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SECTION 1135 FISH & WILDLIFE RESTORATION PROJECT
PROJECT MODIFICATION REPORT/ENVIRONMENTAL ASSESSMENT

The Wynoochee Dam Section 1135 Study has investigated methods of restoring the coho and steelhead fish runs in the Wynoochee River to pre-project historical levels. Studies in the 1970s showed that a significant number of coho and steelhead smolts that pass through the project during their downstream migration are killed. This Section 1135 Project will significantly reduce this loss in three steps. First, improved fish passage will be gained through the hydropower intake structure where an Eicher fish screen will move the juvenile fish out of the penstock into a bypass system for transportation into the Wynoochee River downstream of the project. The second step will be the construction of rearing facilities just downstream of the project. These rearing ponds will be used to acclimatize coho and steelhead smolts before their release into the Wynoochee River. The third step will include increasing the river flows by increased releases from the project in the spring and summer months to assist in the downstream migration of fish and help enhance the habitat in the lower 52 miles of the Wynoochee River. The combination of these three steps will restore the fish runs to a more historic condition.

1. PROJECT HISTORY

A. <u>Completed Project.</u> The Wynoochee Reservoir Project was authorized by Public Law 87-874, Flood Control Act of 1962, enacted by the 87th Congress, Second Session. The project name was changed subsequently to the Wynoochee Lake Project by direction of the U.S. Army Corps of Engineers, Office of Chief of Engineers (Figure 1-1). The project authorization required local cooperation by the city of Aberdeen, Washington, and other local interests for repayment to the United States of America for water supply and irrigation after construction. Project costs were allocated to water supply, irrigation, flood control, and fishery enhancement. Project construction was recommended provided that local interests agree to reimburse the United States for costs allocated to water supply and irrigation in accordance with the Water Supply Act of 1958, as amended, and Federal irrigation law, respectively. The Wynoochee Lake Project was authorized for flood control, water supply, irrigation, fishery enhancement, and recreation. Hydropower was added under FERC license for the project as FERC No. 6842. The license for FERC No. 6842 was issued September 9, 1987, to the cities of Tacoma and Aberdeen, joint licensees, to construct, operate, and maintain the project subject to the terms and conditions of the Federal Power Act and to the regulations FERC issues under the provisions of the Act. Public Law 101-640, November 28, 1990, authorized the Secretary of the Army to transfer the Wynoochee Lake Project to Aberdeen subject to the condition that Aberdeen shall operate, maintain, repair, replace, and rehabilitate the project in accordance with regulations prescribed by the Secretary which are consistent with the project's authorized purposes. Transfer took place on September 20, 1993.

Figure 1-1 Wynoochee Basin Diagram

The project, completed in 1972, is located on the Wynoochee River in Grays Harbor County, Washington. The upstream fish passage facilities and barrier dam are located at river mile (R.M.) 49.6 and the main dam is at river mile 51.8 above the confluence with the Chehalis River. The dam is approximately 37 road miles from Montesano, Washington, via County Road 141 and U.S. Forest Service Roads 22 and 2294. Access from U.S. Highway 101 via Forest Service Road 22 is 22 miles.

Water impounded in the reservoir is released under controlled conditions to prevent downstream flooding during periods of high runoff and to augment low natural river flows for the benefit of downstream water users and fisheries during periods of low runoff. The drainage area above the reservoir covers 41 square miles. The reservoir at full pool level, elevation 800.00, extends 5.4 miles upstream from the dam to river mile 57.2, covers an area of 1,122 acres, and has a gross capacity of nearly 70,000 acre-feet.

Upstream migration of fish is prevented by the concrete barrier dam located at river mile 49.6. The facilities for attracting, trapping, sorting, and transferring the fish for hauling by truck comprise the left abutment structure for the barrier dam. Fish are attracted through the entrance and intermediate pools into the holding pool, trapped there, and then crowded into the sorting chute where non-salmonid fish and hatchery salmon surplus stock are diverted back into the river and salmon and trout are discharged into the transfer hopper. The fish then are transported by the fish haul truck, approximately 7.5 miles upstream, and released into the river about 0.5 miles above the reservoir. Juvenile outmigrants, the offspring of the transported fish, pass downstream through the project in the spring and summer, using the multilevel outlet works.

B. <u>Resource Problems and Opportunities.</u> Conditions on the Wynoochee River have been impacted by the construction of Wynoochee Dam. The reservoir inundates 5.4 miles of previously usable spawning habitat by coho, steelhead, cutthroat and chinook. Estimates of habitat indicate a production loss of 1500 steelhead, 1400 coho, and 500 cutthroat. Mitigation for the original construction of Wynoochee Dam was limited to the fisheries habitat that was inundated by the project pool but did not include possible losses associated with fish passing through the downstream outlet works.

Downstream fish migration of salmon and steelhead also does occur at Wynoochee Dam; however studies by WDF and the University of Washington indicate that there is approximately a 14% loss of coho smolts and a 28% loss of steelhead and cutthroat smolts as a result of passage through the dam low-level outlets (Dunn 1978). Loss of downstream migrating fish is a restoration issue that has been outstanding since the construction of Wynoochee Dam.

A portion of the downstream migrants do not pass through the dam but stay in the reservoir, a problem known as residualization. Large numbers of coho and steelhead were found during reservoir trapping studies which is indicative of a residualization problem. Estimates vary based on hydraulic and reservoir conditions but range from 26% - 63% for coho and 9.9% - 91% for steelhead (Dunn 1978). The residualization is thought to be caused by poor configuration of the downstream passage system at the dam. Smolts were found to mill inside the wetwell during a 1995 HTI hydroacoustic test and found to have difficulty getting to the depth of the penstock

entrance, thus were not able to pass through the penstock. Before that, observations of fish behavior in the late 1970's inferred difficulty of outmigrants to adequately find the outlet gates. Both of these observations may have been related partially to low velocities through the project.

Fish passage improvements are a necessity to improve 25 years of inadequate reservoir and dam passage conditions. These project impacts, in conjunction with the 5.4 miles of lost spawning and rearing habitat in the reservoir along with low instream flows, have cumulatively depressed Upper Wynoochee coho and steelhead runs to such an extent that additional restoration features are required. There appear to be several opportunities for improvement to fish passage.

The wetwell can be modified to increase attraction velocities and decrease fish residualism. An Eicher screen fish bypass facility can be installed to safely pass fish through the dam. Water releases from the project can be increased to improve downstream habitat of all Wynoochee fish stocks and outmigration of juvenile salmon and steelhead. The existing fish trap can be enhanced to selectively remove natural stock versus hatchery stock. Two short term rearing and release ponds can be constructed to better acclimate hatchery smolts to the Wynoochee River. Changes during spring refill and additional year-round flow augmentation will improve instream habitat, benefiting all freshwater life stages of the two stocks of particular interest as well as all other native stocks in the Wynoochee River Basin. Supplemental rearing ponds for these two stocks have long been considered necessary to replace production lost from habitat degradation and would provide immediate benefits in rejuvenating these two fish runs.

C. <u>Limits of Scope.</u> This project is proposed under the authority of Section 1135 of the Water Resources Development Act of 1986, and the Flood Control Acts approved in 1948 and 1950. The objective of this section of the Water Resources Development Act is to make modifications to the structure and/or operation of existing water resource projects which are feasible and consistent with the original project purpose in order to improve the quality of the environment. Projects developed under the 1135 authority are limited no more than five million Federal dollars per project and $25 million per year for the entire 1135 program.

This investigation is based upon the results of on-site inspections, environmental surveys, inter-agency coordination, and engineering analysis. In accordance with the authority of Section 1135 of the Water Resources Development Act, as amended, the study and recommended alternatives at the Wynoochee Dam have concentrated on modifications to the Wynoochee Project, vicinity, and operations.

D. <u>Project Conditions.</u> Under the current operational plan, releases are set to augment natural flows for fish migration and industrial water supply during the dry summer and fall seasons and to reduce flood discharges in the lower valley during the winter flood control period. Operating constraints for regulation of the project and the (spring refill curve) are listed in Appendix F.

Normally the thermal stratification period for water impounded in Wynoochee Lake is from April through October, the onset and duration depending on hydro-meteorological conditions. During this period, considerably warmer temperatures occur in the surface layers of the reservoir than

would be desirable for the downstream cold-water fishery. Project releases are regulated through temperature panels in the intake structure or the selective withdrawal system in the dam to meet water temperature objectives.

The selective withdrawal system in the dam is used during the period April 15 through June 30 each year while the hydroelectric facility is shut down. The requirement to operate the high-level outlets either fully opened or fully closed for safe fish passage makes regulation for temperature control difficult during the filling period because of the potential necessity to maintain the minimum permissible outflows to obtain required storage. When natural runoff is high and surplus water is available, there is greater flexibility for achieving optimum conditions for the various downstream water uses. During these periods, discharges greater than the minimum release amounts will permit selection of multiple outlets and improvement of water quality control. Regulation for control of dissolved oxygen is not a concern in Wynoochee outflows as levels of this constituent have been satisfactory at all levels in the reservoir through the year.

The operation of Wynoochee Dam provides higher summer flows in the river downstream of the dam site than those under natural pre-project conditions. The project is operated to provide at least the minimum instream flows for the fishery resource. According to the Wynoochee Dam Water Control Manual, prepared by Seattle District, project operation currently provides a minimum of 120 cfs below the Aberdeen diversion year round (Black Creek river mile 5.5). The minimum discharge from the project is 190 cfs between July 1 and May 1 and 140 cfs from 1 May to July 1.

2. PROJECT SELECTION PROCESS

The project selection process was a collaborative effort between the Corps, Tacoma Public Utilities, and several key resource agencies. This Technical Committee consisted of individuals with specific plan formulation, design, and analysis tasks. Members of this group were technical and study management individuals from the Corps, Tacoma Public Utilities, and the Washington Department of Fish and Wildlife. This group was the core study team for this project. Comments were also received from representatives of key resource agencies, public interest groups, consultants, and private citizens.

Through a series of coordination meetings, twenty-five biological criteria were established to be used in project alternative design and selection. These criteria, explained in Appendix G - Wynoochee Dam Hydraulic Reports, set standards for flow, velocity, and other hydraulic conditions to be used in designing alternatives.

A preliminary design and cost estimate was prepared for various alternatives, whereupon the least cost and most practicable alternative was selected. The preferred alternative was selected by means of a comparison of project alternatives' costs. Each alternative was considered to have indiscernible differences in the environmental outputs because the twenty five design criteria had set the standard for the alternatives to maximize environmental output. A design that met these criteria was considered a viable alternative. With no discernable difference in environmental output, the only selection criteria between alternatives were cost and practicality. Therefore, with equivalent environmental outputs, the preferred alternative selection was a matter of choosing the least cost and most practicable alternative.

To verify this analysis, the various alternatives were also analyzed for their constructability, operability, maintainability, and common sense. The original preferred alternative was considered technically complex. So much so, that there existed a number of questionable features and unknowns which eventually made the design impractical from a cost perspective. A modification to the preferred alternative was proposed by National Marine Fisheries and the City of Tacoma. To test the modified preferred alternative a series of physical tests were performed at the Wynoochee Dam. These were done to determine if the new fish passage alternative would be successful. These tests showed that indeed the fish would be attracted to and pass through the preferred alternative fish passage facility.

The preferred alternative, as described in Section 3 - Recommended Modification, was based upon common sense, known technology, and a series of physical tests, all of which create an affordable and practical solution to the fish passage problems at Wynoochee Dam.

The objective of the selected project is to improve instream habitat and anadromous fish production for all life stages and all existing native Wynoochee stocks. Original Wynoochee project mitigation was limited in scope in that it mainly addressed habitat lost when the dam was constructed. The following Section 1135 project components deal with such restoration issues as: fish migration, outlet mortality, quality of fisheries stock, and segregation of fisheries stock to restore runs depleted by fish passage and residualization problems.

The problem of smolt residualism at Wynoochee Dam will be corrected by modification to the existing penstock wetwell. A combination of a new intake opening coupled with special temperature panel and project operation have proven to attract high numbers of smolts to the new bypass facilities. A series of tests performed since 1994, see Appendix H - Wynoochee Dam Eicher fish reports, have determined that fish will not only enter the wetwell, but are immediately drawn into the penstock entrance. The increase of flow velocity through the wetwell has shown an increase in fish attraction to the system. With little delay, they will be drawn through the wetwell passing quickly to the penstock.

An Eicher screen will be installed in the project penstock to screen the fish out of the flow before they reach the hydropower plant. Eicher screens have been installed at Elwha Dam in Washington and the Puntledge Project on Vancouver Island in British Columbia. There have been survival rates of 90% to 95% seen at the Elwha facility and greater than 98% at Puntledge. Attaining this level of survival is key to the successful restoration of the Upper Wynoochee natural and wild fish stocks. Tests have been conducted to answer the question of fish attraction through the wetwell.

Improving fish quality is another important element of the project. Fish quality is a function of genetic diversity, local adaptation and overall survival and productivity. Genetic diversity is important because it helps fish populations cope with the highly variable environment they live in. Local adaptation improves productivity by providing fish that have characteristics that match local conditions. Both of these factors have been affected by the loss of stock abundance due to survival and passage problems associated with the dam, and the use of outside stocks for past supplementation efforts.

Improved survival and passage due to the proposed project will help maintain larger population sizes and prevent the extinction of local stocks. Large populations maintain greater diversity within the population and prevent localized extinction which help to maintain the overall stock diversity in the Chehalis Basin. Local adaptation will be maintained and improved through the use of local, naturally produced fish for passage above the dam and in the supplementation program. Fish produced in the supplementation program will be fin-clipped to identify them as hatchery fish. Only unmarked fish will be taken from the Wynoochee fish trap for use in the hatchery or for insertion above the dam. By using only unmarked stock, a larger, more diverse gene pool can be tapped. For development of the pond stock, a minimum 20 adult fish (per stock) are needed, but 40 adult fish would be optimal to ensure adequate diversity. The rest of the unmarked stock will be inserted above the dam. Modifications to the fish trap will provide the ability to sort natural from fin-clipped fish.

The survival quality of the hatchery production will be improved by the use of the supplementation ponds which will allow fish to recover from the transfer process, provide controlled acclimation conditions, reduce stress from trucking during smoltification, and provide volitional releases that better match the fish's need to migrate. The Washington Department of Fish and Wildlife will follow its agency guidance and policy when preparing final operation and maintenance plans for the supplementation ponds and fish trap.

