SUMMARY OF KEY WETLAND FINDINGS OF THE *SEA-TAC RUNWAY FILL HYDROLOGIC STUDIES REPORT*

Parametrix, Inc.
August 11, 1999

The *Sea-Tac Runway Fill Hydrologic Studies Report* (Pacific Groundwater Group 2000) provides an analysis of many wetlands and other ecological issues of interest to the Corps, Ecology, and other agencies reviewing the JARPA for the Port of Seattle Master Plan Update Improvements. Conclusions the report makes on some key issues of concern to federal and state agencies are highlighted below, with relevant pages of the report attached.

1. **Page 30**
   The study finds that the wetland delineations completed within the project area are conservative in estimating the extent of wetlands, meaning that the marginal areas were more likely to be called wetlands rather than uplands.

2. **Page 41**
   Limiting habitat characteristics of the creeks are identified in Section 3.4.6.5. Note that the Port's mitigation plan focuses on enhancing these habitat conditions by:

   - Management of construction activities to mitigate for potential increases of fine sediment in streambed pools.
   - Addition of woody debris to create more complex in-stream structure, and
   - Enhancement of riparian vegetation along Miller Creek throughout the acquisition area.

3. **Page 42**
   The overall significance of Des Moines, Walker, and Miller Creeks-3.4.7 to regional fisheries is small. Note that the mitigation proposed by the Port focuses on assuring conditions in the creeks are enhanced so local declines in fish do not occur.

4. **Page 55**
   The report identifies the potential of 1.68 acres of secondary, indirect impact from embankment (especially to the Wetland 18 and Wetland 36 complex). Further analysis of this potential impact is the subject of Section 3.2 and 3.6. The analysis concludes (pages 7, 51, 52, and 60) that the loss of these downslope wetlands would not occur due to seepage into the embankment and the delay in water movement through the embankment. This water will eventually discharge to the downslope wetlands. The report identifies that some potential net benefit to wetland hydrology during the summer months is possible due to the delay in discharge.

   Note that this analysis of potential benefit to wetland hydrology for wetlands located downslope of the embankment is applicable to the indirect impact analysis for the following wetlands: 3, 4, 5, 7, 8, 9, 11, A1, A11, A13, 18, 37, Channel B, and riparian wetlands located in the west-side acquisition area.

   Also note that the impact analysis completed by the Port was conservative in that indirect impacts to several small wetlands located downslope of the embankment and partially impacted by fill were considered significant (Wetlands 12, 13, A5, A6, and A8,). The total areas of these five wetlands are included in the 18.33 acres of impact reported in the public notice.

5. **Pages 30 and 55**
The functional assessment completed for the project provides a reasonable representation of the functional ability of the wetlands within the project area.

Section 3.6.7.2 is consistent with the functional analysis prepared by Parametrix, Inc. For most functions, the wetlands affected by the project are of low to moderate value. No rare or unusual wetland types or functions were identified by the analysis. No significant losses in the regional or local diversity of wetland types or functions are identified.

6. **Page 56**
Section 3.6.7.3 This section identifies a need for contingency measures to assure that potential indirect impacts to Wetlands 18 and 37 do not occur. Note that contingency for indirect impacts to wetland partially filled is to monitor wetlands have been designed into the project, and evaluated in the report (see Pages 7, 51, 52, and 65). The hydrologic analysis completed in the report has not identified significant impacts to wetlands downslope of the embankment.

The Port will monitor (monitoring was started in May and June of 2000) downslope wetlands to determine if wetland hydrology sufficient to maintain existing vegetation persists following construction of the embankment. If wetland hydrology is lacking, excess baseflow (reported by the Hydrologic Studies) can be directed through the drainage channels to specific wetland where wetland hydrology has been reduced. Based on analysis of the Hydrology Study (Section 3.6.4), the need for this contingency appears unlikely.

7. **Page 57**
The study finds the overall mitigation plan is reasonably designed to compensate for the wetland impacts identified in section 3.6.7. The plan also has the potential to increase the habitat suitability of the project area along Miller Creek. The off-site mitigation would create a single large contiguous parcel that would attract all types of wildlife. With the exception of bonding, the additional safeguards that are recommended in Section 3.6.7.5 are acceptable. The Port could fund third party monitoring if agencies feel they are unable to adequately review monitoring the activities the Port will be required to perform.

8. **Page 58**
Section 3.6.7.4 concludes that the proposed mitigation seems adequate and appropriate to compensate for the loss of wetlands.

9. **Page 60**
Delayed surface water expression would have a generally positive effect on the local wetlands that remain and a less pronounced effect on low summer base flow in Miller Creek in general. A similar effect on wetland and summer base flow would occur in Walker Creek.

10. **Page 60**
Section 3.6.8.2 states that the Miller Creek relocation has the potential of providing a net gain of salmonid habitat within the Miller Creek watershed

11. **Pages 64-65**
Section 3.6.10 concludes that the runway embankment is not expected to create adverse temperature effects on Miller Creek during the critical low flow periods in the streams.

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#1 indicators can be marginal at best. Based on the wetland flagging present in the project area, the delineations completed within the project area are conservative in estimating the extent of wetlands, meaning that the marginal areas were more likely to be included as wetland area, rather than upland.

#5 In reviewing the functional assessment completed for the project, the analysis also showed that the qualitative assessment provided a reasonable representation of functional ability of wetlands within the project area. The framework used for this analysis used *Methods for Assessing Wetland Functions* (Hruby et al. 1999) which was not available during the preparation of the previous studies completed at STIA.

