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November 26, 2001

Colonel Ralph H. Graves
Ms. Muffy Walker
Ms. Gail Terzi
U.S. Army Corps of Engineers
Seattle District
P. O. Box 3755
Seattle, WA 98124-3755

Dear Colonel Graves, Ms. Walker and Ms. Terzi:

Re: Corps Ref. No. 1996-4-02325: Port of Seattle Low Flow Mitigation

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As you know, Northwest Hydraulic Consultants has been retained on behalf of the Airport Communities Coalition (ACC) to provide a technical review of stormwater facilities and streamflow impacts from development activities at SeaTac airport. The main purpose of this letter is to serve as a reminder that there are numerous substantive deficiencies and uncertainties in the Port's proposed plans for low flow mitigation in Miller, Walker, and Des Moines Creeks. This letter is also intended to identify an additional serious deficiency which we have not addressed previously, but which is evident from documents recently obtained by the ACC.

Our previous comments in this matter are already on record and remain unresolved. The most recent of those comments are in the form of legal declarations by William Rozeboom and are cited in Peter Eglick's letter to you dated November 16, 2001. Now, as then, public comment is forced to rely on incomplete draft documents. In the case of the Port's Low Flow Analysis, the documentation of the evaluation continues to be so poor as to make an informed review virtually impossible. There continues to be an absence of critical design and project operation information necessary to demonstrate how the system will function in practice. Because of these deficiencies, the Port's proposal does not provide any assurance that impacts to low streamflows will be adequately identified or mitigated.

We had hoped to have the opportunity to review a credible "final draft" of the Port's low flow analysis and mitigation plan prior to offering additional comments. However, the ACC has expressed concern over the possibility that the Corps might reach a decision regarding the third runway in advance of that opportunity, and has requested that we now convey any additional comments we might have based on the latest documents. In that light, please regard the comments in this letter as supplementing the points made in Mr. Rozeboom's declarations in September and October 2001.

Since the date of Mr. Rozeboom's declarations, several additional documents have been obtained by ACC public disclosure requests which pertain to the low-flow analyses. We have a few additional comments based on the recent documents identified below.

- Report dated August 8, 2001, by Pacific Groundwater Group for the Port of Seattle, "Port of Seattle Sea-Tac Third Runway Embankment Fill Modeling."

- Letter dated October 24, 2001, from Keith Smith, Port of Seattle, to Ann Kenny, Ecology, regarding Low Streamflow Analysis and Summer Low Flow Impact Offset Facility Proposal. The letter requests a time extension to finalize the Low Streamflow proposal and asserts that the "actual impacts to summer low flow will be less than previously thought, and the facilities proposed to offset the impacts can be reduced in size."

- E-mail dated October 25, 2001, regarding "Pre Low Flow Meeting Briefing" from Kelly Whiting (King County) to Ann Kenny and Raymond Hellwig, Ecology.

- Undated "Notes on HSPF Modeling of Miller, Walker and Des Moines Creeks" by Norm Crawford of Hydrocomp, retained by the Port.

- 401 Permit–Post-Issuance Clarification Sea-Tac International Airport, Third Runway Draft Meeting Notes, Low Flow Analysis, October 30, 2001.

Our first comment pertains to how the low flow revision process is being conducted, and in particular whether the many outstanding certification requirements and public comments are being addressed. The above documents show that the Port is requesting a time extension to finalize the Low Streamflow proposal. But the October 25, 2001, e-mail from Kelly Whiting indicates that the Port's HSPF consultant was "not aware of anything being done to address comments other than those by Hydrocomp." It is of concern that as close as two weeks before the end of the 45-day period specified by Ecology for the Port to submit a revised low flow analysis, there is no evidence of progress by the Port in responding to the numerous low streamflow mitigation issues raised by King County and incorporated as conditions for the 401 certification. The Corps should be concerned by this and the fact that even less attention is apparently being given by the Port in responding to outstanding public comments presented by us and other technical experts on behalf of the ACC.

Our main additional technical comment is that there are serious flaws in the Port's analysis of runway secondary recharge which cause the volumes of embankment recharge to be greatly overstated, stream low flow impacts to be understated, and reserve storage mitigation volumes to be correspondingly undersized. These are discussed below.

The main issue or question is, how much of the runoff from runway and taxiway impervious surfaces will infiltrate into pervious grassed filter strips adjacent to the runway? The answer to that question can be addressed by comparing the filter strip infiltration capacity to the intensity at which water is applied to the filter strip. In this case, the rate of water being applied is equal to the intensity of the rain falling directly on the strip plus the rate of runoff onto the strip from runway and taxiway impervious surfaces. When the input intensity (direct rainfall plus runway runoff) is greater than the soil infiltration capacity, then the excess water flows off as surface runoff and/or shallow subsurface flow and is captured by the storm drain system.