The final feature of this project is modification to the existing dam discharge and refill regulation. Improvements to fish migration and downstream habitat will be seen through the implementation of a new spring refill curve and modified project discharge. Implementation of this curve will allow for earlier project refill, leading to ability to pass spring freshets. The additional discharge from the dam assists the downstream migration of juvenile salmon, steelhead and cutthroat by providing a more natural habitat including higher velocities for passage and additional rearing habitat. An increase in base flows at the Save Creek USGS gauging station during the summer and early fall will assist with the upstream migration of adult fish and provides more available spawning area.

3. RECOMMENDED MODIFICATION

A. Description.

1. Eicher screen. The Eicher screen fish bypass facility (fully described in the hydraulic appendix) consists of seven (7) components; possible modifications to the existing intake wetwell and gate shaft, the Penstock Eicher screen, pressure bypass, distribution box, multi-level discharges, gravity flume, and outlet channel.

(a) Intake Wetwell and Gate Shaft. As a result of testing conducted in May and June of 1997, it appears that intake modifications may not be required. For that testing the City of Tacoma cut a 5-foot high by 9-foot wide opening in the wall between the wetwell and gate shaft at elevation 777. A closure gate was also fabricated for the opening. Temporary gate hoisting machinery and flow baffles were also installed. The conclusion of the testing was that the opening was extremely effective in attracting and transporting fish to and through the penstock. Later testing also indicated that the high level opening may not be necessary as fish are swept down the wetwell under the lower penstock gate. The proposed plan is to conduct testing with the completed Eicher screen with no further intake modifications. Once this evaluation is complete, the Corps, TPU and interested resource agencies will determine the optimal wet well operation and if the upper portal is needed. If the upper portal is deemed necessary or beneficial, permanent hoisting equipment, baffles, and transitional concrete removal between the gate well and penstock will be completed. Budget for completing the upper portal is included in the project. If, after testing, the portal is deemed unnecessary, the air shaft portal will be sealed.

(b) Penstock Eicher Screen. About 200 feet downstream of the dam face, a section of the 10-foot diameter penstock about 40-feet long would be modified to incorporate an Eicher screen. A small diameter outlet at the top of the penstock near the downstream end of the Eicher screen passes fish which have been screened from the main flow into a 24-inch diameter pressure bypass pipe. The Eicher screen is designed to allow fish to be guided along or above its surface, to the top of the penstock, where a small percentage of the penstock flow and all the guided fish are accelerated into a pressurized pipe bypass system. The fish bypass is designed to withdraw an average of 20 to 30 cfs, roughly 5- to 15-percent of the penstock flow. Bypass discharge is controlled by the hydraulic head differential between the selected multi-level discharge (discussed below) and the reservoir.

(c) Pressure Bypass. A pressure bypass pipe carries the bypass discharge from the Eicher screen across the Forest Service bridge to the distribution box. Flow in the pressure bypass system accelerates throughout the entrance and into the pressure bypass. Average velocity throughout the bypass will remain moderate (6.4 - 9.5 fps) and uniform. Smooth HDPE walls and moderate velocities would prevent abrasion injury to the fish. Multiple access ports, long radius bends and downstream flow monitoring will be incorporated to prevent debris jams, insure early detection, facilitate removal, and to protect fish from hard surface obstructions in the line. The uniform velocity throughout the bypass would also encourage fish to follow, rather than fight, the water particle velocity. Fiberglass epoxy pipe may be used across the bridge to reduce weight and increase rigidity between supports.

(d) Distribution Box. A multi-port distribution box will be used to smoothly connect the pressure bypass with the appropriate multi-level discharge. This box will house an S-curved pipe that rotates within a bell and spigot connection and discharges to the selected multi-level discharge. This system permits smooth flow with no wye's or gate valves to disrupt flow or accumulate debris. When it is necessary to shift discharges the pipe will rotate to the next connection and the previously used discharge pipe will be drained with any trapped fish back into the flume.

(e) Multi-level Discharge. The multi-level discharge consists of an arrangement of parallel pipe runs and discharges to the flume at different elevations. The highest discharge will produce 30 cfs flow in the system at reservoir elevation 800 (full). As reservoir levels fall approximately seven feet the bypass flow will drop to 20 cfs. The next lower discharge (shown at 5 feet down) will then be opened which will produce nearly 30 cfs. The preliminary design has approximately a 2 foot hydraulic grade overlap and the preliminary plans show even spacing of the discharges. Final design and hydraulic analysis will determine the exact number of discharges and their elevations. Reservoir levels from elevation 770 to elevation 800 with some overlap of flow settings to accommodate hydraulic uncertainties will probably result in only five discharges. Individual discharges to the flume may consist of a short drop from pipe into the flume (as shown on the drawings) or lateral flume connections depending on consensus of the fish restoration committee.

(f) Gravity Flume. The gravity flume runs from the multi-level discharges to the outlet channel. The flume runs at multiple grades with the steepest being 20%. Horizontal and vertical curves will be accommodated by allowing up to 5-degree angle changes at each connection of precast sections. Concrete surfaces and joints will be made smooth by use of geomembrane liner or epoxy paint system. Supercritical flow will be maintained at all locations to avoid a hydraulic jump. The upper flume above the U.S. Forest Service road consists of a pre-cast, open top structure with a 24-inch diameter half-round bottom. Side wall freeboard of 24-inches above surface will be maintained. Crossing under the U.S. Forest Service road will be done in 24-inch diameter PVC or a covered flume section. After crossing the road the flume will run parallel to the powerhouse access road on the uphill side. The flume in this portion will be pre-cast with a smaller radius bottom and sloped sides to maintain the minimum 9-inch flow depth on the steeper grades. The pre-cast units provide both the freeboard to prevent fish escapement and a retaining wall for the 2-foot cut required on the uphill side of the road. All sections will also incorporate a top screen to prevent debris such as limbs from blowing in and keep the public out. The flume flattens out with a minimum 0.5% grade to traverse the powerhouse substation area (without formation of a hydraulic jump) prior to descending to the river elevation. Another under road crossing will be necessary to allow vehicular access to the powerhouse substation and fish supplementation ponds. The flume will then descend at a 20% grade to the discharge outlet at the river. This slope will require a cut in the final bank approaching the river. A preliminary HEC-RAS analysis confirms minimum water depths of 9-inch can be maintained and velocities will remain between 12 and 25 feet per second. A hydraulic profile can be provided later.

(g) Discharge Outlet. The fish discharge from the flume will flatten into a round bottomed tall outlet channel at the river. The outlet channel is set with the invert approximately three feet below minimum river flow level and configured such that the hydraulic jump will always occur within the channel and not the steeper flume. The design is based on the successful White River Project fish return system which passes 20 cfs to a shallow river.

(h) Test Facilities. Not shown on the drawings but contained within the budget are plans for test facilities to examine fish passing through the system. One possible method would be to incorporate an additional outlet from the distribution box tied to a pressurized version of the Elwha testing facility. This would allow examination of fish passage through the screen separate from the flume. Another idea is to shunt fish from the flume into one of the supplementation ponds. Either method has costs and needs to be discussed by the fish restoration committee. Budget will be reserved for fish passage testing.

2. Supplementation Ponds and Fish Trap Modification

(a.) Supplementation Ponds. The current supplementation pond proposal includes two small conditioning ponds: one for 25,000 winter run steelhead (5 - 7 fish/lb.) and the other for 55,700 coho (16 - 18 fish/lb.). Size of the ponds has yet to be determined but are expected to be approximately 30'x 60'x 8' feet deep. Water supply will be gravity flow via an extension line from the hydroelectric project. Outlet structures will be a stop log and removable screen type mechanism. The outlet stream will consist of a buried conduit to transport the smolts to the river. The conduit will be connected to a volitional release outlet to provide quick, safe release of smolts. The conduit will follow the alignment of an existing road. Fish will be fed from demand feeders (with docks) with two feeders per pond. Allowable loading densities for these ponds is approximately 19,200 pounds fish/pond, well over the proposed loading densities. Decreased loading capacity due to decomposition of fish feed and fish growth have been accounted for. The Washington Department of Fish and Wildlife is responsible for design and construction of the supplementation ponds. Measures will be taken to prevent sediment flow to the river during supplementation pond construction.

The ponds would periodically be cleaned. Specific cleaning instructions have not been received by us from the Washington Department of Fish and Wildlife at time of printing. It is expected that after each year's brood, the pond would be drained and flushed with either higher velocity water or with mechanical means (i.e.: backhoe). No downstream pollution effects are anticipated with either the operation or cleaning of the ponds. The location of the ponds is located on the opposite bank and slightly downstream of the hydroelectric powerhouse (Figure 3-1). The supplementation ponds will be secured against public entry and vandalism.

Figure 3-1. Wynoochee Dam Section 1135 Fish Restoration Project

Rearing time will be three months from February through April or May. The ponds would require that project personnel perform daily duties to feed and maintain the ponds. A fish culturist will periodically visit the site for less routine tasks. Fish will be collected at the barrier dam fish trap. Coho adults will be collected from the mid-October run. Adult broodstock will be spawned and eggs reared at the Bingham Creek hatchery, an off-site facility located on the Satsop River. At 20 - 25/lb for coho and 8 - 10/lb for steelhead, the fish will be trucked to the supplementation ponds for further rearing. Fish will be fed from automatic feeders which will be recharged when needed by Tacoma staff. At a smolt size of 16 - 18 fish/lb. and 5 - 7 lb./fish for steelhead, the outlet screen will be removed for volitional release.

(b.) Trap Modifications. Without trap modifications and subsequent sorting capability, selection of wild stocks to be transported upstream of the dam, and selection of Wynoochee stock for hatchery supplementation would remain difficult if not impossible with larger runs. Current ability to sort fish is limited to manual collection within the holding area. Sorting hatchery from native fish at times of mixed presence will be possible after modification of the fish trap. For example, the trap is currently closed after June 1 to prevent hatchery summer run steelhead from spawning with native steelhead above the dam. The Wynoochee River Basin will benefit in many ways by modifying the fish trap. Hatchery managers will benefit from the ability to separate natural and hatchery fish allowing greater flexibility in transportation, stocking and broodstock selection. Fish stock managers will benefit from the denial of hatchery fish to the upper watershed to preserve the upper watershed for natural and wild stocks. Lastly, the fish will benefit from the minimization of trap shutdowns. Trap shutdowns during the tail end of the run is thought to narrow the genetic composition of wild stocks. The shutdowns are counter to the Washington Department of Fish and Wildlife Wild Salmonid Policy and potentially the Endangered Species Act.

Proposed trap modifications are shown in Figure 11. An additional holding tank will be installed for sorting wild fish. The holding tank will be installed along side the existing flume. The tank will be approximately 18'x 4'x 3' and be able to hold 60 adult fish. The existing sorting flume will be modified (or a new flume constructed) by the addition of a hinged selection gate located about two feet downstream from the existing false weir, and a side-wall bypass chute into the new wild fish holding tank. The selection gate will be perforated to allow only six inches of water to be contained. The gate will be hinged up from the floor and operated in the up position where it would briefly trap fish after the pass over the false weir. The wall of the flume will be raised for additional freeboard. The operators platform will be extended for better fish observation and identification. From this platform, the operator can direct fish either to the wild fish tank or the hopper. The fish will be loaded into the main hopper after the hatchery fish are removed and therefore available to load into a truck for transport. The hopper will need to be modified by adding an opening with a closure device to accept transfer of water from the wild fish holding tank to the hopper. New lifting devices will be installed to assist in truck loading. Water supply to the wild fish tank will come from the 24" holding pond water supply and buried under the concrete work area. Other changes include modification to the state hauling truck to match the hopper for water-to-water transfers. A second holding tank on the opposite side of the sorting flume may be added to handle large numbers of returning fish.

3. Flow and Spring Refill Curve Modification. The selected minimum flow alternative will allow increased stream flows during periods throughout of the year on the Wynoochee River, particularly during periods critical to the life cycle of migrating fish. The increased stream flows will be realized by observing a flow target of 330 cfs at the Save Creek gage when the reservoir level is at or above elevation 770 feet. When the reservoir level drops below elevation 770 feet the Save Creek gage target flow will no longer be maintained. All the other existing minimum target flows and diversions will be met or exceeded throughout the year regardless of the reservoir level. Sufficient water is available in the system to provide for all the existing flow demands as well as the additional instream flow of 330 cfs at Save Creek. In 61% of the years, the pool falls below 770 feet for some period of time while in 39% of the years, the pool never drops below 770 feet and, therefore, the target flow of 330 cfs is met all year long.

The spring refill curve will be modified to allow the reservoir to be filled earlier. Earlier filling improves the chance of filling the reservoir to 800 feet, increases the amount of time the higher target flow of 330 cfs can be maintained throughout the summer and fall, and allows natural flows to be passed downstream during the second half of April and early May more frequently. The revised refill schedule will begin on March 1 instead of March 25 and it will reach full pool approximately 7 to 10 days earlier than the old refill schedule. Excess flow will then be passed to provide a more natural downstream riverine environment. In Section **8.04**. Overall Plan for Water Control - **b**. Spring Reservoir Filling (March 25 to May 1) it states that "filling from 795 to 800 feet will be delayed to as late a date as possible to preclude runoff from an unexpected heavy rain forcing the elevation above 800 feet or requiring a rapid increase in discharges". This section of the water control manual will be modified to reflect the new operations.

B. Consistency with Purpose. The Wynoochee Dam and Reservoir is a multi-purpose project. The proposed modification would have no effect on flood control or other project authorized purposes to the extent such purposes would be impaired or compromised and so is consistent with authorized project purposes - flood control, recreation, or irrigation. The power project will be able to operate the powerhouse during the current 77 day downstream migration period when the Eicher screen is installed. The existing FERC license directs that the powerhouse will be shut down during this period and the existing outlet structure used to pass downstream migrants. The FERC license will be modified to the changed project operation. The proposed project modification will not affect the aesthetic quality of the Wynoochee River and surrounding areas.

C. Expected Environmental Changes with the Modifications

1. Eicher Screen and Fish Bypass Facility. Expected environmental changes with the fish passage facility are directly related to smolt survival and operation of the hydroelectric facility, these include: 1) increase effective smolt passage through the dam outlet; 2) increased attraction velocities to decrease reservoir residualism; and 3) TPU ability to operate the hydroelectric facility during the 77 day shutdown period.

During the spring outmigration period (approximately April 15 to June 30) downstream migrant chinook (underyearling and yearling), coho salmon and steelhead smolts experience mortality

rates of approximately 14% to 42% (58% - 86% survival) when passing through Wynoochee Dam using the existing outlet facilities (Dunn 1978). The new bypass facility and Eicher screen are expected to improve dam passage survival rate by an estimated 14% - 66%. The target for the restoration project is to attain a 95% dam passage survival rate (**Table 3-1,** Dam Passage Survival). To reach this estimated project survival rate, the Eicher screen and fish bypass system were designed to meet 25 distinct biological hydraulic criteria, from maximum screen velocity to minimum water depth in the bypass (Hydraulic Appendix, Section 1.02).