Methodologies and references referred to in the Wetland Functional Assessment and Impact Analysis included *the Wetland Evaluation Technique* (WET) (Adumus et al.1987), *Hydrogeomorphic Classification of Wetlands* (Brinson 1993) and *Wetland Values: Concepts and Methods for Wetland Evaluation* (Reppert et al 1979). However, to some extent, professional judgement is the key to the analyses presented in the report. While neither previous wetland evaluations, nor the quality and functional assessment conducted as part of this analysis provide numerical quantification of wetland impacts, both approaches effectively identify those functions that would be impacted by the implementation of the Sea-Tac improvement projects. Numerical quantification of wetland impacts would not necessarily improve the overall qualitative assessment of impacts, particularly in light of the fact that a significant portion of the wetland impacts are to slope wetlands, for which there are no recognized/approved models.

3.4 Character of Fish Habitat and Populations

This discussion of fish habitat in Miller, Walker, and Des Moines Creeks focuses on the abilities of these creeks to support salmonid species. Different salmonid species and life history stages have different optimal habitat preferences that fall within a range of acceptable values. The optimal habitat preferences for juvenile and adult coho salmon (*Oncorhynchus kisutch*) are presented in **Tables 3-6, 3-7, and 3-8** for comparison purposes with existing habitat conditions. Only those habitat parameters that commonly limit salmonid survival and production are presented. Because optimal habitat preferences for coho salmon are generally more restrictive than cutthroat trout (*O. clarki*), decision making based on coho salmon habitat preferences should also be protective of cutthroat trout.

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habitat condition, the results of the surveys conducted on Walker Creek were consistent with the BioAnalysts (1999) habitat assessment. In general, the habitat assessments identified that the primary limiting characteristics for the maintenance of salmonid populations are fine-sediment in streambed pools, lack of woody debris and complex in-stream structure, and sparse riparian vegetation.

3.4.7 Regional Significance of Local Fishery

Puget Sound coastal watersheds in King County encompass 92 square miles. In southern King County, Miller and Des Moines Creek watersheds encompass 9 and 6 square miles, respectively, and are two of the largest Puget Sound coastal streams. Coastal Puget Sound streams are typically small stream systems that drain highly urbanized areas. In 1992, 67% of the land use in coastal Puget Sound watersheds in King County was urban/residential. King County estimates that urban residential land use will increase to 77% in these watersheds by the year 2012. Forest and park land use is not expected to change over this same time period, however, rural land use is expected to decrease from 23% to 14% to compensate for the increase in urbanization (King County 1995).

Historically, these watersheds have supported abundant anadromous and resident fish populations. Today, many of the coastal Puget Sound streams support small salmonid populations. Although coastal Puget Sound streams do not support regionally significant numbers of fish, they are important locally. Numerous community-based restoration efforts have begun in a number of the watersheds to enhance salmonid habitat and to plant salmon within the creeks. For example, in 1993, the Hylebos Creek/Lower Puget Sound Basin Plan was the first comprehensive basin plan developed for an urban stream in King County. The basin plan identifies that the costs of restoration are very high, and even if completely implemented, full restoration of the basin is not possible (King County 1995).

Two major river systems exist in the area: the Green River/Duwamish River watershed and the White River watershed. The lower watersheds of both of these river systems are highly urbanized, with similar urban/residential land use estimates compared to the percent of urban land use reported above for small coastal Puget Sound watersheds. Significant portions of the upper watersheds in both of these river systems remain undeveloped. However, projected increases in urbanization would modify the existing land use in the watersheds and likely result in habitat and water quality degradation.

Annual escapement estimates for the four-year period of 1988 through 1991 indicate that the Green River/Duwamish River Watershed supports a total of 44,928 anadromous salmonids: 14,048 are considered wild and 30,880 are cultured. Wild fish are defined as any fish that spawns naturally, which could include hatchery fish that are successfully reproducing. Two fish hatcheries in the watershed contribute to the cultured anadromous salmonid returns: the Soos Creek Hatchery operated by the WDFW and the Keta Creek Hatchery operated by the Muckleshoot Indian Tribe. The Green River/Duwamish River salmonid escapement comprises 50% coho salmon, 45% chinook salmon, 4% chum salmon, and 1% winter steelhead.

Salmonid escapement estimates for the same four year period on the White River indicate a total run of 20,967 anadromous salmon: 5,563 wild fish and 15,404 cultured fish. The White River Hatchery operated by the Muckleshoot Indian Tribe is a significant contributor to the total annual salmon production in the White River watershed. The White River salmonid escapement comprises 75% coho salmon, 15% chinook salmon, and 9% chum salmon. The White

River supports the White River spring chinook population which is a distinct stock not found in other basins (King County 1995).

#3 Therefore, regional river systems support orders of magnitude greater numbers of anadromous salmonids than do Miller, Walker, and Des Moines Creeks. Thus, population effects to salmonids in Miller, Walker, and Des Moines Creeks would be local; no significant regional effects to salmonid populations would occur if population declines in these local creeks were to occur.

3.5 Threatened and Endangered Species

This section provides information on aquatic wildlife species (state and federal listed species), which may occur in the project vicinity. Two federal agencies, acting in accordance with the Endangered Species Act (ESA), manage threatened and endangered species populations: the United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). Federal projects that could affect listed species under the ESA are subject to consultation with both agencies. Among the federally listed species that might occur within the area include threatened coastal/Puget Sound bull trout and threatened chinook salmon. The USFWS is responsible for the threatened coastal/Puget Sound bull trout. The threatened chinook salmon is managed by NMFS whom also manages other anadromous threatened and endangered aquatic species.

