K. Whiting

BEFORE THE POLLUTION CONTROL HEARINGS BOARD
STATE OF WASHINGTON

AIRPORT COMMUNITIES COALITION, Appellant, CITIZENS AGAINST SEA-TAC EXPANSION, Intervenor/Appellant, v. STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY; and PORT OF SEATTLE, Respondents.	PCHB No. 01-160 DIRECT TESTIMONY OF KELLY WHITING SUBMITTED ON BEHALF OF THE DEPARTMENT OF ECOLOGY

AR 015747

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Kelly Whiting declares as follows:

I. My Background

1. I am an Engineer III (Senior Engineer) employed by the King County Department of Natural Resources and Parks. I have held that position since June 1, 1994. My duties include the development and maintenance of an HSPF based continuous hydrologic computer model, development and implementation of stormwater regulations, basin plan implementation, development of subbasin compliance program, preparation of engineering studies of complex drainage problems, training and technical support on hydrologic/hydraulic modeling and mitigations for review engineers, designers, hydrologists, and regulators from other jurisdictions (e.g., Ecology, local cities), and lead technical staff for development of the 1998 King County Surface Water Design Manual (Manual). I also provided technical support for Ecology's 2001 stormwater manual update. I have 11 years of experience in stormwater management including the review of stormwater management plans for compliance with the Manual. My educational background is a Bachelor of Science in Civil Engineering, University of Washington, 1990. I am a licensed professional civil engineer in Washington State with expertise in hydrology and surface water management. My resume is attached hereto as Attachment A.

II. My Review

2. Pursuant to a contract between the Department of Ecology and King County, I reviewed the Port of Seattle's (Port) Comprehensive Stormwater Management Plan (SMP) for Master Plan Update Improvements at SeaTac International Airport (STIA) on behalf of Ecology. I also reviewed the Port's Low Flow Impact Analysis-Low Flow Impact Offset Facility proposal on behalf of Ecology (Low Flow Plan). These two plans are related because the hydrologic computer models used for purposes of the SMP also were used to model low flows resulting from the STIA expansion project. Also, the facilities designed by the Port to manage stormwater are related to the facilities designed to offset the low flows. I have spent

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hundreds of hours providing review services and in technical meetings with Ecology staff, the Port's consultants, and others, discussing and reviewing these plans. Many of those meetings were facilitated by Floyd and Snider and the substance of the meetings are documented in facilitated meeting notes.

3. My review of the SMP was limited to determining compliance with the performance standards in the Manual. The scope of my review and my comments on the SMP are set forth in a letter from King County to Ecology dated August 3, 2001 signed by Pam Bissonnette. In general, I concluded that the SMP meets the technical performance goals of the Manual for both flow control and water quality treatment. In some instances, the SMP goes beyond the requirements of the Manual.

III. The Stormwater Management Plan

4. The Port's SMP proposes to manage stormwater by identifying and sizing flow control and water quality treatment facilities for both new and existing development at STIA. The flow control facilities include primarily ponds and vaults. The water quality treatment facilities include filter strips, wetvaults, bioswales and similar facilities that filter and treat stormwater before it discharges to area streams. The Port's storm drain system (SDS) has a number of outfalls that are designated by number and location. Thus, "SDN1" refers to a storm drain outfall in the north part of the airport, "SDS3" refers to an outfall in the south part of the airport, while "SDW1" refers to an outfall on the west side of the airport. The location of the Port's proposed and existing outfalls, and stormwater detention facilities, is shown on maps and figures in the SMP. See, for example, Figure 6-1.

5. The Port utilized the Hydrologic Simulation Program – Fortran (HSPF) computer model to develop the SMP. This model is well accepted in the field of stormwater management. Basically, what the model does is simulate stormwater flows and stream flows based on given data about land coverage, soil type, rainfall, groundwater movement, and other factors. The HSPF model includes settings which control the hydrologic response

characteristics of different combinations of soil and landcovers. These data are referred to as the model's input parameters. For example, for a given year, the hourly rainfall for that year may be obtained and input into the model along with information regarding land coverage and hydraulic routing to obtain a simulated hydrograph of area streams. The land coverage data is expressed in terms of acreage of various soil and landcover types, such as effective impervious, till soils with forest cover, and outwash soils with grass cover. The intent is to develop a model of the tributary drainage area (basin) that mimics the observed hydrology. Within the framework of the calibrated model, the project site's landcover assumptions can be run backwards or forwards in time to simulate pre- and post-project conditions. The pre-project simulated flows establish the target flow regime to be met by the SMP. Flow control facilities may then be designed, using post-project simulated flows, to match the target flow regime.

