ESSENTIAL FISH HABITAT CONSULTATION FOR CERTAIN MASTER PLAN UPDATE IMPROVEMENTS AND RELATED ACTIONS

PACIFIC COAST SALMON
ESSENTIAL FISH HABITAT ASSESSMENT
MASTER PLAN UPDATE IMPROVEMENTS

SEATTLE-TACOMA INTERNATIONAL AIRPORT

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LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation/Acronym	Complete Word, Phrase, or Formal Name
ac	Acre
ADAF	Aircraft De-icing and Anti-Icing Fluids
ASDE	Airport Surface Detection Equipment
BA	Biological Assessment
B-IBI	Benthic Index of Biotic Integrity
BMPs	Best Management Practices
CWA	Clean Water Act
DO	Dissolved oxygen
Ecology	Washington State Department of Ecology
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FAA	Federal Aviation Administration
ft	Foot, feet
HSPF	Hydrological Simulation Program – Fortran
IWS	Industrial Wastewater System
LWD	Large Woody Debris
MSA	Magnuson-Stevens Act
MCDF	Miller Creek Detention Facility
mi	Mile/miles
mm	Millimeter/millimeters
MPU	Master Plan Update
MLLW	Mean Lower Low Water
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
OHWM	Ordinary High Water Mark
PFC	Passenger Facility Charges
PGIS	Pollution Generating Impervious Surface
Port	Port of Seattle
PSFMP	Pacific Salmon Fisheries Management Plan
RDF	Regional Detention Facility
RM	River Mile
SASA	South Aviation Support Area
SMP	Stormwater Management Plan
SR	State Route
STIA	Seattle-Tacoma International Airport

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

Abbreviation/Acronym	Complete Word, Phrase, or Formal Name
USACE	U.S. Army Corps of Engineers
USFWS	United States Fish and Wildlife Services
WDFW	Washington Department of Fish and Wildlife

EXECUTIVE SUMMARY

This salmon essential fish habitat (EFH) assessment has been prepared for consultation by the Federal Aviation Administration (FAA)[1] and the United States Army Corps of Engineers (USACE) with the National Marine Fisheries Service (NMFS) under Section 305(b) of the Magnuson-Stevens Act (MSA) pertaining to those elements of the Master Plan Update (MPU) improvements at the Seattle-Tacoma International Airport (STIA) over which the FAA and USACE retain discretionary involvement or control as of September 27, 2000. This evaluation is being undertaken in response to NMFS' recent approval of Amendment 14 (dated September 27, 2000) of the Pacific Salmon Fisheries Management Plan (PSFMP), which designated marine and freshwater EFH for Pacific coast salmon. This Pacific salmon EFH assessment analyzes potential affects of FAA and USACE actions (those actions authorized, funded, or carried by FAA and USACE on designated EFH for chinook, coho, and Puget Sound pink salmon). An EFH assessment for Coastal Pelagic Fishery species and West Coast groundfish (i.e., non-salmonid species) was included in the Biological Assessment (BA) for the Reinitiation and Initiation of Consultation for Certain Master Plan Update Improvements and Related Actions (FAA 2000), submitted to NMFS on June 15, 2000.

The FAA is now initiating EFH consultation with NMFS over certain actions for which it possesses discretionary involvement or control and which could affect EFH for those species addressed in Amendment 14 of the PSFMP. Through this EFH evaluation, the USACE also initiates EFH consultation with NMFS concerning its approval of a Clean Water Act (CWA) Section 404 permit application pertaining to the STIA MPU improvements. This EFH evaluation concludes that the proposed FAA and USACE actions would have "no effect" on chinook and pink salmon EFH. This EFH evaluation also concludes that the proposed FAA and USACE actions "may adversely effect" coho EFH in the short-term, but would have "no adverse effect" in the long-term, and would provide long-term conservation benefits for coho salmon.

PACIFIC FISHERIES SALMON SPECIES AND ESSENTIAL FISH HABITAT

Amendment 14 of the PSFMP identified EFH for stocks of three species of Pacific salmon (chinook, coho, and Puget Sound pink salmon). All three species have been identified as potentially present in some part of the project vicinity[2]. This assessment therefore addresses the potential for the proposed actions to affect EFH for chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and pink salmon (*O. gorbuscha*).

Potential effects of the proposed MPU improvements were evaluated in this EFH evaluation by first identifying the EFH for each species present in the identified action area. Two primary hydrologic systems are located in the action area—Miller Creek Basin and Des Moines Creek Basin. Additionally, the Auburn Wetland Mitigation site is located within the Green/Duwamish Watershed.

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[1] In accordance with applicable regulations, the FAA has assumed the role of lead federal agency for purposes of this consultation and has designated the Port of Seattle as its non-federal representative for the purposes of preparing this EFH assessment. See 50 C.F.R. § 600.920(b)-(c).

[2] Although pink salmon has been identified as uncommon (Tacoma Public Utilities 1999) in the Duwamish/Green River, this is likely the only part of the Action Area where EFH for this species could potentially be present.

PROPOSED ACTION

At this time, FAA is consulting pursuant to the Endangered Species Act (ESA) over actions taken since May 24, 1999 related to implementation of certain STIA MPU improvements, and approval of certain as yet unapproved passenger facility charges (PFC) for collection and use authorizations related to implementation of MPU improvements. FAA actions which were complete and over which FAA did not retain discretionary involvement or control relating to STIA MPU implementation are not part of the ESA consultation. Matters over which FAA had discretionary involvement or control as of May 24, 1999 were included in the ESA consultation because that is the effective date of the listing of Puget Sound chinook salmon. In the exercise of discretion, FAA has included analyses in this EFH Assessment potential impacts on salmon of the same action covered by the ESA consultation, i.e., actions relating to implementation of the STIA MPU since May 24, 1999. Included in the proposed action will also be the relocation of Miller Creek, the development of avian habitat at a mitigation site near the Green River in Auburn, and certain other actions for which a CWA Section 404 permit is required from USACE. The "action area" for this proposed action was determined to be the area of the airport project construction and vicinity where direct, indirect, or cumulative effects could reasonably be expected to occur (i.e., the aquatic habitat of Miller, Des Moines, and Walker creeks downstream of the airport and the associated nearshore estuary, and the Industrial Wastewater System (IWS) Puget Sound outfall).[3] The Auburn wetland mitigation site and vicinity, where indirect or cumulative effects could reasonably occur, are also included in the action area.

AQUATIC HABITAT IMPACTS AND MITIGATION

Aquatic habitat impacts resulting from MPU improvements include short-term changes in water quality (from turbidity and suspended sediment), water quantity (from diverting flows in two Miller Creek segments), and habitat structures (from vegetation clearing, riparian regrading, and channel reconstruction—including the relocation of 980 ft of Miller Creek). Long-term changes include the relocated Miller Creek channel, beneficial habitat features and native riparian vegetation throughout Miller and Des Moines creeks, enhanced riparian buffers, the permanent loss of poor-quality habitat structures and migration impediments, and the filling of 18.33 ac of wetlands.

Several on-site mitigation elements are proposed to compensate for the MPU improvement projects' potential impacts to stream, wetlands, and aquatic habitat. The mitigation establishes 48.06 ac of on-site wetland enhancement and stream buffer that will be restored and protected in perpetuity from future development. In-basin mitigation is directed toward restoring all impacted wetland and stream functions, except avian habitat. In-basin mitigation is also directed toward removing certain existing land use conditions that degrade on-site wetland and aquatic habitat. Overall, this mitigation will maintain or enhance EFH in and along STIA streams, estuaries, and marine shorelines.

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[3] A water tower will be constructed in the Outfall 012 and 013 subbasins that drain to Gilliam Creek and the Green River. This project will redevelop existing impervious surfaces and have no impact on Gilliam Creek or the Green River, as discussed in the BA.

WATER QUALITY IMPACTS AND MITIGATION

Potential water quality impacts to Miller and Des Moines creeks, resulting from construction and operation of MPU improvement projects and associated mitigation actions, include construction sedimentation, as well as sediment and erosion control practices that themselves may result in potential impacts (e.g., changes in stream temperature and pH, release of flocculation agents, and changes in base and peak flows). Potential water quality impacts in the proposed MPU action area related to operations include changes in storm water quality and quantity associated with increased impervious surfaces, airport anti-icing and de-icing operations, application of nutrients and pesticides to landscape management areas, as well as hydrology changes in hydrology affecting Miller and Des Moines creeks.

Operations at STIA following implementation of the MPU projects could affect water quality through the discharge of conventional pollutants and chemicals used in ground and aircraft de-icing to adjacent creeks, and the discharge of these same chemicals to the Puget Sound in IWS effluent. Overall, the MPU improvements will result in a greater volume of stormwater undergoing detention and treatment. This will be accomplished through retrofitting areas currently inside and outside of the project area as these improvement projects are completed, as well as detaining and treating all stormwater associated with new impervious surface. An additional result of the retrofitting will be reductions in copper and zinc currently discharged to Miller, Walker, and Des Moines creeks through the collection and routing of stormwater to the IWS system. Analysis of aircraft de-icing and anti-icing fluids (ADAFs) used at STIA as well as the projected loadings of copper and zinc to stormwater and IWS effluent indicate that the concentrations of these chemicals will not adversely affect coho salmon EFH in Miller, Walker, and Des Moines Creeks or coho, chinook, and Puget Sound pink salmon EFH at the estuaries of Miller and Des Moines Creeks, the IWS outfall, or in the Green River near the Auburn Mitigation Site.

All identified water quality impacts will be mitigated (to maintain or improve the existing condition) by establishing and maintaining water quality treatment best management practices (BMPs). These BMPs not only protect salmon species and their EFH, but also meet or exceed the requirements of the Washington State Department of Ecology's (Ecology) Manual (Ecology 1992). Additionally, existing developed areas lacking BMPs consistent with the Manual will be retrofitted with water quality treatment BMPs, to the maximum extent practicable, to further protect EFH species and their habitat. The MPU improvements will treat both new pollution generating impervious surface (PGIS) and existing impervious areas in a ratio of 1:1.89 (i.e., for each acre of new impervious surface, 0.45 ac of existing impervious will be retrofitted). Additional measures to mitigate water quality impacts include source control and the operation and expansion of an IWS to treat stormwater runoff generated from high-use areas.

In addition to the proposed water quality BMPs, currently degraded wetlands in the Miller Creek and Des Moines Creek basins will be enhanced to: (1) restore water quality functions, (2) benefit water quality by eliminating existing pollution sources from agricultural land, (3) increase settling and mechanical trapping of particulates, (4) remove metals and other chemicals that bind to particulates, (5) reduce and bind metals in humic material, (6) biologically remove and uptake nutrients, and (7) enhance the riparian buffers.

HYDROLOGIC IMPACTS AND MITIGATION

MPU improvements will increase impervious surface areas in the Miller Creek and Des Moines Creek watersheds, which could further increase stormwater runoff rates, volumes, and pollutant loads to the receiving streams. Additionally, the filling of wetlands could affect stormwater storage, loss of filtration, ground water recharge, and groundwater discharge, all of which could affect the hydrology of surface streams.

The Port will construct stormwater conveyance, detention, and treatment facilities to manage runoff from both newly developed project areas and existing airport areas, as described below. The net result of flow controls for the MPU improvements will be to reduce peak flows in Miller, Walker, and Des Moines creeks downstream of the STIA discharges. These actions will enhance hydrologic conditions in the streams and associated estuaries. The target flow regime will achieve the level of flow control required by regulations and reduce flows in the stream channels to a stable condition that reduces erosion and sedimentation in the creek estuaries where EFH is present.

The Port has proposed mitigation in each watershed to compensate for any potential reductions in base flows in Miller and Des Moines creeks. This will be accomplished through the acquisition of real property in the Project Area, which will concomitantly transfer all water rights associated with these properties to the Port. On Miller Creek, the Port is acquiring and will cease exercise of water right permits, certificates, and claims associated with acquired properties. Additionally, any unapproved water uses will be terminated once these properties have been acquired. The Port is currently proposing to transfer these water rights in the Miller Creek drainage to Ecology's Trust Water Rights Program[4]. On Des Moines Creek, the Port will augment flow using an existing well to which it already has all required water rights. The effects of these actions will compensate for any potential reductions in base flows[5] related to MPU improvements projects in Miller or Des Moines creeks.

EFFECTS DETERMINATION FOR CHINOOK, COHO, AND PUGET SOUND PINK SALMON EFH

Chinook and pink salmon have not been documented to occur in the Miller Creek, Walker Creek, or Des Moines Creek basins upstream of their discharge with Puget Sound (Batcho 1999 personal communication; Des Moines Creek Basin Committee 1997; Hillman et al. 1999). Construction and operation are not expected to affect the freshwater life stages or EFH of chinook or pink salmon. Although results of these actions are intended to improve baseline habitat conditions for all salmonids in the Miller Creek and Des Moines Creek basins (through increased stormwater management and habitat restoration), future use of the streams by chinook or pink salmon (i.e., through straying from other basins) is unlikely and not expected. Therefore, since these two salmon species do not occur in these basins, construction and operation of the project will have no adverse effect on freshwater EFH of chinook or pink salmon in the Miller Creek or Des Moines Creek basins or estuaries. When the potential effects of the proposed STIA MPU improvements on EFH of chinook or pink salmon are considered relative to the proposed conservation measures, the action agencies (FAA and USACE) determined that the proposed action will have "no effect" on designated EFH for chinook and pink salmon (see Table E-1).

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[4] Such a transfer will be dependent on acceptance by Ecology.

[5] Maintenance of base flows will ensure adequate flows of freshwater in Miller and Des Moines creeks EFH.

Coho salmon are present within central and lower reaches of Miller, Walker, and Des Moines creeks and may be present in several areas where direct impacts could occur from construction of habitat improvements (e.g., installation of large woody debris, removal of rock weirs, and/or water quality alteration from turbidity, suspended sediment, or stormwater chemistry). When the potential effects of the proposed STIA MPU improvements on coho salmon EFH in the action area are considered relative to the proposed conservation and mitigation measures, the action agencies determined that the proposed action "may adversely effect" designated EFH for coho salmon for a short-term period, but would have "no effect" long term, and would ultimately be beneficial (Table E-1).

Table E-1. Summary effect determinations for salmon EFH in the Action Area.

Common and *Scientific name*	Life Stages Considered	Essential Fish Habitat	EFH Effects Determination
Chinook salmon *Oncorhynchus tshawytscha*	Freshwater and marine phases	Estuaries of Miller and Des Moines creeks, marine waters at the IWS Outfall, and Green River near Auburn Mitigation Site	No effect (freshwater and marine)
Pink salmon *O. gorbuscha*	Freshwater and marine phases	Estuaries of Miller and Des Moines creeks, marine waters at the IWS Outfall	No effect (freshwater and marine)
Coho salmon *O. kisutch*	Freshwater and marine phases	Miller and Des Moines creeks downstream of identified features, marine waters at the IWS Outfall, and Green River near Auburn Mitigation Site	May adversely effect (short-term, freshwater only) No effect/beneficial (long-term, freshwater and marine)

1. INTRODUCTION

This Pacific Coast salmon EFH assessment has been prepared by the FAA[6] and USACE. Under Section 305(b)(4) of the MSA, NMFS is required to provide advisory EFH conservation and enhancement recommendations to federal and state agencies for actions that adversely affect EFH. NMFS EFH guidance documents provide that EFH consultations may, but are not required to be, combined with ESA consultations to accommodate the requirements of both Acts. Since EFH for Pacific salmon was approved by NMFS after FAA and USACE submitted the Biological Assessment (BA) to NMFS (FAA 2000), this EFH Assessment is being submitted as a separate document.

The FAA and the USACE are presently consulting with NMFS under the ESA over certain STIA MPU improvements over which the agencies possess discretionary involvement or control (Figure 1-1). This EFH Assessment is for consultation relating to potential impacts of the same range of FAA actions, since May 24, 1999, related to STIA MPU improvements, and proposed USACE actions. Analyses contained in the June 2000 BA are hereby incorporated by reference. The USACE proposed action relates to those MPU projects that result in the placement of fill in wetlands, as regulated by Section 404 of the Clean Water Act. The USACE's action also includes the temporary, indirect, and cumulative impacts to wetlands and the environment which the USACE is mandated to consider. The BA addresses impacts to wetlands and stream in Section 7.3, specifically:

- The impacts of MPU projects that place fill in streams on listed species are considered in Section 7.3.1.1 and Section 7.3.1.2 of the BA. The impacts relate primarily to the relocation of a portion of Miller Creek.
- The impacts of MPU projects that directly affect wetlands on listed species are addressed in Section 7.3.1.3 and Section 7.3.1.4 of the BA. These potential impacts include filling of wetlands for construction projects, and the grading or excavation of wetlands to implement mitigation projects.
- Potential indirect impacts to wetlands that could affect listed species are part of the USACE 404 permit action. These indirect impacts are addressed in Section 7.3.1.5 of the BA.

Finally, the USACE will consider the potential impacts of MPU projects on local streams and listed species. The effect of the projects on baseflows, high flows, and water quality are addressed in Sections 7.1 and Section 7.2 of the BA.

This evaluation of Pacific salmon EFH analyzes the effects of FAA and USACE actions on EFH for chinook, coho, and pink salmon. This EFH evaluation was developed in response to NMFS' recent approval of Amendment 14 of the PSFMP (dated September 27, 2000), which designated marine

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[6] In accordance with applicable regulations, the FAA has assumed the role of lead federal agency for purposes of this consultation and has designated the Port of Seattle as its non-federal representative for the purposes of preparing this EFH assessment. See 50 C.F.R. § 600.920(b)-(c).

and freshwater EFH for Pacific Coast salmon. Under Amendment 14 to the Pacific Coast Salmon Plan, the geographic extent of freshwater EFH is specifically defined as all waters currently available, and most of the waters historically accessible to salmon. Salmon EFH excludes areas upstream of longstanding naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). Salmon EFH includes aquatic areas above all artificial barriers except the impassable barriers (dams) listed in Appendix A of the 2000 Final Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). However, activities occurring above impassable barriers that are likely to adversely affect EFH below impassable barriers are subject to the consultation provisions of the MSA.

This EFH evaluation was prepared to evaluate the effect of the STIA MPU improvements on the three commercially harvested species of Pacific salmon pursuant to section 305(b)(2) of the MSA. This document presents the potential effects of STIA MPU improvements on the EFH of the three species of Pacific salmon included in Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999).