Management of other sensitive wildlife species varies, and usually is conducted in cooperation with State wildlife agencies. The federal action agency for this project is the FAA and they are directed to plan, implement and consult on projects, which might impact federal listed species. However, other laws and regulations effect wildlife control at airports.

Only one aquatic species, the threatened coastal/Puget Sound bull trout (*Salvelinus confluentus*) potentially occurs in the project area. The bull trout has very specific life history requirements such as cold water temperature and clean gravel and cobble substrate that is often associated with unaltered stream systems. Because of its specific habitat requirements, the bull trout has difficulty inhabiting or adapting to stream systems with anthropogenic or natural perturbations. Therefore, the bull trout is not expected to be present in Miller, Walker, or Des Moines Creeks. In addition, E&E could not find conclusive records indicating that the bull trout historically inhabited these creeks.

NMFS manages anadromous threatened and endangered aquatic species. In Puget Sound, no anadromous salmonids are listed as endangered, but chinook salmon is listed as threatened. Unconfirmed data indicate that chinook salmon have been observed in Miller Creek, however, no conclusive records could be found supporting this observation (Fish 1999). The Puget Sound/Strait of Georgia evolutionary significant unit (ESU) of coho salmon is currently a candidate species being considered for listing under the ESA. Small spawning populations of coho salmon exist on Miller, Walker, and Des Moines Creeks. Therefore, outcome of the NMFS ESA listing process for Puget Sound coho salmon will have significant impacts on the protection and habitat restoration efforts for the species and the allowable activities within watersheds with known coho salmon populations. Two additional anadromous salmonids documented to occur in Miller, Walker, or Des Moines Creeks include chum salmon and steelhead. Small numbers of chum salmon were observed in Walker and Des Moines Creek during the carcass surveys; steelhead presence in the creeks was not confirmed. NMFS has determined that the Puget Sound chum salmon ESU and

E&E calculated that the fill activities associated with the airport improvement projects would result in the permanent loss of 13.88 acres of impact in the Miller Creek watershed. In addition to the permanent impacts, construction activities would also result in the temporary loss of 1.86 acres in the Miller Creek watershed (**Table 3-22**). As shown in **Table 3-23**, 36 wetlands would be impacted. Of these 36 wetlands, 11 wetlands would have impacts greater than 1/3 acre. These 11 wetlands account for 11.26 acres (>60%) of the direct impacts from the entire project.

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E&E also evaluated secondary (indirect) impacts, defined where a loss of about 50 percent or more of existing wetland acreage would occur. Additional secondary impacts are identified because loss of that much acreage within a wetland could have significant ramifications on the functional ability of the remnant wetland. Based on these assumptions, an additional 1.68 acres of secondary wetland impact could be associated with the project if the functionality of the remaining wetland cannot be maintained. This potential acreage loss is attributed to the Wetland 18/37 complex adjacent to Miller Creek.

Table 3-23 presents a summary of impacts compiled by E&E, associated with proposed construction activities. These impacts are presented by hydrogeomorphic classification, as well as by cover type.

3.6.7.2 Functional Impact

Of equal importance to the acreage loss is the functional impact that would occur. The effectiveness and opportunity of wetlands to provide functions associated with water quality improvement, water quantity, and habitat was discussed in Section 3.3.3.3.

The Miller Creek watershed is located within a highly urbanized area. The undeveloped areas (both upland and wetland) provide some filtering of runoff prior to discharge into the creek. As a result, the larger wetlands within the watershed have a moderate-to-high potential to provide nutrient and sediment trapping. The functionality of the slope wetlands within the project area is somewhat lower due to the rate of water flow through them. Even with this reduction, the wetlands are frequently cited as providing moderate-to-high capability because of the influx of urban runoff. The creation of over 50 acres of new impervious surface as proposed as part of the Master Plan Update could increase overland flow to Miller Creek, and carry with it an increased sediment load. As a result, the loss of 0.14 acres of wetlands in the Runway Safety Area, and 13.74 acres of wetlands in the embankment area could have significant consequences if not mitigated.

Most wetlands in the project area serve to provide base flow to Miller Creek rather than absorb and temporarily store floodwaters. Wetlands that contribute to the flood storage capability and that would be significantly impacted by the proposed airport expansion projects are restricted primarily to the riparian Wetland 18/37 complex, Wetland A1 located adjacent to Lora Lake, and 41a and b which is a farm pond and pasture. Construction of the airport improvement projects would result in a reduction of wetlands that seep to Miller Creek and floodwater retention capability of the watershed. Any proposed mitigation would need to account for these losses by providing equal or greater base flow to Miller Creek and sufficient flood detention to prevent any increase in downstream flooding.

Being located in an urban area, the wildlife expected to occur in the project area is restricted to common, highly-adaptive species that use both wetland and adjacent upland areas. Species integrally tied to the wetland areas are likely restricted to waterfowl, amphibians, and small mammals. The extensive fragmentation of the available habitat, in conjunction with the surrounding urban character limits the suitability of the quality is further degraded because of indirect construction effects such as an uncontrolled release of turbid water, resident populations of cutthroat trout and anadromous Coho salmon would likely decline.

The enhancements to the riparian buffer corridor and instream habitat of Miller Creek will undoubtedly benefit local stream habitat for resident cutthroat trout if they are implemented and maintained properly. However, the proposed mitigation is limited in that it will only affect localized Miller Creek habitat and resident cutthroat trout. Indirect construction and post-construction effects such as alterations to base flow, peak flow, and sediment input could affect the entire stream systems, not just the airport project area. The Port predicts reduction in summer base flow in Des Moines Creek as a result of reduced groundwater recharge and supports augmenting low summer stream flows by pumping from a Port-owned well and discharging the water into the creek.

