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Delta Independent Science Board

June 12, 2012

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To: Phil Isenberg, Chair, Delta Stewardship Council
Members of the Delta Stewardship Council

From: Richard Norgaard, Chair
The Delta Independent Science Board (DISB)

Re: Recommendations from the DISB on the Sixth Staff Draft of the Delta Plan

In its review of the Fifth Staff Draft Delta Plan, the Board recommended that improvements were needed in four broad areas: integration, adaptive management, monitoring needs and performance measurements, and science needs. The Board finds that the 6th Staff Draft of the Delta Plan makes significant headway in addressing all four of these recommendations. The following specific recommendations will help bring the 6th draft closer to the Board's expectations. The Board also realizes that the Plan will be updated every 5 years and that with a better integrated science program and improved funding, the Plan can become ever more clearly explicated.

The following comments and editorial suggestions have been compiled from comments made by individual members, synthesized and edited, and discussed and approved during a teleconference meeting of the Board on June 8.

EXECUTIVE SUMMARY

- 3, 3-5: Suisun Marsh is downstream of the junction. To avoid beginning with this error, the paragraph could start: "Debates about California water commonly center on the Sacramento – San Joaquin Delta, where two of the state's largest rivers converge."
- 3, 18-19: Avoid implying that the agricultural lands are home to 0.5 million people.
- 3, 23: According to G.K. Gilbert (1917), hydraulic-mining debris continued through the Delta to southern San Francisco Bay, where it allowed salt marshes to prograde.
- 3, 31: "Although the numbers of several species of fish in the Delta have fluctuated over time, four in particular....." Likely ALL have fluctuated in numbers over time
- 4, 18: "Act notably required that Californians reduce their reliance on the Delta." Even in the Executive Summary, or perhaps especially here, the document needs to reiterate that most of the diversions occur before the Delta and that reliance on this water also needs to be reduced through increasing water-use efficiency and better coordinated surface and groundwater management.
- 5, 1: Rather than "minimum flows", the goal should be to identify the volume and timing of flows and flow paths necessary for meeting ecosystem functions.

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- 5, 15: The recommendation should be to achieve a more natural functional flow regime for the Delta and its major tributaries, not minimum flows. That is the recommendation supported by science and what is in the text of the Plan.
- 5, 15-16: “To do this, minimum flows must be established for the Delta and its major 15 tributaries as part of a comprehensive effort to address all ecosystem stressors.” How about “ecologically based assessments of flow needs”?
- 5, 19-20: This sentence is unclear. Why does high flood risk “mandate” that agriculture and natural resource land uses are the most appropriate?
- 5, 23: There appears to be a word(s) missing following “seeks to first”.

CHAPTER 1. INTRODUCTION

- 9, 8-9: This expansion of “the Delta” beyond its conventional (and legal) boundaries undermines the Plan’s clarity and integrity. The Plan writers show ample skill to use “the Delta and Suisun Marsh” wherever both are invoked. The selective conflation announced in lines 8 and 9 sows confusion wherever “the Delta” appears without “and Suisun Marsh” because in many of those uses “the Delta” either excludes or need not include Suisun Marsh (p.123, for instance).
- 11, 1-4: Here is a place where the fundamental importance of adaptive management should be included. Rather than “calls for further investigation and focused study of specific issues” it should read something like “calls for all management actions to be implemented using principles of adaptive management.”
- 12: Missing from this discussion of California water supply is the information on amount of water diverted prior to its arrival in the Delta. This is a very large number, and therefore, very important in understanding the big picture.
- 12, 13: “Today, nearly two-thirds of the state’s population (approximately 25 million people) depend on water” this number represents the 2/3 of the population. But as written, it’s not clear if it’s that or the whole state population. In the parentheses perhaps say “approximately 25 of the approximately 38 million people in the state”
- 13, 11-13: These sentences should not be included as a separate paragraph without additional development. The first sentence of this paragraph is poorly written and needs a word(s) in phrase, “at times run backward”.
- 3, 16-17: Revise to, “Today, striped bass, which are voracious predators, both support a major sport fishery and are blamed ...:
- 13, 17: “accidental tourists” seems too informal. Use non-native species.
- 13, 23: Do not begin this sentence with “And”.
- 13, 31: More than “marshland”; could mention more from page 122
- 13, 43: There is a typo - “theses” should be “these”.
- 14, 4: Specify what is meant by “changing ocean conditions” here or provide a citation to published work.
- 15, 3: The estuary extends westward to the Golden Gate (p. 126, lines 33-35). It also functions southward to San Jose; Delta water flushes southern San Francisco Bay (Conomos, 1979, p. 75-77).

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- 17, 34- 35: Maintain past tense throughout this sentence – “ensured better groundwater monitoring, and provided for increased enforcement.”
- 18, 20-23: "Practicality." There is little evidence in this statement that would guarantee the Plan would be "practical." The statement in fact says nothing about practicality.
- 19, Figure: Label this figure as Figure 1-3 and provide figure caption.
- 19, Map: What elements of the Delta Plan does the map show?
- 22, Table 1-1: Move “by 2032” to the next column if the probability quoted there is for a time interval that ends in 2032, not in 2050.
- 23, 17: Word missing – reduce?
- 23, 27: Ecosystem restoration and protection rather than just ecosystem protection; ecosystems are in a degraded state and need to be restored or rehabilitated, not just protected.
- 23, 10: Revise to, “No water rights decisions or water contracts that directly or indirectly impact the Delta will be made without consideration of the coequal goals.”
- 23, 17: Rewrite, “The Delta Plan seeks to first declining water reliability...”
- 23, 23: “considerably” is vague. Suggest revision to, “California’s water supply will be more efficient ...”
- 23, 39: Revise to, “undertaken”.
- 24, Timeline: “Action depends on” column in “Policies.” Consider adding “State Budget” for item Prioritization of State investments in Delta levees and risk reduction.
- 24, Timeline: “Action depends on” column in “Recommendations”. Consider adding “State Budget, Support of California taxpayers, Assembly and Senate for item, “Finance local flood management activities.”