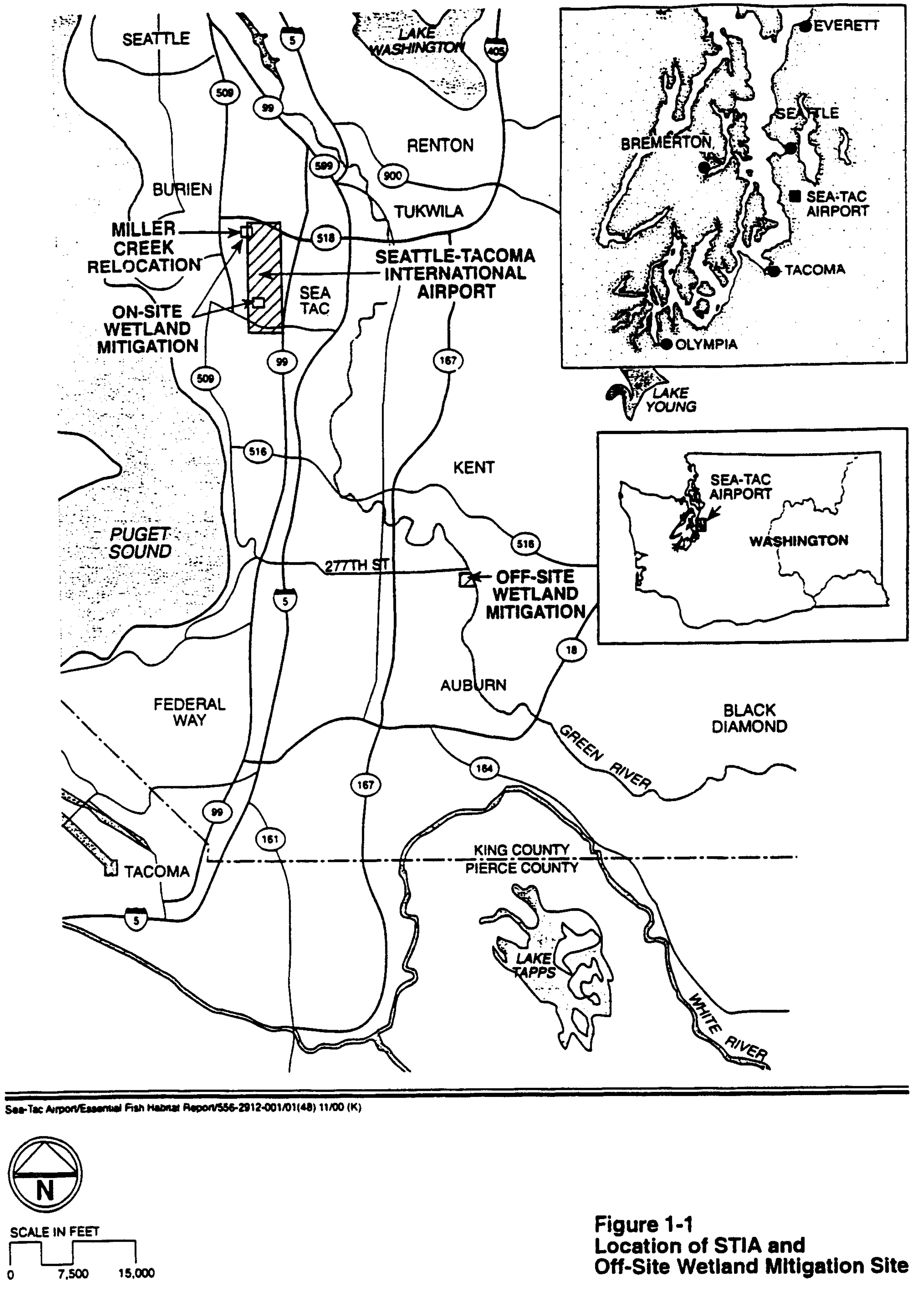

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Figure 1-1
Location of STIA and Off-Site Wetland Mitigation Site

2. PACIFIC SALMON FISHERY SPECIES LIFE HISTORY SUMMARIES

Amendment 14 of the Pacific Salmon Management Plan identifies and describes EFH for three species of salmon—chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and pink (*O. gorbuscha*). Descriptions for pink or sockeye salmon originating from outside of Puget Sound, and for chum salmon (*O. keta*), steelhead (*O. mykiss*), and cutthroat trout (*O. clarki*) are not included because incidental catches of these species in Council-managed ocean fisheries are rare and thus were excluded from the FMP for EFH (PFMC 1999). Review of the information presented in the BA (FAA 2000) indicated that chinook, coho, and pink salmon could potentially be present in some areas of the project vicinity. Therefore, this evaluation addresses the potential effects of the STIA MPU improvements on the EFH for these three species.

This section describes the life history and habitat requirements for chinook salmon, coho salmon, and Puget Sound pink salmon. Species descriptions are general, but focused where possible on features and conditions specific to stocks within the drainage basins potentially affected by STIA.

2.1 GENERAL CHINOOK SALMON LIFE HISTORY

Chinook salmon in Puget Sound are commonly known as either spring-run or summer/fall-run, depending on the time at which the adults return to freshwater. Summer/fall chinook are much more abundant than spring chinook; no self-sustained runs of spring chinook presently inhabit the Duwamish/Green River (although a few spring chinook sometimes return to the Green River). Adult summer/fall chinook typically return to freshwater during July through October and primarily spawn from September through November. Juvenile summer/fall chinook typically spend only about three months in freshwater before emigrating to Puget Sound, and must have access to margin areas of streams during their fry stage. In addition, survival of marked hatchery chinook decreases significantly with lower flow (Wetherall 1971), presumably because downstream migrants are more vulnerable to predators during low flows.

Upon entering Puget Sound, subyearling chinook salmon smolts typically migrate near the shoreline and then move offshore as they grow. Yearling chinook salmon, which are typically produced by spring-run parents that are uncommon in the project area, probably spend less time in littoral areas of Puget Sound. Juvenile chinook salmon feed opportunistically in Puget Sound. They consume large zooplankton, such as euphausiids and large copepods, amphipods, juvenile shrimp, and larval fishes (e.g., herring and sandlance) (Miller et al. 1977; Simenstad et al. 1982; Fresh et al. 1979). In areas where riparian habitat is abundant near the Sound, terrestrial insects can be an important prey item for juveniles up to around 75 mm. Larger chinook will typically consume larger prey and the proportion of fish in the diet increases with size.

Chinook may reside in the Puget Sound region until at least November before migrating to the North Pacific Ocean. Estuarine habitat is a critical component in the life cycle of chinook salmon, as described in detail in the BA; however, the Miller Creek, Des Moines Creek, and Green/Duwamish River estuarine habitats will not be affected by any activities associated with this project. Mature chinook salmon return to their natal rivers predominately as three-, four- and five-year-olds.

Water temperature can be exceptionally warm in the lower Duwamish River during June through September, due to low river flows and the lack of shade. Chinook salmon hold in the lower river (Duwamish to Kent area) until approximately mid-September, depending on temperature and flow (T. Cropp 1999 personal communication). Movement prior to this period is probably constrained by low flows, shallow water in riffles, and warm water temperatures in the lower river. Low oxygen levels in the lower river and estuary (e.g., near 14th Avenue bridge) and warm water may also inhibit upstream migration (Miller and Stauffer 1967; Salo 1969). Duwamish River mainstem spawning occurs between river mile (RM) 24 and 61; additional spawning occurs in the Soos Creek (primarily RM 0.5 to 10 and some tributaries), Newaukum Creek (RM 0-10), and Burns Creek tributaries. No chinook spawning occurs in the Green/Duwamish River within Seattle's built environment.

Chinook salmon that could be present in the action area are most likely produced from either the Green/Duwamish River (in the off-site mitigation action area) or the Puyallup River (in the STIA-MPU action area). (A detailed description of each of these stocks is provided in the BA.) Three runs of chinook salmon inhabit the Puyallup River Basin, and are described in detail in the BA (FAA 2000). Juveniles from this stock are believed to migrate along the coast of Puget Sound; these stocks may be found near the estuaries of Miller and Des Moines creeks.

2.2 GENERAL COHO SALMON LIFE HISTORY

A status review of coho salmon was recently completed by NMFS in response to petitions seeking to list several Pacific Northwest populations as threatened or endangered (Weitkamp et al. 1995). Based on genetic, life history, biogeographic, geologic, and environmental information, the ESA defined six Evolutionarily Significant Units (ESUs) for coho salmon in Washington, Oregon, and California. Despite recent stable trends in population abundance near historic levels, the status of the Puget Sound/Strait of Georgia ESU was determined to warrant further consideration for listing due to concerns over current genetic, environmental, and habitat conditions (NMFS 1995). Risk factors identified as potentially deleterious to Puget Sound coho salmon stocks included high harvest rates, extensive habitat degradation, unfavorable ocean conditions, and declines in adult size (Weitkamp et al. 1995).

Hatchery supplementation in Puget Sound has been extensive. An average of 43 million coho salmon juveniles were released annually into the Puget Sound ESU between 1987 and 1991 (Weitkamp et al. 1995). Coho salmon broodstock released into various Puget Sound basins between the early 1950s and 1981 included substantial numbers of both fingerlings and yearlings from Issaquah Creek and the Green, Samish, Skykomish, and Skagit rivers (WDF et al. 1993). Virtually all accessible streams and tributaries in the Puget Sound region were formerly utilized by coho salmon (Williams et al. 1975). In addition to natural spawning that occurs in the basin, Trout Unlimited operates a small hatchery on Miller Creek from which volunteers scatter-plant coho juveniles throughout Miller Creek, Walker Creek, and Des Moines Creek. The egg sources for this hatchery are Green River hatchery stocks maintained by the State of Washington and the Muckleshoot Indian Tribe (Batcho 1999 personal communication).

Coho salmon in the Green River basin are a mixture of native and hatchery origin fish, and two distinct races are recognized—the Soos Creek and Newaukum Creek stocks (WDF et al. 1993).

Substantial releases of hatchery coho have occurred throughout the basin since the early 1950s. Spawners return to the Duwamish River from August through late January, with most entering from late October through December. Peak returns typically occur in mid- to late November (Grette and Salo 1986; WDF et al. 1993). The Soos Creek stock spawns from late October to early November, while spawning by the Newaukum Creek stock may extend into mid-January. Coho spawn in mainstem reaches and all accessible tributaries in the Green River basin (Grette and Salo 1986, Williams et al. 1975). Spawning in the lower Duwamish River occurs primarily in side-channels, such as the Black River basin, Springbrook Creek, and Mill Creek (USACE 1995). Coho salmon spawning above Auburn use both mainstem and tributary reaches, including Soos and Newaukum creeks. Some spawning occurs above the Green River Gorge, but this area likely contains more rearing than spawning habitat (USACE 1995).

Coho salmon typically return to spawn at age 3, though sexually mature 2-year-old males are not unusual. These "jacks", as they are called, return to fresh water to spawn after only 5 to 7 months at sea. The proportion of jacks within a population is highly variable and is influenced by genetic and environmental factors (Weitkamp et al. 1995). All coho salmon are semelparous (die after spawning) and usually spend two weeks or less on the spawning grounds from the time of their arrival to the time of their death (Sandercock 1991). Key habitat characteristics for spawning coho include stable channel and hydraulic features and unembedded substrates ranging from 13 to 100 mm (Bjornn and Reiser 1991).

Coho typically hatch after 6 to 8 weeks and emerge from the gravel 2 to 3 weeks later (Wydoski and Whitney 1979). The length of time required for incubation depends largely on water temperatures, as it does for other salmonids. After emergence coho feed voraciously on terrestrial and aquatic insects, often selecting prey that drifts on the surface or in the water column (Sandercock 1991). Juvenile coho salmon seek off-channel sloughs and wetlands for rearing and overwintering (Grette and Salo 1986). The most productive rearing areas for coho tend to be the small streams with abundant slack water habitats (Wydoski and Whitney 1979; Sandercock 1991). Rearing juvenile coho tend to prefer pools (Bisson et al. 1988) and woody debris is an important structural element that creates this type of habitat (Bustard and Narver 1975; Bisson et al. 1987). Woody debris also provides areas of cover, and provides food to many aquatic insects that are in turn prey for rearing coho juveniles and other salmonids. Side channels are important overwintering habitat to juvenile coho in the lower Green River (Grette and Salo 1986). During summer rearing, highest juvenile coho densities tend to occur in areas with abundant prey (e.g., drifting aquatic invertebrates and terrestrial insects that fall into the water). During fall when stream flows increase, coho salmon will commonly seek refuge in ponds and small tributaries where they can avoid being flushed downstream during extreme high flow events (Skeesick 1970; Peterson 1982; Cederholm and Scarlett 1982). Diking, dredging, ditching and other methods of bank protection have vastly reduced the amount of complex low-gradient side channels available for coho summer and winter rearing habitat (Beechie et al. 1994).

Coho generally rear in fresh water from 1 to 2 years then migrate to salt water where they remain for about 18 months prior to returning to fresh water to spawn (Wydoski and Whitney 1979, Sandercock 1991). Smolt outmigration from the Green River occurs between February and June, with peak activity occurring between late April and early May (Weitkamp et al. 1995). Sampling of juvenile salmonids in the Duwamish Waterway during 1980 provided no evidence of residency in the waterway but instead a concerted migration towards the open waters of Puget Sound

(Parametrix 1982). No coho were collected in the 1980 sampling effort after June 1st (Parametrix 1982). Few or no coho were captured in Elliott Bay during this study, indicating that upon migrating from rearing areas, coho juveniles move directly to Puget Sound (Parametrix 1982).

2.2.1 General Puget Sound Pink Salmon Life History

{The following information about pink salmon life history was taken verbatim from the EFH Appendix A (PFMC 1999).}

Pink (or "humpback") salmon are the smallest of the Pacific salmon, averaging just 1.0 to 2.5 kg at maturity (Scott and Crossman 1973). Pink salmon are unique among Pacific salmon by exhibiting a nearly invariant two-year life span within their natural range (Gilbert 1912; Davidson 1934; Pritchard 1939; Bilton and Ricker 1965; Turner and Bilton 1968).

Upon emergence, pink salmon fry migrate quickly to sea and grow rapidly as they make extensive feeding migrations. After 18 months in the ocean, the maturing fish return to freshwater to spawn and die. Pink salmon spawn closer to tidewater than most other Pacific salmon species, generally within 50 km of a river mouth, although some populations may migrate up to 500 km upstream to spawn, and a substantial fraction of other populations may spawn intertidally (Hanavan and Skud 1954; Hunter 1959; Atkinson et al. 1967; Aro and Shepard 1967; Helle 1970; WDF et al. 1993).

In general, pink salmon select sites in gravel where the gradient increases and the currents are relatively fast. In these areas, surface stream water must have permeated sufficiently to provide intragravel flow for dissolved oxygen (DO) delivery to eggs and alevins. Pink salmon spawning beds consist primarily of coarse gravel with a few large cobbles, a mixture of sand, and a small amount of silt. Pink salmon are often found spawning in the same river reaches and habitats as chinook salmon. High quality spawning grounds of pink salmon can best be summarized as clean, coarse gravel (Hunter 1959).

Newly emerged pink salmon fry are fully capable of osmoregulation in sea water. Schools of pink salmon fry may move quickly from the natal stream area or remain to feed along shorelines up to several weeks. The use of estuarine areas by pink salmon varies widely, ranging from passing directly through the estuary en route to nearshore areas to residing in estuaries for one to two months before moving to the ocean (Hoar 1956; McDonald 1960; Vernon 1966; Heard 1991). In general, most pink salmon populations use this former pattern and, therefore, depend on nearshore rather than estuarine environments for their initial rapid growth.

Pink salmon populations that reside in estuaries for extended periods utilize shallow, protected habitats such as tidal channels and consume a variety of prey items, such as larvae and pupae of various insects (especially chironomids), cladocerans, and copepods (Bailey et al. 1975; Hiss 1995). Even more estuarine-dependent pink salmon populations have relatively short residence periods when compared to fall chinook and chum salmon that use estuaries extensively. For example, while these other species reside in estuaries throughout the summer and early fall, pink salmon are rarely encountered in estuaries beyond June (Hiss 1995).

In contrast to the typical extended ocean migration of northern stocks, it is believed that some Stillaguamish River and possibly other Puget Sound pink salmon remain within Puget Sound for their entire ocean residence period (Jensen 1956; Hartt and Dell 1986). This tendency to reside in Puget Sound and the Strait of Georgia is commonly exhibited by both coho and chinook salmon, but is unusual for pink salmon. In North America, pink salmon regularly spawn as far south as Puget Sound and the Olympic Peninsula; however, most Washington state spawning occurs in northern Puget Sound (Williams et al. 1975; WDF et al. 1993). Pink salmon were not listed by NMFS and Washington Department of Fish and Wildlife (WDFW) (in EFH Appendix A) as a stock either currentiy or historically present in the Duwamish River. The river systems nearest the project area with pink salmon stocks are the Puyallup and Nisqually.

3. ESSENTIAL FISH HABITAT

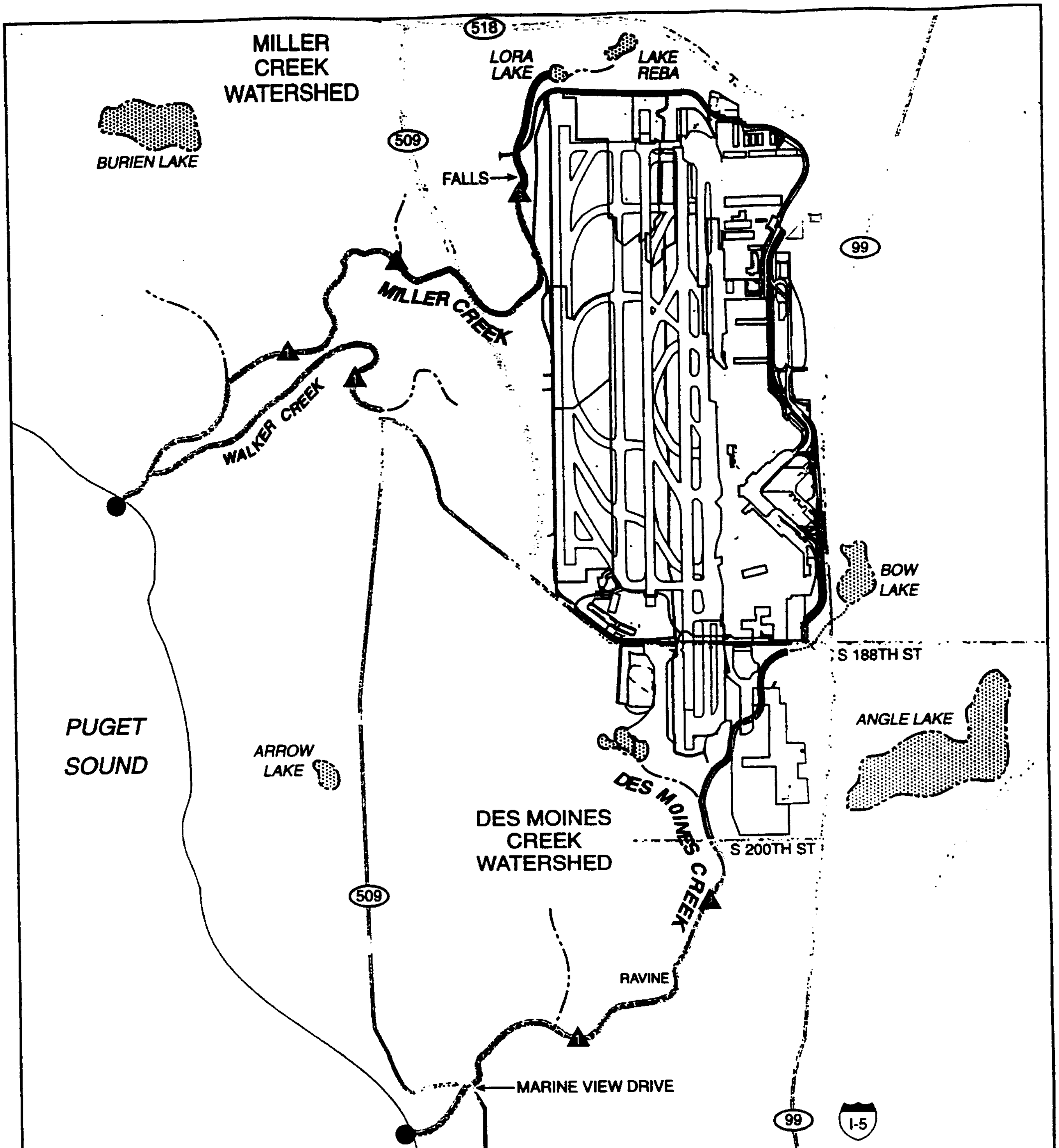
Summaries of baseline watershed and EFH conditions for chinook salmon, coho salmon, and Puget Sound pink salmon that may occur in drainage basins affected by MPU improvement projects are discussed in this chapter. General EFH requirements for each of the salmon species are presented first, followed by summaries of baseline habitat conditions and EFH features specific to Miller Creek, Des Moines Creek, their estuaries, and the Green River near the Auburn Mitigation Site. Locations of EFH of Des Moines Creek, Miller Creek, and Walker Creek basins are shown in Figure 3-1. Detailed discussions of baseline watershed conditions and chinook salmon designated critical habitat are provided in the BA (FAA 2000) and are incorporated here by reference. The effects of the MPU improvement projects on federally listed fish species are also described in detail in the BA (FAA 2000).