Table 3-1. Dam Passage Survival

	Without Project	**With Project**	**Improvement (%)**
Dam Passage Survival			
Chinook underyearling	58%	96%	66%
Chinook yearling	80%	98%	23%
Coho smolts	86%	98%	14%
Steelhead smolts	72%	98%	36%
Reservoir Survival[1]			
Chinook underyearling	25%	44%	76%
Chinook yearling	54%	81%	50%
Coho smolts	55%	83%	51%
Steelhead smolts	52%	78%	50%
Overall Survival			
Chinook underyearling	15%	42%	180%
Chinook yearling	43%	79%	84%
Coho smolts	47%	81%	72%
Steelhead smolts	37%	76%	105%

1. Reservoir survival = 1 - reported residualism rate: data used is from 1973 and 1975, trapping equipment could not be used in 1974 because of high flows.
2. Overall survival rate = Dam survival x reservoir survival.

Comparison of existing (without project, from Dunn 1978) fish passage survival versus expected post-project survival and overall improvement. Note, existing survival rates are for only 2 years of data and cannot be considered an accurate long-term estimate of smolt survival and are used only for comparison purposes.

To date, several studies have been performed on the survival of juvenile salmonids passed through high velocity incline screens such as the Eicher and a similar design, the Modular Inclined Screen (MIS). Survival analysis in these studies has included immediate mortality as well as residual mortality resulting from minor injuries and descaling. These studies have consistently shown that for the normal range of flows (250 - 600 cfs) and velocities (<7 fps), survival rates for outmigrant salmonids should exceed 95% (Taft et al. 1993; Winchell et al. 1993; and Smith 1994). Even with the expected survival rates of 95%, some concern was raised about the screen diameter (10 feet selected versus a larger 11 feet, NMFS letter, February 23, 1994). To illustrate the potential survival rate for the minimum sized outmigrant (coho fry ~ 44 mm, 1.8 inches), a comparison of calculated survival rates for a 10 feet versus 11 feet diameter

screen is provided **(Table 3-2**, details provided in Hydraulic Appendix). There appears to be virtually no difference in calculated survival for either penstock diameter.

Table 3-2. Calculated monthly and total survival of Upper Wynoochee River coho fry[2] for 10 and 11 feet diameter Eicher screen penstock.

Month	Coho Outmigrants	10 ft Penstock Survival	Total Survival	11 ft Penstock Survival	Total Survival
April	0%	90.1%	0.0%	92.2%	0.0%
May	14%	94.6%	13.2%	95.9%	13.4%
June	28%	96.3%	27.0%	96.7%	27.1%
July	58%	97.0%	56.3%	97.0%	56.3%
Total			**96.5%**		**96.8%**

1. Survival calculations for coho fry are presented by month and by penstock diameter in the Hydraulic Appendix: outmigration percentage is from Dunn (1978) and penstock survival estimates are from Elwha studies in comparison to Wynoochee monthly exceedance flows.
2. Coho fry were selected for comparison as the smallest sized outmigrant expected to use the penstock during the normal spring outmigration period.

In addition to the documented mortality occurring in the existing low level outlets, previous and current researchers have documented an attraction velocity/flow and sounding (depth) problem for outmigrating coho salmon and steelhead smolts (Dunn 1978, Nealson and Scott 1995). The inability of outmigrating smolts or other juvenile anadromous salmonids to exit the dam can result in residualism and decreased survival. The existing wetwell velocities range from 0.5 - 4 fps depending on panel alignment. To identify whether a wetwell modification could overcome the lack of attraction, several studies were performed in the spring of 1997 by Tacoma Public Utilities. The studies documented the effectiveness of increasing attraction velocities inside the wetwell by pulling fish through an existing air shaft located at the back of the wetwell. The smaller cross section of the air shaft allowed for a surface collection outlet with approximately five fps down to the penstock. Fish attraction and passage through the air shaft was successful enough to warrant an early shutdown of the study due to excessive fish mortality. In combination with the spring refill change which increases flows through the reservoir and dam (discussed below), reservoir survival will improve for all downstream migrants. Estimated improvements in reservoir survival for smolts could increase by 50% (**Table 3-1,** Reservoir Survival).

Lastly, the Eicher screen and fish bypass system will also allow TPU to operate the hydroelectric facility during the 77 day period (currently precluded under in the FERC License) in the spring after April 15. It was assumed that without the Eicher screen and fish bypass, that smolts passing through the turbines are injured or killed at unacceptable rates and, therefore, TPU has been required to shutdown the facility during the normal smolt outmigration period. This assumption was validated during spring studies which showed that 92.2% of the fish attracted to the modified wetwell were subsequently killed in the project.

2. Supplementation Ponds and Fish Trap Modification

(a.) Supplementation Ponds. The proposed supplementation ponds are designed to restore in part coho and steelhead losses due to ineffective passage through the outlet structure at Wynoochee Dam and reservoir inundation of spawning habitat. An artificial rearing facility is proposed to restore an estimated production loss of 806 adult coho and 254 adult steelhead (Washington Department of Fish and Wildlife (WDFW 1977). To ensure the restoration of these adults, additional fish must be reared to the smolt stage which amounts to the rearing of 55,700 coho smolts and 25,000 steelhead smolts. Salmon recruited to the fishery from fish releases at supplementation ponds will reduce pressure on wild stocks inhabiting the river. Excess fish will contribute to the sport and commercial harvest.

(b.) Trap Modifications. Modification of the fish trap will allow separation of natural and wild fish from hatchery fish. This will create additional transportation and stocking flexibility. Hatchery fish will be denied access to the upper watershed in preservation of more sensitive natural and wild stocks. Handling of fish for separation and trap shutdowns will be minimized.

3. Flow and Spring Refill Curve Modification. There are several environmental changes with the spring refill and flow modification, among which are: 1) change in refill start date; 2) decreased flows March 1 - March 24; 3) increased average flows March 1 - May 5; 4) increased number of freshets from April 15 - June 30; 5) increased reliability of reaching full pool; and 6) increased minimum flows for a longer period of time (details of Flow and Spring Refill Curve Modification are provided in Hydrologic Appendix).

Spring Refill Curve Modification. The spring refill curve changes the starting date of refill from March 24 to March 1. Analysis of flood flow recurrence shows there will be no impact to existing project purposes in protecting downstream resources with the earlier refill starting date (Hydrologic Appendix). With the change in starting date, flows during the refill period from March 1 to 24 are lower than under the existing condition; for most years under the existing condition, natural inflow is passed during March 1 to 24. By beginning refill earlier and extending the period of refill, average outflows from March 1 to May 1 will be 24 cfs higher than existing under the spring refill change.

Flows during the normal outmigration period of salmon, steelhead, and cutthroat smolts (typically April 15 - June 30) will be higher under spring refill modification with natural inflows passed most years after May 1. Comparing spring flow releases for existing and spring refill conditions for 1973 to 1975 shows that average flows increase 15% (53 cfs) and the number of days exceeding the existing flows increase 41% (32 days) with the spring refill change (**Table 3-3).** The average number of days with freshets increases under the spring refill change over the existing condition from 81% for flows 50% greater than minimum (300 cfs) and 95% for flows 100% greater than minimum (400 cfs) (**Table 3-4).**

Table 3-3. Comparison of average flows during the smolt outmigration period (April 15 - June 30) for 1973 - 1975[1] for: 1) existing flows; and 2) new flows or with project condition (from spring refill curve change and flow modification).

Year	Average Flow (cfs) Existing	With Project[2]	Improvement Over Existing (cfs and %)	No. of Days Exceeding Existing
1973	229	290	61 (27%)	46 (60%)
1974	535	581	46 (9%)	25 (32%)
1975	260	313	53 (20%)	24 (31%)
Average	**341**	**395**	**53 (15%)**	**32 (41%)**

1. Years 1973 - 1975 were chosen for comparison as these were the only years with outmigrant survival estimates (Dunn 1978).
2. New project condition with minimum 330 cfs at Save Creek and 770 feet pool elevation.

Table 3-4. Comparison of number of days exceeding 200 cfs target by 50% (300 cfs) and 100% (400 cfs) during smolt outmigration period, 1973 - 1975[1] for: 1) existing flows and 2) new flows or with project condition[2].

	Days > 300 cfs			Days > 400 cfs		
	Existing	With Project	Improvement Over Existing (% time)	Existing	With Project	Improvement Over Existing (% time)
1973	9	22	144%	4	11	175%
1974	58	67	16%	53	62	17%
1975	23	42	83%	13	25	92%
Average	**30**	**44**	**81%**	**23**	**33**	**95%**

1. Years 1973 - 1975 were chosen for comparison as these were the only years with outmigrant survival estimates (Dunn 1978).
2. New project condition with minimum 330 cfs at Save Creek and 770 feet pool elevation.

The resultant increase in average flow, and especially in the number of days of higher flows or freshets should significantly improve outmigrant survival of salmon, steelhead, and cutthroat juveniles and smolts. No accurate estimate of improved survival is available, however, studies from a similar Western Washington Corps dam and reservoir, showed that coho and steelhead travel through the reservoir and exit from the dam were directly related to increased flow releases (Dilley and Wunderlich 1993; Aitkin et al. 1996). Also, during one year with high outflows at Wynoochee, 1974, reservoir survival was assumed to be greater than 90%, although this could not be confirmed because high flows prevented recapture of marked fish (Dunn 1978). Because of the spring refill and flow modification, and in combination with the improved attraction to the wetwell entrance and exit, smolt survival through the reservoir could improve 50% with overall project survival potentially increasing from 37% - 47% to 75% - 80% (**Table 3-1,** Overall Survival).

Flow Modification. Filling earlier also increases the reliability of reaching full pool (800 feet elevation) and maintaining minimum flows. Under existing conditions, the reservoir will fill about 80% of the time (51 out of 64 years), while with spring refill modification the reservoir fills 92% of the time (59 out of 64 years). The improved occurrence of fill is due entirely to the revised spring refill curve. In the 13 years where the existing condition does not reach full pool, the higher pool of the proposed flow modification provides increased target flows for a longer period of time in 11 of those years.

In general, Grisdale, Save Creek, and Black Creek flows are greater under the flow modification alternative than under existing conditions (Plates 6 - 8, 10 - 12, Hydrologic Appendix). On average, Save Creek flows are 12% greater than existing flows throughout the year. During periods when targets could not be met, except for the very driest years, the new flow target provides up to 50 cfs more water than existing flows (**Table 3-5**).

Table 3-5. Comparison between existing (without project) and new target flows for: 1) percent of days in the year when flows fall below 330 cfs; and 2) average flow for periods when flows fall below 330 cfs.

Recurrence Interval	% of Days Below 330 cfs		Average Flow When Below 330 cfs	
	Without Project	**With Project**	**Without Project**	**With Project**
Minimum	95%	41%	264	251
P-10	51%	18%	272	270
P-25	39%	7%	277	284
P-50	27%	0%	278	0
P-75	16%	0%	278	0
P-90	10%	0%	291	0
Maximum	1%	0%	315	0
Average	**15%**	**3%**	**287**	**329**

Spring refill and fall draw down are two exceptions to this overall flow increase. As noted above, flows between March 1 and March 24 are lower under the flow modification alternative than under existing conditions. Water is being stored during this period under the selected alternative while inflows are passed under existing conditions. During the summer, prior to draw down, the existing condition requires less water because of the lower target flow than the flow modification alternative. Consequently, more water remains in storage and reservoir levels are higher into September. This results in storage being drafted more often in September under existing conditions with greater downstream flows than the flow modification alternative.

Increased flows throughout most of the year, greater reliability in providing the higher minimum flows, and higher flows during the lowest flow period will provide instream benefits to over 50 miles of the Wynoochee River. These flows will increase available habitat for rearing and spawning fish, both resident and anadromous. In particular, anadromous species that require one or more year of freshwater rearing (coho, steelhead, and cutthroat), and are late spring, summer and fall spawners (steelhead, spring and fall chinook, and coho) will benefit the most. Spring chinook will also benefit. Also, these higher flows will provide improved conditions for outmigrant juvenile salmonids as well as for large, upriver-bound adult salmon and steelhead. This last improvement is critical for all stocks in the Wynoochee River, without adequate attraction flows and water depth near Black Creek, adult salmon and steelhead could be blocked during their upstream migration or become overly stressed from exertion under low water conditions.

D. Costs

The total project cost for the selected plan is estimated to be $4,666,000. Table 3.6 summarizes the first costs and Federal/non-Federal cost shares. Since the land is currently owned by the local sponsor and the Federal Government, no real estate acquisition would be required for the construction or operation of this project. A detailed cost estimate of this project has been prepared. The cost estimate for the Eicher screen is contained in Appendix E. The total construction cost in Appendix E is $3,303,000. An additional $309,000 is required for the monitoring plan, which brings the construction phase total to $3,613,000. The estimates are based on July 1997 price levels.

Table 3-6 - Summary of Estimated First Cost and Cost Sharing Requirement in Thousands of Dollars

Item	Non-Federal	Federal	Total
PMR/EA	325	328	653
Plans and Specs	100	300	400
Construction	741	2,872	3,613
Totals	**1,166**	**3,500**	**4,666**

After construction, the operation and maintenance of the Section 1135 project features will be the responsibility of Tacoma Public Utilities. Tacoma Public Utilities will enter into an agreement with the Washington Department of Fish and Wildlife for the operation and maintenance of the fish trap and supplementation ponds. Upon implementation, the modified dam discharges and spring refill curve will have no operational expense beyond that already defined for the operation of the dam. It is estimated that operation and maintenance activities for this Section 1135 would average $68,000 per year. Please refer to Section 8 for details of the OMRR&R and Section 9 for the monitoring plans.

E. Benefits.

1. Eicher Screen and Fish Bypass Facility. Installation of the Eicher screen and fish bypass facility will restore downstream fish passage at Wynoochee Dam. Accurate estimation of smolt loss through the facility depends on long-term study results, but based on Washington Department of Fisheries (WDF) work in the 1970's, more than 50% of all smolts may not survive through the reservoir and dam. Improved dam passage survival and attraction at the dam outlet with the proposed fish passage facilities (along with increased flows) could improve overall smolt survival by 72% - 105% (**Table 3-7**). Because of the inherent variability in environmental conditions, short-term improvements in survival may not be noticeable, but in the long-term, improved smolt survival will lead to increased adult returns for all anadromous stocks utilizing the Upper Wynoochee watershed.

