Puyallup/White River Watershed have exacerbated flooding and degraded aquatic ecosystem health.

Sediment/Streambed Conditions. The causes of altered sediment regime and streambed conditions in the Puyallup/White River Watershed are based on several factors found within the basin. Sediment transport has been estimated to range from 440,000 to 1,400,000 tons annually with the majority of these sediments characterized as fine sediments being transported out of the upper reaches and deposited into lower gradient reaches and Commencement Bay. The operation of MMD and the PSE diversion dam -- both on the White River -- are contributors to the altered sediment regime. Although MMD was designed to allow the downstream passage of sediment in the river naturally without active sediment management, there can be short-term accumulation of sediment in the reservoir during infrequent and short duration periods when water is stored for flood control, but this is only a short-term phenomenon. Sediment accumulated upstream of MMD during flood control operations is naturally transported downstream by the river once the project returns to a run-of-river operation. Operation of the PSE diversion dam has altered natural sediment transport in the basin. Along the 2-mile flowline between the diversion and Lake Tapps there are several sediment basins where suspended material and bedload are removed from the system. It has been estimated that the average annual sediment transport rate upstream of MMD is 500,000 tons per year. These high levels of natural sediments, in conjunction with an existing watershed that is less resilient due to natural flow alterations, land use conversions, channel modifications, and reduced flood plain connectivity may contribute to degrading habitats essential to fish. Because these altered sediments are characterized as fine, the likelihood of these particulates settling in areas critical to spawning areas and smothering eggs is relatively high.

Other factors influencing streambed and sediment conditions include a lack of LWD to maintain coarse sediment, increased bank and surface erosion, channelization of the river, and landslides -- all contribute to increased sediment. Debris torrents and dam-break floods have scoured channels and contributed to a decrease in LWD. Much of the non-natural surface erosion (including landslides) comes from dirt and gravel roads and forestry/agricultural lands. Again, these factors contribute greatly to the further degradation of fish and wildlife habitats.

Riparian Conditions. Degraded riparian conditions currently exist in the Puyallup/White River Watershed as a result of riparian harvest, fires, agriculture, construction, and operation of in-water structures and land development. Areas with no vegetation, little vegetation, or vegetation that is composed primarily of young deciduous trees characterize the degraded riparian conditions. Areas with little or no vegetation do not provide adequate shade and result in increased water temperatures which limit fish survival and reproduction. Degraded riparian areas also do not provide for future large woody material recruitment nor do they adequately provide cover to the streams and/or provide a buffer for stormwater runoff or other human-related activities. Remnant riparian forests in the basin are unable to provide adequate large woody material recruitment (especially since most of these forests are also young), which leads to channel profile degradation including decreased pool habitat and increased scour.

Water Quality. Some of the primary water quality problems in the Puyallup/White River Watershed are high water temperatures, turbidity, and pH. Cleared or degraded riparian forests no longer provide shade along streambanks. Calving and eroding banks have made low-flow channels wider and shallower allowing temperatures to increase. The naturally high sediment regime in the White River due to headwaters in the glaciers of Mt. Rainier and its erosion into the geologically young Osceola mudflow through 18 miles of the White River canyon results in high turbidity. It is estimated that 440,000 to 1,400,000 tons of sediment are transported downstream annually. Finally, pH levels are an issue at selected sites within the basin with a few in particular being related to the discharges of the sewage treatment plants operated by the Cities of Buckley and Enumclaw which have an indirect cause in increased pH levels. The Corps has limited authority related to water quality parameters such as pH levels or issues related to point-source or non-point-source discharges; nonetheless, these are limiting factors in the basin and need to be considered in relation to other restoration actions within the Corps' restoration authorities.