Freshwater EFH for coho, chinook, and pink salmon consists of four major components: spawning and incubation areas, juvenile rearing areas, juvenile migration corridors, and adult migration corridors. Within these areas, essential features of EFH include:

- adequate substrate composition
- water quality (e.g., DO, nutrients, temperature, etc.)
- water quantity, depth, and velocity
- channel gradient and velocity (for chinook and pink salmon)
- cover/shelter
- habitat complexity (e.g., large woody debris, channel complexity, etc. for coho and pink salmon)
- aquatic vegetation (for coho salmon)
- food
- riparian vegetation
- space
- habitat and flood plain connectivity (for pink and coho salmon)

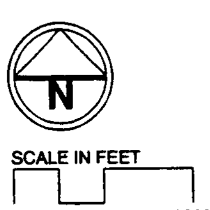
NMFS further identified marine EFH for coho and pink salmon to include estuarine rearing, early ocean rearing, and juvenile and adult migration. Important features of coho and pink salmon estuarine and marine habitat are adequate water quality; temperature; prey species and forage base (food); and depth, cover, and marine vegetation in estuarine and nearshore habitats.

The identification of EFH is based on life history and habitat conditions utilized by coho, chinook, and pink salmon that may be found in the STIA project area. For this project, the geographic extent of EFH is specifically defined as all currently available waters and most of the habitat historically accessible to coho and chinook salmon within the Miller Creek, Des Moines Creek, and the lower Duwamish/Green River basins that may be affected by STIA. Some historically inaccessible freshwater habitat is included in this EFH, as directed by NMFS, because of uncertainty of fish passage up a natural migration barrier in Miller Creek and a constructed barrier in Des Moines Creek In the estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments, which includes the Miller and Des Moines creeks estuaries and STIA's National Pollution Discharge Elimination System (NPDES)-permitted stormwater outfalls and IWS outfall to Puget Sound (see Figure 4-2 of the BA). Freshwater and marine EFH for the Miller and Des Moines Creek subbasins and Puget Sound is shown in Figure 3-1.



Data Sources: Des Moines Creek Basin Committee (1997); Hillman et al. (1999); Parametrix 1999a

Parametrix, Inc. Sea-Tac Airport/Essential Fish Habitat Report/556-2912-001/01(48) 11/00 (K)



- Stream
- Piped Stream
- Lake
- Potential Chinook Essential Fish Habitat
- Potential Coho Essential Fish Habitat
- Potential Coho Essential Fish Habitat Above Adult Migration Barriers
- Rivermile

Figure 3-1
Salmon Essential Fish Habitat in Des Moines Creek, Miller Creek, and Walker Creek

3.1 MILLER CREEK BASIN

The Miller Creek watershed drains approximately 8 mi^2 of predominantly urban area, mostly within the cities of Burien and SeaTac (see BA Figure 3-2). STIA facilities located in this basin cover an area of about 162 acres representing about 3 percent of the watershed. Estimates of impervious surface within the Miller Creek basin range from 49.4 percent, based on aerial photo analysis (May 1996), to 23 percent, using digitized land use data and Geographic Information Systems (GIS) (Parametrix 1999b). King County Surface Water Management (1987) reported an intermediate value of 40 percent[7]. Although the Miller Creek watershed is generally highly developed, several small bogs, depressions, and wetland lakes remain in the upper basin; this area formerly had a more extensive network of headwater wetlands that buffered the stream from winter storms and provided recharge during summer dry periods (May 1996).

Flows in Miller Creek originate from Arbor, Burien, Tub, and Lora lakes, Lake Reba, and seeps located on the west side of STIA. In reaches downstream of 1st Avenue South (RM 1.8), Miller Creek flows through a well-incised ravine and cuts through glacial material before entering Puget Sound via a small estuary. The outlet stream from Burien Lake enters the ravine reach at RM 1.2.

Walker Creek drains an approximately 2.5-mi^2 subbasin of the Miller Creek watershed. The creek originates in a 30-acre wetland (Wetland 43) located west of STIA, between Des Moines Memorial Drive and SR 509. The stream flows through both residential and commercial development before its confluence with Miller Creek approximately 300 ft upstream from Puget Sound. Much of the riparian areas adjacent to the creek have been eliminated or altered by adjacent development. Water from Walker Creek is diverted through a pipe into a small pond impounded by a weir and released into Miller Creek approximately 10 ft upstream from Puget Sound. The 3-ft-wide diversion channel is incised approximately 1.5 ft and is tidally influenced to within approximately 100 ft of the control weir.

3.1.1 Miller Creek Freshwater Fish Habitat

The lower basin of Miller Creek has benefited from instream habitat restoration conducted by Trout Unlimited that has improved the pool to riffle ratio, pool quality for rearing juvenile salmonids, and habitat complexity. Coho salmon returning to the lower basin appear to have responded favorably; recent returns number about 300 adults per year. Earlier surveys in 1980 found sparse numbers of coho spawning between the mouth of Miller Creek and RM 1.4, with four live spawners, seven dead spawners, and nine redds observed (Egan 1982). With fully restored habitat, Miller Creek is expected to support between 700 and 1,200 adult coho per year (Batcho 1999 personal communication).

The historical record indicates that coho ascended Miller Creek at least to the falls at RM 2.8 (see BA Section 5.1.1). A waterfall, which drops over a hardpan lip at about RM 2.8, has been described as a complete barrier to upstream migrations of anadromous fish (Williams et al. 1975; Ames 1970). Recent spawning surveys conducted by Trout Unlimited (Batcho 1999 personal communication)

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[7] These variations are due to differences in analytical methods and resolution available.

have also identified this waterfall as the upper limit to coho salmon distribution in Miller Creek. Coho salmon were found rearing below the falls at RM 2.8 (Parametrix 1999a).

Based on these reports, this waterfall appears to serve as an effective migration barrier; however, empirical information discussed in the BA suggests that salmonids (specifically, coho) may be capable of leaping the waterfall. Although coho salmon may be physically capable of ascending the waterfall, several factors may explain why they have not been reported upstream of this location: hydraulic conditions are variable during the spawning season, and are not often conducive to ascending the falls; observations of spawning coho in Miller Creek are limited, and may not have occurred when coho salmon may have been present above the falls; and upstream conditions provide limited habitat to coho salmon capable of ascending the waterfall. The need to ascend the waterfall may be density-dependent, and coho salmon do not occur in numbers sufficient to prompt leaping into vacant habitats. Alternatively, those coho unable to successfully defend spawning areas below the falls are also unable to ascend the falls. Nonetheless, this area above the falls has been identified as coho EFH for the purposes of this assessment.

Most components of EFH (specifically, stream channel habitat conditions necessary to sustain coho salmon) are not found above the waterfall at RM 2.8. However, a crucial component of EFH, instream water supply and water quality, is generated and transmitted from the upper reach above the falls and headwaters into the lower reaches. It is this upper reach that will be affected by the project when a segment of the creek is relocated. Pink and chinook salmon fresh water EFH was not identified in Miller Creek because these species have not been observed in the creek. Additionally, each of these creeks lack the general physical features associated with pink and chinook salmon spawning and rearing habitat.

3.1.2 Miller Creek Estuarine Fish Habitat

Miller Creek is tidally influenced for roughly 150 ft upstream of Puget Sound. The estuary is approximately 15 by 150 ft (~ 0.05 acre)[8], and comprises a low-gradient rocky beach composed of 3-inch-minus[9] coarse and fine gravels embedded with sand (see BA Section 4.1.2 and Appendix G for further details.) Along the tidal channel, the stream is approximately 15 ft wide and fringed with overhanging salt marsh vegetation, including Pacific silverweed (*Potentilla pacifica*), saltweed (*Atriplex patula*), and sedge (*Carex* sp.). At the upstream part of the estuary, the creek channel is bordered by a private park (grass and deciduous trees) to the south and several houses to the north. Analysis of baseline estuarine conditions (summarized in Table 4-2 of the BA) indicate significant modification of this area by park development.

For several hundred feet north and south of the creek, the estuarine shoreline ordinary high water mark (OHWM) is defined by houses and cement bulkheads that have been built at the high tide mark. Approximately 200 ft south of the estuary, the OHWM is defined by wrack[10] and large woody debris (LWD). The slope of the beach along the upper intertidal zone is moderate (about

[8] This estuary may have been larger prior to development of a private park in the vicinity.

[9] Indicating that 95% of the gravel present would pass through a 3-inch screen.

[10] Wrack is seaweed and other marine debris that is cast up on shore.

1:6), dropping approximately 5 ft over a distance of 30 ft, then flattens toward the water (less than 1:100), dropping approximately 4 ft over 150 yards to mean lower low water (MLLW).

The intertidal zone at the mouth of Miller Creek is composed predominantly of mixed gravel and sand, with a smaller component of cobble, boulders, and sand. The creek channel in the upper intertidal zone contains more cobble than adjacent areas.

The channel is vegetated with green algae (*Enteromorpha intestinalis*). The substrate has some attached barnacles, mussels, and snails. Upper intertidal areas adjacent to the stream have very little algae or other attached marine life; however, amphipods and isopods are abundant under rocks and in the sand. In the middle intertidal zone, *E. intestinalis* becomes less abundant in the creek channel, while barnacles and mussels become the dominant species adjacent to the creek. In the lower intertidal zone, the creek channel is poorly defined and the substrates within and adjacent to the creek channel are similar (mixed gravel and sand). Barnacles and mussels are present, but less dense than found in the middle intertidal zone. Additionally, species of brown, red, and green algae are all sporadically present and bivalve siphons can be observed in the sandy areas.

3.1.3 Miller Creek EFH Condition

Coho salmon have historically used the lower reaches of the Miller Creek basin. The historical carrying capacity of coho salmon in this basin is greater than current abundances. Reduced coho production is due to a variety of factors including habitat degradation resulting from historic residential, agricultural, and commercial development in the Miller Creek watershed.

The Washington Department of Fisheries reported that Miller Creek had undergone extensive alteration and "total deterioration" due to heavy residential and commercial growth in the drainage in the early 1970s (Williams et al. 1975). Stream conditions necessary to adequately support spawning and rearing of salmonids "were virtually nonexistent" upstream of 1st Avenue South (RM 1.9) due to excessive amounts of sand and silts that comprised 70 to 100 percent of the bottom substrate (Ames 1970). King County's Surface Water Management (1987) evaluation of the Miller Creek basin noted that the high level of urbanization had degraded water quality, increased the volume and rate of storm flows, promoted erosion and mass wasting processes, and destroyed riparian habitat and vegetation.[11] These factors (summarized in Table 4-1 of the BA) have greatly reduced the habitat quality of streams, which in turn has affected fish populations.

Miller Creek Stream surveys completed by Trout Unlimited (1993), Luchessa (1995), Parametrix (1999a), and Hillman et al. (1999) identified numerous factors that contributed to the loss of instream habitat, including: degradation of water quality by pollutants, sediment, eutrophication of lakes and wetlands, and filling of wetlands; loss of protective streamside vegetation; and loss of instream large organic debris, natural meanders, and other diversity. In addition, high water temperatures in Miller Creek during the summer constitute a water quality concern, as do high fecal coliform counts, low DO levels, and residues of lawn and garden chemicals, especially in the upper reaches (Parametrix 1999a).

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[11] Despite reported water quality degradation, Miller Creek is not on the 303(d) list of impaired waterbodies.

In Miller Creek, benthic macroinvertebrate sampling near the MPU projects found benthic index of biotic integrity[12] (B-IBI) scores of 10. These scores are similar to scores observed in other urban streams subjected to hydrologic and habitat degradation (Kleindl 1995; Fore et al. 1996; Horner et al. 1996; Ecology 1999a; May et al. 1997). Studies of Puget Sound lowland streams have demonstrated that the macroinvertebrate community, as evaluated through B-IBI analysis, correlates to fish use. Specifically, coho salmon abundance diminishes in streams with B-IBI scores of 33 or lower; these degraded stream reaches were used by resident cutthroat and not by anadromous salmon (Ecology 1999a; May et al. 1997). These findings are consistent with observations of fish use in Miller Creek and support surveys that suggest the portions of the creek adjacent to the MPU improvements projects do not currently provide high-quality habitat for coho salmon.

While portions of Miller Creek might appear to fall within the strict application of the definition of EFH[13], there appears to be no chinook EFH present in Miller Creek upstream of the estuary. This determination is based, in part, on NMFS' further definition of accessible reaches as *"those within the historical range of the ESUs that can still be occupied by any life stage of salmon or steelhead"* (NMFS 2000). Available data (reviewed in the BA) does not support the historical usage of Miller Creek by chinook salmon. Chinook salmon have not been observed in Miller Creek. Additionally, examinations of Miller and Walker creeks have found a lack of specific physical features preferred by chinook salmon for spawning, rearing, and migrating. Consequently, EFH in Miller Creek is limited to the estuarine area as defined by the zone of tidal influence at the mouth of Miller Creek. This determination is based on the findings discussed in the BA (based on life history information summarized in PFMC [1999]) that chinook juvenile rearing areas, chinook juvenile migration corridors, areas for chinook growth and development to adulthood, adult chinook migration corridors, and chinook spawning areas are not present in Miller Creek.

Walker Creek parallels Miller Creek for roughly one-half its length and shares similar effects from urbanization. KCSWM (1987) reports several problems in the Miller/Walker Creek watershed created by urbanization, including excessive runoff from streets, parking lots, and commercial areas that has increased the volume and rate of storm flows. These increased flows have lead to mass-wasting and stream erosion, flooding, and loss of habitat. Runoff from urban development has also impaired water quality and fish usage. Even though coho salmon occur in the lower reaches of Walker Creek (Batcho 1999 personal communication), the absolute upstream limit of coho use has not been documented. Coho use in Walker Creek is approximated in the BA Figure 4-1. Hillman et al. (1999) conducted spawning surveys in Walker Creek from October 1998 to March 1999, and tallied 66 coho redds in the lower 3.6 km (2.3 mi).

Puget Sound pink salmon EFH is not found in Miller Creek. No pink salmon have been observed in Miller Creek, and the natural habitat features required by these fish are not present. The nearest

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[12] B-IBI for Puget Sound lowland streams (Kleindl 1995) quantifies the overall biotic condition of a stream based on measurements of benthic macroinvertebrate diversity, abundance, and species composition. B-IBI scores for streams in the Puget Sound lowlands correlate with levels of urbanization (Fore et al. 1996; Horner et al. 1996) and fish use (Ecology 1999a; May et al. 1997).

[13] Based on the lack of physical barriers that could restrict accessibility of this water body to the various life stages of chinook salmon.

populations of pink salmon are located in the Nisqually and Puyallup Rivers (Tacoma Public Utilities 1999). Similarly, chinook and Puget Sound pink salmon EFH is not found in Walker Creek. Neither of these salmon have not been observed in Walker Creek. Finally, both natural and hatchery produced chinook salmon from the Puyallup River watershed could pass through the action area near the Miller Creek estuary as they migrate to and from their ocean rearing areas.

3.2 DES MOINES CREEK BASIN

The Des Moines Creek watershed covers about 5.8 mi^2 of predominantly residential, commercial, and industrial area lying within the cities of SeaTac and Des Moines; it also includes a small area of unincorporated King County (Des Moines Creek Basin Committee 1997). The STIA occupies 23 percent of the upper Des Moines Creek watershed. Baseline environmental conditions in the creek (see Table 4-3 of the BA) are highly modified from natural conditions by a variety of development and land-use practices. King County has estimated that the Des Moines Creek basin is 32 percent impervious surface, based on digitized land use data and GIS (Parametrix 1999a). May (1996) reported a value of 49.1 percent impervious surface, based on aerial photo analysis.

The headwaters of the east branch originate at Bow Lake, 3.7 RM from Puget Sound. The upper half mile of the east branch, from Bow Lake downstream to about RM 3, is conveyed through underground pipes. The west branch originates from the Northwest Ponds stormwater detention complex located at the western edge of the Tyee Valley Golf Course and joins the east branch at approximately RM 2.4. Downstream of South 200th Street (RM 2.2), the stream flows through Des Moines Creek Park, a forested riparian wetland. The park includes an incised ravine from about RM 1.5 to 1.8. The ravine is a high-gradient reach that the stream has cut to hardpan for most of its length. The creek is paralleled within the ravine by a paved trail and/or service road and sewer line protected in places by rock bank armoring.

