



980 NINTH STREET, SUITE 1500
SACRAMENTO, CALIFORNIA 95814
WWW.DELTACOUNCIL.CA.GOV
(916) 445-5511

Delta Independent Science Board

June 16, 2017

To: Randy Fiorini, Chair
Delta Stewardship Council

Charlton Bonham, Director
California Department of Fish and Wildlife

Cc: Cindy Messer, Chief Deputy Director
California Department of Water Resources

From: Delta Independent Science Board

Subject: Review of the Final Environmental Impact Report/Environmental Impact Statement for California WaterFix

Chair
Stephen Brandt, Ph.D.

Chair Elect
Elizabeth Canuel, Ph.D.

Past Chair
Jay Lund, Ph.D.

Members
Brian Atwater, Ph.D.
Tracy Collier, Ph.D.
Harindra Fernando, Ph.D.
Richard Norgaard, Ph.D.
Vincent Resh, Ph.D.
John Wiens, Ph.D.
Joy Zedler, Ph.D.

SUMMARY

The Delta Reform Act of 2009 directs the Delta Independent Science Board to review environmental impact assessments of the Bay Delta Conservation Plan (now California WaterFix). Here, in our fifth such review, we focus on the adequacy of the scientific information presented in the final Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) for the California WaterFix by revisiting the six main concerns we raised in our September 2015 review of the Recirculated Draft EIR/Supplemental EIS. We discuss improvements and shortcomings. We also comment on the need to improve impact assessments for scientific evaluation and effective stakeholder engagement.

The Final EIR/EIS contains a wealth of detail and considerable insight. This version improves on its predecessors but retains some persistent shortcomings. Improved content on adaptive management is still short on detail about how adaptive management would be implemented under changing and uncertain conditions. Summaries and comparisons, more abundant than before, lack insightful syntheses and graphics that ease comprehension of the vast amount of material presented. Expanded discussion of Delta levees stops short of evaluating interactions with water supply reliability and neglects changing views of earthquake hazards. Long-term effects are better addressed in several ways, but with insufficient attention to uncertainties in defining the No Action Alternative and to the interplay between California groundwater sustainability and Delta water supplies. Other content missing includes evaluation of environmental effects of water use south of the Delta. Evaluation of ecosystem impacts, though extensive, retains gaps on using restoration as mitigation.

The completion of our reviews of the Final EIR/EIS and its predecessors prompt us to reflect more broadly on the use and communication of science in the Delta and more specifically on the false tradeoff between thoroughness and intelligibility that has become common in environmental impact assessments. Overwhelming readers with content that addresses the many scientific issues related to a proposed project and its alternatives, while neglecting the thoughtful presentation and synthesis of insights and performance tradeoffs among alternatives, diminishes the value of this important document as a comparative guide to the expected environmental effects of the alternatives considered.

Delta Independent Science Board Review of the Final EIR/EIS for California WaterFix

Contents

| | |
|--|----|
| SUMMARY | 1 |
| INTRODUCTION | 2 |
| IMPROVEMENTS AND SHORTCOMINGS IN THE FINAL EIR/EIS | 2 |
| Adaptive management | 2 |
| Informative summaries and comparisons | 4 |
| Levee risk..... | 5 |
| Long-term effects..... | 7 |
| Missing content: Impacts of San Joaquin Water Reliability..... | 8 |
| Restoration and mitigation..... | 9 |
| REFLECTIONS: PARALYSIS BY ANALYSIS, AND AN OPPORTUNITY MISSED..... | 11 |
| REFERENCES CITED..... | 13 |

INTRODUCTION

The Delta Reform Act of 2009, in section 85320(c), directs the Delta Independent Science Board (Delta ISB) to review the environmental impact report of the Bay Delta Conservation Plan (BDCP) and to provide the review to the Delta Stewardship Council and the California Department of Fish and Wildlife. We provided brief reviews of the Administrative Draft EIR/EIS (Delta ISB, 2012, 2013), a fuller review of the Public Draft EIR/EIS (Delta ISB, 2014), and further comments on the Recirculated Draft EIR/Supplemental Draft EIS (RDEIR/SDEIS, Delta ISB, 2015). Here we provide a further review that has been occasioned by the Final EIR/EIS, which like the RDEIR/SDEIS identified the preferred alternative as California WaterFix.

Most of this review focuses on the adequacy of the scientific information presented in the Final EIR/EIS. We ask how well this document provides a scientific basis for evaluation of California WaterFix and its alternatives. Revisiting the six main concerns that we raised in reviewing the RDEIR/SDEIS (Delta ISB, 2015), we find welcome improvements, but persistent shortcomings in the Final EIR/EIS.

Our review concludes with broader commentary on the EIR/EIS process. Our concerns emphasize the challenge of producing environmental impact assessments that are both scientifically thorough and readily comprehended.

IMPROVEMENTS AND SHORTCOMINGS IN THE FINAL EIR/EIS

Adaptive management

Summary of Delta ISB comments on the RDEIR/SDEIS

Although the RDEIR/SDEIS clearly recognized the importance of adaptive management as a way to deal with uncertainties and adjust water-management practices as necessary, it did little to improve on the superficial treatment of adaptive management in the BDCP. As before, the adaptive

management process was envisioned as something that would be developed during the course of project construction and operation, rather than being incorporated into the proposed project plan. Potential impediments to implementing adaptive management were not acknowledged. No details on how adaptive management might be integrated into habitat restoration or flow management were provided. The focus was more on how adaptive management and monitoring might be organized in collaborative science programs (e.g., with the Delta Collaborative Science and Adaptive Management Program, CSAMP) than on how it might actually be done.

