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May 19, 2006

Jay Manning, Director
Washington State Department of Ecology
Post Office Box 47696
Olympia, Washington 98504-7696

Re: Draft Phase I and Phase II Western Washington Municipal Stormwater National Pollutant Discharge Elimination System and State Waste Discharge General Permits

Dear Mr. Manning:

Thank you for the opportunity to review and provide comments on the February 15, 2006 draft of the Phase I and western Washington Phase II Municipal Stormwater National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permits. The National Marine Fisheries Service and U.S. Fish and Wildlife Service (jointly the Services) offer the following comments on the proposed permits pursuant to our role as providers of biological and technical assistance under the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*), as amended (ESA), and the Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq.*). In addition, these comments are provided per the processes outlined in the Memorandum of Agreement between the Environmental Protection Agency (EPA) and the Services regarding enhanced coordination under the Clean Water Act (CWA) and ESA (hereafter "MOA") (May 22, 2001, 66 FR 11202-11217).

With the CWA authority delegated from the EPA, the Washington State Department of Ecology (WDOE) proposes to re-issue a Phase I permit to seven entities in Western Washington: the cities of Seattle and Tacoma; King, Pierce, Snohomish and Clark Counties; and the Washington State Department of Transportation (WSDOT). For the Phase II permit, the WDOE proposes to issue a new permit to 104 cities and counties in Washington. The geographic area covered by these permits overlaps eight populations of federally listed threatened salmon (Puget Sound and Lower Columbia River Chinook (*Oncorhynchus tshawytscha*), Lower Columbia River coho (*O. kisutch*), and Columbia River and Hood Canal chum salmon (*O. keta*), Lower Columbia River steelhead (*O. mykiss*), and Columbia River and Coastal/Puget Sound bull trout (*Salvelinus confluentus*)), as well as designated critical habitat for all of these species, except coho. The areas covered by the permits also overlap with the area addressed by the Puget Sound Shared Strategy Recovery Plans, Draft Recovery Plan for Bull Trout, Lower Columbia River Fish Recovery Board, and the Governor's Salmon Plan.

We support many elements of the current draft permits and the impending issuance of the permits, as we believe implementation of the permit conditions will provide better protection for listed species and their habitats than is currently provided. However, as with the comments we provided on the preliminary drafts of these permits in September of 2005[1], and on our review of the Stormwater Manual in December of 2004, we believe the current NPDES permits should be improved to better protect salmonids. The EPA and the WDOE have an important regulatory role in addressing stormwater runoff as it affects listed salmonids, and this authority should be used as much as possible in these permits and the stormwater program to maximize the likelihood of their recovery.

Since September 2005, several meetings have taken place between the EPA, WDOE and the Services to discuss the Services' concerns regarding the permits. We all agreed that fully addressing stormwater effects in Washington State will require a comprehensive two pronged stormwater strategy that includes NPDES permits as well as other programs outside the permits that deal with the effects of stormwater. Although we believe these permits are an essential and valuable component in addressing stormwater effects, we have not concluded that all of the issues identified below should be in the permits, or as a part of supplemental programs outside of the permit. We look forward to continued discussions in this regard, perhaps involving affected local governments.

Much of the discussion between the Services, EPA, and WDOE has focused on the Services' priority issues for these permits. Basin planning and watershed–based permits, inconsistent protection between Phase I and II permits, and monitoring are three of the highest priority issues for the Services. The remainder of this letter will highlight these issues and briefly describes other priority issues. We have provided more detailed comments on specific permit issues regarding monitoring in Attachment A.

