SEI Science Panel
Final Workshop, August 28-29, 2001

Transcript of Discussions

Overview of the SEI Process
Steven *Courtney*, SEI

Collier: Steve [*Courtney*], just a slight correction. It's presumed that there is exposure via the diet.... Stomach content analyses have shown that... It's not true to say we don't think they're being exposed via their diet... There's a contribution from hatcheries, but at the same time wild fish and hatchery fish are mixing. [Inaudible]

Boesch: In that regard, I'd just clarify, I think it's almost entirely likely that contaminants moving through the estuary associated with fine particles are an important mechanism that direct consumption of these particles by eating through prey that exposes the fish to these contaminants. The operable question is that whether the proposed activity -- dredging -- would substantially alter the amount of flux of that fine particulate contamination in the estuary. Contaminants have to get there some way, and certainly some of these contaminants are from upstream sources.... associated with fine particles, they're going to be transferred by diet. The question is whether the proposed activity is going to significantly alter that flux....

Goldman: Just to amplify a bit. It seems to me that the straight channel dredging of pretty clean sand is not going to be a major source of contamination, but if dredging extends into contaminated areas then we are going to have fine particles which the filter feeders pick up indiscriminately with their food supply and this is where you probably get your major contamination. It's the washload, not the bedload, that's of concern. Wherein a really comprehensive modeling program combined with adequate monitoring is going to be really important for following this.

The other point is that I think a monitoring program of less than 10 years in scope isn't going to be really adequate. A good example is in Tahoe where we got a reversal of the trend for a period of five years simply because of physical factors. The lake wasn't mixing.

Courtney: Let me attempt to capture what you've each just said. I think the sense coming out of the workshop on toxics, sediments... of the issues we were dealing with, this was a relatively straightforward one... second-order issue...

Boesch: What we heard was a greater basis of concern about the long-term consequences of channel water habitat than there is about the short-term consequences of re-mobilizing contaminated sediments.

Courtney: One other thing I wanted to mention about the June workshop is that we

started to change the process a little bit. As part of the preparation for the workshop, Larry *Curtis* spent some time with the group helping to design how that workshop would operate and going through some of the materials one-on-one with the presenters. During the June meeting, we [SEI and the project managers] also held some breakout sessions with the panelists. That was a recommendation that resulted from the panelists themselves that they felt the smaller group was more productive. So we cancelled the July workshop because everyone felt that we weren't yet in a position to talk about adaptive management and monitoring. Instead of the workshop, we arranged for three of the panelists -- Drs. *Bartell*, *Boesch*, and *Cody* -- to come back to work with some of the managers and scientists to try to bring forward the discussion of what would be an appropriate monitoring program. All the materials we dealt with in the July meeting are now being brought forward at this meeting. One of the goals of this meeting is to bring all of those things we discussed in July into the public forum so that everyone can understand why we're thinking the way we are.

In turning to the questionnaire, the panel wants to see monitoring and adaptive management. They consider that there are risks and uncertainties associated with the proposed project, and view monitoring and adaptive management as essential. However, those techniques need to be appropriately designed, they need to be flexible -- it's so easy to set up a monitoring program with no real tie-in to anything. In terms of scale, risks need to be balanced with effects. If we were to identify things of highest priority for monitoring those should be those issues exhibiting higher risk or higher uncertainty. Issues of lower risk and lower uncertainty are lower priority issues for monitoring. Further, the panel endorsed the idea of some sort of decision process, that is you've got to know how you're going to use the monitoring before you set it up. In other words, you monitor for a reason. Typically, that might be done in an adaptive management framework. Monitoring should be integrated with the things that already going on. There was discussion about how long the monitoring program should be ongoing. The smallest number anyone recommended was five years and the largest was the life of the project, 50 years. There was disagreement among the panelists with those numbers but general agreement among panelists that monitoring should be appropriate to the issues. It might be that the monitoring program will evolve in the course of the project. They agreed that there should be some oversight. Some issues could be monitored for a short period and some for a longer period, perhaps the lifetime of the project.

The panel emphasized that an adaptive management program should be put in place. The panel went further and attempted to prioritize issues for monitoring. Essentially those are the areas where we know the least. So side-channel and peripheral habitats within the project area is one of the highest priorities. Other priorities include: emerging vegetation, bathymetry, what the fish are doing there in terms of growth, habitat opportunity, are there wild fish or hatchery fish, what's the food. Those were some of the things identified by the panelists that they'd like to hear more about. I should say that there was not unanimity among the panelists about the individual topics they wanted monitored, but some of that disagreement reflected their particular areas of expertise. I think, nevertheless, it's fair to say that people emphasized biological issues. Other issues, like toxics and physical parameters, should be monitored, but were perceived to be of lower

priority. I want to emphasize that the panelists were pretty strong on the idea of monitoring, of a pro-active approach to address issues of risk and uncertainty.

Presentation on Modeling Results
Antonio *Baptista*, OGI/OHSU

Baptista: In terms of preliminary conclusions, 1) There is no evidence that the project will have a significant impact on salinity intrusion. The impact is dwarfed by the natural variability of the system, it is 'small' by the metrics used, and it appears to be reversible through 'small' changes in river discharge. 2) There is no evidence of 'significant' impact on habitat opportunity. No, or a small negative impact, however, spatial patterns of mild (negative plus beneficial) impact. Need to explore high river discharge conditions. 3) The temperature question remains to be addressed, but it is the least logical of the three questions. May be restricted to regions where ocean discharge is inhibited. (Items in quotes represent Dr. *Baptista*'s personal opinion, based on his analysis of the modeling results).

Bartell: How deep would the plan have to be for your model in its current state to predict changes that exceeded the error bounds?

Baptista: I was actually very pleased to the duplicate the size of impact that you showed before, even if the numbers are not exact. Because they made physical sense and they are intuitive . So it is telling me to some extent that the model is picking a difference that makes some sense. [Suggests other things they could do with the model, but isn't sure there is enough time.]

Bartell: We could debate that [that the model is picking a difference]. That's certainly one interpretation.

Tortorici: The model is a snapshot in time What is the predictive capability of the model?

Baptista: As you know, the model base represents existing conditions. [You can test proposed actions, like the channel deepening, against the model.] I think these results give you a framework to think about the problem. That's all they are intended to do. You can make predictions, but not on a two- or three-month-long effort. I think we are giving you an ability to think about the problem.

Larson: Based on the small changes you found, what would you guess would be the changes on the long term?

Baptista: Well, obviously we are seeing only small changes. And if this [channel deeping] is the only change that is done to the system, then my guess is that the long-term changes will be small.

Jay: Do you have an objective basis for the decision you made about what river flow

maximum effects would be seen?

Baptista: It's a great question [but not my charge.]

Jay: My guess is there's something to be said for intermediate discharges as having the maximum changes because the neap-spring transitions play such a big role in changes in salinity intrusion

Boesch: Do you see this neap-spring transition that David's [*Jay*] talking about?

Baptista: Oh, yes.

Beasely: [Largely inaudible, but: How much work are you going to do on that bottom friction related to the channel... What type of thresholds are we now at the point where we are going to cause sedimentation or erosion from events across the river?]

Baptista: [Sheer stress is not my charge].

Boesch: [Appreciates the speed with which *Baptista* pulled all the modeling together and the care he used in addressing the concerns behind the questions. Suggests that regulatory agencies provide some feedback on *Baptista*'s results.].

Bartell: Assuming the model is accurate, is the adding up of those small, incremental differences into some summation of hours of potential lost habitat relevant to the way that salmon see and use the system in terms of an impact? And if it is, how many hours of lost habitat would be required in order for the agencies to say 'no go' for the project, and what would be the basis for that decision?

Tortorici: Is that a rhetorical question?

Bartell: I guess so. In other words, what I'm trying to emphasize is the kind of output you're getting from this model useful in the overall decision-making process, and can you come up with scientifically defensible criteria by which you could use that information to make a decision regarding salmon in the estuary?

Casillas: From our perspective, the issue that I presented at the start of this SEI process was the interpretation of physical change and the biological consequences. And that's the gap that we still have difficulty in bridging. One of the elements that Antonio provides for us is some more quantitative and tractable measure to answer your questions in terms of the physical features that are important to salmon. That was information that we didn't have before. And so, what I can say is that we're a step closer with this information, but the difficulty would be making that bridge to that interpretation of how many hours, as you posed, where's the cut-off going to be? We don't have that capability right now to make that statement in a very objective way. And that will be a task for us -- probably more of a judgment call.

Bartell: Sure. And in a sense, it might not be a 'go or no-go' position, but in terms of adaptive management, there may be some triggers where you say, 'Well, maybe we need to re-think this situation,' or re-double our monitoring efforts, or something along those lines.

Bottom: I agree. The question is how do you translate these numbers to what actually happens to the individual fish. Clearly, that's where we started out as a problem and it still is a problem. As suggested, it's helped a little bit in the sense that we arbitrarily chose some metrics that we thought were biologically meaningful without being able to put an absolute number on them. A range of values. So now we have some range of changes within those range of values that we can ask, 'Is that big, or is it small?' .....Using that same thought process in designing your monitoring and evaluation, you may be able to do this in some kind of step-wise fashion.

