

**External Peer Review Comments for EPA's  
Draft Vulnerability Assessment,  
*A Novel Approach Using Expert Judgment –  
Volume I: Results for the San Francisco  
Estuary Partnership***

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Submitted to:

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***A Novel Approach Using Expert Judgment – Volume I:  
Results for the San Francisco Estuary Partnership***

**Responses to Charge Questions**

**Provided by External Peer Reviewers**

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**Taewon Kim, Ph.D.**  
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**Submitted on  
October 14, 2011**



**1. Do you believe that the “expert elicitation” method developed for this study was effective for assessing the sensitivities of ecosystem processes to climate change? If not, how could expert elicitation be more effectively used?**

Reviewer	Comments	Response to Comments
<p><b>Hershner</b></p>	<p>No. In the end, this method proved to be incredibly cumbersome with significant limitations for any conclusions drawn. The report is honest, although not particularly loquacious about these drawbacks.</p> <p>One has to read through almost the entire report to get to the admissions found in the Conclusions that the method has a significant list of important caveats and limitations. Even in this section the identification of limitations is submerged in a determined optimism that this “novel” approach is beneficial and exportable. The truth of the matter is that the method did succeed in identifying ecosystem process sensitivities to climate change, but the more important observations seems to this reviewer to be that many/most of those sensitivities were already well known. The incredibly detailed coding exercise provided lots of data for further analysis, but yielded very little in terms of new insights, or useful guidance for managers.</p> <p>Indeed, if a manager were to read the entirety of this report very carefully, the evidence of large and pervasive uncertainties and divergent opinions on a very large percentage of the rated processes would be discouraging – assuming they could indeed wade through all of the stuff presented here.</p> <p>Expert elicitation is a very useful process in some cases, and the approach used here, to replace forced quantitation of uncertainty with a categorical qualitative assessment seems to be an approach that will also have real value in some cases. But here the focus of the elicitation exercise was at a level of system detail so complex, that by the time it was simplified to a point that became tractable, it was simultaneously trivial. In addition, the effort to extract so much information from participants through the complex coding typology rendered the outcome too precise to be useful. The analogy that occurred to me in reading this was that you were trying to figure out an effective way to turn a ship. Typically in expert elicitation, you would posit three or four methods to steer toward a desired destination and ask a diverse group of experts</p>	<p>We agree that the first run of the newly invented method was cumbersome, but not that future use would be cumbersome; we have suggested methods for simplification and improvement that would significantly streamline the method for next time.</p> <p>Actually, the caveats are listed at the front of the document, in the Executive Summary.</p> <p>We agree that some sensitivities were already known, but not all of them (according to the participants), especially in relation to each other with respect to resulting trade-offs.</p> <p>We cannot speak to generalizations of how managers will feel about the information.</p> <p>Thanks for this thoughtful analysis. We believe the coding could be simplified from 13 to 6 codes, as laid out in section 2.2.2.5, which would greatly simplify the method. This has been added to the Conclusions.</p>

	<p>for considered opinions about which method would be most likely to get there. Here you have gathered folks from every department on board and tried first to conceptualize the entire navigation and steering system of the ship and tried to evaluate the importance of each and every linkage. It is an interesting exercise – but it effectively subverts the power of expert elicitation which lies in the inexplicit integration of diverse/ diffuse knowledge by an expert to provide a summative judgment. This project seemed determined to force an articulation of as much of that diverse/diffuse understanding as possible – and ultimately it founders on the welter of exposed uncertainty. Instead of rising above the detail to focus on the insight, this undertaking tries to look behind the curtain, and in so doing it has lost almost all the value of expert thinking, because now it cannot effectively ignore what was exposed.</p> <p>So, to more effectively use expert elicitation in this particular case I believe the very first issue that needs to be resolved is: “Why are you doing this?” More specifically:</p> <ul style="list-style-type: none"> <li>• Is this to provide some guidance to managers? If so, clear articulation of the management goals, and identification of strategy options derived from literature reviews, stakeholder input, and/or expert focus groups can be the frame for useful expert opinions. The approach here of using the process to build a rationale for management options ultimately stops short of generating any really useful guidance for a manager.</li> <li>• Is this to identify priority research needs? If so, identification of the most sensitive ecosystem processes is an appropriate frame for determining where experts believe critical uncertainties lie. The approach here would still seem to be overly complicated for that outcome. I appreciate the desire to extract as much information as possible through the matrix of coding options. But for an appropriate level of insight to guide research, less would truly seem to be more in this case.</li> </ul> <p>In either case, it is my belief that expert elicitation, with or without quantification of uncertainty, is most appropriately used when it is looking for the gestalt. It is a means to access expert opinion, not a method to examine it. As such there are practical limits to its useful application – and I believe the welter of influence diagrams and Tables 3.1 and 3.2 are evidence of an effort that seriously overshot that mark.</p>	<p>Doing the analysis of management options was beyond the scope of this report, but would be an interesting thing to consider as a before-step next time.</p> <p>We believe the study accomplished this, and have suggested how it could be simplified for the future to shed some of the detail.</p> <p>Noted.</p>
<p><b>Kim</b></p>	<p>Yes. I agree that “expert elicitation” is needed to assess the sensitivities of ecosystem processes to climate change because it takes time to fully assess the ecosystem response to climate change despite urgency on taking management actions.</p>	<p>Thank you.</p>
<p><b>Talley</b></p>	<p>Taken as a whole, the expert solicitation method developed for</p>	<p>Thank you.</p>