Table 3-7. Expected improvements in overall survival (dam and reservoir) for smolts passing through the Wynoochee Project.

	Without Project	**With Project**	**Improvement**
Chinook yearling	43%	79%	84%
Coho	47%	81%	72%
Steelhead	37%	76%	105%

2. Supplementation Ponds and Fish Trap Modification.

(a.) Supplementation Ponds. Construction of the supplementation ponds will allow for the efficient rearing of coho and steelhead smolts. The release of 55,700 coho smolts and 25,000 steelhead smolts will contribute to adult escapement and increased adult returns. The ponds will incorporate the latest in WDFW pond design while allowing for maximum acclimation of salmon smolts to wild conditions. The supplementation ponds and volitional release strategy should provide adequate smolt to adult survival of the coho and steelhead and minimize interaction with wild fish. Excess fish returning to the trap as a result of supplementation could be recycled, or used as carcasses to fertilize the upper watershed, or disposed of.

(b.) Trap Modifications. Current conditions do not allow direct sorting of wild and hatchery salmonids at the fish trap. With the modifications proposed, the separation of wild and hatchery salmon will be possible. The new ability to perform this sorting promises great benefits in fishery management. Marked fish used in studies or released as part of on-going hatchery practices will be monitored and sorted for transport to different facilities. Current operation of the trap may cut off some portions of the run in order to avoid releasing hatchery fish, which may be interspersed with wild fish in the trap. Losses of adult native fish production during the tail of run timings will be avoided with the proposed trap modifications. Resident fish trapped at the barrier dam can also be separated or selectively released above the reservoir. Flexibility to manage the transport of resident fish will be greatly increased with the addition of

separation facilities. Stress from handling adult returns will be lowered due to the trap modifications. Smooth transitions from the false weir to the holding tanks and then to the hopper eliminate awkward crowding and manual sorting of fish. This should reduce the stress-induced susceptibility to disease which commonly arises from some fish handling and bypass systems. The trap modifications will act to increase the quality of the Wynoochee River coho and steelhead populations.

3. <u>Flow and Spring Refill Curve Modification.</u>

Spring Refill Curve Modification. The resultant increase in average flow, and especially in the number of days of higher flows or freshets from refill modification should significantly improve outmigrant survival of salmon, steelhead, and cutthroat juveniles and smolts. Because of the spring refill and flow modification, and in combination with the improved attraction to the wetwell entrance and exit, smolt survival through the reservoir could improve 50% with overall project survival potentially increasing from 37% - 47% to 79% - 81% (**Table 3-7**). Increased smolt survival isn't limited to passage through the project; freshets will increase survival of smolts throughout the river basin and will result in more natural riverine conditions for spring spawning and rearing stocks.

Flow Modification. Increased flows throughout most of the year, greater reliability in providing the higher minimum flows, and higher flows during the lowest flow period will provide instream benefits to over 50 miles of the Wynoochee River. These flows will increase available habitat for rearing and spawning fish, both resident and anadromous. In particular, anadromous species that require one year or more of freshwater rearing (spring chinook, coho, steelhead, and cutthroat), and are late spring, summer and fall spawners (steelhead, spring and fall chinook, and coho) will benefit the most. Also, these higher flows will provide improved conditions for outmigrant juvenile salmonids as well as for large, adult upstream migrants. This last improvement is critical for all stocks in the Wynoochee River. Flow modification will ensure adequate attraction flows and water depth near Black Creek. Otherwise, adult salmon and steelhead could be blocked during their upstream migration or become overly stressed from exertion under low water conditions. Total improvements in downstream habitat from flow modifications could increase adult returns rates of coho salmon and steelhead by 15% and return rates for chinook salmon could increase by 10% (Harza 1992, and D. Gufler, WDFW, pers. comm.).

4. <u>Total Project Benefits.</u> The traditional means of measuring the success of dam passage and flow enhancement projects is by estimating increased adult fish returns. However, estimating increased anadromous salmonid adult returns is an inexact science. Migratory fish undertake migrations of thousands of miles beyond project boundary limits, often through extreme environmental conditions, natural and manmade. Coded-wire tags have provided some measure of the return rate of Western Washington hatchery salmon and steelhead, but even these adult survival estimates have shown variation (Aitkin 1996). Recent evidence points to even larger decadal differences in salmon survival based on oceanic and climatic conditions (Hilborn 1996).

Anadromous Production. Even with the inexactness of the traditional adult return approach, based on internal and external coordination this is the preferred method to measure the output of the Wynoochee Section 1135 Project. Understanding the limits of this approach is important when viewing the potential total project benefits, over 3500 additional adults, and individual benefits from each of the project alternatives (**Table 3-8**). For example, estimated annual returns to the Upper Wynoochee from passage improvements (fish facility and spring refill) could result in over 1,000 additional adults. However, the accuracy of this estimate is dependent on data that isn't available -- number of smolts produced, long-term passage survival estimates, and specific adult returns. The supplementation pond estimated adult return (1210 coho, 1000 steelhead) may be one of the more precise estimates because the number of smolts is known and hatchery survival rates are available. This alternative, while having the greatest adult production, is meant to supplement, not replace existing natural production and should, therefore, not be considered the most important alternative for the long-term production and survival of Wynoochee anadromous stocks. Flow benefits are conservative for this analysis (about 170 adults), but could eventually become a multiplier, resulting in increased adults through time, for all salmon stocks in Wynoochee Basin. The multiplier effect for flow benefits is relevant since this is the one project alternative that influences virtually every life phase and stock in the basin.

General Improvements for Anadromous and Resident Fish. All fish stocks in the Wynoochee Basin should benefit from the proposed improvements of the restoration project (**Table 3-9**). For anadromous stocks, coho salmon and steelhead should benefit from every one of the project alternatives, sea-run cutthroat, fall chinook and spring chinook (if still present) should directly benefit from all alternatives but the supplementation ponds, and chum salmon should benefit from the spring refill curve and flow modification. Impacts of the supplementation ponds to other stocks have been minimized to the greatest extent possible by trap modifications, development of genetic broodstock collection protocols, modern pond design, and volitional release. Increased adult salmon returns will also play a critical role in sustaining the instream productivity of the Wynoochee River. The biomass of these large fish is a large reservoir of critical nutrients that can significantly increase the productivity of aquatic and riparian resources of nutrient-poor northwest streams. Pacific salmon have been recognized as a "keystone" species whose presence and sustained productivity is necessary for continued survival of numerous vertebrate and invertebrate species. Long-term benefits from cumulatively higher adult returns and increased nutrient return is just beginning to be studied and understood.

Table 3-8. Estimated additional anadromous production above and below Wynoochee Dam and Reservoir from implementation of restoration project alternatives.

	Coho Salmon	Fall Chinook	Sea-run Cutthroat	Steelhead	Total
Upper Wynoochee					
Without Project Dam/Reservoir Survival	47%	15%	37%	37%	
Smolt Production	50,000	25,000	200	10,000	
Adult Return Rate	5.0%	2.2%	10.0%	10.0%	
Adult Production	1,175	83	7	370	1,649
With Project Dam/Reservoir Survival	81%	42%	76%	76%	
Smolt Production	50,000	25,000	200	10,000	
Adult Return Rate	5.0%	2.2%	10%	10.0%	
Adult Production	2025	231	15	760	3056
Additional Adult Production	**850**	**149**	**8**	**390**	**1415**
Lower Wynoochee					
Supplementation Pond Production					
Number of Smolts	55,000			25,000	
Adult Return Rate	2.2%			4.0%	
Additional Adult Production	**1,210**			**1,000**	**2,210**
Flow Modification Improvements					
Adult Production	15,680	11,289	500	2,140	
Without Project Return Rate	5.0%	2.2%	10%	10.0%	
With Project Return Rate	5.8%	2.4%	11.5%	11.5%	
Additional Adult Production	**118**	**25**	**8**	**32**	**169**
Total Improvement	**2178**	**173**	**16**	**1422**	**3,777**

1. Smolt production rates are generic values for existing adult escapement. Adult return rates are primarily based on adult returns for other systems (steelhead hatchery is from Wynoochee, Hiss and Boomer 1983) but are considered adequate for this analysis. Wynoochee adult production is estimated based on escapement (SASSI 1994, Deschamps 1966) and general harvest ratios. Searun cutthroat adult production, 500 adults, is assumed to be about 15% of previous run estimates (3300 adults, USACOE 1978).

Table 3-9. Potential benefits and impacts to anadromous and resident salmonids resulting from implementation of Section 1135 alternatives (+ = positive, N = neutral, - = negative).

Species	Eicher Screen	Supplementation Ponds	Trap Modification	Rule Curve	Flow Modification	Cumulative Effect
Salmon and Steelhead						
Chum	N	N	N	+	N	N
Fall Chinook	+	N	+	+	+	+
Spring Chinook	+	N	+	+	+	+
Coho	+	+	+	+	+	+
Winter Steelhead	+	+	+	+	+	+
Trout/Char						
Cutthroat	+	N	+	+	+	+
Resident Trout	N	N	N	+	+	+
Bull Trout	N	+	N	+	+	+

Resident trout stocks should see direct improvement from all alternatives except for possibly the Eicher screen and supplementation ponds. Benefits from the Eicher to resident trout are not known since the migratory behavior of these fish have not been studied. The supplementation ponds may not provide direct benefits to resident trout and char, but will certainly provide larger trout/char with increased prey opportunities while the increased biomass and nutrient enrichment from supplemented adult returns can increase instream productivity and ultimately trout production.

F. Justification

Project justification for each of the selected alternatives was identified from eight evaluation criteria and from expected benefits necessary to meet the overall project goal of improving the aquatic resources of the Wynoochee River: Description of each of the alternatives is provided in Section 3.G. The evaluation criteria were developed from: 1) the Section 1135 project authority; 2) scoping comments received during the course of the project development; and 3) through continuing agency and sponsor coordination. The final selected alternatives in relation to all proposed project alternatives are summarized in **Table 3-10**.

Evaluation Criteria used in alternative selection: 1) meets project objective: improved instream habitat and anadromous salmonid production (all life stages, existing stocks); 2) meets Section 1135 Environmental Restoration Authority; 3) within Section 1135 funding limit ($5 million); 4) consistent with existing project purposes (flood control, water supply, fish passage, hydroelectric generation); 5) meets all agency fish passage screening criteria (Hydraulic Appendix lists 25 separate criteria); 6) consistent with Washington Department of Fish and Wildlife (WDFW) Wild Salmonid Policy; 7) consistent with WDFW fish culture criteria and protocols; and 8) sponsor selection through incremental analysis (discussion in Hydrologic Appendix).

Table 3-10. Summary of all Wynoochee Section 1135 restoration alternatives and selected alternatives based on evaluation criteria (a check mark (√) = meets evaluation criterion).

		Criteria								Selected
Category	**Alternative**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Alternative**
Juvenile Fish Passage										
	Eicher Screen	√	√	√	√	√	√	N/A[2]	N/A	√
	Re-plumb Existing Outlets	√	√					N/A	N/A	
	Mod. Incline Screen (MIS)	√	√			√	√	N/A	N/A	
	Modified MIS	√	√	√				N/A	N/A	
	Existing Condition			√	√			N/A	N/A	
Hatchery or Supplementation Ponds[1]										
	Full Hatchery	√		√	√	N/A			N/A	
	Concrete Lined Ponds	√	√	√	√	N/A	√	√	N/A	√
	Natural Lined Ponds	√	√	√	√	N/A	√		N/A	
	Trap Modification	√	√	√	√	N/A	√	√	N/A	√
	No Action			√	√	N/A			N/A	
Spring Refill Curve										
	Begin fill before March 1	√	√	√		√	√	N/A	N/A	
	New Refill Schedule A[3]	√	√	√	√	√	√	N/A	N/A	√
	New Refill Schedule B	√	√	√	√	√	√	N/A	N/A	
	Existing (3/24-5/1)			√	√	√		N/A	N/A	
Flow Modification										
	Save=330 cfs/Switch @ 763	√	√	√	√	√	√	N/A		
	Save=330 cfs/Switch @ 770	√	√	√	√	√	√	N/A	√	√
	Save=345 cfs/Switch @ 763	√	√	√	√	√	√	N/A		
	Save=345 cfs/Switch @ 770	√	√	√	√	√	√	N/A		
	Existing Condition			√	√	√				

1. All hatchery or supplementation alternatives are dependent on trap modification to separate hatchery fish from naturally produced fish.
2. N/A = not applicable.
3. Refill schedule A = Begin refill March 1 at 776.1, fill to 795 by April 13, hold at 795 to May 1, after May 1 fill to 800 feet as soon as possible. Refill schedule B = Begin refill March 1 at 776.1, fill to 800 feet by May 5.

1. <u>Eicher Screen and Fish Bypass System</u>. The Eicher screen and fish bypass system are clearly justified by agency and U.S. Army Corps of Engineers requirements to restore lost production from inefficient downstream fish passage. Fisheries studies to date have documented several problems related to inefficient passage or poor survival of outmigrating juvenile salmonids through the Wynoochee Dam Project (Dunn 1978; Lavoy and Fenton 1978; Nealson and Scott 1995). Based on Dunn (1978), existing survival through the project is estimated to average between 37% - 47% for spring chinook and coho salmon and steelhead smolts. Without improvements to the dam passage facilities, continued mortality of smolts and smaller juveniles at this magnitude could eventually lead to extirpation of native anadromous fish stocks above Wynoochee Dam. To date, both spring chinook and sea-run cutthroat trout escapement counts have become so low as to assume these stocks are no longer viable (although spring chinook losses are presumed mostly dependent on lost spawning habitat). The Eicher screen and fish bypass system should improve dam passage survival to greater than 95% (the standard survival objective for all new screening projects) and with improved attraction velocities in the wetwell as seen during the spring testing and more freshets; overall outmigrant

survival could improve to 75% - 80%. Selection of the Eicher screen and fish bypass system required meeting 25 distinct agency screening criteria (Hydraulic Appendix Section 1.02).

2. Supplementation Ponds and Fish Trap Modification.

(a.) Supplementation Ponds. The supplemental rearing ponds are clearly justified by agency and U.S. Army Corps of Engineers requirements to restore lost production from reservoir inundation of spawning habitat and inefficient downstream passage. Artificial production of fish otherwise lost through project impacts is a necessity. This view is supported by many resource agencies with the idea of supplemental rearing ponds consistently referred to in project memorandums since the 1970's. The proposed artificial production facilities as originally conceived included the expansion of an existing large off-site hatchery facility, or the construction of a new on-site hatchery facility. Through the course of this study, the scope of the proposed production facilities was reduced to include only two natural rearing ponds and supporting structures located on the opposite bank and slightly downstream of the hydroelectric powerhouse.