CHAPTER 2. THE DELTA PLAN

Chapter 2 certainly indicates that adaptive management will play a key role but how it will be done depends on the effectiveness of the implementation of material presented in Appendix A. In general, although incorporating adaptive management into this chapter has in some ways elevated its importance, the description of adaptive management is weakened. The entire Plan is put in the framework of adaptive management, which is good, but as a result it becomes less clear that the policies and recommendations are also to be implemented within the framework of adaptive management. The absence of any reference to conceptual models guiding development of the Plan and of individual actions is a serious omission that needs to be corrected.

- 31, 85052: “Adaptive management” means a framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in management planning and implementation of a project to achieve specified objectives. Is this definition then consistently used throughout the report?
- 36, 4-5: It might be useful to add that implementation of the Delta Plan will also require a commitment of resources by the California taxpayers and members of the California State Senate and Assembly.
- 36, 24: Replace “approach based on a strong scientific foundation” with “approach based on a strong scientific foundation in an adaptive management framework”

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- 37, Table 2.1: should indicate that it's a partial list of agencies, given statements made earlier.
- 38, 21: The term "good science" might better be rewritten as "best available".
- 39: Science in the Delta. The cited work by Glibert et al (2011) and Dugdale et al. (2007) is still preliminary and does not carry the same weight as other findings cited in this section. This is illustrated in the use of language such as "may be having a significant impact" and "have been hypothesized". Use examples that are less controversial and better supported. Under water quality, for example, perhaps use the recent paper by Schoellhamer (2011) *Estuaries and Coasts* 34:885–899 describing a statistically significant 36% decrease in suspended sediment concentration (SSC) in San Francisco Bay from water years 1991–1998 to 1999–2007. These findings have many implications for the Delta such as sediment supply and its influence on wetland restoration, delivery of sediment-associated contaminants, and light limitation and changing phytoplankton production. Further support for decreasing SSC was provided in a paper documenting decreasing suspended sediment concentrations in the Sacramento River (Wright and Schoellhamer (2004) *San Francisco Estuary & Watershed Science* 2(2)).
- 39: The list of new scientific findings is an excellent addition.
- 39, Box "Water Quality": The emphasis on the possible negative role of ammonium in the Delta ecosystem may be overplayed. The major problem according to most experts is increasing nitrogen loading, not just ammonium increases, in a system where light penetration also is increasing. Most experts believe that implying trophic cascades that have major food-web effects related to ammonium levels, which have impacted fish communities and the delta smelt in particular needs further research. Probably, the Box should recognize nutrient loading in general as a problem that is likely to get worse. It should point out ammonium explicitly as it relates to sewage pollution, but also recognize the broader implications of increases in all forms of nitrogen in the system. (Does Ch 6 address the ammonium issue?)
- 41, 26 and 49, 6-8: It is problematic that non-scientists (the Council) are going to be making the ultimate decision on choosing among competing interpretations of available science. It will be critical that the Science Program provides them with clear advice.
- 42-45: Missing from the description of the "Plan" part of the adaptive management framework is any mention of the need for conceptual models to guide the development of specific parts of the plan.
- 40, 16-17: Adaptive management requires establishing goals and objectives and associated performance measures that are used to evaluate whether a given action has achieved its intended goals.
- 42, 8: The language about the importance of establishing performance measures and monitoring to document whether performance measures have been met should be stronger here. Performance measures are "key" to the adaptive management framework.

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- 43, 28: Suggest revising to, “When completed, it will be incorporated into the Delta Plan if it meets certain statutory requirements.”
- 48, 40 to 49, 8: This section should identify the role of the Delta ISB in updating and amending the Delta Plan.
- 46, Sidebar, second line from bottom: Should be BCDC not BDCP
- 48, 31: The statement that the Council will “use existing monitoring efforts” appears to preclude the development of new monitoring efforts, which should be part of a Delta Science Plan. This paragraph should also acknowledge the potential for new monitoring efforts established as a result of the Delta Science Plan.
- 49, 14-15: Spell out “Independent Science Board” and consider rephrasing to grant the Board its touted independence. We are pleased to see that DISB will be able to review performance measures and that there is a deadline for their development.
- 49, 11-12: The sidebar’s description of performance measures as “primarily administrative” seems to contrast with the description of “output performance measures” as evaluating the effects of “natural phenomena outside of management control”. Could revise the text here and reference specific examples by page number.
- 50, 10: Add peer-reviewed literature here or as a separate bullet.
- 52, 1-2: There are potential conflicts with the fact that activities that occur in the upstream watershed that may have downstream implications for the Delta (e.g., changes in water storage or diversion), are not considered “covered actions”. The Delta should not be viewed in isolation from its upstream tributaries and downstream San Francisco Bay (NRC 2012 report).
- 57, 24-31: The section below needs to be more specific—they are less specific than the points mentioned in Chapter 4. Is it brief because a separate science plan is being developed 2012-2017 by the DSP staff? Then perhaps say so.
- 57, 32-35: The bullet continues the practice of emphasizing the biological side of Delta science. How much physical science, social science, and engineering belong in the Delta Science Plan?
- 58, Figure 2-4: Is not useful in its present format. This table should include more specific information (e.g., list specific items under policies section) and document the specific lead agencies.
- 53, 3: So a proposed action that is covered under a recommendation would not be considered a covered action? That is what is stated here. That weakens the recommendations considerably, making them little more than wishes.