6. In the case of the Port's SMP, the 1994 base year condition was chosen and the regional average HSPF input parameters were adjusted through a model calibration process to improve the ability of the model to mimic the observed hydrology. Pre-project conditions were defined using a theoretical set of conditions of 75% forested, 15% grass, and 10% maximum impervious. This theoretical condition is more restrictive than would be required by the Manual, which generally uses a base year of 1979. The theoretical condition used by the Port is more restrictive because it means that the Port's flow control facilities must meet a target flow regime based on essentially predevelopment conditions. Under such conditions, stormwater flows generally are released to the streams at a slower rate than under existing and future developed conditions. Using the theoretical pre-developed condition in the Port's SMP results in detention facilities that are sized much larger than would normally be required by the Manual. In addition, the Port's SMP proposes to retrofit existing outfalls to meet this more stringent target flow regime.

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7. The Port's SMP satisfies the requirements of the Manual for Level 2 flow control. Level 2 flow control is a more stringent level of control of stormwater than the Level 1 standard which is the Manual's current base standard in Miller, Walker and Des Moines stream basins. To meet the Level 2 standard, the Port was required to demonstrate that post project peak flows and durations would match pre-project flows over a wide range of flow conditions. Under Level 1, the Port would only have had to show that its detention facilities could detain the post project 2 and 10 year peak flows to existing conditions.

IV. Model Calibration

8. An important step in using the HSPF model is to ensure that it is properly calibrated. The term "calibration" refers to the adjustment of model input parameters to better match observed conditions. Because of variations in storm events, inaccuracies in the recorded stream gauge records, and the inherent limitations of the model, it is not possible to match observed hydrographs exactly. Thus, a model may be properly calibrated even though it does not exactly match observed flows. In general, a model is considered calibrated when, in the judgment of the modeler, the results it produces are reasonably reliable for the purposes for which the model is being used. This determination involves a great deal of judgment by the modeler because there are no set standards for model calibration. I usually consider a model sufficiently calibrated when the modeler has demonstrated that logical adjustments were made to the accepted regional average input parameters, resulting in an improved mass balance and hydrograph fit to the observed stream flows, while maintaining proper distinction between different soil and landcover types.

9. In the case of the Port, the HSPF model used for determining calibration was the 1994 land cover condition. For each creek – Miller, Walker, and Des Moines – simulated stream flows were generated using the model and the results compared to stream gages located at the mouth of the creeks and in the upper reaches of the streams. Based on my review of the Port's calibration results presented in the SMP, I was satisfied that the models

were sufficiently calibrated for the purpose of sizing flow control facilities in the SMP. The Des Moines Creek model is based on the existing basin planning model used in the Des Moines Creek Basin Plan. Minor refinements were made to model parameters in the SMP, in conjunction with updated landcover and groundwater routing information. The Miller Creek model is based on the model used for the Port's Environmental Impact Statement. This stream model was recalibrated in 2000 using improved landcover information and field data. At the same time, a unique calibration for Walker Creek was developed, which resulted in a substantially different calibration than had been previously used (previously assumed to be same as Miller Creek). These calibration efforts have been demonstrated to provide improved accuracy over previous modeling efforts and over the usually accepted regional average parameters.

V. Water Quality Treatment

10. With respect to water quality treatment, the Port's SMP for STIA proposes to utilize various source control and treatment BMPs for treatment of stormwater. The BMPs set forth in the SMP satisfy the requirements of the Manual's basic water quality treatment menu. The particular BMPs proposed for each new and existing outfall at STIA are set forth in the SMP in Table 7-8. The Manual contains additional treatment menus, such as the resource stream protection menu, which include enhanced water quality treatment facilities. However, these enhanced treatment menus are not typically applied to projects in Miller, Walker and Des Moines creeks, as those creeks are not known to meet the criteria for application of these menus. Nevertheless, the SMP states that "on-going water quality monitoring may indicate the need for future additional water quality BMPs. Technology in the field is continually improving the effectiveness and application of new water treatment systems. While the airport has unique operational requirements (i.e. wildlife control), the proposed drainage design would allow the application of future stormwater treatment technology to the proposed drainage system." Sec. 2.2.2. It is my understanding that Ecology may require the Port to

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institute additional treatment BMPs. It is my opinion that doing so is feasible under the proposed SMP.

