SEI Science Panel
Sediments and Sediment Quality Workshop, June 7-8, 2001

Transcript of Discussions

Note: Much of the discussion is reconstructed from notes, and is therefore not a verbatim transcription.

Karl *Eriksen*, Army Corps
Overview of River Sediments

Boesch: The other slide earlier that you showed compared suspended flow concentrations as a function of flow showed that there's been no change in that relationship.. How do you make that jog with this interpretation which suggests that there's been a six-fold reduction in sediment transport?

Eriksen: Peak of spring freshet has been lowered substantially.

Boesch: Okay.. So you have lower flows.

Eriksen: The spring freshet period, May-June, that's when we slow water. Annual peak reduced from about 600,000 cfs to about 350,000 cfs. Stored later in the year, from October on.

Boesch: So if you go back to the concentration vs. flow, you just have fewer of those basically at high flow.

Eriksen: Right. [Presentation continues].

Dunne: How did you make those projections?

Eriksen: Each bar has its own forecast. A bar is about 3 miles of river. What we did was to start at Portland and work our way down, looking at each of those bars. And we looked at the changes that had happened in the river since 1980.... So the forecast for the whole river is a composite of 28 individual forecasts made for each of those bars.

Dunne: When you're at each of those 3-mile sections, what's the addition and subtraction?

Eriksen: How about if I continue the talk and we'll get to that?

Boesch: Is this based on empirical experience or some sort of a mathematical model?

Eriksen: No, no mathematical model.

Cody: So it's an extrapolation.

Eriksen: Right. [Presentation continues].

Cody: Are those sand peaks always in the same position spatially, or do they move over time?
Eriksen: They move over time. It's hard to get data on them. [Presentation continues].

Bartell: Is that an analysis for the river section you just showed us, or is it for the whole system?

Curtis: What do these look like outside the channel?

Eriksen: They tend to shorten up and the height drops. [Presentation continues].

Cody: What was the year the channel dropped from 37 to 40 feet?

Eriksen: That was 1970.

Dunne: The report were given had a 1990 date. Have you found any other changes or surprises?

Eriksen: No.

Dunne: Kinds of problems that have arisen in recent disposal sites?

Eriksen: Recycling material.

Dunne: What about environmental concerns?

Eriksen: Shoreline sites, filling a strip along the beach. When we do that, we're burying habitat. So there's been concern about the loss of habitat and wetlands. We avoid wetlands. Less of a concern on stranding of fish.

Dunne: [question about dredging deeper]

Eriksen: We'll dredge past the mouth, but at the mouth, it's already deeper..

Goldman: Side effect of tern habitat creation.

Whitney: By disposing of dredge sand, we are creating more habitat for terns. Are we likely to see an increase in salmon predation because of this?

Eriksen: I'm not really the one to answer that.

Casillas: For clarification, we don't know the relationship between turbidity and those impacts. Those uncertainties will remain. It's inappropriate to say that from the changes that we're going to impose on the system in terms of turbidity that that impact will not have any effect on these biological features..

Cody: Is the project one that will dredge continuously or is it related to flood conditions?

Eriksen: We like to do it year round. Lot of cost involved in stopping and starting.

Cody: You use this figure of 30 percent retained in the estuary and 70 percent flushed right through. And that might seem to be an important figure if the effects vary. So I wonder if those figures are substantially fixed?

Eriksen: It's plus or minus.

Cody: Over the long term the estuary must be in equilibrium....

Eriksen: No, the estuary is slowly filling in; it's not in equilibrium.

Curtis: Are there buried sections of sediment in the channel that are qualitatively different from place to place? What is the periodicity for filling and scouring out?

Eriksen: Waves are moving all the time; the rate varies. Peak to trough -- 18 feet a day, one wave length a month.

Curtis: So in the channel, it's not likely to be years. [Correct]. Any coring?

Eriksen: Yes, but no opportunity to look at those yet.

Courtney: Are there any data gaps? [None mentioned]

Ron *Thom*, Battelle
Sediment Processes Within the Conceptual Model

Boesch: Turbidity could have a possible effect on predator avoidance? [Yes].

Quinn: If sediment is so important, then if the Corps stopped dredging now, would things get better or worse for salmon? [Laughter from audience]

Bartell, To follow up on that, in Bottom et al., what fraction of the opportunity has been realized historically?

Thom: I don't remember the number exactly. Perhaps someone else can answer that. The current velocity in the estuary is probably less than it used to be because the flow is slower...

Eriksen: We didn't calculate a percent change in our report because the system is dynamic. What we were trying to show was the changed relationship in the opportunity, that is the availability of habitat in relation to features that are important that affect opportunity, like flow. It's difficult to put an absolute percentage to it.

Boesch: I thought it resulted in a wash.

Casillas: I wouldn't call it a wash. It was a change response; it was never calculated as an absolute gain or loss. What we were trying to characterize was the response of the system...

Bartell: >From a risk perspective, can you in fact demonstrate that the results of the project shift the system response outside the historical range?

Thom: The system is less dynamic than it used to be. But there's still a lot of variability.

Curtis: What's producing the most biomass? Is this basically the suspended deposit driven.....

Thom: The food chain is primarily based on the supply of detritus coming down the river. Simenstad et al. have estimated a five-fold increase in primary production in the river because of the rate of residence time of water in the river due to the presence of dredge spoil.