CHAPTER 3. A MORE RELIABLE WATER SUPPLY FOR CALIFORNIA

This Chapter is also significantly improved over earlier versions. It is thorough, clear, easy to follow, and with some exceptions noted below, remarkably precise. The summary of conditions is useful. It is a nice synthesis. It is also clear that this plan remains hostage to other plans, but that cannot be avoided. The need for water reuse is mentioned several times but never developed as a topic. Is it in the water quality section (Chapter 6)? Should it be developed there or here?

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The Plan refers to “fisheries” in numerous places. Fisheries should refer to commercial and recreational harvest of fish. Since there are many more fish than those harvested, they probably should just use “fishes” instead.

As throughout the document, Performance Measures are not defined well and are clearly a work in progress. It is also unclear what will happen even when Performance Measures are established. You cannot propose to adaptively manage this program without clear performance measures and triggers.

- 76, 6: A different population size (36 million) is given here than in earlier chapters. Should be consistent (as of January 1, the Bureau of the Census estimates California’s population to be 37,692,000).
- 78, 20: Delta water doesn’t just flow out the Golden Gate, it also flushes southern San Francisco Bay (Conomos, 1979, p. 75-77)
- 87, Fig. 3-2: This chapter contains excellent graphics, and Figure 3-2 needs to be brought up to these standards. The figure would be clearer if divided into four parts, stacked against a common time scale. The bottom graph could show the water-year type, as on page 97. Separate graphs could show Sacramento and San Joaquin flows, for ease of seeing how their peaks and troughs compare. The top graph could show south Delta exports as a percentage of combined inflows. The existing labels on the graph itself (the ovals and the text linked to them) are confusing because the text seemingly refers to what’s inside the ovals only, and because the graph does not directly show exports as percentages of inflows. The export data are presented as a curve even though it’s also annual.
- 89: The text box on adaptive management could use refinement and precision if the Council decides to keep it in the text. The definition of the problem is vague and simply captured in the term “not adequate”. Adequacy can include size, connectivity, operations, location, etc. Also, there appears to be a substitution of the term “predictability” for reliability (also occurs on page 108, line 4). If this is intentional, it should be clearly defined. If it was defined earlier, reference should be made. Finally, the goals and objectives sections appears to be only about wet years when, in fact, you are attempting to convey water to storage during wet years so that it can be conveyed and used during dry years.
- 100, WR P1: This is perhaps the most important policy covering proposed actions in the Plan. However, there seems to be conflicting language. In the first and second paragraph the policy is pointed at those who use water directly from the Delta. The third paragraph appears to include those who use water from the Delta watershed. The conclusion is that the Council is choosing to only focus on in-Delta use and exports, and not upstream actions. This should be clear in the policy (and justified in the rest of the text).
- 102, 22: Regarding percent of groundwater use. This does not seem consistent with earlier statements.
- 104, 2: The statement can be interpreted as suggesting that there is insufficient volume of groundwater storage to achieve the coequal goals. There is a 70 maf “empty” aquifer in the Tulare Basin and extensive potential storage in the Sacramento Valley, so this

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hardly seems justified. It might read better to separate groundwater storage from surface water storage here.

- 105 WR P2: Transparency in Water Contracting. This policy is vague, perhaps by necessity. What specifically would be needed to meet the consistency determination in this regard by SWP and CVP?
- 106, 11-34: This does provide some specifics, more than mentioned in Chapter 2.
- 108, line 26: Make clear how agricultural water efficiency translates into improved inflows to the Delta.

Chapter 4. PROTECT, RESTORE, AND ENHANCE THE DELTA ECOSYSTEM

In general, this chapter is well written and based on the best available science. The sidebars make a significant contribution to the clarity and completeness of the chapter. It is a significant improvement over previous drafts. But: the Plan sketches a general approach, more specific in some places than in others. The real test will be in the development of specific restoration actions, and the Plan does not provide much guidance on *how* this will be done, how the science will be synthesized, how the landscape designs will be derived, or who will do it.

- 119, 8 and 120, 1: Should “resistant to future disturbances” be added as well as resilience?
- 119, 22: Is “envisions” the best word or is it more like “hopes for”?
- 119, 24: Some species will never be “abundant”; it’s more important that populations persist at sustainable levels.
- 120, 1-2: All ecosystems will absorb and adapt to multiple stressors, but humans may not like the end result of this adaptation (e.g. loss of native species, reduced productivity). Hence, this statement is not adequate. Isn’t the goal that a resilient ecosystem will absorb and adapt to multiple stressors without a significant reduction in the goods and services it provides?
- 120, 1-2: Somewhere, (perhaps not here), there needs to be an explicit recognition that thresholds and nonlinear dynamics may shift the ecosystem into an alternative state; there are inherent limits to ecosystem resilience. And there are limits to science and management to restore and maintain resilience and keep ecosystems from thresholds...
- 120, 18; 125, 18 and 145, 15: Restoring habitat won’t do any good unless species have access to it.
Access to habitat or connectivity should be included as part of this bullet.
If it is implied in the concept of habitat used here, that needs to be clarified.
- 120, 17-21: and remainder of chapter: It is odd that the words “threatened or endangered species” are never mentioned in the chapter or in the context of “harvest” to control take. BDCP is emphasizing these concerns, but threatened and endangered species should have figured prominently into Ch. 4., unless the writers purposefully are avoiding these terms. The word “listed” does appear in one of the Recommendations at the chapter’s end.