Basin (or Watershed) Plans and Watershed-based Permits

The Services strongly encourage the use of basin planning and plan implementation for each Phase I and II permittee to make a better linkage with salmonid recovery plans organized at the watershed scale. Basin Plans could assess the current condition of the basin; predict future changes based on development patterns; identify ways to protect valuable stream, wetland, and fish habitat; and prevent and reduce flooding and stormwater effects in a collaborative, landscape-level manner. These plans could provide resource protection by focusing on the most valuable or sensitive resources, and identifying causative and cumulative factors. The use of preventative non-structural Best Management Practices (BMPs), (consistent with Federal regulations CFR Title 40 Volume 18 Part 122.34) for Municipal NPDES permits could provide critical elements of the plan and could include the following: policies and ordinances that provide requirements and standards to direct growth to identified areas; protect sensitive areas such as wetlands and riparian areas; provide buffers along sensitive water bodies; minimize percent impervious surface, disturbance of soils and vegetation, water quality impacts, and

[1] The Services acknowledges the draft and unsigned preliminary comment letter sent September 2005 does not represent a policy statement for the agency. It does represent our best technical analysis of the effects of stormwater as they pertain to salmonids, and is relevant to the subject draft NPDES permits from that perspective.

directly connected impervious surface impacts. In addition these plans could: implement clearing and forest cover removal and impervious surface limits; provide public education, incentives, enforcement, and penalties; and identify and prioritize capital improvement projects to improve stormwater management and restore habitat on a landscape scale.

We recommend a monitoring and adaptive management strategy be a part of any basin plan. Monitoring should include gathering information on the effectiveness and efficiencies of stormwater BMPs, the outcomes of zoning restrictions, clearing and impervious surface limits, and riparian and floodplain regulations; the effects on habitat and salmon in the receiving waters; as well as the overall effectiveness of plan implementation. The results of a monitoring program may identify new or alternative stormwater controls or treatment strategies. An adaptive management program should be implemented to improve stormwater-management methods and maintain, create, and restore salmon habitat where necessary.

King County developed several Basin Plans in the 1990's. We understand their rationale for conducting basin plans was to help address current methods for mitigating impacts to hydrologic and biologic functions in surface waters that did not work, and to prevent problems, rather than try to correct problems. They acknowledge problem correction is substantially more expensive than problem prevention (King County 1991). The Independent Science Panel (ISP) in their review of the WDOE's 2001 Stormwater Manual (ISP 2003) stressed that basin or watershed-scale planning is needed to effectively coordinate the objectives of stormwater management and other beneficial uses of water and streams. They urged more clarification and guidance be developed and applied to link stormwater and watershed-scale planning, and recommended that stormwater management be an integral part of watershed-scale planning processes for several reasons, among them evaluating the effects on aquatic systems and salmonids. In their concluding remarks their primary recommendation emphasized "that stormwater management and land use planning be integrated and coordinated through watershed-scale planning, assessments, monitoring and adaptive management." We couldn't agree more.

Without basin or watershed planning, it will be difficult for jurisdictions to prevent resource degradation and collaboratively plan, prioritize and implement actions necessary to address on-going and anticipated future stormwater discharges that are considered a limiting factor for salmonid survival and recovery (Shared Strategy for Puget Sound 2005). Booth et al., (2002) state that stable stream channels cannot be maintained by flow control regulations alone, and that watershed land cover limits (impervious surface and clearing) must be incorporated. With basin planning, these limits are more easily identified and implemented.

A watershed-based permitting approach is a logical link with basin (or watershed) planning, and would be a more holistic approach to protecting listed salmonids and their habitat. The EPA committed their Water Program to Advancing the Watershed Approach in 2002, has supported a watershed-based approach under the NPDES program since the development of their 1994 NPDES Watershed Strategy (Tetra Tech 2003), provides guidance for the implementation of watershed-based NPDES permits (EPA 2003), and has issued watershed-based permits in other parts of the country. As with basin (or watershed) planning, watershed-based NPDES permitting emphasizes addressing all stressors within a hydrologically-defined drainage basin, rather than addressing individual pollutant sources (or other water resources problems) on a discharge-by-

discharge (or other individual) basis. As a result, watershed-based NPDES permits will likely provide better protection for entire watersheds, particularly compared to the status quo.

The ISP emphasized that a watershed approach is necessary to: "assure that desired goals are meet in concert with all other land uses and downstream water issues, including salmon." King County has advocated a watershed-based permit approach for this round of the Municipal Stormwater NPDES permits, drawing a link between the watershed-level planning that produced Shared Strategy for Puget Sound and watershed-level implementation of municipal NPDES permits stating " ... a watershed approach is essential to the protection and restoration of water and water-dependent resources" (King County 2005).