Coming back to the comments this morning about surprises, indeed, surprise is what we're worried about and that's what we have to prevent. And so I think we don't accept small changes in a model as saying there will be no surprises. But we set up the same kind of thought process in making sure that that's the case.

Courtney: Maybe I could comment on the process. One of the things we do for you is to give you the opportunity to hear the opinions of impartial scientists on whether these are big issues or not. Process-wise, we have established for the record that the panel does not see a 'smoking gun' in terms of these physical changes.

Beasley: I appreciate the complexity of all the modeling that's been done, but I wonder if the surprises might arise from not looking at the project from a holistic approach. We're not looking at the incremental assaults that have occurred over time. In a way, we're looking at it with blinders on.

Baptista: [Inaudible; but basically his charge was to look at a specific set of questions]

Casillas: What we're still looking for from Antonio, and I realize he hasn't completed his work yet, is the full range of flows. That's one of the key elements we want to look at. Its a big leap from classifying physical changes as insignificant or small to saying the same for biological consequences. [Need to be careful about value-laden terminology and extrapolations from the physical to the biological based on that terminology. Stick with factual changes.] Antonio's presentation has been very helpful; it gives us a better foundation for making interpretations, but we still need to recognize there's a big gap.

Boesch: But I think the value of this approach is that Antonio took what experts thought... biological needs criteria, a priori, and then put it in the context of a physical model. So in a sense, it addresses the biological. As Dan [*Bottom*] mentioned these criteria are imperfect, but the criteria can be changed and you can ask the same questions of the model. So I think it is more than just a physical model and asking what does it mean biologically? Because here you're writing a model to predict criteria on the basis of biological parameters.

Casillas: [Agrees. Says he did not expect to see dramatic changes in the OGI modeling, but regardless of the biological context in the selection of physical features, the gap between the physical and biological still remains. They are not empirically-derived numbers; they are a range].

Curtis: One of the things the presentation did for me was validate the value of the calibration of these models... where you apply them. You've only got 12 weeks. How much will you be able to use that calibration data to refine your model for the next iteration?

Baptista: [Tried to compress as much as they could in 3 months, but fine tuning of the model used in the calibration will be beyond the 12-week period. In the process of beginning a year-long certification process. At the end of the one year, it will be fairly fool proof.]

Courtney: [Typically engineers say that you can be 'fast, accurate or inexpensive – choose any two of the three'. complements *Baptista* for being fast and accurate – the Corps got good value.]

Presentation on Modeling Results
Rob *McAdory*, Corps of Engineers

Jay: I would expect the sensitivity in terms of what flow conditions cause the greatest salinity changes to not be at the lowest or at the highest in some areas....

McAdory: [Agrees]

Jay: [Inaudible, but continues discussion on intermediate flows (120-200 cfs)]

Bartell: How big of a project do you think you would have to impose on the system to see impacts that would be outside of the noise of these calculations?

McAdory: If you deepened it a whole lot, you probably wouldn't see any effect because all the salt would stay out in the channel. [Salt has a hard time getting up out of the channel.] If you want to have the biggest change, let it fill it back up.

Bartell: Has this modeling approach been applied to other systems?

McAdory: [Galveston Bay. There was an impact on the salinity. It actually showed that the oysters improved slightly.]

Goldman: Maximum impact would probably be when you've got a high-high tide with a strong wind behind it. Does the model consider that kind of extreme?

McAdory: [No, but you could do that].

Conceptual Model
Rick *Mishaga*, Port of Portland

Bartell: Have you ever thought of trying to translate it from a conceptual model to an operational model?

Mishaga: It certainly can be done. [But not yet. Need to first have the conceptual before the numerical].

Bartell: We were talking earlier about surprises. One of the things that struck me while you were talking was the fact that the organisms that would contribute to the primary production base may also be impacted by changes in velocity, salinity, elevation, turbidity. And perhaps is that while the physical modeling is suggesting very minimal, if any, impacts to salmonid habitat, as it was described this morning, there may be surprises down the road over the long term but small changes in those parameters as it might affect the production dynamics of the system. I'm not sure how you grapple with that in this context other than trying to make the actual operational connection between the physical/hydrodynamic modeling and some operational manifestation of this model, and putting it in the context of risk assessment and uncertainty.

Mishaga: [Need to figure out where the uncertainties are].

Bartell: It certainly would be challenging, but it might be worth the effort.

Marsh: I just want to follow up on what Steve just said. Parametrix is doing that in our analysis. We are looking at all the potential effects on the ecosystem and how they relate to salmonids. We don't have all of the answers...

Bartell: So you're implementing this in a mathematical simulation model of some kind, or you're using sort of a qualitative evaluation of...

Marsh: I guess the question I have, for example, if you just looked at your habitat/primary productivity pathway model, if you consider monitoring strategies that go along with the project, would you use this to look at ships and primary productivity in making a monitoring plan? I'm just trying to come up with a concrete application of some these models to our issue. For example, would you look at ships and prey consumption of these different food resources? Would that be something to recommend, or you just want to know that they are possibilities? Where would that lead you?

Mishaga: In terms of the process, the model helps us identify all the issues we might want to look at. Each one of these pathways, as you recall, is really a more complicated model. [This is just a guidepost... more detailed analysis to follow].

Curtis: At the first workshop where Dan *Bottom* talked about ocean-type chinook and how they used the estuary... 90-year-old data... Since we know so little, I was wondering if the outcome of your efforts would be if you were going to use ocean-type chinook productivity as something you would use in an adaptive management context if something like this might be useful. I'm just wondering where this model is going to lead you.

Mishaga: It helps us understand how any one thing affects all other things in the estuary in terms of salmon production. We use the model to trace relationships.

Goldman: One thing we've noticed over the years with the Tahoe system is the importance of coupling physical forcing with the biological aspect. This is particularly true with salmon runs because of the importance of, for instance, weather patterns in determining the success of the size of a year class. Isn't it important to embed on top of the biological model a real recognition of the importance of climatic change in the forcing aspect?

Mishaga: [Good point. Range of uncertainty is important to consider.]

Whitney: To me, this looks a lot like Ecosystem Diagnosis and Treatment (EDT) where you're looking at the biological and physical environments and how they influence salmonid survival. Something that's near and dear to my heart.

I have a procedural question for Steve. We're supposed to be taking a population approach to salmonids, but here we have an ecosystem approach. I think it's a good approach, but how do you align the two and maintain the rules of the process?

Courtney: [Sees no conflict with an ecosystem matrix when applied to salmonids. Need to understand all the pathways that could affect salmonids.]

Whitney: Johnson and O'Neill in a new book talk about fish-wildlife interaction. They categorize 9 species of wildlife that are strongly associated with salmon, an additional 40 are closely associated, and about another 80-100 mildly associated. So we're not going to look at those associations. We're only going to look at the ones that are in this model. It seems that if you're going to take an ecosystem approach, you need to look at the ecosystem -- all of it.

Courtney: [BA will address all the other critters that interact with salmon. SEI has a specific charge that we are fulfilling here].

Bartell: Clearly there's only one Columbia River system out there. There are different ways for ecologists to look at that system and it has to do largely with the kinds of simplifications they make, the particular phenomena that are of interest. It's led to a kind of, what I call a 'file-drawer hierarchy of ecology.' It's a convenient way to organize material in a textbook; it has very little to do with how the ecosystem actually functions.

For example, I'm interested in the population dynamics of salmon. There are various mathematical simplifications and constructs that have proven useful in looking at problems from that particular perspective. I could try to characterize the population dynamics of those species in the context of a compound interest problem. Some fraction of each life stage will survive from one life stage to the next. Set up a population and demographics model and use that to make projections about the population dynamics of these fishes. Well, I made an awful lot of simplifications and assumptions. Does that mean that the complexity of the system has gone away? Of course not. All that complexity is rolled up into the particular kind of parameter values that go into that particular model. In fact, you could make a logical and justifiable argument to call it a very simple ecosystem model.

We can also take a look at the population dynamics from a different perspective and use a different currency. Now I'm interested in describing the dynamics not as a compound interest problem but in terms of bioenergetics. We know from the conceptual model that we have an energetic base to this system, some fraction of energy flows through a very complex food web. There are mathematical model constructs that have been used to describe population dynamics from that perspective. So I can have another kind of 'population model.' All the complexities of the ecosystem that I choose not to explicitly represent didn't go away; they're still there, affecting the accuracy and precision of the results that I get from that particular modeling tool.

Now I'm going to put on my ecosystem model hat. Everything looks important all the time, so I'm going to try to write down as many equations and include as many variables and use the historical accumulation of information to try to explicitly represent as much of the structural and functional complexity of the system as I possibly can. And within the context of this ecosystem model, I can still look at my state variable which corresponds to the population of salmonids. What have I constructed? Well, it's really a very complex population model. I've just chosen to explicitly represent more or less of the structure that I seem to think is important in terms of characterizing the dynamics.