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- 120, sidebar: The phrase “natural potential” in the Water Code section cited is unclear and probably worthless, operationally. It certainly is not obvious how to measure or evaluate the “natural” potential of a population, much less of an ecosystem.
- 121, 19: If possible cite the SFEI tome that’s due out in June.
- 122, 5-6: See next comment on non-island tracts in the Central Delta.
- 123, Fig. 4-2: The bolded “Flood Basins,” “Tidal Islands,” and “Distributary Rivers,” are unfortunate holdovers from an early attempt by Alison and Robin to summarize. To the best of our knowledge, they are now going with “North Delta,” “Central Delta,” and “South Delta.” These geographical terms are indisputable and they allow for nuance: the North Delta had distributary rivers, the South Delta had flood basins, and the Central Delta had large tracts of tidal wetland that lapped onto the toes of alluvial fans without being enclosed as islands.
- 124, sidebar: The variability in natural flows involves more than “cycles.” The 1969-2009 averages plotted could be called “observed” or “measured” instead of “historical.” The footnote on natural and unimpaired flows could refer the reader to page 131. In this footnote, who is the “we” of “our”? The differences between natural and unimpaired could be summarized briefly, beyond saying that they “could be substantial at times.”
- 125, 1 ff: On stressors, cite the 2012 National Research Council report
- 125, 15-21: Listing these points as ecosystem strategies suggest that they will be the next topics covered but climate change is—perhaps the “climate change” section should be later and also the headings should be the same for the sections as they are for the points listed below
- ◆ Altered Delta flows
 - ◆ Habitat degradation and loss
 - ◆ Impaired water quality
 - ◆ Nonnative species proliferation
 - ◆ Impacts of hatcheries and harvest management
- 126, 28-29: No mention of a conceptual model here; yet it is an integral aspect of this process. A vision won’t get you anywhere without a conceptual model of how it can be achieved. Alternative models or plans are also often proposed at this stage, before management gets underway.
- 126, 28: Why cite chapter 2 here—it’s not really presented there as it is in the Appendix or the sidebar in Chapter 4 on p. 137?
- 126, 35: Recognition of flow as a key controlling variable here would be appropriate and based in science as evidenced by the citations.
- 127: Sidebar on ecological principles is excellent, but these principles may also serve to set unattainable goals, and therefore diminish credibility of science by contributing to the image that scientists don’t understand reality. For example, while it is true that what happens in the Delta is affected by the larger, regional system, we should be careful about setting the bar so high that findings of studies conducted in the Delta could be challenged because they ignored conditions elsewhere. Similarly, we should be cautious w.r.t. whether “historical natural variability” (principle 5) is a realistic benchmark for management. We rarely know what this is, the span of relevant

“history” is undefined (and perhaps indefinable), and we know that the future will in all likelihood move beyond historical bounds. Finally, it might be worth adding to the list that, as conditions change, so also will ecological communities, in some cases creating so-called “no analog” assemblages that contain mixes of species and species interactions that neither we nor the species have seen before. So, some cautionary text along these lines may well be in order.

- 128, side box: last bullet: Integrating these projects may be a role for DSP
- 129, 19: Is net outflow “measured” at Carquinez Strait? Some location indicating where net outflow is being considered would help here.
- 129, 27: The role of changes in landscape (e.g., urbanization) should be included here. As written, it sounds as though changes in flow are entirely a result of in-stream actions, and that is obviously not the case.
- 131: Good sidebar on more natural functional flow. There is some confusion in the last line of “What does natural flow look like?” It states “abridge the timing of seasonal peaks”; how does one abridge timing? Wouldn’t “abridge duration” make more sense if you are trying to say peaks may be shortened? Or “alter timing” meaning the time of year (day, month) that the peak flow occurs is different. Clarify the final sentence, perhaps in this way: “Relative to natural flow, unimpaired flow tends to increase the height and decrease the duration of a seasonal and shorter-term peaks in discharge.” Cite the February 2012 draft of the SWRCB flow criteria for the San Joaquin River and its tributaries.
- 133, 10: “the earlier these objectives are updated”
- 133, 35-36: Good way of handling the predation concern.
- 134, 22-23: Add “fishing” to these other stressors.
- 135, 6: “ecologically damaging” is unclear and too broad. They are a threat to native species.
- 136: The five priority restoration areas are well justified. One wonders how these areas relate to what is being proposed in BDCP.
- 137: An example like this is great. But where are the performance measures under step 2? That step lists goals, objectives and performance measures, but nothing is said about performance measures there. They are mentioned again and presented under step 4. Should they be mentioned in 2 if they are not developed until 4?
- 140, 19-20: It is good that the plan is expressing an opinion on this matter.
- 141, 32: The Encyclopedia of Invasive Species edited by Dan Simberloff is a good source of information on this topic. This reference could be added on line 32. A discussion of this is not beyond the purview of the plan and at least references should be added to this section.
- 141, 34 and 39 and 142, plants in section starting on line 9: The scientific names of these species should be indicated in parentheses.
- 142, 23-25: Some of the centrarchids (e.g., largemouth bass) are clearly potentially important as predators on salmon and other native fishes but the sunfishes and bluegill aren’t in that category. They possibly could eat the tiny larvae of delta smelt but they won’t be predators on salmon fry or smolts.