One way to jump start participation in watershed-base permits is to require that all regulated municipalities in a watershed be issued one watershed-based permit, and participate in basin or watershed-based plans (as described under basin planning above) that address limiting factors from recovery plans. The Services understand the difficulty of trying a new approach in an established program like this one. Given all that has occurred around Washington State and Puget Sound in the development of locally driven watershed plans in support of salmon recovery, it seems there is no better time to try this new approach than now.

Inconsistent protection between Phase I and II permits

Protection of listed species and habitats should be consistent regardless of jurisdictional boundaries. However, there are inconsistencies in protection provided between the Phase I and II permits that may have adverse effects on salmonids. These include: land development thresholds, structural stormwater controls, and monitoring. In the Phase II permits, development of 1 acre (43,560 square feet) or less is exempt from stormwater control requirements (unless the project is part of a larger common plan of the development or site). In the Phase I permit, development of 0.11 acres (5,000 square feet) or more requires stormwater quality treatment and development of 0.23 acres (10,000 square feet) or more requires stormwater flow control. Phase I also requires on-site stormwater management BMPs for smaller land conversions and areas of impervious surface. As a result, Phase I permits provide some form of stormwater management for almost all projects that generate stormwater, whereas Phase II permits do not provide any protection until projects are 1 acre (43,560 square feet) or more.

The ISP review of the WDOE's 2001 Stormwater Manual, which has the same land development thresholds as the Phase I permits, determined that the Manual thresholds were adequate. A speaker at the ISP workshop pointed out that the manual thresholds were similar to other stormwater thresholds nation-wide, but may not result in full watershed treatment (Schueler 2003). The Phase II thresholds are significantly larger (4-9 times) than the Phase I thresholds, and will be applied across 88 cities and counties in the State. Even land conversions, which generate less stormwater runoff than development with impervious surface, can have a significant effect on stormwater runoff rates and volumes (Booth 2000). When added to numerous small scale developments without stormwater controls as allowed by the Phase II permits, as well as the existing stormwater discharges which could be largely untreated, the cumulative effects of these factors will likely increase degradation to streams and other water bodies albeit at a slower rate than the current permits.

In addition to this difference in development thresholds, Phase I permits require structural stormwater controls for existing Phase I discharges, while there is no requirement for structural stormwater controls for existing Phase II discharges. Structural stormwater controls are required in Phase I to address impacts to beneficial uses resulting from disturbances to watershed hydrology and stormwater pollutant discharges. The permit requires permittees to consider areas of existing development and new development, and identify necessary actions and an implementation schedule to address the impacts. The Phase II permit does not have the same or a similar requirement. Given the high number of 303(d) listed waters adjacent to these Phase II jurisdictions, this lack of structural stormwater control requirement likely means that existing impacts to beneficial uses will be unaddressed at least throughout the permit term (5 years or longer). During that time these unaddressed impacts will contribute to the on-going degradation of critical habitat for listed salmonids. This is a serious matter and deserves better treatment in our view.

Further, the Phase I permit requires monitoring, while there is no requirement for monitoring in the Phase II permit (see discussion under monitoring below).

The Services recommend that the Phase II permit requirements concerning development thresholds, structural stormwater controls, and monitoring be consistent with the Phase I permit requirements. Without this consistency, adverse effects to listed species and their habitat are unlikely to be avoided or minimized through on-site stormwater controls or retrofitting, and the cumulative effect of these small actions and uncontrolled discharges will likely decrease salmonid survival and increase habitat degradation in these areas.