Curtis: What percentage of this suspended deposit is fueled by this plankton flowing down...

Thom: As you know *Corophium* is the main actor here, but I don't think we know the percentages.

Curtis: Ballpark estimate?

Thom: I would say it's largely unknown.

Bartell: Which of these are characteristic of benthic communities associated with the channel?

Boesch: Salmon aren't feeding on the bottom of the channel.

Thom: Right; up on the flats.

Bartell: But that was one of your points.

Thom: It's pretty dynamic in the channel. I would say that anything that's a suspension feeder, and that's a mobile macroinvertebrate, is going to be more likely to survive ....

Larson: The deposit feeders are the dominant group.

Bartell: [Relationship of the model to opportunity.] Are the impacts likely to be more important in terms of the physical changes in the dredged channel?

Larson: The impacts in the channel are generally not as important as those that modify shallow-water areas. Productivity in the channel is low; it's not used much.

Goldman: Nutrient limitation studies in the San Francisco Bay system show that turbidity and light exposure are the main factors controlling food supply. So I can't help feeling that turbidity

must be a major factor in this system, as well.

Thom: Yes, I'm sure it is. The incremental effect of dredging and disposal on turbidity is the issue.

Boesch: How do terms fit into another matrix?

Thom: It could be done, but we're not planning to do it.

Boesch: The matrix approach used in CRI doesn't assume density dependence. But the habitat approach in your terns capacity assumes density dependence. You have to have an approach, it seems to me, to assume density dependence. I'm trying to make the link between this model that assumes density dependence and the importance of habitat, and the CRI analysis that's being used to judge the salmon situation, assumes it's not important. How do you reconcile that?

Thom: To be honest with you, I haven't thought about that.

Courtney: [Focus discussion. Critique conceptual model relative to its utility and understanding of the affects sediments.] I think I've heard from the panel that we can't even predict the direction of change on the basis of sediments. The conceptual model is exactly that; it's conceptual, heuristic. It allows you to think about processes in a systematic way. It's not predictive in the sense we can plug numbers into it and see where it's going to go..

Boesch: The question is can it become something more than an unweighted conceptual model. Which relationships are the most important to focus on? Which of the many possible connections are the most critical?

Thom: [Salinity can be weighted]

Boesch: How does one determine what the relative importance of these factors is to salmon? How do you put it all in a common framework?

Thom: [Realistically, you can't. EDT (Ecosystem Diagnosis and Treatment) process, use of a simple ranking scale for some semi-quantitative assessment.]

Dunne: [How about removing things that clearly aren't that important? Might end up with a level of complexity that's on the 'low side of the middle..' Even if resolution is lacking, it's a wonderful tool for discussion, especially with regard to adaptive management]

Boesch: EDT is not a data-free process; it's a perfect tool to address this issue, and it can be related to CRI. EDT is like an 'aquatic HEP' (habitat evaluation procedure).

Thom: [Looks promising.]

Goldman: [Need to simplify in order to analyze. Top down vs. bottom up. He favors the latter..] I would guess that the basic fertility of the estuary, as impacted by turbidity, is going to be the

most important factor.

Thom: [Could use a 'trophic transfer model' and link back to turbidity.]

Goldman: It's not just food abundance; it's food quality, too.

Jay: The Columbia River system is much like the San Francisco Bay delta system. It really is very strongly driven by an external limitation of primary production in situ.. There's always excess nutrient driven to the ocean, but that's not what governs the secondary production of the system. That comes primarily from re-processing of external supply of detritus, and by 'external' I mean 'in the river.'

John *Malek*, EPA
Sediment Quality Evaluation

[No questions..]

Mark *Siipola*, Army Corps
Overview of Corps Sediment Quality Analysis

Quinn: What are calling a 'fine'? What's the size?

Boesch: 63 microns; that's the difference between fine sand and silt. [presentation continues]

Cody: How deep was your sampling?

Siipola: Surface only because of shoaling.

Malek: We concluded that the banding sample, rather than the core, was homogeneous all the way through.

Siipola: Subsequent testing has verified that.

Cody: In your one or two hot spots, is the surface sample representative of 10 feet below?

Siipola: [Essentially, yes.]

Curtis: [Tributary data. Just ballpark. Total organic carbon. How do they compare?]

Siipola: [Don't see a lot of contaminants in tributaries, either. Total DDT and PCBs were under detection limits.]

Curtis: So if there's a point source in there, you haven't found it. And as far as non-point source, there's not much. We find stuff in eagle eggs; it's strange that we don't find any hot spots.

Boesch: One of the problems... This whole type of analysis is done to try to judge the safety of depositing dredge sediments. When they're in place do they cause you a problem? I think a reasonable person would say 'no.' In any case it really doesn't matter that much because you're just taking sediments from the channel and moving them to another... some of those sediments to another area in the same reach. So you're not really introducing, even if there were higher concentrations in that same reach. The real issue, it seems to me, for reasons that we don't fully understand, there are high concentrations of some things in salmon in this system. It seems to me that 1) the sources are upstream, 2) they're coming down the river with fine particulate matter.. So the concentrations in bulk sediments are unimportant. The real question is what are the dynamics of those contaminants as they're moving through the system in association with mostly suspended particles, and whether disturbance of bottom sediments through dredging is going to increase the exposure risk to fish? That's the fundamental question. This analysis very effectively addresses the benthic concern, but not the suspended particle concern. What is the concentration of contaminants -- not in bulk sediments -- but in the fine fraction ?

