California WaterFix Hearing
Exhibit No. SWRCB-60

Delta Science Program

Review Panel Summary Report

Bay Delta Conservation Plan (BDCP) Effects Analysis Phase 2 Partial Review[1]

[1] Appendices 5.E: Habitat Restoration, 5.G: Fish Life Cycle Models, 5.A: Climate Change Implications for Natural Communities and Terrestrial Species; Climate Change Approach and Implications for Aquatic Species were not complete in time for review by the Panel

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Table of Contents

Executive Summary

Introduction

Under the auspices of the Delta Science Program, the seven-member Independent Scientific Review Panel is reviewing the adequacy of the Effects Analysis component of the Bay Delta Conservation Plan (BDCP). As the second of this two-phase review, the Panel was charged with assessing the scientific soundness of Chapter 5: Effects Analysis and many of the associated technical appendices. However, the Panel could only partially complete Phase 2 because appendices 5.A: Climate Change Implications for Natural Communities and Terrestrial Species and Climate Change Approach and Implications for Aquatic Species, 5.E: Habitat Restoration, and 5.G: Fish Life Cycle Models were not complete in time for the review.

The Panel encountered many obstacles to reviewing such a long, highly detailed, yet fragmented and ultimately incomplete Effects Analysis. While recognizing the challenge of integrating such a complex and voluminous body of analyses and supporting documentation, the Panel universally believes Chapter 5: Effects Analysis fails to achieve the fully integrated assessment that is needed to draw conclusions about such a momentous Plan. By missing or obscuring key concepts and specifics, it falls short of presenting an analytical framework for a compelling and rigorous analysis of whether and how the BDCP would achieve its biological and other objectives. Perhaps one of the more disappointing gaps in the analysis is the lack of any process for assessing ("rolling up") the net effects across the species and ecosystems of concern. A specific example of the incomplete analysis is the simple listing of beneficial and adverse effects in the Chapter 5 Summary (5.1.5) without any attempt to integrate the effects, draw conclusions, and describe the certainty in the conclusions. The absence of finished habitat restoration, fish life cycle models, and climate change considerations amplifies the vast uncertainties of BDCP inherent in assumptions of biological conservation measures effectiveness. In addition, the hydrodynamic modeling, the foundation model for much of the ecosystem analysis, is lacking the documentation details necessary for the Panel to evaluate the underlying assumptions made when modeling the future Delta physical configuration, adding major uncertainties to the net effects analysis.

However, given the concepts and approaches of the effects analysis framework presented (or suggested in the case of the incomplete appendices), in the initial two review phases, the Panel believes that a persuasive integration of the essential components would be effective with substantial revision, including attention to the following recommendations:

Recommendations

Recommendation 1	Analysis of biological effects needs more consistency and specificity
Recommendation 2	Net effects assessment needs greater objectivity
Recommendation 3	Increase consistency of stressor analysis across covered species, and provide more detail

Recommendation 4	Chapter 5 must be a "stand alone" document
Recommendation 5	Clarify the baseline
Recommendation 6	Provide systematic understanding and planning for conservation actions, especially restoration
Recommendation 7	Include indirect effects of contaminants as part of Appendix D: Contaminants
Recommendation 8	Accurately characterize food resources and food webs
Recommendation 9	The hydrodynamic modeling needs to capture the entire domain of effects
Recommendation 10	Incorporate life cycle models for all species, as quantitatively as possible
Recommendation 11	Consider salmonids at stock and life history scale
Recommendation 12	Identify analytical tools that need to be developed to address the extremely high uncertainty involved with calculating sediment supply and turbidity
Recommendation 13	Levels of uncertainty are not adequately addressed
Recommendation 14	The DSM2 model Sacramento boundary condition should be moved northward to above Fremont Weir
Recommendation 15	Include sensitivity analyses and model validation in the effects analysis for covered fish species
Recommendation 16	Provide more detail about the specific approaches that will be used when implementing adaptive management
Recommendation 17	Ensure a declining fish population (e.g., longfin smelt) does not decline further while waiting for possible beneficial effects of habitat restoration.

Conclusions

As it is currently written, the Effects Analysis is too inconsistent in its treatment of how effects are analyzed across listed species and the potential costs and benefits of the planned BDCP activities are too uncertain to provide an objective assessment of the BDCP on covered species. The Effects Analysis should be viewed as a working hypothesis with considerable uncertainty that requires a strong monitoring and adaptive management plan to ensure status of species improves over time. As such, the Effects Analysis should provide the best, scientifically defensible, assessment of how the covered species and ecosystems will respond, both positively and negatively, to BDCP implementation. The Effects Analysis can only achieve this goal by looking at the sum of effects across covered species; it is then up to resource managers to implement only if the BDCP does not appear to result in further declines, and to continue to monitor and evaluate adaptively through the evolution of the Plan. The Panel continues to find considerable lack of clarity in the description of the Effects Analysis process and details that would ensure it will meet that obligation.

INTRODUCTION

This document describes the second phase review recommendations made by the seven-member Independent Scientific Review Panel (Appendix A; hereafter "Panel") on the adequacy of the Effects Analysis component of the Bay Delta Conservation Plan (BDCP). The BDCP Working Draft was released November 18, 2010 without a detailed Effects Analysis. Subsequently, components of a draft Effects Analysis have been released for review. The purpose of the Effects Analysis is to synthesize all of the analyses contained in the technical appendices and integrate the results in order to provide the best scientific assessment of the likely effects of BDCP actions on the species of concern and on ecological processes in the Bay-Delta system.

This review was structured under a Scope of Work and time schedule (Review Appendix B) involving two phases. Phase 1 specifically included the Appendix A, Conceptual Foundation and Analytical Framework sections, and a draft of the Entrainment Appendix (B). The Panel's Phase 1 report was submitted to the Delta Science Program in late November 2011. It should be noted that a primary recommendation by the Panel's Phase 1 review was that that the Effects Analysis should be a stand-alone document, requiring critical information (e.g., in the Analytical Framework) from other, more comprehensive sources such as the BDCP.

Under Phase 2, the Panel was charged with assessing the scientific soundness of Chapter 5: Effects Analysis and many of the associated technical appendices; Chapter 5 is intended to include summaries of the technical appendices. However, the Panel could only partially complete Phase 2 because Appendix 5.A: Climate Change Implications for Natural Communities and Terrestrial Species; Climate Change Approach and Implications for Aquatic Species, Appendix 5.E: Habitat Restoration and Appendix 5.G: Fish Life Cycle Models were not complete in time for our review. The Panel will make recommendations for how these might be structured in order to meet their stated goals.

After preliminary examination of the existing Effects Analysis and supporting documents, the Panel met on April 30-May 2, 2012, in Sacramento, California, to hear background presentations, agency and public comment and to assemble the initial Phase 2 review recommendations (Appendix C). This report is a synthesis of the Panel's deliberations based on the collective written and presentation information prepared for Phase 2. The following section lists the questions that were specified in the Charge to the Panel.

Charge to Panel Questions

The 'Charge to Panel' questions provided specific guidance for the Panel about how to approach the scientific review and evaluate the completeness and scientific rigor of Chapter 5: Effects Analysis and associated technical appendices. The Panel's recommendations were organized within the Charge to Panel Questions and follow a consistent format: 1) Problem; 2) Why These Issues Need to be Addressed; and, 3) Overall Conclusions and Potential Solutions. The separate review comments on the technical appendices (**Technical Appendices** section) address the respective seven questions in the Charge.

Chapter 5: Effects Analysis Section

Goals, Purposes, Objectives and Scope

1. How well does the Effects Analysis section meet its expected goals?

Completeness, Structure and Effectiveness of Description

2. How complete is the Effects Analysis section; how clearly are the methods described?
3. Is the analysis in the Effects Analysis section reasonable and scientifically defensible? How clearly are the Effects Analysis results conveyed in the text, figures and tables?

Approach and Analysis

4. Does the Effects Analysis section integrate an appropriate suite of analyses? Were appropriate analyses used?
5. How well is uncertainty addressed? How could communicating uncertainty be improved?
6. How well does the Effects Analysis section describe how conflicting model results and analyses in the technical appendices are interpreted?
7. How well does the Effects Analysis section link to adaptive management and associated monitoring programs?

Technical Appendix (to be answered for each technical appendix)

Approach and Analysis

1. How well are the proposed analytical tools defined, discussed and integrated?
2. How clear and reasonable is the scale of the analysis?
3. How well was the vision of the Foundation and Framework (appendix A) applied to the technical appendix / analysis? How consistently was it applied?
4. How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable?
5. Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?

Models

6. Were appropriate models used in the technical appendix? If model results conflicted, was this clearly stated and were appropriate interpretations made?
7. How well are the models and analyses described, interpreted and summarized?

Assumptions and Constraints Underlying the Panel's Recommendations

The Panel has prepared this synthesis of our Phase 2 recommendations based on the following assumptions and recognized constraints:

- The Effects Analysis is fundamentally a multispecies Habitat Conservation Plan (HCP), with the associated mandates, provisions and assumptions under the

Endangered Species Act (ESA; Section 10[a]) that is designed to compensate for the taking of individuals by promoting survival of the population or species in some other way, but the Panel recognizes that the ESA still does not specify how that should be accomplished (e.g., habitat management or restoration, reserve networks) (Wilcove *et al.* 1996).

- The Panel is not only conducting a scientific review, but intend to provide constructive advice for the revision of the existing Phase 2 Effects Analysis documents and all new documents not review in Phase 2, as well as the BDCP overall.
- The Effects Analysis contains substantial uncertainty in potential outcomes and in many cases the direction of effect (positive or negative). In some cases the level of uncertainty is reasonably well articulated within the technical appendix but is especially lacking when the specific stressor effects are "rolled up" to the population level and when considered cumulatively in the Chapter 5: Net Effects. Adverse effects of specific stressors on populations that are declining or have declined should be given priority status and approaches to minimize the adverse effect should be identified (e.g. requiring water conservation, or purchase of upriver water rights).
- A significant limitation of the Panel review is that we are evaluating an analysis based on existing and ongoing investigations; therefore, the Panel is largely dependent on information contained in Chapter 5 analyses. Although the Panel did review some of the original investigations, in many cases time did not allow us to go back to the original work. Therefore, some critical information about the original investigations may not have been considered in the Panel's review of the Effects Analysis. Furthermore, some of the review materials are inconsistent, e.g., Chapter 3 is only "supporting information."
- The majority of the comments involve the hydrodynamic (circulation) modeling because the hydrodynamic modeling is the basis for all the other modeling of ecosystem responses. As a result, the circulation components need to be presented before evaluating the other aspects of modeling and assessment of effects. Appendix C is approximately a 1300-page document with its own appendices and was also one of the last appendices given to the Panel. Therefore, this should be considered an interim review that may have significant additions as the BDCP evolves. Similarly, the Panel has not commented on specific simulation numbers because we recognize that these numbers may change significantly with any future changes in future Delta configurations.

RESULTS OF PANEL ASSESSMENT

General Comments

The Panel recognizes that there is considerable uncertainty about outcomes of terrestrial and aquatic ecosystem restoration; terrestrial ecosystem restoration has proven to be more challenging compared to riparian and aquatic ecosystem restoration.

This demands that rigorous adaptive management, driven by ecosystem process based monitoring, is implemented effectively because of the considerable uncertainties in the outcome of long restoration trajectories.

The Panel found a number of Effects Analysis elements that constituted a significant improvement over the Phase 1 review material:

- The scoring system of net effects is good given the mix of qualitative and quantitative information.
- The Panel is encouraged that the scoring considers uncertainty.
- The Effects Analysis was fairly thorough in the variety of stressors that it addressed and it considered potential climate change effects
- The appendices were typically written objectively and seemingly without bias, although the Panel did find some inconsistencies and a tendency to gloss over detailed negative effects when drawing conclusions in Chapter 5.

Expectations for Missing Appendices

Appendix A: Climate Change

The Climate Change appendix was released on the day that the Panel review occurred (April 30, 2012). Because it was made available late in the review process and replaced the original "Framework" Appendix A, the Panel did not have an opportunity to discuss our expectations for this Appendix during our in-person discussions. The Panel expects to have an opportunity to comment on this Appendix because climate change has been identified by the National Research Council (Huggett and the National Research Council Committee on Sustainable Water and Environmental Management in the California Bay-Delta 2012) as a critical component for future planning of the Delta.

Appendix E: Habitat Restoration

While a preliminary draft of Appendix E: Habitat Restoration was available on the BDCP website (http://baydeltaconservationplan.com/Library/DocumentsLandingPage.aspx) in mid-January 2012, it was not considered sufficiently complete for Panel review. This was an unfortunate impediment to a complete Effects Analysis review because the ultimate outcome from the proposed mitigation and compensation of the Plan's effects is integrally dependent on the details of approach, scope and timing of habitat restoration in the Delta. Based on our assessment of the Effects Analysis and other appendices assessed during Phase 1 and Phase 2 reviews, the Panel itemized the following recommendations as critical elements that should be included in the final version of Appendix E in order for analysis of BDCP effects to be scientifically and technically rigorous:

1. Include status and description of existing restoration activities occurring in the Delta.

   The current and proposed status of watershed and tidal restoration actions should be an explicit part of the BDCP baseline. The type, distribution and age of these projects will be an important factor in determining the most strategic implementation of BDCP restoration actions.

2. Document what specific measures contribute to successful restoration and what does not (e.g., invasive species).

   There is a tremendous accumulation of scientific, technical and socioeconomic information from past and on-going restoration in the BDCP region. Yet, the Effects Analysis appears to assume that restoration is ultimately "successful" despite considerable uncertainty in the ecosystem processes, trajectories and rates associated with different approaches and landscape settings. While the variability in responses of seemingly identical restoration actions can be dramatic, a basic synthesis of past results and identification of critical uncertainties is essential to understanding how habitat restoration might, or might not, achieve BDCP objectives.

3. Describe how restoration is going to be directly linked to conservation strategies (location, type) described in Chapter 3.

   Deployment of different habitat restoration actions <u>should</u> explicitly reflect the BDCP conservation strategies. An important interpretive tool for assessing the potential outcome and performance of different proposed restoration actions would be a matrix of how each strategy would employ different conservation strategies and how they would potentially reflect changes in the area, arrangement and quality of natural ecosystems at the site and the landscape scale.

4. Describe how specific rules for particular species will be applied in aggregate to conservation measures that incorporate landscape ecology and population biology principles (e.g. connectivity).

   Conservation strategy rules will presumably vary by species. It will be important for the comprehensive assessment of the BDCP effects to document how the different conservation strategy rules that influence the choice and design of restoration actions are complementary or conflicting for the overall suite of species being addressed.

5. Devote detailed discussion to how conservation measures can be designed and implemented to expand on and emulate the encouraging results from the Yolo Bypass.

   Although acknowledged to contribute significantly to the potential production and survival of listed species (e.g., Sacramento River winter-run Chinook), seasonally-inundated floodplain, restoration actions such as the Yolo Bypass are still relatively rare and poorly studied. Given the location of the North Delta diversion in the BDCP, it will be critical for further consideration of seasonally-inundated floodplain habitat restoration to be fully evaluated for this, as well as other, regions of the Delta. Given the potential importance of Yolo Bypass habitat to covered fishes, the report should describe options for increasing continuous flows in the habitat.

Appendix G: Fish Life Cycle Models

Appendix G: Fish Life Cycle Models was not included in the Phase 2 review because the draft appendix report had not been completed by early April 2012. Life cycle models have been recommended as part of the analyses in the Biological Opinion, reasonable and prudent alternative (RPA) assessments, and the BDCP (CVPIA Review 2008, CALFED 2009, NRC 2010, 2012). The Panel concurs with this recommendation and supports ideas presented in the recent Salmonid Integrated Life Cycle Models Workshop (Delta Science Program 2011).

The Panel has the following expectations for the life cycle model appendix:

- Ensure that Appendix G is linked to the biological objectives in Chapter 5.2-5.
- Include different life cycle models for each salmonid species and stock.
- Indicate limiting factors on fish performance for each life stage affected by BDCP.
- Quantify BDCP effects in the context of the total life history and population dynamics of covered species.

The Panel recognizes that the existing life cycle models may not address all of these issues. The implication of incomplete or unavailable life cycle models is lower certainty in the outcomes of the BDCP, especially in terms of how the BDCP might affect overall population dynamics and recovery of the covered species. A less certain outcome implies that greater attention is needed to develop and implement monitoring programs to ensure that the biological objectives are achieved, and to develop a comprehensive adaptive management program that provides the pathway for future management of the Plan and project operations depending on observations from the monitoring program. The BDCP monitoring program and adaptive management were outside the scope of the Phase 2 Review.

The Panel was encouraged that a fairly quantitative list of biological objectives for BDCP outcomes was presented in the Effects Analysis (and in Chapter 3). Life cycle models and other effects analyses should be used to directly evaluate the extent to which the BDCP might achieve these objectives along with an evaluation of outcome certainty.