The watershed trust funds for the Miller and Des Moines Creek watersheds can be beneficial. However, significant habitat restoration in Miller, Walker, and Des Moines Creeks will require substantially more funding than what is currently offered through the basin trust funds.

1.4.4 Effects on the Hydroperiod in Local Wetlands

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A hydroperiod is the seasonal change in the timing of groundwater discharge to wetlands and streams. For this project, effects to the hydroperiod were evaluated using a cross section of the proposed embankment fill near Miller Creek. The following effects are predicted if the embankment is built:

- Recharge would be 11 percent less along the cross section, and would spread-out within the fill, causing a significant timing lag in discharge to the wetlands and creek west of the embankment compared to the current condition.

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- Discharge to remaining wetlands and the creek under the built condition would vary less throughout the year and the period of minimum discharge would be shorter. Flows would be lower in winter than under the current condition, and greater in summer compared to the current condition. The total quantity of water flowing to the wetlands would decrease because total recharge would decrease.

The timing changes would generally benefit the local wetlands that remain after filling and would slightly moderate seasonal low base flows and temperatures in Miller Creek. However, all water quantities are reduced on an average annual basis because total recharge is smaller under the built condition. Also, since the embankment is a small part of the Miller Creek watershed, the overall effect on streamflow is small. If the constructed fill has a lower silt content than was assumed for this analysis, the lag may be overestimated and the recharge volume may be underestimated.

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near the middle of the range observed in Phase I soils. However, most field samples were measured to have a lower silt content than the modeled fill.

A simple finite difference slice model was developed to simulate horizontal and vertical groundwater flow within the drain layer and existing soils below the embankment. It is similar in structure to the slice model of the current condition presented in Section 3.2.4. Both slice models are described further in **Appendix E.** For the built condition slice model, outflow from the Hydrus-2D model was used as input to the simulated drain layer. **Figure 3-5** presents the geometry of the embankment slice model.

The slice model was used to simulate groundwater flow for both the current and built conditions. Two versions of the model were constructed to represent expected differences in flow system geometry and hydraulic properties. The slice model is based on a quasi-two-dimensional finite-difference formulation of the partial differential equation describing transient groundwater flow through a saturated medium. Model cells were only connected to laterally adjacent neighbors as opposed to overlying or underlying cells – thus the quasi-two-dimensional nature of the model. Each model cell can contain up to three different "soil layers", differing in thickness and hydraulic conductivity. The bottom elevation of each cell is defined by the top of the till layer, and downward flow through the till can be simulated. For each cell, the model also specifies storage coefficient and recharge per time-step. The model assumes unconfined flow (variable transmissivity) under horizontal gradients defined by head differences between adjacent cells. The model was implemented in a Microsoft Excel spreadsheet, using direct (explicit) methods to solve the finite-difference equation.

Figure 3-13 shows results of the embankment (built condition) slice model. It summarizes water outflow at the bottom of the proposed west wall in terms of drain outflow and groundwater flow (horizontal flow in soils below the drain layer). Recharge to the drain layer at the bottom of the fill (Hydrus-2D output) and seepage through the till to a second (Qva) aquifer are also shown but are summed over the entire cross section). Units of measurement on the plot are cubic feet per day, per foot of width (cfd/f). The water volumes summed over the year are listed in the legend. Changes between current and built conditions were interpreted by comparing **Figures 3-6 and 3-13** and indicate that:

- Recharge would be 11 percent less along the cross section, and would spread-out within the fill, causing a significant timing lag in discharge to the wetlands and creek west of the embankment compared to the current condition.

- Discharge to remaining wetlands and the creek under the built condition would vary less throughout the year and the period of minimum discharge would be shorter. Flows would be lower in winter than under the current condition, and greater in summer compared to the current condition. The total quantity of water flowing to the wetlands would decrease because total recharge would decrease. Based on the total volumes and the timing plots, the model suggests that 71 percent of surface flow predicted by the model under the current condition would discharge from the drain below the wall under the built condition. The surface flow occurs in winter and spring, whereas the modeled drain discharge is less seasonally variable (more detailed interpretation of the timing of modeled discharge is inappropriate, especially for the built condition, for which no confirmatory field observations are available).

- The *volume* of seepage downward through the till would likely change only slightly under the built condition; however, the *percentage* of recharge seeping through the till would increase substantially.

A formal model sensitivity analysis was not conducted. However, the distribution of water quantity between surface/drain flow and till seepage is known to be sensitive to assigned hydraulic conductivity for the till. Higher hydraulic conductivity for the till allows more water to seep downward, and less is left over to discharge horizontally. Appendix E presents the assumptions and basis for modeling the till with a hydraulic conductivity of 0.004 ft/day ($1.4x10^{-6}$ cm/sec) in both models. Although the *water quantities* are sensitive, the model results indicate that change in the *timing* of surface and drain flows between the current and built conditions is generally consistent over a range of till hydraulic conductivities.

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The timing changes would generally benefit the local wetlands that remain after filling and would slightly moderate seasonal low base flows and temperatures in Miller Creek. However, all water quantities are reduced on an average annual basis because total recharge is smaller under the built condition. Also, since the embankment is a small part of the Miller Creek watershed, the overall effect on streamflow is small. If the constructed fill has a lower silt content than was assumed in the model, the lag may be overestimated and the recharge volume may be underestimated.

