Columbia Biological Assessments
1314 Cedar Avenue
Richland, WA 99352
(509) 943-4347
(509) 946-1467 (fax)
jstrand427@aol.com

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Mr. Tom Luster,
"401" Permit Coordinator
Permit Coordination Unit
Washington Department of Ecology
P.O. Box 47703
Olympia, WA 98504-7703

Subj: The Port of Seattle's Revised Implementation Plan for the Des Moines Creek Flow Augmentation Facility (see transmitted letter to Tom Luster, Department of Ecology, from Keith Smith, Port of Seattle, dated August 18, 2000).

Dear Mr. Luster:

At the request of the Airport Communities Coalition, I have evaluated the Port of Seattle's revised plans to use City of Seattle drinking water (also referred to as Seattle Public Utilities [SPU] water) to augment summer low flows in Des Moines Creek. You will note that I reviewed the Port's initial plans in my letter to you on August 21, 2000.

Of particular concern in my assessments, has been the potential toxicity of chlorine and fluoride, which are introduced to the City of Seattle's drinking water supply by the Seattle Water Department. Possible effects associated with differences in conventional water quality parameters, e.g., temperature, dissolved oxygen, pH, and alkalinity, between drinking water or well water and stream waters, were also assessed.

Formation of Potentially Harmful Chlorinated By-Products Is Ignored.

I am pleased to see that the Port has at least considered dechlorination in their revised plan when considering use of City of Seattle drinking water as the source of augmentation water. I still have concern that even after treatment, residual chlorine will persist and form chlorinated by-products harming fish and other aquatic life in Des Moines Creek. The Port has yet to decide on which treatment alternative it will use and presents no data on the efficacy of any of the treatment alternatives it is considering, e.g., chemical feed system using sodium thiosulfate, or a passive system using sunlight. With most dechlorination alternatives, there is residual free chlorine that can react with natural humic materials in the receiving waters to form a variety of chlorinated by-products. In other words, most dechlorinators are not 100 percent effective. As I said in my August

21st letter, even with treatment, there is still a need to access the fate, transport, and potential bioeffects of chlorine and chlorinated by-products with each treatment alternative the Port considers, because chlorine and chlorinated by-products are toxic to fish and other aquatic life at very low levels, i.e., 3-6 ug/L. Only in this way will the public be assured that the trout and salmon in Des Moines Creek will be protected.

Fluoride in City of Seattle Drinking Not Considered as Potentially Harmful.

I was disappointed to read in the Port's revised plan that their "review of water quality reports from SPU indicate that removal of chlorine is the only treatment required as no other constituents are present in amounts that cause toxicity concerns or that violate water quality standards." As I said in my earlier letter, fluoride is found in City of Seattle drinking water at 1.0 mg/L, which is above the lethal or sublethal toxicity limits for many aquatic species. It clearly should be of concern.

As reviewed in Foulkes and Anderson (1994), a red alga was killed after four hours exposure to 0.9 mg/L, and daphnia, the water flea, was killed at <0.1 mg/L. The toxicant in both cases is assumed to be sodium fluoride. Using data from Angelovic et al. (1961) and Pimental and Bulkley (1983), the LC_{50} for rainbow trout exposed to sodium fluoride at a hardness of 12 mg/L (typical hardness of Des Moines Creek in wet season) was estimated to be 0.2 mg/L (Foulkes and Anderson 1994).

Fluoride also may mask olfaction and adversely affect migration in salmonids. Damkaer and Dey (1989) in field tests at John Day Dam on the Columbia River found that fluoride at 0.5 mg/L, from a smelter 1.6 km above the dam, significantly increased migration times of Chinook and coho salmon in the reach below the dam to 155 hours, with a 55 percent loss in adult fish. At 0.17 mg/L fluoride, the migration time was reduced to 28 hours with only an 11 percent loss of adult fish. At 0.2 mg/L, the loss of adult salmon was reduced to 5 percent. The results of the field tests were essentially duplicated in the laboratory using a two-choice or "y" flume, where it was determined that 0.2 mg/L fluoride again was detected by test fish and avoided.

Fluoride also may not be reduced to harmless levels employing current waste treatment technology. Principal fluoride removal methods are precipitation by lime, absorption on activated alumina, or removal by an ion exchange process, all of which are expensive, and may not remove fluoride below 1-2 mg/L level (Liu et al. 1997). This level of efficacy, as determined in my previous assessment, will not be fully protective of fish and other aquatic life.

Differences in Conventional Properties of City of Seattle Drinking and Well Water When Compared with Des Moines Creek Water Are Not Fully Appreciated.

While the Port acknowledges that there may be differences in temperature between City of Seattle drinking water and Des Moines Creek water, they only propose to address the potential effects of different temperatures after flow augmentation begins. The Port's

plan "includes monitoring and testing during the first year of operation to determine the effects of various temperature settings on downstream temperatures, and determining optimal augmentation rates to achieve desired results." Clearly, if they proceed as they say, there could be serious impact (thermal shock to fish and other aquatic life) in Des Moines Creek during the first year of augmentation. To fully protect the aquatic resources of Des Moines Creek, the Port should determine what adjustments in conventional water quality properties need to be made before undertaking flow augmentation. These adjustments must then be made to the makeup water source (City of Seattle drinking water) prior to its discharge to Des Moines Creek. The Port might have to use simulation modeling or conduct bench-scale tests to determine the magnitude of any such adjustments.

As stated in my earlier letter, differences in temperature of more than $2\text{-}3^0$ C could kill fish and other aquatic life in streams receiving a significant volume of either cooler or warmer water (Nielsen et al. 1983). Temperature of the makeup water should be as similar to the temperature of Des Moines Creek as possible, and at the outset of augmentation, not at some unspecified time later. The alkalinity and pH will be lower in drinking water when compared with Des Moines Creek and also may have to be adjusted upward to avoid osmotic shock. Again, all such adjustments should be made before the makeup water is discharged to Des Moines Creek.

The Port appears to have planned a similar approach if well water is the source of makeup water; that is, they plan to again test and adjust the makeup water after startup. This is wrong for the same reason stated above when addressing the potential differences in water quality between City of Seattle drinking water and Des Moines Creek water.

While use of well water from sites within Des Moines Creek watershed could prove a less harmful alternative, again care will need to be exercised to see that all the conventional properties of the well water, e.g., temperature, dissolved oxygen, ph, alkalinity, are similar to the conventional properties of Des Moines Creek water. In particular, the temperature of the well water will likely be different, and dissolved oxygen may also be depleted, so that aeration may be required. Dissolved oxygen should always be maintained at or above a level of 5mg/L (Nielsen et al. 1983). Again, determining what adjustments will be needed in the event well water is used should be done before the outset of augmentation using simulation modeling and or bench-scale tests.

Conclusions

In my opinion, there still are too many unanswered questions associated with the Port's revised plan. The Port has yet to decide on which treatment alternative it will use and presents no data on the efficacy of any of the treatment alternatives it is considering. Their assertion that removal of chlorine is the only treatment required, as no other constituents are present in amounts that cause toxicity, is also inaccurate. Fluoride found in City of Seattle drinking water can have both lethal and sublethal effects for fish and other aquatic life, and may not be reduced to harmless levels employing current waste

treatment technologies. Until simulation modeling and or bench-scale tests are done and prove out, neither the Port nor DOE should assume that any of the methods being considered would work and represent a viable, practical basis for DOE approval.

Thank you for the opportunity to comment on this Report. I am available to discuss any of my comments in greater detail.

Yours very truly,

John A. Strand, Ph.D.
Principal Biologist

Cc: ACC

References

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