Review Comments and Recommendations

Chapter 5-Effects Analysis

Goals, Purposes, Objectives and Scope

1. *How well does the Effects Analysis section meet its expected goals?*

Recommendation 1 Analysis of biological effects needs more consistency and specificity

Problem

Despite many common elements required for basic information and analysis needs in developing species recovery plans that underlie HCPs, the Effects Analysis is inconsistent and surprisingly unspecific in how it addresses covered species and natural communities under the Plan. Most notably, key biological objectives for covered fish and wildlife species do not appear to be reflected in the analysis of effects, and many objectives that would seemingly be essential for assessment of recovery potential (e.g., survival of juvenile spring run Chinook salmon) are rejected because the analyses are currently lacking (i.e., described as “would require modeling exercise to inform the necessary improvement in survival required to result in a stable or expanding population). Although Table 5.2-5 indicates most of the objectives were assessed in the Effects Analysis, the discussion of effects on each species rarely referred to the biological objectives for each species. Thus, the anticipated outcome of BDCP with respect to the objectives is not currently evaluated to the extent that it should be, assuming the biological objectives are adequate. The Panel did not review adequacy of the biological objectives, which are described in more detail in Chapter 3.

There are no life-cycle models that integrate the factors that BDCP will influence. Such quantitative demographics that measure population responses to changes in species’ habitat, ecological interactions or other stressors should be fundamental to any adaptive management assessment as proposed in the BDCP (Conservation Strategy, Section 3.6).

Furthermore, other than some rare examples for covered terrestrial species, biological objectives are not specifically linked to conservation measures at the ecosystem or landscape scale. How many of the natural communities conservation measures will specifically benefit covered species (e.g., increased connectivity under CM3, CM7 and CM8) needs to be explained by conceptual or numerical models (see **Recommendation 10**). Similarly, all covered species and natural communities are treated in isolation, with no assessment of trade-offs among differential responses by multiple species that are expected to benefit from the same conservation measures in the same habitat, mosaics and landscapes.

Why These Issues Need To Be Addressed

Even if it is beyond the current, albeit stretched level of scientific understanding, it seems unacceptable to ignore the need to acquire this fundamental information, upon which the validity and success of BDCP conservation measures would appear to pivot. While the Panel acknowledges that population-scale demographics are often not available (although this information gap should be considered in any new monitoring initiative), biological objectives that cover demographic responses of species life cycles at the scale of implemented BDCP conservation measures should be uniformly evaluated at all relevant scales if the Plan’s effects are to be effectively characterized.

Overall Conclusion and Potential Solutions

Biological objectives should be consistently applied and assessed for all covered species with quantitative (e.g., population demographics) metrics that can be monitored. Key demographic indicators that are not currently available need to be identified for focused effectiveness monitoring. Biological objectives should also be provided for the ecosystem and landscape scale and interactions among covered species analyzed where overlap is relevant. Biological objectives, and appropriate indicators of response and performance to conservation measures, should be based on ecological models, conceptual and preferably quantitative, that consider species/natural community interactions as well as individual species response to environmental conditions. One of the more effective means to illustrate the necessary modeling, monitoring and research needs in the Effects Analysis would be to explicitly link the biological objectives table entries with the assessment of net effects (see **Recommendation 2**).

Recommendation 2 Net effects assessment needs greater objectivity

Problem

The Net Effects sections ultimately conclude with a statement regarding the general magnitude, direction, and certainty of the Plan's effects on a covered species. Such conclusions appear to be based on somewhat subjective integration of the best available information and science. However, for most of the covered fish species, a quantitative scoring approach was also used. Effects scores are available for each of the 22 conservation measures, along with relative measures of uncertainty (e.g., Figure 5.5-1).

Why These Issues Need To Be Addressed

A more objective interpretation of the effects assessment is necessary to evaluate the impacts of the Plan and compare effects across species.

Overall Conclusion and Potential Solutions

The effect scores (EC_i) should be summed over the 22 conservation measures, and this tally compared to the heuristic conclusions, i.e.,

$$\sum_{i=1}^{21} EC_i \, . \qquad (1)$$

Ideally, the direction and magnitude of the summed effects scores should be consistent with heuristic conclusions based on professional judgment. If a discrepancy occurs, the difference should be discussed and explained.

The quantitative assessment of the Proposed Plan's effects on a species should also be evaluated by taking into account the uncertainty (Ui) values, i.e.,

$$\sum_{i=1}^{21} EC_i \cdot U_i \,, \qquad (2)$$

and any differences in conclusions based on Equations (1) and (2) should be discussed.

The current set of effects scores is based on the professional judgment of the authors with regard to the importance and magnitude of the anticipated effects. The Panel recommends these numerical rankings be vetted by expert panels, and the robustness of the conclusions evaluated. We do not recommend a formal Delphi approach (Linstone and Turoff 2002) but, rather, to use the vetting to evaluate the sensitivity of the conclusions to alternative expert opinions.

Although provided elsewhere in the Plan, the species summaries (i.e., Net Effect) should begin with the status of the covered species. This information should include whether the species is listed as endangered or threatened at the state or federal level. The summary should also describe in general terms the contribution of the Plan Area to the species range. If the species is listed under the Endangered Species Act, a brief description is needed on how the BDCP and conservation measures relate to the rational and prudent alternatives (RPAs) of the recovery plan for the species.

The Chapter 5: Effects Analysis is a key document that should contain all relevant information needed to evaluate BDCP effects on each covered species. The document contained some general information on species status and life history, but more detailed information is needed to inform the reader about when, where, and how each species is utilizing the Plan Area. For example, when does each species and race of juvenile and adult salmon use in the Plan Area? What proportion of the population originates from natural habitat versus hatcheries? Key factors known or suspected to affect the species in the Plan Area as well as beyond the Plan Area should be identified. The description in the Effects Analysis does not need to be detailed, but it should reference other key documents where detailed information can be found.

The Panel suggests inclusion of the following information for each covered fish species:

- Population status, including federal and/or state listing.
- Species range and timing of use relative to Plan Area.
- Habitat requirements in Plan Area for each life stage.
- Key factors affecting population throughout their range.
- Criteria for significant “contribution” to recovery.

The Panel makes these recommendations for summing individual stressor effects and uncertainties because readers may naturally perform some of these suggested analyses. By having Chapter 5 include some of this analysis, the authors may avoid contradictions and misinterpretation of results by others.

Recommendation 3 Increase consistency of stressor analysis across covered species, and provide more detail

Problem

For four of the six covered fish species, a quantitative approach to stress analysis was performed (e.g., Figure 5.5-1). The Panel generally agrees with this quantitative assessment approach and recommends it be applied to the other fish species. In so doing, consistency and objectivity of the effects assessment are enhanced. The Panel has already recommended that the stressor scores be summed across conservation measures to obtain a net effect estimate (see ***Recommendation 2***).

Why These Issues Need To Be Addressed

A consistent approach is required to better evaluate the impacts of the Plan on all covered species.

Overall Conclusion and Potential Solutions

The analysis approach should be extended to sturgeon and lamprey. Most of the information needed to perform such analyses is already contained within the narratives for the individual species. Reluctance to extend that assessment method to the other fish species because of lack of information can and should be reflected in the uncertainty values.

The bar charts illustrating the magnitude of different stressor scores for covered fish species (e.g., Figure 5.5-1) should be extended to terrestrial animal species. The summary tables (5.1-3 – 5.1-5) of benefits and effects for terrestrial species already include information on the direction (positive or negative) of effects for each conservation measure. The Panel recommends this directional data be coupled with information on the magnitude and importance of the stressors to produce bar charts similar that for covered fish species (e.g., Figure 5.5-1). In order to do so, however, a new set of stressors specific to terrestrial species may need to be established.

Completeness, Structure and Effectiveness of Description

2. *How complete is the Effects Analysis section; how clearly are the methods described?*

Recommendation 4 Chapter 5 must be a "stand alone" document

Problem

Given that Chapter 5 is designed to act as an integration of various effects (*aka* "roll up") it is felt that the document needs to contain a minimum of relevant information allowing the reader to understand the full scope of the Effects Analysis as well as its limitations.

Why These Issues Need To Be Addressed

It is important to have all of the relevant information in one place. Due to the sheer length of the complete BDCP document, the Panel is concerned that readers will lean heavily on Chapter 5: Effects Analysis in order to understand the basic structure, underlying assumptions made during design, and the anticipated outcomes of BDCP activities. As Chapter 5 is written, readers need to consult other elements of the BDCP document (e.g. it appears from the discussions during the April 30-May 2 meeting in Sacramento that several key sections are within Chapter 3) in order to fully understand the Effects Analysis. A more comprehensive (albeit less detailed) Chapter 5 would put all relevant information in the hands of the reader.

Overall Conclusion and Potential Solutions

Specific elements that were felt to be lacking within Chapter 5 included:

- A good map of the Plan Area as well as the larger watershed. Plan Area maps are available in other chapters of the BDCP, but it was felt that adequate maps are critical for understanding both the overall scale of the project as well as the degree to which Plan elements (conservation measures) and their associated effects are truly integrated across the Delta landscape.
- Sufficient background on current wetland restoration activities underway within the Plan Area and in areas that will be impacted by the BDCP. Some background information on benchmarks and outcomes of restoration activities that are currently underway is necessary to differentiate between ecosystem benefits associated with BDCP and other restoration activities that occur in parallel to the BDCP.
- Findings from the individual technical appendices are not always adequately reported within Chapter 5 Net Effects. The technical appendices generally provide a complete picture of anticipated effects of BDCP activities as well as the associated uncertainty of the direction and magnitude of effects. However, it was felt that in some cases the full range of potential anticipated effects were not clearly articulated within Chapter 5 (e.g. evaluated impact of entrainment on delta smelt was inconsistent between Chapter 5 and Appendix B: Entrainment). In general, Chapter 5 did not address uncertainty as completely as the technical appendices.
- The Appendix G: Life Cycle Models was not available for review. However, there was little evidence that a life cycle approach was used for any species in the Net Effects section of Chapter 5.
- Prioritize species based on their current endangerment, their vulnerability to Plan actions, and their range (see Introduction).
- A list of critical “unknowns” identified as part of the Effects Analysis that may be used to develop future research priorities and guide special studies.

- The “Summary of Conclusions” did not develop conclusions regarding the effect of the BDCP on covered fish species (see Table 5.1-2 for a simple list of positive and negative factors).

Recommendation 5 Clarify the baseline

Problem

The Effects Analysis identified baseline conditions as existing conditions with some exceptions, e.g., some provisions of the OCAP BiOps that require additional documentation and permitting were not included as baseline conditions (Table 5.2-2.). Additionally, many restoration actions have already been implemented and will require time before benefits are fully achieved. Does the baseline include these ongoing restoration activities? How will benefits of the BDCP restoration activities be separated from benefits of these ongoing restoration projects?

Why These Issues Need To Be Addressed

Baseline conditions are necessary for the initial analysis of BDCP effects and for subsequent evaluations after implementation.

Overall Conclusion and Potential Solutions

The Panel recommends clarification in the description of baseline conditions. This clarification should include a metric or relative estimate of species abundance and distribution that can serve as a baseline for future comparison. Likewise, quantitative baseline estimates of each habitat type that will be affected by the BDCP should be developed so that BDCP actions can be evaluated against these metrics.

3. *Is the analysis in the Effects Analysis section reasonable and scientifically defensible? How clearly are the Effects Analysis results conveyed in the text, figures and tables?*

Recommendation 6 Provide systematic understanding and planning for conservation actions, especially restoration

Problem

The Plan presents a series of “Conservation Measures” which aim to provide benefits to the biota of the Delta ecosystem. Two of these, CM3 & CM11, create and manage a reserve system, while eight others acquire and restore as much as 121,000 acres (or ~14% of the Plan Area) of habitat for covered species. These conservation measures are key to the BDCP because much of the mitigation depends on increasing habitat and food supply. Yet, little detail exists about most of these measures. Considerable uncertainty exists, however, about the likelihood of one of the co-equal goals, i.e., the conservation of the Bay-Delta system. Among the principal issues are the sequencing and scale of the implementation of the planned conservation measures. The Plan recommends a large number of conservation measures, but provides no explanation as to how and when they would be implemented, what the particular sequence would be and the intervals between implementation of conservation measures. The Plan also proposes to increase restored tidal and other habitats at a large scale. In terms of general approaches, large-scale efforts at protection and restoration are theoretically positive but on-the-ground implementation can be difficult and is fraught with uncertainty.

In short, the Panel finds the following lacking:

- Specificity about approach is needed in order to evaluate the potential for desirable outcomes.
- Understanding of the proposed sequences of phasing actions and how that particular sequence compared with alternatives will influence outcomes.
- Consider effects of implementation of some conservation measures in the short term (e.g. herbicides and invasive aquatic plant removal, restoration and promotion of other invasive species).
- Consider other unintended consequences of these conservation measures such as impacts on suspended sediment and the effects on tidal wetlands downstream.
- Develop a scheme for prioritization based on state and federal listings, population status, geographic range (see ***Recommendation 10***).
- Incorporate reintroduction into restoration strategies.
- Incorporate landscape and conservation ecology principles. For example, linking of migratory corridors and connectivity of food exports.

Why These Issues Need To Be Addressed

Achieving beneficial conservation measures requires a complex and detailed sequencing, adaptive management responses, understanding thresholds for certain actions, and understanding interactions and other consequences of these actions, otherwise, this isn't a conservation plan, but rather a conservation menu. The BDCP lacks a description of all the components of the Bay-Delta system integrated in a manner that reflects a model of how the components relate to one another, how they influence each other, and the general magnitude of influences or interactions. The lack of alternatives discussed other than the Preferred Plan versus current conditions projected is not a very comprehensive approach. The Plan needs to provide more detail for an effects analysis to be assessed. The large number of conservation measures has not been placed in any type of temporal and spatial framework; the order of implementation is a critical issue and their spatial relationships and influences are critical. This set of conservation measures has not specified any alternative actions, nor the order and timing of these measures. The long list of conservation measures appear as a menu of potentially beneficial actions, but analysis of their actual effects in many cases is prevented by the lack of implementation strategies. Given the large number of covered species and potential actions, the Panel was surprised that there was no prioritizing of species or actions, that species with the greatest threats to their populations were not considered of greater importance that those found within the Delta boundaries but whose survival is not threatened. Further, of the large number of proposed conservation measures relating to restoration activities and reserves, rarely was assessment provided of the feasibility of these actions, which ones might be readily achievable, while indicating those that might prove difficult. This leads us to the principal overall summary, that there is not a comprehensive, synthesized framework for conservation that incorporates coordination and integration of all of these actions.

Specificity and Clarity is Lacking, Making it Difficult to Evaluate the Potential for Desirable Outcomes*.* No detail is provided concerning implementation methodology, or sequencing of the numerous modifications of habitat and proposed restorations. No detail has been provided concerning an 'ideal' sequence of restoration and why alternate sequences were not selected. No detail on which animals and plants in the terrestrial habitats are most at risk and therefore should have priority or a method to determine that. No criteria have been provided that will be used to assess whether there has been any restoration achieved, nor whether unspecified population goals have been met for species at risk. There is no explanation of who will monitor any of these actions and how adaptive management may be incorporated.

The lack of temporal and spatial aspects of implementation suggests a lack of comprehensive framework about what Bay-Delta components, how they are distributed, how they interact, how modifying some physical or biological components will influence other components. Little integration of well-accepted landscape and conservation ecology principles is apparent. While some numbers are provided (Appendix F, for example) for spatial extents of potential habitat that might be added, their spatial distribution is not analyzed with respect to ecological performance; hence, are there appropriate migratory corridors, are particular sites large enough for the intended covered species, is there connectivity to appropriate food and other habitat resources, or other fundamental aspects.

Sequencing of 'Conservation Measures' Will Itself Influence Outcomes. Two aspects of sequencing conservation measures are apparent and these actions require careful and sequential planning. One is that ecological communities are contingent and will not automatically assemble in some predictable manner (Parker 1997) and sequences have major influences (Drake 1990, 1991; Hobbs and Cramer 2008). Sequencing of management tasks seems crucial. Should the tidal restoration begin prior to the elimination or reduction of submerged aquatic invasives such as *Egeria*, as an example, then past experience suggests that *Egeria* will expand rapidly into the new tidal habitat. Consequently, the *Egeria* problem has become much larger and proposed benefits from the tidal wetland restoration may not occur. Similarly, changing the order of different conservation measures will push ecological systems onto different trajectories. Usually these cannot be predicted, but because no integrated monitoring and adaptive management structure is incorporated into the conservation approach, uncertainty about the ultimate impact of many of these conservation measures rises considerably.

Secondly, given the scale and number of species impacted, some prioritization is required based on state and federal listings, population status, geographic range, or other characteristics. Not all of the covered species currently are equally at risk, and not all are equally threatened by future climatic changes. Not only are temporal and spatial aspects of habitat modifications and restoration needed, but also prioritizing which species are most at risk. How will different sequences impact the species most at risk, how will any particular scenario impact all covered species as a group?

Lacking a plan of how these measures will be sequenced and the intervals between them, means that their impacts cannot actually be predicted. Further, the Plan has not discussed or considered alternative sequences nor provided justification for their current approach. While the Bay-Delta system is large and complicated, the implementation measures themselves are numerous and occur in an explicit spatial context. Because the physics of hydrological flows will be impacted along with critical thresholds of salinity, dissolved oxygen, suspended sediment, and other physical and biological responses, understanding the conservation plan requires placing the actions explicitly within a framework that indicates interactions, and that synthesizes the system as a whole.