3.2.1 <u>Des Moines Creek Freshwater Fish Habitat</u>

Documentation of EFH in Des Moines Creek is provided in a Des Moines Creek Basin Committee report (1997) and Hillman et al. (1999), and is mapped in Figure 3-1. Along the lower reaches, extending from Puget Sound to Marine View Drive, a relatively wide floodplain allows the channel to meander, coincident with better habitat conditions and well-developed riparian vegetation. The stream reach through Des Moines Beach Park provides some of the most accessible and heavily spawned fish habitat in the system. At Marine View Drive (RM 0.4), a 225-ft-long box culvert conveys the creek under the roadway, but acts as an impediment to migrating salmon and trout because of its high velocities (greater than 7 ft per second) and length (225 ft) (Des Moines Creek Basin Committee 1997). The Midway Sewage Treatment Plant is located at RM 1.1, where the floodplain narrows. The channel in this reach contains several aging weirs originally intended to be fish-passage structures, although in their present state they may act as impediments to fish passage. Des Moines Creek enters Puget Sound through Des Moines Park located in the City of Des Moines. Within the park, two bridges cross the creek and the stream bank is stabilized with riprap. Riparian vegetation consists of grass, deciduous trees, and sparse ornamental shrubs.

Known coho habitat use extends to approximately RM 1.5. A cascade at RM 1.5 in the ravine reach was mapped as impassible to upstream-migrating fish (Williams et al. 1975). However, recent surveys have not identified this cascade as a fish barrier (Resource Planning Associates et al. 1994). From about RM 1.5 to 1.8, the hardpan channel bed and steep slope provide little (if any) usable habitat for salmon. Between RM 1.8 and South 200th Street, the stream flows through a forested wetland area that harbors resident trout and pumpkinseed sunfish. These upper reaches support cutthroat trout and non-native warmwater fish species, including largemouth bass (*Micropterus salmoides*), a salmon predator. In contrast to coho salmon, chinook and pink salmon have not been observed in Des Moines Creek.

3.2.2 Des Moines Creek Estuarine Fish Habitat

A small estuary is present where Des Moines Creek enters Puget Sound, which provides habitat for coho salmon and possibly chinook salmon. Baseline environmental conditions (see Table 4-4 of the BA) in this estuary have been highly modified by park development. During low tide, the stream flows onto a low-gradient rocky beach composed of 3-inch-minus coarse and fine gravel embedded with sand. The intertidal zone at the mouth of Des Moines Creek is composed of gravel and sand with some cobble and boulders. This substrate type is fairly uniform throughout the intertidal zone north of the creek.

The beach at the creek mouth and northward has a gentle slope, dropping approximately 5 ft over 100 yards (1:60). For several hundred feet, the OHWM is defined by wrack of LWD. The northern marine shoreline is stabilized with riprap extending from the creek mouth to a vegetated bluff. Approximately 400 ft north of Des Moines Creek, private cement bulkheads have been constructed along the high tide mark. South of the creek mouth for about 50 ft, the OHWM is defined by a riprap wall extending across the beach to a fishing pier and the Des Moines Marina. The riprap wall drops steeply from the high tide mark to the lower intertidal zone over a distance of 25 to 30 ft. South of the fishing pier, riprap covers the entire intertidal zone.

Throughout the Des Moines Creek estuary, *E. intestinalis* is the dominant algae in the upper intertidal zone, covering cobble and boulders about 75 ft into the Des Moines Creek channel. Lesser amounts of *E. intestinalis* are attached to rocks adjacent to the creek, with barnacles sporadically present. The middle intertidal zone is dominated by barnacles and mussels, except for in the stream channel where *E. intestinalis* dominates most cobble with some presence of barnacles. The lower intertidal zone has abundant barnacles and mussels, and green, brown, and red algae are common. Isopods, shore crabs, and snails were more readily found in this zone and bivalve siphons were periodically observed in sandy areas. The riprap south of the creek hosts an intertidal community very different from the gradual beach to the north of the creek. Here, the majority of the intertidal zone is densely occupied by barnacles, mussels, and the red algae *Mastocarpus papillatus*. Littorina snails and limpets are also abundant throughout this area.

3.2.3 Des Moines Creek EFH Condition

Coho salmon have historically used lower reaches of the Des Moines Creek basin. The historical carrying capacity of coho salmon in this basin is greater than current abundances. Reduced coho production is due to a variety of factors including habitat degradation resulting from historic residential, agricultural, and commercial development in the watershed.

Previous stream studies and habitat inventories dating back to 1974 (Des Moines Creek Basin Committee 1997) established that Des Moines Creek has been severely degraded by urbanization. Des Moines Creek is on the Washington State 303(d) list of impaired water bodies for exceeding standards for fecal coliform levels at both storm flows and base flows (Parametrix 1999a; Ecology 1998a; Des Moines Creek Basin Committee 1997). High water temperatures in summer have also been identified as a water quality concern (Parametrix 1999a; Des Moines Creek Basin Committee 1997).

Little usable salmonid habitat exists in the system upstream of South 200th Street. Downstream of South 200th Street, where the stream flows through a forested wetland area, a short reach harbors resident trout and pumpkinseed sunfish. Better native fish habitat exists in meanders below the Midway Treatment Plant; however, the culvert under Marine View Drive restricts most migrating salmon and trout from reaching this habitat. The Marine View Drive culvert limits most salmon production to the creek's lower 0.4 mile. As described previously, the stream reach through Des Moines Beach Park is heavily used by coho salmon.

As discussed in detail in section 5.1.4.1 of the BA, Des Moines Creek also appears to lack suitable spawning habitat, and historically would not have been used by chinook salmon. The most recent assessment of current fish use in Des Moines Creek indicates a lack of historical use by chinook (Des Moines Creek Basin Committee 1997). The assessment of Williams et al. (1975) regarding the lack of chinook use of Miller Creek is applicable to the analysis of chinook use of Des Moines Creek. Potential habitat limitations for chinook in Miller Creek also apply to Des Moines Creek (Des Moines Creek Basin Committee 1997). Given these considerations, the freshwater portion of Des Moines Creek does not fall within the defined range of chinook salmon EFH.

The Des Moines Creek estuarine boundary for chinook EFH is similar to that described for Miller Creek. Because both natural and hatchery-produced chinook salmon from the Puyallup River watershed could pass through the Des Moines Creek estuary as they migrate to and from their ocean rearing areas, chinook EFH is limited to the estuarine area as defined by the zone of tidal influence at the mouth of Des Moines Creek.

3.3 GREEN RIVER BASIN

The Green River watershed comprises 482 mi^2. Development of the Green/Duwamish watershed has resulted in a variety of changes to the basin's suitability for salmonids. This development includes the diversion of Black and White rivers during the early 1900s, construction of the Tacoma Diversion (RM 60.5) and Howard Hansen (RM 64) dams that block salmonid access to significant habitat, diking of the mainstem below RM 38, forest practices, agriculture, urbanization, and industrialization in the lower Duwamish River (USACE and KCDNR 2000). Of the original Green/Duwamish estuary, 97 percent has been filled, 70 percent of its original flow has been diverted to other basins, and 90 percent of the original floodplain is no longer flooded on a regular basis (USACE 1997). The middle portion of the basin remains primarily rural; however, agriculture has increased sediments and nutrients in the river, degrading water quality as well as salmon spawning and rearing habitats. The lower reaches are becoming increasingly urbanized. The tidally influenced Duwamish Waterway has been extensively dredged, riprapped, and channelized for maritime use by the Port and private industry.

3.3.1 Green River Freshwater Fish Habitat

Of the more than 30 fish species identified in the Green River basin (Tacoma Public Utilities 1998), three are anadromous salmonids (i.e., chinook, coho, and pink salmon) whose habitat is protected under the MSA. The Green/Duwamish River watershed has undergone significant modification over the last 100 years and these changes have influenced the distribution and use of these aquatic resources by each fish species.

Chinook and coho salmon spawn in the Green River, several hundred feet from the wetland mitigation site (Pentec Environmental 1999; Malcolm 1999 personal communication). Pink salmon were formerly common in the mainstem river and several tributaries, but few have been reported in many years (USACE 1997 in USACE and KCDNR 2000). Recent distribution assessment by NMFS did not include pink salmon as a current or historic stock of the Duwamish River (PFMC 1999), and the Tacoma Water Habitat Conservation Plan identified it as uncommon in the Green River (Tacoma Public Utilities 1999). Baseline environmental conditions in the Green River near the wetland mitigation project were summarized in the Table 4-5 of the BA.

3.3.2 Gilliam Creek Freshwater Fish Habitat

Gilliam Creek is a small creek that discharges to the Green River in the vicinity of the City of Tukwila. This creek, which has been impacted by development, is extensively culverted and receives stormwater runoff that causes high peak flows and low base flows. The creek is used mainly by resident fish because of migration barriers that limit anadromous fish passage (City of Tukwila 1997), although during high flows or floods, juvenile salmon may be able to enter culverted sections of the creek. A matrix of existing baseline conditions is found in Table 4-1 of the BA. Construction of the MPU improvements project water tower will occur in the basins that drain to Gilliam Creek through stormwater outfalls 012 and 013.

3.3.3 Auburn Wetland Mitigation Site Freshwater Fish Habitat

The Auburn wetland mitigation site is a 67-acre parcel of land, located west of the Green River in the City of Auburn. Approximately 6 acres of emergent wetlands bisect the site (DEA 1995; Parametrix 1996) and extend to the north, where they physically connect to the 100-year floodplain of the Green River backwater area through a series of roadside ditches and drainage channels (see Figure 3-4 in the BA). During rainy periods, the wetlands convey surface water from farmland south of the site northward to the Green River. Although the wetlands contain no inhabitable fish habitat, adjacent areas of the Green River that are influenced by the wetlands' drainage support chinook and coho salmon. A detailed description of baseline conditions is provided in Chapter 4.2 of the BA.

The completed mitigation project will expand existing and create additional wetlands and connect them to the Green River (about 1 mile north of the site) via a flood control outlet channel north of the project, which connects to an existing drainage channel that flows along South 277th Street and then north via culverts under the road embankment, which connect to existing channels that flow north to the Green River (see Figure 3-4 of the BA).

3.3.4 Green River EFH Condition

The Green River action areas for the MPU improvement projects include the parts of the Auburn Wetland Mitigation Site to be directly adversely affected by project construction, and downslope drainage ditches that could be indirectly adversely affected by the project. The wetland mitigation project is not expected to provide habitat directly usable by salmon.

Rainwater and seepage runoff from the site will drain from the site to the Green River. During flood events, the Green River will back water into drainage channels and the wetland mitigation area (during events greater than the approximate 10-year flood). The existing farm drainage ditch between the site and South 277th Street will be enlarged to create the outlet channel for the wetland[14]. All other drainage channels will be unchanged by the project.

The extensive culverting of Gilliam Creek and the lack of spawning gravel makes it very unlikely that adult chinook salmon use this tributary for spawning or juvenile rearing. This creek discharges to a part of the Green River used by adults for migration and by juveniles for outmigration and rearing during winter and spring.

In the Green River, decreasing flows combined with decreasing food availability may result in expanded territories by juvenile coho in summer (Grette and Salo 1986). The territorial behavior of rearing juveniles may lead to limited habitat availability in the Green River during low-flow conditions. Alteration of the lower Green and Duwamish rivers associated with agricultural development and urbanization has eliminated much of the important juvenile rearing habitat.

3.4 IWS OUTFALL MARINE HABITAT

The IWS outfall is located in Puget Sound 1,800 ft offshore and in 170 ft of water. This area can be considered potential EFH (as a migration corridor) for returning adult chinook salmon; chinook do not concentrate at the surface as do other Pacific salmon, but are most abundant at depths of 90 to 210 ft and often associated with bottom topography (Taylor 1969; Argue 1970). Adult coho and pink salmon typically associate with shallower marine habitat (less than 120 ft) for foraging and migration (PFMC 1999); therefore, the IWS outfall is not considered EFH for the adult life stage of these species.

Juvenile chinook, coho, and pink salmon are believed to associate with nearshore habitat that is shallower than the IWS outfall depth. During their first several months at sea, juvenile chinook salmon smaller than 130 mm are predominantly found at depths less than 110 ft (Fisher and Pearcy 1995). Pink salmon, at least for the first few weeks at sea, spend much of their time in shallow water of only a few centimeters deep (LeBrasseur and Parker 1964; Healey 1967; Bailey et al. 1975; Simenstad et al. 1982). Coho salmon smolts occur in intertidal and pelagic habitats, with deep, marine-influenced habitat often preferred (Pearce et al. 1982; Dawley et al. 1986; MacDonald et al. 1987); in marine environments, they are generally found in the uppermost 35 ft of the water column. Thus, the IWS outfall is not considered EFH for the juvenile life stage of coho, chinook, or pink salmon.

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[14] The Port has secured easements necessary for enlarging this ditch.

4. PROPOSED ACTION

The STIA MPU improvements are located within the cities of SeaTac and Des Moines, in King County, Washington. An additional project element, the construction of associated off-site wetland mitigation, is located southeast of STIA in the City of Auburn (see Figure 1-1). FAA's proposed actions for the purposes of this EFH Assessment at this time are construction of the Airport Traffic Control Tower and navigational aids, future grants and grants issued to the Port since May 24, 1999 related to the implementation of STIA MPU improvements, and future approval of PFC collection and use authorization related to implementation of MPU improvements. USACE's proposed actions relate to those MPU actions for which the Port has applied for a Section 404 permit. The USACE proposed action relates to those MPU projects that result in the placement of fill in wetlands, as regulated by Section 404 of the Clean Water Act. The USACE's action also includes the temporary, indirect, and cumulative impacts to wetlands and the environment which the USACE is mandated to consider. The BA addresses impacts to wetlands and stream in Section 7.3, specifically:

- The impacts of MPU projects that place fill in streams on listed species are considered in Section 7.3.1.1 and Section 7.3.1.2 of the BA. The impacts relate primarily to the relocation of a portion of Miller Creek.
- The impacts of MPU projects that directly affect wetlands on listed species are addressed in Section 7.3.1.3 and Section 7.3.1.4 of the BA. These potential impacts include filling of wetlands for construction projects, and the grading or excavation of wetlands to implement mitigation projects. (See Figures 7-4 and 7-5 of the BA, reprinted in Appendix B of this document for the specific locations where wetland fill will occur in the project area.)
- Potential indirect impacts to wetlands that could affect listed species are part of the USACE 404 permit action. These indirect impacts are addressed in Section 7.3.1.5 of the BA.

Finally, the USACE will consider the potential impacts of MPU projects on local streams and listed species. The effect of the projects on baseflows, high flows, and water quality are addressed in Sections 7.1 and Section 7.2 of the BA.

4.1 MASTER PLAN UPDATE ACTIONS

A detailed description of the MPU improvement actions, construction schedule, stormwater management facilities, the Auburn mitigation site, and the Miller Creek relocation can be found in the BA (FAA 2000) and is incorporated here by this reference. Additional information about Des Moines and Miller Creek habitat enhancement is presented in this section because of potential effects on coho salmon EFH that were not evaluated in the BA, which was limited to chinook critical habitat.

Four Miller Creek instream enhancement projects are proposed in areas that provide or effect coho salmon EFH (see Figure 4.1-3 of the Natural Resource Mitigation Plan reprinted in Appendix B of this document). Instream Enhancement Project #1 is located immediately downstream of the proposed Miller Creek relocation segment, above an area identified as an impassable falls. Project elements consist of the installation of large woody debris, riparian vegetation restoration, the removal of bank riprap and concrete structures, and the removal of several footbridges. Although this project area is probably not accessed by coho salmon, effects on water quality from construction of this project could indirectly adversely effect coho EFH downstream. Project construction and habitat features are discussed in detail in the BA (FAA 2000) and the *Draft Natural Resource Mitigation Plan for Seattle-Tacoma International Airport Master Plan Update Improvements* (Parametrix 1999a); only water quality effects from construction are evaluated in this EFH Assessment. The three remaining instream enhancement projects are briefly described here because they are accessible to coho salmon, and therefore considered coho EFH.

The Miller Creek Enhancements Project #2, just downstream of the impassable falls, consists of the installation of large woody debris, riparian vegetation restoration, the removal of bank riprap and concrete structures, and the removal of a footbridge. Additional elements include bank stabilization with fiber (coir) logs and lifts, restoration of a gravel bar, and a stream channel restoration that consists of the removal of two weirs and installation of new grade controls in the channel. Removal of the weirs is necessary to improve fish passage (Schneider 2000 personal communication). Channel restoration will require the temporary diversion of 120 feet of Miller Creek to prevent sedimentation impacts during construction. The channel would be diverted through pipes around a temporary dam (consisting of sandbags or water-filled pillows wrapped in plastic). Diversion would occur during summer low-flow conditions (typically, July through September). The creek channel would be temporarily dewatered to avoid turbidity and sedimentation effects in the channel and downstream. The diversion would occur only while the weirs were being removed and would be supervised by a biologist. The portion of work requiring diversion is expected to occur in one work day or less. If possible, both weirs would be moved on the same day; however, if more than one day is required, work would be completed sufficiently at the end of each workday to direct the stream back into the natural channel. Fish would be removed by seining in the affected reach prior to dewatering, and relocated to an unaffected area. Turbidity and sedimentation controls are further described in Chapter 5, Water Resource Impacts and Mitigation.

Miller Creek Instream Enhancement Project #3, downstream of South 160th Street, consists of the installation of large woody debris, riparian vegetation restoration, and the removal of bank rock and tire structures. Additional elements include bank stabilization with fiber (coir) logs and lifts, and construction of a new gravel bar.

Miller Creek Instream Enhancement Project #4, upstream of 8th Avenue South, consists of the installation of large woody debris, riparian vegetation restoration, the removal of bank riprap and concrete structures, and the removal of a footbridge and private driveway/bridge. Additional elements include bank stabilization with fiber (coir) logs and lifts, and construction of a new gravel bar.

4.2 EFFECTS OF THE ACTION ON EFH

Following guidance described in the PSFMP Amendment 14, actions were evaluated to determine whether they would have no effect on EFH, or may adversely effect EFH. An adverse effect is any impact which reduces the quality or quantity of EFH. Adverse effects may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction of species' fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions." 50 CFR 600.810(a). Cumulative and synergistic effects analysis includes the effects of all reasonably foreseeable future actions, including future federal actions, which are identified in this analysis to include the STIA MPU improvements over which FAA has had discretionary involvement or control since May 24, 1999 and the USACE proposed action are discussed here and in the BA (FAA 2000).

STIA MPU improvements were evaluated for areas of the airport project where project construction and operations may cause direct, indirect, site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic effects (i.e., the aquatic habitat of Miller, Des Moines, and Walker creeks downstream of the airport, the associated estuaries, and the IWS Puget Sound outfall). The Auburn Wetland Mitigation Site and vicinity where effects could reasonably occur are also included in the action area.