So it's unfortunate that we have these different titles and short hand for how much ecological structure and function we think is necessary to address different kinds of -- not just environmental system problems -- but problems in theoretical systems ecology to begin with. So, unfortunately, there's no theory to prescribe a priori how much of that detail we need to explicitly represent in order to get answers to a specified degree of accuracy and precision. So I think while it's useful short-hand notation to ecologists to talk about population models, ecosystem models, I think there's a real danger in conveying that that's the way we think the world functions. And of course it's not. We've never completely characterized any ecosystem on the planet. So the real challenge then, particularly from an environmental assessment perspective, is trying to determine just exactly how much of that structure and function we need to explicitly represent in our conceptual or operational model to get answers that accurate enough and precise enough to be used in decision-making.

It's meaningless to say we can use population models but not ecosystem models. You

could call either one by the other name. The question is to try to determine what are the simplifying assumptions that we can get away with to make our job easier, but still capture the salient features of the system to get a reliable answer.

Young: Using those portions as a framework, that makes sense to what we're dealing with here. We're dealing with an ESA consultation. The ESA has a couple of framework processes we have to feed this through. One of them is that we use existing baseline conditions as a foundation for our analysis. The second part is that the proposed action is what we analyze. So within that framework, you then decide on the type of models that would represent baseline conditions, right now in time, that are related to the proposed action. I'm going to speak to this later today. How does the ESA consultation process pick up the SEI process, the developments of the conceptual model, the numerical model. How do we put those together? To this specific point, when you have other kinds of information, such as several hundred species interactions, I think the conceptual model would need to look at those species that, in the current baseline and in respect to the proposed action, might have influence in the river and estuarine portions of this project. So there's where the ESA gives us some sideboards for an analysis. That's not saying that this whole project doesn't have other responsibilities outside it. But for this process, those in my mind are the two key sideboards.

Whitney: I agree with what you both said. In the literature I read (Cedar/Home, Johnson/O'Neill, Bruce Marcot), ecosystem functions are categorized into about 90 functions that sort of encompass all ecosystem functions. Here [in the conceptual model], you're looking at about 10 functions. It's the right approach to take, but there are about 80 other functions that are important to the ecosystem.... We have to acknowledge that there are all these other functions out there that we do look at within the context of this program that don't apply to other projects. I think there's a danger there of having that sort of ripple or go to the next step of outside this process. There's the appearance that we're taking an ecosystem approach here and it applies to all aspects of the Columbia River. I don't think it does.

Courtney: There are nods behind you (NMFS).

Mishaga: I just like to say, Paul, that you might recall at one of the earlier workshops we were told to simplify the conceptual model. This is a conceptual model for a particular project. I think that's the difference. This is not a generalized conceptual model.

Outstanding Issues

[Doug *Young* presented a brief update on the soon-to-be-released paper on the status of coastal cutthroat trout in the estuary. The paper will be made available on the SEI web site.]

Courtney: [Panel has acknowledged side channels and peripheral areas as major areas of concern. Project managers have agreed on what constitutes baseline conditions. Food chains, salt wedge, suspended sediments, and turbidity are issues where there is no new

information but the various agencies acknowledge they need to be addressed. They've committed to do so in the BA.

On the issue of ETM, it has not been a focus of the modeling. The discussion that I've heard about ETM is that NMFS has said that it's hard for us to get at that. It's of lower concern to us than other issues. The modelers have said that they don't see how they can provide any new information. And the panel has said it's lower priority.

Boesch: That follows from the kinds of presentations given by Rob and Antonio....

Jay: The primary changes that one would expect regard to the ETM that follow on as a consequence in changes in position of salinity intrusion... changes in the location of the ETM.

Boesch: The other issue that has the potential to be confused concerns the effects of increased activity as a result of the dredging activity. The conclusion I drew from the presentations on that is that that would be developed against a background of fairly high turbidity anyway and be mobilized in terms of its extent. So I don't think any great concern came out of that discussion regarding the effects of locally increased turbidity as a result of dredging.

Bottom: [I would agree that turbidity is not a major concern where salmon are concerned. Regarding ETM, ... as far as a food chain issue per se for salmon, it might be more of a secondary issue.]

Courtney: The physical parameters are being modeled.... can be incorporated into the conceptual model. It's my understanding that issues like that will be dealt with in the BA. But we have essentially no new information to present at this point.

The last point about including a futuristic component, specifically climate change, into the conceptual model. In this case, the project managers elected not to incorporate that on the grounds that it was outside the scope of the project as defined by existing and reasonable future conditions. But I don't think that means they completely blew off that comment. It's been incorporated into the public record and will be addressed in some fashion at some point, but it's not going to be a focus of the BA.

What happens upstream from the estuary? Some of the work the modelers are doing will be applied to this question, and essentially when those data come in they will be incorporated and addressed in the BA.

Whitney: Very clearly, the river in the Vancouver area is not "narrow". To characterize the upper river as narrow is inappropriate.

Courtney: [So noted.]

Boesch: It's relative. Relative to the lower estuary, it's narrow.

Whitney: [Maybe so, but it's not narrow. Narrower than the lower estuary, but not narrow.]

Courtney: It's my understanding that the issue of shoreline drying will be addressed through the physical modeling. Results, such as they are, are available now. We've seen some changes in habitat. Does anyone have any comments on that?

Whitney: Rob *McAdory*'s modeling did not include the upstream, Vancouver portion. It was interesting how the influence of depth was increasing as you went upriver. It would be interesting to carry the model upstream to see if that depth trend continues.

McAdory: I make no pretense of anything above Longview in my model. We were concentrating on the estuary per se, which doesn't even go up to Longview in terms of salinity. Above Longview, my model is not useful in it's present form. Now, Antonio's model, when completed, will be useful all the way up to Bonneville. Even given that, those changes are so small, I'd bet you a hundred dollars you can't measure them out in the field. You're just talking an inch or two. Antonio's model should be able to answer your questions.

Whitney: [Doubts that an inch or two can be dismissed as 'small'. Agrees with *Casillas* that modelers need to 'stick with the facts.'] In a modeling exercise, if you want to look at the consequence of the action, sometimes you need to look at the extreme. If you just look at the small interval, it would appear that there's no consequence.

You also need to understand what the baseline condition is that you're trying to achieve when we want to recover these fish. So if you want to go back to that original habitat, if you're going to break dikes and open them, you might not get the water flowing into those tidal marshes the way the water historically did because the water elevation has dropped from what it was historically. So it's important to know those things, what the consequences of dredging are, for setting your targets for the mitigation. And the mitigation is important, setting those target correctly, for your adaptive management. So I think looking at the consequence of dredging as a whole is going to help you come up with better mitigation.

Courtney: Respectfully, we're not charged with looking at dredging as a whole. We are charged with trying to understand the effects of this project. I'm aware of your concerns of seeing that in the context of the historical background, and I think that comment has been heard. But this project was set up to focus on the incremental change from the current conditions.

Whitney: But Steve, if you're going to look at adaptive management, you need to monitor in relation to the success criteria you've set out for your mitigation. Assuming there's going to be some mitigation. I think looking at historical aspects of this are important for your adaptive management to work.

Jay: [Largely inaudible, but concurs with *McAdory* that tidal effects upriver would be minimal as a result of dredging]. We have actually been looking at historical changes in tidal regime.. In 19th century… taking channel from 20 feet to 40 feet, we were amazed at how little the tides have changed. What I think is going to be the bigger change… tidal range decreases to square root of increasing river flow. Linear relationship with river flow. And the decrease in river flow gets much more steep as you go upriver. And so what has really … is the change in the spring freshet. The spring freshet is only about 60 percent of what it used to be. It's a huge effect…. Quite a large effect on tidal range… increases as you go upriver. In comparison, my experience with this system does not indicate that dredging is indicated…

Tortorici: We are considering historical conditions in the sense that the baseline, even though it's a snapshot in time, is based on everything it's taken to build it up to today. So because of that, we recognize that the baseline is not in pristine shape. There has been a certain amount of degradation that's happened in the system… conditions, so we are trying to value changes in the current condition, but understanding where the system was from past to present, if that helps.

Courtney: Back to our list of issues. Essentially, we don't have any new news to report on a number of these things. We don't have any more information on adult salmon. We have no new information on upstream migration. We do have more information on coastal cutthroat. We have no new information on the source of toxins in estuarine fish. Don't know much about the concentration of contaminants. No new information on what's happening in the washload.

Buck: …We would like to know more about the concentration of contaminants in suspended particles, especially in relation to ETM and also to surface sediment in that particular zone. Also, it might tie in ship wake effect on re-suspension.