Siipola: What I was just talking about, that is the fine fraction.

Stein: Are you saying that you took those samples and you sieved out the fine grain sediments and analyzed strictly the fine grain that was present?

Siipola: No.

Siipola: We're letting the system separate out those fines.

Malek: EPA is giving money to states and tribes to look at bedded sediments and we're finding the same things; basically, we're not finding a lot of contaminants in those sediments. It would be useful to have money to look at that suspended load in the water column.

Stein: I agree that it worth doing those kinds of studies, and I agree that we have a good understanding of bioavailability and accumulation in critters, but we do not have an exact understanding. So going from bulk sediment to predicting what's in the critters is not an exact science. So all my contention is that we should be asking the biota what's going on with them, and then working backwards.. I personally wouldn't pick crawdads as my biota of choice. I agree that the Corps has done a very good job of analyzing sediment for disposal of sediment.. That's not the question. I think Don [*Boesch*] articulated it very clearly.. The question is what is happening that may increase risk of exposure to the animals that live there. Not whether you're putting it at a site and disposal of that sediment may degrade or alter that site.

Curtis: Let's get to the pathway.

Buck: [Presence of clay band in the channel about half a meter down and containing cadmium.]

Malek: [Band is not very thick.]

Cody: Would you conclude that, while we don't understand the pathways by which these toxins

get into juvenile fish, that the project will not affect that pathway, and therefore, unlikely to affect fish?

Siipola: [Yes].

Curtis: At least for sediment movement. If there's an indirect effect through some hydrological change....

Boesch: Couple that kind of analysis in terms of concentration with what Karl [*Eriksen*] discussed earlier -- trying to estimate what kinds of increased flux of fines that would be caused by dredging. Then you can address that issue of whether re-mobilization of toxins associated with deposited fine sediments is significant or not compared to flux of fine sediments....

Courtney: Maybe I've missed something. My understanding is that even in those areas where we've got fine sediments, we're still not seeing high levels of toxics. So we still don't know the pathway.

Curtis: Yes, and I'm interested in the piece that John [*Malek*] mentioned. What if it's not in the benthic, but suspended in the water column?

Malek: [EPA national source inventory -- permitted outfalls and loading calculations. Couldn't find it in sediments.]

Boesch: This body of water has a pretty substantial dilution potential.

Siipola: [USGS studies show no heavy loading from above the river. Local sources - Johnson Creek for DDT. Radio nucleotides no serious problem in estuary.]

Thom: [In terms of the food web model, maybe there's a source outside the system that is associated with contaminants.]

Boesch: At river mile 76, we have one sample for 600,000 cubic yards and we know that I think it's 67 percent fines at that site. It seems that if you follow Corps protocols, even for just dredging, that you'd want to do some additional sampling there. John, [*Stein*] if the Corps did additional samples collected at depth, or every 50,000 cubic yards, would that start to get at some of the issues you're thinking about?

Stein: Not necessarily one site. What we're thinking about is that if you have fines, but not necessarily high total organic carbon, the contaminants there would be highly bioavailable. The things are highly linked. So it's how you present and interpret the data. What we're more interested in there has to be more coupling of biological sampling with the sediment sampling.

Cardwell: I'm getting confused; it shouldn't matter. Does it matter whether corophium are getting their dose in the total organic carbon in their diet or ventilating in the water? They're still getting the same dose.

Stein: I agree.

Collier: [Suggests discussion be deferred to his presentation.]

Young: How long are the samples that you took for the EIS valid for?

Siipola: Varies in protocols, but if we notice something abnormal, we're out there sampling for it. About every 5 years in general.

Curtis: Is the building of sand waves contingent on sand material? Will it have a different mobility than sand?

Eriksen: [Yes; ongoing process. Complete turnover of those fines, presumably.]

Malek; [Grain-sized analyses in drop zone and down stream several times a year. In most cases, the material is gone in about 6 months.]

Courtney: Can we make any statements about the pathways that toxics might make it into the fish, and how that might link to the conceptual model, and in turn, how to predict the potential effects of the project.? [Ask the panel to review what they've heard and characterize what they've heard so far from the Corps].

Curtis: It looks like we have enough data to start looking at for the potential of at for least organic contaminant transport. I'm less certain about metals. If you've got a contaminant that's a problem, it's going to show up in the fish. It looks like some of the things Karl [*Eriksen*] did would plug into looking at how much sediment might move around because of the project.. I found the sand wave information very interesting; it makes sense that it's material specific. The concern about the one site where the material as quickly as anticipated might be explained in those ways. Are we stirring up a large contaminant reservoir in the channel? From the data we do have, it looks like no. Even though total organic carbon is below detection level, how do we know for sure that it's not significant? That could be examined a little more. It seems to me the potential for another pathway is important. What are the linkages between the project and an alternate pathway?

Goldman: [High level of uncertainty as to how things are getting in to the food chain. Biomagnification is a major factor. Missing piece in the information.]

