King County
Department of Natural Resources
Director's Office
King Street Center
201 South Jackson Street, Suite 700
Seattle, WA 98104-3855

August 3, 2001

Ann Kenny, Senior Permit Specialist
Washington Department of Ecology
Northwest Regional Office
3190 – 160th Avenue Southeast
Bellevue, WA 98008-54552

Dear Ms. Kenny:

King County is pleased to have had the opportunity to assist the Department of Ecology by making its technical review capacity and knowledge of local stormwater conditions available for the review of the Port of Seattle's *Comprehensive Stormwater Management Plan* (SMP) for Master Plan Improvements at SeaTac International Airport. This effort has set an excellent example of how state and local government can work cooperatively in addressing pressing issues facing the region.

As with our previous reviews of this project, it is important to keep in mind the limitations of the work that we have performed. First, this review is limited to ascertaining whether the SMP attained minimum compliance with the 1998 *King County Surface Water Design Manual.* Compliance with the technical provisions of the Design Manual does not mitigate all potential impacts of development and may not provide sufficient information to allow for approval under other codes and regulations. Compliance with the Design Manual is, however, a good start towards mitigating the impacts of this large and complex project.

It is also important to remember that this review is limited to those development activities identified by the Port of Seattle as being Master Plan Update Improvements. While other projects of varying magnitude are being proposed for this area, only those projects included in the formal SMP submission were reviewed for this comment letter. No assumption of concurrence with the technical details or effectiveness of additional projects should be assumed without our specific written comment.

Our reviewers found this version of the SMP is consistent with the technical requirements of the *King County Surface Water Design Manual.* The SMP demonstrates a feasible conceptual strategy for complying with the technical provisions of the *King County Surface Water Design Manual* and effectively demonstrates that the proposed improvements could fully comply with Design Manual requirements.

Enclosure 1 provides general commentary on how the SMP responds to the specific core and special requirements of the *King County Surface Water Design Manual*, as well as an overview of the review scope and limitations.

Enclosure 2 provides a summary of the various surface water facilities proposed for construction, along with specific information on each facility, such as the volume of the facility, the drainage area served, and the amount of impervious area tributary to each facility.

Thank you for this opportunity to work together on behalf of the region. If you have any questions, please contact David Masters, Senior Policy Analyst, or Kelly Whiting, Senior Engineer, both with the Water and Land Resources Division. David can be reached at (206) 296-1982 or via e-mail at david.masters@metrokc.gov. Kelly can be reached at (206) 296-8327 or via e-mail at kelly.whiting@metrokc.gov.

Sincerely,

Pam Bissonnette
Director

PB:tv F968

Enclosures

cc: The Honorable Ron Sims, King County Executive
Ray Hellwig, Northwest Regional Director, Washington Department of Ecology
Paul Tanaka, County Administrative Officer, Department of County Administration
Tim Ceis, Chief of Staff, King County Executive Office
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Joanna Richey, Manager, Strategic Development Section, WLRD, DNR
David Masters, Senior Policy Analyst, Watershed Coordination Unit, WLRD, DNR

ENCLOSURE 1
OVERVIEW OF REVIEW SCOPE AND LIMITATIONS

The December 2000 Comprehensive Stormwater Management Plan (SMP), as revised in July, 2001 has been reviewed for consistency with the technical provisions of the 1998 King County Surface Water Design Manual (KCSWDM). The review has concluded that the SMP has demonstrated that the mitigations proposed in the SMP are consistent with the standards set forth in the KCSWDM. This enclosure details key findings regarding this compliance assessment.

Review has been limited to those development activities identified by the SMP as being Master Plan Update (MPU) Improvements (see SMP Table A-3). Projects not included in the SMP were not reviewed and therefore no presumption of consistency with KCSWDM should be drawn for these projects. Review was performed per the KCSWDM technical requirements which would have applied under Full Drainage Review (see KCSWDM excerpts in next box on page 2), except where the SMP identifies performance goals exceeding the KCSWDM standards. Compliance with King County's technical standards may not be sufficient for project approval under other codes and regulations, and these standards are known to be insufficient to fully mitigate all potential impacts of development. Specifically excluded from the review scope are all procedural requirements of the KCSWDM.

Review and concurrence of a stormwater management plan is primarily a review of design concepts and assumptions to determine if the proposed mitigations demonstrate a feasible approach to comply with the identified performance goals. As the proposed MPU development projects move from the planning stages to development of construction plans, the proposed stormwater mitigations may need to be updated to reflect any changed conditions. Prior to construction of specific projects, additional review and approval of the final construction drawings and associated technical information report is typically required. Oversight and monitoring are key elements to successful implementation of any stormwater management plan. It is recommended that Ecology and the Port develop a plan to oversee and monitor compliance with the mitigations set forth in the SMP. One option is to create an Ecology "Compliance Team", representing the necessary disciplines, to work with the Port to achieve compliance with the goals and objectives laid out in the SMP and related documents.

It has not been determined what legal vesting an Ecology approved SMP affords the future development activities identified within. The SMP includes projects where specific flow control and water quality mitigation approaches and conceptual plans have been identified, but which may be adjusted during final design. The SMP also lists other development projects which do not have specific mitigations identified (see SMP Table A-3). Ecology and King County are working on updated stormwater standards needed to implement Clean Water Act and Endangered Species Act protection objectives. Review of the SMP against these draft standards was not performed. If final facility designs include revised on-site performance goals, Ecology may wish to review the final proposed facilities against the standards in effect at that time.

EXCERPT FROM 1998 KCSWDM

1.1.4 DRAINAGE DESIGN BEYOND MINIMUM COMPLIANCE

This manual presents King County's minimum standards for engineering and design of drainage facilities. While the County believes these standards are appropriate for a wide range of development proposals, compliance solely with these requirements does not relieve the professional engineer submitting designs of his or her responsibility to ensure drainage facilities are engineered to provide adequate protection for natural resources and public and private property.

Compliance with the standards in this manual does not necessarily mitigate all probable and significant environmental impacts to aquatic biota. Fishery resources and other living components of aquatic systems are affected by a complex set of factors. While employing a specific flow control standard may prevent stream channel erosion or instability, other factors affecting fish and other biotic resources (such as increases in stream flow velocities) are not directly addressed by this manual. Likewise, some wetlands, including bogs, are adapted to a very constant hydrological regime. Even the most stringent flow control standard employed by this manual does not prevent increases in runoff volume which can adversely affect wetland plant communities by increasing the duration and magnitude of water level fluctuations. Thus, compliance with this manual should not be construed as mitigating all probable and significant stormwater impacts to aquatic biota in streams and wetlands, and additional mitigation may be required.

In addition, the requirements in this manual primarily target the types of impacts associated with the most typical land development projects occurring in the lowland areas of the County. Applying these requirements to vastly different types of projects, such as rock quarries or dairy farms, or in different climatic situations, such as for ski areas, may result in poorer mitigation of impacts. Therefore, different mitigation may be required.

OVERVIEW OF CORE AND SPECIAL REQUIREMENTS

Core Requirement #1 Discharge at Natural Location
The Master Plan Update (MPU) development activities will result in modifications to the constructed and natural drainage systems within the Seattle-Tacoma International Airport (STIA) area. Below is a summary of STIA areas per the landuse tables in Appendices A and B. The differences in basin sizes can mostly be attributed to the collection and conveyance of potentially polluted stormwater runoff to the Industrial Waste Treatment System (IWS).

Summary of Drainage Basin Areas (acres)

	Calibration	PreDev	PostDev
Des Moines STIA	1672	1585	1577
Walker STIA	234	234	234
Miller STIA	1247	1212	1184
Total STIA Storm	3153	3031	2995
Des Moines IWS	285	331	375
Walker IWS	0	0	0
Miller IWS	0	86	80
Total STIA	3438	3448	3450

Note: numbers taken from landcover tables dated 12/00

Core Requirement #2: Downstream Analysis
Downstream analysis is provided in Appendix P of the document. Identified downstream problems include channel erosion and potential existing flooding problems in Miller Creek. The associated on-site mitigations for these problem types include.

Channel erosion - apply Level 2 streambank erosion standard

- The Level 2 standard is the base standard being applied across the project site. The entire airport site is being retrofitted back to predevelopment conditions corresponding to 75% forested, 15% grass, and 10% effective impervious. This will serve to reduce the existing rates of erosion, although the benefit will be diminished further downstream due to other existing development not having been retrofitted to the same level of protection. Implementation of the Des Moines Creek Basin Plan and development and implementation of a Miller/Walker Creek Basin Plan will help address stormwater needs across the entire basins.

Existing flooding problem - match 100-year peak flows in addition to the Level 2 standard.

- The SMP includes the matching of 100-year peak flows as a specific performance goal and was achieved through the flow control mitigations proposed.

Core Requirement #3: Flow Control
The SMP uses a flow control performance standard equivalent to the KCSWDM Level 3 standard. This includes the control of the duration of high flow discharges between 50% of the 2-year and the full 50-year peak flows. In addition, the 100-year peak discharge is controlled to the predeveloped 100-year level.