Adaptive management in the Final EIR/EIS

The Final EIR/EIS includes a new section 3.6.4.4 dealing specifically with adaptive management and monitoring. It proposes a framework for adaptive management based on the Comprehensive Everglades Restoration Plan. Drawing from similar experiences in another large, complex ecosystem is a good idea (Ebberts, et al, in press), although the shortcomings noted by Doremus et al. (2011) should be considered.

Section 3.6.4.4 describes the kinds of adaptive changes that might be made and goes through what will be done in the major phases of adaptive management. The emphasis is on the role of adaptive management in bounding uncertainties and enabling flexibility in decision-making (pages 3-287 to 3-288). For example, “[T]he Adaptive Management Program will evaluate the effects of water operations and habitat restoration on the delta smelt population, including adjustments as appropriate to improve water supply reliability” (p. 11-1201). The description of how adaptive management might be used in addressing uncertainty in the effectiveness of physical and nonphysical barriers in controlling predaceous fish (p. 3-207, 11-2117) is another good example. Adaptive management is referenced throughout as a way to assess the effectiveness of Mitigation Measures.

Explicit consideration is given to establishing thresholds that might trigger the decision-making process and to the use of decision trees, pilot studies, and research to address critical unknowns (e.g., for delta and longfin smelt, pages 11-1418, 11-3208). The Final version, like those before it, proposes an Adaptive Management and Monitoring Team that would oversee a comprehensive program, building on the model of CSAMP. Few details are offered about how this team would be formed, how its responsibilities would mesh with those of multiple agencies working in the Delta, or how it would function, although it would be responsible for developing monitoring protocols (p. 3-226) and would oversee funding (p. 3-204).

Overall, the Final version provides a satisfactory explanation of why adaptive management is important and how it will be used, but not details of how it will actually be done.

Remaining Delta ISB concerns

Although the treatment of adaptive management and monitoring in the Final version is improved over earlier drafts, it remains weak on details, particularly in relation to the extensive and detailed coverage of other topics in the Final version. We are assured that an adaptive management and monitoring plan will be developed “during early years of project implementation” (Responses to comments on Draft EIR/EIS 2546-79). As we have noted previously, developing such a plan at the outset is essential if adaptive-management is to be used effectively. A plan and structure for adaptive management and monitoring should be in place *before* actions are initiated. A compelling case of adaptive management implementation to mitigate environmental impacts of the projects over the long term is lacking.

There also remains no mention of potential impediments or constraints on conducting adaptive management; many of these can be anticipated (as discussed in the Delta Plan and the Delta ISB review

of adaptive management, Delta ISB, 2016).

The organization and use of adaptive management as proposed is closely tied to the Biological Opinions (BiOps) required under the Endangered Species Act (ESA). Given the regulatory context of an EIR/EIS, this is understandable; management of the Delta and its waters is constrained to operate within relevant laws and regulations. Designing the adaptive management and monitoring program more broadly, to consider actions, decisions, and their consequences for the Delta and its inhabitants would be far more valuable. That said, the Final version does describe (briefly) a procedure for considering the application of adaptive management to management changes falling outside the purview of the BiOps and ESA authorizations (section ES.3.2.3, page 3-287).

Informative summaries and comparisons

Summary of Delta ISB comments on the RDEIR/SDEIS

“Environmental impact statements shall be written in plain language and may use appropriate graphics so that decision-makers and the public can readily understand them” (Code of Federal Regulations, 40 CFR 1502.8). This guidance for project proponents applies all the more to a project of the scope, complexity, and importance of California WaterFix. Far-reaching decisions should not hinge on environmental documents that few can grasp. Decisions about California WaterFix should be guided by comparisons among alternatives in integrated tables, graphics, and text. Summaries of impacts should state underlying assumptions clearly and highlight major uncertainties. The presentation of alternatives should include, in addition, explicit comparisons of water supply deliveries and reliabilities as well as environmental and local and regional economic performance.

We stated these concerns in our first reviews of the Administrative Draft EIR/EIS of BCDP (Delta ISB, 2012, 2013). We elaborated on them in our review of the Public Draft (Delta ISB, 2014) and again in our review of the RDEIR/SDEIS (Delta ISB, 2015). We repeatedly emphasized the need for informative summaries—in words, tables, and graphs—that compare the proposed alternatives and their principal environmental and economic impacts in each resource area. We specifically requested such summaries and comparisons in each of our prior reviews (Delta ISB, 2012, 2013, 2014, 2015). In 2014, for instance, we noted that the Public Draft provided text-only summaries for just the two longest of its resource chapters (Chapters 11 and 12) and that a fragmentary comparison of alternatives was buried in section 31.3. We asked that each resource chapter begin with an informative, analytical summary of how the alternatives compare and how underlying assumptions and uncertainties play out. We also called for graphics that offer informative summaries at a glance.

Clear, thoughtful text in the successive iterations of the EIR/EIS showed that the preparers were fully capable of providing cogent summaries, clear comparisons, and informative graphics. There was ample time to build these essential components into the Public Draft and the Recirculated Draft. On August 14, 2015, representatives of California WaterFix assured us that resource chapter summaries would appear in the Final EIR/EIS.