Bartell: [important to link to effects of the project]

Quinn: [Conceptual model is too complicated. CRI model is too simplistic. Each has its own value, but neither seems appropriate for this issue.]

Cardwell: [Sand wave intrigued him. Like a washing machine. In terms of pathways, does it really matter if a contaminant is on detritus or in deposited total organic carbon in sediment or in the water column? These organisms are either ventilating it or eating it. If in this washing machine there's some relative equilibrium, it doesn't seem like it matters how they get their

dose. If you believe in equilibrium partitioning, it shouldn't matter.

Curtis: [Doesn't believe in equilibrium. He's curious if it's washing through on dead organic matter, or dead organic matter associated with bedload, or up in the water column. An academic question, mostly.] The reason I hedged on equilibrium, with the amount of sediment transport through the system, as fast as this stuff is moving through, if it is associated with let's say the planktonic food chain, unless something picks it off for lunch, it may never have a chance to get in equilibrium with the benthic community because it goes through too quickly. That's a lot of water. Fusion is going to be a miniscule contributor to dynamics in that type of a system. That's why it's important.

Boesch: It seems to me that the first order is to get our minds around the question of whether this is just 'a small dust up in a sandstorm'; whether the amount of fine sediment that could potentially be subtracted is really trivial with respect to the flow through that's taking place. If it isn't, then all the other stuff doesn't matter.... I think one of the problems we're having is that we're not understanding scale. Also, there's not a lot of contaminants in the fine sediments, but somehow these fish have high concentrations. What's going one? We're not talking about a fish that's hanging out; we're talking about fish that are basically moving through. Their body burdens are affected by a lot of things.. So I think it's important for us to think about a lot of things in the context of the spatial and temporal scale.

Bartell: Let's suppose that we've conclusively demonstrated the pathway from coarse-grained sediment contamination to accumulation of contaminants in salmon.. I would want to know how large an effect the proposed project would have on bioaccumulation, and how confident I would have to be in order to make a decision to either prove or not prove the project [*Boesch* nodding].

Cardwell: Or to say it another way -- you would look at cumulative risk.

Bartell: In other words how much more contamination are you willing to live with? How certain of that do we have to be before we make a decision? Otherwise, you're just wasting your time.

Young: Thinking about how these fines move through the system, will the three-foot deepening cause a sort of 'funneling effect'?

Dunne: Not in any way I can think of. The mechanics are all pretty well understood. The separation of total suspended load, suspended bed material load, and bedload -- the fact that that material of this grain size in a river of this depth and slope moves in sand waves, and the sand waves move at tens of feet per day or less, and they turn over one to several times a year and they're thoroughly mixed, and therefore because... First of all, they're sand. Silt can't stay in there. A small amount of silt gets trapped in the sand because water flows through the sand that by the time it comes to the edge, the silt goes into suspension and the sand wave keeps itself clean.... the sand has a low surface to volume ration. And also it's constantly abrading, breaking down itself. Not much contamination stays on it. So all I want to say is that the mechanics, the separation, and the pathways are all pretty well understood. It doesn't surprise me that for some time in some parts of the channel, finer grain material will persist. The point that Karl made about the relative magnitude of the sand wave ... accelerated a little bit ... small proportion to

have to deal with... most of the time they're finding themselves... gravity because the sediments coming in from the side... The other thing that surprised me -- the perturbation and turbidity because of the dredging process itself. Karl's calculations were conservative. Sand hops and rolls... Make a calculation that it can't travel very far. So the scale of the perturbation Don's talking about is quite limited. I would've expected more treatment in Karl's presentation of the disposal process itself. I'm still a little unsure about the degree to which the Corps has thought about the consequences... Don't know whether it's biologically significant or not, but it seems more discussion of that is needed..

Courtney: [Data gaps and supplemental analyses remain. Tom's comments here should go into the BA process.]

DAY 2

***Jeremy Buck*, USFWS**
Trophic Transfer of Contaminants in the Lower Columbia River

Boesch: To what degree will the project affect suspended sediment and distribution of carbon?

Buck: I don't know; we need more data to answer such questions.

Dunne: Do you have any reason to believe that the impact of dredging will increase suspended sediment load?

Buck: I don't think it's so much an issue of increased suspended sediment load as it is redistribution of carbon. There's carbon at some level.

Dunne: What's the level?

Buck: At various locations in the level it's at 2.5 milligrams per litre. I've also seen it as high as 10.

Dunne: Can you sketch the probability distribution of that? Is 10 an outlier? You can't have an outlier of 2. Because bedload stays close to the bed, even if stirred up by dredging, it's clean. There's no reason to believe that the dredging project would increase suspended load. I'm trying to figure out if we can get any of these issues of the table.

Buck: Have we characterized the navigation channel accurately? [Clay bands in channel...]

Dunne: How did that clay get there?

Buck: I don't know.

Cody: Is it turning over with the sand waves _____.

Dunne: [Ephemeral layers... settles into pockets... Navigation channel ... fairly mobile sediments on bed.]

Jay: I'm unaware of any area of the channel that is not turned over regularly by sand wave action.

Buck: Did find some cadmium in clay.

Boesch: What I'm hearing is that this fine-grained material is embedded in sand.....