Many of the Conservation Measures Will Have Potentially Negative Impacts Yet Are Not Analyzed. The Delta is a highly modified system, and as an example, is filled with several prominent invasive species. Actions taken to impact invasive species will themselves have substantial impacts. For example, at the lowest proposed rate of removal of the submerged aquatic plant *Egeria*, it would take 13-17 years to remove *Egeria* from the system assuming a low rate of *Egeria* response and optimistic abilities to find and remove established populations. The impact of large-scale herbicides over such a long time period has not been evaluated. Similarly, floodplain and riparian areas are other major restoration sites, yet a number of aggressive invasives are already established in these habitats within the Plan Area including, for example, pepperweed. The only viable management approaches to these plants appears also to be large-scale application of herbicides, but there is no assessment of the impact of large-scale chronic herbicide treatments on other plants, phytoplankton, animals in the food chain nor of other 'conservation measures'. This scale of action proposed to eliminate *Egeria* using herbicides is considerable. While laboratory and small-scale applications of some of the proposed herbicides may be effective and have little apparent effect on other trophic interactions, scaling up to over 1600 acres/year at the smallest rate of the proposed conservation measures means large scale applications over a very long time period (13-17 years; assuming 1638 acres/year with remaining *Egeria* increasing at 10-15% per year). There is no assessment of what will happen to the Delta system with such large-scale interventions, nor when added to other interventions applied to other invasive species.

Currently, the BDCP treats all the conservation measures, including the loss of freshwater into the Delta, as positives without actual analyses and comparisons to alternatives.

The conservation measures will create other unintended negative consequences that are not considered, such as impacts on suspended sediment and the effects on downstream tidal wetlands

The restoration of freshwater tidal habitat is a valuable goal, especially for some of the species at risk. However, the BDCP treats restoration as a ‘given’ positive, without considering to much extent that the same actions will also ‘create’ habitat for trophic consumers (e.g., *Egeria* invading and providing habitat for predators of threatened fish), or trophic competitors (e.g., filter-feeling clams creating permanent phytoplankton sinks). Appendix F considers some of these issues, but within Chapter 5, they are glossed over and their impact minimized or ignored.

Even without considering *Egeria*, opening up large amounts of tidal habitat without consideration to a number of other issues fails to determine the effects of these conservation measures. For example, moving intake pumps into the Sacramento River system north of the Delta removes not only fresh water, but also suspended sediment. The proposed restored tidal systems similarly will be sinks for suspended sediment; regions that now will be impacted by reverse flow in the north Delta will also become sediment sinks. At the same time, wetlands in the Suisun Bay region and San Pablo Bay depend upon suspended sediment for not only restoration, but for maintenance of these wetlands as the rate of sea level rise continues to accelerate (Callaway *et al.* 2011, Parker *et al.* 2011). The conservation measures remove considerable sediment from the system temporarily by restoration projects, and permanently by the placement of intake pumps to the north of the Delta. How will the loss of sediment be mitigated in the context of large-scale wetland restoration proposals in San Pablo Bay, Suisun Bay and the Delta, as well as with climate change increasing the rate of sea level rise?

What is the current trend and status of suspended sediment (needed for tidal wetland restoration)? Within Appendix F it is clear that the Plan incorporates knowledge of a declining trend in suspended sediment. What will be the impact of shifting of intakes? What proportion of suspended sediment results from the Sacramento versus the San Joaquin systems? What will be the impact of increasing flow in the Yolo Bypass on sediment entering or leaving the Delta system? How will these changes impact the net export of suspended sediment to the Suisun and Bay and the restoration efforts on tidal wetlands in those systems that have a greater dependence on suspended sediment? Do other sources of sediment exist that could mitigate these changes?

<u>Uncertainty</u>

Uncertainty is not addressed scientifically, particularly in the case of critical biological analyses of restoration, non-fish covered species and invasive species. There is a discussion of some of these, but usually just a list of species, a suggestion that there will be an increase in potential habitat due to ‘restoration’, and a conclusion of net benefits. There are numerous tables for each taxon (Appendix K), but with respect to the overall Plan, methodology, and discussion of goals, the degree of uncertainty involved in achieving the assumed results and benefits are not considered with sufficient detail.

For example, although no specific goals are discussed, there is large uncertainty associated with the assumption of achieving any implied biological goal in restoration. The uncertainty in removing *Egeria* or other invasive species are not well considered. The impact of these invasives in restored habitat is not incorporated for the most part, except as an alternative outcome. The mention of phytoplankton sinks in restored tidal wetland habitat due to invasive mollusks is clear in Appendix F but is ignored when assessing long-term biological impacts. When examining the sections relating to establishing reserves and restoring habitat (within Chapter 5, Appendix F and Appendix K), all the numerous actions are assumed to work perfectly. For the non-fish covered species, few are discussed, most are indicated only in a list of species, with a suggestion that there will be an increase in potential habitat due to 'restoration', and a conclusion of net benefits. There are numerous tables for each taxon (Appendix K), but with respect to an overall plan, methodology, and discussion of goals, the degree of uncertainty involved in achieving the assumed results and benefits are not considered with sufficient detail.

Success in restoration of habitat is not easily achieved; it is not the experience of researchers and managers actually doing restoration (Hilderbrand *et al.* 2005). The fictitious belief that complex ecosystems are fully restorable, and in what is a relatively short ecological timeframe, is essentially without substance, especially for the scale and sensitivity of a region like this (Hobbs *et al.* 2011). Numerous studies indicate that mitigation rarely achieves conservation or biodiversity goals (Hobbs and Cramer 2008, Hobbs *et al.* 2011). As a pointed example, wetland restoration, which would seem to be the easiest to potentially achieve, is actually quite difficult with respect to ecosystem processes beyond tidal flux and especially with respect to ecological equivalency to comparable natural wetlands (Kentula 1996, Simenstad and Thom 1996, Zedler and Callaway 1999, Lockwood and Pimm 1999) and these issues have not improved in more recent evaluations (Burgin 2008, BenDoer *et al.* 2009, Moilanen *et al.* 2009). This remains true for a number of ecological systems, especially grasslands (Bartolome 1989, Brown and Rice 2000, Jackson and Bartolome 2002, Bakker *et al.* 2003), many shrublands, and even riparian zones (Patten 1998, George and Zack 2001, Cione *et al.* 2002).

The Plan presumes to establish habitat for a wide array of different types of species, however, in each case, except for the covered fish, there is little or no indication of what the habitat needs are, if there is sufficient connectivity and habitat resources available, nor a discussion of what habitat means for any particular species (George and Zack 2001). For wildlife, as an example, the Plan needs to consider the size and landscape context of the restoration site and whether it is even appropriate for the target species, identify necessary habitat elements, and produce a strategy for restoring those elements and ecological processes (George and Zack 2001). In one of the few instances of some detail, for the brush rabbit, the Plan indicates restoring riparian areas and even maintaining a particular proportion of habitat in early to mid-successional stages. However, no methodology is provided, no implementation scheme, no explanation of how 'early to mid-successional' would be defined and why it might be important for a brush rabbit, how a successional stage will be maintained or any options. Further, no information is provided about whether rabbits would disperse to such a place, and under what conditions they might disperse. The amount of dispersal, behavioral dimensions to dispersal and the pattern of dispersal are critical determinants of population and metapopulation dynamics (e.g., Szacki 1999, Templeton *et al.* 2011). Whether a specific organism disperses depends upon the nature of the connectivity, the matrix between appropriate habitats, and how organisms respond both to intrinsic genetic issues (e.g., in many animals, dispersal is principally only one gender), and extrinsic features such as the properties of the immediate area as well as the landscape (Templeton *et al.* 2001). This suggests that reintroduction needs to be included in restoration strategies.

Without specific restoration objectives for many of the covered species, reintroduction may be the only solution but differs substantially from conclusions within Chapter 5. Construction activities and other aspects of habitat loss and degradation from invasive species suggest there would be a net loss of habitat, population size and viability for the large majority of species. The example of the brush rabbit indicates the degree to which achieving ecological goals will require enormous and continuous management effort indefinitely.

<u>Conflicting Model Results and Analyses</u>: No specific models were used nor compared for the restoration of habitat. Given the lack of specific analyses other than GIS footprint estimates of acreage, there are no ‘conflicting’ results.

<u>Link to Adaptive Management and Monitoring Programs.</u> The key to achieving any degree of restoration of processes, function, structure and diversity is setting particular goals and assessing progress toward them on a continuous basis (Miller and Hobbs 2007, Hobbs and Cramer 2008). Certainly these linkages are assumed, but no explicit linkage is provided within the effects chapter. No framework is provided for sequencing, for what needs to be accomplished before subsequent steps are taken, what trigger thresholds might exist or be developed, or any additional plan for how conservation management will be established. No series of options are considered that would permit the likelihood of achieving the agreed (but unstated) goals. Given that climate change and constant management of hydrological flows will result in a variable system under continuous change, a set of explicit goals is critical, and a clear framework for how to achieve them, a monitoring system in place, and an adaptive management structure already in place with available options that have been previously assessed and agreed upon.

Overall Conclusion and Potential Solutions

The Net Effects described for many of the conservation measures in the Plan are substantially misleading. The lack of detail and clarity concerning design, sequence, and implementation make it difficult to assess. The absence of specific goals, tailored for covered species, the lack of habitat analyses, and no monitoring or adaptive management framework presented explicitly in Chapter 5 would imply that there will be considerable failure in the restoration process.

Some measures result in habitat loss, e.g., construction activities. These are frequently broken into multiple categories of permanent loss and ‘temporary’ loss among others. Given the uncertainty of restoration, and the lack of goals for restoration, and the lack of an adaptive management structure and plan, the likelihood of restoration success is quite low. Over the time period of the Plan, none of the ‘restored’ habitats are likely to fully achieve structure and function. There is no discrimination or prioritization involved in the Plan; some habitats are easier to restore than others, some species are easier to enhance than others. For most of the covered plants, for example, the net effect is a net loss of population size due to a) permanent acreage losses; b) “temporary” acreage losses with no specifics for restoration of particular populations. There is extreme uncertainty that any positive benefit will be derived from any conservation measure involving restoration because of invasive species impacts with no specific plans (except for spraying of *Egeria*), no specific goals for restoration that must be achieved, no framework for re-establishment or enhancement of populations.

Many of the conservation measures may enhance conservation from the perspective of a subset of the covered species, while simultaneously degrading other species populations. Moving the intact pumps to the north Delta may potentially benefit some of the covered fish if adequate adaptive management considerations are incorporated, however, restoration of tidal wetlands will be greatly impacted due to loss of suspended sediment, and downstream impacts on both restoring and intact natural tidal wetlands will suffer in the context of accelerated sea level rise from this one aspect alone. The degradation impacts of conservation measures are not incorporated into the effects analyses, only the presumed positive benefits.

Another claimed beneficial measure, “Avoidance and minimization,” doesn’t directly result in beneficial effects, rather minimizes adverse effects. While minimizing adverse effects is always a good strategy in a conservation plan, the result clearly remains a net adverse effect. Mitigation of any construction or other action that was ‘minimized’ would have uncertainty associated with whether any benefits actually were achieved.

The Plan overall needs to establish an overall strategy for successful conservation. It provides instead a list of potentially beneficial actions, as well as adverse actions termed ‘conservation measures,’ but does not integrate them into a synthesized program with a prioritized sequence of actions and a prioritized sequence of species on which to focus actions. The Plan requires a temporal and spatial framework, the clear institutional structures in place for monitoring and adaptive responses, and prioritization of covered species.

Recommendation 7 Include indirect effects of contaminants as part of Appendix D: Contaminants

Problem

The current draft of Appendix D: Contaminants limits its discussion to the potential for direct contaminant toxicity on covered species. Discussion of the potential for indirect contaminant effects (i.e., via food web interactions) are excluded from Appendix D and are instead found within Appendix F: Ecological Effects. This division of potential direct and indirect contaminant effects downplays the emerging evidence suggesting a potentially important role for contaminants on the pelagic food web and the success of covered species. It should be noted within Appendix D that while concentrations leading to direct toxicity of many contaminants have been characterized, there is much uncertainty associated with indirect contaminant effects and statements as found in the Executive Summary (page D-1, lines 15-16) suggesting that herbicide applications associated with Conservation Measure 13 will be applied at “safe concentrations” is likely difficult to defend based on the scarce literature available.

The discussion of future increased contaminant load and potential increase in contaminant concentration as a result of the implementation of Conservation Measure 13 (Aquatic Vegetation Control) provides an analysis of the highest detected concentration for several herbicides and their LC50 for three of the covered species (Table D-28). Table D-28 also provides the ‘highest detected concentration’ for the contaminant. However, it is unclear if this is the herbicide concentration measurements under current conditions or modeled herbicide concentration under future conditions. In any case, a complete analysis must include herbicide concentration after the conservation measure is implemented and under future residence time scenarios.

There is a lack of clear discussion of how changes in export operations will influence the contribution that the San Joaquin River will make to the central Delta, and in turn how that will influence the potential for either direct or indirect selenium toxicity or other contaminants associated with agriculture.

Why These Issues Need To Be Addressed

The present analysis of *direct effects* appears to adequately summarize the best available science, however *indirect effects* of contaminants on covered species via food web effects (*i.e.,* contaminant effects on the microorganisms that make up the food web that covered species depend on) are almost certainly important, and as Appendix D is presently written, are not considered.

Overall Conclusion and Potential Solutions

The synthesis of Brooks *et al.* (2012) provides a good overview of both direct and indirect contaminant effects for Delta species, including several of the covered fish species. Additional information may be obtained from the Interagency Ecological Program Contaminants Work Team.

Recommendation 8 Accurately characterize food resources and food webs”?

Problem

Within the Net Effects summary bar chart figures for each of the covered species, “Food Resources” are consistently scored as a major benefit of BDCP conservation measures, individually and in aggregate. In all cases, the benefit is presumed to be positive and generally has one of the highest (if not the highest) score of all of the effects. However, the treatment of food resource availability is grossly incomplete and overly simplistic. There are several concerns within this recommendation; most importantly, (1) the current assessment considers planktonic (pelagic phytoplankton) food resources to be the only consequential contributions to the Delta's food web pathways supporting listed species and their ecosystems, and (2) the Effects Analysis ignores issues of food quality.

Why These Issues Need To Be Addressed

While the estimated loss of phytoplankton production throughout the Bay-Delta, believed due in part to the cascading effect from introduction and expansion of the non-indigenous *Potamocorbula amurensis* (Kimmerer 2004; Sommer *et al.* 2007), has certainly been extensive over the past decades, the potential limitation of organic matter may be just as much driven by the decline in particulate detritus and derivative dissolved organic matter from emergent vascular plants, epiphytic algae, benthic microalgae, and submerged aquatic vegetation produced in emergent tidal marshes and associated shallow water ecosystems. With the development of the Delta, the historic 2200 km^2 complex of Delta wetlands had been reduced by 95% (Atwater *et al.* 1979) with a commensurate decrease in primary production and resulting detrital inputs supporting the Bay-Delta's detritus based food webs. As a reflection of this depletion of detrital sources, Canuel *et al.* (2009) estimated that total organic carbon accumulation in the Delta is now four to eight-fold lower than prior to 1972. Thus, the combination of depressed phytoplankton production and massive loss of organic detritus input into the Bay-Delta have likely <u>both</u> contributed extensively (as well as food *quality*, described below) to the loss of fisheries production in the Bay-Delta (Jasby and Cloern 2000; Jasby *et al.* 2003; Sobczak *et al.* 2005).

The relative importance of detritus-based food web pathways to important Bay-Delta consumer organisms is poorly understood, in part due to the preponderance of scientific and management focus on planktonic (grazing) food webs, and is seldom represented in Bay-Delta restoration planning, as reflected in Effects Analysis. However, recent investigations in the Bay-Delta using stable isotopes suggest that phytoplankton contributions to consumers occupying shallow water ecosystems (including most of the listed species at some points in their life cycles) is considerably less than wetland detritus sources (Howe and Simenstad 2007; Grimaldo *et al.* 2009; Howe and Simenstad 2010). As found by Howe and Simenstad (2007, 2011), fishes and macroinvertebrates restoring tidal wetlands (even those very early in their restoration evolution) are supported extensively by consumers that derived their production from wetland production rather than phytoplankton. These results suggest that, while planktonic production may continue to be limited in the Bay-Delta due to limiting factors such as *Potamocorbula amurensis* grazing effects, the potential contributions of the proposed BDCP restoration of shallow water tidal ecosystems in the Delta to detritus-based food webs deserves much more attention and evaluation.