Project areas that could affect EFH include:

- **Construction sites upstream of EFH at STIA** where construction and operation could result in transport of sediments, nutrients, and other chemicals to downstream waters (Miller, Des Moines, and Walker creeks).
- **Construction sites within or along Miller, Walker, and Des Moines creek channels** where construction activities could directly adversely affect EFH through alterations of physical habitat and/or water quality conditions during temporary or permanent channel relocation, installation of habitat features, or removal of degraded habitat features. Freshwater EFH exists for coho salmon downstream of recognized fish barriers in the middle reaches of Miller and Des Moines creeks.
- The **Miller, Walker, and Des Moines creeks channels** downstream of STIA construction where changes in runoff or water quality conditions from the action could indirectly adversely affect habitat conditions in the creeks. The estuaries and adjacent nearshore habitat of Miller and Des Moines creeks are included as EFH for chinook and coho salmon. Changes in creek hydrology and/or water quality conditions could affect these habitats.
- The **Green River**, where changes in runoff rates or water from Gilliam Creek could affect coho or chinook EFH. This includes the piped sections of Gilliam Creek that coho and chinook may temporarily enter during periods when the Green/Duwamish River experiences high water due to simultaneous flooding and high tides.
- The **existing IWS** outfall located in Puget Sound near Des Moines Creek. This structure is included in the action area because increasing the area served by the IWS at STIA will result in increased discharge of treated stormwater runoff at the outfall, which could affect marine EFH. The outfall is located in about 170 ft of water, about 1,700 ft off shore.
- Construction of **off-site mitigation in Auburn**, which would occur up to 200 ft west of the Green River. During construction, changes in runoff and water quality could affect Green River EFH through construction dewatering and conveyance of runoff through existing farm and roadside ditches to the Green River.

Proposed STIA construction and operations activities were analyzed with consideration of existing EFH conditions to identify potential project impacts. The analysis identified the types of short-term and long-term impacts that might affect freshwater, estuarine, and marine EFH previously identified in or adjacent to the aquatic environments of Miller Creek, Des Moines Creek, and the Green River.

The analysis includes impacts to aquatic physical habitats, water quality, and water quantity (as hydrologic or flow conditions). Conservation and enhancement measures incorporated into the actions to avoid, reduce or mitigate potential impacts are also discussed here and summarized in the next chapter.

4.3 AQUATIC HABITAT IMPACTS

Construction in STIA-area wetlands would occur in habitat that is upstream of any documented salmon EFH; therefore, potential effects are limited to indirect effects (i.e., short-term changes in water quality that could occur from increased turbidity and suspended sediment) transmitted downstream into EFH. BMPs specified in the BA to avoid, reduce, or control turbidity and suspended sediment will prevent potential adverse effects of construction and operations on downstream salmon EFH.

The proposed relocation of Miller Creek would occur in an area upstream of a long-standing natural migration barrier to coho salmon; therefore, it is unlikely that any direct impacts to coho salmon could occur during construction or operations of MPU improvements. However, coho EFH was identified by NMFS as possibly occurring upstream of the migration barrier, so the channel relocation could directly adversely affect coho EFH during construction by the removal and replacement of physical habitat features and associated aquatic prey. Because high-quality habitat will be constructed in the new channel, physical habitat conditions (e.g., bank slope, channel substrate, channel morphology, instream structures, and riparian vegetation) will be greatly improved from current conditions. The short-term loss of low-quality (i.e., low abundances and diversity) aquatic and terrestrial prey constitutes an adverse affect on coho salmon EFH by increasing competition for food in adjacent undisturbed habitat, if these fish were present above the natural barrier. However, these adverse effects will be short-term and the reconstructed habitat would provide greatly improved riparian and aquatic habitat conditions for high-quality prey production within months of the reconstruction. The overall long-term result of these actions will be a "no effect", and, in fact, will be beneficial to the species.

Additional short-term impacts to creek water and substrate could also occur through increased turbidity and suspended sediment from soil disturbance during construction. By incorporating construction BMPs, which include the controlled introduction of water into the new creek channel and "first flush" removal and infiltration, the most significant source of turbidity and suspended sediment will be minimized. Given the distance between the construction site and downstream documented coho EFH, there will be no adverse effects of increased turbidity and suspended sediment in the water column or substrate below the falls, where coho salmon and accessible coho EFH are found.

Construction activity for habitat enhancement is planned at various locations within the middle and lower reaches of Miller, Walker, and Des Moines creeks. Habitat enhancement with large woody debris and gravel bars, bank stabilization with geotextile, auto and footbridge removal, rock weir removal, culvert removal, and riprap/rock/debris removal at numerous locations would involve in-water work that could directly adversely affect water quality and creek habitat conditions where EFH occurs for the short-term. Short-term direct effects could result from increased turbidity and suspended sediment during construction, loss of (poor-quality) habitat features, reduction in aquatic insects (i.e., salmon prey species), and loss of (poor-quality) riparian vegetation. Long-term, there will be no effect on coho EFH, and, in fact the action will likely benefit the species. This will be achieved by implementing erosion control and bank stabilization, habitat enhancement with large woody debris, substrate enhancement with gravel bars, bank restoration following riprap/rock/debris removal, channel enhancement following auto and footbridge removal, and fish passage improvement following weir and culvert removal. In addition, restoration and enhancement of riparian buffers, including plantings of native vegetation, would improve the production of both aquatic and terrestrial insects (i.e., salmon prey species).

By incorporating construction BMPs, which include silt fencing and a temporary diversion (for weir removal), the most significant sources of turbidity and suspended sediment will be minimized. In addition, a variety of in-basin conservation and enhancement and out-of-basin mitigation measures are planned. These potential habitat impacts and associated conservation and enhancement measures are discussed in the BA (FAA 2000) and the *Draft Natural Resource Mitigation Plan for Seattle-Tacoma International Airport Master Plan Update Improvements* (Parametrix 1999a). No long-term adverse effects are anticipated on estuarine or marine EFH from any upstream construction activities.

4.4 WATER QUALITY IMPACTS

Water quality in Miller and Des Moines creeks could potentially be affected by projects described in the MPU; these projects include construction activities and increases in impervious surface that could lead to additional sediment and contaminants in stormwater runoff. Potential impacts to water quality from construction activities were discussed in the Aquatic Habitat section. STIA operations could further impact water quality in each creek because of: (1) conventional pollutants associated with stormwater from transportation-related development, (2) ground and aircraft de-icing activities, and (3) discharge of effluent from the IWS system. Impacts on chinook salmon EFH from construction and operation and proposed mitigation measures are described in detail in the BA (FAA 2000); however, the BA did not include an evaluation of water quality impacts above the estuaries of Miller and Des Moines creeks where coho salmon EFH is present. To complete the BA analysis for coho EFH, an evaluation of water quality impacts on coho salmon EFH (which extends upstream of chinook EFH) is provided here.

A variety of analysis techniques and weight-of-evidence evaluations are necessary to determine if any potential water quality impacts on EFH species may be attributable to airport operations after implementation of the MPU projects. This approach is needed because it is impossible to continuously measure or predict all concentrations in water where EFH species could be exposed or to observe all their responses to these concentrations. This approach is based on the best available scientific techniques used by regulatory agencies, such as the U.S. Environmental Protection Agency (EPA), to establish criteria protective of aquatic resources. Water quality criteria themselves were not used in this evaluation because they were developed to protect 95 percent of all aquatic species, and may not be specifically protective of EFH species (Stephan et al. 1985).

4.4.1 Stormwater Quality and Effects

Chemical concentrations in stormwater and their associated toxicity thresholds for coho salmon were developed using the same approaches outlined in the BA (FAA 2000). Impacts of chemicals in stormwater on coho salmon were then determined by comparing modeled exposure concentrations to the identified toxicity thresholds.

4.4.1.1 Ground De-Icing, Sanding, and Aircraft De-Icing

Impacts from ground de-icing, sanding, and aircraft de-icing were evaluated in the BA (FAA 2000) for chinook salmon in the estuaries. The conclusions presented in that evaluation that these activities would not adversely affect listed salmonids or their critical estuarine habitat apply equally here to pink and coho salmon EFH. Based on the toxicity threshold values presented in Table 4-1, concentrations of aircraft de-icing compounds in Miller and Des Moines creeks are not expected to adversely affect EFH salmon and their habitat.

4.4.1.2 Conventional Pollutants—Copper and Zinc—in Miller Creek, Des Moines Creek, and IWS Effluent

Using methods described in the BA (FAA 2000), copper, zinc, and both propylene and ethylene glycol concentrations were mathematically modeled at the upper limit of current coho presence in Miller (the "falls") and Des Moines (the "ravine") creeks and the IWS outfall. (See Appendix F of the BA [FAA 2000] for a complete description of the modeling approach.) These locations also represent the likeliest highest concentration of these substances related to discharges from STIA during construction and operations. The mathematical model used the hydrologic flow data from Miller and Des Moines creeks over the last 49 years and water quality data to produce a cumulative distribution of predicted copper and zinc concentrations that would occur during a 49-year period (Table 4-1).

Similarly, the maximum potential flow of IWS effluent to marine outfall was used to predict the concentration of copper and zinc in effluent discharged to the Puget Sound (Table 4-2). In contrast to Miller and Des Moines creeks, it was possible to calculate concentrations for copper and zinc near the IWS outfall where EFH may occur because of the likelihood that Puget Sound background concentrations are significantly lower than the concentrations of the effluent. Effluent concentrations were predicted at 0.5 m and 10.8 m from the discharge point at the terminal 5-inch port at the end of the diffuser. These distances were chosen based on a plume velocity of 1.0 m/s (the maintenance swimming speed for an average sized adult chinook salmon [Groot et al. 1995]) and the acute mixing zone boundary. For both adult and juvenile coho, potential exposure concentrations would be lower than those predicted for adult chinook because plume velocities would "push" coho farther from the outfall (i.e., coho salmon's smaller size and relatively slower

Table 4-1. Predicted amount of time in 49 years that copper, zinc, propylene glycol, and ethylene glycol will be at or greater than specific concentrations at the "Falls" and "Ravine", respectively, of Miller and Des Moines creeks.

	Exceedance (Percent)[1]	Exceedance (Days)[2]	Miller Creek at the "Falls"	Des Moines Creek at the "Ravine"
Copper				
	0.01%	2 days	0.0424	0.0857
	0.1%	18 days	0.0310	0.0750
	1%	179 days	0.0255	0.0589

Table 4-1. **Predicted amount of time in 49 years that copper, zinc, propylene glycol, and ethylene glycol will be at or greater than specific concentrations at the "Falls" and "Ravine", respectively, of Miller and Des Moines creeks.**

	Exceedance (Percent)[1]	Exceedance (Days)[2]	Miller Creek at the "Falls"	Des Moines Creek at the "Ravine"
Zinc				
	0.01%	2 days	0.2348	0.2350
	0.1%	18 days	0.1830	0.1955
	1%	179 days	0.1572	0.1487
Propylene Glycol				
	0.01%	2 days	1.9670	34.7400
	0.1%	18 days	1.2830	37.3700
	1%	179 days	0.8045	12.4400
Ethylene Glycol				
	0.01%	2 days	1.4469	15.7400
	0.1%	18 days	0.9368	11.9600
	1%	179 days	0.5872	5.2360

1 Percent of time in 49 years copper or zinc exceeds reported concentrations.
2 Number of days copper, zinc, or glycol concentrations exceeds reported concentrations during 49 years, not all of which would be contiguous over this time period.

Table 4-2. **Predicted concentrations of copper and zinc in the vicinity of the IWS outfall.**

Location in the Action Area	Distance from Diffuser Port	Copper, mg/L	Zinc, mg/L
IWS Outfall	0.5 meters	0.030	0.103
	10.8 meters	0.002	0.007

swimming speeds would keep them farther from the plume) in the extremely unlikely event they are present at the depth of the outfall.

These predicted copper and zinc concentrations were then compared with the acute toxicity thresholds for coho salmon (Table 4-3). Toxicity values for the various Aircraft De-Icing and Anti-Icing Fluids (ADAF) containing either propylene or ethylene glycols are based on the same surrogate species reported Section 7.1.3.2 of the BA. Data for both copper and zinc were available for coho salmon from these sources.

Table 4-3. **Copper toxicity values for coho salmon.**

Species	LC50 Toxicity Value[a]	
	Copper, mg/L	Zinc, mg/L
Coho salmon	0.07025	1.628

Source: USEPA (1985, 1987)
a LC50 toxicity values are based on 96 hours of continuous exposure measured in freshwater. It is unlikely salmon would remain the vicinity of the IWS outfall for 96 consecutive hours.

None of these predicted concentrations at the IWS outfall or the "falls" and "ravine", respectively, of Miller and Des Moines creeks for these exposure periods (distributed over 49 years) should adversely effect on water quality that could present a risk to salmon. Therefore, the discharge of stormwater from STIA will not adversely affect the water quality in creeks, estuaries, or marine resulting in no adverse effect on coho, chinook, or pink salmon EFH.

This conclusion is based on these observations:

- Zinc concentrations in each of the three exposure locations (the "falls" of Miller Creek, the "ravine" of Des Moines creeks, and the IWS outfall) are always below the adverse affects level for coho salmon. Concentrations for exposure durations relevant to the toxicity tests used to develop these toxicity values (96 hours or more) are significantly below these values. Similarly, zinc concentrations 10 meters or more from the outfall diffuser are also significantly below the zinc toxicity values for coho salmon.

- Copper concentrations in both Miller and Des Moines creeks will have limited bioavailability due to the very high levels of dissolved organic carbon present in both creeks, as well as stormwater discharged from Port operations (Table 4.4). These levels are elevated relative to the median total organic carbon (TOC) and dissolved organic carbon (DOC) concentrations of the ambient waters of British Columbia[15], which are generally less than 5.0 mg/L (Fast 1999). Emerging research has indicated that dissolved organic carbon concentrations competitively bind copper, reducing or eliminating copper binding with fish gills (Hollis et al. 1997; Meyer et al 1999; Playle and Dixon 1993). For example, Hollis et al. (1997) demonstrated that 5 mg/L DOC kept copper from binding to gills of rainbow trout in 9-day exposures to 0.5 μM (31.8 μg/L) copper in soft water, eliminating any acute toxicity over this time period. With DOC concentrations in Miller and Des Moines creeks ranging from 3.08 to 12.1 mg/L, increases in copper concentration resulting from stormwater discharges will not be acutely toxic to coho salmon, and will therefore not adversely affect the quality of coho EFH in either stream.

Table 4-4. Total and dissolved organic concentrations in different locations in Miller and Des Moines creeks

Sample Location	Sample Date	TOC (mg/L)	DOC (mg/L)
Des Moines Creek Weir, Just above S. 200th Street	04/14/00	7.55	7.22
Des Moines Creek, East Branch	01/14/99	3.91	3.08
Des Moines Creek, West Branch	01/14/99	7.70	7.36
Lake Reba	01/14/99	6.64	6.18
Main Airfield Outfall	01/14/99	6.25	8.49
Miller Creek	04/14/00	14.10	12.10
Miller Creek, Upstream of Port Discharges	04/14/00	12.50	10.90
Northwest Ponds Inlet	04/14/00	12.60	12.10

[15] These data are provided to establish the general levels of DOC typically present in Pacific Northwest streams. The general soil, parent rock, rainfall, and stream flow characteristics of British Columbia streams are sufficiently similar to Washington State for these levels to be relevant to Washington State streams.

Sample Location	Sample Date	TOC (mg/L)	DOC (mg/L)
Northwest Ponds Outlet	04/14/00	7.63	7.84
SDE4	04/13/00	7.11	6.27
SDS3	04/13/00	12.00	8.88

- Chronic exposure conditions are not present in Miller or Des Moines creeks. Increases in copper concentration in both creeks are directly associated with storm events, which only last an average 18 hours in December (the month with the longest average duration storms) (Perrich 1992). Baseflow concentrations of copper were approximately 2 µg/L dissolved copper (Herrera Environmental Consultants 1995, 1996, 1997), a level that will not be toxic given the very high levels of DOC present in coho EFH in Miller and Des Moines creeks.

The stormwater analysis contained in the June, 2000 BA was based on information contained in the November 1999 *Preliminary Comprehensive Stormwater Management Plan* (SMP) *for Seattle-Tacoma International Airport Master Plan Update Improvements* (Parametrix 1999b). After submission of the June, 2000 BA, King County completed a technical review of the November 1999 SMP through an agreement with the Washington Department of Ecology (Ecology). Following this technical review, an updated SMP was submitted to King County and Ecology in August, 2000 (Parametrix 2000d). King County subsequently completed a technical review of the August, 2000 SMP as well. As part of the ongoing discussions between the Port of Seattle and Ecology concerning CWA 401 Certification, updated data were submitted to King County and Ecology in October 2000 in response to the technical review of the August, 2000 SMP. King County subsequently found these data to be consistent with the stormwater management standards. The updates and revisions provided in this document are based on the King County-reviewed unpublished October, 2000 data and represent the best available scientific and commercial data.

4.4.1.3 Hydrologic Impacts

Water quantity effects on salmon EFH could include hydrologic changes to creek flows (e.g., increased peak and reduced base) and wetland function. These actions could affect instream habitat quality for coho EFH and estuarine habitat quality for coho and chinook EFH at the creek mouths. Detailed descriptions of impacts from base and peak flow alteration, stormwater flows, and wetland fill, and associated mitigation for any identified impacts, are provided in the BA (FAA 2000) and are summarized in the Stormwater supplement to the BA (Parametrix 2000d). Discharge velocities within the IWS marine outfall plume may exclude salmon from using a portion of the marine water column for swimming and foraging, but marine water column habitat has not been demonstrated to be a limiting habitat in Puget Sound. Therefore, the limited use of water column habitat around the IWS outfall will have no adverse effect on salmon EFH.

5. CONSERVATION AND ENHANCEMENT MEASURES

A variety of conservation measures and mitigation actions have been incorporated into the proposed construction and operational phases of the project to protect, enhance, and restore coho stream and riparian habitats in the respective watersheds. These actions will also ensure protection of estuarine and marine shoreline EFH located near the mouths of Miller and Des Moines creeks.

This section summarizes actions incorporated into the MPU improvement projects to mitigate adverse impacts to wetlands, streams, floodplains, and drainage channels. Mitigation activities address three categories of impacts: (1) habitat modification and enhancement, (2) water quality, and (3) changes in hydrology (water quantity) as a result of new impervious surface. These mitigation actions are summarized below and described in detail in the BA Chapter 7 and in the *Draft Natural Resource Mitigation Plan* (Parametrix 1999a). Conservation measures also include BMPs designed to protect aquatic resources during the project construction. These measures will be incorporated to avoid habitat degradation, including potential downstream effects on estuarine EFH that could be used by chinook, pink, and coho salmon.

5.1 HABITAT MODIFICATION AND ENHANCEMENT

Conservation measures to protect and enhance EFH, including fish, riparian, and wetland habitat (Tables 8-3, 8-4, and 8-5 of the BA) are described in Section 7.3 of the BA (FAA 2000). These actions would compensate for project-related impacts to habitat functions and enhance existing habitat through a variety of actions focused on Miller and Des Moines creeks. Additional habitat modification for coho EFH will include instream improvements on Miller Creek from the installation of large woody debris along the channel, the construction of habitat features in the relocated creek segment (e.g., notched log sills with pools), and the removal of rock weirs that may have obstructed fish passage.