The SMP predevelopment landcover assumptions of 75% forest, 15% grass, and 10% maximum impervious provides a target flow regime that is more protective than the current "Existing Site Condition" requirements of the KCSWDM. Using general stream stability guidelines a basin consisting of 75% forest, 15% grass and 10% impervious would provide a flow regime predicted to be geomorphically stable, but

which may have some water quality and base flow concerns. However, since the airport drainage areas comprise a small portion of the entire stream basin, the instream benefits will be less than if all properties in these basins were retrofitted to this standard. Additional mitigations are being proposed to address summer low-flow impacts through a series of low-flow augmentation vaults. Water quality treatment and monitoring is proposed to help ensure that water quality standards would be met.

Under the KCSWDM, flow controls (detention/infiltration) would only be required for new added impervious. Under the draft updates to the Ecology stormwater manual and KCSWDM currently in preparation, flow control retrofits would likely be required for any replaced impervious surfaces. The Port is providing flow control retrofits for all impervious surfaces to the 7S/15/10 landcover conditions described above, although this would not be required by the Ecology manual or by KCSWDM.

The enclosed table (Enclosure 2) provides an overview of the storage reservoirs reviewed under the SMP and the associated landcover (impervious and pervious) assumptions used to size these facilities. Enclosure 2 also provides a list of MPU projects identified to be served by each proposed facility.

The detention ponds located around the toe of the fill embankment could potentially be deep enough to intercept seasonal high groundwater. The SMP proposes that final facility design may be altered to maintain the live storage volume above the groundwater level. If this occurs, it may require raising of berm heights, increasing side slopes, or as a last resort, expanding the facility footprint. Facility footprints may not be able to increase due to site constraints. Modifications to SDN3A may result in that facility exceeding the threshold of State Dam Safety regulations.

The SMP uses a special PERLND calibration for the embankment fill. This calibration was based on limited monitoring data collected from a 1998 embankment area. The effect of this calibration is for fill soils to produce higher runoff than till-grass, but less than impervious. The SMP assumption is that the final embankment will react hydrologically similar to the smaller 1998 embankment area. The SMP has not changed this assumption since it was first proposed during the Miller Creek calibration meetings in Spring of 2000. Ecology's June, 2000 PGG report provides a range of expected soil characteristics for the fill embankment. The expectation is that fill soils will have a hydrologic response more similar to outwash grass with flat slopes than to the previous embankment fill calibration work. At this point in time there was a separation in assumptions between how the fill is characterized in the embankment modeling (used primarily for low stream flow assessment and wetland mitigation) and the SMP modeling (used primarily for high flow assessments, and flow control mitigation sizing). Based on the June 2000 characterization of the embankment's hydrologic response, the SMP assumptions would provide some conservatism in the design of flow control mitigations.

The SMP hydrologic models have assumed that all airport impervious areas are 100% effectively connected to the downstream drainage system. Therefore, the modeled impervious areas equal the total impervious areas. This assumption was used consistently in the HSPF models for all 3 stream basins for the calibration, future and predeveloped (meaningful where use of an effective impervious fraction would result in less than 10% effective impervious) landcover assumptions. If runoff from the runway does infiltrate into the fill embankment as indicated by the June 2000 PGG report, the effective impervious assumptions would provide some conservatism in the design of flow control mitigations.

Core Requirement #4: Conveyance Systems

The SMP indicates that all existing conveyance systems provide at least a 10-year level of capacity. All new conveyance systems will be designed to at least a 25-year level of capacity and will meet the spill containment provisions of the KCSWDM.

The project site includes the challenge of conveying flows down from the runway elevation to the detention and sediment control ponds at the foot of the embankment. The SMP provides, in Appendix W, conceptual designs for energy dissipation structures that will be used to control the high velocity flows at these outfalls.

Core Requirement #5: Erosion and Sediment Control
The SMP provides preliminary erosion and sediment control plans for the proposed 3rd runway embankment. Additionally, the SMP indicates that an erosion control specialist will be responsible for overseeing the installation and performance of these facilities. This is an important aspect of achieving effective erosion/sediment controls on projects of this size.

Of concern is the close proximity of some sediment ponds to the stream channels. However, this cannot be avoided due to the close proximity of the final embankment to the stream channels. Any overtopping, bypassing, or failure of these ponds may result in sediment being discharged to Miller Creek due to the short flowpaths from the ponds to the stream. Extra diligence on erosion control is warranted to minimize sediment transport from disturbed soils (e.g., the embankment fill) to the final sediment ponds. This would include, but is not limited to,

- soil stabilization and cover measures on all disturbed soils.
- minimizing the "open" (without cover measures) areas to only those portions of the project site which are being actively worked.
- further minimizing the areas being actively worked during the wet season (October 1 through April 30), and before forecasted precipitation events.
- frequent inspections of the erosion and sediment control facilities by the erosion control specialist.
- daily inspections of the sediment ponds in close proximity to the stream channels during the wet season, and
- contingency plans developed beforehand to address potential problems which may be encountered with any of the erosion and sediment control BMPs, with emphasis on the sediment ponds serving as the last line of defense prior to discharge to stream.

Core Requirement #6: Maintenance and Operation
This KCSWDM Core Requirement is mostly procedural in nature, written specifically to implement King County's policies and codes. This review is limited to compliance with the technical aspects of the KCSWDM and specifically excludes procedural requirements specific to King County. Therefore, Ecology should ascertain that adequate provisions and agreements are made to ensure the proper maintenance and operation of stormwater facilities on this project site.

The following is the reviewers understanding of maintenance and operation responsibilities at the project site: All facilities on the project site are to be maintained by the Port of Seattle, or their designee. Where maintained by others, Port of Seattle is ultimately responsible for proper maintenance and operations under their NPDES permit.

Some of the deeper vaults exceed the maximum allowable depth to invert (measured from final surface grade) of 20 feet. The SDS7 vault is proposed as an above ground storage structure. An assessment of maintenance feasibility has been provided which supports the SMP position that the Port will be able to perform necessary maintenance activities.

Core Requirement #7: Financial Guarantees and Liability
This SWDM Core Requirement is specific to procedures required under King County policy and code. The intent is to ensure that there is adequate funding available to ensure completion of the required mitigations. It requires that construction be completed, or the posting of bonds and other financial guarantees occur prior to final permit approval.

There are substantial costs associated with the proposed mitigations. Many of the facilities are proposed as underground vaults to avoid the wildlife attraction associated with open ponds. The largest of the eight flow control vaults will have 88 acre-feet of storage, nearly 4 acres in area at 25 feet of live storage depth. The Port has provided a memo indicating the feasibility of the structural design of this facility. A commonly used estimate of vault construction costs is $5- per cubic-foot. With a total volume for new vaults for flow control (347.1 acre-feet), water quality (4.5 acre-feet), and reserve storage (46.1 acre-feet) of 397.7 acre-feet, the total cost in vaults is at $86.6 million. Note: SMP uses a vault cost of about $12- per

cubic foot in assessing feasibility of some water quality retrofits. This value would put the total estimated total vault cost at $207.9 million.

Core Requirement #8: Water Quality
The SMP has provided conceptual designs for water quality treatment facilities consistent with those found in the KCSWDM Basic Water Quality Treatment Menu. The performance goal of basic water quality treatment is 80% TSS removal. The SMP proposes to provide treatment for all new pollution generating surfaces and for all existing pollution generating surfaces through a combination of biofiltration, wetvaults and reroutes to IWS system. Review of these conceptual designs has concluded that they are sized appropriately for the assumed service areas and that they can feasibly be constructed consistent with KCSWDM design standards. STIA areas not proposed for water quality treatment include:

- Approximately 80 acres of existing pollution generating impervious surfaces as shown in SMP Figure 4.4 and Table 7-8. The SMP indicates that the high cost and disruption to airport operations associated with construction of underground wetvaults for these areas make water quality retrofits impractical.

Two instances where source controls are proposed in-lieu of water quality treatment include:
- Landscape Management Plans which implement the source control objectives of the KCSWDM are proposed for all managed landscaped areas, including the runway/taxiway infields.
- Uncoated Metal Roofs are proposed to be coated to prevent leaching. Although not specifically mentioned as an option in the KCSWDM, this approach is consistent with the intent of requiring water quality treatment only for uncoated metal roofs. If the coating process is not successfully completed, water quality treatment would be required.

The above approaches were determined to be consistent with the KCSWDM application of water quality treatment standards for new and redeveloping properties. SMP Table 7-8 provides an overview of the proposed water quality treatment facilities for new and existing pollution generating impervious surfaces.

Previous comments have been provided in regards to copper (Cu) concentrations from some of the existing STIA outfalls. The SMP indicates that the stormwater collection and conveyance system design can accommodate additional water quality treatment measures if deemed necessary through continued monitoring.