The analysis of the effect of constructing additional shallow open water habitat is largely based on the first-order model between phytoplankton growth rate and water column depth, with the assumption that shallow water habitats promote increased phytoplankton growth rates, the result of phytoplankton experiencing higher average irradiance. Empirical models that consider turbidity (*i.e.,* Cole and Cloern 1984; 1987; Parker *et al.* 2012b) calibrated specifically for the Delta (Jassby *et al.* 2002) exist and provide a better approximation of net primary production across shallow water habitats with different water transparencies (secchi depths). Additionally, the underlying assumption that shallow open water habitat will provide increased food resources has been evaluated for several locations within the Plan Area (Cache Slough / Liberty Island, Frank's Tract, Mildred Island) and may be used to evaluate the magnitude and certainty of food resources in these habitat types. Given the trend in suspended sediments (Schoellhamer 2011) and improved water clarity in the SFE (including the Plan Area) nutrient influences on primary production and phytoplankton community composition are likely to increase in importance as light-limited control is reduced in relative importance. In the most extreme case, relatively high nutrient loads (N and P), concentrations, and stoichiometry (Glibert *et al.* 2011) may lead to cultural eutrophication, harmful algal bloom or low dissolved oxygen events*.* This would most likely occur in shallow open water habitats with poor flushing / long residence times, *i.e.,* the type of habitats being proposed under the BDCP. This has prompted management planning discussions (e.g. nutrient numerical endpoints, NNE). Yet, meaningful discussion of such scenarios is largely lacking within the Effects Analysis and is not sufficiently captured in the Net Effects scoring system.

The potential that shallow open water habitats will provide habitat for submerged aquatic vegetation (SAV), including invasive species (to be addressed in Conservation Measure 13) does not appear to be adequately considered given the weight assigned to the effect benefit and uncertainty scores in the Net Effects analysis. Another consideration that appears to not be considered is the potential that these shallow open water habitats will be new habitat for expansion of invasive clams such as *Corbicula.* Under this scenario, the new shallow water habitats would likely act as net sinks for pelagic phytoplankton, and not sources of phytoplankton, thus acting as a net negative effect for food resource availability.

Finally, with respect to pelagic autochthonous (phytoplankton) production as a driver of improved food resources, the current analysis provides no discussion of phytoplankton community composition or food quality. Documented shifts in phytoplankton community composition have occurred in the SFE, including the Plan Area (e.g., Lehman 2004; 2007; Lehman *et al.* 2008; Brown 2008; 2010; Glibert *et al.* 2011). The shift from diatoms to flagellates and cyanobacteria likely decreases overall pelagic trophic efficiency and food web support for covered species. At present, some of the shallow open water habitats (*i.e.,* Mildred Island) with long residence time are habitat for cyanobacteria, including *Microcystis spp.* While specific drivers of *Microcystis* blooms are still not resolved (but see Lehman 2005; Lehman *et al.* 2008), water temperature and residence time have been implicated. Under future climate scenarios, shallow open water habitats may promote

Microcystis and other harmful cyanobacteria species (e.g. *Anabaena, Aphanizomenon*).

Overall Conclusion and Potential Solutions

A complete analysis of food resources needs to incorporate *both* detrital and planktonic food web. Additionally, food quality needs to be considered in addition to food quantity.

Recommendation 9 The hydrodynamic modeling needs to capture the entire domain of effects

Problem

Conservation Measure 1 (CM1) is the most significant of all the conservation measures proposed in the BDCP. CM1 will fundamentally shift the physics of the Delta system as a result of transferring the major export point from the South Delta to the North Delta.

Fundamental Physics Shift Principle #1: The South Delta: The traditional problems that have plagued the system in the South Delta may not be as important. Many regulations that guide exports from the south Delta were put in place to regulate the causes of entrainment at the export pumps. For example, OMR (Old and Middle River) regulations were in place because reverse flows occurred in these channels. Each current regulation needs to be reviewed to see if the regulation will still make sense when the diversion point is shifted.

Fundamental Physics Shift Principle #2: The Western Delta/Confluence Area: The physics around the confluence of the Sacramento and San Joaquin Rivers will change when the BDCP is implemented and water is exported from the Sacramento. With exports drawn from the South Delta, the Sacramento River had more flow than the San Joaquin. In the past, when salt intruded into the Delta past the confluence region, the salt would most likely intrude farthest up on the San Joaquin stem of the confluence. The “QWEST” term was created as part of the Delta Outflow calculation as a simple way to explain when flows were negative along the San Joaquin stem of the system.

When the export is shifted to the Sacramento, the salinity intrusion will likely intrude farthest on the Sacramento side of the confluence. This will require rethinking how salinity intrusion into the system is communicated. X2 will need to be defined for both the San Joaquin and the Sacramento stems of the system. Also the calculation of Delta outflow and QWEST will need to be reconsidered. This accounting system will no longer communicate fundamental information about salinity intrusion when the major withdrawal shifts to the Sacramento side of the system.

Fundamental Physics Shift Principle #3: North Delta: New guidelines will need to be put in place to regulate tidal (and maybe tidally averaged reverse flows) in the north Delta channels including Steamboat, Suttter, and Georgiana Sloughs. The operation of the Delta Cross Channel also needs to be rethought. These new guiding regulations need to be in place before exports start to occur in the system. Part of adaptive management must include the hydrodynamic modeling tools available now to identify problems that will likely occur when the North Delta pumping facility is put on-line. These hydrodynamic models should be used to create the initial regulations for the system. These new regulations need to be incorporated into the CALSIM optimization model to determine if these North Delta restrictions alter upstream reservoir operations.

Fundamental Physics Shift Principle #4: San Francisco Bay: The current Effects Analysis does not consider the influence of shifting timing of withdrawals on San Francisco Bay circulation patterns and ecology. This is a significant omission with ecologically important implications. For instance, freshwater from the Delta is the primary source of fresh water to flush South San Francisco Bay (McCulloch *et al.* 1970**).** If water is withdrawn during peak flow events, less Delta Outflow will be available to flush the South Bay.

Why These Issues Need To Be Addressed

North Bay Implications:

Currently, there are no regulations to guide reservoir releases for North Delta export facility requirements. With these requirements the CALSIM operations model, there are potential issues related to the amount of water released from the upstream reservoirs and the amount of water available in the cool pool.

Putting in guiding rules in CALSIM will alter the way in which the North Delta pump facilities are operated. For instance, in the modeling done for this phase, there are cases where there are tidal flows around the North Delta Facilities.

For example, in the Intake Operation Effects in the North Delta (p. 5.3-4) section it is stated: “Tidal modeling results indicate that the greatest movement during the summer months with a bypass flow requirement of 5000 cfs would be about 0.5 mile (with a reverse velocity for 3 hours). ….Intake structures could provide current breaks that disorient fish and allow increased predation of juvenile fishes. Additionally, the ratchet effect of moving downstream past the intake structure but then being brought back adjacent to it with incoming tides is of some concern, as it exposes juvenile fish to the intake structures twice instead of just once passing with the river outflow and increased swimming performance is needed to avoid impingement on the screens.”

The National Research Council report provides an excellent summary of the ecological issues related to X2 and the Low Salinity Zone (Huggett and the National Research Council Committee on Sustainable Water and Environmental Management in the California Bay-Delta 2012) in the chapter on Environmental Stressors, Flow effects on the physical environment. (pp. 55-57.)

Overall Conclusion and Potential Solutions

- Evaluate current regulations for the South Delta to see if they make sense for the new configuration.

- Re-define an X2 value for the Sacramento and San Joaquin stems of the river for X2 > 81 km (past the confluence region).
- Use the hydrodynamic tools available now to anticipate the regulations that need to be put in place for North Delta pumping operations. These regulations could include the location where distance from the pumping where tidal flows are allowed, the amount of time when reverse flows are allowed in the side channels such as Steamboat, Miner, and Sutter Sloughs, and new operation rules for the Delta Cross Channel.

Approach and Analysis

4. *Does the Effects Analysis section integrate an appropriate suite of analyses? Were appropriate analyses used?*

Recommendation 10 Incorporate life cycle models for all species, as quantitatively as possible

Problem

Conceptual models, which describe how scientists think species utilize habitat and are influenced by Delta conditions such as flow, were briefly mentioned in Section 5.2.6.3, but a brief summary of available conceptual models (e.g., DRERIP) was not provided with each covered fish species. For example, will changes in flow and the X2 position alter the availability of high quality habitat for out-migrating juvenile salmonids, which often slow movement, feed and acclimate when initially encountering brackish water?

Some life cycle models were mentioned in Chapter 5, but it was unclear whether this represented all available life cycle models given that Appendix G: Fish Life Cycles has yet to be completed. Furthermore, Red Flag comments provided by agencies indicated that some quantitative data and analyses were not utilized, including flow-abundance relationships for sturgeon.

Why These Issues Need To Be Addressed

The Panel would like to see a prioritization of the species of concern based on their level of endangerment, threats to the species, the potential for BDCP actions to harm or enhance the species, and the proportion of their range that is included within the Plan Area. A variety of semi-quantitative methods have been developed to prioritize species in the context of conservation and management efforts (Andelman *et al.* 2004), among which life cycle models are likely the most applicable to the BDCP situation.

Both conceptual models and life cycle models play important roles in adaptive management. For example, if future monitoring indicates a biological objective is not being met, then the conceptual model and life cycle model may be used to help identify the mechanism leading to the adverse outcome, so that actions can be taken to address the problem. This approach is often necessary because monitoring may not be sufficient to identify causal mechanisms.

Overall Conclusion and Potential Solutions

Both conceptual models and quantitative life cycle models should be described in Chapter 5. Life cycle models should be used to generate quantitative population level effects of specific BDCP actions so that the overall effect of the BDCP can be assessed.

Recommendation 11 Consider salmonids at stock and life history scale

Problem

Differential timing and use of habitats by salmonids may lead to different effects on each species or race because the BDCP exports and location of exports will vary over time. However, the Effects Analysis combined all four races of Chinook salmon and steelhead, and assessed effects on the egg stage, foraging juveniles, migrating juveniles, and adults. The authors recognized that they may need to analyze each species and race separately, and the Panel agrees.

The Effects Analysis was not always clear to identify whether the BDCP effect was at the population level, or for the subcomponent of the population that experienced the effect. This comment applies, for example, to a statement that says there would be a 5-10% increase in egg mortality relative to existing conditions in most years. Is this effect at the population level (in which spawning distribution of spring Chinook has been considered), or at the subcomponent level? Ultimately, as emphasized by the Panel in the Phase 1 review, the BDCP Effects Analysis should be evaluated at the population level. Expansion of stressor levels to the population level is necessary so that overall effects of the stressors can be compared and summarized.

Another example of whether the scores in Fig. 5.5-6 reflect the effect at the population level involves floodplain habitat in the Yolo Bypass. The Panel agrees that increased use of this habitat by salmonids would be highly beneficial, but the analysis states that less than 10% of salmonids would use the bypass habitat. Fig. 5.5-6 indicates the BDCP effect on floodplain habitat and salmonids would be greater than any other conservation, but it is unclear if this ranking is for the subcomponent that uses the Yolo Bypass, or the entire population.

Why These Issues Need To Be Addressed

Each salmonid species and race utilizes the Plan Area in a somewhat different manner, largely defined by their body size, timing and duration of habitat use in the Plan Area (Williams 2006, Miller *et al.* 2011, Michel *et al.* 2012, Chapman *et al.* 2012). Stocks originating from the Sacramento River watershed will encounter different conditions relative to those originating from the San Joaquin watershed, and should be analyzed separately. Hatchery salmonids are often released at relatively large size and may therefore utilize habitats in the Plan Area differently from naturally-produced salmonids of the same species and race.

For example, the analysis identified a significant adverse effect of the BDCP on winter-run Chinook salmon (Endangered status) during the egg incubation stage (due to increased redd dewatering and higher water temperature), and a lesser effect on spring-run Chinook salmon, yet the summary Effects Analysis (Fig. 5.5-6) lumped all salmonids together. A greater effect on winter-run Chinook occurred because essentially all of these fish spawn in the mainstem, whereas only a portion of spring run Chinook spawn there. The summary of net effects concluded that "the positive aspects of the BDCP appreciably outweigh the negative aspects in regard to salmon and that the net effect of the Plan on salmonids is beneficial to Central Valley salmonids." This conclusion ignores the adverse effects on a species that is listed as Endangered under the Endangered Species Act.

Overall Conclusion and Potential Solutions

The Panel believes that the Effects Analysis needs to include discrete analyses for each salmonid species and race and describe effects of each stressor at the population level. Analysis of juvenile salmonid use of the Yolo Bypass should be updated with more recent analyses that account for timing of juvenile salmonids in relation to the proportion of flow into the bypass (e.g., J. Roberts, California Department of Fish and Game, and analyses in the Appendix). Efforts to maximize the proportion of juvenile salmonids use of this habitat should be considered given that it appears to be highly beneficial yet only a small proportion of the population would during proposed conditions.

Recommendation 12 Identify analytical tools that need to be developed to address the extremely high uncertainty involved with calculating sediment supply and turbidity

Problem

Multiple statements within Chapter 5 and in Appendix C indicate the turbidity distribution is largely unknown. In Chapter 5, there are statements such as:

- "The current balance between the factors regulating sediment supply to the Sacramento River is unknown (Wright and Schoellhamer 2004), so it is not possible to predict the evolution of sediment supply in the coming decades with any certainty." (p. 5.3-14)
- "Changes to turbidity as a result of BDCP implementation are difficult to predict and are likely to vary by ROA and subregion, as discussed in Section 5.3.2.3. At this time no conclusions is made regarding the change to turbidity as a result of Plan implementation." (p. 5.5-7)

Although the Appendix C title implies that turbidity will be evaluated in a systematic manner, turbidity is not modeled in this Appendix. Appendix C.5.4.6.1 (C.5.4-246) gives an in-depth general background of the state of the science.

"No turbidity (water clarity) model exists that is suitable for full integration with other effects analysis tools such as CALSIM. Instead, potential changes in water clarity between the preliminary proposal and existing biological conditions scenarios were assessed for each Plan Area subregion using best professional judgment based on existing published and unpublished literature…" (p. C4.59)

The conclusion for Section C.5.4 (Turbidity) is critical for understanding the state of the science. This conclusion should be stated in the Chapter 5 Effects Analysis as a primary conclusion.

- "Uncertainty in the sediment supply in the future is high, and factors such as the timing of establishing the ROAs and the potential use of options such as fill-in materials or wind breaks in the ROAs to reduce wind-driven resuspension preclude all but the most general analysis. The roles of SAV, benthic filter feeders, organic materials, and other factors have not been considered." (C.5.4-266)

Why These Issues Need To Be Addressed

Phytoplankton production in the Delta has traditionally been understood to be light limited. Therefore, water clarity is a necessary component to predict phytoplankton production. In addition, sediment is required to develop the tidal ROAs proposed. Some fish species, such as delta smelt, utilize turbid zones for protection from predators (Feyrer *et al.* 2012). Therefore, turbidity is an important component that needs to be analyzed.

Overall Conclusion and Potential Solutions

- The conclusion for Section C.5.4 (Turbidity) is very critical for understanding the state of the science. This conclusion should be stated in the Chapter 5 Effects Analysis as a primary conclusion.
- There needs to be a specific method (perhaps an additional Conservation Measure?) to further advance understanding of sediment transport in the Delta. The BDCP needs to indicate which tools are necessary to further advance our understanding in this area.

5. *How well is uncertainty addressed? How could communicating uncertainty be improved?*

Recommendation 13 Levels of uncertainty are not adequately addressed

Problem

Conclusions based on the Effects Analysis will depend on the magnitude and direction of the estimated effects and the certainty of the estimates. In many or most of the assessments, a qualitative rather than a quantitative approach to effects assessment of the BDCP on covered species was performed. As a consequence, expressions of the uncertainty associated with the conclusions were often described with even more generality. While the need to be qualitative is understandable, what was often not clear were the factors incorporated in the uncertainty assessment?

Realistic expressions of uncertainty are important in order to put effects assessments in perspective. For instance, marginally positive or negative estimated effects could have the opposite consequence if uncertainty is large. Only large effects with relatively low uncertainty may be reliable for prediction.

Why These Issues Need To Be Addressed

There are numerous sources of potential uncertainty on the Effects Analysis, including among others:

a. Misspecification of model structure

b. Misspecification of model parameter values

c. Competing model specifications

d. Environmental stochasticity

e. Unexpected delays or changes in implementation of the BDCP

f. Unexpected interactions between the biota due to effects associated with implementing the BDCP

g. Differences in expert opinion concerning:

   - Stressor rankings
   - Effect scores

h. Environmental or land and water use changes outside the scope of the BDCP

i. Time lags between implementation of the Plan and the current population trajectories of covered species

Overall Conclusion and Potential Solutions

The Net Effects sections in Chapter 5 rarely put the conclusions of the effects assessment in context with the sources of uncertainty listed above. When a specific conclusion is drawn and it drawn with little uncertainty, for example, the reader is unable to assess whether that result is due to a thorough consideration or lack of consideration for all uncertainties. A standardized checklist of sources of uncertainty considered in the assessment would be helpful to properly put results into context.