- 142, 33: Invasion is a result of introduction of the species (which is a globally determined stressor) and the successful establishment of the species (which is a result of local conditions that are partly under human control).
- 143, 9: The opening sentence says little the way it is written. It might be recast to be “Depending on the species and the interests of the Delta users,”
- ER R1: The need for taking these restoration actions in the framework of adaptive management belongs in this first paragraph. This is implied by what has been written in Chapter 2, but it is important that it be reiterated as part of each policy or recommendation, which are likely to be read and cited individually.
- 143, 31: Diseases and introduction of them to native fish populations are a major risk from hatchery-stocking and should be noted here.
- 143, 35: It would be good to add a reference as harvest programs often don’t work for introduced species as well as one that indicates that they have worked.
- 143, 45: Reduction in the number of one species of predator may not reduce the overall impact of predation because other predatory species may increase in abundance with the reduction in competition for prey resources or because their young may have been prey of the targeted predator. This problem with the proposed changes in striped bass harvest should be included here as it is relevant to all such predator reduction strategies targeted at just one species.
- 144, 4-6: The 5% survival of tagged smolts seems low, but is not very different from survival of many juvenile fishes, including wild salmon, of this size. This includes young-of-the-year striped bass, cod, and coral-reef fishes, where the natural mortality rates range from $M = 0.01$ to 0.04 per day. This would translate to 9% survival after 120 days at $M = 0.02$ but 3% survival if $M = 0.03$. Of course, building survival from 5% to 10% for a threatened fish stock would be a good thing and if a reasonable predator-control program could be developed, it might help.
- 144, 18: Perhaps a citation to this approach being used for the Rio Grande silvery minnow would be useful.
- 144, 19-40: It is surprising that introduced diseases from hatchery releases are not mentioned. This is a big problem, e.g., whirling disease in salmonids.
- 144, 41: Harvest may not have been a root cause of the major declines in salmon in the Delta system, but once stocks are at a low level and habitat is no longer productive, then fishing mortality can be the most important factor that needs to be controlled.
- 153, 15: Although established non-native species cannot be eradicated, their abundance can be reduced. This should be acknowledged here.
- 153, 18: This is worded awkwardly; rephrase it to “Avoid Introductions and Habitat Improvements that enhance survival and abundance of Nonnative Invasive Species”.
- ER R5 and R6: Both of these recommendations should include the need for development of performance measures and a monitoring plan to support an adaptive management approach.
- 154, 8-21: Again, diseases should be included as a concern, and risk from hatchery fish should be reduced.

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- 156, 4: Does this modeling include attempts to compare restored landscapes with the patterns and processes of the historical ones sketched on pages 121-123?
157: The outcome performance measures are vague but headed in the right direction.

CHAPTER 5. CALIFORNIA DELTA AS AN EVOLVING PLACE

This chapter is now “reasonably good”, which is a significant improvement from earlier versions. It is certainly informative about the Delta, its people, industries, history, threats/risks, and the aspirations for it. The authors have carefully melded relevant information and delicately reworded material from documents with contradictory agendas, especially with respect to the trade-offs between economic vitality/expansion and ecosystem restoration. Still, as noted below, there are some contradictions to address.

The chapter now provides considerably more information about how goals might be reached by the actions of specific agencies, the different roles of DSC in the secondary and primary zones, etc. Unfortunately, it is also now very clear that the DSC can only prevent inconsistent actions, not actually instigate actions to fulfill the plan so that both goals are co-equally reached. Clearly, this will depend on funding incentives, but Chapter 8 on funding argues that a funding plan will be developed after approval of the Plan, so much remains in doubt.

Throughout this chapter, the term “legacy communities” is used (with capital letters implying that it means a special status). Should a sidebar or a descriptor of what this means be added, perhaps with some elaboration on the possibilities for a National Heritage Area as well?

- 167: The opening sentence needs to be simplified.
169, 12-23: The description of the Delta Protection Commission and Delta Conservancy, and their respective areas of authority or responsibility is very important and could be made clearer.
167-9: The introduction is very good, especially the three views and the early emphasis on being historically unique but also very much changing. Private efforts to create a vision of the Delta might also be mentioned (Chambers of Commerce and “Discover the Delta”, etc.)
175, 11: “best improved state park”--awkward wording
194, 33: “value-added processing”—elaborate a bit so the meaning of this phrase clear
199, 12-13: “Water management, ecosystem restoration, and flood management projects minimize conflicts with adjoining uses by including adequate mitigation measures to avoid adverse effects.” This is so vague—can it be recast for clarity?
170, 3: "reclaimed the Delta." Is this the appropriate language? Would "protect the Delta's marshes and floodprone..." be better? The present language implies that the extensive levee systems succeeded in making the Delta a better place and more productive ecosystem. The levees have lowered flood risk, but they have been a cause of many ecological problems.