Monitoring and Adaptive Management

We appreciate the time and effort the WDOE has spent on further describing the monitoring program since the version provided in the preliminary draft permit. Stormwater is a substantial contributor to pollutant loading in 303(d) listed and other salmon-bearing waters, and can significantly alter stream hydrology, channels and habitat. Therefore it is imperative to have an objective, scientifically reliable monitoring program to evaluate assumptions about the efficacy of abatement BMPs and to assess the current and future conditions of salmon-bearing streams. We encourage the WDOE to design and implement a watershed monitoring program that identifies compliance and effectiveness levels and is comprehensive enough to assess the success and cumulative outcomes of the permits with a high degree of confidence. To accomplish this, we believe the design of the program should include both site scale, as well as spatially balanced BMP effectiveness to allow assessment of cumulative effects. The corresponding dataset produced by monitoring must be of high quality, comparable between permittees, and large enough to support statistically significant conclusions that can allow for extrapolation to other areas not directly monitored. Through a systematic approach like this, the WDOE can learn about BMP effectiveness and make needed adjustments over time to correct control system deficiencies. To ensure that data of this caliber is collected, analyzed, and reported consistently, we recommend that the WDOE take the primary responsibility for the planning and implementation of this monitoring program.

The adaptive management element of the program should be fully developed at the same time as the monitoring program. Success of the adaptive management program depends on following explicit steps to define what and how tasks will be accomplished, what measures of success will be used, when timelines with milestones to judge progress are set, what assumptions will be tested, what thresholds of performance are expected, and what changes are necessary if the outcome is different than expected. What is currently being proposed does not lay out these steps and elements. Without these elements it is not clear whether the thresholds are attained, whether beneficial uses (especially listed salmonids and habitat) are being protected, and whether receiving waters that contain listed salmonids and their habitat are continuing to be degraded.

The Services recommend that the WDOE take a leadership role in developing and implementing a comprehensive and rigorous watershed monitoring program that accurately reports on the cumulative outcome of the Phase I and II permits in the geographic area they cover. In addition, an adaptive management program that defines the assumptions being tested, thresholds of performance, and contingencies should be an integral part of these permits.

Low Impact Development (LID)

Because the duration flow control standard that forms the basis for stormwater quantity control can not replicate the hydrological cycle, it does not provide salmonids with the range of flows to which salmonids have adapted. Effects of extended low flow durations, changes to groundwater recharge and discharge, changed individual storm hydrographs, and concentrated point source discharges (Booth et al., 2002) may all adversely affect listed salmonids. Maintenance of base flows and certain durations of low and high flows are of particular importance to salmonids. In developed areas, subsurface flow is likely to be impaired because impervious surfaces prevent infiltration. These circumstances can contribute to a decrease in base flows and resultant decreases in the amount of habitat available to listed salmonids and their prey, and cause increases in water temperatures.

The LID techniques help to maintain the natural hydrologic cycle but still allow development to occur. These techniques, such as keeping stormwater on-site by dispersing roof runoff, using rain gardens, re-using stormwater for other purposes (e.g., irrigation), clustering development, saving large natural areas of forest cover to infiltrate runoff, and infiltration basins, all contribute to maintenance of the natural hydrologic cycle. While the permits allow for LID methods, these practices are not required or emphasized. They are typically only mentioned as suggestions after structural controls have been considered, and the potential cost savings of LID techniques are not discussed.

The Services recommend that the permits create incentives for permittees to contribute funding, staff time, or identify other methods to help ensure that several LID projects are completed within the permit term. This is particularly important in rapidly developing areas. Permittees could document their support and participation in these projects and provide annual reports on their implementation and effectiveness.

Gaps in Permit Coverage

Using census-defined urban areas to identify the list of regulated entities ignores the need for stormwater management in less urbanized areas, and ignores the links to listed species and their habitats. Almost every increment of cleared land and new impervious surface, with resulting stormwater runoff, is likely to result in some degree of aquatic resource degradation, because hydrologically and biologically, there are no truly negligible amounts of clearing or watershed imperviousness (Morley 2000). Changes to stream hydrology and water quality are most dramatic in urban areas, but small amounts of watershed imperviousness (e.g., 4 percent Effective Impervious Area (EIA)) can result in significant hydrological changes to watershed flow regimes if forest clearing also occurs (Booth et al., 2002).