	<p>this study shows great promise for accurately assessing ecosystem vulnerabilities in the face of climate change. This method removes much of the cumbersome qualities of a lengthy quantitative assessment technique, while introducing an ability to inject some of the “intangibles” into the process. Clearly, the selection of experts for the panel becomes particularly crucial, as does a set of checks and balances, to insure that the recommendations and the rationale are transparent. Fortunately, the selection criteria are clearly laid out in the Appendix, and I would recommend that this be used in any future exercises as well.</p>	
<p><b>Valoppi</b></p>	<p>Overall yes, I think it is a useful method for assessing sensitivities of ecosystem processes. In particular I think this method is useful for development of conceptual models and exploring the inter-relationships between variables and processes, and for assessing the level of agreement amongst experts on those influences.</p> <p>I am ambiguous about using this method to “make the link to management”. I think it is a less useful method for that because there are some actions which theoretically are feasible to “manage”, but politically/practically are not – for example Land Use Change in California is controlled at the local level (County and City government), and no amount of trying to direct land development in any meaningful way has happened at the State level in the history of the State (or at least in my 27 years here). As another example, the management action “Reservoir Management” really seems to be code for “moving freshwater to Southern California”. Again, while theoretically feasible, water transfers through the San Francisco Delta has been the subject of much scientific research, management, legislation, and lawsuits. To represent that any one entity has control to “manage” the multiple reservoirs and conveyance systems in the State in a concerted effort to manage for climate change is at best simplistic.</p> <p>For other management actions, such as Restoration, these conceptual models are more useful and the issues more tractable, principally because management is more concentrated and direct. For example, the South Bay Salt Pond Restoration Project would potentially benefit from incorporating various habitat types into our restoration. To that end, it would be helpful to have a better understanding about what Landscape Mosaic features would best enhance shorebird abundance, and how that might change with climate change. There is too high a degree of uncertainty and disagreement amongst experts (in particular with the Community Interactions Diagram) to allow managers to take action solely</p>	<p>Thank you.</p> <p>We completely agree that moving from an understanding of vulnerabilities to implementation of adaptation actions brings in great complexities in the management application context. While outside the scope of this report, next steps for implementation must still be based on the best info available on vulnerabilities and theoretical responses that the science shows that the system would respond to; further steps to prioritize activities would indeed have to be based on feasibility under current management structures, or movements to change those structures.</p> <p>Thank you.</p> <p>We agree that important</p>

	<p>based on this analysis. Management actions based upon the Sediment Retention Diagram seem less uncertain due to the higher level of confidence and higher degree of agreement amongst experts. This may be that inherently physical processes are less variable and “noisy” statistically than are biological processes.</p> <p>In my view, the best use of the Expert Elicitation Exercise would be to use these results to identify what additional study/research needs are for evaluating climate change on these endpoints. That information could then be used to further refine the conceptual models, and the refined conceptual models could then be used as the basis for quantitative models, or to refine existing quantitative models.</p>	<p>knowledge gaps, especially around landscape mosaics, have been exposed.</p> <p>Thank you.</p>
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**2. Is the level of detail and organization of the report useful to the scientific community as well as ecosystem managers? If not, how would you re-organize the report?**

Reviewer	Comments	Response to Comments
<p><b>Hershner</b></p>	<p>The report is impressively detailed. I think the exhaustive listing of interim products and findings may have some utility for a limited portion of the scientific community deeply interested in the methodology.</p> <p>For the ecological sector of the science community, the report is a tough read. The interesting conclusions about “top pathways” is covered over in so much uninteresting material about the method and the basic methodological outputs, that it becomes difficult to effectively assess insights that may or may not be emergent. For the report to be useful for this audience it should be reformatted with a clearer focus on the characterization of the conceptual pathways, and a more open and thorough discussion of the limitations of the analysis. I believe the report reads like a thesis at this point, and it would be much more impactful for an ecological audience if it were formatted and written like a journal article (in a journal with a practical page limit).</p> <p>For the management audience, I have a hard time imagining any</p>	<p>Thank you.</p> <p>In this and a previous comment the reviewer discounts the Executive Summary, where info that is asserted to be submerged far back in the document is also presented right up front, in the ES. There, the top pathways and interpretations are laid out in their most synthetic form (along with limitations) for a ‘bottom-line’ reading of results. The detailed information elsewhere in the report is for those who may want to understand the method more deeply and perhaps use it in future work.</p>