Curtis: When the panel began with the toxics issue, the initial thing I focused on was the actual dredge material in the channel. In the June meeting, it became clear to me at least that the material in the channel itself is largely sand, and I wasn't convinced that there was a tremendous contaminant load to be concerned about mobilization from the channel. But, one thing I want to say for the record is that we were charged to constrain what we consider. That's not to say that there aren't things that you might want to be concerned about with regard to contaminants. The prime example is right out the window - the Willamette River, which is not on the table at this point. But I would feel remiss if I didn't mention that as a point of concern. Although that's not a direct issue in the project we're talking about now, it is an issue relative to the ultimate intent of the project.

The second thing I want to comment on is what Jeremy [*Buck*] just mentioned. We're used to focusing on sediment-derived contaminants moving up through the food web, and Jeremy proposed that it may be a different pathway. Tracy [*Collier*] provided additional information that there are more toxics in the salmon than we would like to see. We don't know if it can be explained by contamination of hatchery diet, which we know occurs, or

if they are continuing to develop a burden in the estuary. We don't know that….

Collier: [Clarifies]. We know there's some contribution from the hatcheries. We know there's some contribution from the estuary. We don't have an idea how much variability there is around these parameters, and we don't have a handle on what's coming from upstream. We know these sources are contributing, and we know that we're close to, if not at, an area of concern.

Curtis: There were some contaminants in the stomach contents. Then the levels in the smolts leaving the hatcheries was really close to the levels of smolts you collected on Sand Island. What we don't know is if there's any growth dilution. And we really don't know how much they're feeding. Basically, we don't know the pathway. But again to get back to the immediate thing of the project, I don't think dredging in the channel is a direct contributor. It's difficult for me to see. That isn't to say that there aren't other sources of contamination out there. I don't know what contaminants look like in the other ports or in off-channel habitats. That channel bedload is moving so heavily… That was news to me. I never really considered that type of bedload movement until I saw the data. It's amazing. But the whole bottom's not moving like that.

Buck: I guess what I also got out of that meeting was that there is a bit of uncertainty in the channel aspect that could be addressed relatively easily by monitoring and assure more confidence in that analysis of the channel. The other thing I want to emphasize.. Again, just taking a look at the ship wake. Since talking to our geomorphologist in our office… A project-related condition could be ships going through the ETM and causing re-distribution. [Needs to be looked at].

Courtney: We are going to have a brief discussion about ship wakes later in this workshop.

Boesch: I think there's a real danger we're falling into with respect to contaminants and their relationship to sediments. In the June meeting, there was an awful lot of effort spent on understanding the contaminant levels and the risks posed using an approach that was inappropriate because it had to do with the risks of depositing contaminated sediment from one site to another. What we're talking about here is a flux of fine material. Flux is dominated, not by bedload, but by suspended load. If, indeed, fish are picking up contaminants in the lower Columbia River estuary as the evidence indicates, that's got to be the source. So we have to understand whether it's disturbance of the ETM or a disturbance of the bed by dredging. All we're doing in that case is re-mobilizing the material, which is fluxing through the system. That is the vector for a lot of the contaminant transport to the estuary. It's not alien material; it's material coming through the system. So in terms of the basic questions of where is this stuff coming from and how does it get there, there are a whole series of questions. But from the perspective of this particular project, the fundamental question is whether the dredging activity will increase the mobilization of that material compared to the absence of dredging. That has to be put into a context of a rather large concentration and flux of sediments to the system. If you focus on that question, then I think you come to the conclusion that it's relatively trivial,

and that you can't put all of the concerns about the fact that there is contamination on dredging because this is material that is naturally contaminated upriver somewhere.

Perry: [Just wants to mention that all of the ports were tested for the FEIS. Any re-testing will be done separately of this project].

Goldman: Just a sidebar… The type of dredging that's done makes a huge difference in the suspension. Suction dredging, for example, can be quite clean and that probably ought to be required where you have contaminated sediments in the ports.

Courtney: [Returns to issue on dissolved oxygen]. My understanding is that there has been an effort to collect more information on that. Is that correct?

Marsh: I can answer that. Yes, there has been an effort. There are times when there is super saturation in the river, and there are times when it is below state standards. We haven't reached any conclusions yet, but it's not clear exactly whether it's a natural condition.... different things that are happening in the river caused by the dams, pollution... that are causing the changes in dissolved oxygen.

Courtney: [No conclusions then, but it will be dealt with.]

Goldman: For years, biologists were under the impression that the bigger the fish you grow, the better the survival when you release them. However, it's actually quite the opposite. If you release them smaller and younger, they survive better. I guess when you raise them on trout chow, when you release them into nature, they go looking for trout chow and there's none around. It takes the adults longer to transition into feeding properly. So that might be another reason to look into the actual operation of the hatchery as it's affecting the run and consider releasing a smaller size. For one thing, if they're picking up heavy metals from the food, they may have a smaller body burden, which will then dilute out faster with growth that they'll make faster because they transition more quickly into natural feed when they're smaller.

Larson: Oregon's been looking at that, not only for size, but timing of release.... It depends on species and actually hatcheries. It's being looked at again under ESA issues.

Courtney: Organics, biomagnification, identifying other risks that could affect salmon -- these will all be dealt with in the BA. Maybe we should spend just a minute talking about dredge disposal. David *Jay* pointed out in his presentation that the estuary might be losing sediments. This led to an "aha" moment when we were later reviewing things with the project managers. We realized that with this concern there was a potential for taking an adaptive management approach. Maybe there is some opportunity for in-water disposal which will lead to the ability to manage the loss of material in different areas. Maybe I could just ask the Corps, where do you stand on these sorts of ideas?

Hicks: Basically, through dredge disposal, we're looking at hopper dredging, _____ dredging. Upland disposal, beach nourishment, a mix of ocean disposal. In the event

available information becomes present, and more material needs to stay in the river system, we have the flexibility to adapt between dredging practices and disposal options.

Eriksen: There's been a number of questions about the sediment discharge to the ocean. It's a regional issue, primarily focused along the southwest coast of Washington... Within the river, our surveys keep good track of sediment changes in the river from river mile 3 on up stream. So we can identify if there is a bathymetric change with the current in long-term trends... That disruption of the sediment budget would start to show... We haven't yet identified any of those in the river. In the ocean, we do know there's a long-term trend of degradation in some areas in the ... channel and off shore. What we don't know is the flux of material in and out of the entrance... Pressing question on a regional basis... This project... dredging six miles from that location.... Impacts from the project... pretty small. Large in-flow of material on the north side of the channel down by river miles 5 and 6. There are changes that happen in the river all the time. To begin to identify a deficit of material. it's going to take a lot more work....

Boesch: [What might be the long-term effects on salmon habitat?]

Eriksen: That's largely true. From the mouth of the estuary to river mile 25(?), we don't pick up the shallow areas.... [Inaudible].

Boesch: If we have a significant reduction in sand supply into the estuary because of the dam, and we have routine removal by new dredging... some volume of sand out of the system. Is there a basis of concern that this system is could potentially be a risk to the salmon stock.

Eriksen: Potentially. [General laughter that everything is a potential risk]. There's no reason to believe or suspect that it would become sand-starved to the degree that the trends would reverse themselves and those areas switch from depositional to erosional. They trap a small percentage of the washload coming down, as well. So you would have to see a major change in sand supply... to see those go in the other direction away from depositional to erosional. We don't have any information to verify either direction on that.... There's sand all the way from Bonneville Dam to the mouth. What we take out is a relatively small volume of sand.

Jay: I was seconding Karl's idea that we need to know what's going *out* of the system... [Some research in the sixties] indicated a rate of deposition that he [the researcher] thought was artificially high, taking into account sea-level rise, etc. He did not think that this had been happening since the Ice Age otherwise the estuary would have disappeared. Since that time, a major decrease in salmon supply... we really have no adequate basis... [need to keep track of what's coming in and how much is being taken out.]

Boesch: [So this might be addressed by monitoring and adaptive management. A long-term goal for managing this estuary.]

Malek: [There is in this region a regional program, part of whose charge is to look at

disposal and management of dredge material, sediment, and effects on aquatic habitat. Begin working on an ecosystem restoration plan. This is a matter that will be looked at closely by EPA.]

Courtney: Last remaining issues essentially come down to a commitment by the Corps and the writers of the BA to provide more information on materials on channel slopes, pre-dredge samples, off-channel areas to resolve the issues about dredge disposal estimates. But the remaining issues that have been raised repeatedly in the course of the workshops have yet to be resolved. And that's to do with the issues of monitoring and adaptive management. There's been extensive discussion outside the panel process on the issues, and we will address them tomorrow. I'd like to look at the final three substantive outstanding issues -- timing of dredging, ship wakes, and crab larvae.