Fish and Wildlife. In general, the majority of fish and wildlife populations found within the basin are in a depressed state in relation to their historic condition. Anadromous salmonid species found in the basin include spring and fall chinook, coho, pink, chum, winter steelhead, and coastal cutthroat trout. Runs of all of these species have declined significantly from historic levels. There are eight Federally listed threatened or endangered species in the basin including three birds (bald eagle, marbled murrelet, and spotted owl) two fish (bull trout and Chinook salmon), and three mammals (gray wolf, Canada lynx, and grizzly bear). Degraded habitat associated with each of these species is the primary factor behind either their threatened status or because of low population numbers.

- **FUTURE WITHOUT PROJECT CONDITION**. Local, Tribal and state governments are individually identifying and conducting aquatic ecosystem restoration in the Puyallup/White River Watershed. However, current and past restoration efforts, while praiseworthy, need augmentation and coordination on a larger scale so that their benefits are fully realized in conjunction with a basin-wide approach. Conditions and problems in the basin are such that it is possible to integrate

flood reduction measures and aquatic ecosystem restoration, gaining respective benefits and advantages of each simultaneously and to a greater degree. The Puyallup/White River Basin in the future without a Corps project would likely experience increased flood damages and a continued decline in the health of aquatic and riparian ecosystems. Non-participation by the Corps in numerous state and local restoration efforts would likely result in a reduced amount of net habitat gain for the basin, and several proposed restoration and flood damage reduction efforts would be passed over. It is anticipated that without restorative intervention to slow, stop, or reverse the present decline in the ecosystem health of the Puyallup/White River Basin, current fish and wildlife populations in the basin may become further threatened or endangered or result in possible local extinction.

- **FUTURE WITH PROJECT CONDITION**. The anticipated with-project condition for the Puyallup/White River Basin includes reduced flood damages and a lowered risk to public health and safety in conjunction with a positive change in the health of the basin's aquatic ecosystems. Leveraging Corps resources with the local jurisdictions' efforts will substantially restore the environment while protecting critical infrastructure and existing urban development. By combining and balancing flood reduction actions that mimic the natural system with aquatic ecosystem restoration, it is likely that the Corps and the local jurisdictions can efficiently address problematic flooding and degraded habitat conditions simultaneously. By implementing sound environmental flood damage reduction and ecosystem restoration measures, both flood damages and ecosystem degradation can be significantly reduced. It is likely that if an aggressive aquatic ecosystem restoration strategy is followed, the decline of fisheries resources and habitat degradation in the basin may be stopped. Implementation of a basin-wide restoration and flood management plan is likely to restore natural physical processes to the basin.

(C) PROBLEMS AND OPPORTUNITIES

The problems and opportunities identified to date, which are consistent with Corps of Engineers National Economic Development and Ecosystem Restoration Objectives, are summarized below:

- **ECOSYSTEM RESTORATION**. There are several limiting factors on the ability of the Puyallup/White River Basin to function successfully in an ecological context: 1) alteration of natural flow and sediment transport; 2) urbanization of the various sub-watersheds has increased peak flows, scour, and sediment deposition which, in turn, reduces aquatic habitat diversity and function; 3) numerous blockages to fish passage exist which prohibit access to and the use of good spawning and rearing habitat; 4) lack of adequate and high quality riparian vegetation has reduced shading and habitat forming processes (pool formation, etc.); and 5) levees and revetments have disconnected the active channel from its flood plain and the rivers' tributaries further causing increased flooding, scour, and sediment deposition, as well as eliminating the riparian zone.

  The ecosystem restoration needs and projects within the basin specifically relate to restoration of process-orientated functions that will ultimately carry over into restoring critical fish and wildlife habitat. One of the most critical or important opportunities in the basin is preservation of habitats that are already considered relatively healthy. The counties and other local jurisdictions are aggressively pursuing this component. The restoration actions that fall within the Corps ecosystem restoration program include:

  * Restoring areas with degraded physical processes

* Restoring migration routes for fish and wildlife
* Restore critical estuarine and intertidal habitats
* Identifying and restoring scarce and critical habitat types in the basin for fish and wildlife.