	<p>of the estuarine ecosystem managers I work with reading this report and coming away with any confidence that it provides actionable insights. The fact that the report really does not – in fact does not attempt – to offer recommended management strategies is a major fault from a manager’s perspective. The report is equivocal and caveated – perhaps appropriately – but to the point that it really offers no substantive guidance to managers beyond scientists have lots of uncertainties and you should design your management projects to help us learn more. It seemed to this reviewer that the analyses at a minimum suggested a need to resolve incompatible management goals, but that conclusion is buried in a few odd sentences scattered through the report.</p> <p>Basically, I believe the report has three potential audiences (elicitation practitioners, ecologists, and managers) and it does not serve any of them particularly well. I think this may be intractable given the need for a single comprehensive final report, and perhaps it is not really an objective to serve all three. I think the elicitation practitioners are probably best served because the report is reasonably complete with regard to method and results. It is a bit facile in self-analysis, which would seem to be the area of greatest interest to those interested in export of the method to other applications. So for the sake of potential export to other areas, I would recommend a more structured and thorough treatment of issues identified at each stage in the process, and an assessment of the impact of those issues on the outcome and the utility of the product.</p> <p>I believe dedicated ecologists can/would plow through the overburden to extract the limited insights encapsulated in the top pathways. I trust they might also exhume some understanding of the confidence issues from the data presented. The report text never rises much above an accounting of results in terms of assessing confidence judgments. Perhaps even the authors are overwhelmed by the volume of information with such seemingly little value.</p>	<p>This work represents a first step – vulnerability assessment – that is meant to “tee up” the next step of adaptation planning. Doing a comprehensive analysis/crosswalk of adaptation options is the next step toward adaptation planning.</p> <p>As explained in the intro, we hope to get into further detail on lessons learned about elicitation and improvements to the method in a subsequent lessons learned report. Given the criticism that the report is already too long, we felt a separate report to get into these details made more sense.</p>
<p><b>Kim</b></p>	<p>Generally, the level of detail and organization of the report is fine.</p>	<p>Thank you.</p>
<p><b>Talley</b></p>	<p>The level of detail in the report is impressive and appropriate. There is a broad pattern of high-level, summary information at the front of the report, with increasing detail and breadth as one reads through it.</p> <p>That said, the structure might not be ideal for serving land managers, who often are looking for “take home messages” and concrete actions they might employ to achieve results. The report should have a section that more clearly presents a “menu” of possible threats and management responses, ideally organized as a hierarchy wherein someone working at a very local level (e.g., land manager for a small reserve) is provided with scale-</p>	<p>Thank you.</p> <p>The Executive Summary is our cut at “take home messages”. If managers read only this section, they would have the “bottom line” of this report. We completely</p>

	<p>appropriate actions (e.g., <i>not</i> something along the lines of “manage dam release”). Section 3.2 and associated figures and tables roughly attempts this, but adding a piece to the document that makes it easier to pick a threat or concern and rapidly evaluate both knowledge gaps and possible management actions. The authors seem to be aware of this need, as indicated in section 4.2.</p>	<p>agree that a more comprehensive analysis of management options is a critical next step. The work of this report represents a first step – vulnerability assessment – that is meant to “tee up” the next step of adaptation planning. Doing a comprehensive analysis/crosswalk of adaptation options is the next step toward adaptation planning, but outside the scope of what this first report could do.</p>
<p><b>Valoppi</b></p>	<p>I think the coding scheme is too complex, and is confusing. Page xviii indicates there is potential to simplify coding, which I think would be a positive thing to pursue. The level of complexity is too great, implying a greater degree of precision that is warranted given that you are asking experts for their opinions, which is inherently subjective.</p> <p>My biggest criticism of the approach used is the coding scheme shown in Table 2-2. I think it would have been more straight forward, and perhaps resulted in better agreement amongst the experts, if there was a 2 step process – 1)Options 0 – 5 defined first for the influences, then 2) refine and narrow the options with the level of detail in Options 6-13 based upon what was determined in Options 0-5. This would allow the experts, and those reading the report, to first go from general to specific in evaluating first the type, and then the degree of influence.</p>	<p>We agree that the coding scheme could be greatly simplified from 13 to 6 codes, as laid out in section 2.2.2.5. This point has been added to the Conclusions.</p> <p>This is an interesting idea that we will explore when evaluating lessons learned.</p>