For example, in King County, Booth (2000) found stream channels were stable if 65 percent forest cover and 35 percent cleared land was maintained in the watershed, but if cleared land exceeded 35 percent, unstable stream channels resulted even if EIA was under 10 percent. To be most effective in avoiding and minimizing impacts to stream hydrology, water quality, and channel stability, we recommend that less developed jurisdictions be included in the Phase II permit program.

An example of this situation is illustrated by Kitsap County. A map of the county developed in 2001 shows urban areas, similar to the area identified to be covered by the Phase II permit (Kitsap County 2001). Adjacent to the urban areas are portions of six watersheds that are partially covered by the Phase II permit, but large areas of these watersheds are outside the permit. Also adjacent to these identified urban areas are six additional watersheds entirely outside the permit area. These twelve watersheds are identified as important for listed salmonids and also for already not meeting the 65 percent forest cover and exceeding 10 percent impervious area thresholds needed to support stable stream channels. If jurisdictions do not begin to address the impervious surface and forest cover thresholds this permit term, in the next permit term (at least 5 years from now) it may be too late to effectively address land cover levels, and more costly and less effective structural controls will be needed to protect water quality and beneficial uses. By then, significant impacts to listed salmonid resources or their habitats may have occurred, and structural BMPs may only address the most egregious consequences of urbanization (Booth et al., 2002).

The Services recommend that additional areas and/or jurisdictions beyond the census-defined urban area, be included in a watershed-based permit and share permit responsibilities with larger jurisdictions in the watershed (at least in areas considered important for listed salmonids). Inclusion in the permit is especially important for rapidly developing areas and those already not meeting 65 percent forest cover and exceeding 10 percent impervious surface thresholds.

In conclusion, the Services expect under the proposed Phase I and II permits, that both stormwater discharged from existing development (some with no stormwater treatment at all) and new development (even with the use of structural stormwater BMPs) will over time, adversely affect the hydrology, biotic integrity, habitat elements, riparian corridors, channel morphology and connectivity, and basin condition of the streams within the geographical bounds of the permits. The most obvious effects will be alterations to stream channels and habitat,

decreased base flows, increased peak flows, and increased pollutant loading and concentrations. We anticipate that these effects will incrementally decrease the amount and quality of habitat for all life stages of listed salmonids and their prey. Without strengthening the permits, and improving other related stormwater programs outside the permits, we expect these adverse effects on listed salmonids will contribute to long-term declines in their numbers and distribution through additive negative effects to spawning, rearing, migration and foraging, and from habitat degradation.

The Services appreciate the opportunity to comment on these permits. We look forward to continuing work with the EPA and the WDOE to minimize adverse effects of stormwater to listed salmonids and other trust resources under our jurisdiction. We recommend that the comments discussed above be addressed in the permit to the extent possible, as one prong of a successful comprehensive stormwater strategy. We also ask that you refer to our earlier draft comment letter from September 2005 for additional detail on a broader suite of technical issues than presented here.

Finally, we believe that without the combination of a strengthened permit and a feasible plan for a more comprehensive stormwater strategy, more than minor detrimental effects to listed species and their habitat are likely to occur. The adverse effects, will have both short-term and long-term effects on these already threatened salmon, steelhead and Bull Trout populations, and their critical habitat. We believe that by our agencies working together, we can ensure that actions under your purview are not likely to jeopardize listed species or adversely modify their critical habitat.

Sincerely,

Steven W. Landino
Washington State Director
Habitat Conservation
National Marine Fisheries Service

Ken S. Berg, Manager
Western Washington Fish and
Wildlife Office
U.S. Fish and Wildlife Service

Attachment

cc: Dave Peeler, WDOE
Bill Moore, WDOE
Mike Gearheard, EPA

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Attachment A

Monitoring

The following paragraphs provide specific suggestions for inclusion in the monitoring component of the permits. The Services believe that both the Phase I and Phase II permittees should develop and implement a watershed-based monitoring program. The monitoring program should ensure that permit conditions are being efficiently implemented and create the framework for adaptive management.