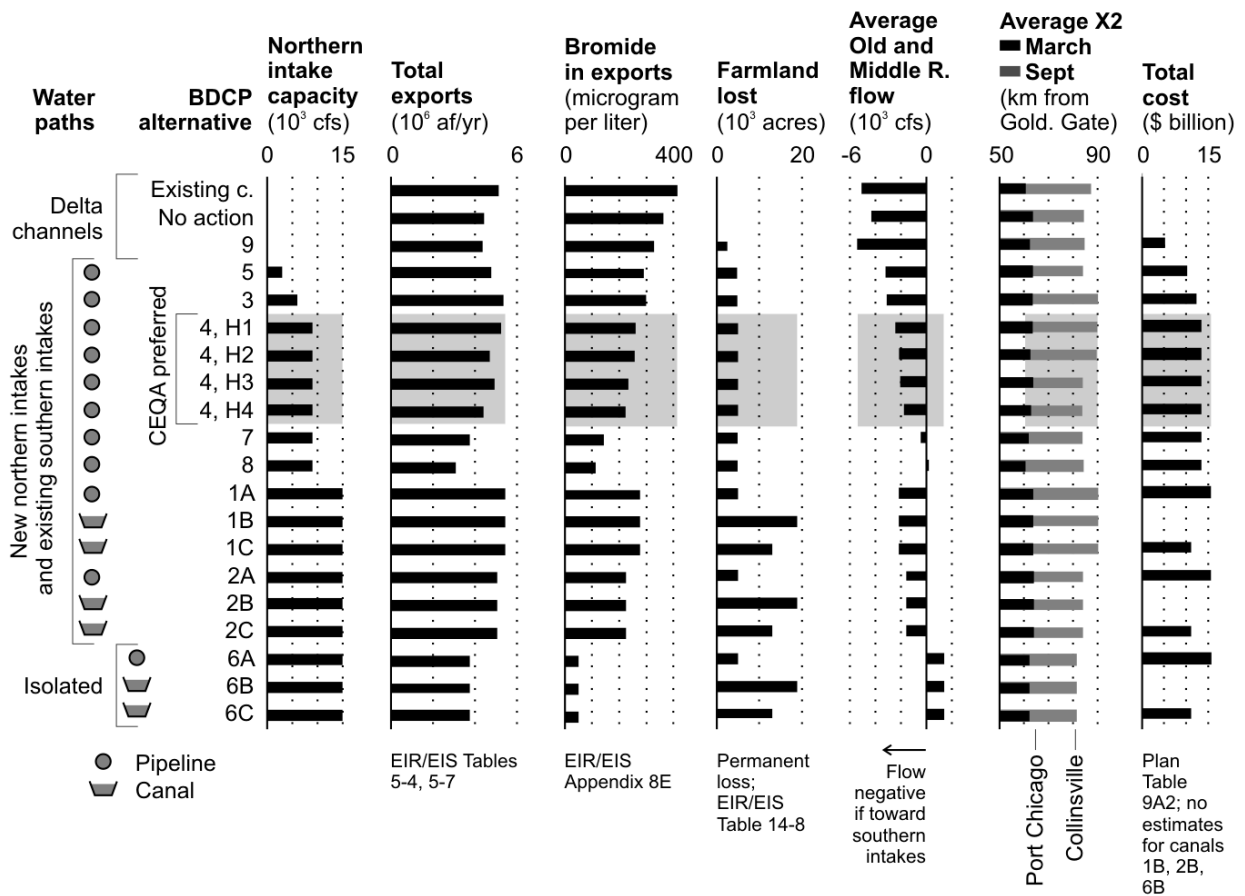
Related changes in the Final EIR/EIS

The Final EIR/EIS takes some steps in this direction. A summary text, supported by a color-coded table that compares alternatives, begins each resource chapter in the Final EIR/EIS. The Executive Summary brings these additions together.

Remaining Delta ISB concerns

Despite these additions, the Final EIR/EIS resembles its predecessors in failing to communicate clearly the principal findings and uncertainties of an enormous report. Two examples:

1. Most decision-makers and members of the public will struggle with jargon in the tabular summaries. These encode each of the alternatives with cryptic names, instead of providing the reader-friendly handles used in section 29.3.2.
2. The Final EIR/EIS, in its responses to comments, downplays the need for improved graphical communication of California WaterFix alternatives and their impact. Reproduced below is an example we provided of the kind of graphic that could provide informative summaries at a glance for comparing alternatives on some major performance objectives (Delta ISB, 2014, 2015). In response, the Final EIR/EIS states that the graphic “does not raise any additional issues related to the environmental analysis in the 2015 RDEIR/SDEIS or the 2013 Draft EIR/EIS that are not already addressed in the Final EIR/EIS.”¹ This response, like the Final EIR/EIS itself, completely misses the point about using diagrams, integrated with text, to make the report readily understood by decision-makers and the public.



Levee risk

Summary of Delta ISB comments on the RDEIR/SDEIS

We found the RDEIR/SDEIS incomplete in its evaluation of how California WaterFix would affect Delta levees. We saw Delta levees as important enough for impacts on them to be evaluated

¹ Response to comment number 88, Recirculated Draft letter 2546, in Final EIR/EIS Volume II, part 2-2, Table 2-2, at http://baydeltaconservationplan.com/FinalEIREIS/FinalEIR-EIS_ResponseToComments.aspx.

systematically in a “resource chapter” much like the chapters on water supply, fish and aquatic resources, agriculture, socioeconomics, and so on (chapters 5–30).

