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TO: William Ruckelshaus and Curt Smitch, Co-chairs
Monitoring Oversight Committee

FROM: Kenneth Currens, Chair

SUBJECT: Comments on the Comprehensive Monitoring Strategy Draft Working Outline (Version 2.4)

On behalf of the Independent Science Panel (ISP), thank you for the opportunity to review the Comprehensive Monitoring Strategy Draft Working Outline (CMS, Version 2.4). The outline is beginning to describe the backbone of the monitoring strategy and some of the technical details. We are interested in both. Consequently, we have tried to organize our comments into two categories: (1) issues about the approach that we believe are fundamentally important to the success of monitoring, and (2) suggestions or comments on the technical details, which may be useful to the project management team or the different technical workgroups.

Our criteria remain the completeness, clarity, approach to uncertainty and logical consistency of the approach (Independent Science Panel (ISP) Memorandum to the Co-chairs of the Monitoring Oversight Committee dated October 10, 2001). In this review, we pay special attention to completeness of the CMS by examining the progress towards developing the eight characteristics for successful monitoring that we identified in our December 2000 report *Recommendations for Monitoring Salmonid Recovery in Washington State*.

Our most important recommendation at this stage is for the project management team and the appropriate workgroups to focus on the important short-term and long-term decisions that monitoring can inform and build the subsequent design of the project around those.

Other summary recommendations include:

- Consider reorganizing the goals and objectives hierarchically where the highest level goals express what is most important, and lower level objectives into explain how to achieve that goal.
- Choose detectable level of difference (certainty) based on the expected biological impact of the change on the organism or watershed, as well as the properties of the data.
- Continue to develop and refine the three-tier approach to monitoring across the state, within Evolutionarily Significant Units (ESUs) and among populations, and at local sites, and expand the role of validation monitoring (Tier 3) and clarify its linkages to Tier 2 monitoring.

- Choose indicators by identifying the most important short-term and long-term questions that need to be answered and the population or ecological models that will be used to answer the questions.
- Include and develop monitoring and sampling protocols in the outline.
- Include and develop quality control/quality assurance in the outline.
- Make all publicly funded data available once it has been properly validated.
- Develop a scheme for prioritizing monitoring to ensure that the most important issues will be addressed.
- Include and develop the integration of monitoring into decision-making (adaptive management) in the outline.

Goals and Objectives

As stated in our previous comments to you about goals and objectives, we recognize there are various ways they can be structured. After undergoing revision however, the current structure of the goals and objectives remains confusing. As we noted in *Recommendations for Monitoring Salmonid Recovery in Washington State,* goals and objectives can be organized hierarchically where "goals are the highest level objectives that express fundamental values about what is important. They can be broken down into more specific fundamental objectives, performance objectives, and means objectives." Goals 1 and 2 do not express any fundamental values about the status, trends, or factors affecting salmon populations and watershed health. In our vocabulary, the current goals in the outline are means objectives, which simply tell you how to do something, not why it is important to do so.

As an alternative, an hierarchical structure for the goals and objectives makes clear why specific actions (objectives) are taken or needed because the answer lies in the associated higher order objectives. Similarly, how a specific goal or objective will be addressed, is made clear by logically structured lower order objectives. As we noted in our earlier comments on goals, our recommended criterion is "If we succeeded in all the objectives, would we have accomplished the goals?" We believe that the outline would be much stronger by providing a framework of hierarchically organized, consistent objectives, because they will guide the development of statistical designs and choice of variables and indicators at both broad (state, region, etc.) and local scales.

We suggest that for each objective the project management team begin by asking, "Why is it important to measure and report on this objective?" The answers should describe a higher-level objective or goal. Taken together, they should describe how we would know whether we are recovering healthy and harvestable salmonid populations and improving the habitat on which the fish rely—the ultimate goal of the *Statewide Strategy to Recover Salmon: Extinction is Not Option*. As we discuss later, the answers are also important for integrating the data into decision-making, which we identified as the eighth critical characteristic of successful monitoring. To put it another way, from the most specific variable or indicator listed in the outline to the most general objective, we should be able to explain why it would be important for making decisions about salmon and watershed health.

Individual Independent Science Panel (ISP) members noted different inconsistencies about the goals and objectives, because of the lack of a logical hierarchical structure. For example, Objective 1(G) and 2(H) are redundant with the other objectives in those goals. In fact, if objectives 1(G) and 2(H) identified the "key questions" to which they refer, they might come

closest to being the overall goal statement for salmon and watershed health, respectively. We also note that objectives 1(B) and 2(F) to analyze the condition and trends of large-scale ocean and climatic conditions on salmon survival and habitat will be very difficult. These are important for understanding and interpreting trends in salmon and their habitat, but again, the project management team needs to ask, "Why is this important? How would we use this information to make decisions about salmon or watershed health?" The same consideration should be given to management or habitat changes outside of the state of Washington (e.g., Idaho, Oregon, British Columbia) that affect salmon recovery and watershed health.