11. The treatment goal in the Manual under the basic menu is 80% removal of total suspended solids (TSS). Based on my review of the Port's SMP, the proposed facilities can be designed consistent with the Manual's design criteria which should meet that goal. Concern has been expressed by the ACC regarding dissolved metals in the Port's stormwater discharges. The Manual's basic menu is not designed to remove dissolved metals; however, the treatment BMPs proposed by the Port should be partially effective at removing metals because some of those metals will be associated with solid particles. The monitoring data provided in the SMP does not provide sufficient information to determine the breakdown of particulate and soluble fractions. The Manual's Full Drainage Review application of treatment menus would not require additional treatment for dissolved metals in these stream basins. Additionally, the Manual would not require water quality retrofits for existing pollution generating surfaces not being redeveloped, yet the Port's SMP proposes such retrofits. For example, section 7.1.4 of the SMP states: "Additional BMPs were identified to provide runoff treatment to the maximum extent practicable for subbasins where existing BMP coverage is not consistent with the Ecology Manual."

12. The ACC contends that the Port's STIA Master Plan Update projects SMP does not comply with the King County Manual because it did not go through large site drainage review as it would have been required to do had the procedural aspects of the Manual been applied to the project. Large site drainage review is a process set forth in the Manual to tailor stormwater mitigations to specific landuses and natural resources. The performance standards established in the Manual that would otherwise apply to a project may be varied through this process. In this case, the large site drainage process was not followed because the Manual does not directly apply to the project, and my scope of review specifically excluded

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any procedural requirements of the Manual. It is not possible to predict what the outcome would have been in terms of performance standards, had that process been followed.

VI. The Low Flow Plan

13. The Port's Low Flow Plan proposes to offset annual low flow impacts to Walker, Miller, and Des Moines creeks by treating, capturing, and storing stormwater during winter storm events and then releasing the water in a controlled manner to the streams during annually occurring low flow periods. The plan proposes to provide three months of late-summer/early-fall flow augmentation via actively managed reserve storage vaults. On behalf of Ecology, I reviewed the Port's July 2001 Low Flow Plan and the Port's revised December 2001 Low Flow Plan. My comments with regard to the July 2001 Plan were set forth in a letter from Pam Bissonnette to Ecology dated August 3, 2001. In my August 3 comments, I expressed several concerns regarding the Low Flow Plan. Many of these concerns have been resolved or rendered moot by the December 2001 plan. The December plan represents a substantial improvement in level of detail and documentation over the July plan.

14. Both the December and the July plan utilize HSPF modeling to determine the extent of low flows to be experienced in the creeks after project completion. In particular, the Port utilized the 1994 calibration model to simulate preproject flows and then modeled the 2006 conditions to simulate post project flows. The 1994 model used by the Port for the December Low Flow Plan differed in its land cover assumptions and groundwater routing from the 1994 calibration model developed for the SMP. It is not known whether this redefining of 1994 existing conditions would alter the base model calibrations, or whether a refined calibration would make a difference to the proposed low flow offset mitigation. Therefore, one of my comments on the December low Flow Plan is that the Port prepare a validation report to verify the base calibration work under the revised 1994 existing condition assumptions. If this validation report confirms the use of the existing calibrations, it is my opinion that the calibration of the models is sufficient to accurately predict low flow impacts

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in Miller and Walker creeks, provided some adjustments and checks are performed as will be explained more fully below. The Des Moines creek calibration matches the basin plan model with two exceptions. The HSPF input parameter DEEPFR, controlling the lose of groundwater to a deeper aquifer, was reduced which would be associated with a higher impact (per pervious acre lost) than the basin plan model. Secondly, the IRC parameter, which controls the discharge of shallow groundwater, was increased which would not be expected to have much effect on the simulation of low flows.

15. The December plan proposes to offset low flows in Walker and Des Moines creeks using stormwater captured in reserve storage vaults. The conceptual vault designs include a number of design features used in standard wetvaults used to provide water quality treatment. These include passive aeration, long flowpath lengths, depths not greater than eight feet, along with water quality monitoring prior to discharge. Water will be delivered from the vaults to the streams via pipes and open channels discharging to wetlands adjacent to the streams. My review comments recommend evaluation of a more direct outfall location for Des Moines Creek.

16. I have reviewed the December 2001 plan in detail and it is my conclusion that the low flow offset mitigations proposed can be feasibly implemented. However, I have several outstanding comments. Included in my comments are the recommendations that the Port re-evaluate reserve storage fill times in the Walker creek vault to insure sufficient water can be collected in a timely manner to offset the predicted low flow impacts in Walker Creek, and that the Port correct modeling inconsistencies in Miller Creek prior to determining whether there are low-flow impacts to Miller Creek. My specific comments are set forth in draft form in a memorandum I prepared dated February 23, 2002. Since preparing that memorandum, I have received additional information from the Port that, as of this date, I have not had the opportunity to fully review. It appears that the material is intended to address a

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portion of my comments but I have not reviewed it in detail. It is expected that Ecology will receive additional related materials from the Port.