Young: From an ESA standpoint, if there's annual turnover of sediments, the main time of that turnover would be during the high-water period.. There's a timing that perhaps the majority of these fish that have been occupying a long time in the estuary aren't there. That if the dredging is releasing, especially in the re-suspension of dumping in certain areas, is a timing issue, the re-suspension naturally is occurring temporally differently than what you're doing with the dredging release and that you're releasing much more than is being released at that point. So there is potentially a difference in natural vs. the project. So teasing out the effects, that would be a temporal concern.

Jay: [Three differences -- reach at the entrance, which turns over every tide; most of the estuary which turns over on spring cycle; and river.... seasonal. There are differences between the deepest part of the channel and the sides of the channel.... Distinctions..]

Boesch: Is the amount of fine sediment is at least a surrogate for... organic carbon?

Buck: I don't know; I guess that's the key.

Boesch: If that's the case, then you need to go back to Karl's analysis of the estuary...

Siipola: There's a small amount of total organic carbon out there and it's pretty uniform throughout the system. Not much variability.

Cody: Did you say that with an increase in total organic carbon, bio-availability is reduced?

Buck: Yes.. We're talking really high total organic carbon.

Cody: So the anticipated direction here of changing total organic carbon by in-water disposal would be to increase total organic carbon. And that increased total organic carbon would decrease bio-availability? [Directionality is changed depending on the level of total organic carbon.]

Curtis: [Not an excess of carbon to compete...]

Bartell: [Increased bio-availability because of low carbon content offsets...]

Buck: I'm saying what carbon you do have is probably contaminated. And if it is there, it's moving through the system.

Boesch. You can't have it both ways. You're saying it's a low-carbon system and then you're saying well these fine sediments have a lot of contaminants in them. Well, if that's the case, you have to look at the carbon content of those fine sediments, not the total carbon content of all sediments.. I also think there's a real trap here of thinking all carbon is a threat.. There's a lot of labile carbon in sediment which has very different properties from other carbon. Mischief in the details...

Goldman: One of the mysteries seems to be how the contaminants are getting into the food chain. Estuaries are a nutrient trap.

Buck: Right.. What is the possibility that there's carbon still associated with coarser materials and the small amounts of fine being re-distributed and trapped in that area. Is that greater or less than natural background levels? We don't know what's important in this system for contaminant pathways. Is the distribution any different than background levels? Some of Karl's presentation suggested that yes it is, but I want to make sure this is on the table for discussion.. I don't think this is a futile exercise.

Dunne: Wherever the carbon is coming from, the material the Corps is proposing to dredge is the cleanest.... So there's not likely to be any major source of toxic materials. We can rule out hotspots - they're rare... Do we have that consensus? That even given the occasional clay band, the area to be dredged is not a conceivable source of this carbon.

Cody: Are sands as clean in side channels as in navigation channel?

Buck: I don't know. It's not our responsibility, but it's a big concern for us.

Eriksen: [Most of the ports are on the main navigation channel.]

Malek: [Ports will have to go through separate actions. Any improvement have to be approved separately..]

Siipola: [None of the ports used for in-water disposal. Only in-water is near Rice Island; the rest is upland.

Degans: We did do sampling for the channel deepening project. The channel deepening is being done for grain and container facilities. There's a discrete number of facilities like that in the harbor. We did samples in the system; we sampled at all of the grain elevators that would require deepening. The sample results showed that some of the facilities did exceed screening levels. The assumption is that that material would need to be handled appropriately following the guidebook. Generally, I would say the material is deeper it goes because we're getting into native material, as opposed to in-fill. So the likelihood of material actually going unconfined in water... it would only do that if the screening met the requirements.. But we do not have the

disposal site permitted at this point.

Eriksen: One other point: the volumes that would be measured out of there would be measured in tens of thousands of yards, not millions of yards, so relatively small levels would come out of port facilities.

Buck:....Small levels may be important.

Boesch: [Any connection of contaminant levels with Newberg Pool? Same with river otter. Is it worthwhile to look at those two disconnects in relation to this problem.]

Buck: [Not enough toxicological information available.]

Curtis: The data we have on the Newberg Pool are not very good. Data go back as far as 1951, so it's not a recent problem. With Portland Harbor and cadmium -- fish in the harbor are responding quite strongly with planar contaminants (e.g., furans). So river otter might be having a toxic response to that is not surprising. But what's going on the harbor is different. Harbor sediment samples are very different. So I don't know how useful those comparison are.

Cody: Levels of PCBs are highest in eagles. Does that have anything to do with their size and longevity?

Buck: They are the highest members of the food chain. They mostly consume fish, but they also eat cormorants and terns. So the boost in their PCB levels is probably due their consumption of all three.

Hicks: [Data on eagles are old (1994-1995). Concern for eagles is good, but without any plans to re-survey, it's nothing more than concern.]

Mishaga: [Potential for exposure to contaminants before reaching estuary. How can we make assumptions about the effects of the project when fish and other wildlife can be contaminated in any number of places above the estuary?]

Buck: [Definitely have documented evidence of contamination below Bonneville.]

Mishaga: [Nobody's questioning that contaminants are in the estuary. But connection to project is weak.]

Tracy *Collier*, NMFS
<u>Establishing Effect Thresholds and Dose Response Relationships</u>

Siipola: You don't have any information on fish from further upriver?