Young: This is in the context of how the USFWS deals with dredging timing. Usually we respect ODFW' and their in-water work periods that are developed for specific waters and specific fish stocks of interest. Generally anadromous stocks. In the context of this project, ODFW in-water work periods go from November 1 through February 28. We (USFWS) don't necessarily agree to a work window; we usually look site specifically at what the species' needs are, timing of activity, and type of effects. These are guidance documents the state puts out; they're not necessarily linked to a consultation document. So, if in the context of this project, a proposed action is brought to the Fish and Wildlife Service that's outside one of these work windows, we're going to be asking for a justification on how that project is going to minimizing the type of effects that work window is .... So, in the context of dredging, for example. If a work window is proposed for November 1 through February 28, and the main issue of concern would be entrainment, if the type of dredging does not entrain fish -- it's pipeline instead of clamshell -- then we would have more ability to grant that waiver... So if anybody has a specific question, maybe Cathy [*Tortorici*] or I can try to address it. Let me add that the proposed action, through the consultation process, will be brought to us and we will be reviewing the timing of that action and the type of direct effect that action would have on the listed critters. In-water work periods are generally established to minimize effects on a particular species. So we would be looking very carefully at what species might be there and where in regard to the project. And work is under way as far as that negotiation discussion analysis.

Huhtala: [An evaluation as far as pipeline dredging to an upland site through the shallow-water area...]

Hermans: [**Brief presentation on effects of ship wakes**].

Larson: Did you take a look at how hull shape, or direction of ship against or with the current, affected any of this.

Hermans: No, not for this.

Goldman: If you held the vessel the same size, you increase its depth say by loading it

more, so you're displacing more water, decreasing the suction, what's going to be the amplitude effect on the wave height? The implication was it wouldn't have any increase. That's what I was concerned about -- wave height.

Hermans: I think that's correct in the sense that you deepen the channel and load the vessel as you describe, both with three feet, so in theory you increase the cross section of the vessel, percentage-wise, a little bit more than you increase the cross-section of the channel.... So therefore, theoretically, there's a [small -- one percent] potential for... increase in suction.

Curtis: What's the relationship between a one percent increase in suction on magnitude of wave height. The relationship between suction and how big a wave you get? Is it a direct relationship? If you get a one percent increase in suction, is the wave one percent bigger? Or is it 50 percent bigger?

Hermans: No it's not a direct relation. I can't say right now, off the top of my head, what the relationship is. There are formulas...

Curtis: That would be a good one to look at. My second question is, I remember reading about the Panamax vessels in the material the Corps provided. Is this analysis for a Panamax vessel? Or is there a different hull design or shape that would be different from the kinds of ships and hull shapes that are coming into the river now than it would be if the channel were deepened? Just related to waves.

Hermans: I don't know.

Eriksen: The expectation is that there are Panamax ships that call on the river now that have the draft potential... that are now loading to 39 or 40 feet because of the channel ... And essentially it would be that same class of ship, in many cases the same ships, coming in that would.... channel right away. Over time, it would be that class of ship, which we expect to be around for quite some time because of the efficiency...., that would take the most advantage of a deeper channel. There wouldn't be any change in the design in ship design or hull shapes because of the deepened channel.

Curtis: So the question really becomes simpler, at least for the immediate term, all you need to do is the conversion of this suction number to amplitude of wave, and you'd have the answer. As long as you're not changing the kinds of ships... So it would be relatively simple to finish the equation.

Eriksen: [Also, heavily loaded ships will travel more slowly. Offsetting factor...]

Courtney: [So we need more information on wave height, and we don't have assurance on the types of ships that might be coming up the channel. Just flagging this for the BA.]

Huhtala: Another variable to consider.... With a deeper channel, do we expect to see more or fewer ships? Did the Corps address this already in the EIS?

Eriksen: [Expectation is for larger, but fewer ships. It was in the EIS.]

Buck: You stated that mass of the vessel has no relation to the height of the wave. Is there currently a speed limit for ships on the river, and is that speed limit obeyed?

Hermans: I don't thinks there's a regulatory speed limit... There's a range of speeds to operate the vessel safely.

Edmondson: As I understand it, the greatest concern is speed of vessel. On Puget Island, we're very much aware of ship wakes. [Basically says river pilots have incentives to travel quickly up the channel]

Hermans: [Feels that range within which pilots operate is controllability of the vessel, not unsafe incentives. Personal opinion is that they would not recklessly exceed the speed limit.]

Courtney: [Attempts to bring discussion back around to effects of ship wakes on fish.]

Young: I'll try to provide the linkage. If speed creates greater wakes, if wakes create greater habitat change. And if wakes and suction can change the availability of contaminants in the system, all of these are concerns under the ESA. Under the withdrawn BO, I understand that there was a proposal that the Corps would work the Coast Guard which sets the speed limits. Under ESA, the actual regulatory connection would be the entity that sets those speed limits. But a conservation measure could be proposed, and was, that there would be set speeds. That we could reduce speeds as a cooperative venture as part of this project. There may be some benefits -- this would be above and beyond the responsibilities under Section 7(a)2 of jeopardy, this would be more of a conservation measure. But I guess I would propose that this might be something that should be put in the final proposed action by the Corps.

Boesch: Doug, you have to support that with some evidence that ship wakes are deleterious to the survival of juvenile salmonids.

Young: Yes, if we were skillful in our negotiations of analyzing that in the BA.

Courtney: We've looked at several interactions that might lead to effects on fish or ETM. I've yet to see it all put together. I've yet to see the physical effects translated to the biological.

Tortorici: We're in the process of working right now with all the agencies, the ports, and Parametrix to do just that. In terms of using the conceptual model and translating that into potential physical and biological impacts.

Goldman: One thing engineers are really good at is devising tables. What we need is a table of tonnage times speed equals wave height. And then you could adjust the

regulations on the basis of that factor. [There must be an optimal speed given our understanding of the channel depth and ship size, speed, and hull shape.]

Courtney: [Suggests we move on since the issue cannot be resolved until we have more information.]

Larson: [**Brief presentation on how fish are affected by stranding**..]

Beasley: Have you looked at stranding in these pools due to tidal action as a result of backwater filling....

Larson: The research has only looked at stranding beaches. Backwater areas, where the water goes down for one reason or another -- because of flow regulation or just natural water surface elevation changes, there will be stranding as far as water left standing.

Courtney: [Move on to the last topic -- loss of crab larvae as fish food.]

Marsh: [**Brief presentation on crab larvae**.]

Boesch: So the idea is that the disposal of dredge material would reduce the success of the megalops for finding suitable habitat, and that would affect the prey...

Marsh: It would affect adult crabs, and therefore, the population size of the crabs and their spawning...

Jay: What about the estuary as habitat for crab larvae? [Something about area between north and south channel where a lot of crabbing is done]

Larson: NMFS and Corps have done studies. Distribution of crabs in the estuary is high in Baker Bay because it's a fairly salty bay. Some crabs are found in the north channel. Mostly past mile 3 or so, the abundance is not that great as far as juvenile crabs are concerned....

Jay: [Doesn't feel his question was completely answered.]

Marsh: Parametrix will continue to analyze information on whether dredging has an effect on this particular food source for salmonids.

Courtney: This SEI process is not even going to attempt to understand all the potential issues associated with dredge disposal in the ocean. When you say, you're looking at it from the BA, you're talking about what effect does dredging have in the estuary on anything which could potentially have effects on fish. You're not talking about dredge disposal...

Marsh: We had to look at direct and indirect effects, and disposal is an indirect effect...

Donohugh: [Inaudible, but asks for clarification]

Marsh: [Reiterates that Parametrix is not looking at all the potential impacts on crabs; looking solely at effects of project on crabs as a food source for salmonids].

Beasley: [Salinity has a large part in crab distribution in the estuary. Accounted for large number of crabs in the river this year, as opposed to the ocean. So some of this dredging could be arranged around biological windows related to salinity intrusion. Concern about loss of salinity and increasing sedimentation in lower estuary over the last several decades in terms of its effects on primary productivity in lower estuary. He thinks this may be one of the long-term surprises of the project's effects. Urges the parties to look closely at the issue.]

Courtney: [Group is aware of the need for long-term monitoring, and the need to have processes in place to address risk and uncertainty].

Overview of the Reconsultation Process
Doug *Young*, USFWS

Jay: Under the last category, would that also include effects of, say, change in flow management by Bonneville Dam?

Young: It's baseline.

Jay: ...Change in the future?

Young: Right now, because we have a Biological Opinion on the operation of federal hydropower, they're under consultation, their operations would be part of baseline. Because they've already done consultation, when they would change their projects, they would update the baseline and consult on that. If that new information would affect this project in the future, then we would re-initiate on this project. I'm not sure I'm getting quite to your longer term view here. Can you give me more specifics about what your concern is here?

Jay: [Largely inaudible] .... is strongly dependent on river flow as well as channel _____. We're concerned with presumably changes in salinity _____. So the channel... that modifies those things. It's probably more river flow. So how do changes in river flow_____. How does does that play back into your process?

Young: I guess I would stay with my original answer that because there's a federal nexus to those changes in river flow, there's a separate consultation that if it has effects moving into the estuary that's where the federal regulators would work with those changes in flow. Our modeling efforts were done over what was anticipated to be a range of flows ... for the project's effects would help us define out suite of effects. I'm still not sure I've addressed your concern.