VII. Comments on ACC's Testimony

17. I have reviewed the declarations filed by the Airport Communities Coalition (ACC) in the above-referenced case. I can offer the following comments related to those declarations. The calibrations were first presented to me in the 11/99 SMP. The Port revised the calibration for Miller/Walker a few times in 2000. The last of these revisions included "real-time" review by myself and an experienced HSPF modeling consultant working on my behalf. Substantial improvements were made to those stream models as a result of this direct oversight, as acknowledged in ACC comments from that period. At the completion of that process, the HSPF models for Miller and Walker creeks were accepted for use in the design of stormwater mitigations included in the SMP. At the same time, the Des Moines Creek calibration was accepted based on the finding that it was substantially unchanged from the model developed by King County for the Des Moines Creek basin plan, which is being used to develop regional stormwater mitigations for both peak and low flow conditions. While these calibrations fall short of providing a perfect match to observed data, they constitute an improvement over the regional average parameter settings used by most development proposals subject to the Manual.

18. A comparison of the Des Moines Creek simulated low flows to observed data was first provided in the December 2001 report, and does show a pronounced underestimation of low flows at Tyee Pond. While my scope of review focused on ensuring consistency between the SMP modeling and the low-flow plan modeling, my comments do include the recommendation that the problems be investigated and there be a validation report prepared which looks at the KC gauge 11F and compares the results of the current calibration against the original basin plan calibration work. In general, it is my opinion that the low flow mitigations being proposed constitute a substantial amount of mitigation beyond the minimum

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requirements of the Manual. In some years the Des Moines Creek low flow offset will be providing 25% of the in-stream low flow. Groundwater routing assumptions are often speculative, but the SMP includes groundwater mapping that supports the contention that there is a substantial amount of groundwater tributary to Walker Creek that comes from areas providing surface runoff to adjacent streams. A reassessment of GIS data performed in November 2001 appears to have resolved problems with overlap of tributary groundwater areas.

19. The modeling of the embankment using Hydrus under future conditions was done due to the inability of the HSPF model to simulate the hydrologic response of the deep embankment material. The Hydrus runs were reportedly conducted using assumptions consistent with previous modeling work performed for Ecology, from which the resulting instream flows are compared to the basin specific runoff response of the existing soils as defined by the HSPF calibrations. This was the recommended approach of the consultant who conducted the independent embankment study for Ecology. My draft review comments include recommendations that the groundwater seepage from the Miller Creek embankment be introduced to the stream model at a point further downstream, consistent with previous modeling work. The SR509 point of compliance is also recommended to be moved one stream reach further downstream to coincide with the furthest upstream point at which all hydrologic changes associated with STIA activities are accounted for in the model. This may actually result in reduced simulated impacts as it often becomes harder to distinguish project related impacts further downstream due to mixing of project flows with additional off-site flow contributions from lakes and other baseflow sources.

20. My review comments recommend the correction of the direct precipitation onto PERLND80, consistent with ACC findings, in addition to other modeling inconsistencies found during my review. My review also raised concerns related to the ability of the proposed monitoring to assess the hydrologic performance of the embankment. The use of hourly

timesteps was recommended by the modelers, and is an improvement on the previous embankment recharge analysis, and was accepted due to the long, relatively flat dispersed flowpaths provided by the extra long filter strip areas. It is my understanding that these review comments are currently being addressed and that a revised impact analysis will be submitted to Ecology.

21. The ACC assertion that water quality retrofits have not yet been determined is not entirely correct. The SMP identifies water quality treatment retrofits to the Manual's basic water quality treatment standard for all but 80 acres of pollution generating surfaces. These 80 acres were presented as being impractical for retrofits at this time, consistent with provisions of the Ecology manual. It is worth noting that the King County manual does not require retrofits (water quality or flow control) of existing developed areas not being redeveloped. Also, the SMP does not propose deferring decisions on flow control (detention) retrofits. However, the SMP does indicate that if regional detention is constructed that the SMP detention facility needs may be reassessed, which presumably would be subject to Ecology review.

I declare under penalty of perjury under the laws of the state of Washington that the foregoing is true and correct.

DATED this 7th day of March, 2002.