The STIA Industrial Wastewater System (IWS) is regulated by Ecology under the Clean Water Act Section 402. The KCSWDM does not set standards for industrial wastewater systems, such as the IWS. The TSS removal efficiency of the IWS is not presented in the SMP. Evaluation of the IWS storage capacity using future landcover, storage capacity, and processing rates indicated that the IWS lagoons are not predicted to overtop to stream. The biggest concern is the sustainability of the assumed future processing rate. As the IWS outfall is proposed to be redirected to the sanitary sewer which may include constraints on allowable processing rates, the issue of potential overtopping should be addressed once future maximum discharge rates to sanitary sewer have been determined. The SMP results do not support the contention of the IWS feasibility report that sufficient storage exists to allow the IWS discharge to be slowed or stopped during storm events. It may be necessary for the Port to retain the use of the current outfall to Puget Sound depending on conditions placed on the proposed connection to sanitary sewer. Since specific future storm volumes cannot be reliably predicted, the IWS operation appears to require near maximum processing rates (3.7 to 4.0 mgd) whenever lagoon #3 is receiving inflows. Any additional areas being rerouted to IWS and not included in the analysis would also warrant evaluation. Note: The modeled future IWS service area includes approximately 410 acres of impervious and 24.6 acres of grassed pervious area. The ultimate storage volume is modeled as 76.9 million gallons, and the maximum sustained processing rate is assumed whenever lagoon #3 is storing wastewater.

Special Requirement #1: Adopted Area Specific Requirements
This would include the Des Moines Creek Basin Plan. The SMP mitigations do not rely on construction of the regional detention facility, or low flow augmentation facility for mitigating existing or new impervious

areas. However, the SMP indicates that if conditions change (e.g., the regional facility is constructed prior to MPU development), that the SMP mitigations may be revised. Since this alternative approach was not analyzed by the SMP, Ecology review and approval of the plans and sizing for final construction may be necessary. The Port is an active member of the Des Moines Creek Basin Committee.

Special Requirement #2: Floodplain/Floodway Delineation
A copy of the floodplain analysis on Miller Creek is included in SMP Appendix J. MPU development has been identified within the floodplain delineation, specifically the 156th/154th roadway realignment in the Vacca farm area, and a relatively small displacement from the 3rd runway embankment near where Miller Creek turns west towards SR509. Calculations provided demonstrate that the roadway realignment is fully compensated for in the Vacca farm area at the 100-year level flood. The embankment calculations indicate that an additional 5 cubic yards is displaced by the embankment footing. The indication is that the base floodplain elevation was determined to not rise due to this amount of displacement, which in turn will not affect the flood carrying capacity of the stream.

Special Requirement #3: Flood Protection Facilities
This special requirement is not applicable as none of the streams are restrained by levees or revetments in the vicinity of the project site.

Special Requirement #4: Source Control
The SMP proposes the use of source control BMPs, many of which are currently being applied to maintenance and operations of the site. Two new source control BMPs are proposed for the site under the SMP. These include retrofitting of existing non-coated metal roofs to prevent leaching of metals, and the implementation of improved landscape management guidelines to minimize the use of pesticides and fertilizers to managed landscape areas including the infield areas surrounding the runways and taxiways. Both of these source control BMPs are consistent with the requirements of the KCSWDM.

Special Requirement #5: Oil Control
Several areas within the project site meet the threshold for high-use sites under the KCSWDM criteria. Most of these areas are being, or are proposed to be, diverted to the IWS which has oil control and spill containment provisions and is regulated as an industrial wastewater discharge rather than a stormwater discharge. One additional area was identified under the SMP as meeting the high-use threshold, the Terminal Drives. The SMP proposes to either install treatment BMPs to this area, or to divert these areas to the IWS. Both alternatives appear to be feasible and consistent with the requirements of the KCSWDM.

Enclosure 2: Facility and Project Schedules Sorted by Flow Control Facility

Landcover data from HSPF Input files Schedule/Project data from SMP Table A-3

Basin Name	Facility Name	Year Facility Enters Service	Facility Type	Storage Volume (Ac-Ft)	Projects Served by Facility as Described in SMP Table A-3	Year Project to be Constructed	Comments
[illegible]	SD5A	5	Vault	12.9	Runway 34R Safety EA Dual Taxiway 34R Extension of Runway 34R by one-half	1998 10 -- 15 00 -- 10	rebuilt rebuilt rebuilt and new
	SD5B mitigates for SD5BA and SD6B	6	Vault	9.0	Decommissioning Taxiways N5-34L New Snow Equipment Storage Phase 1 - 1998 Taxiway Construction Phase 2 - 1999 Taxiway Construction	1995 1997 1998 1999	rebuilt new new new
	SD5BA	Existing	Vault	3.4	Phase 1 - 1998 Taxiway Construction Phase 2 - 1999 Taxiway Construction	1998 1999	new new
	SD6F mitigates for SD6B and SD6E	6	Vault	21.7	Phase 3 - 2000-2004 Runway N5R/23R	04 -- 08	new
	SD6A mitigates SD6E4 and SD6I	4	Pond	38.6	Relocation of Alliance Cargo New ATCT Central Terminal Expansion Expansion of Concourse A (South Terminal) Improvements to Main Terminal Roads (Ground access and entrance improvements, widen lower terminal drive, widen north entry drive) SASA and Access Taxiway (North Hold) Expansion of Concourse A (South Terminal) Improvements to Main Terminal Roads (Ground access and entrance improvements, widen lower terminal drive, widen north entry drive) Ground Support Equipment Location Ground/Cargo/Air Aviation Facilities (SASA) Relocation of United Maintenance Complex to SASA Improved Access and Circulation Roadway Improvements Phase 1 - North Unit Term/Out (South Pier) North Unit Terminal Roadways New ARFF (fire station) Improvements to South Access Connector Taxiway Phase 1 - North Unit Terminal Parking Structure Improvements of North Unit Terminal (North Pier) Complete Connectors to South Access Roadway	00 -- 00 00 -- 02 02 -- 04 00 -- 04 1999 04 -- 07 02 -- 04 02 -- 05 02 -- 01 01 -- 05 04 -- 05 04 -- 00 01 -- 05 00 -- 00 00 -- 00 00 -- 07 05 -- 00 05 -- 00 00 -- 10 00 -- 02	rebuilt rebuilt rebuilt rebuilt rebuilt new rebuilt rebuilt and new rebuilt and new new new rebuilt rebuilt rebuilt rebuilt rebuilt and new rebuilt rebuilt rebuilt

LANDCOVER ASSUMPTIONS BY FACILITY (acres) EIA = Effective Impervious Area				IMPERVIOUS SURFACES (acres) (DIVERSION SITE METHOD)		
Effective Impervious or Total Area	Existing Conditions 1994	Predeveloped Conditions (Pre-central Impts) PRE	Future Conditions (Area Served by Facility) FUTURE	Existing/Replaced Impervious to be Rebuilt REMAINS (=1994 - PRE)	Post-1994 and Future Added Impervious (Destroyed) NEW (=FUTURE-1994)	Impervious Surfaces Mitigated TOTAL (=FUTURE - PRE)
EIA	88.2	0.5	92.5	87.7	13.3	26.0
Total Area	91.6	91.6	91.6			
EIA	178.3	37.8	383.4	[illegible]	[illegible]	66.1
Total Area	349.6	376.7	376.7			
[illegible] SD5B and SD6B breakdown						
EIA	7.1	7.0	35.1	0.1	28.1	28.2
Total Area	69.6	69.6	69.6			
EIA	73.6	70.5	48.4	3.1	24.9	27.7
Total Area	117.2	117.1	117.1			
EIA	148.2	31.9	178.7	119.4	35.5	154.9
Total Area	210.2	210.2	210.2			
[illegible] TOTALS	1994	PRE	FUTURE	REMAINS	NEW	TOTAL
EIA	509.6	83.3	488.8	276.9	126.4	404.7
Total Area	845.7	845.6	845.6			
Total Live Storage		161.4 Ac-Ft				