We further suggested that this evaluation include potential effects on State priorities in levee investments. The criteria in setting these priorities, the Board noted, include the role of a given levee in protecting water supplies (letter 2546, comment 71).

Related changes in the Final EIR/EIS

The Final EIR/EIS takes a step toward providing a resource chapter on Delta levees by adding Appendix 6A, “Coordination with flood management requirements.” Its content includes a section headed, “Potential impacts of the California WaterFix” (section 6A.6). The appendix states up front (p. 6A-1):

“The proposed project does not include a commitment to improve the current levee system except where the project explicitly includes levees in the project construction. However, it would provide additional adaptability to catastrophic failure of Delta levees by providing an alternative mechanism to continue making water deliveries . . . even if the Delta were temporarily disrupted.”

“Levees are an important public safety resource and the proposed project would not change levee policy or replace ongoing programs and grant projects aimed at facilitating and supporting levee improvements in or outside the Delta.”

Section 6A.6 further states that the proposed project would be “required to be flood neutral as it relates to flood risk” from “construction and operations of the conveyance facilities and restoration actions” (p. 6A-26).

Appendix 6A is clearly written, and it is apparently new for the most part. It recycles parts of the longstanding Appendix 3E, “Potential seismic and climate change risks to SWP/CVP water supplies” (p. 6A-26 and 6A-27). However, it also contains informative summaries of policies and legislation about Delta flood risk (section 6A.2), the existing programs for funding levee maintenance (6A.3), response plans for emergencies that include disruption to water supply (6A.4), and threats from climate change, sea level rise, and earthquakes (6A.5). Appendix 6A goes beyond the Public Draft EIR/EIS, and the RDEIR/SDEIS as well, in bringing together these discussions of Delta levees.

Remaining Delta ISB concerns

Despite excellence in its Appendix 6A, the Final EIR/EIS still falls short in assessing impacts to Delta levees, and it has also become out of date on seismic threats to the levees.

1. Appendix 6A does not assess levee impacts systematically across the broad range of BDCP alternatives, nor among the three California WaterFix alternatives.
2. Absent as well is assessment of potential impacts of State priorities in levee investments. We did not notice any reference to the asset estimates included in the Delta Levees Investment Strategy (Ellis et al., 2016).
3. Estimates of seismic risk in Appendices 6A and 3E, and in Chapter 9 (“Geology”), rely mainly on findings that are a decade or more old. Recent advances neglected include the UCERF3 estimates of California fault-rupture probabilities (Field et al., 2013), lowered estimates of average slip on the Southern Midland fault (Unruh et al., 2016), and revised estimates of Delta ground motions (Fletcher and Boatwright, 2013; Eberhart-Phillips et al., 2014; Baltay and Boatwright, 2015; Erdem et al., 2016; Eberhart-Phillips, 2016; Fletcher et al., 2016).

The Final EIR/EIS provides, in chapter 29, an example of how further assessment of potential impacts to levees could have been presented (concerns 1 and 2). Section 29.3.2 systematically analyzes an aspect of climate-change impacts on the California WaterFix options 4A, 2D, and 5A, and on the No Action Alternative.

Keeping the Final EIR/EIS current with respect to Delta seismology (concern 3) is more than a matter of citing incremental advances of purely academic interest. Evolving views of Delta seismic hazards are important because the EIR/EIS describes earthquake-induced failure of Delta levees as a justification for the proposed project (p. ES-1, 6A-1).

Long-term effects

Summary of Delta ISB comments on the RDEIR/SDEIS

Several potential long-term impacts of or on the proposed project no longer received attention in the RDEIR/SDEIS. These effects may not be problematic during the initial permit period, but some are likely to affect project benefits and impacts over the long operational life of the proposed conveyance facilities. The major areas identified included:

More detailed assessment is needed of the No Action Alternative baseline for evaluating impacts and benefits. Climate change, for example, is considered under the No Action Alternative in the Draft and Final EIR/EIS, as is sea-level rise. Failure to consider how climate change and sea-level rise could affect the outcomes of the proposed project is a concern that carries over from our 2014 review and is accentuated by the recent drought.

Groundwater regulation under the recently enacted Sustainable Groundwater Management Act (SGMA) will have long-term effects on the proposed project, which are not assessed. Ending one to two million acre-feet per year of overdraft in the southern Central Valley under the SGMA will likely increase demand for water exports from the Delta in the coming decades, despite limits from various Delta regulations. The implications of prolonged droughts and of the consequences of SGMA receive too little attention.

Consideration of these long-term effects should be part of the scientific foundation of the proposed project.

Related changes in the Final EIR/EIS

Some clarifications have been made on the inclusion of climate change in the No Action condition. As summarized in Chapter 3 Appendix 3D, p. 24, "The No Action Alternatives also include assumptions for climate change related to sea level rise and 3 changes in precipitation patterns, including changes in ratios between snow and rainfall." This is supported by profuse amounts of modeling in the many Appendix 5As. However, "The No Action Alternatives do not include future changes in facilities operations, land use, or policies by agencies in response to climate change." Chapter 29 and its appendices provide some useful information regarding climate change assumptions, modeling, and discussion, but do not provide particularly insightful or strategic discussions of how climate change issues may affect the relative performance of alternatives.