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Summary of Qualifications

- ⇒ *Professional Civil Engineer, State of Washington*
- ⇒ *Experience in performing hydrologic/hydraulic analyses of complex drainage systems*
- ⇒ *Knowledgeable in local and state stormwater regulations*
- ⇒ *Able to manage multiple projects to completion.*
- ⇒ *Computer experience with the following programs: KCRTS-Runoff Files, KCBW-Backwater, SBUH based models, ArcView, Word, Excel, Powerpoint, FORTRAN-90, HSPF, Annie, HEC2, d-Base.*

Professional Experience

King County, Surface Water Management *June 1994 to Present*
Seattle, WA
Senior Engineer-Engineering Studies and Standards. Managed the development and implementation of an HSPF-based continuous hydrologic computer model including the instruction of computer workshops. Senior lead staff providing engineering and hydrologic modeling support for the development, implementation, and State NPDES equivalency review for the 1998 updates for the Surface Water Design Manual. Oversee and support a pool of engineers in providing technical support for the County's stormwater standards and hydrologic/hydraulic models. Provided technical input and review for the Tri-County ESA 4d proposal and State Ecology SWM manual update. Provide stormwater expertise and review services to local jurisdictions and state agencies. Provide support for the preparation and implementation of large- and small-scale basin plans through technical assistance in developing mitigation measures consistent with protection goals, implementation of regulatory standards, and hydrologic modeling support for CIP design. Developing program for the completion of Subbasin Compliance Plans (small-scale basin plans) in response to anticipated NPDES Phase I permit requirements. Responsible for the maintenance of hydrologic/hydraulic model source code, GIS coverages for geographic-based stormwater standards, stormwater management standard drawings, and drainage webpages. Perform engineering studies of complex drainage problems, and case study analyses for proposed stormwater standards.

King County, Surface Water Management *March 1992 to June 1994*
Seattle, WA
Engineer- Engineering Studies. Apply engineering principles and methodologies to analyze complex drainage problems. Conduct hydraulic and hydrologic analyses of complex drainage problems. Identify alternative solutions and perform cost-benefit analysis on alternatives. Coordinate involvement of other work units, such as survey or ecological review. Prepare written report and engineering sketches and transmit the most cost effective solution to construction or final design. Monitor progress until completion.

King County, Building and Land Development *May 1990 to March 1992*
Bellevue, WA
Engineer-Engineering Review. Review of engineering plans in conjunction with urban development in the following areas, hydraulic analysis of drainage systems, floodplain analysis, roadway design, and sensitive area protection. Review and recommend conditions of approval for subdivisions applications, right-of-way use permits and Surface Water Management variances. Produce staff reports and provide testimony at public hearings. Work and communicate directly with technical/clerical staff, other departments, developers, design engineers, property owners and concerned citizens.

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Additional Engineering Experience

University of Washington, Environmental Engineering Department — *January 1990 to July 1990*
Seattle, WA
Research Assistant. Conduct research experiments on ion absorption kinetics, collect and analyze samples using ICP atomic emission spectrophotometer, compile and present data.

City of Ellensburg, Public Works (Water) Department — *June 1985 to September 1989*
Ellensburg, WA
Student Summer Intern. Performed fire hydrant, mainline and service installation and repair, design and installation of thrust blocks, contractor oversight on two street projects, valve inspection and mapping project, installation and maintenance of automated sprinkler systems, park maintenance.

Department of Energy, Richland Operations Office — *January 1988 to June 1988*
Richland, WA
Engineering Student Intern. Transmitted monthly NPDES discharge monitoring reports to regulatory agencies, oversaw sanitary landfills, modified and implemented a division-wide commitment control system in d-Base, participated in audit of contractor's groundwater monitoring program, coordinated site-wide review and comments on proposed DOE directives.

Central Washington Univ., Engineering Department — *September 1985 to September 1986*
Ellensburg, WA
Surveyor/Engineering Aide. Conducted radial surveys and mapping projects, field inspections, soil and concrete tests. Drafted As-Built diagrams and bid proposals.

Education, Training and Organizations

Bachelor of Science Civil Engineering		**University of Washington**	**1990**
Blackberry Creek Futures Project (pending)	**Presenter**	**USEPA, Kane County, IL**	**Dec. 2001**
Low Impact Development	**2-day**	**Puget Sound WQ Action Team**	**2001**
Urban Stream Protection	**Presenter**	**Canada Fisheries and Oceans**	**1997**
HEC-2 Backwater	**3-day**	**West Consultants**	**1994**
HSPF10	**2-day**	**Aqua Terra Consultants**	**1993**
Volunteer		**King County Flood Warning Center**	**7 years**
Professional Civil Engineer		**State of Washington**	**1995**
Member		**American Society of Civil Engineers**	**1988**