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Basin Name	Facility Name	Year Facility Enters Service	Facility Type	Storage Volume (Ac-Ft)	Projects Served by Facility as Described in SMP Table A-3	Year Project to be Constructed	Comments	Effective Impervious Area (EIA) / Total Area	Existing Conditions 1994	Predeveloped Conditions (flow control target) PRE	Future Conditions (Area Served by Facility) FUTURE	Existing/Replaced Impervious to be Retrofitted RETROFIT (=1994 - PRE)	Post-1994 and Future Added Impervious (Controlled) NEW (=FUTURE-1994)	Impervious Surfaces Mitigated TOTAL (=FUTURE - PRE)
MILLER	[illegible] mitigation for [illegible]	4	Vault	14.4	Safety Areas 16R/34L Interconnecting Taxiways 16R-34L Phase 1 - 1995 Taxiway Construction Phase 2 - 1999 Taxiway Construction Removal of displaced threshold on runway 14L	04 -- 05 1995 1995 1999 2000	new retrofit new new retrofit	EIA Total Area	30.5 92.1	7.8 80.9	40.7 [illegible]	25.5	17.2	42.7
	CARGO	4	Vault	4.5	Continued Expansion of North Cargo Facilities Cargo Warehouses at 24th Avenue South	04 -- 05 06 -- 10	retrofit new	EIA Total Area	1.3 8.1	0.0 8.1	8.1 8.1	0.3	7.1	7.[illegible]
	SDN[illegible] includes [illegible] in existing and 199[illegible]	4	Vault Wetvault	5.5 1.6	Redevelopment of North Air Cargo (ground support equipment relocation)	01 -- 05	retrofit and new	EIA Total Area	41.2 65.3	6.4 65.3	13.2 21.6	34.0 ***includes diversion to IWS	[illegible]	6.[illegible]
	[illegible]	4	Vault	55.2	Interconnecting Taxiways 16R-34L Phase 1 - 1995 Taxiway Construction Phase 2 - 1999 Taxiway Construction	1995 1999 1999	retrofit new new	EIA Total Area	14.5 73.2	4.0 73.2	34.2 73.8	0.7	9.0	19.[illegible]
	NEPP	4 existing	Vault Vault	13.9 4.0	NEPL, Phase I	1999	retrofit	EIA Total Area	0.9 47.3	4.2 47.3	32.3 48.7	-9.4 *** more EIA in PRE than 1994 *** [illegible]	31.4	20.[illegible]
	[illegible]A	6	Pond Vault	25.5 7.4	Phase 3 - 2002-2004 Runway [illegible]	04 -- 08	new	EIA Total Area	0.9 147.0	0.0 [illegible]	15.4 57.4	0.0	14.[illegible]	[illegible]
	[illegible]	6	Pond	32.6	Phase 3 - 2002-2004 Runway 16R/34R	04 -- 08	new	EIA Total Area	4.3 86.9	4.5 86.9	27.8 96.8	0.0	27.[illegible]	22.[illegible]
	[illegible]A	6	Pond Vault	14.8 7.0	Phase 3 - 2002-2004 Runway [illegible]	04 -- 08	new	EIA Total Area	1.0 30.8	1.0 30.5	6.2 30.8	0.0	6.4	6.[illegible]
	[illegible]		Pond	0.82	ASR site	04 -- 04	new	EIA Total Area	1.0 3.9	0.1 3.9	0.0 3.8	0.0	-0.[illegible]	0.[illegible]
	[illegible]	Exist	Pond		154th/156th Street Relocation NEPL, Phase 1	02 -- 08	154th/156th providing flow control for 10% of NEPL							
	Airport Area Impervious Removal				154th/156th Street Relocation	02 -- 08	154th/156th							
	SR518 Interchange		Pond		Temporary SR 518 Interchange	2	temporary not included in SMP							

MILLER TOTALS	1994	PRE	FUTURE	RETROFIT	NEW	TOTAL
EIA	98.2	30.4	170.[illegible]	67.8	80.8	140.[illegible]
Total Area	485.1	482.8	418.[illegible]			
Total Live Storage		176.3 Ac-Ft				

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Miller Creek [illegible]

AR 050892

							LANDCOVER ASSUMPTIONS BY FACILITY (acres) EIA = Effective Impervious Area			IMPERVIOUS SURFACES (acres) DETENTION SIZING/MODIFIER		
Basin Name	Facility Name	Year Facility Enters Service	Facility Type	Storage Volume (Ac-Ft)	Projects Served by Facility as Identified in SMP Table A-6	Year Project to be Constructed	Effective Impervious or Total Area	Existing Conditions 1994	Predeveloped Conditions (Pre-created Jungle) PRE	Future Conditions (Area Served by Facility) FUTURE	Existing/Replaced Impervious to be Redetained (-1994 - PRE)	Post-1994 and Future Added Impervious (Detained) (+FUTURE-1994)	Impervious Surfaces Mitigated TOTAL (=FUTURE - PRE)
[illegible]	SCWM	0	Pond	10.8	Phase 3 - 2003-2008 Runway RENTON	04 -- 08	EIA	2.0	2.2	6.6	1.1	6.7	7.8
							Total Area	41.0	41.0	44.5			
	SR900 Interchange		???	???	Temporary SR-900 Interchange	1	temporary not included in SMP						
Various	Projects not requiring Flow Control				Auburn Wetlands Mitigation	no impervious							
					Miller Creek Relocation	no impervious							
					WACCA FRMS Floodplain Restoration	no impervious							
					Miller Creek Sewer Relocation	no impervious							
					Property Acquisition, Street and Utility Vacations	impervious removed							
					Sewer Sites 3A and 4		TESC ponds						
					Phase 1 - 1997 Embankment Stockpile		TESC ponds						
					Phase 2 - 1999 Embankment Fill	mid-projects	TESC ponds						
					Phase 3 - 2000 Embankment Fill	mid-project	TESC ponds						
					Phase 4 - 2000 Embankment Fill	mid-project	TESC ponds						
					Satellite Transit Shuttle System Rehab	00-05	SWS						
					Main Garage Expansion to South, North, East	2000	SWS						
					SR900 Site Preparation	00-05	mid-project						
					Ramps off SR-518, S 180th Improvements	project cancelled							
					Additional Expansion of Main Parking Garage	04-08	SWS						
		HOV Projects not facilities cited in SMP			Expansion of RSFL to 2000 stalls	00 -- 05	not included in SMP						
					Additional Tenancy Gifts on NE/SW	00 -- 10	not included in SMP						
					Additional Expansion of Main Parking Garage	00 -- 10	not included in SMP						
					Additional Expansion of North Employee Parking Lot	00 -- 10	not included in SMP						
					Expand North Unit Parking Structure	10 -- 20	not included in SMP						
					SR-900 Extension/South Access	10 -- 20	WSDOT project						
					ASDE, RWY/RDY	02 -- 04	not included in SMP						

King County
Department of Natural Resources
Director's Office
King Street Center
201 South Jackson Street, Suite 700
Seattle, WA 98104-3855

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DEPT OF ECOLOGY

August 3, 2001

Ann Kenny, Senior Permit Specialist
Washington Department of Ecology
Northwest Regional Office
3190 – 160th Avenue Southeast
Bellevue, WA 98008-5452

Dear Ms. Kenny:

King County is pleased to have this opportunity to work with the Department of Ecology (Ecology) by making its technical review capacity and knowledge of local stormwater conditions available to assist in reviewing the Port of Seattle's *Low Flow Impact Analysis - Low Flow Impact Offset Facility Proposal (July 2001).*

This analysis of low flow impacts, and the proposed facilities for offsetting identified impacts, constitute a substantial proposal to provide mitigation for natural resource impacts which goes well beyond the basic requirements of the *King County Surface Water Design Manual.* Since this proposal goes beyond the requirements of the Design Manual, reviewers did not have the benefit of clear performance standards for low flow mitigation efforts against which to measure the proposals.

The enclosure provides general comments on the low flow study, as well as specific comments on the analysis and proposed facilities grouped by drainage basin. To assist Ecology, substantial commentary has been included to help clarify the reviewers' understanding of the technical issues and the logic contributing to specific comments.

Reviewers did find several inconsistencies and gaps in data, primarily in the report documentation, that we recommend correcting in the final proposal's preparation. While most of these appear to be minor errors attributable to the multiple iterations and edits that the document has gone through, several of them have the potential to affect facility design and plan effectiveness beyond a trivial amount.

Due to the number of minor corrections needed, we recommend that a final version of the document be prepared that incorporates the necessary corrections and any additional technical memoranda or addenda in a single document. This final document would allow permitting agencies to locate all relevant documentation relating to this portion of the permitting decision

and mitigation requirements in a single document, greatly easing record keeping and documentation of compliance.

It is important to note that King County did not review the models for the proposed embankment and offers no comments on the accuracy of predictions derived from these models. Since impacts and subsequent mitigation measures are derived from the embankment models, any shortcomings in the embankment models would potentially affect both predicted impacts and subsequent mitigation measures.

Thank you for this opportunity to continue working together on behalf of the region. If you should have questions regarding our comments please contact David Masters, Senior Policy Analyst, or Kelly Whiting, Senior Engineer, both with the Water and Land Resources Division. David can be reached at (206) 296-1982 or via e-mail at david.masters@metrokc.gov. Kelly can be reached at (206) 296-8327 or via e-mail at kelly.whiting@metrokc.gov.

Sincerely,

Pam Bissonnette
Director

PB:tv 8970

Enclosure

cc: The Honorable Ron Sims, King County Executive
Ray Helwig, Northwest Regional Director, Washington Department of Ecology
Tim Ceis, Chief of Staff, King County Executive Office
Kurt Triplett, Deputy Director, Department of Natural Resources (DNR)
Nancy Richardson Ahern, Manager, Water and Land Resources Division (WLRD), DNR
Debbie Arima, Assistant Manager, WLRD, DNR
Curt Crawford, Supervising Engineer, Drainage Services Section, WLRD, DNR
Kelly Whiting, Senior Engineer, Engineering Studies and Standards, WLRD, DNR
Joanna Richey, Manager, Strategic Development Section, WLRD, DNR
David Masters, Senior Policy Analyst, Watershed Coordination Unit, WLRD, DNR

Review Comments on the Low Flow Impact Analysis - Flow Impact Offset Facility Proposal, July 2001

Review Scope and Limitations

The July 2001 Low Flow Analysis Flow Impact Offset Facility Proposal (Low Flow Report) has been reviewed for consistency in hydrologic modeling and for consistency in meeting the performance objectives identified by the Department of Ecology (Ecology) and Port of Seattle (Port). The Low Flow Report supplements the Port's Comprehensive Stormwater Management Plan (SMP). While the 1998 King County Surface Water Design Manual (KCSWDM) does not include performance standards for low flow mitigations, the following comments do include some references to KCSWDM design criteria. This review summary concludes that the low flow report proposes substantial mitigations for offsetting low flow impacts annually during the timeperiod when most low flow events occur. There are, however, some significant gaps in the documentation of the analyses performed and the associated mitigations. This enclosure summarizes key findings and recommendations generated from this review. These comments include a substantial amount of commentary as to the reviewer's understanding of the analyses performed.