The Groundwater chapter (Chapter 7) briefly discusses the SGMA, but the Final EIR/EIS does not appear to have a systematic discussion of the interaction of these large and uncertain sources of water statewide, particularly as it affects long-term demands and management for the Delta.

Remaining Delta ISB concerns

Given the considerable uncertainty in the degree and timing of sea level rise and other aspects of climate change, it remains surprising that there is not a more targeted discussion and analysis of the

sensitivity of the relative long-term performance of alternatives with respect to various aspects of climate change. This is a critical omission.

Reductions in groundwater overdraft as part of the SGMA will likely increase demand for water from the Delta, the primary and historical source of supplemental water for the southern Central Valley, the state's primary overdraft area. Uncertainties in the interaction of SGMA implementation with Delta alternatives are likely to significantly affect the relative implementation, water supply, and environmental performance of alternatives.

Climate change: Even though Alternatives 4A, 2D, and 5A do not do not seek 50-year incidental take permits (p. 11), there will be long-term impacts and effects of climate change. "Too much uncertainty" about such effects is not a reason to ignore the topic.

Missing content: Impacts of San Joaquin Water Reliability

Summary of comments on the RDEIR/SDEIS

In our 2015 review, we noted that the RDEIR/SDEIS continued to neglect potential effects of changes in operations of the State Water Project (SWP) and Central Valley Project (CVP), or other changes in water availability, on agricultural practices in the San Joaquin Valley.

In our 2014 review on page 13, we pointed out in item 3 that the "effects of increased water reliability on crops planted, fertilizers and pesticides used, and the quality of agricultural runoff" was overlooked. The RDEIR/SDEIS considered how the project might affect groundwater levels south of the Delta (7.14 to 7.18), but continued to neglect the environmental effects of water use south of the Delta. Section 4.3.26.4 of the recirculated draft described how increased water-supply reliability could increase agricultural production, especially during dry years. A separate benefit-cost analysis by ICF and the Battle Group² estimated the economic benefits of increased water deliveries to agriculture in the Delta. The RDEIR/SDEIS did not fully consider the consequences of these assumptions, or of the projections that the project may enhance water-supply reliability but may or may not increase water deliveries to agriculture (depending on a host of factors, such as SGMA implementation). We were told that such possibilities are "too speculative" for an EIR/EIS. Yet such consequences nevertheless seem to bear directly on the feasibility and effectiveness of the project, and sufficient information is available to bracket a range of potential effects. Our concerns from 2014 remained.

Related changes in the Final EIR/EIS

A response to point 3 refers us to the response to 2546-66, which is:

"Please refer to Section 30.3.4.1, Agricultural Contractor Export Service Areas, Chapter 30, of this Final EIR/EIS. This section describes potential indirect *effects of reductions in SWP and CVP deliveries to Export Service Areas resulting from implementation of the project*, including increases in cost of water, using empirical evidence from past behavior of agricultural and M&I contractors to increases in cost of water.

The issue of crops and water use is beyond the scope of the proposed project. For more information please refer to the updated California Water Plan's strategy for agricultural water use efficiency, which describes the use and application of scientific processes to control agricultural water delivery and use." (*Italics added for emphasis*)

² Seemingly unavailable in full from WaterFix. Available at: <http://www.restorethedelta.org/wp-content/uploads/2016/09/CA-WaterFix-Economic-Analysis-Sunding.pdf>.

This response denies the relevance of the concern in point 3. We found nothing in the Final EIR/EIS that addressed point 3.

Remaining concerns of the Delta ISB

The response cited above directs us to section (30.3.4.1) which addresses the economic impacts of not having as much water as “before Delta environmental restrictions,” but never addresses the environmental benefits (if any) of not having water, i.e., the environmental costs of having more.

The next section (30.3.4.2) on municipal and industrial water use discusses how water agencies would adjust to lower supplies without the project in accordance with how they managed during the drought. The report does not address potential environmental benefits and costs arising from less urban water supplies.

The benefit-cost analysis finds economic benefits from the delivery of water that would not otherwise have been delivered due to Delta environmental constraints, while the EIR/EIS argues that there are no environmental impacts because this is water that would have been delivered anyway. The economic and environmental analyses are not using the same baseline.

More generally, the impacts, particularly of project construction, on Delta residents and visitors are substantively addressed, but not presented in a coherent and understandable way. Such impacts are often well discussed in detail, but are scattered across a variety of chapters and un-summarized for informing local Delta decision-makers and those concerned with Delta residents and visitors.

Restoration and mitigation

Summary of comments on the RDEIR/SDEIS

Our concerns included:

Long-term commitment—“...The missing details...include commitments and funding needed for science-based adaptive management and restoration to be developed and, more importantly, to be effective....”

Landscape context— “Restoration projects should not be planned and implemented as single, stand-alone projects but must be considered in a broader, landscape context.”

Wetland loss—Although wetland restoration is a key element of mitigation, “We noticed little attention to the sequencing that is required for assessing potential impacts to wetlands: first, avoid wetland loss; second, ...minimize; and third, ...compensate.”