The recent August 2001 embankment fill modeling report by the Port's consultant, Pacific Groundwater Group, incorporates a critical (and incorrect) assumption that all runoff from the runway impervious areas is infiltrated to groundwater. This is justified by the statement (PGG report page 4) that "Earth Tech's analysis indicates that virtually all runoff from runways should infiltrate in the filter strips." The Earth Tech analysis referenced was prepared by Earth Tech for the Port in a December 2000 report titled "Seattle-Tacoma Airport Master Plan Update Low Streamflow Analysis." However, close examination of the Earth Tech report shows that the Earth Tech analysis does not support the assumption adopted by PGG. Instead, Earth Tech (pg 11) reports that: 1) pavement runoff occurs about 18% of the time, and that surface runoff would occur less than 5% of the time. Graphs in the Earth Tech report show that "time" refers to the full analysis period including dry not-raining conditions. The Earth Tech graphs are blank (do not show any data) for the wettest 5% of time. The Earth Tech results are therefore properly interpreted as saying that surface runoff from the filter strips should be expected to occur up to 27% (5/18) of the time that rainfall (and runoff) occur. The Earth Tech analysis completely fails to address and quantify the filter strip runoff and infiltration performance during the wettest 5% of all time, corresponding to the wettest 50% of all hours with some rainfall, when infiltration capacity is most likely to be exceeded. Because of this significant deficiency, the Earth Tech analysis does not support a conclusion that "virtually all runoff from runways should infiltrate."

The adoption of an hourly time step is another significant flaw in the past and proposed analyses by the Port's consultants. One practical consequence of using HSPF hourly modeling to determine runway runoff is that the HSPF model generally (and inaccurately in this context) artificially damps out runoff resulting from short bursts of rainfall. For accuracy, a much shorter time step should be used which is consistent with the very short time needed for water to sheet-flow across a 105-foot wide runway half-section. Using the guidance of the 1998 King County Surface Water Design Manual (pg 3-7), "[T]he quicker a basin responds hydrologically (e.g., due to small size, land cover, or lack of detention), the smaller the time step should be." Also (pg 3-23), peak flow analyses should use a maximum time interval of 15-minutes, corresponding to the shortest time step for which continuous data are readily available. Hourly data will fail to provide reliable results. It should be recognized that even the 15-minute data will underestimate peak flows from the runway to the filter strip and hence overestimate the capacity of the filter strip to infiltrate this flow.

A continuous duration 15-minute time series data set of SeaTac Airport rainfall for water years 1949 through 1998 was developed by King County and is publicly available from the county's website. We evaluated these data to make an independent estimate of how much runway runoff would exceed the filter strip infiltration capacity and therefore be unavailable to provide recharge. The 15-minute data set consists of 1,753,152 individual data values for the 50 years of record. Non-zero rainfall is reported by 95,345 of these data values, representing about 5% of the full record. In other words, the data show that it rains about 5% of the time and that it is not raining about 95% of the time. A similar review of the hourly rainfall data for SeaTac Airport found that rain occurs in about 11% of all hours of record. Earth Tech's hourly low flow analysis reported (pg 11) that runway runoff occurs about 18% of the time (meaning 18% of all hours of record). Clearly, use of an hourly time step and then adding flow routing with HSPF has the effect of exaggerating the duration of time when runway runoff occurs and suppressing the intensity of that runoff. The 5% versus 18% numbers suggest that the Port's low flow analyses may have very significant (over 300%) errors in the timing and rate of peak flows available for secondary recharge, due to use of hourly rainfall routing simulations rather than a smaller and more applicable time step.

Estimation of filter strip infiltration capacity requires an estimate of the maximum rate at which infiltration can occur. This is a difficult number to estimate with accuracy. Also, if the filter strip is intended to provide a water quality function by trapping particulates, as we understand is being proposed, then it should be expected that the strip will tend to plug up and lose infiltration capacity over time. Pacific Groundwater Group, in an earlier June 2000 report for Ecology, estimated the hydraulic conductivity of the embankment fill matrix at 1.35E-4 cm/sec, which is equivalent to about 0.19 inches per hour. In previous comments, we observed that this infiltration rate seemed too high in light of the flow monitoring data collected by the Port to quantify actual embankment runoff. For our independent assessment of infiltration strip capacity, we used the maximum filter strip infiltration rate indicated from Figure 3 of the Earth Tech report prepared for the Port. This rate, 6.0E-5 cfs in a 30 foot by 1 foot segment of taxiway filter strip, is equivalent to 0.0864 inches per hour (or 0.0216 inches in 15 minutes), and may be a reasonable estimate of infiltration capacity for a filter strip providing water quality treatment.