**3. Does the report effectively:**

**3a. Provide sufficient background information on the estuary program?**

Reviewer	Comments	Response to Comments
<p><b>Hershner</b></p>	<p>I found the report to be exceptionally limited in this regard. Even being quite familiar with the San Francisco program, I felt the results of this project were presented with very little context. The CCMP is mentioned, but really only to suggest relationships between some management plans and the findings of this report. The overall NEP management effort and particularly the SF activities under the Climate Ready Estuary program are not well</p>	<p>We have added some information to the Preface to help with this.</p>

	developed as a rationale and framework for this undertaking, and so the value of the project seems underplayed.	
<b>Kim</b>	I do not think so. I was surprised to see there is no literature cited in the background information. I recommend including citations to provide enough rationale to conduct “expert elicitation” methods.	The Expert Elicitation White Paper that is cited is the result of a large EPA analysis and contains copious citations upon which the paper is based, and upon which this method is based.
<b>Talley</b>	The report could have been more detailed on providing background information the estuary program, but thoroughly and carefully explained the scoping process and integrated conceptual models. This is particularly impressive given the short time for the workshop, but undoubtedly is in large part due to the quality of the expertise they brought to the table and the pre-workshop efforts (e.g., see 1.2.2).	Thank you.
<b>Valoppi</b>	I believe the report could have provided more information on whom the intended managers are that would be using this information. It did this for specific pathways in Section 3.2.2, Adaptation Planning, but it would have helped to have a better understanding of how the information would be used in the beginning of the report, or at least at the beginning of Chapter 3 (Making the Link to Management). My perspective in reviewing the document is from management options for the South Bay Salt Ponds Restoration project, the project that I work on, so perhaps managers at SFEP have a broader perspective and more management options available to them.	We have provided some information in the Preface to help with this. We also agree that different managers will bring different perspectives to looking at the information, which is fine.

**3b. Explain the scoping process to select vulnerable ecosystem processes?**

Reviewer	Comments	Response to Comments
<b>Hershner</b>	<p>It seems to be well explained. I have to admit I remain a bit unclear about the degree to which the experts modified the “straw man” influence diagrams. The report suggests that this process was one during which participants felt many of the basic insights were garnered or identified. So it may be the most important part of the exercise for export. If indeed insights emerged in this phase it would be interesting to know the experts opinion of the relative value of those understandings at this point compared to the relative value after the extensive coding and interaction analyses. Did those activities add value comparable to the effort?</p>	<p>Thank you.</p> <p>The experts spent a few hours settling on a final group diagram; after the workshop, participant responses to a survey indicated they had a very positive experience. They also had a chance to comment on the workshop report weeks later. We hope to get more into some of these details in a lessons learned report.</p>
<b>Kim</b>	Yes.	Thank you.
<b>Talley</b>	<b>See 3a. above.</b>	Noted.
<b>Valoppi</b>	<p>I think the report did a reasonable job of explaining the scoping process. I offer these specific suggestions for changes:</p> <ul style="list-style-type: none"> <li>• Page 2-6, line 16 indicates that interactions scored by “three or more participants” were judged useful for interactive influences, however line 1 on that same page used “majority (4 or more participants)”. Why the discrepancy in setting the level of agreement?</li> <li>• Page 2-7, lines 22 – 35, are very confusing because the quotient “2/3” is used instead of the “Codes 2&amp;3”. It took me a few minutes to realize it was not referring to a quotient, but</li> </ul>	<p>Thank you.</p> <p>Since participants were not required to score all interactions but rather only those that “jumped out” at them, there were very few interactions scored by more than 3 participants, and none scored by more than 5. Given this situation we set the criterion for agreement on interactions a little lower, as we felt it was useful to look at them rather than “throw them out” based on an overly-rigorous criterion.</p> <p>Lines 22-26 are devoted to explaining that these are pairings.</p>

	<p>to Codes “2 and 3”.</p> <ul style="list-style-type: none"> <li>Section 2.2.2.5 refers to Type, Degree and Pairings of Influence, and then Sensitivity, while Section 2.2.2.6 refers to Relative Impacts of Influence. Overall, it is not clear the distinctions between the categories. The following Section 2.2.2.7 Key Questions did not seem to help much as it gave yet a different set of definitions for the categories of information. For example, “Relative Impact of Influences” seems superfluous, as this would seem to be defined by the Typed and Degrees of Influences; by having a separate set of questions for this category of information seems to make the exercise more complex than it needed to be, and is confusing.</li> </ul> <p>Page 2-16 is the first time the terms “interactive influences and synergy” are used, but they are not described in Section 2.2.2.5, adding to the confusion.</p> <ul style="list-style-type: none"> <li>The coding scheme on Tables 2-3 and 2-4 use “characterize interactive influences” and “characterization of confidence” instead of “Pairings of Influence”, and “Sensitivity”, and “Relative Impacts of Influence”, so it is not clear what is actually being evaluated and coded.</li> </ul>	<p>As explained on p. 2-8, relative impact integrates not only sensitivity but how greatly the variable is changing relative to other variables, and so is a measure of the relative importance of a variable to the overall process, compared to other variables. So even if an influence is less sensitive, if the variables are changing hugely, that influence could have a higher relative impact on the process than an influence that may be more sensitive but for which the variables are not changing much. The Key Questions do not give new definitions but rather use the terms as defined.</p> <p>Interactions are actually introduced and explained on page 2-6; they also appear in the Key Questions on page 2-9.</p> <p>Characterizing interactions is a separate exercise from first characterizing the individual influences and the confidence in them.</p>
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**3c. Use conceptual models of ecosystem processes?**