Quantitatively, measures of uncertainty can generally be easily combined. For example

$$\mathrm{Var}\left(\sum_{i=1}^{n} x_i\right) = \sum_{i=1}^{n} \mathrm{Var}(x_i)$$

for independent ’s

or

$$\mathrm{Var}\left(\sum_{i=1}^{n} x_i\right) = \sum_{i=1}^{n} \mathrm{Var}(x_i) + 2\sum_{\substack{i=1 \\ i<j}}^{n}\sum_{j=1}^{n} \mathrm{Cov}(x_i, x_j)$$

for x_i’s not independent. In either case, variances (i.e., uncertainties) sum, such that uncertainty plus uncertainty means more uncertainty. Even small uncertainties, if there are enough of them, sum to a resultant large uncertainty. The net effects assessments seemingly ignore this property of uncertainty in their summaries. *i x*

Finally, the effects assessment is based on the 22 conservation measures as being fixed and without alternatives. While the review committee understands the purpose of the effects assessment is not to consider or select among alternative plans, variations in the 22 conservation measures may be worth discussion. For instance, how would the anticipated effects of the Plan change if water conservation was added to the measures?

6. *How well does the Effects Analysis section describe how conflicting model results and analyses in the technical appendices are interpreted?*

Recommendation 14 The DSM2 model Sacramento boundary condition should be moved northward to above Fremont Weir

Problem

Issue #1: In the current configuration of the DSM2 model, the Sacramento River flow boundary condition is applied at Freeport, directly upstream of the proposed North Delta Facilities. This is the traditional location where the DSM2 model has been driven. During high flow periods with this configuration, the DSM2 model requires an additional inflow condition at the Yolo Bypass Weir to drive flow through the Yolo Bypass. These two model boundary conditions are provided by the CALSIM model output.

Driving the boundary conditions in this manner assumes that the boundary conditions are far enough apart that the boundary conditions do not depend on each other. This assumption is likely valid for current pump operations in the South Delta. However, pump operations in the North Delta have the potential to lower the stage elevation in the channel in the Sacramento between the Yolo Bypass and Freeport. Because weir diversions volume is based on stage elevation, it is important to understand the relationship between North Delta pump operations and export volumes into the Yolo Bypass.

Issue #2: The boundary condition for the DSM2 model is approximately 12 km upstream of the North Delta export facilities. The Plan should identify time periods where there is a potential that boundary specifications may be influencing circulation pattern representation near the proposed North Delta Pump facilities.

Why These Issues Need To Be Addressed

The amount of flow actually going through the Fremont Weir into Yolo Bypass will determine the amount of flooded habitat in the region, the timing and duration of access to that seasonal floodplain habitat by juvenile salmonids and splittail, and the productivity and food web resources those fishes can utilize. Evidence suggests that fishes that use this habitat will have higher survival, therefore maximizing the availability of this habitat to salmonids and splittail would be worthwhile.

Overall Conclusion and Potential Solutions

- The DSM2 model Sacramento boundary condition should be moved significantly northward to above Fremont Weir in order to evaluate the coupling of flows through the Cache Slough complex including several ROAs and the North Delta export facility operations.
- The fisheries red-flag comments also mentioned concerns of reduction of flood plain habitat in the Sutter Bypass. The DSM2 model boundary could potentially be moved above the Sutter Bypass diversion point as well in order to address these concerns.

Recommendation 15 Include sensitivity analyses and model validation in the effects analysis for covered species

Problem

For most fish species, only one demographic model appears to have been used in the effects analyses. As such, inter-model comparisons are rare. The analysis of salmonid survival and migration parameters in Appendix C.5.3 were performed over a range of 17 historical years, which included a range of wet to critically dry water years, and over four difference baseline and two proposed Plan scenarios. However, sensitivity analyses were not performed over a range of alternative parameterizations of the model. For each of the many survival and diversion probabilities simulated, two rather redundant summary tables and one figure were generated (i.e., estimates, delta estimates).

The simulation studies in Appendix C.5.3 make occasional references to comparisons of model output with empirical field results. However, a systematic comparison of model output with empirical data is absent.

Why These Issues Need To Be Addressed

Sensitivity analysis and model validation are critical to documenting the robustness of the models.

Overall Conclusion and Potential Solutions

The Panel recommends reducing the redundancy in model output and using some of the space for sensitivity analyses, wherein a systematic comparison of model output with empirical data is included in the Plan. The table below is a comparison of model output with the most recent acoustic-tag data for the Sacramento and San Joaquin rivers. In general, field estimates of survival tend to exceed model output in the Sacramento River, while acoustic-tag estimates from the San Joaquin River tend of be lower than model output. For many of the fish stocks, field data are unavailable. It is rather disconcerting that, for the relatively few cases where field data exists, simulation and field results do not agree better when the ranges of outcomes are compared.

Table: Comparison of model output on salmonid survival and diversion probabilities with acoustic-tag data 2006–2010. Fish stocks, measures, and locations identified with corresponding tables and values in Plan with acoustic-tag estimates, years of study, and associated references.

			Modeled Values in Plan		
Fish Stock	Measure	Region	Table No.	EBC	All
Late Fall Run Chinook-Sacramento R.	Survival	Through Delta	C.5.3-89	10.5 - 26.9	10.5 - 26.9
Late Fall Run Chinook-Sacramento R.	Survival	Sacramento River: Freeport -Steamboat/Sutter Slough	C.5.3-93	72.5 - 85.4	72.5 - 85.4
Late Fall Run Chinook-Sacramento R.	Survival	Steamboat/Sutter Slough	C.5.3-95	39.4 - 58.9	36.9 - 58.9
Late Fall Run Chinook-Sacramento R.	Survival	Sac. R: Steamboat/Sutter Slough - DCC/Georgiana Slough	C.5.3-97	86.8 - 93.7	86.8 - 93.7
Late Fall Run Chinook-Sacramento R.	Survival	Sac. R: DCC/Georgiana Slough - Rio Vista	C.5.3-101	41.3 - 60.8	39.6 - 60.8
Late Fall Run Chinook-Sacramento R.	Survival	Through Interior Delta	C.5.3-103	11.6 - 19.8	11.6 - 26.6
Fall Run Chinook - San Joaquin R.	Survival	Through Delta	C.5.3-105	11.8 - 19.4	11.5 - 19.7
Fall Run Chinook - San Joaquin R.	Survival	San Joaquin R: Mossdale - Chipps Island	C.5.3-107	16.6 - 24.5	16.5 - 24.5
Fall Run Chinook - San Joaquin R.	Survival	Old River	C.5.3-111	8.8 - 14.4	8.7 - 14.5
Late Fall Run Chinook-Sacramento R.	Route Entrainment	Georgiana Slough/DCC	C.5.3-91	43.9 - 73.8	43.9 - 73.8
Fall Run Chinook - San Joaquin R.	Route Entrainment	Old River	C.5.3-109	40.2 - 63.8	39.5 - 66.5

Available Empirical Estimates			
Estimates	Source	Year(s)	Note
0.174, 0.543, 0.174, 0.195, 0.386, 0.339	Perry et al. 2012, Table 1; Perry 2010 Tables 4.2, 5.4	Winter 2006/2007, 2007/2008, 2008/2009	survival to Chipps Island
0.947, 0.959, 0.919, 0.919, 0.920, 0.861	Perry 2010 Appendix Tables 1.2, 3.3, 4.3	Winter 2006/2007, 2007/2008, 2008/2009	
0.389, 0.681, 0.274, 0.576, 0.6, 0.584	Perry 2010 Appendix Tables 1.2, 3.3, 4.3	Winter 2006/2007, 2007/2008, 2008/2009	
0.947, 0.976, 0.919, 0.915, 0.928, 0.881	Perry 2010 Appendix Tables 1.2, 3.3, 4.3	Winter 2006/2007, 2007/2008, 2008/2009	
0.691, 0.703, 0.651, 0.627, 0.6(DCC open), 0.616 and 0.901 (DCC closed)	Perry 2010 Appendix Tables 1.2, 3.3, 4.3	Winter 2006/2007, 2007/2008, 2008/2009	
0.571, 0.227, 0.146	Perry 2010 Appendix Tables 1.2, 3.3	Winter 2006/2007, 2007/2008	
0.01 - 0.10	SJRGA 2011, Tables 5-19, G-2	Spring 2010	from Mossdale to Chipps Island through all routes
0.01 - 0.08	SJRGA 2011, Tables 5-19, G-2	Spring 2010	
0 - 0.17	SJRGA 2011, Tables 5-19, G-2	Spring 2010	survival from Head of Old River to Chipps Island
0.088, 0.311, 0.288 with DCC closed; 0.352, 0.267, 0.398 with DCC open	Perry 2010, Tables 4.2, 5.4; Perry et al. 2010, Table 1	Winter 2006/2007, 2007/2008, 2008/2009	includes estimates when DCC was closed
0.41 - 0.64	SJRGA 2010 (Table 5-8), 2011 (Table 5-19)	Spring 2009, 2010	

7. *How well does the Effects Analysis section link to adaptive management and associated monitoring programs?*

Recommendation 16 Provide more detail about the specific approaches that will be used when implementing adaptive management

Problem

The Effects Analysis does not include adaptive management discussion and measures. Although the adaptive management concept, elements and process is fully described in Chapter 3.6, the absence of essentially any detail in the Effects Analysis about how adaptive management will be implemented to reduce the effects of scientific and technical uncertainties does not impart confidence in the Plan. The result is the impression from Chapter 5 that the Plan is more certain and rigorous than it actually may be.

Why These Issues Need To Be Addressed

As recognized both in the Effects Analysis and accompanying appendices, as well as in the Panel reviews and independent assessments such as the NRC (2010, 2012), the scientific and technical uncertainties underlying the BCDP are immense. Confidence in the ability of the BDCP to plan and implement conservation measures that can minimize the deleterious impact of this uncertainty is contingent on an adaptive management process.

Overall Conclusion and Potential Solutions

Adaptive management needs to be explicitly tied to specific metrics, identified for every biological objective, which will be monitored to assure that net affects will be achieved. Both objectives and metrics should be classified relative to their level of uncertainty and, presumably derived from conceptual or quantitative models, the potential impacts to net benefits if assumptions and hypotheses underlie adverse outcomes. The Plan should at least identify what to monitor and the associated adaptive management metrics, decisions, and corrective actions, should they be necessary. Thus, at a minimum, the Effects Analysis should derive from Chapter 3.6 the essential elements of the Plan's adaptive management strategies that demonstrate the compelling need for:

- Identification of the mechanisms and processes by which adaptive management will be employed to minimize the potential deleterious effects of scientific and technical uncertainties for each biological objective and associated performance (effectiveness) metrics;
- Conceptual or numerical models that guide monitoring metrics that inform the adaptive management process;
- "Trigger points" for monitoring metrics that will initiate adaptive management revisions and adjustments, and how those are related to the causal mechanisms identified by the conceptual/numerical models; and,
- Description of the different time and space scales for those trigger points and corrective actions.

Recommendation 17 Ensure a declining fish population (longfin smelt) does not decline further while waiting for possible beneficial effects of habitat restoration

Problem

Transport flows were ranked as having an exceptionally high effect on the longfin smelt population, based on several correlation analysis studies, but confidence in this conclusion was ranked by the authors as speculative (lowest ranking) apparently because the mechanism of influence was uncertain. Although the BDCP would adversely affect smelt transportation flows, the Effects Analysis concluded that this adverse effect would be offset by the beneficial effects of increased food resources produced by habitat restoration, leading to a grand conclusion of no net effect on the longfin smelt population (low certainty of conclusion). The authors noted that potential adverse effects would be reduced or controlled by adaptive management but this optimistic view was not supported with triggers and potential management actions in the report (see ***Recommendation 16***). Furthermore, the offsetting effects of habitat restoration versus transport flows did not consider the fact that habitat restoration will take years to produce additional food for smelt, whereas potentially adverse transport flows would be immediate. Additionally, the benefits of habitat restoration for longfin smelt are not highly certain. Potential adverse risks for declining populations should receive careful consideration and evaluation to ensure that the population does not decline further in response to the BDCP.

Why These Issues Need To Be Addressed

This is an example of where monitoring and adaptive management triggers need to be identified in the Effects Analysis. The Effects Analysis did not consider the time needed for habitat restoration to have a positive effect on smelt and the certainty of whether habitat restoration will be effective (see comments above).

Overall Conclusion and Potential Solutions

Provide specific monitoring actions and adaptive management triggers to ensure populations do not decline further while waiting for habitat restoration to have a beneficial effect.

Technical Appendices

Appendix B Entrainment

An earlier draft of Appendix B: Entrainment was reviewed by the Panel during the Phase 1 review. Additional comments on the revised draft are shown below.

Approach and Analysis

1. *How well are the proposed analytical tools defined, discussed and integrated?*

Appendix B: Entrainment provided a brief overview of the methods used to evaluate entrainment at the existing delta pumps, agriculture diversions, and proposed intakes at the north delta. Primary assumptions, benefits, and limitations of each approach were noted. For some species (e.g., splittail), a statistical relationship between delta inflow and salvage density (entrainment) was shown graphically, which was useful. In some cases, a statistical model equation was shown along with the percentage of variation explained by the model (R^2), e.g., proportional loss of delta smelt via entrainment, Delta Passage Model for Chinook salmon. The Salvage Density Method involved expansions of entrainment observations and an assumption of a linear relationship between entrainment and export flow. The Salvage Density Method involved additional assumptions, but it was not clear whether associated predation related losses were included for each species. For example, Table B.5-3 stated that predation loss was included in the Salvage Density Method, but the text on page B.5-8 did not mention predation. Predation is believed to be a highly important source of mortality associated with entrainment, therefore the text should be clear if the estimated entrainment did or did not include predation. Furthermore, the methods section needs a description of how predation mortality associated with entrainment was estimated. Overall, the methods section provided a brief overview of the approach and methods used to evaluate entrainment losses, and some description of their usefulness and limitations. In most cases, the authors identify key assumptions leading to uncertainty.

A process to normalize observed salvage to mean population abundance of the species was described in order to account for some of the year to year variability in salvage associated with fish abundance. Given the large and variable effect of survival at sea on adult salmon abundance, it seems that normalization of the juvenile salvage data to mean adult salmon abundance could introduce considerable error. Was adult run size lagged back to the appropriate smolt year? Both normalized and non-normalized values of entrainment were provided, which is good.

One approach compared survival loss of salmon associated with entrainment at the south delta with overall through delta survival. The formula used to generate this estimate should be shown and described in the methods section.

Each approach described in the methods section was applied to each species when appropriate. However, the findings from each method or approach were not directly integrated, compared and contrasted. This type of comparison would be beneficial for showing the degree of similarity or differences in findings, thereby provided an additional means to evaluate certainty. If multiple approaches lead to the same finding, then there may be greater confidence in the results. For example, the Delta Passage Model results could have been compared with the Salvage Density Model results even though Delta Passage Model was based on larger tagged smolts whereas the Salvage Density Model evaluated all sizes of juvenile salmon.

2. *How clear and reasonable is the scale of the analysis?*

Appendix B: Entrainment attempted to evaluate the effects of the south delta pumps at the level of the population, but this key metric was sometimes lost in the immense amount of detail. Ultimately, the goal of the analysis should be to evaluate impacts of entrainment on the population of each species so that the overall effect of the BDCP can be evaluated. Presentation of findings in Appendix 5.B at the population level versus local level should be clarified to avoid confusion in this report where both types of results are intertwined. BDCP effects may have a large effect on fishes that approach the south delta pumps, but this effect may be small at the population level because few fish approach the area.

For example, it is not readily transparent in summary Table B.0-2 whether the metric is at the local (subcomponent) level or at the population level because both values are shown in the table and both are treated equally even though population level effects are most relevant. To reduce potential confusion of these metrics, local versus population level effects might be shown in separate tables. The first table could show the impact on fish that approach the south delta pumps (local effect), and the second table could show the impact of entrainment on the total population. For fall, late fall, and spring Chinook salmon, assumptions were made and described in order to estimate total juvenile population size entering the delta and the overall population level effect. No such assumptions were made for steelhead, but it seems that a population range could be assumed as a means to approximate a population level effect.

Appendix B evaluated entrainment for two baseline scenarios, the BDCP, and two periods of climate change. Multiple water year types (extreme wet to critical dry) were analyzed. Evaluation of entrainment resulting from the six scenarios and water type years is comprehensive, and it shows how scenarios may have different effects depending on the water year.

3. *How well was the vision of the Foundation and Framework (appendix A) applied to the technical appendix / analysis? How consistently was it applied?*

The Foundation and Framework (appendix A) was removed from consideration.

4. *How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?*

Appendix B: Entrainment systematically used each applicable approach to evaluate entrainment of each species. Details of the analyses were provided in numerous detailed data tables. While detail is good in an appendix, it also inhibits comprehension of the findings, including the highly important findings. The large amount of detail requires that an extra effort be made to provide clear text when describing the results in Appendix 5.B, and when providing captions on tables and figures. As noted previously, the text and tables need to clearly state whether the analysis reflects the impact on a subcomponent or the population level. The length and detail of the report highlights the need for a synthesis summary for each species at the end of each species evaluation. This synthesis should compare and contrast findings from multiple approaches and discuss the certainty in the conclusions. This information can then be used more directly in Chapter 5.