The following outlines specific ecosystem restoration opportunities in the basin:

Fish and Wildlife Habitat Areas – Construct off-channel habitat areas to provide overwinter rearing and refuge habitat for juvenile salmonids and refuge for adults during high flows. These habitats and their associated riparian zones are also valuable for many species of waterfowl, migratory birds, and mammals. More natural river meanders, increased sinuosity, and natural creation of off-channel habitat could be possible if bank-hardening structures were removed and connections made to the existing, isolated off-channel habitats. Placement of LWD would introduce in-stream cover and in-channel structure, increase channel complexity, and increase sediment storage, particularly spawning gravel retention. Construction of off-channel areas can serve as small natural detention basins for floodwaters. Revegetation of riparian areas that have been cleared would increase shading and reduce water temperatures in reaches that do not currently meet Class A standards, particularly in the tributary streams. Restore degraded riparian zones to provide cover and nutrient and detrital input into the aquatic ecosystem. Plant riparian areas with conifer species to increase LWD recruitment. Riparian revegetation would also result in reduced surface and bank erosion and improved filtration of runoff from the flood plain and uplands. Riparian zones are important corridors for wildlife movements and are also extensively utilized by many species as primary foraging and nesting sites.

Stream Bank Restoration – Plant riparian vegetation, incorporate vegetation into areas currently dominated by riprap, remove riprap from the upper bank area, and install bio-stabilization, and place large woody material or engineered log jams in appropriate reaches in the basin. Severe bank erosion in numerous locations along the main stem Puyallup/White River and on tributary streams has caused great increases in suspended sediment loads, decreasing fish habitat quality and increasing flood damage potential in downstream area. Stabilization projects must be clearly and directly linked to ecosystem functions and processes to be eligible under the Corps program.

Assessment of Instream Structures – Remove or upgrade culverts and other structures that would allow fish passage for all species during all flow conditions. This would result in access to many miles of tributaries currently inaccessible because of migration blockages, generally improving production of fish by increasing total area available for spawning, rearing, or refuge. Improving culvert passages will also reduce localized flood impacts associated with insufficiently sized culverts during high flows.

Estuarine and Intertidal Habitat – Restoration of critical intertidal habitat would provide for holding and refuge areas for salmon. Restoration of shoreline would also support primary productivity.

Conveyance Modification - Modify river facilities by constructing setback levees or removing unnecessary or non-functioning levees to reconnect the watercourses to their flood plain in specific locations. Sloping back revetments and non-leveed banks and creating excavated flood plains or wetlands would allow more-frequent inundation of the flood plain in selected locations and improve bank stability. Flood plains provide habitat for a variety of fish

and wildlife species and are especially effective at reducing water velocities, trapping sediment, and providing winter rearing habitat for juvenile salmon. Road re-routing would also be conducive to increased flood plain connectivity. Revegetation of flood plain areas would further improve the sediment trapping and groundwater recharge functions. Wetlands can be restored or created in flood plain areas to further allow groundwater recharge and provide seasonal fish habitat during high flows.

Sediment and Large Woody Debris - Assess and augment as needed the volume of LWD in the system to provide for increased structural in-channel complexity, instream cover, habitat diversity, and overall improved functions**.** Assess current sediment transport and timing throughout the basin with focus on the White River and modifications to the natural system.

- **FLOOD DAMAGE REDUCTION.**

The following summarizes flood damage reduction options and alternatives the local jurisdictions have considered to date:

Non-Structural Measures - These actions are defined as flood plain management as opposed to modifications of flow and/or river channel modifications. Non-structural measures include flood proofing or relocating structures and infrastructure, implementing warning systems and such items as land use regulations that implement new flood and channel migration hazard mapping. Over the past 5 to 10 years, King and Pierce Counties have aggressively pursued buy-outs of flood-prone residences and land acquisitions to preserve and increase flood storage.

Levees and Revetments - This category includes a diverse array of options from constructing new levees, to increasing the level of protection of existing levees, to setting back existing levees. King and Pierce Counties have policies on setting back existing levees and removing levees that are no longer functional as flood control facilities. This type of action not only opens up restricted channels but also restores natural flood plain functions and processes.