Reviewer	Comments	Response to Comments
<p><b>Hershner</b></p>	<p>Clearly the process is based on this, so I am not sure what the point of the question is. I think it is noteworthy, particularly given the uncertainty I have about the role/extent of the participants in developing these models, that the models effectively bound the output of the process. Because of this they are determinants of the outcome. This factor is noted in the report</p>	<p>As explained in the report, the experts modified the straw man before the workshop, then collaborated at the workshop to modify it into an acceptable</p>

	<p>in passing in a mention of an issue about disease as a missing element in the community model.</p> <p>I do believe that the process undertaken for this project has real utility in facilitating ecosystem based management, if it is structured as the starting point for adaptive management. Basically the conceptual models and the top pathways, become the articulated understanding of how the system operates and what potentially effective management strategies might be – with some identification of respective uncertainties. This is the framework for experimental management, aimed at iterative reduction of those uncertainties. At the outset of my review I believed this was going to be the desired outcome and so anticipated a concise synthesis at the conclusion that drew all of the information together in a set of explicit management recommendations with a project-based rationale for each and an analytical design that would indeed reduce the uncertainty. Instead the report seemed to suffer the same problem graduate students typically have as they come to the end of intense and complex thesis investigations – they lose sense of the value of the project and so have difficulty seeing past the data to its potential application. The result is a failure to present the work in a final form that facilitates and promotes its ultimate use.</p>	<p>“group” diagram for use in the exercise. So we are not clear what is uncertain about the role of the participants.</p> <p>Thank you for these thoughts.</p>
<b>Kim</b>	Yes.	Thank you.
<b>Talley</b>	<b>See 3a. above.</b>	Noted.
<b>Valoppi</b>	<p>I found the figures to me most useful in understanding what the expert elicitation method generated. I found the Tables 2-6, 2-10, 3-1, 3-2 confusing, primarily because there are too many options and influences to keep things straight, and as noted above the coding scheme in Tables 2-3 and 2-4 don’t align with the text. As I noted in my answer to Question 2, having a two-step process for experts ranking the individual influences would have allowed the results to be displayed in a less complex, and hopefully more understandable, format.</p>	Thank you. Please see previous responses.

**4. Please comment on whether the project steps were adequately described in the report and in detail appropriate for an ecosystem manager to begin to develop adaptation strategies. Please provide any recommendations for improvement.**

<b>Reviewer</b>	<b>Comments</b>	<b>Response to Comments</b>
<b>Hershner</b>	See the preceding comments. There is plenty of detail for	Thank you.

	<p>most steps. But ultimately I find the report to be not well focused on the needs of an ecosystem manager looking to begin strategy development. I think the report needs to try a bit harder to synthesize its findings and present them in the form of strategy recommendations for managers – specifically for San Francisco Bay managers. Somehow the report needs to get beyond recognition that there are a lot of different things that could be done, some of which may be compatible and some of which may not. Surely the blue, green, and purple pathways can be sorted by potential efficacy, practicality, sustainability ... whatever, to provide a clearer sense of how this project can inform management.</p>	<p>See previous responses about the scope of this report.</p>
<p><b>Kim</b></p>	<p>Even though I agree the objective of this project to apply ecosystem management, I recommend that improvement is needed for the ecosystem managers to develop adaptation strategies.</p> <p>I feel that the report based on evaluation of experts is so professional that ecosystem managers might have problems to understand the core theory and to apply this to the management and adaptation plan. It might need translation into easy-to-understand words and charts. I think it would be great for this report to have a separate chapter for ecosystem managers to have “handbook-like” information on how to apply the concepts to management and adaptation strategy in response to climate change. For that, not only diagrams for expert elicitation processes but also action matrix for ecosystem managers to apply priority steps (based on management options given in the Executive Summary) to local ecosystems would be helpful.</p> <p>Especially, I think that there are too many charts and flow diagrams to understand the sensitivity of ecosystems well. Presentation of key arrows is not always intuitive and should be changed. For example, in figure 2-3, summary influence diagrams could be clearly presented by changing the arrow type for each sensitivity. When the figures are printed in black and white, there is very little difference between key arrows. If key arrows have different hues and thickness, it would be easier for readers to understand flowcharts.</p> <p>I recommend that the key arrow for intermediate-to-high trend sensitivity all throughout the report should be changed into the other type than dashed arrow (It should have stronger impression than intermediate trend. Right? ).</p>	<p>We very much agree that a handbook that makes the simplifications/improvements mentioned would be highly desirable. While beyond the funding scope of this project, this is high on our list for follow-on. In this report the Executive Summary is the simplest summary to read.</p> <p>Three figures have been deleted. Regarding arrows, previous versions did experiment with different arrow designs in response to internal review comments, and we ultimately simplified the diagrams to this form. The report will be printed in color.</p> <p>A dashed arrow signifies that there was less than majority agreement; the intermediate-to-high arrows are ones for which there was not majority agreement but rather a mixture of intermediate and high codes. Using a solid arrow would misrepresent the</p>