5. *Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?*

Appendix B: Entrainment did not attempt to draw conclusions from its detailed analyses with regard to overall effects of entrainment at the south delta pumps on most fish populations. The report presented tabular results at the subcomponent level or population level for one or more life stages, and compared the BDCP to baseline and climate change scenarios. The report briefly notes that population level effects of entrainment are described in Chapter 5. Nevertheless, it would be worthwhile to follow through with the detailed analysis in Appendix B and provide population level effects of entrainment on each species because this is the location where readers will find the details that led to the conclusions. Some key information that could be used in the synthesis is presented in Table B.0-2, but additional assumptions may need to be described when drawing conclusions. This effort should address the level of certainty in the conclusions at the population level.

Summary Table B.0-2 and the summary text should include the existing effect of entrainment on each species (population level effect) as a means to show the importance of entrainment during current conditions. Without this description, important information about how entrainment is affecting each population is lost from the summary and readers cannot judge whether additional efforts are needed to improve the condition. For example, Fig. B.6-22 in the delta smelt chapter shows that the effect of entrainment on delta smelt (all life stages combined) is high during all implementation scenarios during below normal (~22% population loss) to critically dry water years (~32% population loss); population loss is lower during above average water years, the period when BDCP has the greatest beneficial effect on exports from the south delta. This high level of population mortality (up to 32%) highlights the need to address the entrainment issue during below normal water years. However, this information is not captured in Summary Table B.0-2 or the associated summary text, which shows that there is relatively little effect of the BDCP during below normal years, i.e., the period when improvements are most needed if the species is to be conserved. Summary Table B.0-2 should show the combined effect of entrainment on all life stages as it did in the species chapter.

It is important to note that the high impact of entrainment by the south delta pumps on delta smelt during below normal water years was not captured in Chapter 5, where the entrainment stressor was only ranked as 2 out of 4. Clearly, direct mortality of 22-32% during nearly 50% of the water years is a major stressor on the population and that failure to address this stressor suggests that the population will have low probability of recovery. The issue of continued high entrainment mortality was not adequately addressed in the Chapter 5 discussion of ESA take.

The level of uncertainty and identification of key assumptions were described in the methods. Some of the approaches enabled calculation of 95% confidence intervals, e.g., Salvage Density Model. But it was not clear whether all assumptions in the Salvage Density Model estimates were incorporated into the 95% confidence intervals. If not, then the confidence values provide an optimistic view and this should be stated. Confidence intervals or a coefficient of variation should be provided whenever a statistical model is used, e.g., proportional entrainment of larval, juvenile and adult delta smelt.

Ultimately, the accuracy of the findings depends on the reasonableness of the assumptions and the appropriateness of the model. The south delta entrainment analysis was based on available models and approaches. Appendix 5.B did not attempt to evaluate accuracy, although it did provide findings based on multiple methods when available. Findings for a specific topic using multiple methods should be directly compared as a means to evaluate certainty.

Models

6. *Were appropriate models used in the technical appendix? If model results conflicted, was this clearly stated and were appropriate interpretations made?*

Relevant models were used to evaluate entrainment at the south delta pumps. There was little direct comparison of model results that address the same issue. Direct comparison of model results should be made in the appendix, as noted previously.

7. *How well are the models and analyses described, interpreted and summarized?*

The analysis of entrainment effects at the south delta pumps was based on a variety of models developed for each species. See comments about the use of these models in Question 1 above.

Appendix C Flow, Passage, Salinity, and Turbidity

Appendix C is the most extensive supporting document for Chapter 5. The appendix is approximately 1300 pages and has its own supporting appendices. As an example, Appendix C.5.2: Upstream Habitats Results contains 414 figures and 155 tables. Undoubtedly, a tremendous amount of effort was expended to analyze the effects of the BDCP in this Appendix. However, the length and detail of the report appendix highlights the difficulty and uncertainty in assessing the effects of the BDCP on the covered species. For this reason, a detailed monitoring plan and adaptive management program are necessary to identify unintended adverse effects of the proposed BDCP project.

There were substantial delays this Spring in getting Appendix C to the reviewers. The Red Flag comments by the Fish Agencies (provided to the panel on April 25, 2012) also indicate that ICF is continuing to work with the Fish and Wildlife agencies on issues (e.g. North Delta diversion rates, particle tracking near the North Delta facilities.) that could substantially change portions of Appendix C. Therefore the comments stated here are general in nature and big picture ideas. The Panel has not commented on specific simulation numbers because we know that these numbers may change significantly in future iterations. Therefore, this should be considered an interim review that may have significant additions as the BDCP Effects Analysis evolves.

Appendix C has many different models used for many different applications. The Panel has focused our comments on the hydrodynamic modeling and the Upstream Habitat Results in this Appendix C review. More important points have been highlighted as recommendations.

The majority of the comments for Appendix C involve the hydrodynamic (circulation) modeling because the modeling is the basis for all the other components of the modeling. The circulation components need to be right before the other aspects of the modeling can be evaluated. The Panel has also focused on the Upstream Habitat Results because this section utilized a very different suite of modeling tools.

Approach and Analysis

1. *How well are the proposed analytical tools defined, discussed and integrated*

Hydrodynamics: Although the analytical tools are defined somewhat, the discussion of very important details including how the hydrodynamic models were calibrated for future scenarios, the configurations of channels and flooded islands assumed for future scenarios is not sufficient to fully evaluate the model results.

Upstream Habitats Results:

- Appendix C.5.2: Upstream Habitats Results consistently uses the same approach to estimate the effect of the Preliminary Plan (PP) versus Existing

Baseline (1 or 2, early or late long-term) on each life stage of each covered salmonid. The effort typically focuses on the predicted relative changes in seasonal flow, flow fluctuations (stranding, redd dewatering), water temperature, and salmon habitat (weighted usable area) during each water year type (critically dry to wet) as a means to compare and evaluate the effect of scenarios on each species. This approach is reasonable for the purpose of evaluating relative scenario effects on specific life stages in each specific habitat, especially when there is little change in the specific metric. The approach, which typically does not estimate population level effects (e.g., percent change in population abundance), is less beneficial when attempting to integrate scenario effects across all life stages in all habitats so that an overall conclusion can be drawn about the total effect of the BDCP on each species population. The Appendix C summary notes this important deficiency.

- Appendix C.5.2: Upstream Habitats Results used a variety of fish models in its evaluation, e.g., SALMOD, Sacramento Ecological Flows Tool, Reclamation Salmon Egg Mortality Model, etc., plus models to predict BDCP effects on flow and water temperature. The methods section briefly notes the purpose and limitations of the models. Evaluation of assumptions used in the models and reasonableness of their predictions would require detailed examination of each model, i.e., information that is not contained within the appendix. Critique of each model is beyond the scope of this review.
- The analysis of water temperature effects on adult steelhead in the mainstem Sacramento River (P. C.5.2-35) used the NMFS threshold for rearing steelhead (65°F) rather than the target for adult steelhead migration, spawning and egg incubation (55-56°F; Table C.5.2-3). Based on the NMFS thresholds (Table C.5.2-3), the Effects Analysis may underestimate adverse effects of water temperature during each scenario. However, the methods section (Table C.4-16) presents a different table of temperature metrics for salmonids indicating an "optimal" temperature for adult steelhead of 50-68°F. This analysis needs clarification.

Recommendation C1 ***The DSM2 model configuration for all the modeling runs needs to be available to the Expert Review Panel so that the assumptions made in the model can be fully evaluated.***

Flow is the master control variable which guides many of the other analyses and models. DSM2-PTM (Particle tracking/ entrainment), DSM2-Qual (salinity and temperature modeling), and DSM2-Fingerprinting (water source tracing), all use the DSM2-Hydro (1D hydrodynamics model) as the flow field for their calculation. How the Delta is configured for the modeling needs to be very explicit because circulation patterns in the Delta are directly driven by how the channels and open water areas are connected in the hydrodynamic model.

The only "hint" of how the configuration of the model is put together comes from Section 5.4 Delta Habitat-Results. For this review, the Panel has assumed that the connections in the DSM2 model show a similar configuration. (See coupled Recommendation C7 for question #4).

Recommendation C2 Describe together all findings relevant to a specific topic.

Appendix C.5.2: Upstream Habitats Results identified relevant life cycle models (Appendix G) but it did not present the findings even though the results could have been compared with findings presented in Appendix C. Presenting findings on the same issue in separate appendices complicates the evaluation of effects when reviewing the Appendices, and conflicting statements could misinform the reader. Findings from relevant life cycle models (e.g., OBAN, IOS) should have been presented in association with findings in Appendix C as a means to judge the strength of the conclusion based on all relevant information. Inclusion of all relevant information, at least a brief concluding remark, is especially important when different approaches lead to different conclusions, as in winter-run Chinook salmon. The Panel recognizes that the purpose of Chapter 5 is to summarize and integrate the findings, but findings related to the same topic need to be described and cross-referenced in the appendices so that the reader is not misinformed.

2. How clear and reasonable is the scale of the analysis?

Hydrodynamics: The Delta hydrodynamic modeling should be extended in order to couple Sacramento River and Cache Slough complex. In addition, the Effects Analysis should include the influence of reduced high flows on San Francisco Bay.

Upstream Habitats Results: The geographic scale of Appendix C is appropriate for the Upstream Habitats Results. Appendix C spans not only the BDCP Plan Area but it also incorporates associated BDCP effects related to flow and water temperature upstream of the delta. Appendix C.5.2: Upstream Habitats Results addresses in detail each covered fish species in all mainstem and tributary habitats where conditions may be influenced by the BDCP actions. The geographical area includes the Trinity River in the Klamath Basin and tributaries to the Sacramento and San Joaquin rivers. The analysis also appropriately spans the near-term and long-term periods so that interactions with climate change and its anticipated effects on flows and temperature can be addressed. However, the scale of the analysis did not attempt to compare the BDCP or existing baseline with conditions that occurred in the unregulated watershed, a period when the covered fish species were relatively healthy.

Recommendation C3 The Sacramento boundary condition for the DSM2 model should be extended above the Fremont Weir (Also in Chapter 5 Recommendation 9, above).

The coupling between the effects of the North Bay export facility and the Yolo Bypass needs to be modeled separately. The boundary condition of the DSM2 model would need to be moved to make this evaluation.

Recommendation C4 Appendix C analysis should also evaluate the potential influence of reduced high flows on the circulations patterns of San Francisco Bay. (Also in Chapter 5 Recommendations 9 and 14. above)

Effects on San Francisco Bay are not incorporated into the analysis. Yet, high flow events are important for flushing of that system. (e.g., South San Francisco Bay is primarily flushed by high flow events from the Delta.)

This issue was also mentioned in the Fish Agency Red Flag comments (pg. 11)

Recommendation C5: Include a scenario that involves unregulated flows.

Appendix C.5.2: Upstream Habitats Results assessed the relative effects of proposed BDCP scenarios with baseline condition scenarios, which approximate current conditions along with specific regulatory constraints. The analysis did not attempt to compare BDCP scenarios with flow and water temperature conditions associated with an unregulated watershed, e.g., a comparison involving a historical baseline. While it may be impossible and impractical to restore unregulated flow conditions, this type of approach could inform managers about the degree to which the proposed actions may contribute towards recovery of the covered species. This type of analysis would provide perspective for ongoing efforts to improve habitat and to rehabilitate fish populations.

Recommendation C6 Evaluate effects at the population level.

Ultimately, the goal of the effects analyses should be to describe BDCP effects on populations of salmonids and other covered fishes. Analysis of effects at the population level is especially important when attempting to relate the project to recovery of ESA-listed species. Some BDCP actions may only affect a portion of the total population in the watershed. Therefore, the text needs to clearly state the approximate proportion of each population during each life stage that is exposed to the BDCP action that is being evaluated. In the upper watershed, most BDCP actions involve the mainstem Sacramento River but many salmonids also use tributary habitats that are not directly affected by BDCP actions. This issue was mentioned in Appendix C.5.2: Upstream Habitats Results when evaluating spring-run Chinook salmon, which utilize tributaries in addition to the mainstem Sacramento River, but quantification of the proportion of the population exposed to the BDCP action is needed to evaluate the effect at the population level. Presentation of a large affect associated with a small proportion of a population can be highly misleading when shown without explanation next to an effect that influences the entire population. Thus, the first step of the analysis should be to evaluate the effect of BDCP on the fish that are exposed to the action. The second step should be to consider the proportion of the population in the watershed that is exposed to the BDCP effect as a means to describe the BDCP effect on the population. It is possible that data are insufficient to accurately describe the proportion of the population exposed to BDCP effects. If so, this should be stated and incorporated into the level of certainty in the finding at the population level. Evaluation of BDCP effects in Appendix C at a population level could then be more readily compared with the other BDCP effects described in Chapter 5.

3. *How well was the vision of the Foundation and Framework (appendix A) applied to the technical appendix / analysis? How consistently was it applied?*

The original "Foundation and Framework" appendix has been removed and distributed into Chapter 3 and Chapter 5. There is now no clear guideline to refer to evaluate the application of the Foundation and Framework.

Appendix C is so cumbersome that it really should incorporate hyper-links to help the reader better understand the big picture roadmap without getting lost in the details. Even the digital formats of this document are not arranged in a manner such that a big picture roadmap can be assessed for Appendix C. For instance, one digital file "app_C-1_thru_C-7_minus-C-5_Flow_03-23-2012.pdf" removed all of the results sections into different files because the files were too large. This file also referred to an extensive appendix C.A (e.g. C.4-11), the appendix of supporting information to the appendix C.

4. *How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)*

Hydrodynamics: Flow and salinity were evaluated for one configuration of the assumed locations of the CM4 (Tidal Natural Communities Restoration) Restoration Opportunity Areas (ROAs). Flow and salinity values will be sensitive to the placement of the ROAs and the location and configuration of breaches into these ROAs. Turbidity is not modeled in this Appendix.

Upstream Habitats Results: Appendix C.5.2: Upstream Habitats Results provides a fairly comprehensive review of potential effects of flow and water temperature changes on covered fishes during each life stage and habitat area. Analyses evaluated effects on each life stage based on available models and data. A tremendous amount of detailed results were presented (414 figures, 155 tables), but the length and detail complicates interpretation of the findings, especially since the description of each species is not associated with a brief summary (one needs to skip ~500 pages to reach the conclusion section of Appendix C). As noted elsewhere, a primary shortcoming of the analysis is the lack of a synthesis that integrates findings for each analysis at each life stage and develops an overall conclusion at the population level effect. The Panel recognizes that Chapter 5 is used to synthesize the overall effects, but it would have been worthwhile to develop conclusions regarding the specific topics in Appendix C since this is where all the details are presented.

Recommendation C7 ***The assumed locations of the CM4 (Tidal Natural Communities Restoration) Restoration Opportunity Areas (ROAs) need to be clearly defined and the location and connections/levee breaches points need to be specified explicitly. This is especially critical in the highly energetic tidal regions of the Western Delta.***

As stated in Recommendation 1, since the actual model configuration is not being released, the configurations of ROA shown in Figures (5.4-59 through 5.4-5.4-64) are assumed for the DSM2 modeling in Appendix C.

There are two potential ROAS that are of critical concern for hydrodynamic circulation patterns throughout the Delta. First, Figure 5.4-60 shows a breach in Three Mile Slough with a breach at the first bend on the Sacramento connection. This is a tidally dominated channel with complicated exchange properties. Putting a breach in this location will alter the exchange in a critical link between the Sacramento and San Joaquin rivers. This has implications for tidal dispersion of scalar constituents in the water. Second, Figure 5.4-59 shows a breach on the Western side of the Sacramento deep water ship channel directly south of Cache Slough. This breach would likely change the tidal propagation up the deep water ship channel as well as the tidal exchange with the Cache Slough complex where many restoration projects are currently being implemented and others proposed.

Recommendation C8 ***Turbidity needs to be more directly addressed in this Appendix.***

Although the Appendix title implies that turbidity will be evaluated in a systematic manner, it is not effectively addressed. Pg. C4.59: “No turbidity (water clarity) model exists that is suitable for full integration with other effects analysis tools such as CALSIM. Instead, potential changes in water clarity between the preliminary proposal and existing biological conditions scenarios were assessed for each Plan Area subregion using best professional judgment based on existing published and unpublished literature…”

Recommendation C9 ***Consider the effect of temperature change on emergence timing of juvenile salmonids.***

The effects analysis used temperature thresholds (Table C.5.2-3) and frequency that these thresholds were exceeded during each life stage as a means to evaluate the effects of water temperature change on salmonids. This approach does not consider the influence of water temperature (degree-days) on emergence timing of salmonid fry and growth. In natural systems, emergence timing is linked to the availability of prey, and time of spawning is linked to emergence timing through daily water temperature (Miller and Brannon 1981). In natural streams, earlier springs (earlier prey availability) are generally associated with earlier emergence of salmonid fry.

Cumulative water temperature (degree days) after spawning could be examined to evaluate the timing of fry emergence for each scenario. Ideally, this analysis would calculate emergence timing during unregulated conditions as a means to evaluate the amount and direction that emergence timing has changed during baseline and BDCP conditions.