Review has been limited to the HSPF hydrologic modeling, the impact assessment, and the conceptual design of the associated facilities. With the exception of the hydrologic inputs and outputs, the review of specific aspects of the embankment modeling used in Miller Creek was performed by Ecology staff with expertise in that area.

Review of a stormwater management plan is primarily a review of design concepts and assumptions to determine if the proposed mitigations demonstrate a feasible approach to comply with the identified performance goals. As the proposed Master Plan Update (MPU) development projects move from the planning stages to development of construction plans, the proposed low-flow mitigations may need to be updated to reflect any change in conditions. Prior to construction of specific projects, additional review and approval of the final construction drawings and associated technical information report is typically required. Oversight and monitoring are key elements to successful implementation of any stormwater management plan. It is recommended that Ecology and the Port develop a plan to oversee and monitor compliance with the mitigations set forth in the Stormwater Management Plan and Low Flow Report. One option is to create an Ecology "Compliance Team", representing the necessary disciplines, to work with the Port to achieve compliance with the goals and objectives laid out in the SMP and related documents.

General Comments-

Certification:
The final low flow study should be stamped by a professional civil engineer. The engineering work included in the report should be performed by, or under the supervision of, a licensed civil engineer.

Non-Hydrologic Effects on Low Stream Flows:
The proposed low flow mitigation includes flow augmentation for identified non-hydrologic changes effecting low stream flows. These changes include the removal of septic systems in Walker and Miller creek basins, and the relinquishment of water withdrawal rights in Miller Creek. The water withdrawal numbers have been refined from early SMP drafts. The septic system numbers have also been revised since the 12/00 low flow report. The net effect of these changes is a relatively small additional reduction in calculated future low stream flows (0.01 cfs in Walker, 0.02 cfs in Miller). The Port is proposing to provide additional flow augmentation to offset these non-hydrologic changes during the proposed 3 month mitigation period. Additional water quality benefits are expected associated with the removal of 277 septic tanks from the former residential areas adjacent to Miller and Walker creeks.

While some of the comments below address how the non-hydrologic changes were handled in the low-flow statistics, none are meant to question the appropriateness of the quantity or duration of the proposed non-hydrologic mitigations.

Calibration Accuracy:
The low flow analyses used the same HSPF calibration files used in the SMP to define the existing baseline low flow conditions. This calibration has been accepted for stormwater design and therefore the low flow analysis and mitigations will be consistent. The final low flow report needs to include a discussion of the accuracy of the calibrations in predicting low flows at upper stream gauges, and a statement of adequacy of the calibrations for the purpose of low flow simulation.

Biological Conclusions:
The flow frequency plots of ranked annual low flow events show substantially complete mitigation of the annual minimum low-flow events by providing augmentation during the timeperiod when streams are at their historically lowest flow levels (August-October). Inspection of the 1991 through 1994 hydrographs shows that June-July baseflows will also be reduced by a similar amount. The flow frequency analyses generally predict an increase in number of annual low flow periods occurring in July under the augmentation plan. The low flow report's biological assessment concludes that this change in timing of low flow events will not have an adverse impact on salmonids or their habitat.

The late spring and early summer periods are when fish typically grow at the greatest rate. It is difficult to put these early summer hydrologic changes into perspective without an evaluation of what these flow reductions will look like in-stream. Will fish be forced into pools at times they currently are not? Will the number of available pools be reduced? Will this change the spatial distribution of fish? Will juvenile fish be subject to increased predation? Will there be impacts to invertebrate diversity and/or abundance? Will there be shifts in timing and duration of insect hatches?

- The final low flow study should put these spring-early summer low flow periods into perspective through a quantitative assessment of the effects of flow reductions on representative stream channel cross-sections.

- A monitoring program should be developed to verify the biological findings of no adverse impact to stream biology. This monitoring should begin as soon as possible so that baseline data can be obtained prior to substantial development changes.

- A monitoring program should be developed to ensure adequate water quality of reserve stormwater prior to discharge to stream.

Documentation:
The report should clearly document and narrate the analyses used to generate the results used to determine the impact and develop proposed mitigations. Presentation (including narrative) of alternatives considered is appropriate. Likewise, if electronic files are provided they should be limited to those files which correspond to the results presented in the report. A readme.txt file (or text in the report) should detail specifically which electronic files are provided and what information they contain. There should only be one CDROM. In the event additional files are needed, an entire replacement CDROM should be provided. The analyses and information are complicated enough without insufficient documentation (narrative) and superfluous supporting documents creating unneeded confusion.

Conceptual Drawings:
Conceptual drawings of the reserve storage facilities were received July 31. They show reserve vault locations and size for all of the proposed low flow vaults. The Low Flow Report needs to include details on how constant discharge will be maintained in a reservoir with variable hydraulic head pressures. Specific Comments provided below.

The reserve vault inlets and outlet should be configured so that water is added/discharged from the middle of the reserve storage depth. This will help avoid disturbing sediments and/or floatables which could be present in the reserve vault. Some drawings have notes indicating that internal piping will be used to

promote circulation and flushing of stored water. A similar note would be applicable to situations like SDS3 vault where the inlet pipe is located 12.9 feet above the reserve storage.

To help keep the retained water well aerated, reserve storage vaults should include open ventilation consistent with KCSWDM wetvaults. Mechanical aeration may be needed if grating is not feasible (e.g., vaults considerably below grade). At conceptual stage, a note to this effect would suffice.

Des Moines Creek -

Overview

Point of Evaluation: S 200th Street, near golf course weir.

Existing conditions: represented by the SMP 1994 Calibration HSPF input file.

Future conditions: represented by the SMP 2006 Future HSPF input file.

Target flow condition: 1994 landcover, 2-year 7-day low flow = 0.35 cfs

2006 flow condition: 2006 landcover, 2-year 7-day low flow = 0.25 cfs

Hydrologic change: 0.10 cfs

Additional Non-Hydrologic mitigation: 0.00 cfs

Total Low Flow Augmentation: 0.10 cfs

Low Flow Augmentation Period: July 24 - October 24; 91 days

Reserve Storage Volume: 12.2 acre-feet

Start of Filling: January 1

Duration of Reserve Storage Filling (maximum): 32 days (vault filled by February 2)

Comments

Calibration Documentation:
No data was found in the low flow report, or the accompanying three CDROMs, comparing the existing condition simulation of low flows against the Tyee Golf Course weir gauge data. Provide representative hydrographs, associated discussion and statement of adequacy of the calibration for simulating low flows.

Low Flow Statistics:
The proposed augmentation period starts on July 24 due to a large number of late July low flow events in the 2006+ augmentation record which occurred prior to an August 1 start date. (note: these low flow events before or after the mitigation window are less severe than would occur during the late summer if no low flow augmentation was provided.) However, there remains 11 annual low flow events (out of the 47 year record) which occur outside of the mitigation window, six starting around July 15. The reserve storage filling analysis determined that there will be at least 36 days (lowest of the 47 year record) worth of flow augmentation remaining in the vaults at the end of the proposed augmentation period (October 24). The vault storage volume remaining was not known when the July 24 and July 15 start dates were discussed previously. It is recommended that the reserve storage be evaluated with a July 8-15 start date to see if the filling analysis continues to show enough remaining storage to continue mitigation through October. Provided the final operations plan includes the provision to continue discharging any available water during

the month of November, or until substantial rains occur, the flow frequency analysis would be consistent to assume events within this extended period of water availability to be augmented.

The flow frequency plots of ranked annual low flow events show substantially complete mitigation of the annual minimum low-flow events. The proposal provides augmentation during the period when streams are at their lowest flow levels. Inspection of the 1991 through 1994 hydrographs show that June-July baseflows will also be reduced by approximately the same 0.10 cfs. The flow frequency analyses predicts an increase in number of annual low flow periods occurring in July under the augmentation plan. The low flow report's biological assessment concludes that this change in timing of low flow events will not have an adverse impact on salmonids or stream habitat.

The late spring and early summer periods are when fish typically grow at the greatest rate. It is difficult to put these early summer hydrologic changes into perspective without an evaluation of what these flow reductions will look like in-stream. Will fish be forced into pools at times they currently are not? Will the number of available pools be reduced? Will this change the spatial distribution of fish? Will juvenile fish be subject to increased predation? Will there be impacts to invertebrate diversity and/or abundance? Will there be shifts in timing and duration of insect hatches?

- The final low flow study should put these spring-early summer low flow periods into perspective through a quantitative assessment of the effects of flow reductions on representative channel cross-sections.

- A monitoring program should be developed to verify the biological findings of no adverse impact to stream biology. This monitoring should begin as soon as possible so that baseline data can be obtained prior to substantial development changes.

- A monitoring program should be developed to ensure adequate water quality of reserve stormwater prior to discharge to stream.

Conceptual Designs:

- Conceptual designs should include details on how constant discharge will be achieved with variable head pressures.