Tortorici: In terms of flows coming from Bonneville Dam, at this point in terms of defining baseline for this project, reviewing existing flows from Bonneville and working with that in the context of this consultation, Ed [*Casillas*] and I were just talking. I can't remember the extent to which, if at all, the hydropower BO calls for changes in flows that are going to result in significant changes in flows below Bonneville Dam. But if that was to be the case, and it causes a significant change to something in the estuary, then maybe we'd have an opportunity to look at that. But it's the meshing between what's going on upstream for the hydropower BO and this BO that our agency in particular is going to have to pay attention to. And for both of those BOs, there's the opportunity to re-initiate consultations if significant changes appear to be happening. So I think the answer that Doug [*Young*] provides is essentially correct.

Jay: It seems to be cumbersome as a process to have re-initiate a consultation every time somebody wants to change _____ It seems like it would be more sensible. To adopt adaptive management.

Young: I guess I'm anticipating the ability to develop adaptive management components to this proposed action that would hopefully instead of triggering a re-initiation.... Re-initiation occurs when there's a change in the proposed action or there's a change in the effects of the action that we didn't look at before. If we looked at a wide enough change of flows in our modeling, I would hope that we'd done a good sweep for the interim, short-term, long-term... That re-initiation would be triggered but that adaptive management would keep us continually looking at things and changing things as necessary.

Jay: That's the answer I was looking for.

Whitney: Mitigation is discussed throughout the questionnaire. Could you define conservation regarding 781 as it relates to mitigation?

Young: If a portion of the proposed action has, for instance, no measurable effect and no uncertainty around it, most likely -- and I'm not prejudging it -- the regulatory agencies would not try to require a change in that in the BO. If there was no measurable effect from the numerical modeling or the conceptual model or other effects analyses, but we have a level of uncertainty, especially to the longer term aspects of it, what logically flows is a monitoring or investigative component to that and a possible conservation measure.

And here's where I want to differentiate, in my mind, between a mitigation and a conservation measure. Our effects analysis is saying no measurable effect, but we have some uncertainty. So we can't necessarily link a change to the project to that effect. It becomes a conservation measure. We try to look at baseline and say these are the types of features in the baseline, in the function, that are broken. This where we would want to try to negotiate under 781 something beneficial. If we've got a measurable effect -- for instance, Cathlamet Bay -- from the physical model says there's a hot spot someowhere,

we see changes in salinity, changes in velocity. We feed this into a measurable effect, we determine whether there's a level of risk and uncertainty around that based on the ESU or critter that's in there, the timing of that use and the timing of this activity, and you would end up with trying to modify that action, monitor and investigate it, or a specific mitigation for that effect that would offset to minimize it. So there's the kind of fine line, but fairly major difference, between a conservation measure... This would be something that we try to negotiate.... would be composed specifically in the BA. This is something that we've got a measurable effect and we've got an opportunity to try to offset that. I'm calling that a mitigation. This is how you're going to see the consultation documents flow out of this process.

Courtney: I just want to say a word about the questionnaire submitted to the panel. That is an SEI document and we take full responsibility for it and for any errors in terminology.

I want to bring you up to speed since our last session with the panel. We had originally intended that the July workshop would be focused on monitoring. In essence, we cancelled that workshop because the group was not ready to develop a monitoring program. Since then, some of that work has gone forward and is presented at this workshop. We did, however, have a working session with three of the panelists in lieu of the July workshop to kick around ideas of monitoring and adaptive management. I've asked Steve *Bartell* to make a presentation on how monitoring and adaptive management are framed.

Framework for Monitoring and Adaptive Management
Steve *Bartell,* Cadmus Group

[No questions.]

Monitoring and Adaptive Management in the Context of Risk and Uncertainty
Cathy *Tortorici,* NMFS

Courtney: Before we take any questions, I just want to point out that we first started talking about adaptive management when Anne Fairbrother of Parametrix gave a presentation on the subject which is now on the web site. It's a useful background document, which you guys should incorporate into your discussions.

I'd like to press the panel to say what are the areas you anticipate seeing as part of the monitoring program. The questionnaire explicitly addresses some of these issues, and the audience will also have an opportunity to ask the panel questions about the questionnaire.

One of the major issues that was raised early on in the process was the list of issues that NMFS prepared relative to monitoring. Would the panel like to comment on that in terms of where you think we are now?

Curtis: One of the outcomes of the process has been -- I hope -- the ability of the agencies with the responsibility for protecting the resource to sharpen their monitoring goals from the list that we saw initially. I hope that the information that's been brought to bear assists with that and that the action agencies and the regulatory agencies are closer to coming to agreement on that. When we entered the process, my hope was that this meeting today would be the meeting where we reviewed the monitoring plan, and we don't seem to be there. That's not surprising, I suppose. It's a little disappointing, but maybe not surprising because this has been a difficult issue that was begun long before this committee was constituted. So to expect us to be reviewing the monitoring plan today, at the end of the process, was a little naive on my part, but that's where I had hoped we would be. I sure think that the agencies -- both the action agencies and the regulatory agencies -- need to be there. In other words, you need your monitoring program and you need it in place.

We should really understand where we were before and after the project. I just really urge before you get too far down the line... It's so easy to put off these difficult things. But I think this project is too high profile... The action agencies and the regulatory agencies both have responsibility here. Go ahead and do the hard part now and get it worked out and roll this whole thing in when you go and try to get this thing funded. I don't see any advantage to anybody other than just, "I'm tired of this, I don't want to go any farther." But just to go ahead and bite the bullet and... I just hope this process has focused you enough so that you can agree what a monitoring program would like. That's where I hoped we'd be today and we're not. The SEI phase is ending, and that's probably fine. But for the agencies, I just think it's essential that you go ahead and... You've done the conceptual piece; you really need to do the real piece. Cathy [*Tortorici*] provided context about what's going on out there now. I totally support that. You want to do your monitoring plan in the context of ongoing activities. But I think you need to get on with it, and get your monitoring plan together.

Goldman: To amplify what Larry has said, I think it would be unconscionable to proceed with the project without having a monitoring program in place. I see it as absolutely essential for the protection of the Corps. If the salmon run is going to decline, and there's a lot of prospects that it will decline from just the existence of the dams -- we've lost so much spawning area upstream -- that the Corps is very likely to get the blame for further decline in the salmon runs if they don't have the scientific basis to show that the clean dredging of the main channel is not responsible.

It took me about seven years of monitoring to establish that Tahoe is losing transparency of about a foot per year, and that the primary production, or eutrophication of the system, was essentially increasing at about 5.5% per year. I like to think that well-organized monitoring is good research. We get support for it in competition with everyone else that's seeking competitive funding because it is good research. You can do the kinds of analysis that are going to be more and more important in this changing global ecosystem with long-term, carefully planned monitoring. I think we have to recognize that monitoring, as such, got off to a bad start in the 60s, 70s, and into the 80s in some cases. And it was largely because of inability to handle data properly. I certainly would urge

that data management and coordination of the monitoring program... bringing in all of the different actors that really are involved. There are a lot of people collecting data on the Columbia River. Pulling those people together can certainly develop an economy of scale of the sort that Don [*Boesch*] can talk about along the Pacific Coast further to the south.

So to conclude, I think it would be irresponsible to move ahead with a project of this importance and with this magnitude without having the protection of a careful monitoring program in place. I think it can be tuned up appreciably in a fairly short time -- just a few more meetings. You don't want to collect a lot of irrelevant data. That's another aspect of monitoring that really needs up front attention. It's no good to collect data if somebody isn't carefully analyzing it as it comes in. So with that, all I can say is that I hope the next time I hear about this project that we have a good monitoring program in place that is agreed between the lead agencies -- who's going to do what, who's going to fund what, how you're going to manage the data, and how you're going to report on the data, and that you're going to have some intelligent people looking at the data as they come in so that adaptive management will actually work as laid out by our two previous speakers.

Courtney: [Inaudible, but asking project managers for some time frames for developing a monitoring plan]

Young: We're in the process of trying to use the numerical modeling information to help the review team come to some conclusions based on our knowledge of existing information characterizing risk and uncertainty and decide whether a monitoring effort for those specific aspects is necessary. We're within two or three weeks of coming to some of those finer decision points. If I can step back for a second... We've been carefully going through a process that provides a documentable, logical flow based on the fact that this is a re-initiated consultation, based on potential litigation, based on the concerns that all the parties have expressed about this process. So we are not moving into some of these point as rapidly as this SEI process has moved along. So my apologies because there's nothing more I like to hear than have you guys [Science Panel] pick holes in what I do, so.... Anyhow, personally, I would hope that there would be an opportunity to include an additional level of discussion as we develop that next part. But I hope that we will be to a point where we can have specific discussions and put together the pieces within those frameworks that were presented today. The effects analysis needs to be done through this scientific process first. And then we would need time to develop the monitoring program on top of that. So I would say we would probably have pieces of this in a month and a half.