(b.) Trap Modifications. Based on the need to separate fish for use in the rearing ponds and broodstocking of several nearby hatchery facilities, the need for hatchery modifications is clearly justified. The trap modifications will make the use of the supplementation ponds and other aspects of the 1135 study feasible. Current methods of separating, handling and transporting fish do not allow fishery managers sufficient flexibility.

3. <u>Flow and Spring Refill Curve Modification</u>. The flow and spring refill curve modification would help to address agency and U.S. Army Corps of Engineers requirements to restore lost production from inefficient downstream fish passage and insufficient instream flows. The spring refill rule curve modification is intimately tied to improved downstream survival of outmigrants through the Wynoochee Project. Without the ability to pass freshets through the reservoir and dam outlet, it has been shown that up to 63% of coho and 90% of steelhead smolts may not outmigrate through the reservoir and dam outlet (Dunn 1978). With the new spring refill curve, reliability of filling the pool is improved (from 80% to 92%) as is the ability to pass freshets (from 81% to 95%). In conjunction with the improved attraction velocities in the wetwell, and improved bypass survival, overall survival through the project could improve to 75% - 80% for outmigrating smolts.

Besides improvements to flow during the spring outmigration period, the revised target flows provide more water during the low-flow period for more years than the existing condition. The new flow target provides more water on average about 12% of the time. During times when targets could not be met, except for the very driest years, the new flow target provides up to 50 cfs more water. This amount of flow is critical in providing sufficient water depth for upstream migration and spawning and rearing habitat for all Wynoochee anadromous fish stocks. Selection of the Save Creek 330 cfs, 770 feet pool alternative met sponsor incremental selection criterion (Hydrologic Appendix, Table 3).

G. <u>Alternatives.</u>

1. No Federal Action Alternative. With the no action alternative, no project would be implemented using Federal funds. There would be a continued loss of coho, steelhead, and cutthroat smolts. Losing smolts at the current rate will lead to an eventual elimination of natural fish runs above the dam.

2. Fish Passage Alternatives. The development of the fish bypass design was achieved during a series of planning meetings of the technical review and advisory group. This group was composed of staff from the Washington Department of Fish and Wildlife, the National Marine Fisheries Service, Tacoma City Light, and the Corps of Engineers. The alternative was designed based upon biological criteria that had been determined by the technical review set forth in Appendix G pages 3-4. Based upon preliminary cost estimates, only the Eicher screen fish bypass kept the total project costs within the financial limits of the Section 1135 program, while also meeting all of the biological criteria. The following is a list of the fish collection alternatives that were evaluated.

Alt. 1 Upstream 'gulper' collector similar to the one constructed at Green Peter Reservoir project in Oregon. A free surface screen with adjustable submergence depth intake horn which would pass screened flow into the existing penstock intake, while fish would pass through the dam via one of several small ports then into a small flume leading to the river below. Flume design alternatives included a larger, much longer low velocity flume (<10 fps) and a short steep very smooth high velocity flume (<30 fps).

Alt. 2 Upstream floating MIS high velocity screen passing flow into the existing hydropower wetwell intake structure. Fish pass into small diameter bypass conduit and through a submerged, adjustable slope enclosed flume, then through the dam structure and downstream to the river in a short, steep, smooth, high velocity flume.

Alt. 3 Upstream floating "mini" MIS high velocity screen passing flow into the low level outlet. Fish pass into small diameter bypass conduit and through a submerged, adjustable slope enclosed flume, then through the dam structure and downstream to the river in a short, steep, smooth, high velocity flume. This alternative was only a conceptual idea that was analyzed to find a low cost MIS alternative.

Alt. 4 Modification of the existing low flow (fish bypass) outlets through the dam. Existing outlets pass fish under pressure at high velocity through a series of 90 degree or near 90 degree bends to a submerged jet release outlet into the tailwater pool. Proposed modifications include passing the conduits horizontally entirely through the dam and connecting them each, with a short section of pipe, directly to a large stilling well chamber constructed on the downstream face of the dam. The chamber would be dewatered through a floor screen and gated outlet, while the fish would pass over a weir and into an adjustable slope flume connected to a fixed steep slope flume leading to the river.

Alternatives for the downstream components for the fish bypass system were designed to pass fish from the Eicher screen to the river without having adverse impacts related by sudden depressurization or high discharge velocity. Two alternative types were considered.

Alt 1 This alternative consists of a telescoping depressurization tower and articulated flume. The pressure bypass, atmospheric pressure relief manifold, downstream bypass, and discharge outlet were designed to meet the determined biological criteria established in meeting with resource agencies. Simply put, this system would adjust itself according to the reservoir elevation in order to ensure a constant bypass flow coming off of the Eicher screen. Modification to this alternative looked mainly at changes in feature location and alignment, with each component included. Discussion of the component alternatives can be found in the hydraulic appendix.

Alt 2 This alternative abandons the idea of the telescoping depressurization tower and articulated flume for a more simple piping system with multiple discharge outlets. The bypass flow would be directed across the forest service bridge to the left bank where it would proceed through one pipe to a series of fixed outlets. Depending upon reservoir elevation, a particular valve would be opened to discharge the bypass flow into the gravity flume. Fish would be discharged into a outmigrant stress relief pond. A large portion of flow would be drained off. The smolts would then proceed through a volitional release to the river.

3. Supplementation Pond and Fish Trap Modification Alternatives.

(**a.) Supplementation Ponds.** Two alternatives were initially proposed. WDF Alternative 1 provided for a concrete raceway, facilities and equipment for the production of coho smolts on the Wynoochee River for release into the river. Alternative 2 provided for similar supplemental facilities and equipment for the production of coho at an existing WDF facility. The coho would then be transported and planted into the Wynoochee River. Later, alternative one was modified by eliminating the construction of on-site facilities and adding a second supplementation pond to produce steelhead. The resource agencies agreed to continue design of alternative 1 with a few additional changes. The concrete raceways were dropped early in the project in favor of naturally lined ponds due to public comments. However, due to design, operation and maintenance concerns WDFW is in favor of traditional concrete ponds.

An early location alternative for the supplementation ponds proposed placing the ponds below the barrier dam at river mile 49.6. Designs show a single supplementation pond utilizing an existing 12” water line from the fish trap for its water supply (Washington and Noble 1987). This alternative was dropped in favor of the current pond location across from the Tacoma powerhouse slightly downstream from the dam.

The no action alternative would prevent construction of the ponds. The “no action” alternative was rejected due to agency support for the ponds and proven need of this feature.

(b.) Trap Modifications. The trap modification alternative has remained unchanged throughout the project history. The objective has always been to allow easier sorting of fish at the current trap location. The no action alternative would perpetuate the need to shut the facility down during times of mixed hatchery and native steelhead presence. This practice currently limits the flexibility and quality of fish rearing and spawning distribution of native fish. Sorting has been done without modification to the fish trap but is labor intensive and inefficient. Both the no action and manual labor alternatives were dropped in favor of the trap modifications due to the need to supply fish for the supplementation ponds in an efficient manner and increase the flexibility for native and hatchery spawning operations.

4. Flow and Spring Refill Curve Modification Alternatives. The proposed alternative spring refill curve was determined by establishing the necessary flood storage pocket in March and April to provide a 200-year level of protection, which is consistent with the winter level of protection. Using these constraints, only one alternative to the existing refill curve is presented.

The existing condition and four new alternative minimum flow targets were analyzed. Under the existing condition a minimum flow of 190 cfs is always observed at the Grisdale gage, a minimum flow of 120 cfs is always observed at the Black Creek gage, and 140 cfs is diverted above the Black creek gage by Aberdeen. Under each of the alternatives investigated the above targets were always maintained while an additional target flow at the Save Creek gage of 330 or 345 cfs was observed while the reservoir level was at or above elevation 763 or 770 feet. The combination of the two alternative target flows with the two switching levels provides four alternatives as shown in the table below. Analysis was performed in conjunction with the sponsor to determine if the proposed flow alternatives would yield a monetary cost due to power loss. The goal of this analysis was to find a scenario where minimum dam discharges could be increased while maintaining the smallest loss in power generation. The following chart shows the various alternatives for increasing minimum dam discharge.

Table 3-11. Costs to Power Production. Values are given in Average Annual dollars

Scenario	Loss in Power Production
Base Case, Existing Condition	0
Save Creek=330, Switch at 763	$20,000
Save Creek=330, Switch at 770	$10,000
Save Creek=345, Switch at 763	$30,000
Save Creek=345, Switch at 770	$20,000

Full details about these alternatives are in the Hydrologic Appendix.

4. DESCRIPTION OF ENVIRONMENTAL RESOURCES

A. General. The Wynoochee River originates on the southern slopes of the Olympic Mountains within the Olympic National Forest. At R.M. 62, it plunges over Wynoochee Falls and meanders approximately five miles before entering the full-pool area of the Wynoochee Lake Project at R.M. 56.2. Downstream of the dam, located at R.M. 51.8, the river flows through alternating gorges and open, brushy bottomland and at R.M. 27 opens into a 1/2-mile-wide valley. The lower mile of the river crosses the Chehalis River flood plain and is under tidal influence. The confluence of the Wynoochee River with the Chehalis River is approximately 13 miles upstream of the mouth of the Chehalis River which flows into Grays Harbor on the Pacific Coast of Washington.

Environmental resources of the Wynoochee River include Socio-Economic Resources, Recreational Resources, Natural Resources, Threatened and Endangered Species, Cultural Resources, and Hazardous and Toxic Wastes. The report focuses primarily on natural resources and specifically aquatic resources. Aquatic resources receive much of the report focus because they are targeted as the primary beneficiaries of the proposed project. Other resource benefits or impacts will be described as they occur.

B. Natural Resources.

1. Water Quality. The surface water quality of the Wynoochee River from the mouth of the Wynoochee River to R.M. 45.9 is classified as Class A (excellent). R.M. 45.9 to the headwaters is classified as Class AA (extraordinary) by the State of Washington. The uppermost portion of the basin is wholly enclosed by the Olympic National Forest and silviculture is the only activity of man significantly affecting the quality of water in the upper basin. This activity is reflected chiefly in temporary increases in suspended sediment and turbidity during logging or road building periods.

Normally, the thermal stratification period for the reservoir extends from April through October and from November to March the reservoir exhibits uniform temperature characteristics at all depths (isothermal). Outflows from the reservoir are currently reoxygenated by the discharge outlet.

2. Streamflow. Peak flood flows usually occur during the rainy season, October through March. Mean annual flow into the project is 535 cfs; with the maximum average monthly flow of 1023 cfs for December and the minimum average monthly flow of 138 cfs for August.

3. Air/Noise Quality. There are no sources of air pollution in the area. There are some seasonal increase in noise levels due to recreational activities around the lake.

4. Terrestrial Resources.

(**a.) Vegetation**. The Wynoochee Project area lies within the western hemlock (Tsuga heterophylla) vegetation zone as defined by Franklin and Dyrness (1973). The vegetation reflects the 100+ inches of annual precipitation that the area receives, including mixed stands of western red cedar (Thuja plicata), western hemlock (Tsuga heterophylla) (climax species) and Douglas fir (Pseudotsuga menziesii), interspersed with large stands of bigleaf maple (Acer macrophyllum). Older stands are more open and are characterized by mosses and lichens draping over the trees' branches. The subcanopy is usually dominated by vine maple (Acer circinatum). The shrub layer is most often composed of vine maple, cascara (Rhamnus purshiana), and snowberry (Symphoricarpos albus), but may also contain gooseberry (Ribes spp.), salmonberry (Rubus spectabilis), red elderberry (Sambucus racemosa), and huckleberries (Vaccinium spp.). The herb layer, which is relatively diverse, especially in more open areas, is dominated by sword fern (Polystichum munitum) and wood sorrel (Oxalis oregana). Vegetation along low-lying sections of the river's edge, both upstream and downstream of the reservoir, consists primarily of riparian species, such as red alder (Alnus rubra) and black cottonwood (Populus trichocarpa). Clearing of land associated with construction of the Wynoochee Lake Project and ongoing logging in the vicinity have resulted in opening up the canopy in some areas within the project area and has permitted increased sunlight penetration to the forest floor. As a result, understory vegetation in these areas and along the reservoir shoreline has increased. This early seral stage is diverse in plant life supportive to wildlife.

With the creation of Wynoochee Lake, several terraces have been cleared in the reservoir pool and are exposed when the pool is drawn down for flood control purposes. These areas remain exposed during the winter and early spring months, and provide browse for the area's resident elk. The Forest Service began a shoreline rehabilitation/forage planting program in September 1983. Plantings have enhanced certain areas of the terraces and include sedges (Carex spp.), willow (Salix spp.), red-osier dogwood (Cornus stolonifera), spirea (Spiraea douglasii), and tufted hairgrass (Deschampsia caespitosa). Sedimentation problems and the period of time plants are inundated have limited the success of plantings below the 780 foot level.

(b.) Wildlife. Black bear (Ursus americanus), cougar (Felis concolor), bobcat (Lynx rufus), and coyote (Canis latrans) use the Wynoochee Drainage Basin. At present, both resident and migratory Roosevelt elk (Cervus elaphus) and Columbia black-tailed deer (Odocoileus hemionus) are present in the project area. The project area provides year-round food supplies and protective cover and water. Lands bordering the river are important elk calving and wintering areas because of their relatively low elevation and moderate micro-climate. As part of the Wynoochee Lake Project, approximately 230 acres of range land are maintained as mitigation for elk and deer habitat lost by formation of Wynoochee Lake. Some of the farmed area has been lost to erosion after project construction (approximately 8 to 10 acres eroded from area II but aggradation has occurred on the opposite bank within the area boundary), but additional lands have been made available to farming in area I. Fur-bearing animals native to the Wynoochee basin include muskrat (Ondatra zibethicus), beaver (Castor canadensis), mink (Mustela vison), marten (Martes americana), fisher (M. pennanti), snowshoe hare (Lepus americanus), and river otter (Lutra canadensis). The Wynoochee River Basin also supports populations of game birds

including: ruffed (Bonasa umbellus) and blue grouse (Dendragapus obscurus), band-tailed pigeon (Columbia fasciata), and small numbers of mourning doves (Zenaida macroura). Small numbers of goldeneyes (Bucephala clangula and B. islandica), bufflehead (B. ableola), mallard (Anas platyrhynchos), wood duck (Aix sponsa), hooded merganser (Lophodytes cucullatus), harlequin duck (Histrionicus histrionicus), common loon (Gavia immer), and great blue heron (Ardea herodias) utilize the reservoir area. All but the loon might nest in the project vicinity.