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- 176, 1-15: It seems that goals 1, 2, and 3, are missing. The text thereafter only apparently addresses 2 and 3 but it would be good to make these goals explicit in the list and in the elaboration in the text!
- 176, 27: How the DPC's land use plan "guides" land uses and under what circumstances the DSC might find inconsistency with the outcome of that process might be made more explicit.
- 179, 8-17: The Delta's recreation and tourism industries are either flat or declining. Here, matter-of-fact statements are made of the situation. More text about the implications would be welcome because later in the chapter there is optimism about developing these industries and recommendations to undertake development and enhancement.
- 179, 43: The Solano wind development area is outside the boundaries of the Delta, though obviously very visible from the Delta and an attraction to those who are fond of wind development, but also a potential conflict for those who are not.
- 180, 3-26: a little more elaboration on the purposes of the Delta Investment Fund and how it is funded now and might be funded in the future would be appropriate here.
- 182, 11-15: A little more detail on why farmland is decreasing and crop mixes are changing would help the reader understand the dynamics here.
- 185, 1-5: "Safe Harbor Agreements." More needs to be said about these agreements and their potential for both good and poor outcomes with respect to protecting and restoring the Delta ecosystem.
- 185-190: Here the recreation and tourism industries are described in some detail, with an apparent optimistic outlook that seems at odds with the statistics on these industries over the past two decades (page 179).
- 190, 3: Anglers may "pursue salmon and sturgeon" in the Delta, but it might be relevant here to note the regulations in place to protect species that are threatened, endangered, or listed, i.e. some sense that the fishing is kept complementary with ecosystem goals and how this dynamic may change over time.
- 191-195: There are numerous recommendations, many of which seem highly desirable. All are put forward stating that an appropriate agency or entity "should" develop, undertake, encourage, improve, etc. But, the reader is left with the impression that there is insufficient resolve to really pursue many of these recommended actions. The "should" language is purposeful to account for "non-covered actions" and it also appears in other chapters, but perhaps the Delta Plan "should" be addressing how to resolve or overcome the conflicts and funding issues that leave these agencies relatively ineffective.
- 196: Under "Sustain a Vital Delta Economy." Here, it would be good to remind readers of the "two coequal goals" and that promoting the Delta economy is not independent of them.
- 197, 6-12: "Science and Information Needs." This is a remarkably sparse statement of science and information requirements to insure a healthy Delta. Surely, this section can be expanded. There are numerous tradeoffs within the Delta between activities that need to be much better understood by Delta interests. Nothing is said about the need for much more integrated social, economic, and ecosystem-level science and how that might be

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promoted. Nothing is said about information and science needs to contribute to adaptive learning and management. Nothing is said about the need for regular monitoring of the Delta ecosystem and its human industries (although we suspect that monitoring is intended).

- 199: "Performance Measures." Not very inspired. The Plan writers ran out of steam here and will hopefully revisit this section and develop it.
- 200: Citations DPC 2012a and b seem to be reports from 2011, especially since October is well ahead of us still. This needs to be corrected throughout the text as well.

CHAPTER 6. IMPROVE WATER QUALITY TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

Overall this chapter is much improved, and largely in good shape. Throughout the chapter the use of references is somewhat inconsistent. Some of these inconsistencies are noted on specific comments below, and we suggest several additional references to include.

Broader inclusion of bacterial contamination (human and animal) might be considered for this chapter. It is a problem in terms of some of the categories mentioned in the Table on p. 208 but is only briefly mentioned in one sentence on p. 218 line 12 and under the pathogen section on p. 219.

- 207, 13: "very high flows" should be defined (e.g., $> XX \text{ m}^3 \text{ s}^{-1}$)
- 207, 13: Omit "can" or specify conditions when this happens.
- 207, 22: What is meant by, "high-quality inflows"? Presumably the implication is that inflows of high-quality water are needed.
- 207, 35 and 37: Should a note be included to refer to subsequent sections (page 219) on disinfection and its byproducts? Recommend that writers specify what cancer-causing disinfection products they are referring to in these sections (e.g, USEPA regulates two classes of drinking water by-products: trihalomethanes (THMs) and haloacetic acids (HAAs). This section should be strengthened with references to the primary literature.
- 207, 36-37: Drinking water treatment (e.g. chlorination and ozonation) react with dissolved organic matter (DOM) components to form toxic halogenated compounds (Leenheer, J.A. and Croue, J.P. (2003) Characterizing dissolved aquatic organic matter. *Environmental Science and Technology* 37, 18A–26A).
- 207, 36-37: Cite Kraus et al. (2008) Assessing the contribution of wetlands and subsided islands to dissolved organic matter and disinfection byproduct precursors in the Sacramento–San Joaquin River Delta: A geochemical approach. *Organic Geochemistry* 39: 1302–1318).
- 207, 37: While there are data supporting the role of DOM from wetlands (see Kraus et al., 2008), are there data supporting a relationship between disinfection by-products and creation of wetlands?
- 208, 17-19: Consider using bold or italics to emphasize the specific goals of this chapter.
- 208, Table: Wouldn't they still depend on water quality in terms of salinity? See also line 9 on p. 215 where industrial processes are mentioned.

Industrial Service Supply

Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining cooling water supply, hydraulic conveyance....