5.1.1 Water Quality Mitigation

Water quality conservation and mitigation activities include pollutant source control, water quality treatment (including the IWS), and off-site enhancements of wetland and stream water quality functions. These actions are listed in Table 8-1 of the BA and Section 7.1.4 of the BA. As described in Section 7.1.4.4 of the BA (FAA 2000), stormwater treatment is designed to serve 189 percent of the new impervious surface associated with the project. At this level of treatment, the potential inefficiencies of BMPs are compensated for and no significant water quality degradation would occur (Appendix C).

Short-term water quality degradation, through turbidity and suspended sediment, could adversely affect the portions of the Miller Creek Enhancements Projects requiring earthwork in or near the active channel (i.e., creek relocation, removal of weirs, placement of log structures in the banks, placement of large woody debris). Flow diversion around construction areas (i.e., at the Miller Creek relocation site and at the rock weirs to be removed) will be used to prevent increases in turbidity and suspended sediment in the construction areas and downstream. Diversion methods were described in detail in the BA (FAA 2000).

In all construction areas along the wetted channel, silt curtains will be used to limit the adverse effects of construction-related turbidity and prevent suspended sediment from being transported into the stream channel and downstream. In small areas of localized bank construction (e.g., where large woody debris or log sills will be anchored), silt curtains would be placed along the waterline, possibly extending into the water, to completely isolate the work area from any flowing portion of Miller Creek. The silt curtain would be constructed by attaching an impermeable fabric to a wire backing, supported by stakes driven into the substrate. The bottom of the silt curtain would include enough material to place flat on the streambed, weighted with sandbags to form a rough seal.

The work area within the silt curtains would be dewatered to allow more effective earthwork. Because a perfect seal against the substrate will not likely be possible, a pump will be operated to remove water leaking into the enclosure and to maintain a negative gradient. Any water pumped from the enclosure will be dispersed over upland areas for biofiltration and infiltration. The pump intake will be screened to prevent amphibians (e.g., frogs, salamanders) from being drawn into the pump.

5.2 HYDROLOGIC IMPACTS AND MITIGATION

This section provides the most current information on the hydrologic impacts and mitigation of MPU Improvements on salmon EFH. King County completed a technical review of the November 1999 SMP through an agreement with the Washington Department of Ecology (Ecology), and an updated SMP was submitted to King County and Ecology in August 2000 (Parametrix 2000c). King County has subsequently completed a technical review of the August 2000 SMP. As part of the ongoing Port and Ecology discussions regarding the Ecology 401 Certification, updated data were submitted to King County and Ecology in October 2000 and subsequently found by the County to be consistent with the stormwater management standards described below. The revised accepted stormwater data will be published in a revised SMP prior to the new Public Notice for the 404 permit. The updates provided in this section are based on the King County-reviewed unpublished October 2000 data.

The listed species evaluated here could be impacted from increasing the impervious area. These actions could increase peak flows and reduce base flows in Miller and Des Moines Creeks, and thus effect habitat quality at the mouths of these creeks. The addition of new impervious area associated with the MPU improvements affecting the hydrology of Miller and Des Moines Basins are discussed in the following sections, along with associated mitigation measures that compensate for these actions.

5.2.1 Flow Impacts

The activities associated with implementing the MPU improvements will include adding new impervious surfaces (new runways, taxiways, parking, and roadways) This action, if unmitigated, could change the hydrologic flow regime of Miller and Des Moines Creeks, including increased peak-flow magnitude and frequency, and increased peak-flow duration. The potential effects of high-flow impacts in the stream are increased erosion and sedimentation, habitat damage from scouring flows, and impaired habitat use during high-flow period.

Potential impacts in critical habitat in the estuaries of Miller and Des Moines Creeks include increased sedimentation in these estuaries caused by high-flow erosion in the upper watershed and potential changes in the estuarine hydrology. However, with flow mitigation, it is unlikely that the critical habitat at the mouths of these creeks could be affected by hydrologic changes when flows in the creeks relative to the influence of tides are considered. Proposed peak-flow mitigation reduces peak flows from existing levels in both creeks, which will reduce bank and channel erosion as well as sedimentation in estuaries. Additional detail on hydrology and stormwater management are provided in the *Preliminary Comprehensive Stormwater Management Plan for Seattle-Tacoma International Airport Master Plan Update Improvements* (Parametrix 2000c), which addresses mitigation of flow impacts on the drainage basins. The plan includes modeling conducted to estimate the impacts of the project on the Miller and Des Moines Creek systems. The Hydrologic Simulation Program – FORTRAN (HSPF) model was used for this purpose. Details of the model application are discussed in the SMP (Parametrix 2000c). This section discusses the results of HSPF modeling and flow mitigation design.

5.2.1.1 Impervious Area

In the Miller Creek Basin, MPU improvement projects will result in a net increase of 98.3 acres[16] of impervious surface area (Table 5-1), increasing the overall impervious area in the basin by about 1 percent above the existing baseline condition (about 25 percent of impervious surface—see Table 4-1 in the November 2000 SMP). In the Walker Creek Basin, MPU improvements will result in a net increase of 2.7 acres. In the Des Moines Creek Basin, MPU improvements will result in a net increase of 137.2 acres of impervious surface, increasing the overall impervious area in the basin by about 4 percent above the existing base condition (approximately 35 percent impervious surface—see Table 4-1 in the November 2000 SMP).

The new impervious surfaces could increase stormwater runoff rates (FAA 1996) and volumes. Unless mitigated, changes in runoff would be expected to increase flooding and erosion, and would degrade instream habitat and water quality in Des Moines and Miller Creeks downstream of stormwater inputs from the improved areas. Chinook salmon critical habitat in the estuaries of Miller and Des Moines Creeks will not be directly altered by runoff from new impervious surfaces in the MPU. In addition, existing hydrologic impacts from existing impervious surfaces will be mitigated.

<u>Stormwater Peak Flow Mitigation</u>

As part of the MPU improvement, the Port will construct stormwater conveyance, detention, and water quality treatment facilities to manage runoff from both newly developed project areas and existing airport areas, as described below. Additional detail on the proposed stormwater controls is provided in the *Preliminary Comprehensive Stormwater Management Plan for Seattle-Tacoma International Airport Master Plan Update Improvements* (Parametrix 2000c). This plan was

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[16] The net change in impervious area includes a reduction of 51.8 acres of impervious surfaces (streets, driveways, and rooftops) that will result when existing houses and streets are removed in the acquisition area. Demolition in these areas is ongoing and is expected to be completed by 2002.

prepared to analyze and describe stormwater management for projects associated with the STIA MPU improvements. The stormwater management facilities will mitigate the impacts of new construction on Miller, Walker, and Des Moines Creeks, as required by current stormwater regulations and mitigation goals identified during the environmental review process. The facilities will also mitigate stormwater impacts from current development by reducing the magnitude and duration of existing peak flows.

Table 5-1. Summary of Miller, Walker, and Des Moines Creek drainage areas at STIA and change in impervious area between 1994 baseline and 2006 future conditions (acres).

	1994 Baseline			2006 Future Condition			Increase in Impervious Area
	Pervious	Impervious[1]	Total	Pervious	Impervious[1]	Total	
Miller Creek							
SDN1	6.2	9.9	16.1	3.5	12.7	16.1	2.8
SDN1LWR	5.0	0.4	5.4	4.8	0.6	5.4	0.2
SDN1OFF	25.8	10.5	36.3	28.3	8.0	36.3	-2.5
SDN2X	7.2	0.3	7.5	5.3	2.2	7.5	1.9
SDN3	33.4	14.5	47.9	23.6	24.3	47.9	9.8
SDN3A	28.6	1.9	30.5	22.2	8.2	30.4	6.3
SDN3X	25.4	0.0	25.4	25.4	0.0	25.4	0.0
SDN4	27.7	2.6	30.3	18.0	12.3	30.3	9.7
SDN4X	14.1	1.1	15.2	11.0	4.2	15.2	3.1
SDW1A	51.9	0.9	52.8	37.4	15.4	52.8	14.5
SDW1B	92.5	4.4	96.9	69.9	27.0	96.9	22.6
NEPL	41.4	0.9	42.3	10.0	32.3	42.3	31.4
CARGO	7.0	1.1	8.1	0.0	8.1	8.1	7.0
Other STIA[2]	246.6	15.1	261.7	247.8	13.9	261.7	-1.2
Walker Creek							
SDW2	41.3	3.3	44.6	35.1	9.5	44.6	6.2
MC8	22.2	6.6	28.8	22.2	6.6	28.8	0.0
MC9	76.1	22.5	98.6	76.1	22.5	98.6	0.0
Des Moines Creek							
SDE4	50.7	115.5	166.2	40.1	126.1	166.2	10.6
SDS1	0.9	16.8	17.7	1.4	16.3	17.7	-0.5
SDS2	7.7	1.5	9.2	8.1	1.0	9.1	-0.5
SDS3	165.5	178.0	343.5	144.3	199.2	343.5	21.2
SDS3A	62.7	7.1	69.8	34.6	35.1	69.8	28.0
SDS4	45.4	19.2	64.6	32.1	32.5	64.6	13.3
SDS5	32.1	0.4	32.5	28.3	4.2	32.5	3.8
SDS6	12.5	4.3	16.7	13.5	3.2	16.7	-1.1
SDS7	83.2	8.0	91.3	55.1	36.2	91.3	28.2
SASA	25.3	8.9	34.3	0.0	34.3	34.3	25.4
Other STIA[3]	135.0	25.0	160.0	134.9	24.8	159.7	-0.2
IWS System							
NCPS	6.9	28.8	35.7	4.8	30.9	35.7	2.1
NSMPS	6.6	0.0	6.6	4.7	2.0	6.6	2.0
NSPS	0.3	13.5	13.8	0.3	13.4	13.7	-0.1
Primary	24.9	233.9	258.8	13.5	289.1	302.6	55.2
SASA	51.8	6.5	58.3	0.1	58.3	58.4	51.8
Total	**1463.9**	**763.4**	**2227.3**	**1156.4**	**1114.4**	**2270.8**	**351.0**

Source: GIS coverage.
[1] Impervious area includes impervious area, lakes, and detention ponds.
[2] Includes subbasins M6, MC1, MC2, MC3, MC4, MC5, MC6, MC7.
[3] Includes subbasins D5, D6, D11, D13.

The overall goal of the SMP is to provide a design basis for all MPU improvements to meet applicable local and state stormwater regulatory requirements for stormwater management and mitigate potential stormwater runoff impacts. The King County Surface Water Design Manual (the King County Manual; King County Department of Natural Resources 1998) and Ecology's Stormwater Management Manual for the Puget Sound Basin (the Ecology Manual; Ecology 1992, 1999b) provide the foundation for these requirements. Additional stormwater management standards were identified to protect Miller, Walker, and Des Moines Creeks from increased stormwater runoff. To achieve these goals, the following specific objectives have been identified:

- Design the MPU improvements in accordance with applicable stormwater regulations and the conditions of approval for the MPU Final Supplemental Environmental Impact Statement (FSEIS) (Port of Seattle 1997b) and the Governor's Certification of Compliance with Applicable Air and Water Quality Standards (the Governor's Certification; Locke 1997);
- Meet Level 2 stormwater discharge criteria (as described in the King County Manual) for all airport runoff, as measured downstream of proposed detention facilities, to mitigate impacts of stormwater peak discharge and flow duration, thereby reducing potential impacts from stream erosion; and
- Reduce existing stormwater impacts by identifying a predevelopment target flow that uses reduced impervious area and extensive forest (retrofitting existing stormwater impacts and developed areas).

In addition to providing stormwater management for all new MPU improvements, the Port is actively working with King County and local jurisdictions to implement the recommendations of the Des Moines Creek Basin Plan (Des Moines Creek Basin Committee 1997), and is supporting a similar planning process for the Miller Creek Basin. The Port is committed to supporting the recommendations of these studies to: (1) improve the management of stormwater runoff in Miller and Des Moines Creeks, (2) help implement those recommendations that are found to be feasible, and (3) explore opportunities to increase the performance of existing facilities, if the proposed enhancement does not create a safety hazard to air traffic.

5.2.1.2 Flow Control for New MPU Improvements and Retrofitting for Existing Airport Areas: Level 2

To protect instream and estuarine habitat the Port has committed to achieving streamflows that maintain or reduce existing peak flow magnitude and duration in Miller and Des Moines Creeks. The Level 2 flow control standard, as defined by the King County Manual, requires matching or improving post-developed flow duration to pre-developed flow durations[17] for all flow magnitudes between 50 percent of the 2-year event and the full 50-year event.

The Level 2 analysis is more protective than stormwater control standards that have been used in the past. Previous controls allowed using an "event model", which is a hydrologic model that compares predevelopment runoff with post-project runoff using a hypothetical design storm. Only peak flows

[17] Flow duration control refers to limiting the duration of geomorphically significant flows (i.e., those flows which initiate bedload movement) to baseline (pre-MPU conditions).

were evaluated for compliance with standards. The Level 2 analysis requires that a "continuous simulation" model is used and actual precipitation runoff is modeled. Pre-development runoff is compared with post-project flows over a range of probable flows. Level 2 flow analysis evaluates flow protection and mitigation measures over a wide range of erosive storm flows, whereas Level 1 analysis and event models are only protective of certain peak flows or flooding events. Level 2 is more protective of stream morphology, habitat (such as stream substrate), and hydrologic flow patterns. The Level 2 flow control standard, as defined by the King County manual, requires matching or improving post-developed flow duration to pre-developed flow durations[18] for all flow magnitudes between 50 percent of the 2-year event and full 50-year event.

The pre-developed condition for the Level 2 standard will be based on a *target flow regime*. The target flow regime used assumes that the existing watershed land cover is 10 percent impervious (or less if the existing impervious area is less that 10 percent impervious), 15 percent pervious "grass," and 75 percent pervious "forest"[19]. Basing target flow on theoretical basin development of 10 percent (Miller Creek and Des Moines Creek existing impervious areas are 25 percent and 35 percent respectively) is expected to reduce existing peak flows and be beneficial in maintaining stable stream channels.

In the Des Moines Creek Basin, the target flow regime was determined in a study by the University of Washington (King County CIP Design Team 1999). The flow regime determined for Des Moines Creek coincides with a target flow regime that would occur with an effective watershed impervious area of 10 percent. In studies of several Puget Sound streams, Booth and Jackson (1997) identified an approximately 10 percent impervious area threshold above which stream channel instability and habitat degradation occur.

The net result of flow retrofitting in the watersheds will be to replicate a flow regime that would occur at a watershed imperviousness of 10 percent, downstream of STIA in Miller Creek Des Moines Creek , *before flow impacts and controls for the MPUs are considered*. That is, even though the Miller Creek and Des Moines Creek watersheds have an existing impervious area of about 25 and 35 percent, respectively, the flows in both streams would be reduced to a level corresponding to approximately 10 percent impervious area in each basin[20] (for the basin upstream of the MCDF and Des Moines Creek RDF).

5.2.1.3 Estimated Detention Storage Requirements

Proposed stormwater detention facilities for the MPU were designed based on the drainage area served by each facility, the detention standard, the detention storage volume required to meet the

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18 Flow duration control refers to limiting the duration of geomorphologically significant flows (i.e., those flows that initiate bedload movement) to baseline (pre-MPU) conditions.

19 In areas where existing impervious area is less than 10 percent, the impervious area is not changed and the difference between actual percent impervious and 10 percent is assumed to be grass.

20 The HSPF model was calibrated with recorded flow data and actual basin land use prior to simulation of adding Level 2 flow control retrofits. The calibration accounts for flows attributable to each type of land use, based on existing conditions. Flows for other land use and hydrologic control conditions (such as 10 percent impervious surfaces and the Level 2 flow control retrofit) were then simulated using the HSPF model.

flow control standards, and potential for waterfowl attraction. Approximately 327.4 acre-ft of new stormwater detention storage will be needed to mitigate the impacts of increased stormwater runoff (Table5-2) associated with MPU projects. The locations of new facilities are shown in Figure 2 of the *Supplement to the Biological Assessment, Master Plan Update Improvements Seattle-Tacoma International Airport* (Parametrix 2000c) (see Appendix A for a reprint of this figure).

Further refinement of stormwater detention storage volumes will occur during the final design of the Stormwater Management Improvements for each MPU project. During this process the hydraulic design of the facilities will be reevaluated and detention volumes adjusted as appropriate to ensure that the Port's stormwater management standards are met. Hydraulic design reports for each proposed facility will document these detailed modeling and design analyses.

Pond and Vault Construction and Operation

The feasibility of proposed stormwater ponds and vaults is demonstrated by the recent construction of similar facilities at STIA, including the NEPL Vault (1997) and the Interconnecting Taxiways Vault (1998). Only the South Aviation Support Area (SASA) detention pond will displace wetlands, a 0.06-acre shrub wetland. All other on-site detention facilities will be constructed in non-wetland areas. The primary discharge from the detention facilities is predicted to be surface discharge (not infiltration), although infiltration will continue to be evaluated to enhance base flows or reduce detention facility size. Detention facilities will consist of dry ponds with live storage[21] and will not include wet ponds with dead storage

Net Result of Hydrologic Mitigation

The net result of flow controls for the MPU improvements will be to reduce flows in Miller, Walker, and Des Moines Creeks to a stable flow regime downstream of STIA discharges (Tables 5-3 and 5-4). Level 2 facilities will retrofit existing flows to the target watershed flow regime before new development is considered. The net effect of flow controls for Miller, Walker, and Des Moines creeks (Figures 5-1, 5-2, and 5-3) will be to maintain flows below existing conditions or the target watershed flow regimes following Master Plan construction and flow mitigation, whichever is less. The target flow regime will reduce flows in the stream channels, thereby reducing erosion and improving channel stability.

21 Live storage is that volume of stormwater stored in a detention facility that drains following the storm. Live storage is used for hydrologic benefit to reduce flow peaks and durations.

Table 5-2. Summary of required detention facility volumes.

Watershed	Hydrologic Evaluation Point	Volume Required (acre-ft)	Type of Facility[a]	Comments
Miller Creek	NEPL	13.9[b]	Vault	In addition to existing 4 ac-ft
	CARGO	4.5	Vault	
	SDN2x + SDN4x	14.9	Vault	
	SDN3/3x	25.6	Vault	
	SDN1	5.6	Vault	
	SDN3A	Pond: 14.8 / Vault: 7.0	Pond/Vault	
	SDW1A	Pond: 25.5 / Vault: 7.4	Pond/Vault	Infiltration used
	SDW1B	38.3	Pond	Infiltration used
Total Miller Creek		**157.6**		
Walker Creek	**SDW2**	**7.2**	**Pond**	
Des Moines Creek	SASA Detention Facility	33.4[c]	Pond	
	Interconnecting taxiway (SDS3A)	5.5	Vault	
	Third Runway South (SDS7 and 6)	21.6	Vault	
	SDS3	88.3	Vault	
	SDS4	12.9	Vault	
Total Des Moines Creek		**161.7**		

[a] Types of facilities: Vault – enclosure with multiple orifice outlets on vertical riser with overflow spillway; Pond – open earth construction with netting or other means to provide wildlife deterrent.