The analysis examined the effects of flow on rearing habitat of juvenile salmonids, but it did not evaluate the effects of the altered hydrograph on juvenile and smolt emigration timing and rates of passage. Numbers of emigrating salmon smolts often increase with river flow. Timing of high river flows can influence the date at which smolts enter the delta, San Francisco Bay, and the ocean. Timing of entry to each new habitat area is an important factor influencing growth and survival of salmonids.

Trinity River (Klamath Basin). The text concludes that “BDCP operations would have a negligible effect on the risk of dewatering in the Trinity River relative to existing biological conditions”. However, Table C.5.2-69 indicates that the maximum monthly reduction in instream flow during January through April was 81% for PP_LLT versus 68% for EBC2_LLT during below normal water years. In most water year types there was little difference, but this table indicates there are exceptions, and these should be noted. Furthermore, a somewhat small change during a period of adverse flow conditions, such as LLT, may have a relatively large effect on the species that is struggling to maintain itself.

Some analyses indicated flows were more adversely affected by climate change (e.g., LLT conditions) than by project effects, and some of these analysis indicated little relative change between the baseline and BDCP effects. However, adverse effects on a species may be nonlinear with respect to climate change. For example, climate change may have a large adverse effect on flow and the status of a species. In these situations a relatively small change in flow conditions may have a relatively greater impact on the species than the same relative change in flow during current conditions. Species may be more susceptible to adverse impacts at low population levels. The nonlinear effect of climate change on the BDCP impact analysis should be considered in terms of the magnitude of impact and the uncertainty it brings to the evaluation.

Feather River. Table C.5.2-84. For the Feather River high flow channel, the text did not explain why PP flows were substantially lower than existing baseline (ELT, LLT) flows during August and September (e.g., a decline from 8,400 cfs to 1,263 cfs in a wet September). Tables C.5.2-103, 104 show that PP flows are as much as 85.9% lower than existing baseline flows (ELT, LLT) during July, August, and September. Flow reduction was typically much greater than 20% during these summer months when temperatures can be high. How does this significant flow reduction affect temperature, dissolved oxygen and covered fishes the Feather River? These flow and temperature effects were briefly discussed for lamprey in the Feather River, but there is no summary of population level effects. Presentation of mean temperature values over a range of months (e.g., August through March; Table C.5.2-117) may mask the adverse effects of high temperatures on fishes. The frequency of temperature exceedence analyses should be based on daily or monthly means, not mean values spanning multiple months (data smoothed).

5. *Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?*

Hydrodynamics: This question is answered by the recommendations below.

Upstream Habitats Results: This question is answered by the recommendations below.

Recommendation C10 ***The conclusion for Section C.5.4 (Turbidity) is very critical for understanding the state of the science. This conclusion should be stated in the Chapter 5 effects analysis as a primary conclusion. (Also incorporated into Chapter 5 Recommendation 12, above).***

"Uncertainty in the sediment supply in the future is high, and factors such as the timing of establishing the TOAs and the potential use of options such as fill-in materials or wind breaks in the ROAs to reduce wind-driven resuspension preclude all but the most general analysis. The roles of SAV, benthic filter feeders, organic materials, and other factors have not been considered (C.5.4-266).

Recommendation C11 ***In addition to the conclusions related to fish, the Summary of Conclusions table (Table C-0-2) should state general conclusions that focus on the parameters modeled/evaluated (i.e., salinity, temperature, and turbidity).***

Some examples would include: 1) Turbidity: The Panel finds high uncertainty in these results and recommends using professional judgment in this area. 2) Salinity: We see more salt intrusion (X2) in the Western Delta than historical periods. 3) Temperature: During several periods (e.g., dry), the models indicate that temperatures will exceed the necessary temperature limit X amount of time.

Recommendation C12 ***Provide a summary of findings for each species in the Results section.***

A tremendous amount of detail is contained in the Results section of Appendix C. The detailed charts and figures are useful, but comprehension of 414 figures and 155 tables is problematic and highlights the need for a summary following the analysis for each species. The Results section for each species has no synthesis of findings (text) to assist the reader in interpreting the long list of details, and to provide a basis for the Conclusion section (C.6). The summary for each species should identify the proportion of the population affected by the action in addition to the effect of the action on that proportion. The inability to translate the relative impacts on each life stage to a population level effect for each species is a major short-coming, and this leads to uncertainty in the overall effect of the BDCP (see other comments on the population level effects issue).

Recommendation C13 Incorporate uncertainty in the analyses of upstream effects.

The analysis of upstream effects typically did not discuss the level of certainty in the findings, except when discussing sturgeon and lamprey. The uncertainty analysis should incorporate what is known about the proportion of the population affected by the action. Uncertainty could be discussed in the summary section for each species, as recommended above.

Recommendation C14 Accurately describe findings and their certainty in the Executive Summary.

The Executive Summary section did not adequately describe the specific effects of the BDCP on each species and the certainty of the effects analyses considered in Appendix C. For example, Section C.0.1 Summary of Conclusions states "In general, there are very few upstream effects….." and Table C.0-2 states "Some benefits and adverse effects to winter-run rearing habitats are expected." These statements apparently do not incorporate all analyses, including the OBAN model that indicates changes in the Sacramento River could adversely affect winter-run Chinook salmon, a species that is listed as Endangered under the ESA. The Executive Summary needs to more accurately describe BDCP effects in the text. The color-coded chart is a reasonable approach for presenting effects of the actions on each life stage of each species but it is not clear if this chart only involves the proportion of the population that is affected. Ideally the chart would include a conclusion that integrates effects on each life stage of each species.

Models

6. *Were appropriate models used in the technical appendix? If model results conflicted, was this clearly stated and were appropriate interpretations made?*

Hydrodynamics: This question is answered by the recommendations below.

Upstream Habitats Results:

The methods section stated that both SacEFT and SALMOD models were used to assess redd dewatering of all races of Chinook salmon in the mainstem Sacramento River (P. C.4-16). However, only results of the SacEFT model were presented when discussing redd dewatering of winter run Chinook salmon (P. C.5.2-42). Therefore comparison of redd dewatering based on two different approaches could not be made as a means to evaluate uncertainty in the redd dewatering estimates (see ***Recommendation C2***).

Appendix C.5.2: Upstream Habitats Results referenced the OBAN and IOS models, which incorporate upstream effects, but there was no comparison of the findings from these life history models with findings discussed in this section. Findings of the OBAN and IOS models should be briefly discussed so the reader can judge whether the findings are consistent or not.

Recommendation C15 When evaluating the particle tracking results, keep in mind that the hydrodynamic model driving the particle transport is a 1D model.

Salmonid smolt survival through the Delta is highly correlated with transit time. The particular tracking model should be calibrated against the extensive information available on travel times from fish tagging studies. A formal comparison of this information should be included in the Plan. Similarly, there is considerable information on salmonid smolt diversion probabilities at junctions from acoustic-tag studies. These studies suggest movements can be approximated much better by near-term hydraulics than by general flow patterns (Perry *et al.* 2012). The time scale of the particular models can therefore be an important factor in predicting fish survival through the Delta.

There are two major assumptions that need to be considered. First, mixing at the junctions is not physically represented; All particles are assumed to be equally distributed at the junction. Second, any particles that enter an open water region will be treated as a continuously stirred tank reactor (CSTR). Monsen 2002 showed that this representation is very simplistic and not necessarily an accurate representation of the mixing properties of a flooded island.

Recommendation C16 The modelers need to justify the use of tidally-averaged means in the Delta Passage Model.

The Delta Passage Model is currently using daily (tidally-averaged) flow output from the DSM2-HYDRO model (p. C.4-37). Lagrangian transport is very important in the Delta. An Eulerian estimation (tidally-averaged flow at a fixed point) of transport over a tidal cycle is a very poor representation of this process in many parts of the Delta. Can the more detailed flow information from the DSM2-HYDRO model be incorporated into the Delta Passage Model?

7. How well are the models and analyses described, interpreted and summarized?

Hydrodynamics: Currently, the description of the DSM2 model can be found in Attachment C.A, essentially an appendix to the appendix. This information is too critical to the assumptions made throughout the analysis to be buried this far down in the documentation.

Recommendation C17 A much more through explanation of how the DSM2 model was calibrated for future conditions is necessary. The coupling of the UnTRIM/RMA models with DSM2 results is critical and needs to be described further.

DSM2-HYDRO is a 1-D model that requires a tuning coefficient at each junction in order to work. It is not designed so that it can evaluate future physical changes to the system. Physics based multi-dimensional models are needed to evaluate these changes. However, the 1D model is being used because the higher order models are not as efficient to run for simulations that extend over decades.

Several key questions that need to be explained in the appendix:

- How was the DSM2-HYDRO model calibrated to match multi-dimensional results? Please include in the discussion results that state where the model matches well and where there is uncertainty in the results.
- How were the multi-D models used to develop the Artificial Neural Network results for ELT and LLT cases?
- When the multi-dimensional models were used to make adjustments to the baseline salinity, what boundary conditions were used to drive these models?

Appendix D Contaminants (Toxins)

Approach and Analysis

1. How well are the proposed analytical tools defined, discussed and integrated?

Overall, Appendix D provides a clear summary of major contaminants of concern and the potential for increases in contaminants as a result of implementation of Conservation Measures and direct toxicity on covered species.

Recommendation D1 ***The Appendix suffers somewhat from a fragmented discussion and inconsistent use of terminology. Also, inclusion of some grey literature (theses, IEP Newsletters, technical reports) could add to discussion of current knowledge of contaminants in the Delta.***

The format and terminology appeared to be somewhat fragmented within this Appendix. Specifically, at one point this Appendix was entitled “Toxics” and it appears that in some places within the text this title persists. The appendix does not use consistent formatting within sections. The use of summary sections for some contaminants (e.g. mercury and selenium) was helpful but was not carried through to all of the contaminants that were evaluated.

There are a few places in which the discussion could use additional background information and missed some studies and citations. For example, the discussion of ammonium / ammonia effects could be clearer with respect to which form of the total ammonia was being considered as well as what environmental conditions lead to different ionic forms. The use of Jabush (2011) as a citation is not sufficient and the Effects Analysis authors should go to the primary literature with respect to this issue. A recent paper (Parker *et al.* 2012) characterizes ammonium concentrations in the Sacramento River along with biogeochemical transformations (*i.e.,* phytoplankton uptake and nitrification). This citation should be included in the revised Appendix.

The Appendix should consider work of Edmunds (1999), Blaser *et al.* (2011), and Blaser (2012) for indirect contaminant effects on primary producers. Also, Parker *et al.* (2010) provides additional analysis of ammonium impacts. There is likely more information on major contaminants of concern (e.g. mercury and selenium) as well as emerging contaminants of concern available through the San Francisco Estuary Institute and the IEP Contaminants Work Team. For organochlorine pesticides it is indicated that EPA criteria are likely to be revised (page D-48, lines 32-33) but it is not indicated how (more or less stringent).

2. *How clear and reasonable is the scale of the analysis?*

Recommendation D2 ***Limiting the discussion of contaminant effects to only direct toxicity effects on covered species is not sufficient to fully capture the potential for contaminant effects via indirect pathways.***

As discussed in Chapter 5, ***Recommendation 7***, limiting the analysis of contaminant effects to direct toxicity of covered species is insufficient to adequately address actual potential contaminant effects as indirect contaminant effects are likely important to the overall success of covered species. It would be preferably that both indirect and direct contaminant effects be included within technical Appendix D. That said, the overall conclusions of potential direct contaminant toxicity appears consistent with current understanding contaminants in the Delta.

3. *How well was the vision of the Foundation and Framework (appendix A) applied to the technical appendix / analysis? How consistently was it applied?*

It is difficult to evaluate how well the overall Analytical Framework and Conceptual Foundation (former section: Appendix A) were applied to evaluating contaminant effects as Appendix A is no longer part of the overall Effects Analysis. The conceptual models used to evaluate contaminant impacts appear to be sufficient and the analysis includes the potential effect of BDCP implementation on contaminant load, concentration and direct toxicity effects.

4. *How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?*

The analysis of the effect of implementation of Conservation Measure 13 (Aquatic Vegetation Control) contaminant concentrations were unclear as presented (see Chapter 5 ***Recommendation 7***).

5. *Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?*

Recommendation D3 ***The high degree of uncertainty (the result of incomplete site-specific information for ROAs) must be made clear within the technical appendix as well as within Chapter 5.***

A major limitation of the analysis, as pointed out on page D-24 (lines 3-10), is that "uncertainty analysis" is lacking for Appendix D as site-specific information detailing ROAs is not available. For this reason the conclusions must be considered qualitative in nature and should be interpreted as such. The role of contaminants as outlined in Chapter 5: Effects Analysis needs to make this point clear and uncertainty should be highlighted within the "Net Effect" analysis.

Models

6. *Were appropriate models used in the technical appendix? If model results conflicted, was this clearly stated and were appropriate interpretations made?*

The DMS2 model was used for water source tracing to utilize the model set-up already developed for the modeling work in Appendix C. It is a logical approach to use. However, there are many assumptions related to using a 1-D model that need to be considered when doing source tracing. (See ***Recommendation D4***).

7. How well are the models and analyses described, interpreted and summarized?

Recommendation D4 ***Discuss how the validation of the DSM2 model was performed for future conditions. In addition, explain how the 1-D representation of channels and flooded islands will introduce uncertainty in model results for water source distribution.***

The DSM2 model was used extensively throughout this chapter to evaluate the effect of changing hydrology on concentrations of methylmercury and selenium. The DSM2 model is a simple one dimensional hydrodynamic model that does not model the complex chemistry of methylmercury or selenium.

The hydrodynamic modelers are using DSM2 to "fingerprint" the sources of water at each location in the system of interest. That is, they are estimating the percentage of water from the Sacramento, San Joaquin, Bay, and Agriculture. Then, they are assuming that no chemical reactions occur between the boundary of the model where they have concentration information and the location in the interior of the Delta.

One of the key questions that must be asked by anyone evaluating these results is: how well does the DSM2 model represent the source distributions throughout Suisun Bay and the Delta under current conditions and under future conditions?

The DSM2 model has tuning coefficients for every channel in the model. This model represents salinity throughout the Delta very well for the current configuration of the Delta because the model has been calibrated to this physical calibration. However, because these tuning coefficients are not physically based, the tuning coefficients are not valid for any other physical configuration of the Delta.

Appendix E Habitat Restoration

Appendix E was not completed in time for Panel review.

Appendix F Biological Stressors on Covered Fish (Ecological Effects)

Appendix F focused on three categories of biological stressors thought to have major impacts on covered fish species, invasive aquatic vegetation, fish predators, and invasive mollusks. These represent stressors in different ways. Invasive aquatic vegetation generally modifies habitat negatively for most of the covered fishes, reducing turbidity, and displacing potential spawning habitat. Invasive aquatic vegetation also creates habitat for some predators and provides cover for predators. Floating aquatic species vegetation reduces potential resources for phytoplankton, and may increase invertebrate food for both covered and non-covered fish. Predators, which include non-native fishes, are a major food web interaction that directly reduces population size of covered fish. Invasive mollusks are direct trophic competitors with most of the covered fish and can reduce phytoplankton population sizes to the point where some shallow water habitat may become phytoplankton sinks.

This appendix explains generally the ecological circumstances and history of these three issues, suggests conservation measures that may mitigate these stressors, and discusses uncertainties and research needs associated with each.

Approach and Analysis

1. *How well are the proposed analytical tools defined, discussed and integrated?*

The structure of this appendix dispersed items throughout, repetitively considering each covered fish species separately for each potential conservation measure, making it somewhat difficult to easily synthesize. This appendix focused on the control of invasive species, including aquatic vegetation, fishes and mollusks, which reportedly represent 95% of the biomass in the Delta. Invasive species undoubtedly have a significant impact on the covered fish species, and their control is an important task in the recovery of the covered fishes. For example, in other watersheds such as the Columbia River Basin, scientists concluded that the impact of invasive species on salmon could equal or exceed that of habitat alteration, harvests, hatcheries, and hydropower (Sanderson *et al.* 2009).

For invasive aquatic vegetation, a history of two species, *Egeria* and water hyacinth, were provided, and potential ways they can be considered ‘stressors’ was discussed. Control was recommended for *Egeria* and a continuation of current control efforts for water hyacinth. Overall, this section was sufficiently discussed.

The section on fish predators utilized both a conceptual model to define issues and describe how conservation measures would affect those issues, and a bioenergetics model to estimate consumption of juvenile salmon and steelhead by striped bass. Any integration was focused at the scale of fish populations; no overall integration at larger spatial or temporal scales was provided. For example, the fish predator removal program focused on predator hotspots. The human effort would be large in terms of time and cost. However, it was admitted that the scale of the program may not actually control predators or actually reduce predator density overall (the scale of the removal program was limited). Additionally, the proposed measures require enormous manpower and costs, yet the length of the program was not indicated, nor particular goals established to evaluate the program. Potentially, this speaks to a lack of specific goals, both in predator reduction or in terms of covered fish recovery. Great uncertainties were involved in the conservation measures, including efforts to control fish predators and evaluate their impact on salmonids at the north intakes.