	<p>It was also hard to understand typologies for understanding influences and sensitivities (p. 2-7). Why the direct relationship was coded as 2, 3, 6, 8, 11, 13 and Inverse relationship was coded as 4, 5, 7, 9, 10, 12? When I first saw the codes, I could not find any rules and logistics provided. Because of this, I had hard time to understand Table 2-1. Is there a specific rule to code types irregularly? Then please explain what it is. Additionally, isn't there other way to present Table 2 with different columns with different hues and different fonts (like italics) than having different colors? Problems when printed in black and white occur here again.</p>	<p>level of agreement. By definition a direct relationship is one where as X increases, Y increases, whereas an inverse relationship is one where as X increases, Y decreases. We have added a parenthetical to p. 2-7 lines 16-17 to specify this. If you look at the codes in Table 2-2 you will see that they break down as direct and inverse relationships of varying magnitudes. We will consider color changes in subsequent versions of reporting.</p>
<p><b>Talley</b></p>	<p>As mentioned above, a manager with sufficient time to carefully read the report could indeed begin to develop management strategies. That said, the recommendations made in my answer to charge question #2 would improve this ability by leaps and bounds. Better still would be a “menu” of sorts that lists not only specific objectives (e.g., “increase sedimentation”) and management actions to achieve them, but that highlights knowledge gaps and possible ways to test them. One of the stated goals on the document is “mainstreaming” adaptation into planning, and the authors specifically reference the iterative nature of planning (i.e., adaptive management). Many land managers (and, for that matter, academics) are eager to find small scale projects that will help to further our understanding on processes shaping coastal systems, and a report like this could, with little added effort, provide a blueprint for doing just that, and for filling those gaps in knowledge that inject so much uncertainty into some of the models in the report.</p>	<p>This report represents the first step of examining vulnerabilities in preparation for then doing a comprehensive analysis of management responses; the stated goal was to provide info to support the next step of mainstreaming, not to do the mainstreaming. That has to be done by the NEP managers themselves, who know the specifics of management context in which they are operating. A workshop of NEP managers would be a great idea for getting at this next set of information.</p>
<p><b>Valoppi</b></p>	<p>I think it would be difficult, based solely on this expert elicitation, for a manager to then move forward and develop adaptation strategies that involved a major change in resource management (e.g. changing reservoir management or water management for freshwater flows). There simply is not enough scientific basis from expert opinion, no matter how good. As I indicated in my answer to Question 1, I think the best next course of action would be to develop some quantitative models based upon these conceptual models, that could then begin to examine different scenarios, identify key parameters or part of the conceptual models that need further research/information, and perhaps optimize management options where there are competing trade-offs (e.g. the desire to release more sediment into the system to enhance net</p>	<p>Opinions noted.</p>

	<p>mineral accumulation, against the need to not do this in streams with salmonid habitat). The management actions defined here are also not specific enough, for example enhancing landscape mosaic to enhance shorebirds is not specific enough to begin developing adaptation strategies for restoration – what mix of mosaics is optimal for which species? What about balancing shorebirds needs against other waterbirds like diving or dabbling ducks, or marsh-dependent species such as the clapper rail? The elicitation of expert opinion contained in the report is a valuable first step in chain of activities that would eventually lead to managers being able to develop effective, and likely costly, adaptation strategies.</p> <p>I think some interesting ideas for adaptation strategies were noted. I think further work developing potential adaptation strategies would be useful, in particular related to restoration and maintenance of mudflat/marsh habitat by reuse of dredged materials. The specifics of developing these management strategies and a pilot study would be useful for my project to be able to apply some of them within our restoration actions.</p>	<p>This first pilot was not comprehensive, and results need to be balanced against further information needs as well as multiple priorities.</p> <p>Glad to hear this.</p>
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**5. Beyond the scope of this report and looking ahead to future work on adaptation to climate change, please comment on the following. This report presumes that to develop adaptation strategies, the first step is to identify system vulnerabilities and sensitivities. Do you agree?**

**5a. If no, what alternative method can you suggest for developing adaptation strategies?**

**5b. If yes, what is the most effective way of identifying those ecosystem characteristics that are most vulnerable to climate change, for deeper focus with sensitivity analysis?**