- SDS4 vault: The vault inlet pipe will need to be reconfigured at a lower elevation. A note similar to the one found on exhibit C131 should be included here.

- SDS3 vault: not all inlet pipes are tributary to the reserve storage vault. The effects of having a reduced tributary area should be factored into the vault filling calculations.

Des Moines Creek Conclusions:

1. The proposed Des Moines Creek low flow augmentation has increased from 0.08 cfs to 0.10 cfs in the current proposal. The proposal to augment low flows for 3 months constitutes a substantial amount of mitigation.
2. The Low Flow Report needs to include evaluation of the accuracy of calibration for predicting upper stream low flows, a discussion of the evaluation, and a statement of adequacy.
3. Consideration should be given to moving the start date earlier (July 8-15) because of the large amount of reserve storage available at end of augmentation period, and the presence of several low flow events occurring in July.
4. It is recommended that the Low Flow Report include complete conceptual drawings for the proposed reserve storage vault and revised site design which includes the proposed reserve storage release structure to maintain constant discharge.
5. The SDS3 vault includes bypassing some inflows around the reserve storage. It is unclear whether this has been accounted for in the reserve storage filling calculations.
6. The SDS4 vault release rate will need to be only 0.015 cfs. It would be preferable if the reserve storage could be achieved with SDS3 facility alone.

Walker Creek -

Overview

Point of Evaluation: Des Moines Memorial Drive (~Gauge 42C).

Existing conditions: represented by the Calibration HSPF input files.

Future conditions: represented by modified 2006 HSPF input file. 8.05 acres removed from SDW2 subbasin. Embankment flows not included.

Target flow condition: 1994 landcover, 2-year 7-day low flow = 0.79 cfs

2006 flow condition: 2006 landcover, 2-year 7-day low flow = 0.71 cfs

Hydrologic change: 0.08 cfs

Additional Non-Hydrologic mitigation: 0.01 cfs

Total Low Flow Augmentation: 0.09 cfs

Low Flow Augmentation Period: August 1 - October 31; 92 days

Reserve Storage Volume: 15.0 acre-feet

Start of Filling: December 1

Duration of Reserve Storage Filling (average year): 102 days (vault filled by Mid March)

Comments

Low Flow Statistics:
It appears that the low-flow statistics provided for 1994 and 2006 conditions do not account for the non-hydrologic changes, while the 2006+ augmentation includes the additional augmentation proposed for non-hydrologic changes. If this observation is true, the benefits of the proposed mitigation are slightly overstated. This could be done by raising the 1994 curve by 0.01 cfs or by lowering the future condition curves by 0.01 cfs. Either way, it does not change the calculations for the amount of augmentation proposed. Non-hydrologic changes and low flow events occur outside the proposed augmentation window, so it would not be accurate to simply remove the augmentation associated with the proposed non-hydrologic mitigations.

The third CDROM provided, dated 7/26/01, includes timeseries for non-hydrologic adjustments. These timeseries have not been reviewed as there is no indication they were used in the current analysis.

Embankment Modeling:
The low flow study report indicates that the hydrologic contributions from the embankment were not included in the results of the 2006 conditions, nor in the 2006+ augmentation models. However, the low flow report includes information on the Walker Creek fill embankment, which raise the following comments:

- It appears that a significant portion of the modeled Walker Creek embankment is located within in Des Moines Creek surface water basin (SDS7). The embankment analysis found 2250 linear feet of embankment south of the Miller/Walker basin divide. This appears to include the entire length of the 3rd runway outside of the Miller Creek Basin. In comparing against the SMP Grading and Drainage plans, it appears that approximately the southern 1300 feet of the runway either does not have any embankment fill or the embankment drainage would not be tributary to Walker Creek.

- On Figure 1 of the 6/25 PGG memo, the southernmost green area representing fill depths over 40 feet appears to be in an area shown on the SMP grading plans to be in an area identified to be a 40 foot cut (elevation 390 reduced to elevation 350). It is indicated in the low flow report that Walker Creek post-project conditions assume that the embankment fill provides no discharge during summer low flow statistics. This is shown in Walker Creek HSPF input file (wcnofill.inp) received via e-mail attachment on 7/24/01. This is the input file reported to have been used to generate the 2006 low flow statistics. The input file includes the removal of 8.05 acres of till grass, embankment fill, and impervious. The stated purpose for the removal of the PGG embankment flows was "...to allow for the largest impervious area possible to refill the Walker Creek low streamflow vault." This philosophy raises concerns in that simply not modeling the embankment does not change the expected runoff response of the embankment fill.

Non-Hydrologic Evaluation:
The Walker Creek drainage area reportedly includes the removal of 41 septic systems. The low flow impact associated with this removal of water is 0.014 cfs. This is approximately equal to 210 gallons per septic system per day. This is consistent with commonly used numbers for domestic water use.

Reserve Storage Collection:
To facilitate the collection of enough stormwater in the SDW2 surface water subbasin, the low flow report indicates that water will be collected from an impervious cover over Pond F, and by placing liners under some of the infield areas (filter strips) to keep stormwater in the surface collections system for conveyance to the reserve storage vault. The July 25, 2001 letter from Keith Smith, Port, indicates that 3.5 acres of infield area is proposed to be lined with impervious surface underlying the grass lined filter strips. The liner is to offset the 3.5 acres of runway assumed to 100% infiltrate into the embankment in the low flow models. Additionally, the SMP proposes to cover the pond with an impervious cover and to collect stormwater from the cover. Adding impervious surfaces not anticipated in the SMP creates inconsistencies with the assumptions used to size and evaluate the surface water facilities, as well as creating inconsistencies in the amount of water assumed to recharge groundwater and adjacent wetlands.

The SMP hydrologic models have assumed that all airport impervious areas are 100% effectively connected to the downstream drainage system. Therefore, the modeled impervious areas equal the total impervious areas. This assumption was used consistently in the HSPF models for all 3 stream basins for the calibration, future and predeveloped (meaningful where use of an effective impervious fraction would result in less than 10% effective impervious) landcover assumptions. For the facilities serving the embankment area effective impervious (less than total) was used for release rates and total impervious was used for future conditions. Per the June 2000 PGG report, this is a conservative assumption since the embankment fill specifications should result in a much more permeable embankment. However, since it is not possible to verify the future condition of the embankment, the SMP has not changed the original embankment permeability or effective imperious assumptions. The proposed approach for Walker Creek is to consider 3.5 acres of the proposed runway is 0% effective and therefore lining 3.5 acres of infield areas produces no net increase in impervious cover. Comments include,

- Adding impervious surfaces for the sake of mitigation feasibility is a counter-productive strategy for attaining resource protection goals.
- If lining the embankment area, the amount of embankment water available for downstream wetlands will change (likely decrease).
- If lining other pervious areas in Walker Creek (either till grass or outwash grass) this will have a larger effect on the flow control performance than lining embankment area.
- While filling the reserve storage vault the winter hydrology of Wetland 44A will be altered. In an average year the vault filling will take 102 days (mid March), but in drier years filling will extend through Spring and Summer. While filling, the runoff volumes which would have been discharged to the wetlands will be stored (15 ac-ft) and introduced to wetlands during late summer.

If the runway areas draining to the embankments are assumed to be zero percent effective impervious for purposes of designing flow control facilities, infiltration related BMPs such as raised rims on conveyance inlets, or perforated stubouts on the outlets from conveyance inlets should be provided. Unless measures are taken to ensure that runway areas draining to the embankment will be fully infiltrated, the flow control facility performance should be reevaluated to determine the feasibility of meeting stormwater standards using modeling assumptions consistent with the SMP. Performance verification may be possible using the existing proposed facility. Successful demonstration of maintaining flow control performance goals may, in part, be contingent on what portion of SDW2 subbasin is proposed to be lined. Due to the hydrologic response assumptions for the fill in the SMP, it would be advantageous to line an area of embankment fill. However, see Wetland 44A discussion below.

This proposal to add additional impervious surfaces is significant enough (total impervious will increase from 9.5 to 13.0 acres) that the areas to be lined should be provided in a figure to show how it will look either on the grading plans or as a separate figure. It is also necessary to know whether the liner will be located over the embankment or other soils. It should also show any infiltration BMPs, if proposed.

Wetland Hydrology:
Wetland 44A is located at the toe of the Walker Creek embankment. The northern arm of the wetlands receives flows from the outlet swale. The outlet swale serves as the conveyance system for discharges from the detention pond, reserve vault, and possibly serves to collect discharges from the embankment drain. Note: The NRMP indicates that this swale is to be removed after construction which is inconsistent with the SMP that shows the swale as a permanent stormwater conveyance system.

The low flow proposal includes the collection and retention of 11.5 acres of impervious surfaces into the reserve storage vault. The period of filling will average 102 days starting on November 30 (ending around mid-March in average year). During this time there will be almost zero surface inflows/discharges from the detention pond. In less than average years of precipitation, the time period needed for vault filling can extend considerably (in two years of the modeling record the vault did not completely fill). During these periods of filling the wetlands will receive only water from the embankment drains (assuming they are not intercepted into the vault also). This includes about 8 acres of pervious and impervious surfaces in the Walker Creek subbasin. The low flow proposal includes lining of 3.5 acres of pervious area, either on the embankment or east of the embankment. If the liner is located on the embankment, there will be a reduction in the amount of embankment recharge to the northern arm of Wetland 44A. The retained volumes (15 acre-feet) will be introduced to the wetlands as constant low flow augmentation between August 1 and October 31.