5. Aquatic Resources. Anadromous fish known to spawn in the Wynoochee basin are coho salmon (Oncorhynchus kisutch), chum salmon (O. keta), spring and fall chinook salmon (O. tshawytscha), winter and summer steelhead (O. mykiss), sea-run cutthroat (O. clarki), and dolly varden (Salvelinus malma). Resident fish include coastal cutthroat trout, rainbow trout, whitefish (Prosopium spp.), dolly varden and/or bull trout (S. confluentus). Suckers (Catastomus spp.), sculpins (Cottus spp.), squawfish (Ptychocheilus oregonensis) and other non-game species are also present.

Spawning distribution of the principle game species differs greatly throughout the Wynoochee Basin. Coho salmon spawn in tributary streams and headwater areas including Anderson and Big Creeks upstream from the Wynoochee Project (Deschamps 1958). It is believed that 25% - 30% of the basin coho population spawns above the dam (Trap Escapement Records, Table 4-1). Chum salmon spawn primarily in the lower 40 miles of the river but above the limits of tidal influence. Winter-steelhead and sea run cutthroat trout spawn in the main river and tributaries from tidewater to Wynoochee Falls 62 river miles (R.M.) from the mouth (USCOE 1993). Hatchery winter steelhead are taken to the Aberdeen hatchery for broodstock and not released above the reservoir. Approximately 75% of the fall chinook salmon spawn in the lower 40 miles of the river, with the remainder spawning in the lower reaches of Carter and Shafer Creeks (Deschamps 1958). At one time, spring chinook spawned in the main river both above and below the reservoir. The relative abundance of spring chinook in the Wynoochee River is currently unknown. The last recorded observations of springlike chinook were in 1955 and 1959 (SASSI 1994). It is estimated that historically 10% - 15 % of the total chinook run spawned above the dam. The Washington State Department of Fisheries had planted kokanee salmon in the reservoir in years past. The department also planted rainbow and cutthroat trout. Summer steelhead have been introduced to the Wynoochee River but are not transplanted above the reservoir.

Annual returns to the Wynoochee Basin include 5,000 coho, 2,500 chum, 50 spring chinook, 2,000 fall chinook, 4,300 steelhead, and 3,300 sea-run cutthroat (USCOE 1978). Actual escapements vary depending on annual variation. The Salmon and Steelhead Stock Inventory (SASSI) (WDFW 1994) shows Wynoochee fall chinook returns averaging 3,763 from 1985 through 1991 and winter steelhead returns averaging 2,184 for similar years (1985 - 1992). A run size of 250 spring chinook was estimated from spawning habitat work done in 1966. U.S. Army Corps of Engineers trap summaries show an average annual collection of 51 fall chinook, 1,030 coho, 402 steelhead, and 2 cutthroat for years 1985 through 1992 (**Table 4-1**).

Fish production in the reservoir is generally thought to be low due to the annual winter draw down between 23.9 and 37.4 feet which dewaters the summer littoral zone (cities of Aberdeen

and Tacoma 1985). Wynoochee reservoir does provide rearing and migration habitat for juvenile coho salmon. Steelhead trout use the reservoir primarily for migration. Tributaries emptying into the reservoir may provide some rearing habitat for salmon, and resident trout (USFWS 1991).

Table 4-1. Summary of Wynoochee Basin salmon and steelhead escapements for 1985 - 1995: 1) total escapement (from SASSI and WDFW); 2) escapement above Wynoochee Dam; and 3) dam escapement as percent of basin total escapement.

FALL CHINOOK

Escapement	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**Average**
Total Basin	2020	2301	1681	7601	6002	4151	2582	N/A	2038	1359	1378	3763
Above Dam	9	13	21	28	86	147	52	N/A	61	94	104	51
% of Total	0%	1%	1%	0%	1%	4%	2%	N/A	3%	7%	7%	2%

COHO

Escapement	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**Average**
Total Basin	5979	2303	3924	2960	4241	2920	4769	4261	2573	872	4087	3920
Above Dam	2676	272	1294	1033	490	434	976	1066	707	236	716	1030
% of Total	45%	12%	33%	35%	12%	15%	20%	25%	27%	27%	17%	24%

STEELHEAD

Escapement	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**Average**
Total Basin	2168	3190	2878	988	1384	2406	2572	1882	1151	2153	2427	2184
Above Dam	682	680	338	310	253	219	392	341	405	291	155	402
% of Total	31%	21%	12%	31%	18%	9%	15%	18%	35%	13%	6%	19%

SEARUN CUTT.

Escapement	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**Average**
Above Dam	3	1	1	3	2	0	5	N/A	N/A	N/A	N/A	2

Conditions on the Wynoochee River have been impacted from the construction of Wynoochee Dam. The reservoir inundates 5.4 miles of previously usable spawning habitat by coho, steelhead, cutthroat and chinook. Estimates of habitat indicate a production loss of 1500 steelhead, 1400 coho, and 500 cutthroat (Washington et. al. 1987). No appreciable loss is indicated for chum or fall chinook salmon. Spring chinook may have lost over 50% of traditional spawning habitat due to the construction of Wynoochee Dam; however, the populations involved were reported to be of such small magnitude that predicted effects would be negligible (Deschamps 1966).

The reservoir is now used primarily for migration and rearing for coho, steelhead, and cutthroat. Studies done by C.A. Dunn (WDF) from 1973 - 1975 on impacts associated with the project show that impacts from reservoir passage are minor. In fact, delay may be beneficial for coho as coded wire tag results indicated an increased survival for fish reared in the reservoir. However, reservoir test fish were found to be smaller than their control counterparts. Delay through the reservoir was between 7 and 27 days for coho and 6 to 18 days for steelhead. The study attributes delay to outflow volumes. Residualization was also noted during the 1970's studies. Large numbers of 2+ and 3+ coho and steelhead were found during trapping studies which indicate a significant residualization rate. Estimates vary based on hydraulic and water conditions but range from 26% - 63% for coho and 9.9% - 91% for steelhead (Dunn 1975). The residualization is thought to be caused by poor configuration of the downstream passage system at the dam. Smolts were found to mill around inside the tower possibly from low velocities inside the wetwell (Nealson and Scott 1995).

Other survival studies done at Wynoochee Dam indicate that internal project plumbing might be the source of the mortality to salmon smolts rather than the reservoir (Dunn 1978). Studies by WDF (Dunn 1978; Hiss et. al. 1983) and University of Washington (Mathews 1980) indicate that there is approximately a 14 percent loss of coho smolts and a 24-percent loss of steelhead and cutthroat smolts as a result of passage through the dam (USCOE 1993). Latent mortality was not assessed. Overall adult survival has been estimated between .3 and 3 percent (Deschamps 1966; Washington et. al. 1987; Royce 1985).

An overall decline of anadromous stocks has been noted since the construction of the dam (Hiss et. al. 1983). The reasons for the decline could be due to a number of factors outside the dam and reservoir including habitat degradation and modification as well as increased fishing pressures. Nehlsen et. al. (1991) found the Wynoochee spring chinook stock to be at a "high risk of extinction" from cumulative affects of habitat modification. Anadromous cutthroat trout are listed in the same report as a "species of special concern" for the Grays Harbor system. Nehlsen et. al. (1991) attributes the cutthroat decline to habitat modification, over utilization, and other natural or manmade factors. Specifics were not identified for either spring chinook or cutthroat.

Outmigration of smolts leaving Wynoochee River occurs each spring. At the reservoir, native steelhead outmigration peaks between April 29 - May 3 while native coho peak one week later between May 6 and May 10 (Dunn 1975). Dunn (1975) also found that juvenile outmigration was complete by June 21 - 27 with most fish outmigrating at night. Adult migration takes place over several time periods. Spring chinook adults begin migration between March 15 and June 1 followed by fall chinook adults who migrate between August 1 and November 30 (Deschamps 1958). Coho adults return from September 1 to March 15; chum salmon return between October 1 and December 15 (Deschamps 1966); and trap summaries show winter steelhead return to the fish trap between March 1 and June 1 while summer steelhead return between July 1 and September 15.

At the time of dam construction (1972), mitigation requirements included provisions for downstream migrants, adult upstream blockage and spawning impacts from reservoir inundation. To provide for downstream migrant mitigation, an experimental downstream passage facility

(multi-level outlet) was included in Wynoochee Dam. Several studies indicate smolt mortality is a result of passage through the dam (Dunn 1978; Hiss et. al. 1983; Mathews 1980). Upstream blockage by the dam of anadromous fish runs were mitigated through the creation of an adult fish collection facility located at R.M. 49.5, approximately 2 miles (2.2) below the dam. The fish are trucked upstream and released to spawn naturally in the river above Wynoochee Reservoir. Upstream migration is naturally blocked at R.M. 62 by Wynoochee Falls. Added mitigation money was given to the State of Washington for inundated spawning habitat. The Flood Control Act of 1962 (Public Law 87-876), as amended by Public Law 93-251, authorized the Corps to transfer to the state "an amount not to exceed $696,000 for construction of fish hatchery facilities for prevention of loss of natural spawning areas for anadromous trout occasioned by the project construction." The actual amount transferred was $680,00 which has since accrued to over 1 million dollars. These funds were partially spent to expand the WDFW Aberdeen Hatchery, starting in 1989 and completed in 1990. Since there was no appreciable spawning of salmon within the inundated area of the reservoir, there was no mitigation for salmon.

The operation of Wynoochee Dam provides higher summer flows in the river downstream of the dam site than those under natural pre-project conditions. The project is operated to provide at least the minimum instream flows for the fishery resource. According to the USACOE Water Control Manual, project operation currently provides a minimum of 120 cfs below the Aberdeen diversion year round. The minimum discharge from the project is 190 cfs between July 1 and May 1 and 140 cfs from May 1 to July 1 (Deschamps 1966).

C. Threatened and Endangered Species. Bald eagles (Haliaeetus leucocephalus) are listed as threatened and have been sighted in the project area during nine months of the year; most sightings have been during the winter. Bald eagles may feed on spawned-out fish carcasses, particularly those in the reach of the river available to anadromous fish. Nesting has occurred in the area. Only one night roost is known to occur in the general vicinity. It is located on the Skokomish Indian Reservation about 20 miles east of the area. Spotted owls (Strix occidentalis) have been listed as threatened and may occur in the area. The project area is within the normal range of the marbled murrelet (Brachyramphus marmoratus marmoratus) which has been listed as a threatened species by the federal government. The marbled murrelet has undergone severe population decline purportedly from loss of late successional nesting habitat. No marbled murrelet surveys have been conducted in the immediate vicinity however, they have been documented within the basin and may on occasion travel past the project area.

Bull trout (Salvelinus confluentus), may be present in the project area but have not been documented (Goetz 1994). The U.S. Fish and Wildlife Service has not listed bull trout but has indicated that listing is warranted. All the anadromous salmonid stocks (coho, spring and fall chinook, steelhead) are undergoing coast-wide status review for potential listing. In a recent announcement by NMFS, Olympic Peninsula winter steelhead were identified as a separate evolutionary significant unit (ESU). NMFS concluded that this ESU does not warrant listing. The American Fisheries Society has identified spring chinook and sea-run cutthroat as stocks "at risk" (Nehlsen et al. 1991).

D. Cultural Resources. Reconnaissance of the project area took place in 1966 at the start of project construction, finding no prehistoric or historic cultural resource sites. Although part of the dam site area was cleared and accessible, the reconnaissance took place while extremely dense vegetation cover almost completely obscured the ground surface in the reservoir area, preventing discovery of sites that might have been present. Chehalis Indian sources reported use of the project area for fishing and hunting, suggesting that cultural resources may be present in the area. Since the 1966 reconnaissance, cultural resource investigations in headwaters on the Olympic Peninsula have found cultural resource sites that suggest prehistoric people used headwater areas with medium intensity in different time periods. A second field inventory of the reservoir was conducted in October 1990 to reassess what cultural resources might be in the area. The field survey did not identify any significant cultural resources. Coordination with the State Historic Preservation Office (SHPO), for the supplementation pond only, will be completed during preparation of plans and specifications.

E. Socio-Economic Resources. Significant socio-economic features of the area include its timber production potential and the regulation of the river by the Wynoochee Dam for a variety of human uses, including recreation, flood control, irrigation, and industrial water supply. No use of the river is made for domestic water supply except as standby in case of an emergency. Both raw timber and water supply are provided by the plan area (Wynoochee River watershed) for the Aberdeen-Hoquiam industrial area which is dominated by the forest products industry. Salmon which migrate through the project area, contribute to the commercial and sport fisheries in the Pacific Ocean, the commercial gillnet fishery in Grays Harbor, and the Indian and sport fisheries in the Chehalis and Wynoochee Rivers. The steelhead and sea-run cutthroat trout contribute to the tribal and sport fisheries in the Chehalis and Wynoochee Rivers and resident fish contribute to the sport fishery in the Wynoochee Valley.

Downstream of the dam, the floodplain of the Wynoochee Valley consists of some of the most productive bottomlands in Grays Harbor County. Wynoochee Dam can provide up to 35 c.f.s during the months of July, August and September for future irrigation needs. The dam also provides an opportunity for hydropower development. The cities of Tacoma and Aberdeen operate the project as joint licensees under FERC License for Project No. 6842.

F. Aesthetics/Recreational Resources. Within the project area, provisions for recreation activities such as dam visitation, camping, picnicking, boating, swimming, and trails have been made. The aesthetic setting of the area consists of evidence of man's impact on the landscape, including Wynoochee Dam and support facilities, a campground and trail system, paved roads, and logging, combined with the natural undeveloped character of the rain forest, steep canyon gorges, and the Wynoochee River. The Wynoochee River has been considered previously for Wild and Scenic River Status but was not recommended for designation as such. Recreation use in the Olympic Forest includes camping, resort lodging, hunting, picnicking, hiking, fishing and gathering forest products. The Olympic Forest received 1,469,600 Recreation Visitor Days in 1986. Viewing scenery, fishing, swimming and other activities of interest to this project make up approximately 10% of all forest activity.

The Olympic National Forest Plan allocation for the Wynoochee project area is designated as A-2 or Scenic. The standards and guidelines state that the construction, reconstruction and maintenance shall be designed to meet the Visual Quality Objectives. The Visual Quality Objectives surrounding the project site call for Partial Retention which manages specific landscapes in such a manner that their scenic values are protected, maintained or enhanced as viewed from major travel routes, use areas or water bodies. The area is listed as one of two sensitivity level 2 viewsheds managed to retain and create desired natural characteristics. The existing visual condition of the Wynoochee viewshed is considered moderately altered where the landscape is modified less than 20 percent (USFS 1990).