3.6.5 Effects on Deeper Aquifers

The intermediate and deep aquifers of the Des Moines upland supply water to the Seattle Water Department and Highline Water District. The aquifers are laterally extensive, underling virtually the entire Des Moines upland from Federal Way on the south, to nearly West Seattle on the north. They underlie the Qva aquifer which is the deepest geologic layer discussed in detail elsewhere in this report.

The precipitation that infiltrates below the root zone over the large aquifer area is apportioned between shallow, intermediate, and deeper groundwater flow regimes. The shallow regime includes all the groundwater discussed in this report. The deeper regimes include flow within the intermediate and deep aquifers. The regimes are somewhat interdependent, with reductions in recharge to the surface being equal to reductions to stream base flow plus reductions to recharge in lower aquifers. Conversely, pumping from deep aquifers can affect the quantity of water in the shallow regime and thus base flow in creeks. The proper tool for evaluation of these large scale effects is a multi-layer groundwater flow model. The Port is generating such a model at this time.

The small reduction in groundwater recharge to deep aquifers of the Des Moines upland would not materially affect the ability of these aquifers to supply water to wells. This conclusion is based on the relatively large recharge areas of these aquifers compared to the airport, the fact that the effects would be apportioned between shallow and deeper effects, and the shallow recharge estimates reported herein and in Port documents.

3.6.6 Comparisons to Previous Groundwater Assessments

Changes in shallow groundwater recharge resulting from cessation of septic discharges in the area have not previously been reported.

Appendix F to the SWMP presents analyses related to potential base flow impacts from the proposed airport improvements, including the runway embankment fill. Table F-2 of the appendix summarizes the proposed changes in land use upon which the Port derives conclusions regarding base

a water storage compartment that causes a time lag of water discharge to the wetlands and creek compared to existing conditions. Because of the lag time through the embankment, the model predicts that winter precipitation would express itself as surface water through the west wall drain in the summer months. This delayed surface water expression would have a generally positive effect on the local wetlands that remain, and a less-pronounced effect on low summer base flow in Miller Creek in general. Although model predictions are limited to the geologic cross section at the west wall, the model suggests that a similar effect on wetland and summer base flow would occur in Walker Creek.

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The effects of contribution from the fill embankment to stream summer base flow in Miller and Walker Creeks should not be overstated. The embankment represents a small portion of the total Miller and Walker Creek watershed area.

3.6.8.2 Habitat Parameters

No direct construction impacts are expected for stream habitat in Walker or Des Moines Creek.

Direct construction impacts to Miller Creek stream habitat include the relocation of Miller Creek in the Vacca Farm area. This portion of Miller Creek provides poor habitat for salmonid fish populations because it has sparse riparian vegetation, substrate dominated by sand and silt, a lack of habitat complexity, and a lack of instream structure and large woody debris. Since the proposed Miller Creek channel construction includes a mixture of pools and riffles, gravel and cobble substrate placement, riparian vegetation planting, and large woody debris replacement, the proposed Miller Creek relocation has the potential of providing a net gain of salmonid habitat within the Miller Creek watershed. Proper construction and long-term monitoring are vital to successful Miller Creek relocation including control of turbidity during initial wetting. Some sediment transport during initial wetting is likely, and has the potential to damage habitat downstream.

Indirect effects to stream habitat in Miller, Walker, and Des Moines Creeks include alterations to base flow, peak flow, and sediment input to surface water. These habitat parameters currently limit salmonid populations. Low summer base flows affect habitat quality because exposed portions of the channel are no longer available for use which limits available slack water habitat for juvenile salmon refugia, riffles for macroinvertebrate production, and quality pools for resident salmonids. Lower flow also tends to increase water temperature in stream channels exposed to solar radiation. The Port predicts reduction in summer base flow in Des Moines Creek as a result of a six percent reduction in groundwater recharge in the Des Moines Creek basin. The Port supports augmenting low summer stream flows by pumping from a Port-owned well and discharging the water into the creek (Parametrix, 1999e).

Extreme peak flows degrade stream habitat by scouring stream banks and beds, and transporting coarse sediment too quickly through the stream system. High peak flows also washout streambank slack water areas used by juvenile salmonids and often displace smaller fish downstream because of their limited swimming ability. Substrate in Miller, Walker, and Des Moines Creeks have high fine-sediment content from urbanization throughout the watersheds which limits stream substrate available for salmonid spawning and age-0 fish refugia.

3.6.8.3 Effects on Populations

Direct construction impacts would likely have little effect on fish populations because direct impacts are limited to the Miller Creek reach at Vacca Farm. This reach of Miller Creek provides poor quality habitat for salmonids. Therefore, cutthroat trout, if

E&E calculated that the fill activities associated with the airport improvement projects would result in the permanent loss of 13.88 acres of impact in the Miller Creek watershed. In addition to the permanent impacts, construction activities would also result in the temporary loss of 1.86 acres in the Miller Creek watershed (**Table 3-22**). As shown in **Table 3-23**, 36 wetlands would be impacted. Of these 36 wetlands, 11 wetlands would have impacts greater than 1/3 acre. These 11 wetlands account for 11.26 acres (>60%) of the direct impacts from the entire project.

E&E also evaluated secondary (indirect) impacts, defined where a loss of about 50 percent or more of existing wetland acreage would occur. Additional secondary impacts are identified because loss of that much acreage within a wetland could have significant ramifications on the functional ability of the remnant wetland. Based on these assumptions, an additional 1.68 acres of secondary wetland impact could be associated with the project if the functionality of the remaining wetland cannot be maintained. This potential acreage loss is attributed to the Wetland 18/37 complex adjacent to Miller Creek.