Our independent assessment of runway runoff and filter strip infiltration capacity examined the scenario of a one-foot wide half-section of runway 105 feet long onto an adjoining filter strip 75 long. This is the same as the runway scenario examined by Earth Tech. We adopted a direct approach which ignored evaporation losses from the runway surface and assumed that the amount of runoff from the runway in any 15-minute period was equal to the quantity of rainfall on the runway in that same 15-minute period. With this approach, the total water input to the filter strip including both direct rainfall and runway runoff is 2.4 times the amount of direct rainfall alone. The capacity of a 75-foot by 1-foot filter strip using the Earth Tech infiltration value is 0 0216 inches in 15 minutes considering direct rainfall alone. After adjusting for the 2.4x rainfall multiplier effect of runway runoff, the infiltration capacity of the filter strip will be reached, and outflow to the storm drain system will occur, whenever it rains more than 0.009

inches in 15 minutes. The amount (depth) of surface runoff during that same period is equal to the 15-minute rainfall intensity minus 0.009 inches.

With the above assumptions, analysis of the SeaTac 15-minute rainfall record from King County shows that surface runoff will occur about 2.8% of all time. Considering only those 15-minute intervals having some rainfall, surface runoff occurs 52% of the rainy-interval time and accounts for about 53% of the total rainfall volume. In a similar analysis using hourly data, we found that surface runoff would occur about 4% of all time. Considering only the 1-hour intervals having some rainfall, surface runoff occurs 35% of the rainy-interval time and accounts for about 38% of the total rainfall volume. This analysis confirms that Earth Tech's statement of "runoff occurs less than 5% of the time" based on hourly data is technically accurate in a limited context but is extremely misleading and has been misapplied in subsequent analyses by PGG. The more accurate 15-minute analysis of rainfall and runoff volumes shows that more than one half of the total volume of rain and runway runoff will be discharged as surface water to the storm drain system, and will not be available to provide groundwater recharge as has been assumed by the Port's consultants.

The Low Flow Analysis Draft Meeting Notes of October 30, 2001 describe "new" modeling methods which if implemented will further overestimate recharge to the embankment and underestimate impacts to stream low flows and mitigation requirements. The latest proposal as we understand it is to add embankment "AGWI" hourly data (HSPF-derived inflow to groundwater) plus runway "SURO" hourly data (HSPF-derived surface runoff) to compute the total water available to the filter strips. Then, "[P]eak flows to the filter strips that are greater than the infiltration capacity of the filter strips will be categorized as surface runoff, and not used in Hydrus. Flows less than the infiltration capacity of the filter strips will be input to Hydrus." This method as proposed has two significant flaws. First, the total water to the filter strips is the direct rainfall on the filter strip (not AGWI) plus runway runoff. The problem with AGWI in this application is that it is a residual amount after surface and interflow amounts have been subtracted and which therefore underestimates the total volume of input to the filter strip. Another problem with AGWI in this application is that it has attenuation and time lag effects which would mask the actual peak inflows. The problem with applying "excess" SURO amounts directly to groundwater is that it ignores the surface runoff amounts which serve to recharge soil moisture and which are lost to plant evapotranspiration. The proposed "new" methods will produce artificially-high estimates of groundwater recharge, and will compound the time-step problems which were the main focus of this letter.

It is difficult to provide meaningful comments on this moving target of a low flow analysis and mitigation plan when even the most recent report (PGG, August 2001) is obsolete by the time it becomes available for public review. It bears notice that the Port's internal review of low flow materials not available to the public found significant errors in the Port's analysis and that our above review based on the more limited public document set has also found significant errors. On behalf of the ACC, we request that the Corps withhold its decision in the matter of the third

runway until after the Port has prepared and delivered a final and complete low flow mitigation plan and the public is given a reasonable amount of time to review and comment on that plan.

Thank you for your consideration of our concerns.

Sincerely,

northwest hydraulic consultants

William A. Rozeboom, P.E.
Senior Engineer

K. Malcolm Leytham, Ph.D., P.E.
Principal

cc: Peter Eglick, Helsell Fetterman LLP
Kimberly Lockard, Airport Communities Coalition

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