Other Suggestions

Page 2 – The definition for the CMS indicates the document will identify what, when, where, how and who will monitor salmon recovery and watershed health. The CMS should clarify the relationship between it and the Action Plan, for which we have not seen an outline.

Page 4 – Consider moving the 3rd bullet to end of the section so that the limits of the CMS are not mixed in with the rest of the section.

Page 7 – Consider combining objective 2(G) into 2(D) and 2(E). Habitat connectivity is part of habitat quality and quantity in both freshwater and marine nearshore/estuarine environments.

- Consider adding an objective to measure the abundance, productivity, geographic distribution, and diversity of hatchery fish.
- Explain why the condition of freshwater, estuarine, and marine environments is included with monitoring fishing mortality rates and trends in the same objective, especially because these are ignored in the monitoring details later on?

Statistical Design and Models

Our comments in this section focus on two issues: (1) the approach for addressing uncertainty and statistical power, and (2) the proposed hierarchical three-tier structure for monitoring.

Uncertainty and Power – We are encouraged to see the outline addressing sampling design and statistical power to identify useful indicators and to assess the feasibility and effort required to meet specific, quantitative goals and objectives. The outline identifies a desire to be 75% confident of a 20% change in a variable in 10 years and notes that the ability to do this is a function of sample size, effort, and variability in the indicator. Although this is true statistically, it ignores the most important consideration. Choosing a detectable level of difference and timeframe should also be based on the expected biological impact of the expected change to the organism or watershed. For some of the variables identified, a 20% change may be detectable but have a minor biological consequence; for other indicators, a 20% change may be very significant or even catastrophic for salmon recovery or watershed health. It may be more important to apply extra effort to detect a smaller change because it is so significant than to detect a 20% change when it is not important. We reiterate once again that considering why these choices are important and identifying how the data might be used to make decisions should guide the development and priorities of the monitoring strategy. The technical workgroups challenged to identify these indicators should help provide this kind of information to the biometricians.

It is likely that achieving the 75%-20%-10 year goal (or whatever is identified as biologically meaningful and relevant to decision-makers) may be difficult because of lack of resources and

inherent natural variability. Natural events such as wildfires, large storms and associated floods, and earthquakes will occur with effects varying over both space and time. Thus, habitat conditions can improve or decay naturally and monitoring efforts must be flexible to account for such variation. Some examples are: (1) so-called reference areas may not provide a stable nor reliable base for comparison; (2) trends in watershed condition indices (e.g., impermeable area, road densities) may not reflect trends in habitat; (3) and questions such as "Are high flows that are causing undesired scouring of redds and loss of juvenile salmon changing to benefit salmon" may not be answered by the proposed monitoring program.

We recommend that project management and technical workgroups consider how monitoring can be designed to provide prior probabilities for management decisions that can be updated as the monitoring progresses or effort is increased even if the desired certainty cannot be attained. For example, in evaluating ongoing or proposed monitoring needs (Section VII, Strategy for Monitoring Watersheds, pp. 24-51), the assessment should consider the existing broad information base that includes past monitoring efforts as well as the scientific literature. For example, such information can be very helpful in defining the variance associated with different types of monitoring, effectiveness of measurement techniques, and time and personnel costs. A careful assessment of such information should be done to evaluate what constitutes a practical and realistic monitoring program within the bounds of the required scientific certainty. Likewise, coupling the monitoring program with a watershed analysis or assessment wherever possible will help provide specific information to guide what, when, where, and how monitoring should proceed, and the likelihood of different outcomes.

Three-Tier Approach – In general, we support the approach, but the outline needs much more development and clarification to be examined critically. We recommend developing the different tiers in terms of the kinds of decisions that will be made based on the analysis. Tier 1 appears to be simply a scale for reporting on statewide status of salmon and watershed health. What decisions might be based on this? Will this lead to questions about why there are differences between regions or the implications for distributing resources for recovery across the state? If so, then the kind of data collected and the analyses that might inform these questions should be built into this tier. Tier 2 appears to include everything from local populations to major regions and ESUs. This is a big difference in scale, with different biological processes dominating the different levels and different kinds of affecting decisions. Will simply documenting the status and trends of these processes answer these decisions? Tier 3 is the only tier that addresses why the populations, watersheds, or ESUs are changing or remaining the same, emphasizing the local scale. Ultimately, it is Tier 3 efforts that will provide accountability and efficiency in managing natural resources and people. Consequently, it is crucial that the linkages between Tier 3 monitoring and Tier 2 monitoring be well designed and implemented. We look forward to seeing more details as the outline and ensuing narratives develop. Individual ISP members have provided some ideas and comments for technical workgroups to consider, which we include below.