The NRMP shows the outfall from a channel located south of the southern arm of Wetland 44A, which is not shown on the SMP grading and drainage plans. The channel is assumed to convey flows from approximately 200 linear feet of embankment located south of wetland 44A. Since this portion of the runway is located in the Des Moines surface water basin, it is not expected that the proposed lining of the embankment will occur here.

The proposal to add additional impervious surfaces to facilitate stormwater mitigation is not supported by the reviewer. Alternatives recommended for evaluation include: 1) collection of the winter runoff from the 69 acres of impervious being added in the Walker Creek non-contiguous groundwater basin, or 2) the collection of a percentage of water at the toe of the Walker Creek embankment, 3) divert some winter runoff from adjacent SDW1B drainage system.

1. The 69 acres of impervious surface being added in the Walker Creek groundwater basin is likely responsible for most of the mitigation need. A portion of the rain water that would be intercepted by these impervious areas is currently flowing as groundwater to Walker creek. The collection of January runoff from some or all of these new impervious areas (or equivalent) would be unlikely to have an adverse affect on Des Moines Creek winter flows.

2. It is understood that the storm water at the toe embankment has been identified as providing hydrologic mitigation to wetlands 44A. It is not known whether there is sufficient water in the embankment to provide enough runoff volume for both purposes. A portion of the embankment north of the SDW2 pond could likely be directed into the vault by gravity drain.

3. Taking water from SDW1B would be similar to getting water from the non-contiguous groundwater area, except that it would more clearly be a diversion of flows under the KCSWDM. However, the diversion of flows is sometimes approved when determined to have beneficial results. It appears that this would have beneficial results, and that the reduced winter flows from SDW1B would have no negative impact on Miller Creek.

Conceptual Designs:
Conceptual designs need to include details on how constant discharge will be achieved at variable head pressures.

Walker Creek Conclusions:
1. The proposed Walker Creek low flow augmentation has increased substantially from previous conclusions which indicated improvements to base flows, or zero impact. The proposal to augment low flows by 0.09 cfs from August 1 - October 31 constitutes a substantial amount of mitigation.
2. The augmentation proposed assumes no contribution from the embankment fill, perhaps due to what appears to be an overestimation in the size of the Walker Creek embankment. If future updates to the low-flow report include the reinstatement of the embankment model, the true size of the fill embankment tributary to Walker Creek needs to be verified and modeled accordingly.
3. The proposed addition of new impervious surfaces as part of the low-flow augmentation is not recommended. Whether the other 3.5 acres of runway will truly be zero percent effective (entirely infiltrate into the embankment) is not known. If it is not 100% infiltrated, then the flow control facility may not be adequately sized. It appears that treated stormwater needs to be collected from an alternate location to avoid impacts to Wetland 44A and to ensure reliable filling of the reserve storage without extending through Spring and early Summer.
4. The embankment drainage is already intended to provide hydrologic contribution to Wetland 44A. It appears that the quantity of embankment drainage will be approximately half of that indicated in the current embankment model even without the addition of 3.5 more acres of impervious surface. 15 acre-feet of runoff which would have flowed to this wetland will be intercepted and stored for release to the wetlands and stream during August-October.
5. It is recommended that the low flow report include complete conceptual drawings for the proposed reserve storage vault and revised site design which includes the proposed reserve storage release structure to maintain constant 0.09 cfs discharge, the proposal to line a portion of SDW2, and the cover and rainwater collection system being proposed for the SDW2 pond.

Miller Creek -

Overview

Point of Evaluation: SR509 crossing (COPY 55).

Existing conditions: represented by the Calibration HSPF input files.

Future conditions: represented by modified 2006 HSPF input file.

Target flow condition: 1994 landcover, 1991 (~2-year) 7-day low flow = 0.79 cfs

2006 flow condition: 2006 landcover, 1991 (~2-year) 7-day low flow = 0.67 cfs

Hydrologic change: 0.11 cfs (why not 0.12 cfs? See below)

Additional Non-Hydrologic mitigation: 0.02 cfs

Total Low Flow Augmentation: 0.13 cfs

Low Flow Augmentation Period: August 1 - October 31; 92 days

Reserve Storage Volume: 18.8 acre-feet

Start of Filling: January 1

Duration of Reserve Storage Filling (maximum): 58 days (vault filled by March)

Summary of 2006 HSPF PERLND Adjustments (units = acres)

Subbasin	PERLND 26 Removed	PERLND 45 Removed	IMPLND Removed	PERLND 80 Added	PERLND 45 Remaining
SDN3x		0.29		0.29	23.48
SDN3AI			5.69	5.69	
SDN3AO		15.72	2.19	17.91	6.4
SDW1AO	0.67	18.66	0.93	20.26	13.78
SDN1AI			13.07	13.07	
SDW1B	0.54	36.05	22.41	59.00	10.21
SDN2X					0.86
SDN4					0.99
SDN4X					8.31
IWS NSMPS					0.01
TOTALS	1.21	70.72	44.29	116.22	64.04
PGG MODEL 6/25 memo		69.6	42.1	111.7 total PGG	
Difference	-1.21	-1.12	-2.19	-4.52	

Review shows that more area was removed from HSPF stream model than was simulated in the PGG models. Unclear why non-fill PERLND 26 was removed, or why there is an additional 64 acres of embankment fill remaining in the HSPF stream model. These issues would tend to have no effect or a slightly conservative effect on the analysis.

Summary of other 2006 HSPF input file modifications

- WDM DSN7000 timeseries applied to RCHRES 35 (miller creek). DSN includes the embankment model output for water conveyed to toe of embankment via underdrain. DSN units are cubic-feet per day. Scalar converts to acre-feet per timestep.
- WDM DSN7001 timeseries applied to PERLND 80 AGWLI (active groundwater). DSN includes the embankment model output for water lost through bottom of underdrain. DSN units are cubic-feet per day. Scalar converts to inches per timestep per acre of PERLND80. Note: PERLND 80 is not rained on or evaporated from.
- PERLNDS 47 and 57 turned off. Infiltrated water (SDW1A and SDW1B) is not sent to active groundwater. As there remains tributary area in these subbasins after the removal of embankment areas, this would be a conservative assumption.

COMMENTS:

Low Flow Statistics:

It appears that the low-flow statistics provided for 1994 and 2006 conditions do not include the non-hydrologic changes, while the 2006+ augmentation includes the additional mitigation proposed for non-hydrologic changes. If this observation is true, the benefits of the proposed mitigation are somewhat overstated. This could be done by raising the 1994 curve by 0.02 cfs or by lowering the future condition curves by 0.02 cfs. Either way, it does not change the calculations for the amount of augmentation proposed. Non-hydrologic changes and low flow events occur outside the proposed augmentation window, so it would not be accurate to simply remove the augmentation associated with the proposed non-hydrologic mitigations.

The third CDROM provided, dated 7/26/01, includes timeseries for non-hydrologic adjustments. These timeseries have not been reviewed as there is no indication they were used in the current analysis.

The 1993 annual low occurs outside the stated augmentation window, but the reserve storage filling analysis shows that even in the driest year there were 20 days of flow augmentation volume remaining in the vault. Provided the final operations plan includes the provision to continue discharging any available water through the month of November, or until substantial rains occur, the analysis is consistent to assume this event mitigated.

The original 12/00 Low Flow study reportedly used the same input file (1994 calibration input file hasn't changed since 12/00 SMP and Low Flow study) that is currently being used (per Response to Public Comments, Parametrix 2001). There was some confusion over what file was actually used. A set of input files were provided by Parametrix on 4/19/01, but discussions on 4/22/01 indicated uncertainty as to what input files were used in the 12/00 analysis. The 4/19/01 input files appear to be 2006 subbasins with 1994 landcover. This may explain why the existing condition 2-year 7-day low flow dropped from 0.79 cfs to 0.74 cfs in this latest draft of the low flow report. Although the existing 2-year low flow was reduced, the calculated hydrologic impact (including embankment flows), now based on 1991 low flows, increased from 0.06 cfs to 0.11 cfs in this report.

Should the 1991 7-day impact number be 0.12 cfs? All of the data in the provided spreadsheets show 2 decimal places and the difference in 0.12 cfs. The table entitled "Comparison of 7-day Low Flow by Rank" calculates the hydrologic change at 0.12 cfs also. The only place found that uses 0.11 cfs was in the cover letter.

- In the electronic file (7/23/01 CDROM) named: millerdailyaverageflow.xls a check of 7-day low flows for 1991 was performed. This spreadsheet includes daily average flows for the full 47 year period of record and therefore is assumed to be the 2006 conditions with no embankment contribution. The numbers in that spreadsheet would indicate the hydrologic impact to be 0.14 or 0.15, depending on rounding preference. The difference is that the 2006 daily timeseries has a low 7 day average of 0.64, rather than the 0.67 shown in the summary tables. This analysis indicates that if the expected infiltration rates into the embankment are not achieved and maintained, 0.14-0.15 cfs would be the low flow offset for hydrologic changes (0.16-0.17 cfs including non-hydrologic mitigations).