Recreational impact to the Wynoochee area as a result of this project should be very small if any. The pool will remain higher and more stable earlier allowing for better boating and fishing opportunity.

G. <u>Hazardous and Toxic Wastes.</u> A preliminary study (PAS) was conducted February 1992 by Corps of Engineers personnel, to identify any hazardous or toxic wastes sites at the project. A review of project records showed that three underground fuel storage tanks (UST's) were present on site. In addition, the records search showed that the project parking area was used for vehicle maintenance and steam cleaning of project vehicle engines. Runoff from the parking area was directed to the lake.

Petroleum hydrocarbon contamination was found in the soils around the UST's that were removed, and in the sediment downstream of the outfall from the parking lot storm drain system. A team returned to the site on March 5, 1992 to conduct further sampling in order to determine the extent of contamination, which proved to be limited to a relatively small area.

In the process of removing the existing boiler from the facility, asbestos was found in the piping. This material was removed without incident according to existing regulations.

5. ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

A. Natural Resources

1. Air/Noise Quality. There will be no long term effect on air and noise from the proposed action. Generally, short-term construction-related noise and air quality effects similar to those of any small construction project can be expected.

2. Effects on Terrestrial Resources. There will be minor displacement of wildlife due to construction of the pond facilities. Increased flows in the Wynoochee River should generally improve the riverine habitat and benefit a wide variety of birds, mammals and amphibians. Increased fish production, smolt and adult, will increase available food resources for invertebrate and vertebrate species while increased nutrient supplies from salmon carcasses will promote growth of riparian vegetation. Little vegetation will be lost due to construction of the supplementation ponds since of the site has been cleared previously. Vegetation loss elsewhere would be comprised mostly of cottonwood, alder, vine maple and other associates except in the case of the lower portion of the bypass pipeline.

Where the bypass pipeline enters the riparian area prior to discharge into the Wynoochee River, several localized stands of Douglas Fir other coniferous trees exist. During construction, some of those trees might be removed to allow for installation of the pipeline. This tree removal will be reduced as much as practicable during construction. Snags are also present near the proposed pipeline route. To the extent that these snags overhang or present a safety hazard to workers below, they will also be removed. Based on site evaluations, it appears that only a few (3) are likely to need removal leaving several snags to remain in the immediate area. Detailed coordination of snag removal will be coordinated at the time of construction.

3. Aesthetics/Recreation. Construction of the fish bypass structure will have minor impacts to the aesthetic qualities of the Wynoochee Dam and surrounding lands. Construction of the Eicher screen will have short term impacts to an existing recreational site and access to the Visitors Vista area. Current footpaths to the viewing area will be altered. To mitigate for these impacts, interpretive signage, special paint colors, and low impact bypass footprints will be considered. Where possible, trees and native vegetation could remain unaltered to obscure fish bypass features. The Recreational Plan for the project can be revised to consider the proposed changes to the site. The USFS will be involved in determining aesthetic mitigation for structural additions.

The project modification impacts that reflect mitigation measures are not likely to significantly affect recreation and aesthetics of the area. Some effect on fishing may occur due to changes in refill timing as the earlier refill provides a stable higher pool for fishermen in the spring. The project overall should provide additional angling opportunity as a result of increased productivity from the Wynoochee system. Hunting, canoeing, and hiking will not be affected.

4. Effects on Aquatic and Riparian Resources. All aquatic resources, invertebrate and vertebrate species, instream habitat, and plant communities will ultimately

benefit from this restoration project. Impacts related to propagation of artificial species will be limited through the exclusive use of native species for the supplementation pond operation. The more natural springtime flows will promote development of native instream communities, increased year-round flows will provide more available instream habitat throughout the basin, and improved fish passage will conserve and restore native fish communities above Wynoochee Dam. Flow fluctuations between Save Creek and the dam to maintain minimum flows at Save Creek could cause minor stranding of juvenile fish in the broad floodplain reaches. The supplementation ponds will provide immediate benefits in replacing lost production from inundation of river and tributary habitat by Wynoochee Dam and Reservoir. Minor impacts from flow reductions are expected during March refill and September draw down of the reservoir. Potential impacts from interactions among supplemental coho and steelhead and naturally produced stocks are expected to be minor and will be minimized through trap modification, development of genetic broodstock collection protocols, natural rearing conditions in the ponds, and volitional release.

5. Effects on Wetlands. Increased flows may create new or enhance existing wetlands. Construction of the ponds as now conceived would not require destruction of wetlands. Results of Clean Water Act 404 analyses will be documented during preparation of plans and specifications. Negative impacts to wetlands from the construction of the supplementation ponds is expected to be negligible. The ponds will be constructed in an area already disturbed and will not impact wetlands.

B. Effects on Endangered Species. Improvements in available food base are expected to occur for bald eagles if adult returns from the project are realized. All aquatic candidate species are expected to see overall improvements either in actual natural production or in available aquatic habitat (see Benefits Section 3.E., and Tables 9 and 10 for details). Negligible impacts may be associated with limited flow reduction during March 1 to March 24 and during September in some years, however, overall flows are expected to be higher for a longer period of time. In addition, the supplementation pond production of coho and steelhead could result in undesirable or unexpected impacts from interactions between naturally produced stocks and volitional release smolts. These impacts are expected to be minor and will be minimized to the greatest extent possible by trap modification, development of genetic broodstock collection protocols, protected rearing conditions in the ponds, and volitional release. Sensitive nesting areas (late successional coniferous forest) for marbled murrelet and spotted owl will not be notably altered as a result of this project.

Potential impacts to marbled murrelets, spotted owls and bald eagles from noise disturbance will be minimized through implementation of appropriate management practices. Construction timing will be coordinated to reduce impact by avoiding high noise activities (primarily excavation) as much as practicable during critical activity hours (dawn and dusk) or nesting periods. However, construction could begin as early as March 1999 for penstock work and continue through September 1999 for the fish bypass flume and outlet. Supplementation ponds and trap modifications will also be constructed during this time. Construction noise will be limited to truck operations and limited heavy equipment operation for excavation and grading.

Based on detailed discussions with the USFWS and the descriptions outlined within this report, we find that this project will have *no effect* on terrestrial or aquatic endangered species listed on the species list as a result of implementing the proposed action. As a result, this environmental assessment will also function as a biological assessment.

C. Effects on Cultural Resources. The project is not expected to have impacts on cultural values.

D. Effects on Socio-Economic Resources. The proposed modification would benefit ecosystem functions, fisheries, and hydropower with no impact on other purposes - flood control, recreation, or irrigation, with enhancements to power generation and the fisheries. The power project would be a beneficiary if an Eicher screen were installed in that the city of Tacoma would be able to operate their powerhouse during the 77 day downstream migration period. The existing FERC license directs that the powerhouse will be shut down during this period and the existing outlet structure used to pass downstream migrants. The proposed project modification will not affect the aesthetic quality of the Wynoochee River and surrounding areas. Any beneficial impacts to anadromous fish would translate to improvement to sport, commercial and tribal fisheries to the extent their fisheries rely on Wynoochee River fish. Increased riverine flows during the spring refill period could improve conditions for recreational boating and whitewater rafting.

E. Cumulative Impacts. The purpose of the proposed project is restoration of fish habitat and improvement to fish passage in the Wynoochee River. To the extent the project is successful it will contribute cumulatively to the widespread goal of conserving and restoring resident and anadromous fish stocks in the Pacific Northwest (see Benefits Section 3.E., and Tables 9 and 10 for details).

Whereas there will be cut and fill associated with this project, large volumes of haul are not expected. The access road will see additional traffic during the construction especially during mob and demob. The Wynoochee Dam road already sees much recreational and commercial traffic. So cumulative increments from the project will be minor. As a part of construction, road damage related to this project will be minimized and repaired.

F. Hazardous and Toxic Materials. There will be no Section 1135 project-related hazardous and toxic materials impacts.

6. FEDERAL, STATE, AND LOCAL AGENCY COORDINATION

Coordination with other agencies has been ongoing throughout the three years of this study. At the beginning of the study process a Technical Committee was formed that was comprised of representatives of the city of Tacoma and Aberdeen, representatives from the State Department of Fish and Wildlife (later the combined Washington Department of Fish and Wildlife) National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Forest Service, local Indian tribes, Corps of Engineers and Harza (consultant). This group included regionally recognized experts in the Pacific Northwest in the area of fish passage design.

Over the course of the study a variety of fish passage alternatives were evaluated based on the committee-established design criteria. The committee has evaluated the different flow proposals, supplementation pond designs, change in rule curve and modifications to the trap and haul facilities. The committee concurs in the plan presented.

In January 1995, a mid-study workshop was conducted with some of the local public interest groups, Trout Unlimited, Federation of Fly Fisherman and other groups and interested individuals and Indian tribes. Their input also was used in formulating the project presented in this report.

In November 1993 the District conducted a public scoping process pursuant to the goals of the National Environmental Policy Act (NEPA). An information package was provided to the study mailing list (about 200 recipients) with a request for comments. Seventeen agencies, groups and citizens responded. Most respondents were generally supportive of the proposal, but several also expressed concern or reservations about some aspects of it, including impacts of propagated artificial species on wild fish, exclusion of some species (spring chinook and cutthroat trout, for example) and potential effects on endangered species and aesthetics. Some questioned the efficiency of the Eicher screen. In subsequent planning and coordination the District has attempted to address these concerns as documented in this report.

The draft feasibility report and EA pursuant to NEPA were coordinated for a 30 day review during August and September 1996. Comments received and appropriate responses are included in Appendix B.

7. APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

The following table summarizes status of law and regulation compliance. The Olympia area office of the U.S. Fish and Wildlife Service has prepared a report (Appendix I) and recommendations pursuant to the Fish and Wildlife Coordination Act (FWCA). Consultation under Section 404 and 401 of the Clean Water Act and SHPO has been initiated. Further consultation is required during preparation of plans and specifications.

Table 7.1 Status of Project With Applicable Laws and Statutes

Federal Statutes	Full Compliance Date
Archaeological and Historic Preservation Act	1998
Clean Air Act of 1977, as amended	Aug 97
Section 404 - Clean Water Act of 1977, as amended	1998
Endangered Species Act of 1973, as amended	1 Oct 96
Federal Water Project Recreation Act, as amended	Aug 96
Fish and Wildlife Coordination Act, as amended	Jan 97
National Environmental Policy Act of 1969, as amended	1 Jan 97
Watershed Protection and Flood Prevention Act, as amended	Aug 96
Executive Orders (E.O.)	
Floodplain Management (E.O. 11988)	Aug 96
Protection of Wetlands (E.O. 11990)	1998
Protection and Enhancement of the Cultural Environment (E.O. 11593)	1998
State Statutes	
Hydraulic Project Approval	1998
Section 401 - Clean Water Act of 1977, as amended	1998

8. LOCAL SPONSOR REQUIREMENTS

A. <u>Project Cooperation Agreement.</u> Authority for the items of local cooperation and provisions of the Project Cooperation Agreement (PCA) is provided by Section 1135 of the Water Resources Development Act of 1986, as amended. This project would be constructed solely for the purpose of improving habitat in areas associated with an existing Corps project (Wynoochee Dam). On this basis, the Federal Government would bear 75 percent of the total habitat improvement cost at Wynoochee Dam. Included in these total project costs are feasibility study costs, as well as project construction, engineering and design, and plans and specifications. The Corps of Engineers, representing the Federal Government, would be responsible for design and construction of the proposed project. The Federal portion of the project cost is estimated to be $3,358,000

The local sponsor (Tacoma Public Utilities) would be responsible for 25 percent of the total project cost. This share is currently estimated to be $1,119,000. In addition, non-Federal interests would be required to maintain the project after construction.

Prior to construction, local interests would be required to enter into a written agreement that they would provide certain assurances of local cooperation. A copy of the draft PCA is contained in Appendix C. Generally, this Project Cooperation Agreement includes the following pertinent items of assurance:

A. Provide, during the period of construction, 25 percent of the total project cost paid in cash. The sponsor may provide part of all of its requirement in LERRD and may provide up to 80 percent of its share in work-in-kind.

B. Maintain and operate the project after completion without cost to the United States in a manner so that liability will not arise under the Comprehensive Environmental Response, Compensation and Liability Act.

C. Hold and save the United States free from damages caused by the construction and maintenance of the project, except damages due to the fault or negligence of the United States or its contractors.

D. Comply with Section 601 of Title VI of the Civil Rights Act of 1964 (Public Law 88-352) and Department of Defense Directive 5500.11 issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, in connection with the construction, operation, and maintenance of the project.

The local sponsor must provide all lands, easements, and right-of-way, including suitable borrow and dredged or excavated material disposal area, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the restoration project which are not otherwise available due to the construction and operation of the existing project.

The above is no more than a general summary of the non-Federal sponsor's responsibilities. If the project is implemented, a more complete description will be contained in the final PCA for the project, a draft of which is provided in this report in Appendix C.

B. <u>Operation and Maintenance.</u> Operation and maintenance will be the responsibility of the Tacoma Public Utilities. The Corps will provide TPU with a manual during construction that details the operation and maintenance responsibilities. TPU has indicated that they will enter into an agreement with the Washington Department of Fish and Wildlife to gain their assistance with operation and maintenance (see enclosed agreement correspondence in Appendix B). To pay for the operation and maintenance TPU has indicated that they will use the funds that remain in the WDFW fish fund, after capitol construction expenditures have been removed. Included in this section is a discussion of expected operation and maintenance responsibilities.

1. Eicher Screen Fish Bypass Facility. Initially, the Eicher screen will be operated during the 77-day shutdown period. Flows will range between 200 and 600 cfs, but may vary as conditions change or as passage efficiency dictates. TPU has indicated that hydropower revenue during the expected screen operating periods are minor, thus giving them a high degree of flexibility to manage the project discharges to enhance fish passage. The first three years of operation will serve to define the most productive operating parameters for the bypass facility. Project monitoring, described in Section 9 - Modification Evaluation, will help determine these most productive operating parameters. Correspondingly, if better flow scenarios and operation periods are determined, the Operation and Maintenance manual will be modified to reflect the changed condition.

(a.) Intake Wetwell and Gate Shaft. Operation of the wetwell will include adjusting the existing temperature control panels, new air shaft portal gate, and penstock gate to provide sufficient attraction flows as needed to ensure smolt passage. The wetwell prototype testing will continue during the 1998 migration to determine if the air shaft portal is required for fish passage. If needed, the portal will be modified to have permanent features added (mechanical hoist, operating system, etc.).