Boesch: I think Charles [*Goldman*] made some very good points. I would put one different perspective on this. I don't think this is about protecting the Corps' interest; this is about doing what is right for the American public in terms of making very difficult decisions in the face of uncertainty, about resources that are imperiled and at serious risk of extinction. So we have a responsibility to make sure that if this project moves forward there are systematic observations called monitoring, which can assure us that we're not having an effect that we don't anticipate having.

I was pleased to see in Cathy's presentation some of the things that came out in the July meeting because I think there were some important points about a framework to identify which of the things are really important to monitor with respect to the project. I think the other very important point that I want to speak to just briefly here is the need to put in place a targeted monitoring program that answers specific questions about dredging activities and the channel deepening in the context of a much broader array of information. It's really necessary to do both -- to answer specific questions in an adaptive management framework, as well as contribute to and take advantage of the broader array of environmental monitoring that's generated from research and modeling efforts.

The reference Charles [*Goldman*] made to southern California was the result of a discussion we had this morning in which we, through a National Academy study completed about 12 years ago, looked at the issue of monitoring off the coast of southern California where there was a lot of investment generally from waste dischargers and power plants, and so on about the specific effects of their activities. Yet, they couldn't answer the question of what was the overall state of health of the southern California bight. So the Academy study, which I participated in, said there ought to be some way you can take this tremendous amount of resources that are being invested and re-program them to address these broader questions. Now, it's taken about 10 years for that to happen, but it is happening.

Unfortunately, you don't have a lot of in-place investments and long-term monitoring programs to adapt in that way, but nonetheless, Cathy again pointed out that there are a number of ongoing studies. So I think the objective is sort of a dilemma. You want to be targeted to a specific set of questions related to the channel deepening, but you also want to put that in the context of a broader ecosystem context. I might add that it's not just about the lower Columbia estuary. It seems to me there's another important element of integration that needs to be considered since the focus here is the salmonids. And that's what's happening throughout the whole range of environments -- from the spawning areas upstream, the issues related to the dams, the survival in the estuary, and the ocean experience, and fisheries management issues -- there needs to be some level of integration across those environments on these resources.

I also feel the same frustration that others have expressed. When we [the panel] came into this it was because the forces were at loggerheads about this Biological Opinion. My reading of this was that a large dimension of that disagreement had to do with a common understanding of what was going to be required for monitoring and further studies. And I guess we're still there. We have a framework, we've had a lot of discussion, we've got a better understanding of what we think the risks may be -- a sharper articulation of those concerns. But I guess the parties, if I can characterize it, know they need to dance, but they still don't quite know where they can put their hands. I would urge you to figure that out pretty soon with respect to the model that in the parameters have been laid out here.

One other comment. When Steve [*Courtney*] talked about the questionnaire, there are two points I want to make. In the July meeting, we had a discussion about how long the monitoring program should be. My answer was five years, and we were asked to

articulate that at the meeting. It's not that I didn't think that there were longer term questions that needed to be addressed, but that five years seemed to be a reasonable framework for a plan of action that you could logically develop and execute and toward the end of that period, re-evaluate with respect to which of the issues you were monitoring in that initial plan you needed to continue or discontinue, or which new issues needed to be addressed. So it was in that context that I felt five years might be a reasonable first-installment interval and then a re-assessment of what, if anything, was going to be necessary and where should it go.

The second point concerns the dichotomy between the physical and biological consequences. They're interrelated. You can't divide them. So it's clear, even though I think we've got a better base for predicting, what kind of changes, for example, with salinity changes that were discussed here with respect to the models. Those are really only important... we're interested in them in terms of what they mean biologically. So if you're going to understand the changing effects with respect to salmon, you're going to have to measure physical properties. It just doesn't mean.... You shouldn't interpret this that whatever monitoring is going to be required should only be biological because obviously you need the physics to understand it. This is an area where the modeling and the monitoring need to be closely interactive. We've some two sets of models here that are very impressive. But models tell the truth based on the assumptions that we bring to the model. It will only get better as we are able to bring in not only new observations, but new understandings as well. So I had a discussion with David [*Jay*] over the break about the challenging issue of stratification, understanding that salinity stratification in a tidally dynamic, but strongly stratified system, as the Columbia -- which is very important in terms of making those predictions that Antonio [*Baptista*] talked about. So we ought to be looking at designing a monitoring program that is highly integrated with the modeling effort that we've seen and that will be ongoing. A classic mistake is the separation of those two into different camps of different technical experts. It's a bad, bad mistake.

Bartell: I've already weighed in, but there are a few points I'd like to expand upon. In the context of monitoring and adaptive management, what's wrong with this picture [pointing to the map of the lower Columbia River and estuary]? We're not showing anything about historical and ongoing and future changes in land use as it might impact water quality and quantity. Without defining the appropriate environmental or ecological scale in setting up your adaptive management program -- and this is a real challenge because it spans the authorities of the involved agencies. It shows some of the institutional barriers that Walters talks about as well in trying to make these programs effective. It may be that in relationship to influencing shallow-water habitat, food availability, toxic chemicals, that things going on in the greater watershed are a stronger signal... greater contributions to inter-annual changes in the abundance and distribution of those fishes for a differential source of mortality to the various salmonids of concern that you may in fact... there is a certain danger that you could develop the most effective, accurate, precise, comprehensive monitoring program and the conceptual model and framework for what's happening between the river banks and not stand a chance in the world of seeing any impact with regard to the proposed project. If the signal, if you will, from the surrounding changes in the watershed over the next decade is really swamping

out what's happening to salmon, or potentially happening to salmon, as a result of the proposed dredging. So again, just a caveat. If you're going to effectively address adaptive environmental management in the context of protecting salmonids, perhaps there's a larger picture that somehow you have to explore the opportunity to see to what extent that can be characterized.

Audience Questions

Bartell: If you're going to develop a monitoring framework, I would do it in the context of an operational model, rather than just a conceptual model. If nothing else, it certainly allows you to do some screening-level assessments of potential impacts of changes in salinity, temperature, water depth, toxic chemicals, and looking at the relative contributions of the production dynamics, or decreased biomass, of the salmonids….

Mishaga: It's an interesting point you make in terms of the decision-making process and how one uses the conceptual model to come to a systematic, logical, progression of dealing with effects and deciding what would be appropriate to monitor because of uncertainty and risk. One of the things that we're dealing with, with the conceptual model is working through --- we have essentially 37-38 indicators. The team has determined they're appropriate to be looking at in a systematic way to come up with understanding uncertainties and what potential effects we have in a historical concept - historical conditions with present conditions… One of the issues I think in the way we have been using the conceptual model in the decision-making process is to determine where are the uncertainties and where there may be potential effects. And those are the areas we're going to be focusing in on. I see that as different from what you're saying in the sense that you're looking at everything in the system, and then looking at the uncertainties. We're trying to use the conceptual model systematically to work through in a qualitative way to try to determine where we should be focusing our efforts.

Bartell: I guess what I'm trying to advocate here is the quantitative analog to your process…. What I think this approach does allow is to expand upon a qualitative evaluation of the uncertainties. I don't know about you, but for me, once I start to consider maybe three or four or more boxes simultaneously, it becomes intractable. Once I can put it into a quantitative framework, it allows me to explore the implications of the information I have at my disposal in relationship to… risk….

Courtney: [Wants to know if panelists will be willing to look at any monitoring plan the parties develop. *Curtis* in particular said he would be willing to review it.]

LUNCH

Whitney: In addition to the paper that Steve has, I found a paper by Holling that addresses adaptive management surprise for science resilience for ecosystems and … people. Holling talks about two streams of science, and the risks associated with each. The first stream is the one that we associate with error and measurement and healthy biological variation. The second stream of science has to do with the world view --- the reason that

you're doing these things… How are we going to mesh all these different processes together and the uncertainty associated with that second stream of science. Both of those streams of science are important. Having made that point, I'd like to say that I came up with an adaptive management process that was inspired by Anne Fairbrother's talk on adaptive management that showed this as a cycle process. Steve, I saw the things you have laid out in your presentation - the idea of the cycle - how the evaluation and re-evaluation and how decision-making ties into that to me is a real important way to look at it. In comparing your talk with Cathy's and my own ideas, I believe there's a missing piece. And that is the hypothesis - a hypothesis for your management questions and for your monitoring. I think it's important to set those hypotheses because then your success criteria can be related to those hypotheses. I think you should address both hypotheses in the sense of Holling - in the first and second stream science. With that said, I'd like to address something Cathy said about the institutional aspect of this process. I'm associating that institutional aspect with the second stream science. I think we need to have hypotheses that are associated with that second stream science. And so we need to have hypotheses for the institutional framework because there's the perception of institutional inflexibility. So inflexibility is that if you find something in the first stream of science, are you really going to be able to change anything in the second stream? So I think that we need to look for a hypothesis on how to address that perceived inflexibility of the institutional framework.

Courtney: [Project managers are discussing this issue of institutional flexibility, of setting a flexible structure.]