Table 3-23 presents a summary of impacts compiled by E&E, associated with proposed construction activities. These impacts are presented by hydrogeomorphic classification, as well as by cover type.

3.6.7.2 Functional Impact

Of equal importance to the acreage loss is the functional impact that would occur. The effectiveness and opportunity of wetlands to provide functions associated with water quality improvement, water quantity, and habitat was discussed in Section 3.3.3.3.

The Miller Creek watershed is located within a highly urbanized area. The undeveloped areas (both upland and wetland) provide some filtering of runoff prior to discharge into the creek. As a result, the larger wetlands within the watershed have a moderate-to-high potential to provide nutrient and sediment trapping. The functionality of the slope wetlands within the project area is somewhat lower due to the rate of water flow through them. Even with this reduction, the wetlands are frequently cited as providing moderate-to-high capability because of the influx of urban runoff. The creation of over 50 acres of new impervious surface as proposed as part of the Master Plan Update could increase overland flow to Miller Creek, and carry with it an increased sediment load. As a result, the loss of 0.14 acres of wetlands in the Runway Safety Area, and 13.74 acres of wetlands in the embankment area could have significant consequences if not mitigated.

Most wetlands in the project area serve to provide base flow to Miller Creek rather than absorb and temporarily store floodwaters. Wetlands that contribute to the flood storage capability and that would be significantly impacted by the proposed airport expansion projects are restricted primarily to the riparian Wetland 18/37 complex, Wetland A1 located adjacent to Lora Lake, and 41a and b which is a farm pond and pasture. Construction of the airport improvement projects would result in a reduction of wetlands that seep to Miller Creek and floodwater retention capability of the watershed. Any proposed mitigation would need to account for these losses by providing equal or greater base flow to Miller Creek and sufficient flood detention to prevent any increase in downstream flooding.

Being located in an urban area, the wildlife expected to occur in the project area is restricted to common, highly-adaptive species that use both wetland and adjacent upland areas. Species integrally tied to the wetland areas are likely restricted to waterfowl, amphibians, and small mammals. The extensive fragmentation of the available habitat, in conjunction with the surrounding urban character limits the suitability of the project area to highly mobile species and smaller species requiring only minimal habitat sizes. The construction of the airport improvements would have an impact on local wildlife populations simply due to the size of the fill area. Reduction of habitat size and availability would further reduce the suitability for small mammals and amphibians. To prevent a significant decline in the local populations, mitigation would be required to provide supplemental/alternative habitat on-site. However, FAA requirements limit the development of avian habitat within 10,000 feet of existing facilities to minimize the potential bird air strike hazard.

3.6.7.3 *Mitigation*

Mitigation for the proposed third runway fill and safety areas must account for the permanent loss of 13.88 acres of wetland within the Miller Creek Watershed and 1.86 acres of temporary impacts. Based on E&E's analysis, mitigation should include development of a contingency plan that addresses the potential indirect impacts associated with significant reduction of wetland acreage in the remaining wetlands that are only partially impacted by fill activities and temporary construction activities.

The preferred regulatory hierarchy for wetland mitigation is:

- on-site, in-kind,
- off-site, within the watershed, in-kind,
- off site, out of the watershed, in-kind, and
- off site, out of watershed, out-of-kind.

Based on environmental and regulatory constraints, it is not feasible for the Port to offer mitigation on-site and in-kind. The difficulty and uncertainty of creating slope wetlands, and the lack of suitable sites within the basin restricts mitigation opportunities for creation of slope wetlands. Furthermore, the FAA policy of minimizing available wildlife habitat within 10,000 feet of the airport further restricts the opportunity for extensive in-basin mitigation. The Miller Creek and Des Moines Creek watersheds are quite small and are extensively developed, which restricts the mitigation opportunities.

Rather than replacement of a specific wetland type, E&E recommends that mitigation measures focus on the replacement of wetland functions. Therefore, in evaluating in-kind versus out-of-kind, the functions served by lost wetlands should drive the mitigation process.

As shown in **Tables 3-22 and 3-23**, a significant number of the wetlands impacted are slope wetlands. Impacts that need to be mitigated include water quality, water quantity, and habitat suitability as discussed in Section 3.3.3.2.

The Port has proposed the following wetland mitigation measures (Parametrix 1999a):

- On-site mitigation includes removing existing development, establishing a vegetated buffer along Miller Creek, enhancing wetlands within the Miller Creek buffer, enhancing/restoring wetlands within the Des Moines Creek watershed, excavating floodplain to compensate for lost flood storage, developing stormwater management facilities, and restoring and enhancing 11 acres of converted farmland and farmed wetland to shrub wetlands.

- Off-site mitigation includes developing a 67-acre site to mitigate for wildlife habitat. FAA safety regulations restrict on-site mitigation.

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- Establishing a Trust Fund to promote in-basin restoration projects for Miller Creek and Des Moines Creeks downstream of the project area.

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E&E believes that the overall mitigation plan is reasonably designed to compensate for wetland impacts discussed in Section 3.6.7 and has the potential for success. The plan provides for in-basin compensation for loss of water quality and water quantity functions, as well as some mitigation for wildlife compensation. For losses that cannot be entirely mitigated by in-basin remedies, an off-site, out-of-basin mitigation plan has been developed by the Port. The off-site mitigation site offers advantages over other in-basin sites including it's size, the ability to create a single large complex versus numerous smaller wetlands, and it's location adjacent to the Green River. Recognizing the concerns over the success of planned mitigation, additional safeguards would provide assurances that the mitigation plans would be implemented, and result in the successful replacement of lost functions. Additional recommendations for mitigation are presented in Section 3.6.7.5.