Reviewer	Comments	Response to Comments
<p><b>Hershner</b></p>	<p>I agree that some recognition – or assumptions – about system vulnerabilities and sensitivities are needed, but as noted above this effort seems to me to have gotten so far into analysis of the detail of the system structure and function that it blew right past the optimal point of useful insight. I believe expert elicitation could, in fact, be a very useful way to look at the San Francisco Bay ecosystem to identify climate sensitive processes. The value of the approach, I believe, lies in its capacity to integrate a wide diversity of expert opinion to identify the probability that select processes are sensitive, and that management can be effective in achieving specified management goals. But I believe that can be accomplished very effectively, indeed most usefully, without pressing for explicit articulation of all the underlying interactions. This project seems to me to represent an unfortunate mismatch between the level of information developed and the level of information needed and useful for management strategy development. The method is interesting and probably very useful,</p>	<p>Thank you for these thoughts.</p>

	but it needs to be aimed more effectively.	
<b>Kim</b>	Yes. I think that the most effective way of identifying ecosystem characteristics that are most vulnerable to climate change is gathering information on the effect of climate change on ecosystems as much as possible and reevaluating the information based on the expert's reassessment. Without background information, it is hard to identify vulnerabilities just with the experts' opinion.	Thank you.
<b>Talley</b>	Yes, I absolutely agree that the first step is necessarily to identify system vulnerabilities and sensitivities. I would argue that the process presented here is probably the one with the most promise for achieving that goal. This expert elicitation process walks the line between having too little input (and thus becoming very phenomenological, emphasizing "pet" processes of a chosen expert), or having too many voices, where there is a real danger of diluting the message by only presenting vulnerabilities and sensitivities that are so universally accepted as to be banal. In particular, this process benefitted from being very specific about where (and how much) disagreement arose on issues, which provides context for taking management actions.	Thank you.
<b>Valoppi</b>	<p>See my comments above regarding this being a first step in a chain of activities. The below is my attempt to draw a schematic of the chain of activities. This expert elicitation process covers the first 2 steps.</p> <p>Develop conceptual models → refine major pathways qualitatively → refine major pathways to model quantitatively → evaluate sensitivity of pathways quantitatively to determine major sources of uncertainty → refine models → monitor environmental variables to evaluate model output, then refine model as necessary → determine pathways most important for climate change → evaluate adaptation strategies specific to those pathways</p> <p>I also think that first establishing the physical system and making sure there is a clear understanding of those pathways and processes is important, then adding the biological/ecosystem after that would be useful. As the lack of agreement in the Community Interactions group suggests, there is more uncertainty and variability in response in a biological system than in a physical one, and the physical system will lead into and influence the biological system. So, it is most important that the physical components and processes are established first, and then one can move to developing system vulnerabilities and sensitivities of the biological processes.</p>	Thank you for these thoughts.

**6. Please provide any other comments or recommendations that you feel would strengthen the document.**

Reviewer	Comments	Response to Comments
<b>Hershner</b>	I believe I have covered all the major points I wish to make. As a final observation, I would note that the fact that this report apparently took almost 1.5 years to generate following the March 2010 workshop, and yet comes up so short in generating really useful and accessible guidance for a manager, is not a strong argument for its utility and adoption elsewhere. I want to believe this is due more to the level of detail and complexity attempted, than as a result of the fundamental nature of expert elicitation.	Various factors – many having nothing to do with the method – came into play on the timeline.