- 210, 29: Revise to, “for use within and outside the Delta”.
- 214, 13: It would be preferable to describe the Delta as an estuary where freshwater from rivers and streams mixes with seawater from the ocean, rather than ascribing the mixing as being due to tidal effects. Estuaries can have tidal effects even in regions where salt water does not intrude.
- 214, 20: Shouldn’t ecological health be mentioned as well—fish toxicity from chloramines? If you agree, a comment like this could be added on p. 207 line 36. It might also be added to the sidebar on p. 219
- 214, 31: This sentence is unclear. What is meant by “relevant to suitability for water supply”? Figure 6-1 could perhaps be better described as depicting salinity in the Delta under two different scenarios of river inflow.
- 215, 14: These activities have not influenced the strength of the tides but the strength of the effect that tides have on the Delta. Suggest revision to, “have changed salinity patterns in the Delta by increasing the effects of tidal forcings in the Delta ...”
- 215, 27: Suggest revision to, “that already includes salt”.
- 216, 11-19: This paragraph needs more references to the primary literature. Provide supporting citation(s) for salinity preferences of Delta smelt and adult longfin smelt. Provide citation(s) for preferences of largemouth bass and bluegill.
- 216, 14: Moyle reference seems out of place here—is it only referring to that species? If it refers to all, beginning of paragraph should be recast.
- 216, 25: This statement that supports the importance of X2 and 2 ppm needs some substantiation with references. It’s the key justification for even using X2.
- 216, 34-37: Provide literature citation for relationship between X2 and extent of low-salinity habitat.
- 217, 2: Perhaps add about 1% of seawater?
- 218, 6: (salinity) is confusing. Is it necessary?
- 218, 9: Consider using “export” instead of “flux”.
- 218, 32-33: Leachate from decaying vegetation is one source of DOM but DOM may be derived from riverine, wetland, open water and island drainage sources.
- 219: Disinfection Byproducts sidebar. Consider the following revision, “react with bromide and/or dissolved organic matter (DOM).” Leachate from decaying vegetation is one source of DOM but DOM may be derived from riverine, wetland, open water and island drainage sources.
- 220, Line 10: Omit “very” or define what is meant by “very low”.
- 220, 11-12: Define what is meant by “moderately high”
- 220, 20-22: Provide literature citation for contamination by nitrates and other pollutants.

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- 220, 133-36: Polycyclic aromatic hydrocarbons (PAHs) need to be included as a class of concern. Even though they have been studied for decades, recent studies (e.g. Incardona et al 2004, 2005, 2006, 2012) are demonstrating severe toxicity to fish embryos, through impacts on heart development and function. This makes them “contaminants of emerging concern”, because even though these contaminants have been around for a long time, new research is leading to emerging concerns. Probably best to bring PAHs up on p 226, lines 27-29.
- 220, 41: Should it be “various forms of phosphate” since the different forms of nitrogen are given?
- 220, 41: Ammonia and ammonium are essentially the same species. Free ammonia (un-ionized ammonia, NH₃) is highly toxic to fish. Ammonium (ionized ammonia, NH₄⁺) is not toxic to fish but may be used as a source of nitrogen to algae and other plants.
- 221, 15-16: The effects of ammonium on Delta waters have not been resolved. It is important that this be acknowledged through the addition of references to Cloern et al., (2011; *Limnol. Oceanogr.*, 57(2), 2012, 665–668) and the recent report published by the National Research Council (2012; *Sustainable Water and Environmental Management in the California Bay –Delta*).
- 223: Applying Adaptive Management in Water Quality Decisions sidebar: In Adaptive Management Step 3, there is an “a” missing in “algae”.
- 224, 24: The section on pesticides should note the recent work on synergistic toxicity of current use pesticides in salmonids, these ongoing studies will be very pertinent to water quality issues in the Delta (Laetz et al 2009. The synergistic toxicity of pesticide mixtures: Implications for risk assessment and the conservation of Pacific salmon. *Env. Hlth. Perspect.* 117:348-353).
- 224, 31: Why rivers; Delta;? Instead of commas?
- 224, 39: Revise to, “which are common replacements for the OP pesticides”
- 225, 1-4: These sentences are contradictory, and recommend changing the first sentence to read, “Contaminants cannot be eliminated as a possible contributor to the declines in open-water fish populations in the Delta (known as pelagic organism decline [POD]),”. With a cited reference stating that there are not enough data to determine if contaminants played an important role in the POD, then it’s not logical to also state that “contaminants are unlikely to be a major cause of the declines”.
- 225, 18: Omit “very” or define “very low concentrations”.
- 225, 41: Selenium. This section could benefit from discussing the different forms of selenium (like it did for mercury) and their differential toxicity (e.g. selenomethionine cf. selenite and selenate) Also, shouldn’t some mention be made of it’s patchy distribution, where it’s common in some areas and rare in others?
- 227, 15: What is “it” here? I think that the Delta should be specified.
- 227, 23-27: This problem statement should also mention being proactive (e.g., anticipation of changes in water quality in response to climate change and being responsive to contaminants of emerging concern).

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- 230, 5-7: Why are two years required from the time the nutrient objectives studies are completed in 2016 to adoption and implementation in 2018? This would benefit from some explanation.
- 231, 28: Suggest changing to “♦ The effects of the simultaneous presence of multiple pesticides, even at low levels, on species of concern”.
- 232, Timeline: List the lead agencies responsible for actions even when multiple agencies are involved. It is important that the agencies responsible for “protect beneficial uses” and “identify covered action impacts” be specified.

CHAPTER 7. REDUCE RISK to PEOPLE, PROPERTY, and STATE INTERESTS in the DELTA

Although not as well written as some other chapters, this chapter also shows considerable improvement and increasing clarity of policies. However, two issues remain.

First, there is a weak note about climate change in the description of the causes of risk, but it virtually disappears from the chapter until a discussion of science needs. The Council supports the use of levee standards, particularly HMP, along with the use of risk-based assessments (a solomonic solution). But both of these are moving targets due to changes in the factors that drive risk. This is particularly true for the standards based largely on flood elevation frequencies. Those approaches assume that the past is a predictor of the future. To do risk-based and standards-based approaches, the Council should insist that future conditions (not just climate) be incorporated into planning. It would be reasonable to ask that this be included in the 2015 plan.

Second, although the Council promotes risk-based approaches to prioritizing levee investments, they appear to have punted on the issue of what to do with your low-priority levees after they fail. Repair, restore, or leave flooded. The Chapter should explicitly state that they have put this issue off for another day, or choose to address this problem head on.