Mitigation ratios— “In view of inevitable failures and time delays in wetland restorations, mitigation ratios should exceed 1:1 for restoration of existing wetlands. The ratios should be presented, rather than making vague commitments....” “Also...clarify...out-of-kind and...in-kind replacement of losses....and whether such areas will exist with future sea-level rise.”

Early action— “To reduce uncertainty about outcomes, allow for beneficial and economical adaptive management.... mitigation actions should be initiated as early as possible....potential for landowners to develop mitigation banks could be encouraged so restoration could begin immediately...”

Related changes in the Final EIR/EIS

Long-term commitment—In the final EIR/EIS, we saw no call for or strategy to fund restoration and mitigation in a holistic landscape approach. In chapter 11, funding of invasive plant control was mentioned on p. 186 and 332. Funding for steelhead monitoring was mentioned on p. 198. The word “funding” also appears on p. 176. That does not add up to a strategy.

Landscape context— Restoration is now set in the larger context of California EcoRestore. Chapter 11 explains how each construction component would affect each species and how each of several conservation measures will benefit affected species. The Executive Summary states “Mitigation measures have also been developed to reduce significant impacts of each action alternative. These measures are included in each EIR/EIS resource section and tabulated in Table ES-8 [90 pages]. The Mitigation Monitoring and Reporting Plan for the California WaterFix (MMRP) provides a detailed description of the mitigation measures applicable to Alternative 4A, the preferred alternative. The MMRP describes how the lead agencies will implement each measure, the parties responsible for implementing each measure, the location for implementation of each measure, the timing of each measure, and monitoring procedures. Finally, the MMRP indicates the reporting requirement for each measure.” The alternatives evaluated, including the preferred 4A, are not consistent with the science of restoration ecology, which indicates the need to restore historical hydroperiods to restore riparian vegetation and associated wildlife and fish. The field of ecohydrology is developing rapidly; we recommend obtaining and using the latest “understanding of complex interactions between vegetation, groundwater, river flows, channel morphology, and water quality to determine restoration outcome” (Moreno-Mateos and Palmer, 2017).

Wetland loss—There remains little attention to the sequencing that is required for assessing potential impacts to wetlands: In the Executive Summary (p. 16, l. 21), sequencing steps 1-2 are combined as avoidance and mitigation measures (AMMs), and instead of calling the third step “compensatory mitigation,” it is called mitigation. The word “mitigation” simply means to lessen impacts. Then, later, on p. 32: “Additionally, pertinent elements previously included as AMMs and the proposed Adaptive Management and Monitoring Program would be applied to the activities proposed under Alternative 4A. These AMMs, too, would serve a mitigation function under CEQA. All of these components would function as de facto CEQA and NEPA mitigation measures for the impacts of constructing and operating Alternative 4A. Chapter 3, Section 3.6.3 describes the Alternative 4A Environmental Commitments.” How would avoidance and minimization satisfy requirements for compensatory mitigation?

Mitigation ratios—The need to prepare for some mitigation actions not being fully effective is apparently not addressed. The term ‘mitigation ratio’ does not appear in the index. Statements are that impacts will be mitigated. Since ‘mitigation’ means avoid, minimize or compensate, and because “significant effect” and “not significant” are subject to interpretation, specific outcomes are difficult to ascertain.

Early action— This concern for early and adaptive restoration is somewhat satisfied. Restoration via California EcoRestore is mentioned and it says those experiences will inform later restoration. The term ‘mitigation bank’ is not listed in the index. The timing of projects is supposed to appear in Chapter 3.

Remaining concerns

We recommend field experimentation to restore wetlands, testing alternative methods in space and over time. An adaptive restoration approach can reduce uncertainty and explain why outcomes differ.

Chapter 11, p. 246 (of 4,191 pages) lists three reasons why detailed restoration plans are not available: (1) because the habitat restoration and enhancement would occur, if feasible, in areas with willing sellers, none of whom have been identified; (2) to maintain flexibility for adaptive management; and (3) because implementation has a long timeframe. So, for the EIR/EIS, the assessment of the effects for the habitat restoration and enhancement was programmatic and focused on restoration opportunity

areas (ROAs) identified in the BDCP. The ROAs are large land areas centered on Suisun Marsh, the West and South Delta areas, Cache Slough and the Cosumnes/Mokelumne area in the east Delta (Figure 3-1 in Chapter 3, Description of Alternatives). Individual project-level environmental review based on more detailed plans will be required for these actions before implementation.

Vegetation, particularly native vegetation, is under-represented in discussions of habitat restoration. The term “vegetation” nearly always occurs in reference to invasive plants (e.g., one heading is “Vegetation Removal”). On p. 218 of chapter 11, there is one short note about restoring vegetation: “Restoration would likely include pre-breach management of the restoration site to promote desirable vegetation and elevations within the restoration area and levee maintenance, improvement, or redesign.” There is great opportunity for experimentation and adaptive restoration of native vegetation, since restoration of “riparian habitat” is considered a mitigating factor for project impacts.

The literature is clear that restoration efforts have significant “recovery debts” even after a decade or more (Moreno-Mateos et al., 2017). Expectations for ecological impacts of construction and operations being temporary with rapid recovery seem overly optimistic.

REFLECTIONS: PARALYSIS BY ANALYSIS, AND AN OPPORTUNITY MISSED

Several overarching problems encumber the series of environmental documents that were prepared for the BDCP and California WaterFix. We note these problems below in commentary intended to offer perspectives on the use and communication of science in the Delta.