Collier: Right. We have the 2000 sample from Jones Beach. Again, the Columbia's a big system with lots of different stocks. There's a lot of different strategies... I think Si Simenstad said

chinook salmon have 47 different strategies for using the estuary. There's a lot of variability. It would be really difficult, in my view, to do good comprehensive sampling on [fish contamination]. As agencies, we need to be concerned about it and try to address it. [Presentation continues].

Boesch: [Questions the lack of a linkage between fish contamination and healthy gut contents of fish.]

Collier: First is 1-2 parts per billion cause for concern? [Inaudible]

Boesch: We're not talking about a Superfund toxic substance. We're talking about fine-grained sediment, which is abundant and moving through the system in large quantities. It's nothing that's exotic or especially contaminated..

Collier: Right. The question is to what degree can we have certainty that something is not a problem?

Boesch: You can't expect reasonable people, their organizations, to pursue every point of uncertainty about every issue...

Collier: Right; I agree.

Boesch: ...You have to make some judgments about which of those you feel pretty confident about, which of those are critical. And then, you have to focus on those.

Collier: In my view, though, one of the assumptions.... We have not a whole lot of data characterizing this entire activity... It appears to be focused primarily in the channel; we aren't looking in a great deal of detail at the edges of the channel. So is there this potential for depositional sediments to be disturbed? I can't say... What value do you put on the concern?

Boesch: I think you're missing my point. The point is that the material you're so concerned about -- about being re-mobilized and introduced to the system, is the very material for which there is ample reason to suspect that it's not qualitatively different than the suspended sediment that's already fluxing(?) through the system. It constitutes the present milieu of exposure.

Collier: Pretty much correct. Except whatever is in suspended sediment right now presumably contributes to body burdens we see. If there's additional, incremental exposure, the question is does that ratchet up concern?

Hamilton: We routinely sample before we dredge. We have a vast amount of information.

Courtney: I'd like the panel to comment on the statement that only by getting at the assumptions will you reduce uncertainty.

Curtis: I think Tracy [*Collier*] has provided a rational approach, analyzing the problem. We may agree or disagree. I think this is a big step in setting up something that can be analyzed.

Cody: Basically, we're talking about gaps in data that can be reasonably filled. For example, we learned that by taking the main channel down another five feet that material would be sloughing off shallow banks. And it's the shallow banks that lower stream flow, higher silt content, higher toxics...

Eriksen: There's no reason to think that those side slopes are any different than the main channel.

Cody: Is it not correct that the side slopes do have lower flow rates of water, do have higher silt levels, and higher organic carbon?

Eriksen: No.

Cody: They're exactly the same?

Eriksen: Well, the side slopes along the main channel are... yeah.

Cody: So there isn't a gradient of material that would go from the high-flow central channel to the bank?

Eriksen: Not that I'm aware of. Most of the bank line is all disposal material. If there's an exposed beach, it's disposal material.

Jay: [Inaudible]. Most of the side slopes that we're talking about slumping_____. Fine sediments are well away from the main channel. Those slopes have all been disturbed.. Use your intuition for ocean beaches rather than for estuaries.

Siipola: You also have a lot of ocean wave action and natural wind wave processes.

Cody: I think then that we need some data to back this up. That the constitution of the materials and the silts and organic carbons is uniform, and that that uniformity will not be disturbed by dredging the channel...

Courtney: To get us back on track, I just want to get a sense from you, Martin, whether this is a scientifically sensible way to proceed, as Larry [*Curtis*] suggests.

Cody: Yes, although I believe that 90-some samples in the center of the channel don't really give an accurate picture of the cross section of the river. We have reason to believe that the shallow areas are important.

Quinn: I see a strong connection between the physical effects and potential consequences for organisms. On the other hand, I'm much more uncertain about the biological consequences. The things that Tracy [*Collier*] presented here I think are things that need to be looked at more carefully. The habitat opportunity graphs are largely pulled out of thin air.

Goldman: I'd like to see equal emphasis on the washload and bedload, especially as the

washload comes into the estuary. There must be upstream sources of contamination, and it would be valuable to determine those.

Larson: You need to remove variable of hatchery fish before you conclude that these fish are contaminated.

Collier. Yes; I agree.

Courtney: Need to tie monitoring and management procedures to the proposed action. The strength that I saw with Tracy's presentation is that you did that. You said here's how our uncertainties feed into the decisions... We need to be careful about recommendations or suggestions.... There's a lot of things we could study, but they need to be related to the project.

Boesch: Back to your comment, Steve, about monitoring and adaptive management. Monitoring and adaptive management are easier to say than do. We can't follow every wisp of a concern. Need to develop a relevant monitoring program and a process by which information is rapidly interpreted and fed to policymakers.

Rick *Cardwell,* Parametrix
Analysis of Potential Contaminant Risks to Estuary Salmonids Based on Existing Sediment Quality Data

Goldman: This would seem to indicate that the channel is pretty clean and that the concentration of the biology ought to be directed toward the washload (suspended sediment), rather than the bedload.

Cardwell: I think we're in agreement with you.

Cody: This is somewhat at odds with what we learned this morning where we asked about the similarity of the sediments toward the edge of the channel.

Cardwell: I'm not sure what I heard this morning is inconsistent. It just depends on where you look.