Channel Capacity Improvements - This flood damage reduction measure would be operative in situations where levee removals or setbacks are not currently feasible. In constricted channel reaches, capacity improvements may include managing vegetation along levees eligible under the Corps' Public Law 84-99 program, removing debris, and conducting channel dredging. Management of vegetation, logjams, and sediment would be consistent with current policy, agreements, and flood hazard reduction plans unless further evaluation is warranted.

Sediment Transport - The amount of sediment and bedload carried by the Puyallup River and tributaries is one of the highest of any watershed in Puget Sound because of the natural condition of the glacial headwaters and the Osceola mudflow. The sediment transport regime for the White River, which has been altered by MMD and the PSE flow diversion, may be considered during the feasibility evaluation. Modifications to release and transport of sediment by these structures could be a possible solution. Sediment transport that has been affected by forest practices, including roads and mass wasting, may also be assessed. Potential solutions to address this problem for tributary streams include the construction of sediment control structures, control basins, or sediment traps. These

types of solutions have extremely high capital and maintenance costs; however, a more-comprehensive sediment management strategy may be appropriate to consider.

New Flood Control Dams - The Corps of Engineers operates MMD for flood control on the lower Puyallup. Construction of new dams in the basin on the Puyallup or Carbon Rivers is unlikely.

(D) ALTERNATIVES

A variety of alternatives will be considered during the feasibility phase. These will include a spectrum of actions from focusing entirely on flood damage reduction to focusing entirely on ecosystem restoration. The majority of the flood damage reduction alternatives preferred for further consideration are non-structural and items that restore natural flood plain functions such as setback levees. It is unclear from the reconnaissance evaluation the extent of flood damage reduction obtained from individual actions such as those identified in this report. These actions may be more appropriately classified by the Corps as Ecosystem Restoration with incidental flood damage reduction components.

It is highly unlikely that just one alternative will solve the problems in this area. One can expect to use the entire suite of alternatives identified previously. Several of the actions identified either under ecosystem restoration or under flood reduction serve both purposes in many ways. By allowing a combination to exist, it is likely to best represent what is needed to restore the existing environment and provide ancillary flood relief.

During the reconnaissance phase, a significant effort was devoted to identifying potential projects in the basin that meet Corps of Engineers mission objectives in the areas of ecosystem restoration and flood damage reduction. Approximately 120 projects have been identified to date that merit further evaluation in the feasibility phase. These projects have been categorized by project type and include the following (number of projects in parenthesis):

- Barrier Removal (9)
- Estuary-Shoreline Restoration (16)
- Levee removal/setback (18)
- Mainstem & tributary habitat restoration (28)
- Off-Channel habitat restoration (12)
- Relocation (8)
- Culvert Modification (23)
- Miscellaneous (6)

The above projects are outlined in more detail in Appendix C, Project Matrix, of this report. These projects will be further refined and screened during the feasibility phase. Basin alternatives will then be developed based on different groupings of projects.

Preliminary Evaluation of Alternatives: At this level of study, it is apparent that the alternatives would result in net environmental benefits through ecosystem restoration. Additional ancillary benefits may be derived from flood reduction through restoration efforts and visa versa. Of particular importance is that all of the restoration alternatives would provide increased habitat diversity necessary for threatened and endangered species, such as chinook and bull trout. The PMP will be based on refinement and analysis of the combined alternatives. Based on the limited evaluations to date, it appears likely that several alternatives would be technically feasible, environmentally sound, and could be economically justified for implementation.

6. **FEDERAL INTEREST**: The preliminary assessment of flood damage reduction and ecosystem restoration of the Puyallup/White River Basin indicates that measures exist that are most likely economically justified, environmentally acceptable, supported by the local sponsor, and consistent with Corps policies, costs, and benefits. Ecosystem restoration is a high-priority budget output and a primary output of the alternatives to be considered. Flood reduction benefits can either be derived through ecosystem restoration or independently. Therefore, there is a strong Federal interest in conducting the feasibility study.