Other Suggestions

Consider adding a figure that depicts relationships and relative level of effort required for Tier 1, 2, and 3 monitoring.

It is not clear why Tier 3 monitoring must be confined to the local scale. Some adaptive management actions may best be tested at the regional level rather than the local level identified

in the outline. For example, at the regional level, it may be possible to quantify how habitat patchiness can be correlated with fish abundance and landscape patterns or indicators (e.g., patterns of land use, road densities, density and extent of human inhabitants, geology, climate), which will be useful for making decisions about land use. Spatial autocorrelation could be used to test for independence among sites. This kind of analysis could be important for determining cumulative effects of different land use activities. Consequently, identifying reference streams (good condition = positive control; poor condition = negative control) are needed at this level as well as the Tier 3 level. It may also be possible at this tier to pair resident and anadromous species as correlates to segregate potential differences between freshwater and saltwater on population growth.

None of the tiers include any reference to Objectives 1(B) and 1(F) and 2(B) and 2(F). These should be added. Objective 2(B) should be included under Tiers 2 and 3 – perhaps 1 as well; objective 1(F) is likely more site/project specific, so Tier 3 may be an appropriate tier.

Consider rephrasing the "Demands on quantitative expertise" to "Type/Level of Technical Expertise" and then assign some qualitative value to tier 2 and 3, such as "Moderate" for Tier 2 and "High" for Tier 3.

Variables and Indicators

The current list of variables, metrics, and indicators is a good start, but it is not apparent why they were chosen or how you might choose among them, if not all of them can be monitored. We recommend that the technical workgroups choose the indicators by identifying the most important short-term and long-term questions that need to be answered and the population or ecological models that will be used to answer the questions. Each of these has its metrics (variables specified by the model). These are ideal because they relate formally to a model that can be validated. Obtaining these metrics may be difficult or excessively expensive and a series of indicators or surrogates should be ranked. The reasons why any indicator is an adequate and sufficient surrogate for a metric should be clearly stated in the monitoring plan.

Other Suggestions

Table 1 currently identifies Tier 2 as relying only on counts of juvenile and adult fish, although this is not consistent with the objectives listed. This should be changed.

When choosing indicators for tracking population trends, consider the analyses that will be needed and how they relate to the demographic elements of population growth at different life stages, such as the elements of the Lotka-Euler Equation, λ (the growth rate of the populations), Leslie-Gower Projection Matrices, as well as spawner-recruit models. For validation monitoring, consider indicators that can be used to examine elasticities, which will indicate how much of a percent response we will obtain for each percent increase in survival.

For Tier 1 or regional indicators, consider more than just presence/absence. Useful indicators may also include number of species standardized by basin size (species/area curves), metapopulation structure and the correlation with unique habitat factors, the extent and distribution of sensitive species measured in terms of species richness and species diversity.

Is the "wetted" usable area what is intended or should this be the "weighted" usable area? This has implications for the kind of monitoring and data needed.

Monitoring/Sampling Protocols

The outline does not yet address this characteristic of successful monitoring programs. We recommend that it be added to the outline and developed.

Quality Control/Quality Assurance of Data

The outline does not yet address this characteristic of successful monitoring programs. We recommend that it be added to the outline and developed.

Data Access

The outline sketches the beginning of a system for accessing and sharing data. The outline indicates that only some data sets will be available (Page 3 – 4th bullet). To be amenable to scientific analysis and interpretation, we recommend that all watershed health and salmon recovery data should be accessible (once the data are properly validated).

Adequate Funding

The outline addresses the need for adequate funding in the introduction and the strategy of leveraging current agency monitoring investments to provide this. This characteristic of successful monitoring will need more development in the outline. Recognizing the resources will certainly be limiting, we recommend that a prioritization strategy be built into the monitoring design. Just as it is possible to design monitoring around three tiers for different geographical scales and questions, it may be possible to design a prioritization scheme to ensure adequate funding is aligned with the most important monitoring questions. We reiterate here that identifying the critical short-term and long-term questions that need to be answered and anticipating decisions that need to be made will enable development of the most efficient monitoring designs and priorities.

Integration into Decision Making

In this review, we have continually emphasized the importance of understanding the short-term and long-term decisions (subject to and focus of adaptive management) that need to be made to have effective monitoring. These should be generally expressed by the goals and objectives. The outline and the development of the monitoring design do not yet address this characteristic of successful monitoring programs. In our opinion, focusing on this may be the most immediate and effective way to shape the monitoring design and priorities for the strategy. We recommend that it be added to the outline and developed.