[b] Volume needed to retrofit existing facility.

[c] Retrofit STIA area only.

Table 5-3. Summary of pre- and post-project flood peak flow frequency results for Miller/Walker Creek subbasins (all values are cubic feet per second).

Return Period Peak	NEPL		CARGO		SDW2		SDW1B		SDN3A (Vacca)	
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2 [b]	0.61	0.22	0.12	0.05	1.65	0.54	0.68	0.19	0.27	0.09
Q_2	1.22	0.44	0.24	0.09	3.30	1.07	1.35	0.39	0.53	0.18
Q_{10}	1.70	0.73	0.33	0.14	6.22	2.83	2.11	0.82	0.75	0.28
Q_{25}	1.96	0.96	0.38	0.18	7.71	4.60	2.57	1.28	0.87	0.34
Q_{50}	2.16	1.18	0.42	0.21	8.82	6.53	2.96	1.80	0.96	0.40
Q_{100}	2.37	1.46	0.46	0.25	9.92	9.21	3.39	2.54	1.05	0.45

Return Period Peak	SDW1A		SDN3, SDN3X		Combined SDN2X/SDN4/SDN4X	
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	0.15	0.07	0.71	0.25	0.57	0.22
Q_2	0.30	0.14	1.41	0.50	1.15	0.44
Q_{10}	0.58	0.18	2.01	0.83	1.61	0.65
Q_{25}	0.79	0.19	2.33	1.06	1.86	0.78
Q_{50}	0.99	0.20	2.58	1.27	2.06	0.88
Q_{100}	1.24	0.20	2.84	1.52	2.26	0.99

Return Period Peak	Miller Creek at SR509[a]		Walker Creek at SR509		SDN1	
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	22.81	22.36	1.90	0.95	0.28	0.12
Q_2	45.62	44.72	3.80	1.90	0.56	0.24
Q_{10}	67.23	64.93	6.83	3.48	0.79	0.40
Q_{25}	77.29	74.11	8.51	4.57	0.91	0.54
Q_{50}	84.53	80.63	9.83	5.54	1.00	0.67
Q_{100}	91.58	86.92	11.20	6.66	1.10	0.82

[a] Does not include any retrofit of MCDF for non-airport property development
[b] Q represents flow in cubic feet per second. For example, Q_2 is the flow at the 2 year return period peak and Q_{100} is the flow at the 100 year return period peak..

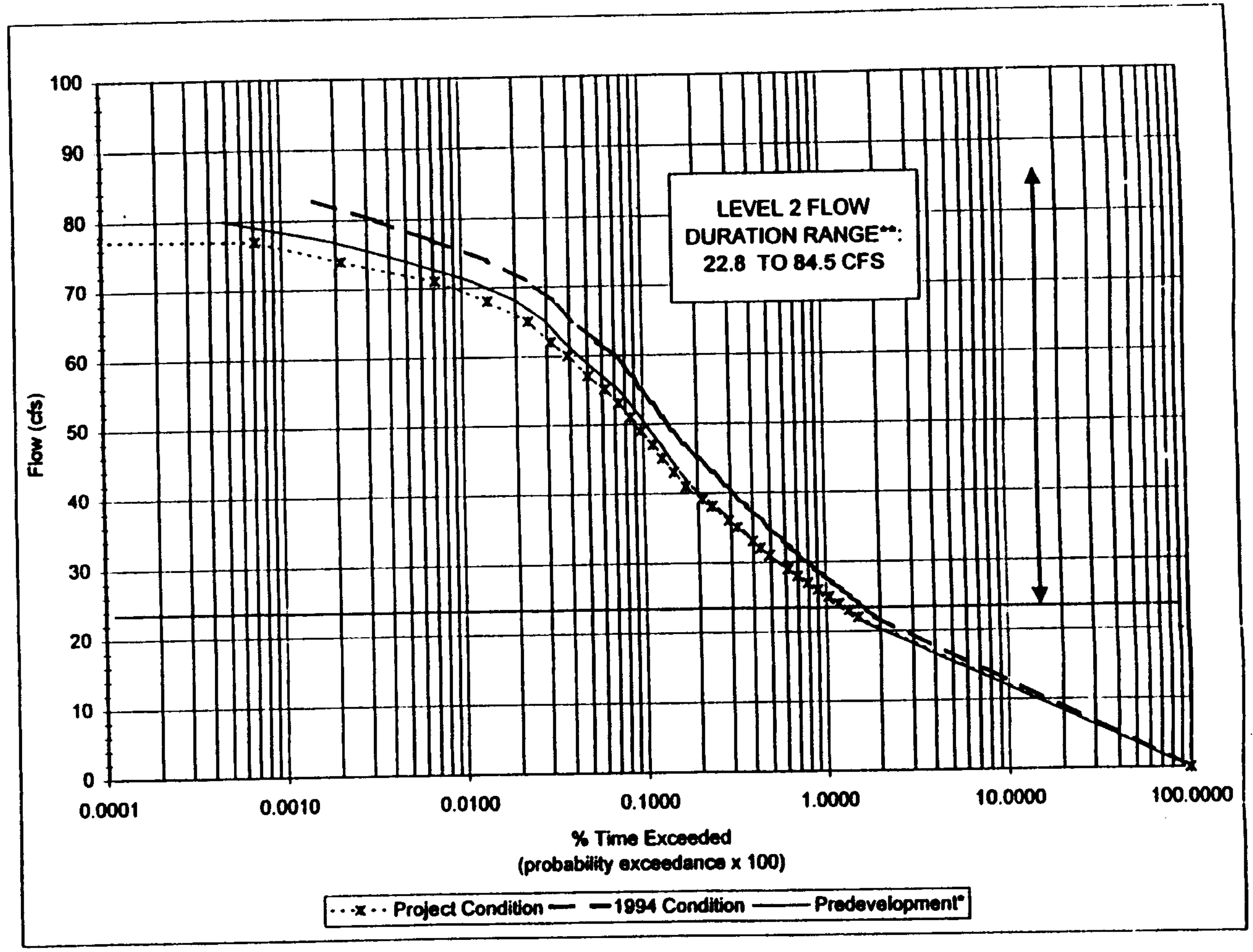
Table 5-4. **Summary of flood peak flow frequency results for Des Moines Creek subbasins (all values are cubic feet per second).**

Return Period Peak	SASA[a]		SDS3		SDS3A	
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	37.25	13.56	6.03	2.40	1.22	1.52
Q_2	74.50	27.13	12.06	4.79	2.45	3.05
Q_{10}	114.55	44.53	21.07	10.85	4.28	7.80
Q_{25}	137.75	56.20	26.92	16.51	5.47	12.09
Q_{50}	156.42	66.33	31.92	22.46	6.49	16.50
Q_{100}	176.31	77.81	37.52	30.39	7.62	22.26

Return Period Peak	SDS4		SDS - Point of Compliance	
	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	0.86	0.35	8.06	4.35
Q_2	1.72	0.69	16.11	8.71
Q_{10}	2.65	1.29	28.45	18.58
Q_{25}	3.21	1.80	36.55	26.66
Q_{50}	3.67	2.29	43.51	34.51
Q_{100}	4.17	2.92	51.33	44.30

Return Period Peak	SDS7		Des Moines Creek @ S. 200 St.	
	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	1.47	0.64	55.72	36.29
Q_2	2.94	1.28	111.45	72.58
Q_{10}	5.23	2.84	184.86	117.11
Q_{25}	6.73	4.45	231.02	145.08
Q_{50}	8.03	6.25	269.81	168.55
Q_{100}	9.48	8.77	312.64	194.44

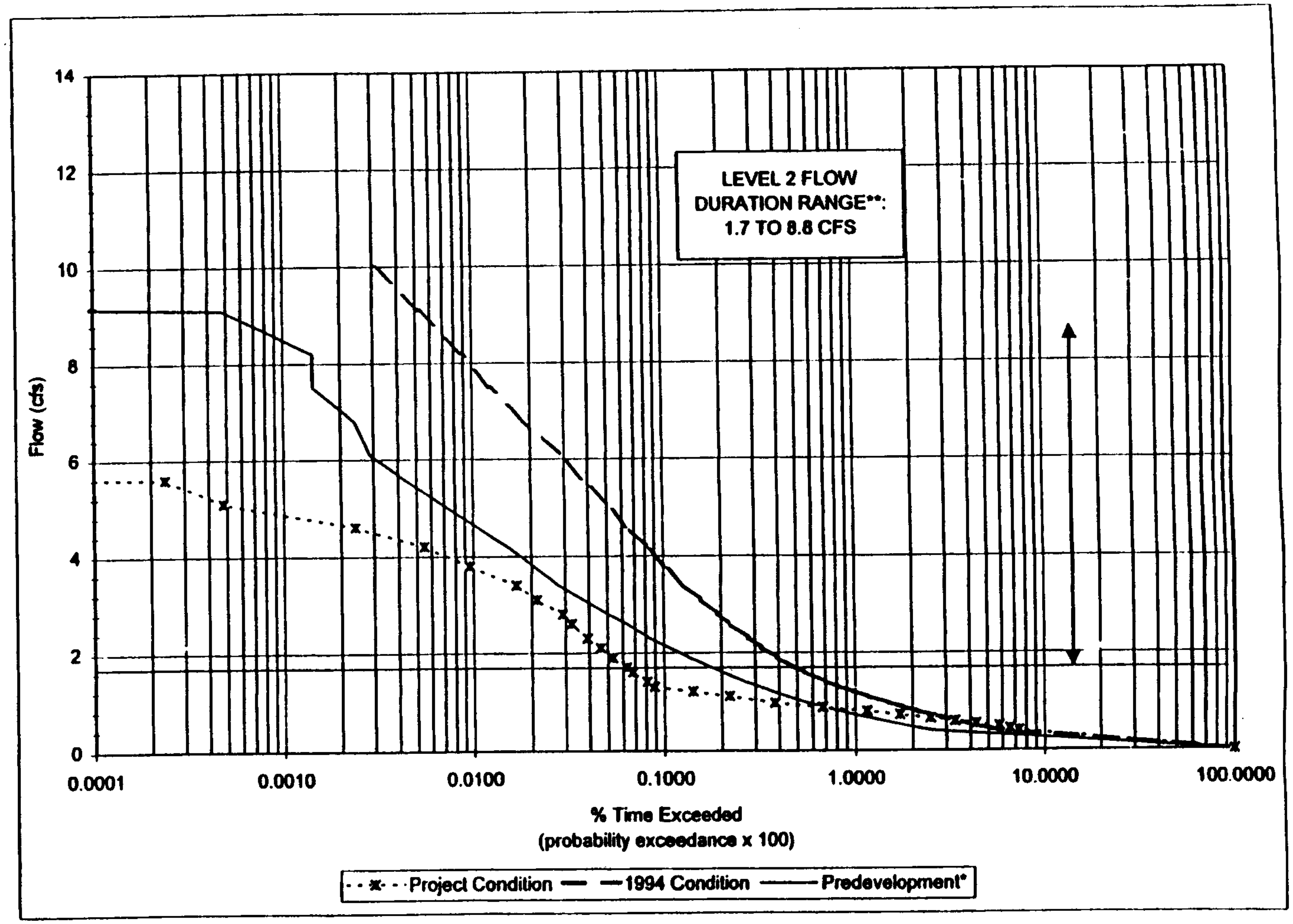
[a] Based on analysis of STIA properties draining to SASA; non-STIA tributary area is not included.



* Port basins use target flow regime (10-75-15). Off-site basins use 1994 conditions.

** For the target flow regime.

Figure 5-1
Flow Duration Curve for
Miller Creek at SR509

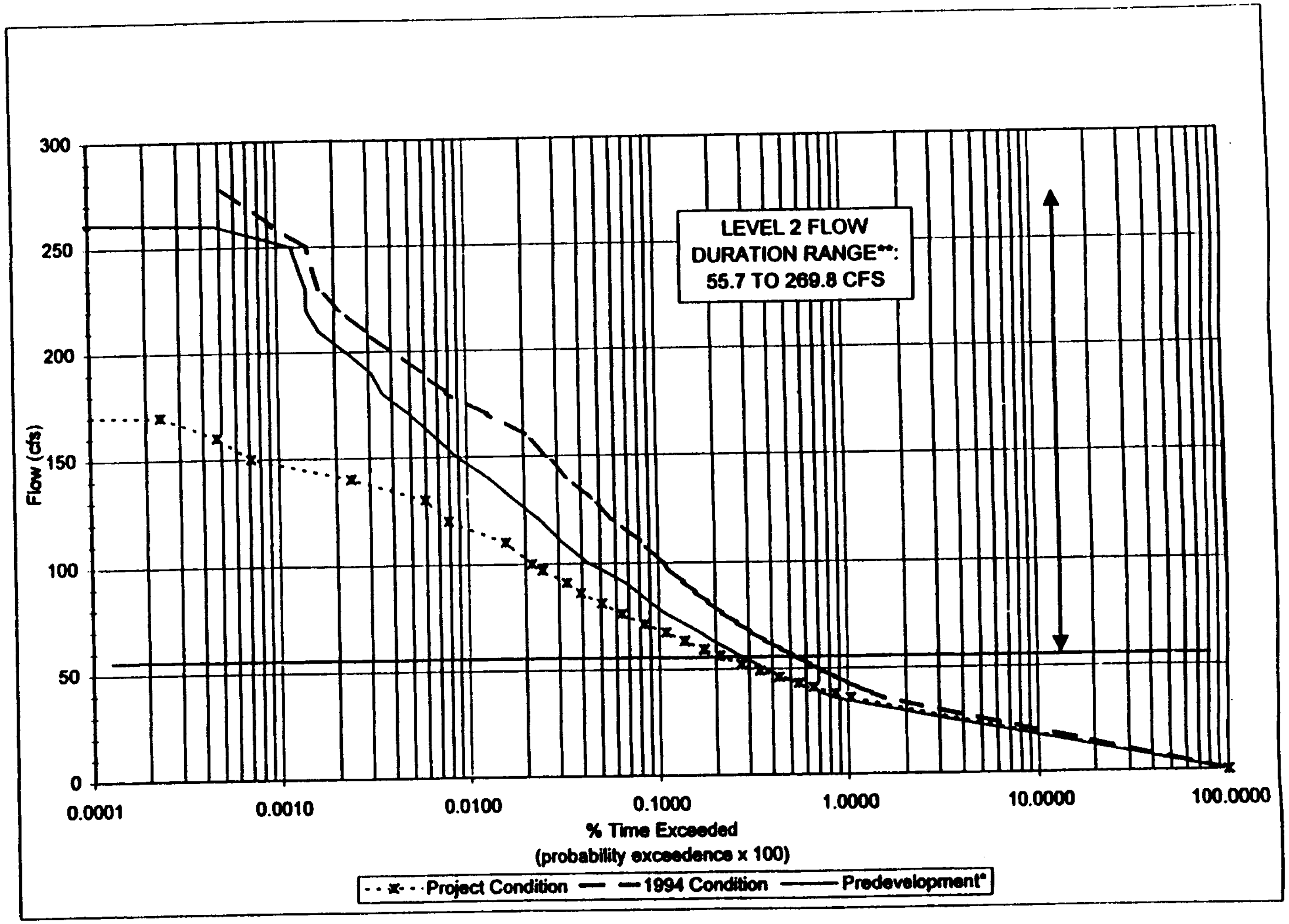


* Port basins use target flow regime (10-75-15). Off-site basins use 1994 conditions.

** For the target flow regime.

Figure 5-2
Flow Duration Curve for
Walker Creek at South 12th Street

AR 019437



* Port basins use target flow regime (10-75-15). Off-site basins use 1994 conditions.
** For the target flow regime.

Figure 5-3
Flow Duration Curves for Des Moines Creek at South 200th Street

6. EFFECTS DETERMINATION

The following section summarizes the effects of the proposed MPU improvements projects on chinook, pink, and coho salmon EFH. The effects of the projects are evaluated based on criteria defined by MSA (NMFS Regulations, 50 CFR §§ 600.905 through 600.930), NMFS Essential Fish Habitat Consultation Guide (NMFS 1999a), and NMFS Washington Habitat Conservation Branch in: *A Guide to Salmon Essential Fish Habitat Assessments* (NMFS 1999b).

6.1 DIRECT EFFECTS

The analysis of effects (either "no effect" or "may adversely effect") is summarized for key project actions according to how they may affect the quantity and/or quality of properly functioning salmon EFH. These actions are:

- Effects of constructing projects in uplands. This analysis considers effects of soil disturbance and stormwater management on construction sites as the primary pathway that could affect salmon habitat. This analysis also considers the significance of altering or eliminating wetland and stream habitat, and the new mitigation created in both the Miller and Des Moines Creek basins. Significant pathways of these actions are direct alteration of habitat and construction impacts (including stormwater runoff).
- Effects of constructing projects in the Green River Watershed. The off-site wetland habitat mitigation in Auburn and new water tower construction are the only actions in the Green River Watershed. Construction of the new water tower will result in no change in impervious surface or land use types. Consequently, potential pathways affecting salmon habitat are only construction impacts (dewatering and stormwater runoff).
- Effects of operation. This analysis considers operational effects of Master Plan projects and mitigation on salmon habitat. The primary pathways affecting habitat are the habitat benefits derived from mitigation, the effects of stormwater runoff (quality and quantity) on habitat at the mouths of Miller and Des Moines creeks, and potential spill of hazardous materials.

6.2 CUMULATIVE, SYNERGISTIC, AND INDIRECT EFFECTS

For the purposes of this EFH assessment, cumulative impacts are impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes such actions. See, e.g., 50 C.F.R. § 600.815(a)(6). Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. [Note, for purposes of EFH, future federal actions are not excluded from the cumulative effects analysis. Therefore, any reasonably foreseeable future actions must be considered.]

For the STIA MPU action areas, cumulative, synergistic, and indirect effects could include development of residential and commercial properties on private or airport property, improvement of local transportation systems, development of property for local government infrastructure, and installation of the fuel hydrant system[22]. Projects that receive federal funding or require federal permits are considered here. Since it is unlikely that significant projects will be developed near chinook salmon habitat (i.e., the small estuaries at the mouths of Miller or Des Moines creeks), the potential pathways affecting chinook salmon are indirect through changes in stormwater hydrology and water quality in the upper portions of the watersheds.

Cumulative direct and indirect impacts to chinook salmon freshwater habitat will not occur from other development projects in the basins because freshwater habitat for the species does not occur in the Miller and Des Moines creek watersheds. Since future development (including potential redevelopment of borrow or acquisition areas) will comply with existing or emerging standards required to protect and improve the environment (stream habitat, water quality, stormwater quantity) for salmon species, habitat in these creeks should improve. These standards should protect water quality, stream hydrologic conditions, stream habitat conditions, riparian buffers, and wetlands. Protection of habitat and water quality in the streams will eliminate significant downstream effects to estuarine areas at the creek outlets.