7. **PRELIMINARY FINANCIAL ANALYSIS**: A draft letter of intent from Pierce County is included in Appendix A. A signed letter of intent is expected in January 2003. This letter indicates the strong interest of the local government in working with the Corps to prepare a PMP and to negotiate an FCSA. Pierce County has indicated that they are willing and able to sign an FCSA upon development of a mutually acceptable scope of studies and PMP. Pierce County will act as the principal local sponsor and represent other local flood control districts, adjacent counties, and individual groups that may provide monetary assistance to the overall planning effort. King County is also interested in financially contributing to the feasibility study for the White River portion of the project and is agreeable to working with Pierce County in its role to be the principal sponsor for the project in developing appropriate interagency agreements that clarify responsibilities and financial contributions. The Puyallup Tribe of Indians is also interested in financially contributing to the feasibility study. It is anticipated that other local jurisdictions will participate in project financially in the out years of the feasibility study when efforts will be focused on specific projects in various jurisdictions. Pierce County will be the official non-Federal sponsor and they will develop inter-local agreements with the other jurisdictions. In addition, funds from Washington State grants and performance of in-kind services will be used to meet the county's local cost share.

8. **SUMMARY OF FEASIBILITY STUDY ASSUMPTIONS:**

a) The PMP and FCSA will be developed to identify the specific studies and issues for the feasibility study. Upon approval of the plan by all parties, the FCSA will be signed;

b) The proposed feasibility study will use as much existing information as possible to gain a clear understanding of flood problems and ecosystem restoration issues within this basin and the potential solutions already studied to determine the best means of proceeding;

c) The feasibility cost estimate will be based on authorization of 30-50 individual restoration projects. For developing the feasibility estimate, it is assumed that no changes in operation of MMD will be considered.

d) The document will be a feasibility report with a programmatic EIS and Biological Assessment;

e) The document will incorporate local efforts targeted for restoration and flood damage reduction as integral parts of the overall action in the Puyallup/White River Basin;

f) The feasibility report will be based upon existing information, revised or updated information provided by the local sponsor, and new studies. The Corps, local sponsor, or contract resources will perform new studies. The decision as to which entity will conduct the studies will be based upon who is the most logical and practical party to complete the task.

g) Other feasibility assumptions will be outlined in the PMP.

9. FEASIBILITY-PHASE MILESTONES: The feasibility study schedule is highly dependent upon the negotiation of the PMP with the local sponsor. As the PMP is developed, the schedule will be revised and refined. Table 2 includes feasibility-phase milestones.

Table 2
Feasibility Phase Milestones

Milestone	Description	Target Dates
054	Submit Draft PSP (submit to NWD & HQ)	30 December 2002
100	Execute FCSA	30 January 2003
105	Initiate Feasibility Study	February 2003
111	PSP In-Progress Review	September 2003
112	Without Project Conditions Complete	July 2004
113	Preliminary Design Complete	July 2005
114	Plan Selection	February 2006
124	Feasibility Design Complete	July 2006
145	AFB	September 2006
165	Public Review Complete	November 2006
170	Feas. Report w/NEPA Complete	July 2007
290	MSC Public Notice	September 2007
330	PED Agreement Executed	December 2007
350	Chief's Report to ASA (CW)	September 2007

10. FEASIBILITY-PHASE COST ESTIMATE: This estimate is a preliminary estimate of feasibility costs based on the alternatives, delineating the estimated costs for studies of the Corps and potential local sponsor. This estimate will be modified pending the formulation and negotiation of the PMP. Table 3 includes preliminary estimates.