We encourage the WDOE to design and fully implement a monitoring program that is comprehensive and rigorous enough to assess the success and cumulative outcomes of the permit with high confidence. Design considerations should include the balance of effort and spatial extent of monitoring required (including number of sites, field protocols, statistical endpoints, analysis methods, benchmarks to judge implementation success, and interpretation). For example, the WDOE should ask how many wet ponds should be monitored so that the range of efficiency of different wet ponds can be shown and compared to the range of efficiency of other BMPs. Without considering these questions before permit issuance, it seems very likely that too little sampling will occur to yield meaningful results. The WDOE has the statutory authority and responsibility under the CWA to ensure that a reliable monitoring program is in place, and that meaningful adjustments to BMP effectiveness are made in a timely manner.

Affected municipalities can play a large role in the implementation of the monitoring program, while the WDOE provides the essential leadership and overall program evaluation. The roles for the WDOE and the permittees could include:

- The WDOE designs specific protocols to be used consistently by all permittees for site selection, equipment, standardized data collection and lab analytical procedures (including tests and detection limits), and data compilation and reporting. To be most effective, the WDOE could require training of key staff of each permittee in these protocols. (Although most permittees may already have monitoring programs and competent staff, ensuring that the data for this permit is collected the same way by each permittee is the only way to ensure that the data can be comparable and used in a comprehensive analysis of the success of different aspects of the permit).
- The WDOE develops Quality Assurance/Quality Control (QA/QC) protocols for the data and performs the QA/QC role itself. The WDOE should decide which data are to be collected consistent with protocols and decide if data are to be used in subsequent analyses. This vital function should be conducted by only one data manager (WDOE) to ensure that QA/QC standards and procedures are exactly the same for all data, regardless of which permittee collected it. Further, the entity that compiles and analyzes the total dataset for the permit should be the same that performs QA/QC.
- The WDOE stores, manages, and analyzes data from all permittees and authors reports using data from all permittees. We believe that one comprehensive data archive and plan for analysis using all of the data will be much more useful than seven (one from each Phase I permittee) or more (from Phase II permittees) individual reports using small

subsets of the data. Analysis of one large dataset will provide stronger statistical power to evaluate trends. Again, without such a provision, the power of the data to affect future decisions about BMP application and effectiveness will be weakened.

The following additional comments and suggestions are provided to help develop a successful monitoring and adaptive management program. We appreciate your serious consideration of them.

- The Management Program Effectiveness Monitoring objectives should define the measures of success, specific thresholds of concern, and attainable thresholds for flow/channel effects and/or a given pollutant. Instead, it is unclear what will be done or how the results will show effectiveness of the permit, the health of receiving waters, or protect beneficial uses. The vagueness of the objective will likely result in a collection of disparate studies that is essentially anecdotal due to their small scope and differences in methods. The WDOE will miss an important opportunity to systematically evaluate the outcome of the application of a suite of BMPs, used by different permittees, in different watersheds.

- Timelines to develop and implement monitoring programs should be shorter and this would be feasible if the WDOE took a more central and strategic role and began developing a comprehensive monitoring program immediately. Different monitoring report timelines (first reports due in December 2009 or December 2010, depending on if permittees are collaborating) may be a good incentive for collaborating, but we believe all entities in a watershed should collaborate to be most efficient in collecting information and identifying the most egregious problems in the watershed. Waiting for Phase II entities to participate in monitoring until the next permit term (5 years or more) subtracts from the program, given the need for monitoring information in a timely manner to most effectively address watershed problems that affect salmonids. The WDOE could complete the monitoring program design discussed above by 2007, allowing Phase I and II entities to submit their first reports by December 2009 or 2010.

- Phase II permittees should fully participate in monitoring through active engagement in program implementation, reporting and data interpretation. This could be part of a larger adaptive management program.

- The monitoring section emphasizes water quality parameters and does not provide much detail on water quantity issues. There is little or no mention of looking at watershed physical conditions, the effects of various flow durations or flow timing on various salmon life stages and beneficial uses, or flow effects on channel and habitat quality. Standards for BMP evaluation of flow reduction should be more detailed. No goal or predicted outcome is mentioned for flow reduction strategies. Flow during various parts of the hydrograph should be compared between natural (historic), paved but unmanaged surfaces, BMP-managed surfaces, and the standards in the permit (e.g. flow matching above 50 percent of Q_2).