- Discussion with modeler on 7/30/01, resulted in the finding that an outdated electronic file was provided for "Low Flow Miller 91-94.xls". Reportedly, the 2006 future conditions column had been updated and the correct results should have a future condition 1991 7-day low flow of 0.67 cfs (not 0.69 cfs calculated in the provided electronic file). No backup data was found on CDROMs which produce a future 1991 7-day low flow of 0.67 cfs, which is the flow indicated by the modeler to be the correct value.

- Additionally, the existing (1994) condition 1991 low flow was consistently calculated in the electronic files to be 0.784 cfs (not 0.79 cfs indicated in all tables). The difference (impact) is reportedly 0.114 cfs, consistent with the low flow report cover letter (0.13 cfs total flow reduction with non-hydrologic changes included).

Reserve Storage:
The drainage area for the existing NEPL vault was probably not intended to be included in vault filling calculations. The NEPL vaults are not in series and retrofitting of the existing vault is not proposed. NEPL new vault serves 26.29 acres of impervious (miller 2006 HSPF model), rather than the assumed 32.31. The % of reserve storage in each vault could be updated to maintain similar depths and/or fill times in the facilities.

The NEPL site design provides water quality treatment downstream of the vaults. The Cargo site also uses biofiltration swales, but it appears that biofiltration is proposed upstream of the Cargo vault. Both sites are subject to motor vehicle use. The draft partial operational plan was written assuming collection of treated runway runoff receiving water quality pre-treatment, and details additional water quality concerns with runoff from areas subject to regular motor vehicle use. NEPL is currently proposed to provide 40% of the total augmentation water. The Cargo site provides an additional 10%. The current low flow plan does not clearly demonstrate whether it is feasible to collect reserve water in these locations. The final proposed vault locations should be evaluated for feasibility and any special design considerations (e.g.., upstream spill control, oil controls, downstream compost filters, etc.) identified for the final low flow plan.

With a large number of reserve vaults, it means that the discharge rates must be proportioned. This will result in individual vault discharges as low as 0.013 cfs. For perspective, the minimum orifice size allowed by KCSWDM is 0.5 inches which produces a calculated discharge of 0.012 cfs with 3 feet of head. The actual discharge will be dependent on factors not considered by the standard orifice equations and will be susceptible to maintenance difficulties. The final low flow report should consider reducing the number of facilities to reduce the maintenance and monitoring needs. This will also allow for larger releases from individual vaults which would be easier to design, and less prone to plugging. The final low flow report needs to include design details on how the constant discharge releases will be achieved.

The low flow report assumes that essentially all runoff from impervious surfaces on the embankment will fully infiltrate into the embankment. Therefore, runoff from these impervious areas will not be available to fill the reserve storage vaults, which has led to the proposal for reserve storage vaults in other subbasins within the Miller Creek drainage area. Although contributing to the low flow condition, some of these subbasins are not located adjacent to Miller Creek. In late summer it may be difficult to deliver the augmentation water to the stream. The outfall locations upstream of the regional detention facility may result in losing the water to the soil rather than delivering it to stream. However this is where much of the impervious surfaces are being added under future conditions. It would certainly be preferred to find appropriate places for infiltration to occur which would offset the low flows without large reserve storage vaults. Investigations into infiltration feasibility have been negative in most areas evaluated. Perhaps approaching the investigation by asking where on the site infiltration would be feasible might be more productive.

Embankment Modeling: (Description of Process, no recommended action items)
The inflow to the PGG embankment models was generated from file Millalt1.inp. The embankment surface was modeled consistent with a typical parameters for flat sloped grass cover on outwash soils. This

was consistent with the embankment characterization in Ecology's June 2000 PGG report. During facilitated meetings, it was originally agreed that the precipitation would be scaled to account for the "run-on" of stormwater from runways and taxiways onto the in-field areas for infiltration. However, the approach used was to scale up the pervious AGWO flows as tributary inflows into the embankment model. Figure 2 of the 6/25 PGG report, shows the different results between the two approaches. Alternative 1 was the approach used, which is shown to provide less water available to the embankment. It is therefore accepted as more conservative than the approach originally agreed to. It was also expected that the normal 1 hour timestep would be used to simulate the embankment inflows and then the results would be aggregated to daily values for input into the embankment model. Discussions with the modeler indicated that using hourly timesteps for Alternative 2 would have lowered the values shown in Figure 2 slightly, but they would remain greater than the approach used, Alternative 1.

The PGG embankment models were reviewed by others at Ecology. As we provided no review of this model, no comments are provided.

The PGG embankment model produced two outflow timeseries. Discharge at the toe of the embankment, and water lost downward from the underdrain, assumed to go to active groundwater. For the four year embankment simulation period these values were added into the HSPF stream model using the 2006 HSPF model with the embankment areas removed. The initial results were run for only the 4 year simulation period. There were significant differences in the low flow statistics (existing conditions) when the model was run for only the 4 years of embankment data (1991 existing condition low flow was 0.79 cfs in full simulation and 0.69 cfs when run for only the 4 years). Reviewer did not support the approach of starting out with a completely "dry" model at the start of the embankment period of simulation, especially when the hydrologic impact is being based on the results of the 1st year. The modeler proposed to "wet up" both models using the calibration model. This approach seems reasonable (and resulted in slight increase in the amount of mitigation proposed). The analysis is consistent with expectations that the largest difference in annual 7-day low flows would be used to assess the hydrologic impact (see above comments).

Infiltration of impervious surface runoff through filter strips is typically assumed not to occur in site designs. However, the current modeling approach is consistent with Ecology's June 2000 PGG report. The infield areas on the embankment typically exceed the standard filter strip lengths which will provide additional opportunity for infiltration to occur. Over time it may become necessary to take corrective actions to maintain the surface infiltration needed to recharge the embankment (e.g., poking holes to ensure good water contact with permeable soils).

To help ensure infiltration into the embankment, there are some simple BMPs which could be introduced to the collection and conveyance system. Raising the rim on the catchbasin inlets 1-2 inches would provide conveyance for high flows while encouraging infiltration of smaller events. Another idea would be to provide 5-10 feet of perforated pipe just downstream of the catchbasin inlets. Note, these proposed BMPs were previously rejected due to concerns over ponding and cost, respectively.

From evaluation of the electronic file provided (MillerDailyAverageFlow.xls) it appears that in the event that embankment infiltration rates are not achieved the total low flow augmentation would increase to a maximum of 0.16-0.17, including both hydrologic and non-hydrologic changes to low flows, assuming no low flow contribution from the embankment. Monitoring should be performed to determine the effectiveness of the embankment to infiltrate and at the embankment drain collection system for verification of the embankment model.

Collection and Conveyance of Embankment Drainage:
Grading and Drainage plans show the collection swale at the toe of embankment in the vicinity of the SDN3A pond. Sheet 129 shows the collection swale flowing northerly to the break-line for Sheet 130. Sheet 130 shows a ditchline flowing in the opposite direction (south) to the same break line. It is not clear where this water is intended to go.

Similarly, there is a ditchline below where the airport security road traverses the slope on Sheet 130. The ditch is located on the up-slope side of 154th St. The ditchline may be collecting a majority of the embankment drainage at the north-end of the runway. The ditchline disappears at the breakline between Sheets 130 and 129. It is not clear where this water is intended to go.

Conceptual Designs:
Conceptual designs need to include details on how constant discharge will be achieved at variable heads.

Special considerations may be needed with the NEPL reserve storage vault. The inflow water will not have water quality pre-treatment and therefore it is reasonable to assume it will have relatively high TSS and possibly oils. A proposal to deal with the water quality concerns is needed at the conceptual design stage, particularly because NEPL is providing 40% of the reserve storage water.

Special considerations may be needed for Cargo reserve storage water quality. This also may affect the conceptual design.

Miller Creek Conclusions:
1. The proposed Miller Creek low flow augmentation has increased 0.10 to 0.13 cfs in the current proposal. The proposal to augment low flows by 0.13 cfs from August 1 - October 31 constitutes a substantial amount of mitigation.
2. The large number of facilities proposed to provide reserve storage volume will be problematic in terms of maintenance, operation, monitoring, and design. Proportioning the storage also implies proportioning the release rates. The release rates in some vaults may be less than can be reliably achieved using the KCSWDM minimum orifice size.
3. There are water quality concerns at NEPL and Cargo due to collection of runoff from regularly used vehicle access areas. The current operations plan needs to be updated to reflect this change. An evaluation as to feasibility of providing reserve storage of adequate water quality is recommended.
4. Clarification is needed as to where the outfall is located for the embankment toe collection swale in the vicinity of the SDN3A pond.
5. It is recommended that some infiltration type BMPs be included to help ensure that the levels of infiltration expected are achieved.
6. It is recommended that the low flow report include complete conceptual drawings for the proposed reserve storage vault and revised site design that includes the proposed reserve storage release structure to maintain constant discharge, and any structural water quality pre-treatment proposed for NEPL and Cargo to help ensure adequate water quality for the reserve storage.