- 246, 23: Rewrite to avoid implying that levees prevent floods from entering the Delta’s waterways.
- 248, 16: It would be more informative to present a graph showing Delta levee failures against time. Comparable timelines, showing water data, strengthen Delta Plan Chapter 3. DWR 2005 is a 21-page position paper that presents almost no data. What part of it supports that statement about 140 levee failures and island inundations and about their occurring mainly during flood seasons?
- 248, 22: Are there no active faults known or suspected beneath the Delta? There are indications that active faults may underlie the western Delta as well. Although low probability of significant seismic activity, the consequences would be high.
- 248, 33: On what fault does the scenario’s 6.5 occur?
- 248, 34: Replace “prediction” with “forecasts”

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- 249, Fig. 7-2: To reach a broader audience, express salinity in parts per thousand instead of conductivity, and note that seawater is commonly 34 ppt. Consider “brackish” instead of “salt” and “saline.”
- 249, 3: Name the fault and show its location on the map.
- 250: The overall discussion of subsidence is not well organized nor cited. The paper by Deverel and Leighton is a state-of-the art assessment of this issue and should be incorporated more into the discussion, particularly their explicit statement that subsidence is continuing (not believed by many in the Delta). Also, the notion of “accommodation space” in Mount and Twiss never really took hold in Delta policy discussions. I would recommend dropping it.
- 250, 8: Help the reader find the subsidence section in Chapter 5 by pointing to the section headed “Protecting Productive Farmlands.”
- 250, 12: The Miller paper describes a biologists’ method for building up peat inside Delta islands. Does this make it a primary reference on levee maintenance and hydraulic stress?
- 250, 17: Revise for clarity: “mobilize to drainage ditches.”
- 250, 20: Narrow the topic sentence to focus on flood risk. The topic sentence should be accurate even if the climate change’s greatest effect on the Delta turns out to be in the allocation of scarce water between humans and wildlife.
- 250, 27: Solely USGS research? See comment below on page 281.
- 250, 28: If the “massive storms” may be in the reader’s memory, give the date of an outstanding example.
- 250, 35: The text should be more explicit (or clear) that all government flood management actions are viewed as covered actions by the Council and must meet consistency standards (or is this an over-interpretation of the text?).
- 256, 44: Does island flooding end up providing habitat for invasive plants that are harmful to native fish?
- 260, 34: The Council may wish to be more thorough in its recommendation/ requirement that the Delta levees be assessed. That is, they should consider spelling out what is needed in assessment (foundation, embankment, geometry, materials, vegetation, etc.), otherwise just inspecting levees will be assessment enough.
- 263, Fig. 7-6: Expand caption to help reader identify the “flood management facilities.”
- 267: Liability concerns. This section talks about liability concerns but doesn’t preview what should be done about them. This is different in style than previous sections.
- 268, 30: The recommendation implies that the local agencies currently lack emergency plans.
- 271, 17: Define “Geometric levee assessment” and encourage looking beneath the surface.
- 278, 8: Please expand this bullet for clarity. Ecosystem function of riprap?
- 278, 11: Could also mention seismic sources – faults and the sizes and rates of earthquakes that occur on them – and the effects of subsurface geology on the strength and frequency content of the shaking.
- 280, 31-32: Cite reference accurately. It’s a research paper in *San Francisco Estuary and Watershed Science*.

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281, 12-13: Cite reference accurately by naming the four authors. Two of them work for USGS. The others work for NOAA and Scripps.

CHAPTER 8. FUNDING PRINCIPLES to SUPPORT the COEQUAL GOALS

This chapter should be significantly less apologetic about the current fiscal crisis of the State of California and be a lot more positive about the tremendous value of water to California's huge economy and the potential for increasing the value through better ecosystem and water management.

Appendix A

The two examples of Adaptive Management that have been left in the chapters are good.

A- 1: The paragraph description of Best Available Science (the list right after the Sullivan citation) says nothing about identifying level of uncertainty. That has to be part of this description!

A-4: Reluctance to establish performance measures was another barrier to adaptive management under CALFED. You can't do adaptive management without performance measures!

The Barriers section especially the Walters (2007) results will make readers wonder why this approach is even being tried. The last section of this sidebar isn't really very reassuring. A comparable sidebar on "When Adaptive Management Has Worked" or "Making Adaptive Management Work" is needed to balance out this negative section. The two case histories presented later on are not really sufficient to overcome the negative tone of this section. The second mainly deals with communication.

A-6, Point 3, paragraph 2: Shouldn't they include a definition of what they mean by conceptual models? They mention qualitative cf. quantitative but I think that they should go into a bit more detail. The examples they give really don't explain this term to non-technical readers.

A-6, end of point 3, the use of the term "stories" may have a negative connotation of the value and accuracy of the models

A-7: To be consistent with what is in Chapter 2, Driver should be changed to Output in the bullets and in the text.

Appendix C

An administrative performance measure for ER R1 states that 100% of the restoration projects are in one of the five priority areas. It is probably best not to say 100% and surely there are local situations where restoration is appropriate even if it does not fit the priorities listed. How does that mesh with what is being recommended in the ERP strategy? It is valuable to identify 5 priority areas, and focus most of the attention to those areas, but less certain that ALL projects need to be there. How well do those areas deal

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with terrestrial species? It would be fine to say that 100% of projects are within the appropriate elevation range as discussed in the text, but there is not any performance measure that says anything about elevation.

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http://downloads.ice.ucdavis.edu/sfestuary/conomos_1979/archive1018.pdf.

Gilbert, G.K., 1917, Hydraulic-mining debris in the Sierra Nevada: U.S. Geological Survey Professional Paper 105, 154 p.