Loss of water quality functions can be mitigated through proper implementation of Best Management Practices (BMPs) during construction and the development/improvement of the buffering capacity of Miller Creek. Under current conditions, Miller Creek meanders through a residential neighborhood and an active muck farm. Elimination of anthropogenic nonpoint source pollution, including septic systems, fertilizers and pesticides, in combination with the stormwater management system proposed for the airport, development of a vegetated buffer along Miller Creek, and the restoration activities proposed at Vacca Farms should mitigate for the loss of water quality functions.

Loss of water quantity effects can be mitigated through implementation of a stormwater management program. Additionally, seepage from the embankment should provide the seepage necessary to maintain remaining local slope wetlands.

While significant loss of wildlife habitat would occur in conjunction with the fill activities, the proposed mitigation has the potential to increase the habitat suitability of the project area by creating a single contiguous open space along Miller Creek. Because of the FAA restrictions within the project area, off-site mitigation is required for the avian wildlife component. The development of this off-site mitigation would similarly provide a single large contiguous parcel that would attract all types of wildlife, not merely avian species.

3.6.7.4 Mitigation Ratios

No standardized mitigation ratios are currently in effect to establish the appropriate level of compensatory mitigation required. In a Mitigation Memorandum of Agreement between the USEPA and USACE (Mitigation MOA effective February 7, 1990), it was established that a permit applicant is required to replace the functional value of wetlands being impacted at a ratio consistent with the policy of "no net loss" and with an adequate margin of safety to reflect the expected degree of success of the mitigation plan. These requirements essentially require a case-by-case determination of appropriate mitigation ratios. To supplement this, Ecology has issued standardized ratio determinations to provide permit applicants with more guidance.

As part of the Washington State Wetlands Rating System (Ecology 1993), replacement ratios of 3:1 (3 acres of mitigation wetland to 1 acre of wetland lost) and 2:1 are proposed for Class II and Class III wetlands, respectively. A ratio of 1.25:1 is proposed for Class IV wetlands. These ratios are essentially doubled for enhancement of wetland areas. These ratios are only general guidelines, with the final ratios determined based on the likelihood of success of the proposed mitigation site. The stated goal of the policy is a 1:1 functional replacement of wetlands. Because of the historic trend of failed wetlands, the ratios have been increased.

However, a more recent publication presents mitigation ratios that are somewhat lower than presented in the 1993 report. The proposed ratios presented in the 1999 Washington State Department of Ecology draft Compensatory Wetland Mitigation Banks guidelines are:

- Wetland Restoration 1:1
- Wetland Enhancement 2:1
- Buffer Enhancement 5:1

These ratios recognize the value of wetlands, but also recognize the need for wetlands to be integrated into a much larger habitat that has upland components. While not receiving equal benefit, as it should not, the development of a large buffer area would be counted as part of the overall compensation package. Based on these guidelines, the proposed mitigation seems adequate and appropriate to compensate for the loss of wetlands.

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3.6.7.5 *Effectiveness of Wetland Mitigations*

The King County Department of Development and Environmental Services published the *Results of Monitoring King County Mitigations* (Mockler et. al. 1998) which concluded that mitigation, in general, is not being implemented, and those that are have not been successful due to design failure, installation failure, and poor maintenance. The document itself does not call for an abandonment of wetland mitigation, but rather for more regulatory control and guidance provided during the planning, installation, and monitoring phases of the project. In response to this document, among others, Ecology also initiated a study to evaluate mitigation compliance on a statewide level.

Ecology is currently finalizing this report that presents a statewide perspective of the effectiveness of wetland mitigation in the recent past. The draft is expected to be issued in spring of this year. This is a two-phase project with only the first phase being completed (MacMillan, personnel communication 2000). Phase I focused on three issues: (1) if the site was constructed; (2) if the final design was constructed according to plan; and (3) if the wetland is operating up to performance standards. The project has shown that while over 90% of the projects were constructed, only ½ adhered to the final construction design, and only 1/3 of those that had performance standards are meeting all of their standards. This initial phase assessed compliance and did not account for any functional assessment of the wetlands to gauge if they were truly successful. Functional success of mitigation projects will be developed in Phase II. Without closer scrutiny of the data, it is impossible to assess the significance of the data, but two conclusions can be drawn:

- Constructed mitigation projects are not a guaranteed success, and
- Closer regulatory oversight is necessary for longer periods to monitor mitigation projects.

While the Port Mitigation Plan offers a reasonable opportunity for success, based on the cursory conclusions drawn, two additional mitigation elements should be considered. The first is financially driven, requiring the establishment of a bond by the project sponsor to insure that 1) the project is properly implemented, and 2) provide funding for contingency planning if the project did not meet performance standards, and additional action needs to be taken to rectify the deficiencies. The second mitigation element would be the establishment of a third-party environmental

a water storage compartment that causes a time lag of water discharge to the wetlands and creek compared to existing conditions. Because of the lag time through the embankment, the model predicts that winter precipitation would express itself as surface water through the west wall drain in the summer months. This delayed surface water expression would have a generally positive effect on the local wetlands that remain, and a less-pronounced effect on low summer base flow in Miller Creek in general. Although model predictions are limited to the geologic cross section at the west wall, the model suggests that a similar effect on wetland and summer base flow would occur in Walker Creek.