Cody: So the follow-up would be that given there are these two populations -- the near shore and the side channel -- that there is a 20-30 overlap [inaudible]....

Cardwell: Exactly. A reasonable person would start digging into that overlap.

Cody: And those are distributed up and down the river, but generally not in the estuary. They're at widely dispersed points upriver.

Panel Discussion

Courtney: The project managers and panel members met over lunch. There was some sense among the panel members that they've heard a lot of information on a number of issues and that really everything is distilling down to two issues of some substance.. One, was the issue of the modification, or creation, or destruction of habitat particularly in peripheral areas, and the other was the issue of toxics and the sensitivity of the system to that. And that there are limits to what we can understand about those systems and that the habitat modeling we have in place will help us get to endpoints of concern. What we heard today is that there's no large concern about toxics issues, but in essence, there's a missing piece. Moving forward with any projects would be appropriate only if that uncertainty is addressed through a monitoring and adaptive management strategy.

Tortorici: Habitat encompasses a number of things. Not necessarily a catchall... [inaudible].

Bartell: Urgency to define a finite set of factors to evaluate the relationship of the proposed project.

Cody: Presentations with this workshop have been very helpful. [Uses as an example Rick *Cardwell*'s figure of contaminants going to total organic carbon in silt, going directly to prey, going directly to sediment.] Earlier on, we were wondering how the contaminants got to the estuary. The estuary is basically where the contaminants are underrepresented in the sediments, so presumably they're being taken down there by the salmon themselves. So that sort of pathway is something we didn't know about before. And now we've identified these near shore fines as a source for what shows up in the estuary. I think that's a real step forward. And it certainly would direct a monitoring effort to keep tabs on that. I think that's clear.

Curtis: With regard to the channel, I think there are two questions. Was the sampling adequate to answer the question of what's there, and second, how homogeneous an environment is the channel? Some monitoring is required. Also, what is the likelihood that deepening the channel is going to deepen the scouring to a horizon lower than what has been exposed in the past? We need to look at other pathways -- the washload.. Off-channel areas may be important to sources of contamination, point sources. Who's responsible for these off-channel areas? Again, need more data.

Goldman: Maybe our unanswered questions on how the estuary operates will direct us toward understanding about whether the estuary is just a place that fish pass through or whether they undergo a lot of mortality there. If this project does nothing more than direct attention toward understanding food chain dynamics, I think it will do a lot. There's some real unanswered questions about the carbon supply, the food chain dynamics in the system, and how this will interact particularly with the fine sediments. The fine particles could be the key to how contaminants are getting into the food chain.

Dunne: [Largely inaudible]. Doesn't give much credence to the concern over scouring and significance of the trough]. Having said that, I think that the sooner you decide to design a monitoring scheme the better.

Courtney: I should point out that the panel felt strongly during the lunch session that monitoring

is an integral part of the program and should be discussed now, not later. Another issue was what should be the appropriate scale for monitoring? Monitoring should be appropriate to the project and address issues and assumptions associated with the project. But, nevertheless, the panel suggested the effort should be informed by a regional application.

Boesch: [Some concern with adaptive management and lack of follow-through. Should be looking for opportunities for mitigation and creating disturbance in the system that might return some of those upland functions that interact with the environment.]

Courtney: [Summarizes]: There's a sense among panel that the conceptual model, although it still needs refining, it's beginning to become useful. Re EPA guidelines, we heard a commitment to move forward both regionally and within the context of this project. An understanding of how screening criteria are being used. On toxics and toxic sediments and the uncertainties associated with that, "it doesn't all add up." Those uncertainties might be an appropriate focus of exploration, possibly in an adaptive management context. Appear to be not especially large, dramatic areas of concern. "We're not hearing substantive levels of concern at this point about re-distribution of toxins from the channel.."

David *Jay*, Oregon Graduate Institute

Jay: If you look at the spring season, the fact that you have deepened the navigation channel very clearly increases salinity intrusion. Both the change in flow and in depth have tended to increase spring salinity intrusion. Most of the rest of the year, the deeper navigation channel and increased flows have opposite effects.

Hicks: Do you mean the mouth of the Columbia River?

Jay: Everywhere there's a controlling depth and you deepen the channel. [presentation continues].

Jay: ...We think we're on pretty firm ground when we say there's a lot of change between the channels and bays, and bays re-supply throughout the summer the ETM.

Boesch: That's tide mobilized or wind mobilized?

Jay: I wish we knew more about that... Salmonids are probably more dependent on Corophium; that's a different food web.

Tortorici: We talked yesterday about the 70 percent and 30 percent figures. Are you pretty comfortable with that?

Jay: I'm going to get to that. That's the best estimate we have. USGS figures.. [presentation continues].

Larson: Now is ETM just in the channel areas, or does it extend up into the peripheral areas?

Jay: It interacts strongly with peripheral areas. We choose not to call that slop over into the peripheral areas ETM proper.

Larson: So that's the mechanism by which the particulates get into the shallow-water areas?

Jay: It's certainly ***a*** mechanism.

Quinn: Is there any relationship between ETM and distribution of fish species?

Jay: I'm not a fish person, but there's an awful lot of feeding by fish in the ETM. That is a major trophic transfer in the food web.

Larson: [Incredulous].