- Land cover change and receiving waters should be monitored as part of the permit. Existing GIS data layers and remote sensing techniques are now of sufficient resolution to allow for tracking of changes over time in these key determinants. Land cover change could be monitored as it should inform the scope of the permit. Integration of site development permits issued by local jurisdictions within watersheds where Phase I and Phase II permits are authorized, should be integrated into the mix of factors controlling the outcomes from these BMPs. Given that many if not most of the receiving waters are already listed on the 303(d) list, and therefore subject to ongoing efforts to define recovery plans (i.e., Total Maximum Daily Loads (TMDLs)) it seem only prudent to take account of the allocation that can be attributed to stormwater through issuance of this permit. Receiving waters should be comprehensively monitored within the permit because this is the best mechanism for evaluating the conditions of the receiving waters and determining compliance with the permit which requires progress toward compliance with applicable surface water, ground water and sediment standards for all existing stormwater discharges.

- Evaluating the relative effectiveness of BMPs over time and in many locales should be a primary objective of the Phase I and II permitting program. In the future, more BMPs applied in different watershed contexts will need to be included to increase statistical power so that conclusions can be supported with confidence. In addition, without specifying which BMPs must be monitored, there is a risk that little or no data will be collected for some BMPs.

- All types of BMPs allowed under the permit should be evaluated as part of the permit. These permits should be accounted for in each affected watershed, however limited in spatial extent. It appears that some BMPs in common use, such as wet vaults and Stormfilter, are not included, and their omission will weaken our collective understanding of all sources that contribute to becoming informed and making adjustments in the future.

- The evaluation for water quality BMPs'should also include removal efficiency for PAHs.

- Stormwater discharges and BMP effectiveness are affected by a variety of factors. Besides water quality, sampling should include storm event data such as total event precipitation, intensity, duration, cumulative precipitation (in the water year), and total antecedent dry period.

- Even though the water quality treatment strategy targets loading through long-term average BMP treatment efficiency, concentrations are important and should be reported. For some pollutants, the durations and concentrations are more directly relevant to aquatic life than total loading.

- Concentrations and loads should be reported for each month. The current draft calls for seasonal reporting. Although there are general similarities within seasons (e.g. precipitation), some trends in concentration and loading and the causes of those trends may be more evident by looking at a monthly scale (e.g. cumulative precipitation). Further, the effect of pollutant discharge on aquatic life varies greatly depending on when

the discharge occurs, and reporting at a monthly scale will make the effect of discharge more evident.

- Enough monitoring should occur at high AADT road sites and commercial, industrial, and multi-family sites to validate the threshold between Basic and Enhanced water quality treatment.

- In addition to the constituents that the WDOE proposes to monitor in the draft, we believe that sediment-associated pyrethroid insecticides should be monitored. These substances are becoming increasingly common for urban/suburban use and can have adverse effects on aquatic life.

- The methods of the seasonal first-flush toxicity test should be more specific. First flush sampling for some storms at various sites/BMPs would be very helpful. Such a study would focus on the change in constituent concentrations and toxicity throughout a storm event and would demonstrate how and if BMPs moderate the effects.

- We encourage the WDOE to incorporate more measurement of biological endpoints into the monitoring program because measurement of individual constituents is inadequate to assess the effects of interacting stressors on aquatic life. Biological endpoints could include toxicity testing of discharge, toxicity of BMP influent vs. effluent, and invertebrate sampling in receiving waters.

A successful monitoring program has reduced usefulness without a well-defined adaptive management program that is designed at the same time as the monitoring program and includes thresholds of performance and commitments to change management practices if necessary. The following are necessary components for an effective adaptive management program in our view:

- Identified tasks and how they will be accomplished,
- Assumptions to be tested,
- Measures of success,
- Timelines with milestones to judge progress,
- Contingency plans, if progress is not as expected.