Bartell: I agree with much of what you said. There's been a push to bring hypothesis testing and sort of the formal inferential statistics from basic research and development into the assessment arena I guess with the idea that somehow that would confer greater technical defensibility to environmental assessment. That may or may not be the case. There are certainly alternatives to expressing problems mathematically and formally other than with hypothesis testing. Some say that it's not always useful or not. When I think about hypothesis testing, the idea is to get a reject or fail-to-reject hypothesis, use that information in an inferential way to design the next experiment or to determine what the next field measure… I'm not sure I see how that approach would be useful in terms of the institutional aspects…. Maybe you could provide an example of how might frame an institutional question in relation to the project as an hypothesis.

Whitney: I think it's very important to explicitly discuss the institutional framework…

Bartell: I agree with that.

Whitney: Then the hypothesis could be "if this, then that". That's a fuzzy, right? I know so little about government. There's money out there for hurricanes. When certain criteria are met, monies are released to take certain actions to address those. But unless you have that institution set up ahead of time, you're going to be unable to react to the data and the hypothesis testing… would be done for the first stream.

Boesch: Let me take a swing at this. I guess with respect to the second stream, you could direct a null hypothesis that management systems are inflexible and test it. In reality though, now that we've gotten more adept at applying adaptive management in a variety of circumstances, in addition to the Walters review paper, there's other literature that talks about 'hard adaptive management' and 'weak adaptive management'. It may different in specific rules and criteria in which you want to apply a more rigid framework for adaptive management that would have numerous check-backs and actions based on the decisions, on a tighter cycle…

So you get all this data, what kinds of decisions are you prepared to take? What are your options? And wouldn't it be useful in designing this [an adaptive management program], you could lay those out to the degree possible before the fact, rather than after the fact. And so I think one of the challenges the team has to make in this adaptive management framework is to try to articulate those kinds of options, this 'decision-tree matrix', in which this monitoring would be designed to inform.

Whitney: There's a concept in law -- 'latches' -- if you have a latch on the gate and nobody complains about it, then it's your land. There's a certain momentum in the institutional process here. I guess I still have a concern that without an explicit statement of the hypotheses of the institutional framework that there will be a certain amount of momentum with this channel deepening that's so focused that that momentum if not challenged at the latch is going to carry over into other aspects of management in the Columbia Basin.

With our model, we're talking about one ecosystem function and that's salmon survivorship. To make sure that some of the logic that I've read in the questions from the panel about 'we haven't heard much about wetlands from NMFS, so wetlands can be an issue. But that's not their institutional charge. They're a function of the state and the Corps. But just because NMFS hasn't talked about it, where it's that relationship between these processes that are going on, does it mean that if we come up with failure to find impact that that doesn't mean that you get to latch that and all aspects of dredging in the Columbia Basin... institutionally have no impact because that's what that agency said.

To me, we've got to be careful in that type of thinking coming from the panel from an institutional, integrated perspective.

Mishaga: I'm not really sure where we're going with this. The reality of the fact is that we have a conceptual plan and we've got a project... this is what we're required to deal with under the ESA. We've set up a process where we've identified pathways and indicators that apply to this particular project. We've examined each one of those pathways and indicators... potential for a measurable effect and there's uncertainty. This is the way we're looking at monitoring programs.... in any good monitoring program there is a contingency plan. A contingency plan is essentially... a hypothesis, which says that if the monitoring doesn't go as you planned you to need to be able to react to that, which is essentially what are you going to do... So you're identifying what would happen if your null hypothesis is... violated. Is this what we're talking about here, or are we

talking about some global philosophy of the regional ecosystems in the Northwest?

Whitney: Rick, I was pretty complementary of your plan, but there is an institutional aspect of it. I give you the on-line citation of Andrew Gray in *Conservation Ecology 2000* in "Adaptive Ecosystem Management in the Pacific Northwest." He talks about barriers to adaptive management, why it won't work. One that he identifies is 'perceived lack of management flexibility.' I think it's a real issue. The extent to which we can address that head on, I think it will be a better process.

Boesch: I think that's what Rick is trying to articulate in terms of these contingencies that, if by monitoring you find something that goes beyond the predictions, that merits some changed action. So, for example, if monitoring were to show that dredging had turned up high contaminant levels in the sediments then you've got an action you might want to take in terms of alternatives for disposal and that sort of thing.

The other thing -- from two almost contradictory perspectives -- on the one hand because we've cast this net (no pun intended about salmon) in a very broad way, looking at a range of environmental conditions that could affect their success, without even strong evidence of cause-effect relationships. We've looked at hydrology in the system, changes in currents, salinity, looked at toxic substances, there's concern about the habitat -- shallow water and wetland -- all those things that could affect salmon. By focusing on salmon, even though it doesn't necessarily cover all potential environmental consequences, it tends to integrate the variety of issues and effects that could affect the broader ecosystem.

Having said that, I would suspect that even though this process is put in place because of ESA and the concerns about salmon, that the Corps is still responsible for an EIS that addresses all of the issues beyond just the salmon issues. So, on one hand we're focused on salmon but the agency is still responsible for a broader assessment. And on the other hand, by focusing on salmon, it really does force you to look at multiple dimensions of this ecosystem.

Perry: It is important to recognize that the SEI process informed the re-consultation process. But for the project to move forward, the project has to come out of NEPA, it has to come out of both states' Clean Water Act... there's a multi-jurisdictional framework of standards that have to be met for a whole array of issues. So when you talk about monitoring, yes, there are institutional considerations. Further, the project is occurring in a basin where there are larger issues going on... I guess what I'm struggling about with your question, Paul [*Whitney*] is, is it that your're concerned that those standards won't be met by the other jurisdictions that are involved, or is it that because this process is focused on endangered species the other objectives won't be met?

Whitney: The bottom line, from Paul King's point of view, is cranes. What is the impact going to be on cranes. If we say the channel deepening is not going to have any impact, it's going to carry over to all aspects of management along the Columbia River. The project is going to dredge all the way from Portland down to Astoria.... There's a latch, a

momentum. If we could have good science brought to bear on salmon, the way it should have the first time, and that could be carried out to the rest of the EIS then I would be very happy. But I don't think that it's going to be. So I think the limitations of this process need to be made very clear -- the limitations of the good science that's been brought to bear. And make it very clear from an institutional point of view what it applies to and what it does not apply to.

Courtney: [Point is well taken. This process does have limitations. This analysis of salmonids shouldn't necessarily carry over to an assumption of no effect on anything else. I think the panel would support me on that.]

Boesch: Maybe not [laughter].

Johnson: This is a process question. This is the last panel meeting. To what degree will the panel be available for follow-up questions?

Curtis: I can only speak for mysleelf. I said earlier that I would be happy, outside the SEI process as an outside consulting-type arrangement, to review -- just as an academic -- the monitoring program. My expertise obviously doesn't pertain to the entire program, but I would be happy to review that just as if it were a grant or manuscript sent to me for scientific review.. I can do that, but to provide extensive interaction with the agencies is beyond what I can promise to do, but I would be glad to follow up with review of written materials because I'm interested. Just as long as I don't get inundated.

Boesch: I, too, can't speak for the others, but I think probably the rest of us feel the same way. We've got an emotional investment in seeing this process become successful that we'd like to see the final product in terms of the monitoring plan. We have broad experience that can contribute to that. If it's something that's an ongoing, systemic issue, then I think you need to talk with Steven [*Bartell*] about how to manage that process.

Johnson: [Concern that her colleagues often make decisions with 'a paucity' of information. Wants to know how widely panel findings will be distributed, etc.]

Courtney: [There are people in agencies whose job it is to interpret science to you. It's their job to tell you what was said here. If that doesn't satisfy you, you can always talk to me. It's part of my responsibility to insulate the panel from being inundated by the press, decision-makers, other stakeholders, etc.]

Boesch: [Sympathizes with difficulty of policy-makers trying to understand the science. Offers to answer any questions that might arise during the legislative or policy-making process.]

Hicks: Just two comments. In Cathy's presentation, she talked about all the different things actions are happening in the system -- federal hydropower buy-out, the LCREP endeavors, etc. We heard earlier the importance of trying to be system-wide and trying to make sure that monitoring efforts dovetail and are complementary to one another. At the

same time, we're trying to be very specific to this proposed action... develop and try to look at change... the project. So I'd just like to say that those projects that Cathy outlined, we have very much the same federal layers in all of those. So there's probably a great opportunity to become more systematic. It might take some time to get there... I want to make sure that people don't have the expectation that in the BO they're going to see a system-wide program that will encompass all of those things.

The second thing I'd like to say before we close is we really appreciate the effort that the panelists have put into this. It's been a long a process, and we'll take you up on your offer to look at what we do have in the way of... for this project in monitoring before we complete the formal consultation.

Boesch: I was about to ask Steve if there are retirement benefits with this... [laughter].

Courtney: [No more questions; thanks all for their hard work in a short time frame and closes the meeting.]