(b.) Penstock Eicher Screen. The Penstock Eicher screen operation includes the switching of the Eicher screen section and the removable penstock section at the start and end of the migration period. During the migration the Eicher screen will be operated to ensure appropriate flow and velocity across the screen. The screen is designed to rotate on an axle by means of hydraulic pistons. Control of the screen, for cleaning purposes, will consist of mechanisms; a timing device used to periodically backwash the screen, and transducers installed upstream and downstream of the screen to sense changes in pressure across the screen. Occasional complete shutdown may be required if large amounts of debris clogged the screen such that back flushing does not clear the blockage.

(c.) Pressure Bypass. The pressure bypass operation will monitored with a series of flow meters to watch for debris jams. If a jam occurs, the bypass will be cleared for one of the series of access portals along its length.

(d.) Multi-level Discharge. The multi-level discharge will monitored with a series of flow meters to watch for debris jams. If a jam occurs, the bypass will be cleared for one of the series of access portals along its length. The multi-level outlets port will be periodically opened or closed as needed for the corresponding reservoir elevation. These operations will typically occur during daylight hours when fish runs are at a minimum.

(e.) Gravity Flume. The gravity flume will monitored with a series of flow meters to watch for debris jams. If a jam occurs, the flume will be cleared by unbolting and opening the grate covering and removing the blockage. The flume will need periodic inspection during the migration period to ensure the lining is intact.

(f.) Discharge Outlet. The discharge outlet will need to be monitored for damage caused by periodic high flows from the dam. The outlet will require no operation, but will be monitored for injury to passing smolts. The outlet will be used in the modification evaluation as netting is periodically attached to the outlet to collect fish as required during the monitoring tests.

2. Supplementation Ponds and Fish Trap Modification

(a.) Supplementation Ponds. Maintenance of the supplementation ponds will be shared between Tacoma and the WDFW. The WDFW possesses the technical expertise in pond management and disease control while Tacoma has on-site staff qualified in building and grounds maintenance as well as pond operation. As such, the division of responsibility can be best drawn between physical and biological maintenance.

Physical maintenance will be the responsibility of Tacoma and will include cleaning and repair of the ponds and supporting structures. The Tacoma responsibility will also include daily monitoring of the ponds for emergencies and food supply. At the time of outmigration, Tacoma will also manage the downstream control structures for proper fish release.

Biological maintenance will be handled by the WDFW through use of technician labor from nearby Aberdeen hatchery or Bingham Creek hatchery. Biological maintenance will include recharging fish food supplies and periodic testing for disease. The WDFW will also perform the hauling of fish from the hatchery into the supplementation ponds.

(b.) Trap Modifications. Maintenance of the fish trap and its modifications under this project will consist primarily of preventative maintenance and repairs of the selection gate assembly, wild fish tank and associated drains. Leaf removal to maintain adequate flow through the trap will still be necessary. Tacoma will be responsible for collection of hatchery and wild fish at the trap. The WDFW will be responsible for hauling wild fish above the dam.

3. Flow and Spring Refill Curve Modification. There will be no significant changes to operation procedures at the dam to implement the flow and spring refill curve modification. Project discharges will be monitored using the Save Creek gage as a control point

rather than the traditional Grisdale gage. Spring refill procedures will be the same, though the schedule will be modified to reflect the proposed refill modification.

9. MODIFICATION EVALUATION

A. Modification Evaluation. From 1973 - 1975, the Washington Department of Fisheries (WDF) performed a series of studies to evaluate the downstream fish passage facilities incorporated into Wynoochee Dam (Dunn 1978). The results of those studies became the basis for the proposed Section 1135 modifications to the Wynoochee Dam fish passage facilities (Eicher screen and fish bypass) and spring refill rule curve change: survival rates for coho and steelhead smolts passing through the dam multi-level outlets were estimated to average 86% and 72%, and reservoir survival rates averaged 52% and 55% respectively. Without the results from this monitoring program, accurate requirements for project modifications to the dam fish passage facilities and refill period would not be available today.

In 1994, Tacoma Public Utilities (TPU) conducted pre-project hydroacoustic monitoring of smolt outmigration through the existing multi-level outlets and turbine intake; additional monitoring of the turbine wetwell also occurred during 1995 (Nealson and Scott 1995). Hydroacoustic monitoring was a requirement of a 10 FERC license monitoring program to determine the distribution and outmigration rates of salmon smolts from the reservoir. This monitoring provides important data used in the Section 1135 to improve the design of the intake tower wetwell estimates of the behavior and total number of fish passing through each potential dam outlet, turbine and multi-level. This monitoring will continue through the year 2003.

As project proponent of the Wynoochee Dam Section 1135, the Corps of the Engineers, in conjunction with all participating resource agencies, is responsible for developing a monitoring plan to evaluate the project's new fish passage facilities. The Water Resource Development Act of 1990 provides for up to five years of post project monitoring. In addition to the TPU hydroacoustic monitoring, the Corps is proposing a three year monitoring and evaluation plan to evaluate the effectiveness of the modified intake wetwell, Eicher screen, fish bypass system and spring refill rule curve modification. The plan parallels the 1973 - 1975 WDF tests which will provide better comparisons for pre and post project survival estimates. The monitoring plan is necessary to evaluate the Eicher screen fish bypass facility. Adjustments will be made to the operating procedures of the bypass to optimize fish passage through the dam.. Without post-construction monitoring as outlined below, the Wynoochee Section 1135 project cannot adequately implement the components of its fish passage facilities.

Objectives of this downstream fish passage monitoring and evaluation plan include: 1) estimating the reservoir survival rate of outmigrating smolts; 2) estimating the attraction rate of the modified wetwell and Eicher screen fish bypass; 3) testing the screen efficiency of the Eicher screen and fish bypass system; and 4) estimating the total project survival of downstream migrants passing through the reservoir and dam.

B. Evaluation Design And Methodology. The study methods for the Wynoochee 1135 evaluation consist of two test types designed to test efficiency of the reservoir and attraction of

the modified wetwell and to test the physical features of the bypass system. To test the attraction and reservoir survival we propose the tagging of coho and steelhead smolts with passive integrated transponder tags (PIT tags) and released at various distances from the wetwell. To test the physical features of the bypass system we propose the release of marked hatchery fish in various places along the passage system to record injury and mortality rates which will be related to survival.

1. Estimation of Reservoir Survival and Attraction of Fish Passage Facility.

To estimate reservoir survival and fish passage facility attraction rate, hatchery coho and steelhead smolts will be tagged, released and monitored as they move through the project. We propose release groups of 500 fish which should be adequate for this application in which the test fish must travel less than .5 miles. The study will be conducted for three consecutive years. Tagged fish would be supplied by the Aberdeen Hatchery from the Upper Wynoochee cohort reared for the supplementation ponds. Releases would occur both upstream of the fish bypass facility at the forebay and 0.5 miles upstream of the reservoir. Release groups will include simultaneous systematic releases of both coho and steelhead smolts and spread out to cover the outmigration period. The use of wild fish for this experiment could be included into the study plan by tagging wild coho and steelhead collected with a scoop trap located above the reservoir.

Tagged fish would be recorded by a two or three coil PIT tag recovery system located within the fish bypass downstream of the Eicher screen or near the outfall. Detection efficiency of the coil system can be calculated using marked objects but is expected between 80% and 95%. Reservoir survival can be estimated by subtracting the detection rate of above reservoir releases from forebay releases. Attraction rate of the fish passage facility will be calculated using the forebay release groups only. The time period cut off for each tagged fish within the reservoir will be 25 days. Study fish will have to be held onsite for at least 48 hours to assess delayed mortality.

2. Effectiveness of the Eicher Screen, and Other Fish Bypass Features.

Testing of the overall fish bypass facility effectiveness will be handled by a series of coho sub-yearlings or releases into the fish passage facility during the current 77 day outmigration period. Coho fry releases are planned in order to test the system with small fish at a more vulnerable life stage. Releases will number 100 fish per replicate with three replicates minimum. Condition of the fish would be measured against controls held on-site. The test will be conducted for two consecutive years. Fry will be released in such a manner as to test both the bypass system and the added effect of the Eicher screen. Tests should be conducted under minimum, median and maximum flow conditions (200, 400 and 600 cfs).

Possible marking methods include elastomer injection, fingerling tag or adipose clip. The fish would be supplied by the Aberdeen hatchery from the Upper Wynoochee coho broodstock collected for the supplementation ponds. The hatchery fish should already have their adipose fin clipped. Adipose clips may be a sufficient mark depending on the presence of non study hatchery fish with clipped fins. Using adipose clipped fish from the hatchery would reduce additional handling stress of a second marking. Two planned test release locations include: above the Eicher screen in the intake wetwell or at the entrance to the penstock and below the Eicher screen in the bypass flume. The two test groups are necessary to isolate the effects of the

wetwell and screen from those of the bypass system. Test releases should occur over a 4 week period beginning no later than the second week of May. Study fish should be held on-site for at least 48 hours to assess delayed mortality from tagging or transportation.

Test groups can be introduced directly into the intake wetwell by a hose attached to the planting truck and directly into the bypass flume by bucket. Recovery of marked fish would occur downstream near the bypass outfall. A collection facility consisting of a shunt gate, dewatering screen and holding tank could be attached to the bypass flume to allow collection of test fish. The shunt gate would divert flow from the flume into a dewatering screen in order to reduce water volume. The dewatering screen must reduce flow from 30 cfs to approximately 1 - 2 cfs to allow safe dumping of water and fish into the holding tank. The holding tank must be sized to handle flows off the dewatering screen. Recaptured fish would be assessed for screen efficiency and potential injury rate. Injuries would be rated using National Marine Fisheries Service protocols. Injuries will be compared to baseline observations of fish condition through control fish held onsite.

3. Estimated Outmigration Numbers and Fish Behavior in Wetwell. Since 1994, TPU has conducted pre-project hydroacoustic monitoring of smolt outmigration through the existing multilevel outlets and turbine intake; additional monitoring of the turbine wetwell also occurred during 1995 (Nealson and Scott 1995). Hydroacoustic monitoring distribution and outmigration rates of salmon smolts from the reservoir. If this type of monitoring could continue through the year 2003 it would provide important data to supplement the PIT tag and screen efficiency tests. This type of monitoring has provided estimates of the behavior and total number of fish passing through each potential dam outlet, turbine and multilevel. The Corps would recommend that TPU provide continued monitoring of the turbine wetwell with hydroacoustics.

4. Estimated Survival Rates through Project. Information on adult returns through the project may be provided through WDFW coded wire tag releases, therefore, allowing overall project survival estimations. Paired releases of tagged hatchery fish both above and below the project over a three year period and subsequent recovery by ocean and terminal fisheries should provide excellent data on long term survival of outmigrants through the project. This action would have to be conducted and managed primarily by the WDFW.

Table 9-1 - Injury Rate Study Schedule

Dates based on work in year 1999	**Feb. 8**	**Feb. 9**	**Feb. 10**
Project Flow (cfs)	200	400	600
Coho Test 1			
Bypass Release	7:00 am	7:00 am	7:00 am
Screen Release	9:00 am	9:00 am	9:00 am
Coho Test 2			
Bypass Release	11:00 am	11:00 am	11:00 am
Screen Release	1:00 pm	1:00 pm	1:00 pm
Coho Test 3			
Bypass Release	3:00 pm	3:00 pm	3:00 pm
Screen Release	5:00 pm	5:00 pm	5:00 pm
Last Collection	7:00 pm	7:00 pm	7:00 pm

Table 9-2 - Pit Tag Study Schedule

Dates based on work in year 1999	Tag Date	May 9-15	May 16-22	May 23-29	May 30- 5	June 6-12	June 13-19	June 20-26	June 27-30
Project Flow (cfs)		200	200	200	200	200	200	200	200
Coho tagging	4-23								
Outside Wetwell Group 1/1-1 coho		10----	------	------	-----4				
Mid-reservoir Group 2/1-1 coho		10----	------	------	-----4				
Data Collection		12	19	26	2	9			
Coho tagging	5-7								
Outside Wetwell Group 1/1-2 coho				24----	------	------	----18		
Mid-reservoir Group 2/1-2 coho				24----	------	------	----18		
Data Collection				26	2	9	16	23	
Steelhead tagging	4-30								
Outside Wetwell Group 1/ 2-1 stlhd			17----	------	------	----11			
Mid-reservoir Group 2/2-1 stlhd			17----	------	------	----11			
Data Collection			19	26	2	9	16		
Steelhead tagging	5-14								
Outside Wetwell Group 1/ 2-2 stlhd					31---	------	------	----25	
Mid-reservoir Group 2/2-2 stlhd					31---	------	------	----25	
Data Collection					2	9	16	23	30

Allow for 2 week healing period on all test groups. Final collection occurs around July 4.

10. SCHEDULE FOR ACCOMPLISHMENTS

Requirement	Scheduled Date
Letter of intent from local sponsor	October 1996
Submit final feasibility report to Headquarters, US Army Corps of Engineers	December 1997
Completion of plans and specifications including CWA and SHPO consultations	December 1998
Signing of project cooperation agreement	March 1999
Advertise for bids	March 1999
Receipt of local cost-share dollars	March 1999
Contract award	May 1999
Complete construction	September 2000

11. RECOMMENDATIONS

I have weighed the accomplishments to be obtained from the proposed wildlife habitat improvements at Wynoochee Dam against project costs and have considered the alternatives, impacts, and scope of the proposed project. In my judgment, the proposed project is a justified expenditure of Federal funds. I recommend that the Secretary of the Army approve the Wynoochee Dam Section 1135 Project. The total estimated implementation cost of the project is $4,477,000 of which $3,358,000 would be the Federal cost according to Section 1135(b)(2) of Public Law 99-662. The remaining $1,119,000 would be non-Federal funds provided by the Tacoma Public Utilities. I further recommend that funds be allocated in fiscal year 1998 to initiate preparation of plans and specifications.

Per CEMP-EV/CECW-E memorandum, subject: FY 96 Civil Works Program Value Engineering (VE) Program, dated 8 March 1996, all projects costing in excess of $2,000,000, a require a value engineering study be performed on the earliest document available that satisfies the functional requirement of the project and includes a comprehensive MCACES cost estimate. The district will perform a value engineering study during the design phase. This is the phase the VE study would be most effective to identify potential cost saving in the detailed design. This has be coordinated with the district Value Engineer. The estimated cost of the VE study is $30,000 and will be funded as a part of the P&S phase.

On the basis of the independent environmental analysis presented in this document, approval of this project would not constitute a major federal action significantly affecting the quality of the human environment. Therefore, a Finding of No Significant Impact (FONSI) is appropriate and an Environmental Impact Statement (EIS) pursuant to the NEPA is not required. The FONSI is included at Appendix J.

Steve Foster
Chief, Planning Branch

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