Table 3
Preliminary Cost Estimates

MAJOR WORK ITEMS	TOTAL STUDY COST
Surveys and Mapping (except Real Estate)	$200,000
Hydrology and Hydraulics Studies/Report	$500,000
Geotechnical Studies/Report	$150,000
Engineering and Design Analysis Report	$1,000,000
Economic & Socioeconomic Studies	$100,000
Real Estate Report	$200,000
Environmental Studies/Report	$300,000
Environmental Compliance (includes USFWS)	$200,000
HTRW Investigations/Report	$150,000
Cultural Resources Studies	$50,000
Cost Estimating	$50,000
Plan Formulation and Evaluation	$200,000
Public Involvement	$100,000
Final Report Documentation	$100,000
Technical Review	$50,000
Federal Project Management	150,000
Federal Program Management (S&A)	200,000
Sponsor Project Management	150,000
Contingencies	200,000
TOTAL PROJECT COSTS	**4,050,000**
TOTAL FEDERAL SHARE	**$2,025,000**
TOTAL IN-KIND SERVICES	$1,012,500
CASH FUNDS	$1,012,500
TOTAL SPONSOR SHARE	**$2,025,000**

11. RECOMMENDATIONS: On the basis of the above findings, I recommend that this 905(b) analysis be certified as being in accordance with current policy and that a feasibility study should be conducted. The preliminary cost study estimate is 4 million. This estimate will be revised as the PMP is developed. The feasibility study is currently scheduled for completion in July 2007. In developing and finalizing the PMP, the District will make every effort to reduce the feasibility schedule.

This recommendation indicates that ecosystem restoration and flood damage reduction measures throughout the entire Puyallup Watershed warrant Federal participation in a cost-shared feasibility study. The identified planning objectives are in the Federal interest, are in accord with Administration policy and budgetary priorities, and are strongly supported by the local sponsor. Recommend approval of this 905(b) analysis as a basis to complete development and negotiations

of the Project Management Plan and to enter into a Feasibility Cost-Sharing Agreement with Pierce County to conduct the feasibility study.

I recommend the Puyallup/White River Basin Flood Damage Reduction and Ecosystem Restoration Project proceed to feasibility phase.

12. **POTENTIAL ISSUES EFFECTING INITIATION OF FEASIBILITY PHASE:** No issues have been identified to date that would effect initiation of the feasibility phase. An issue has been raised related to non-Federal funds available for project implementation. One potential source of non-Federal funds for project implementation are the funds collected by the Natural Resource Trustees from the Potential Responsible Parties (PRPs) to restore or make the environment whole from damages related to the release of contaminants into the Commencement Bay Superfund Site. The Natural Resource Damage Assessment and Restoration Program is used to restore coastal and marine resources that have been injured by releases of oil or hazardous substances and to obtain compensation for the public's lost use/enjoyment of these resources. This is a separate action from the CERCLA response action directed by EPA and stipulated in the Record of Decision. Funds collected by the Trustees are placed in a Federal Court Registry Account but do not become Federal funds. The current account balance is approximately $9 million dollars. The Trustees, including the Puyallup and Muckleshoot Tribes, can draw on these funds to implement specific restoration projects. Very few sites are available for restoration in Commencement Bay and the Trustees are looking at restoration sites in the lower Puyallup upstream of the waterways. Many of these potential restoration projects have also been identified as projects under the Puyallup GI and include such actions as levee setbacks and oxbow reconnections. The question is whether the use of these funds to meet the non-Federal share for project implementation would be consistent with Corps policy.

13. **VIEWS OF OTHER RESOURCE AGENCIES (if known)**: Informal coordination has been conducted with U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and state resource agencies; and each of these entities support ecosystem restoration efforts in the basin. Concern for threatened and endangered species is of paramount importance to the resource agencies within Washington State. It is anticipated the resource agencies will review specific restoration actions in this basin in a very favorable light.

14. **PROJECT AREA MAP:** Maps of the region and study area are included in Appendix B of this report.

Date 19 Jan 03

Ralph H. Graves
Colonel, Corps of Engineers
District Engineer

Appendix A

Draft Letter of Intent
&
Letters of Support

Appendix B

Project Maps

Appendix C

Project Matrix