The effects of contribution from the fill embankment to stream summer base flow in Miller and Walker Creeks should not be overstated. The embankment represents a small portion of the total Miller and Walker Creek watershed area.

3.6.8.2 Habitat Parameters

No direct construction impacts are expected for stream habitat in Walker or Des Moines Creek.

Direct construction impacts to Miller Creek stream habitat include the relocation of Miller Creek in the Vacca Farm area. This portion of Miller Creek provides poor habitat for salmonid fish populations because it has sparse riparian vegetation, substrate dominated by sand and silt, a lack of habitat complexity, and a lack of instream structure and large woody debris. Since the proposed Miller Creek channel construction includes a mixture of pools and riffles, gravel and cobble substrate placement, riparian vegetation planting, and large woody debris replacement, the proposed Miller Creek relocation has the potential of providing a net gain of salmonid habitat within the Miller Creek watershed. Proper construction and long-term monitoring are vital to successful Miller Creek relocation including control of turbidity during initial wetting. Some sediment transport during initial wetting is likely, and has the potential to damage habitat downstream.

Indirect effects to stream habitat in Miller, Walker, and Des Moines Creeks include alterations to base flow, peak flow, and sediment input to surface water. These habitat parameters currently limit salmonid populations. Low summer base flows affect habitat quality because exposed portions of the channel are no longer available for use which limits available slack water habitat for juvenile salmon refugia, riffles for macroinvertebrate production, and quality pools for resident salmonids. Lower flow also tends to increase water temperature in stream channels exposed to solar radiation. The Port predicts reduction in summer base flow in Des Moines Creek as a result of a six percent reduction in groundwater recharge in the Des Moines Creek basin. The Port supports augmenting low summer stream flows by pumping from a Port-owned well and discharging the water into the creek (Parametrix, 1999e).

Extreme peak flows degrade stream habitat by scouring stream banks and beds, and transporting coarse sediment too quickly through the stream system. High peak flows also washout streambank slack water areas used by juvenile salmonids and often displace smaller fish downstream because of their limited swimming ability. Substrate in Miller, Walker, and Des Moines Creeks have high fine-sediment content from urbanization throughout the watersheds which limits stream substrate available for salmonid spawning and age-0 fish refugia.

3.6.8.3 Effects on Populations

Direct construction impacts would likely have little effect on fish populations because direct impacts are limited to the Miller Creek reach at Vacca Farm. This reach of Miller Creek provides poor quality habitat for salmonids. Therefore, cutthroat trout, if

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by qualified personnel throughout construction is critical to minimize the chance of an oversight and to maximize control of runoff from the site.

All construction personnel should be trained in proper erosion control practices and informed of the manner in which the project's TESC systems are designed to operate. Personnel should be informed of the consequences of TESC failure to the receiving streams and the potential for a failure to cause a shut down of construction activities. Because of the potential damage that can be caused to a receiving water body by a single error on a project of this magnitude, training of all staff is critical to minimizing the potential for mistakes.

An embankment construction of the magnitude and duration of the third runway project is subject to a range of climatic events and human errors, and an uncontrolled release of runoff from the disturbed site is probable despite proper implementation of construction BMPs. The role of the TESC efforts is to minimize the probability and extent of such a release.

3.6.10 Long-term Temperature Effects

The changes in land coverages within the embankment fill area were reviewed for their potential effects on receiving water temperatures during warm weather low flow periods in the streams. Conditions both during dry periods and during rainfall events were considered.

During periods of extended low flow in Miller, Walker and Des Moines creeks, the discharge is supplied predominantly by groundwater. Absent rainfall, elevated temperatures in the streams can be caused by direct sunlight and surface contact with warm air. The majority of the precipitation falling on the proposed runway embankment would infiltrate through the fill, remain cool within the fill's mass, and discharge through the subdrainage layer at the base of the fill as cool groundwater to the stream systems. This condition is expected to have a beneficial effect on the receiving streams.

The potential for warm runoff from runway and taxiway pavement areas to enter streams and elevate temperatures was also considered. Such temperature effects are limited by frequency because intense rainfall typically occurs during periods of obscured sunlight and only infrequently during warm-weather periods. The majority of the precipitation falling during warmer weather would infiltrate the fill, even during intense rainfall events, because of low antecedent soil moisture during this period. Pavement runoff would flow to the shoulders of the taxiways and runway, with some runoff infiltrating to the fill or through the perforated storm drainage system (if constructed). The discharge of runoff subject to pavement warming would be a small fraction of the precipitation falling on the embankment fill. Temperature buffering within the fill would likely be high as discussed further below and inferred in the Section 3.6.4 discussion of time-lags within the embankment.

The potential for the proposed retaining wall to elevate stream temperatures was also reviewed. The retaining wall's planimetric footprint is very small, and its westerly exposure is subject to solar gain during a portion of the daylight hours in the warmer weather months of concern. The coincidence of high solar gain with rainfall is limited climatically, and the temperature within the wall is regulated by the mass of cool earth behind it. The small footprint of the wall also limits the amount of rainfall that comes in contact with the wall's surface. The small volume of stormwater directly contacting the wall and the limited opportunity for the wall to significantly elevate the temperature of the runoff suggest that the wall would not contribute to elevated temperatures in receiving streams.

The discharge of runoff subject to warming on pavement within the embankment area is small, most warm weather precipitation would be infiltrated into and cooled by the fill mass, and the year-round infiltration of precipitation through the fill would enhance warm weather low flows in streams with cool groundwater. Based on this combination of effects, the runway embankment is not expected to create adverse temperature effects during the critical low flow periods in the streams.

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