Other potential projects in the vicinity of the off-site wetland mitigation project in Auburn could affect chinook critical habitat in the Green River. These include a proposed trail, improvements to 277th Street, and development of private property to commercial or residential uses (these projects are presumed to be associated with federal actions associated with federal funding, wetland impacts, and/or floodplain alterations and should not be considered in cumulative impacts analysis in the BA). The trail project is proposed on county property in the riparian buffer of the Green River. Development of the trail project could reduce the restoration potential of the riparian area; in particular, the trail could restrict the ability of a restored riparian buffer to deliver wood to the Green River channel.

With existing and emerging regulations, habitat and water quality conditions in the Miller Creek and Des Moines Creek watersheds are likely to improve or remain at their current condition, whether or not other development in the watershed occurs. No adverse cumulative, synergistic, or indirect effects on bull trout are expected to result from operation of the mitigation site near the Green River.

Potential indirect impacts of STIA Master Plan Improvements are discussed extensively in the BA (FAA 2000) and include:

- Effects of altered hydrology and sediment transport on EFH present at the mouths of Miller and Des Moines creeks. Changes in stream hydrology will not occur as a result of the project; therefore, there will be no hydrologic effects on EFH in the estuaries.

- Effects of altered water quality on EFH present at the mouths of Miller and Des Moines creeks. BMPs and other mitigations detailed earlier will not reduce the quality or quantity of EFH present in the estuaries of Miller and Des Moines creeks.

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[22] The fuel hydrant system is an underground piped fuel distribution system designed to transport aviation fuel from storage facilities to aircraft gates and is intended to replace the use of refueling trucks.

- Effects from increased rates of discharge of treated stormwater from the Midway Sewer District marine outfall. Increased discharge rates could potentially reduce the quality of EFH in this locality. The rapid levels of dilution achieved after discharge of effluent from this outfall will reduce chemical concentrations below any level that will reduce quality or quantity of EFH in the vicinity of the outfall.

Indirect effects associated with the project are unlikely to effect EFH. Any cumulative, synergistic, or indirect impacts associated with other projects planned in these basins will comply with existing or emerging development standards required to protect habitat for fish species. These standards will protect water quality, stream hydrologic conditions, stream habitat conditions, riparian buffers, and wetlands. With existing and emerging regulations, habitat and water quality conditions in the Miller Creek and Des Moines Creek watersheds are likely to improve or remain at their current condition, whether or not other development in the watershed occurs. Finally, land areas being developed for safety/runway purposes will not be subject to foreseeable development activities. Rather, such areas will be remediated and used for safety buffers.

6.3 DETERMINATION OF EFFECTS ON ESSENTIAL FISH HABITAT

This determination of the effects of the MPU projects evaluated in this EFH Assessment on EFH is made pursuant to section 305(b)(2) of the MSA.

Chinook and pink salmon have not been documented to occur in the Miller Creek, Walker Creek, or Des Moines Creek basins upstream of their discharge with Puget Sound (Batcho 1999 personal communication; Des Moines Creek Basin Committee 1997; Hillman et al. 1999). Construction and operation are not expected to adversely affect freshwater, estuarine, or marine EFH of chinook or pink salmon. Although results of this action are intended to improve baseline habitat conditions for salmonids in the Miller Creek and Des Moines Creek basins (through increased stormwater management and habitat restoration), future use of the streams by chinook or pink salmon (i.e., through straying from other basins) is unlikely and not expected. Therefore, since these two salmon species do not occur in these basins, construction and operation of the project will have no adverse effect on freshwater EFH of chinook or pink salmon in the Miller Creek or Des Moines Creek basins proper. Because potential effects on freshwater EFH from construction will decrease with distance from the construction site, effects will not be transmitted downstream to estuarine EFH. Therefore, construction and operation of the project will have no adverse effect on EFH in the Miller Creek or Des Moines Creek estuaries.

Potential IWS discharges were modeled for effects on water quality in marine EFH and shown to have no measurable adverse affect on adult chinook salmon. When the potential effects of the proposed STIA MPU improvements on EFH of chinook or pink salmon in the action area are considered relative to the proposed conservation measures, the action agencies determined that the proposed action would have "no effect" on EFH for chinook and pink salmon (see Table E-1).

Coho salmon are present within Miller, Walker, and Des Moines creeks and may occur in several areas where direct adverse effects of construction could occur (particularly being absent in the area of Miller Creek to be relocated). Short-term direct adverse effects on coho EFH could occur from habitat modification and changes in water quality during construction. Effects would be limited to temporary increases in turbidity and suspended sediment during construction and alteration of poor quality habitat. The potential short-term effects of turbidity and sedimentation would be reduced or avoided by construction best management practices and conservation measures. The short-term adverse effects of habitat alteration would be offset by the long-term benefits of new, high quality, habitat features (pool/step complexes, large woody debris, removal of rock weirs, a culvert, bridges, native plant replacement, and enhancement of riparian zones). When the potential effects of the proposed STIA MPU improvements on the EFH of coho salmon in the action area are considered relative to the proposed conservation measures, the action agencies determined that the proposed action "may adversely effect" coho EFH for the short-term, but will have "no effect" on coho salmon EFH for the long-term and will actually prove beneficial (Table 6-1).

Table 6-1. Summary effect determinations for salmon EFH in the Action Area.

Common and ***Scientific name***	**Life Stages Considered**	**Essential fish habitat**	**EFH Effects Determination**
Chinook salmon *Oncorhynchus tshawytscha*	Freshwater and marine phases	Estuaries of Miller and Des Moines creeks, marine waters at the IWS Outfall, and Green River near Auburn Mitigation Site	No effect
Pink salmon *O. gorbuscha*	Freshwater and marine phases	Estuaries of Miller and Des Moines creeks, marine waters at the IWS Outfall	No effect
Coho salmon *O. kisutch*	Freshwater and marine phases	Miller and Des Moines creeks downstream of identified features, marine waters at the IWS Outfall, and Green River near Auburn Mitigation Site	Short-term: May adversely effect Long-term: No effect (beneficial)

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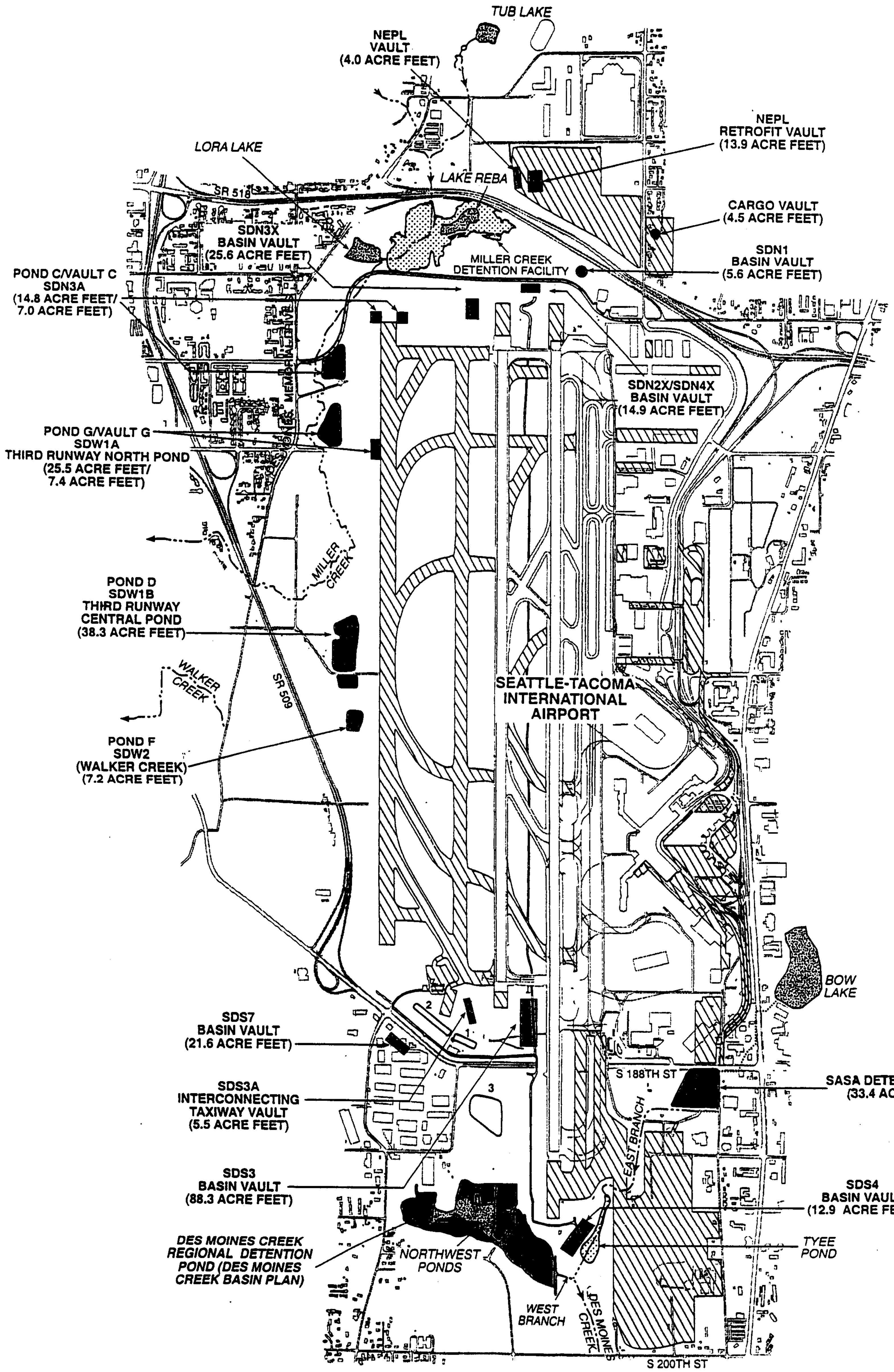
APPENDIX A

FIGURE 2 FROM

"SUPPLEMENT. BIOLOGICAL ASSESSMENT FOR SEATTLE-TACOMA INTERNATIONAL AIRPORT MASTER PLAN UPDATE IMPROVEMENTS. (PARAMETRIX 2000d)"

Introduction

The following figure is Figure 2, reprinted from the "Supplement. Biological Assessment for Seattle-Tacoma International Airport Master Plan Update improvements. (Parametrix 2000d)". This figure is referred to in Section 5.2.1.3 of the above text, and is provided to assist the reader of this document.



Sea-Tac Airport Stormwater Management Plan/556-2912-001/01(48) 12/00 (K)

Water Features
Proposed Stormwater Detention Facilities (With Simulated Maximum Storage Volume)
Master Plan Projects
Creek
Piped Creek
Detention Facility

SCALE IN FEET
0 750 1,500

N

Figure 2
Proposed Detention Facilities for Master Plan Projects

APPENDIX B

FIGURES 7-4 AND 7-5 FROM

"BIOLOGICAL ASSESSMENT FOR SEATTLE-TACOMA INTERNATIONAL AIRPORT MASTER PLAN UPDATE IMPROVEMENTS. (FAA 2000)"

Introduction

The following figures are Figures 4.1-3, reprinted from the "Natural Resource Mitigation Plan (Parametrix 2000b) and 7-5, reprinted from the "Biological Assessment for Seattle-Tacoma International Airport Master Plan Update improvements. (FAA 2000)". These figures are referred to in Section 4.0 of the above text, and are provided to assist the reader of this document.

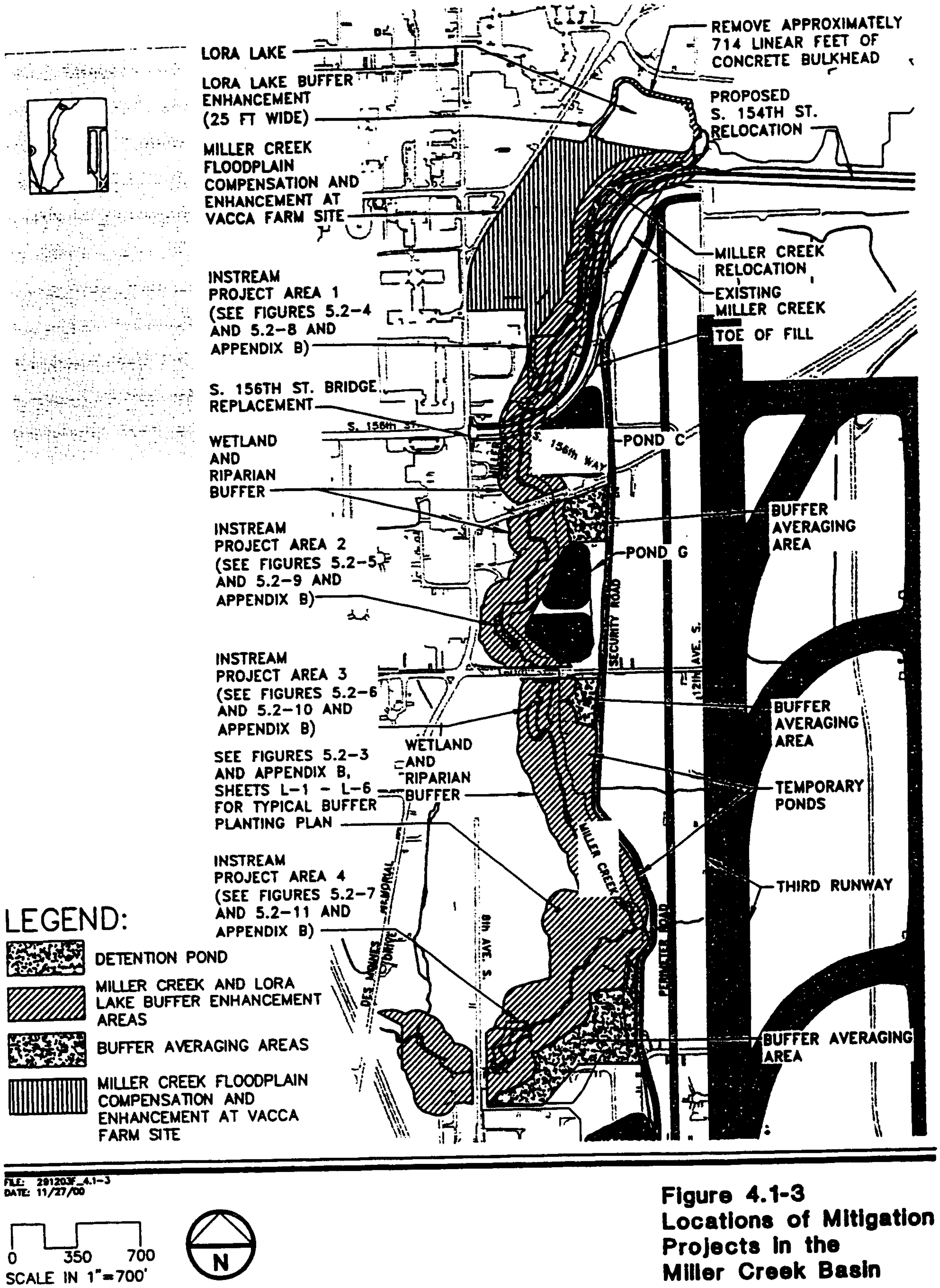


Figure 4.1-3
Locations of Mitigation Projects in the Miller Creek Basin

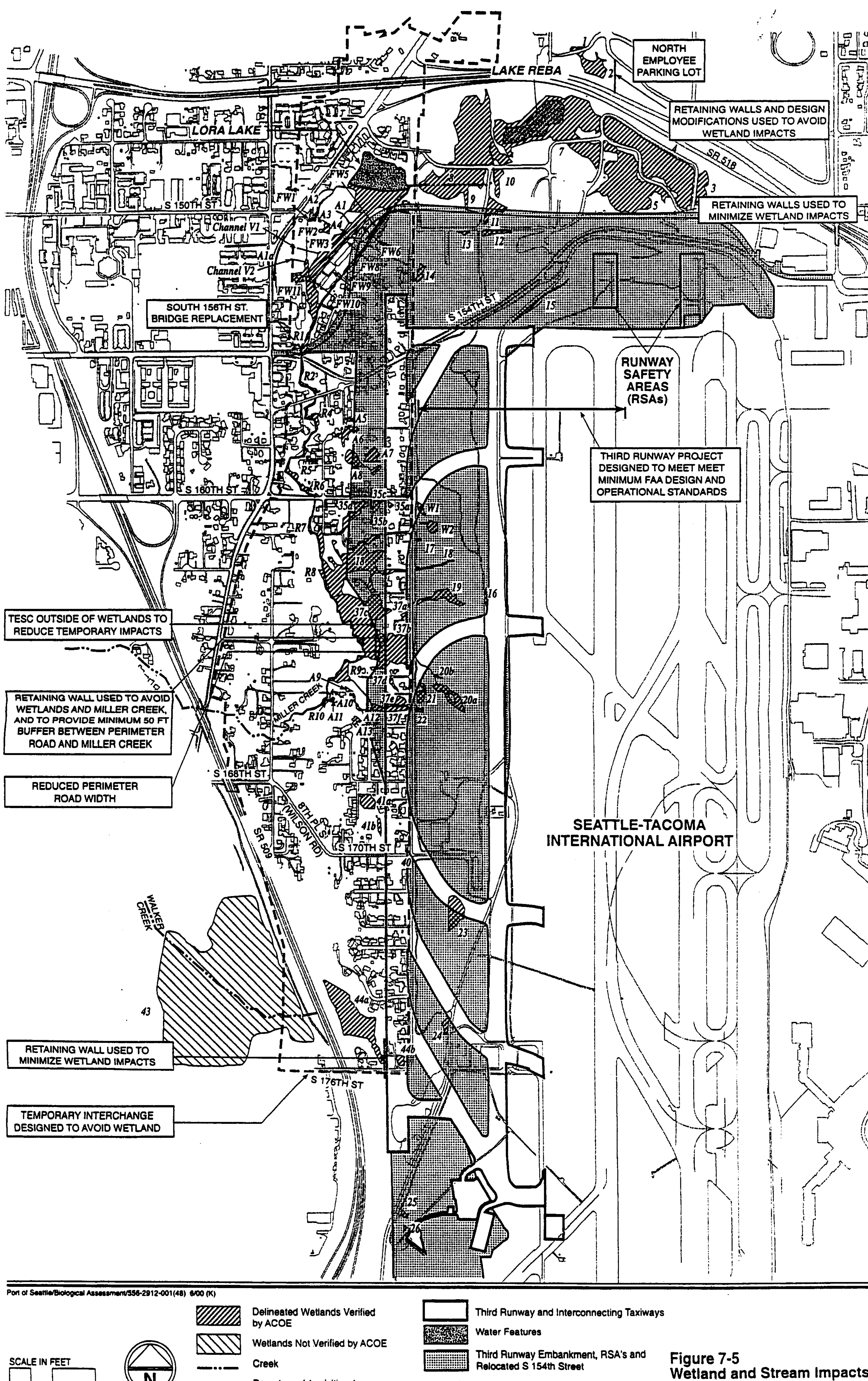


Figure 7-5
Wetland and Stream Impacts in the Miller Creek Basin