Jay: [Believes he's right. "At least they eat what is in the ETM"]. [Presentation continues].

Buck: So as far as bed movement with relation to dredging, regardless of where dredging occurs, disturbing the bed, putting it in suspension, it's theorized that that would either go out to the ocean or be trapped in one of those....

Jay: ...One of those reservoirs. It's not going to spend very long in that river. It passes through the river reservoir in a day or two, ends up in the ETM reservoir, either goes out to sea or goes back and forth between.... Sort of the average picture we have is that 70 percent goes out and 30 percent gets permanently sequestered. That's an average; it could be 40-60 or 20-80, but not much wider than that. [Presentation continues].

Larson: You're talking about the deepening of three feet having an effect, but we're dredging continuously right now. Every year, the mouth fills in by six to seven feet and we dredge that out. Does this impact continuously?

Jay: I think it does. If we look carefully, we ought to see the changes. The issue is that two things are happening at once. Flow cycle is changing and dredging and refilling cycle are happening at once. It could be hard to sort those things out. That's why the modeling is important -- distinguishing flow cycle changes from annual bed movement cycle.

Larson: So it establishes some other base condition...

Jay: We're talking about changing the channel depth on the average of about three feet.. I think the changes will be concentrated at certain flow levels. The problem is we don't know right now, what they are.

Buck: If you were going to pick an area to monitor for contaminant transfer, is the ETM a good place to do the sampling? Could you ever imagine that there would be a way to tell the difference between inputs from dredging vs. inputs from the river.

Jay: We've always thought that we need to monitor in the estuary and in the river. I think you're going to have to sample material that's being put out of the dredging project because if you look at those reservoirs of suspended material that you're going to be bringing up out of the bed, it's really small in relation to the size of the reservoirs, and you aren't going to see it down river, I don't think. That's subject to a re-estimation -- how much can be re-suspended? My guess on that is the only way you're going to see it is right there at the dredge.

Cody: Well, we know how much is dredged in a typical day, how much stuff is removed?

Eriksen: About 20,000 cubic yards a day.

Jay: About 27,000 metric tons.

Cody: And of that, we reckon a very small part would be SPM The inputs to the estuary are about 10,000 _____....

Jay: And the reservoirs are somewhere between 80 and 250,000....

Cody: How much might be contributed by dredge activity related to river processes?

Jay: On the order of 10 tons a day. [Inaudible discussion ensues]

Jay: [Discussion around concluding points]. EIS projected dredging is 6.3 tons per year, but the history suggests there is more than that in the present channel. I made an estimate and Karl correctly pointed out that I hadn't taken into account the residual [line?]... happens every year. He's right about that. On the other hand, I think that [line] is considerably smaller than he thinks it is. So I haven't re-estimated how much I think the dredging estimates are low. Off the cuff, I would say 60 percent.

Boesch: Karl do you agree with those numbers?

Eriksen: Look at 12.7 in those seven years. Dredging practice changes. Mt. St. Helens affected dredging volume from about 1982-86. It's interesting; I'd like to get together with David on it.

Tortorici: What does this discrepancy means in terms of the time it would take to do project construction?

Eriksen: [Basically, no impact].

Boesch: Of all the things we've discussed, this is relatively subject to resolution..

Bartell: Has anyone attempted to see if there's any relationship between physical changes and catch rates of salmon?

Jay: Well, a cold PDO (Pacific Decadal Oscillation) is favorable to salmon. Very tricky.

Tortorici: Did you say the sediment supply is being lost from the river?

Jay: Yes. Sediment supply is a really strong function of river flow. If you take the high flow peaks out of the hydrologic regime, you do not supply the sediment that you would have supplied. That was why I raised the question of if we're not transporting sediment, where the Hell is it? We don't have a good answer for that. People have been arguing about that for 20 years.

Casillas: And what's the implication for salmon habitat?

Jay: The issue there is that if you start taking too much sand out of the system, you may start to erode habitats more rapidly than you're replacing them. It's a several decade issue. Difficult to develop appropriate models.

Boesch: I'm struck by how concerned we are about toxic-laden sediment that could kill all the salmon, and removing too much sediment that could kill all the salmon.. One way or the other, we're going to kill them [*Jay* objects to statement; *Boesch* acknowledges that he's being facetious]. In the long run, there need to be some questions asked about whether the management regime, which is driven toward less in-river disposal, is really the right way.

Tortorici: That's the concern we have.

Hicks: Gets back to what Steve [*Bartell*] was saying that there's an urgency to define the habitat.

Eriksen: Yes, sand transport has been changed over time, but there's no evidence that dredging will affect it. It's likely the system is more stable than it was formerly. Impacts are highly localized. Differences in our approaches/methods.. David is looking statistically at sediment transport and dredging volume; I'm looking at changes in the river bottom, management practices for material disposal. I've looked in the past at sediment transport and discounted it. So we are worlds apart in our methodologies, and it's not easy to meld the two together. It's an interesting theory that I'd like to look into....

Bartell: The information you've presented have made a strong case for monitoring and adaptive management.

Jay: The question I would look at is given that the system is supplying less sand, is it appropriate to be removing sand? If you're deepening the channel, sand is going to move in from peripheral areas, and therefore, affect peripheral habitat..

Courtney: Thanks *Jay* for raising interesting issues.

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