We live in a world where environmental documents often provide more eyestrain than insight. The National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) were enacted nearly 50 years ago with the intent of developing a clear scientific basis for informing decision-makers and the public of the environmental impacts of projects and policy decisions relative to their net economic benefits. To that end, both Acts required analyses and documentation of environmental impacts, along with public hearings to facilitate citizen engagement. Soon after impact analyses were required, however, concerns were raised that adding steps to the decision-making process would delay or halt development—what was described as “paralysis by analysis.”³

Almost from the beginning, projects were delayed through legal challenges over the adequacy of the environmental analyses. Moreover, the Courts, by often favoring comprehensiveness perhaps at the expense of comprehension, have promoted increasingly detailed documentation. Environmental impact analyses have become longer and increasingly impenetrable, to the point where massive and opaque environmental impact statements deter public comprehension and engagement, scientific evaluation, and the participatory, intentions of both NEPA and CEQA. When the preparation of such lengthy documents is turned over to contractors, the responsible agencies and staff may fail to fully understand the underlying analyses. By becoming detached from the process, agencies may lose the opportunity to learn in ways that would lead to better informed decisions or improved science.

Balancing the need for information against the imperative to make timely decisions is always a challenge. Both extremes should be avoided—either assembling too much detailed information before reaching decisions, or making large, irreversible decisions based on inadequate information and analyses. There will always be uncertainty in environmental analyses. The purpose of an environmental impact assessment is to assemble relevant information and conduct analyses to assess the anticipated

³ Example are: Langley, A. 1995. Between “Paralysis by Analysis” and “Extinction by Instinct”. *Sloan Management Review* 36(3)63-76. Lenz, R. T. and M.A. Lyles. 1985. Paralysis by Analysis: Is Your Planning System Becoming Too Rational? *Long Range Planning* 18(4)64-72. The concept dates back to the late 1960s and early 1970s.

environmental effects of a proposed project so that an informed decision can be made (with public input) as to whether or not the project should proceed as proposed.

The challenge of balancing comprehensiveness with comprehension is evident in the EIR/EIS documents for BDCP and California WaterFix. These documents were prepared to support permitting needed to comply with various state and federal regulations and statutes as well as Court orders. The purpose was to identify potential environmental impacts and address how these impacts would be mitigated in accordance with the legal requirements of NEPA, CEQA, and Biological Opinions. We understand this. Yet, as members of the Delta ISB, we are charged to provide oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta and, ultimately, scientifically informed decision processes intended to enhance the Delta ecosystem and ensure water supply reliability while preserving the values of the Delta as an evolving place. These objectives go well beyond a narrow interpretation of the legal mandate of an EIR/EIS, but they are consistent with the underlying intent of these laws. We recommend a separate document be prepared for each project that lays out the critical issues for public and scientific review and presents information for public and scientific analysis in a clear and comprehensible way. This could be informative for the agencies themselves as well as for public engagement and scientific advancement.

In our reviews, we were asked to assess the scientific adequacy of over 50,000 pages of BDCP and California WaterFix draft and final reports. We repeatedly requested intelligible summaries of chapters and summary evaluation tables to help us—as well as decision-makers and stakeholders—better understand how the information might support thoughtful evaluation of proposed actions and decisions. Most chapter summaries were deferred to the Final California WaterFix EIR/EIS, and most of those provided fall short, as elaborated in persistent concerns above. The absence of coherent and useful summaries in such massive documents diminishes the value, and perhaps credibility of this important document as a comparative guide to the expected environmental effects of the alternatives considered.

We also expressed concern that important recent scientific work was not included in the massive compilations. In an instance regarding climate-change science, we were told that the information used in the EIR/EIS was current enough, and that an EIR/EIS kept up to date would “never get finished.”⁴

When we asked about information we considered important for rational decision-making, we were frequently told that the law does not require such information and that lead agencies “*avoid speculation.*” Reasoned speculation, however, can be an important part of science and public policy discussions. This is especially important in a system as complex and dynamic as the Delta, where one meets uncertainty at every turn. Preparation for contingencies emerges from speculations about what might follow from an action; they are the essence of adaptive management. Rather than avoiding speculations, we contend that an impact assessment should clearly identify major contingencies, describe the ideas or observations behind them, and frame them as testable hypotheses as part of the adaptive management process. This is an important tool for establishing reasonable expectations, limiting surprises, and preparing for possible futures. The field of risk analysis offers ample guidance for such problems. Carefully reasoned speculation is a legitimate part of the “best available science” that informs decision-making.

These comments should not be taken as criticism of those who have assembled the information, carried out the analyses, and prepared the BDCP and California WaterFix environmental documents. They faced enormous challenges from such a large and complex system. Yet the Delta's problems are so important that project proponents should go far beyond the norm when providing and synthesizing

⁴ Response to comment number 88, Recirculated Draft letter 2546, in Final EIR/EIS Volume II, part 2-2, Table 2-2, at http://baydeltaconservationplan.com/FinalEIREIS/FinalEIR-EIS_ResponseToComments.aspx.

scientific information. Making this material readily comprehensible is fundamental to rational evaluation of potential environmental impacts by policy-makers and the public. Environmental impact assessments for BDCP and California WaterFix have missed opportunities to increase understanding of the Delta as an ecosystem, a water supply, and as a place where people live and work.