<b>Kim</b>	<p><b>Executive summary</b></p> <p>The reason why the sediment retention in salt marshes and community interactions of shore birds-preys was selected as two key ecosystem processes should be also provided in the executive summary.</p> <p>p. xi. Community interactions of shorebirds -&gt; Community interactions of shorebirds, their predators and prey.</p> <p><b>1.2.2. Scope</b></p> <p>p. 1-3 L 8. What are the predators of the Marbled Godwit and the Western Sandpiper? Please explain it more clearly.</p> <p><b>2.1.2. Novel Application</b></p> <p>p. 2-1 L26. Provide citation for the D. Henrion’s work.</p> <p><b>2.2.2.1 Influence Diagrams</b></p> <p>p. 2- 3 L 17. Interactive effect on freshwater inflow should be changed into interactive effect on sediment supply (As I see the figure 2-1).</p> <p>p. 2-3 L18. There is no figure indication. Which figure should be referred?</p>	<p>We do not believe this level of detail is needed in the ES.</p> <p>Change made.</p> <p>Section A.2.2.2 specifies that Peregrin Falcons and Merlins prey on the shorebirds. This has been moved up to section 1.2.2 as well.</p> <p>Citations added.</p> <p>Thank you! Correction made.</p> <p>There was no simplified diagram presented for community interactions here; here we are just explaining how the scope of that process was constrained.</p>
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	<p>p. 2-14 L18. The word “Figure 2-5” is redundant. Remove it.</p> <p>p. 2-23 L37. There should be citation for this information.</p> <p>Figure 2-3. There is one part in the chart that I would disagree with. I do not agree that tide is less influenced by climate change than wave is. It is common sense that climate change incurs sea level rise and thus will inevitably change the tide range. The land coverage immersed by tides may increase eventually.</p> <p>Figure 2-7. 2-13. I would change the color of “Current” into white and then change the “Climate B” into color with darker hue.</p> <p>Figure 2-9, 2-10, 2-11. Is it possible to change the key arrows with different thickness and hues which could be understood even without color? There is actually no “low sensitivity” flow in this chart.</p> <p>Figure 2-11 Is the primary impact the strongest among three kinds of impacts? Is the secondary impact stronger than the tertiary impact? If so, I would change the color of primary impact into red and secondary impact into blue. If not, please describe what is the primary, secondary, and tertiary impact respectively in <b>2.3.2.4 Relative Impact</b> in p. 2-20.</p> <p>Figure 3-3, 3-4. Are top pathways with same colors for management of the Net Accretion/Erosion endpoint and for management of the Shorebirds endpoints closely related to each other? For example, is the green pathway for management of soil retention responsible for the green pathway for management of shorebirds? If not, I would use different colors for each management to prevent readers from being confused by connecting processes with same color.</p> <p>Figure A-4. Definitely the Marbled godwit also predate crabs. Include crabs in the invertebrate prey group.</p> <p>Authors mentioned that Peregrine Falcons and Merlins prey on shorebirds (p. A-8, L1-2), there is no interaction depicted in the Community Interactions in the Figure A-4.</p> <p>There is no reason described in the text (A. 2.2.2.2) why and how the extent of aquatic habitat in the figure A-4 is used as an indicator in this context.</p>	<p>Correction made.</p> <p>Citation added.</p> <p>Opinion noted.</p> <p>These figures have been deleted.</p> <p>Previous versions did experiment with different arrow designs in response to internal review comments, and we ultimately simplified the diagrams to this form. The report will be printed in color. The “low sensitivity” part of the key has been removed.</p> <p>JUST for this figure, change arrow colors to red for primary, blue for secondary, and green for tertiary</p> <p>Thanks, they have been added.</p> <p>Thanks, they have been added.</p> <p>A 2.2.2.2 explains that the birds depend on extent of habitat for accessing prey.</p>
<p><b>Talley</b></p>	<p>I would like to stress that a focus on very clearly listing gaps in knowledge and potential ways to address them would be a huge plus not just for land managers and academics, but for wetland and climate change science broadly. Overall, I could not agree more strongly with the analysis of the advantages and disadvantages of this process that the authors set forth in section 4.3.2, and it is my hope that this process will see more</p>	<p>Thank you.</p>

	<p>widespread use where rapid assessments are needed.</p>	
<p><b>Valoppi</b></p>	<p>I realize it is a product of the 2-day workshop, but Figures 2-8 and 2-9 seem to be missing an obvious and major pathway, at least from the perspective of the South Bay Salt Pond Restoration Project. There is no arrow going directly from the “Restoration” box to “Extent of Mudflat”. A major issue, and a contentious one, for our Project is that opening ponds for restoration and allowing natural sedimentation to form marshes would “steal” sediment from the mudflats, thereby reducing the extent of mudflat habitat for shorebirds. Also, there would seem to be a direct relationship between “Sediment Supply” and “Extent of Mudflat”, but that is also missing from these figures. Perhaps it is because the workshop was to apply the questions to a North Bay marsh, at China Camp, where there is not active restoration of ponds to marsh habitat occurring? So from my perspective, the Community Interactions conceptual diagrams are of limited usefulness for my project, though they could be adapted.</p> <p>For Figures 2-12, it seems illogical that the group found pathway “DD” as the primary impact on relative influence under current conditions, but found all other pathways leading to “Shorebirds” as having increased impact under climate scenarios. Also unclear is why disease would increase under climate scenarios, or why Predator disturbance would increase? Basically, I just scratched my head, could not see where the group was coming from in developing Figure 2-12. Perhaps some text describing the groups thought processes (realizing there were divergent opinions perhaps).</p> <p>Figures A-1 through A-4 are confusing, and I don’t think they add anything to the understanding.</p> <p>Page 2-23, lines 17-21 refer to the South Bay as being so developed that it precludes the ability of marshes to migrate upland. While it is true that much of the South Bay is developed, the South Bay has large tracts of ponds that could be converted to upland or marsh and allow from the habitat transgression with climate change to occur. That is not the current plan as we have no solid models to guide us as to what proportion of upland habitat, and the slope from upland to marsh, to construct that would be most effective in the face of sea level rise. We are hoping to investigate these issues further as the restoration proceeds and as more information and models are developed evaluating sea level rise and marsh sustainability.</p>	<p>In the diagram, the effect of restoration on extent of mudflat operates through effects of restoration on sediment supply, exactly as described by the reviewer. Restoration activities affect sediment supply, which is then resuspended and deposited at some rate (affected by bed characteristics and tides/hydro) that ultimately determines extent of mudflat.</p> <p>The relative impact of DD remains high. Some information on why the other influences increase in relative impact has been added.</p> <p>Opinion noted.</p> <p>Thanks for this interesting information.</p>