REFERENCES CITED

- Baltay, A.S., and Boatwright, J., 2015, Ground-motion observations of the 2014 South Napa Earthquake: *Seismological Research Letters*, v. 86, p. 355-360, doi:10.1785/0220140232.
- [Delta ISB] Delta Independent Science Board, 2012, Initial recommendations for integrating BDCP science and for improving the reviewability of draft BDCP documents.
- [Delta ISB] Delta Independent Science Board, 2013, *Delta Independent Science Board, comments on current administrative draft of BDCP documents*, letter to Stewardship Council, Sacramento, CA, 3 pp., July 2013.
- [Delta ISB] Delta Independent Science Board, 2014, *Review of the Draft EIR/EIS for the Bay Delta Conservation Plan*, report to Delta Stewardship Council, Sacramento, CA, 133 pp., May 2014.
- [Delta ISB] Delta Independent Science Board, 2015, Review by the Delta Independent Science Board of the Bay Delta Conservation Plan/California WaterFix Partially Recirculated Draft Environmental Impact Report/ Supplemental Draft Environmental Impact Statement: Report to the Delta Stewardship Council, September 2015, 20 p. <http://deltacouncil.ca.gov/docs/final-delta-isb-comments-partially-recirculated-draft-environmental-impact-reportsupplemental>.
- [Delta ISB] Delta Independent Science Board, 2016, Improving adaptive management in the Sacramento-San Joaquin Delta: Report of the Delta Independent Science Board, Sacramento, CA, 66 pp., February 2016.
- Doremus, H., W.L. Andreen, A Camacho, et al., 2011, Making good use of adaptive management. Center for Progressive Reform White Paper No. 1104. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1808106.
- Ebberts et al. (in press), "Estuary ecosystem restoration: Implementing and institutionalizing adaptive management," *Restoration Ecology*.
- Eberhart-Phillips, D., 2016, Northern California seismic attenuation; 3D Q (sub P) and Q (sub S) models: *Bulletin of the Seismological Society of America*, v. 106, p. 2558-2573, doi:10.1785/0120160060.
- Eberhart-Phillips, D., Thurber, C., and Fletcher, J.B., 2014, Imaging P and S attenuation in the Sacramento-San Joaquin Delta region, northern California: *Bulletin of the Seismological Society of America*, v. 104, p. 2322-2336, doi:10.1785/0120130336.
- Ellis, H.L., Gardiner, C., Groves, D., Henricksen, D., Kaira, N., Ludy, J., Roth, L.H., Slattery, G., Smith, T.W., Swenson, R., and Trahan, A., 2016, *Risk analysis methodology* [July 2016 final]: Delta Stewardship Council, Delta Levees Investment Strategy, 191 + appendices p., last accessed July 27, 2016, <http://deltacouncil.ca.gov/docs/delta-levees-investment-strategy-dlis-risk-analysis-methodology-report-july-2016-37mb>.
- Erdem, J.E., Boatwright, J., and Fletcher, J.B., 2016, Ground-motion attenuation for the South Napa earthquake in the Sacramento-San Joaquin Delta, California [abstract]: *Seismological Research Letters*, v. 87, no. 2B, p. 564, doi:10.1785/0220160046., <http://www.seismosoc.org/meetings/ssa2016/abstracts/>.
- Field, E.H., Biasi, G.P., Bird, P., Dawson, T.E., Felzer, K.R., Jackson, D.R., Johnson, K.M., Jordan, T.H., Madden, C., Michael, A.J., Milner, K.R., Page, M.T., Parsons, T., Powers, P.M., Shaw, B.E., Thatcher, W.R., Weldon II, R.J., and Zeng, Y., 2013, *Uniform California Earthquake Rupture*

- Forecast, version 3 (UCERF3)—The time-independent model*: U.S. Geological Survey Open-File Report 2013-1165, California Geological Survey Special Report 228, and Southern California Earthquake Center Publication 1792, 97 p., <http://pubs.usgs.gov/of/2013/1165/>.
- Fletcher, J.B., and Boatwright, J., 2013, Site response and basin waves in the Sacramento–San Joaquin Delta, California: *Bulletin of the Seismological Society of America*, v. 103, p. 196-210, doi:10.1785/0120110347.
- Fletcher, J.B., Erdem, J., Seats, K., and Lawrence, J., 2016, Tomographic Rayleigh wave group velocities in the Central Valley, California, centered on the Sacramento/San Joaquin Delta: *Journal of Geophysical Research: Solid Earth*, v. 121, p. 2429-2446, doi:10.1002/2015JB012376.
- Moreno-Mateos, D., E.B. Barbier, P.C. Jones, et al., 2017, Anthropogenic ecosystem disturbance and the recovery debt. *Nature Communications* 8:14163. DOI: 10.1038/ncomms14163.
- Moreno-Mateos, D., and M. Palmer. 2017. Watershed processes as drivers for aquatic ecosystem restoration. Chapter 14 in Palmer, Falk & Zedler, *Foundations of Restoration Ecology*. Island Press, Washington, DC.
- Unruh, J., Hitchcock, C., Blake, K., and Hector, S., 2016, Characterization of the southern Midland fault in the Sacramento-San Joaquin Delta, in Anderson, R. and Ferriz, H., eds., *Applied geology in California*: Zanesville, Ohio, Association of Engineering and Environmental Geologists, p. 957-976.