Corbula and *Corbicula* were the two focal invasive mollusks considered. A general discussion of their ecology was provided, but given that no feasible control measures currently exist, discussion was on how conservation measures might increase habitat for *Corbula* and *Corbicula*, negating potential beneficial impacts of these measures, and finally on preventing the invasive of more mollusks.

2. *How clear and reasonable is the scale of the analysis?*

The scale of analysis for invasive aquatic vegetation was clear and reasonable but extension of the Effects Analysis beyond the Delta bears consideration. For all of the invasives, they are focusing their efforts only in the Delta region. Because these species occur in surrounding areas, their removal efforts will be temporary and will require a long-term commitment. The analysis focuses principally on freshwater species that are confined to the Delta region, and on potential control measures. These control measures are currently utilized (water hyacinth) or are in the experimental phase (*Egeria*). The impact of scaling up control measures was briefly considered, but principally in the context of beneficial aspects; toxicity effects were considered to some extent, but were judged low in most cases. This was the most serious shortcoming of the analysis. The authors assumed that herbicide applications to control invasive plant species could be applied at larger spatial scales and at higher frequencies with few negative consequences for covered fish species. However, these herbicides are toxic to some fish species and therefore increasing the spatial and temporal scale of the applications could potentially cause harm to covered fish. Overall, the increase in the scale of management impacts was not well integrated into the analysis of this conservation measure.

The scale of analysis for fish predators was reasonable, especially in the context of the conceptual and bioenergetic models. In general, the Delta was the limit of the spatial scale. The focus was on how various conservation measures may reduce fish predators, or simultaneously potentially enhance them. For example, the analysis recognized that the removal of striped bass from specific “hotspots” may have little effect on the overall abundance of the bass and an uncertain effect on salmon. Intensive removal efforts would be frequently required and throughout time, yet as noted in the report, the duration of the bass removal project was not specified in the BDCP. The analysis also noted the potential for the predator removal program to impact non-targeted fishes.

In general, the scale of analysis of the impact of invasive mollusks and the potential for conservation measures to limit them was reasonable. The analysis addressed the potential adverse impact of mollusks colonizing upper delta habitats where few or no invasive mollusks presently live as the X2 salinity gradient shifts east in response to lower flows.

3. *How well was the vision of the Foundation and Framework (appendix A) applied to the technical appendix / analysis? How consistently was it applied?*

No application of the previous Foundation and Framework (former section: Appendix A) was apparent, except in the usage of certain terminology (e.g., biological stressors), and the obvious overlap in content.

4. *How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?*

The Effects Analysis operates under the assumption that the conservation measures would be successful with considerable benefits in the case of CM13 (control of invasive aquatic vegetation); however, no evaluation was made of the potential for negative impacts once this measure is scaled up spatially to be an adequate control measure, nor the impacts of requiring large-scale herbicide treatments over long time periods.

- Predator control was generally assumed to be only a temporarily effective measure.
- No control of mussels was assumed.
- The conservation measure CM20 should limit the introduction of new invasives, but it should fail at some point in the future.

Other aspects are considered below concerning the conclusions.

5. *Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?*

Overall, the conclusions for each of the three categories (IAV, fish predators, invasive mollusks) were reasonable, although often emphasizing the potentially positive benefits, and while considering negative impacts, often downplaying their potential, nor did the conclusions incorporate additional, perhaps unintended effects.

The control of invasive submerged aquatic vegetation (CM13) was assumed by the authors to be successful; such a conclusion is not reasonable, especially considering the extent of *Egeria* distribution and its potential rate of recovery. If successful, they conclude that removing such vegetation consequently will reduce predation mortality of covered fish species by removing habitat for predators and increasing turbidity. CM13 was concluded to provide two additional benefits, first to increase food consumption by covered fish species by increasing food availability, and second to increase the amount of spawning and/or rearing habitat for covered fish species. Uncertainties were generally considered for this section, however overall they were minimized. Application of herbicides at high rates was assumed to provide a reduction in *Egeria*, for example, however, the experiment they mentioned only provided about half of what they suggest will happen. For example, the Appendix F analysis: 1) assumes a low rate of *Egeria* recovery or expansion (10%), 2) appears to assume 100% effectiveness, although the Franks Tract experiments only reduced *Egeria* 57%, and 3) assumed no adverse effects of herbicide treatment at that large scale and over that long time period. No analysis was made of what scaling up might mean for phytoplankton, zooplankton and other trophic levels. Conceptually, the analysis discussed that application rates should be below any acute levels, and at worse, below LC-50 levels. So while they did discuss the issues generally, they did not consider what impacts the magnitude and duration of such management actions might have.

Conclusions about control measures for fish predators were more diverse. Structural changes, such as removal of structures providing shade and improving the Yolo Bypass may reduce predation rates and these were among the conclusions. Other actions are likely to be short-term, and require enormous management efforts, like CM15 which involves from October-June, daily [5 days/wk] predator removal at the 5 proposed north Delta intakes, at the head of Old River, 3 sites in Georgiana Slough, and four sites in Sutter and Steamboat sloughs; and weekly removal at each of the eight CVP/SWP salvaged fish release sites during the October-June time period. They conclude that, considering uncertainties, predator capture methods may not reduce predator populations to a sufficient extent.

Nonphysical fish barriers (CM 16), which involves strobe lights, noise and bubble curtains, are expected, according to Appendix F, to effectively limit movement of covered fishes into Delta reaches known to be associated with low survival. However, Appendix F provided little description and no critical evaluation of the investigation that reportedly demonstrated the effectiveness of this approach.

Their own analyses indicate that potentially adverse effects may offset positive benefits from other conservation measures, e.g., increasing tidal habitat may also provide more predator habitat. Invasive aquatic vegetation removal may reduce opportunities for predators like largemouth bass, but may not increase turbidities sufficient to provide cover for smelt. They also indicated that high uncertainty exists about all expected outcomes with respect to fish predation, which is a reasonable conclusion.

Finally, only adverse effects are indicated resulting from conservation measures in the context of invasive mollusks. CM1 may increase *Corbula* habitat by moving X2 upriver, assuming greater freshwater diversion. Given that *Corbula* is the more effective trophic competitor with covered planktivorous fish, this suggests degradation of habitat characteristics due to CM1. Restoration involved in CM4 (tidal wetland), CM5 (seasonally inundated floodplain), and CM6 (channel margin habitat) may increase potential benthic habitat for *Corbula* and *Corbicula,* overall exacerbating the impacts of these competitors. Tidal and shallow water habitat restoration, if invaded by *Corbula* or *Corbicula* may result in phytoplankton sinks (Section F.6.3.2), actually worsening circumstances for fish. The appendix also indicates that many aspects of the ecology and distribution of *Corbula* and *Corbicula* and the role of nutrients are all poorly known or only hypothesized. Further, no feasible control measures are known for eradicating well-established invasive mollusks. Another conclusion is that funding efforts that avoid the introduction of new invasive mollusk species (CM20) may prevent further habitat degradation; this is concluded as a benefit to covered fish species, but only in the sense that keeping things from getting worse is better than allowing additional adverse effects. Thus, the conclusion for invasive mollusks is that conservation measures will likely worsen habitat conditions for covered fish in the Delta.

Models

6. *Were appropriate models used in the technical appendix? If model results conflicted, was this clearly stated and were appropriate interpretations made?*

7. *How well are the models and analyses described, interpreted and summarized?*

In the section on fish predators, a conceptual model was developed and a bioenergetics model was applied to estimating consumption of juvenile salmon and steelhead by striped bass. The conceptual model helped to organize the fish predator section and the bioenergetic model was illustrative, although limited in application. The bioenergetics model required a number of assumptions, some of which could lead to high consumption rates, as appropriately noted in the report. For example, the report notes that some of the predators holding near the Glenn-Colusa Irrigation District may have been Sacramento pikeminnow not the targeted striped bass; the model also assumed striped bass could eat juvenile salmonids that were larger than the bass. No other models were used; no comparisons of different models were made, so there were no conflicts in results.

Conclusions

Invasive species have considerably altered the Delta ecosystem. At least 185 of the 250 introduced nonnative aquatic and plant species have successfully established (Cohen and Carlton 1995). This appendix focused on implementation of 10 BDCP conservation measures that should affect a) invasive aquatic plants; b) predation on fish; and c) invasive mollusks that affect covered fishes via trophic interactions. Reducing the negative effects of key biological stressors is rightly an important component of meetings goals and objectives for covered fish. Removal of invasive aquatic vegetation may not be practical because of other impacts associated with removal, but at least limiting their spread and reducing their populations in targeted areas may be achievable. Controlling fish predation on covered fishes will be required to accrue benefits from habitat restoration and other modifications of the Delta. Unfortunately, without appropriate sequencing and prioritization of management actions, with a monitoring and adaptive management system in place, some or most of the benefits associated with habitat restoration measures (CM2, 4, 5, 6, 7) could be offset by an increase in predation if the areas are colonized by invasive aquatic vegetation, by an increase in trophic competition due to mollusk invasion, and the reduction of beneficial ecological processes for covered fish. Additionally, potential maximum benefits of habitat restoration will require many years. Overall, this appendix did a good job indicating the difficulties involved in such a large and complex system already overwhelmed with introduced species, the large uncertainties involved in all the steps to try and limit any of these biological stressors. The habitat and predator CMs are designed to improve conditions for covered fishes, but there are many uncertainties in the outcome, which highlights the need for monitoring and adaptive management.

Appendix G Fish Life-Cycle Models

Appendix G was not completed in time for Panel review.

Appendix H Aquatic Construction Effects

Approach and Analysis

1. *How well are the proposed analytical tools defined, discussed and integrated?*
2. *How clear and reasonable is the scale of the analysis?*
3. *How well was the vision of the Foundation and Framework (appendix A) applied to the technical appendix / analysis? How consistently was it applied?*
4. *How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?*
5. *Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?*

Models

6. *Were appropriate models used in the technical appendix? If model results conflicted, was this clearly stated and were appropriate interpretations made?*
7. *How well are the models and analyses described, interpreted and summarized?*

This appendix provides an analysis and discussion of acute effects of construction on covered species. The analysis is largely concerned with the potential impacts of construction related noise on covered species. Overall, the Panel felt that the scale of the analysis appeared reasonable; the analysis adequately evaluated the effects of potential BDCP construction effects and provided a means for adaptive management, assuming unforeseen impacts of BDCP construction impacts. Conclusions appeared to be accurate and appropriate.

Appendix J Scenario 6 Comparison

This appendix compares the effects of “Scenario 6” operations (S6) with effects of the Preliminary Plan operations (PP) for five biological factors. Additional factors would be assessed during a subsequent phase (Tier 2) if desired by the stakeholders. Scenario 6 addresses five operational areas of immediate concern:

1. Reduced flows downstream of the North Delta intakes.
2. Temperature-related mortality on spring Chinook eggs and embryos.

3. April-May Old & Middle River (OMR) flows.
4. Outflow issues (reduced flow) during spring related to longfin smelt.
5. The X2 location during fall to meet RPA criteria.

The executive summary section needs considerable clarification. Some of the analyses mentioned in the summary were not discussed in the report (e.g., migration in the San Joaquin River). No overall conclusions for Scenario 6 were provided to explain whether the Tier 2 evaluation should occur.

Additional background information on the development of S6 concerns is needed in the Introduction. The introductory text needs to briefly describe how S6 differs from the PP and how managers hypothesize these changes might be more beneficial for fishes. The analyses can then be used to evaluate whether the hypothesis was correct or not. This report focuses on flow-related effects, therefore it would have been informative to provide a hydrograph showing median predicted monthly flows during S6, PP, and unregulated scenarios.

Approach and Analysis

1. *How well are the proposed analytical tools defined, discussed and integrated?*

For spring-run Chinook egg mortality, the S6 report relies on the Reclamation Egg Mortality Model and predicted changes in water temperature during the incubation period. This model only considers temperature effects on egg and embryo survival. Other factors that impact egg and embryo survival such as redd scour (flow), redd dewatering (flow), and redd sedimentation, and fish behavior were not considered. The model appears to be accepted by NMFS biologists but verification of the model and confidence intervals were not reported. High mortality was predicted in S6 and PP scenarios during September and October, perhaps explaining in part why few spring Chinook (~5%) currently spawn in the upper mainstem Sacramento River. The analysis did not indicate whether spawning in the mainstem is currently delayed until water temperature declines to suitable levels, or if mainstem spawners seek cold water upwelling areas for spawning, as they do in some warm rivers.

The comparative approach is reasonable for an initial evaluation of how the S6 and PP may affect mainstem temperature and subsequent egg mortality of mainstem spawners, but the approach does not consider fish behavior that could modify the results. A more comprehensive analysis would have compared S6 and PP temperatures to historical conditions as means to evaluate the extent to which spring Chinook have been influenced by changes in water temperature. A more comprehensive analysis would have also considered the effect of water temperature on emergence timing of Chinook fry and whether prey availability is adequate when the fry emerge, assuming water temperature has been significantly altered by upriver actions. In natural unregulated watersheds, timing of salmon spawning and emergence are linked to water temperature during the incubation period and the timing of available prey for the emerging fry. Alteration of water temperature can adversely affect this coevolved relationship between spawning salmon, water temperature, and time of increased prey availability. It is noteworthy that the spawning distribution of spring Chinook salmon reportedly changed significantly after 1991, yet there was no hypothesis given for this shift. Analysis of this shift could provide important clues into factors affecting spring Chinook salmon.

Temperature conditions in the Feather River seems to be adverse for spring run Chinook salmon eggs and embryos regardless of S6 or PP flow conditions. The text notes that the Feather River run of spring Chinook salmon is dominated by hatchery fish. It would be worthwhile to determine whether fry and returning adults are produced by spawners in the Feather River, or if fish spawning there have little or no reproductive success. This important task could be completed if hatchery fish were marked.

The analysis of reduced flows below the North Delta Diversion during the PP was based on predicted monthly flows and the proportion of flow originating from the Sacramento versus San Joaquin to estimate effects on juvenile and adult salmon migrations and longfin smelt. The approach relies upon a comparison of flows and basic assumptions about how flow affects salmon and smelt, rather than attempting to predict how changes in flow affect growth, habitat availability for juvenile rearing or holding by adult salmon, migration rate, survival, etc. The comparison approach provides a reasonable initial qualitative evaluation of whether changes in flow during S6 versus the PP might affect salmon and smelt. The greatest change in flows between S6 and the PP occurred during September (increased flows under S6) and October (reduced flows), but large increases in flow also occurred during July and August. For salmonids, the change in flows primarily influence early emigrating steelhead in October and adult steelhead and fall Chinook. The Conclusions section (J.4.2.4) incorrectly stated that only steelhead would be influenced by S6, but adult fall Chinook are also present and would be affected. For longfin smelt, the analysis could have applied flow data to the statistical model developed by Kimmerer et al. (2009), but apparently the differences in flow during the relevant time period were considered too small (~5%) to warrant this additional analysis. One of the uncertainties raised by the changing flows below the north intake is the flow effect on prey resource abundance and availability for smelt and salmonids. This subject was not discussed in the S6 report.

The South Delta Operations and OMR Flows section evaluated entrainment of winter and spring Chinook salmon, steelhead, delta smelt and longfin smelt during S6 versus PP conditions. For salmon, the analysis relied upon the salvage density approach. The report did not say why the Delta Passage model was not used. Total numbers of salmonids entrained are reported. The text provides context for the importance of entrainment at the population level by stating the approximate proportion of the population that is entrained by the South Delta pumps, at least for winter and spring Chinook (not steelhead). The analysis did not mention the influence of predation near the pumps before fish are entrained, therefore the overall population effect of entrainment is not considered.

Entrainment of delta smelt was analyzed with the proportional entrainment model and the salvage density approach, whereas longfin smelt was analyzed with salvage density and the particle tracking model (PTM). Findings for delta smelt differed with the modeling approach, indicating uncertainty in the findings. Only the proportional entrainment model provided a population level effect for delta smelt, which is the most appropriate metric. Confidence intervals for the predicted effect should have been estimated from the statistical model. The two approaches used for longfin smelt also produced different findings. The PTM approach seemed insensitive to the S6 versus PP changes; neither model provided a population level effect, which is needed.

The analysis of longfin smelt abundance versus the X2 salinity position relied up the Kimmerer *et al.* (2009) statistical model. The report notes the mechanism associated with this statistical relationship is unknown. Nevertheless, the model provides a useful means to estimate population level effects on longfin smelt based on the reasonable hypothesis that changes in the X2 position influence longfin smelt abundance. The analysis is reasonable and smelt abundance changed little during S6 versus PP in response to little predicted change in flow during January to June.

The report examined the Fall X2 position during S6 versus PP conditions to evaluate the potential effects on delta smelt and their habitat. The report does not provide evidence (references) for a relationship between the Fall X2 and delta smelt abundance or productivity. Therefore, while the analysis shows a westward shift in the X2 during S6 conditions, the analysis did not provide evidence for its effect on delta smelt.

2. *How clear and reasonable is the scale of the analysis?*

The Tier 1 S6 analysis was limited by choice to target a specific subset of stressors and species. Comparisons were made primarily between Scenario 6 and the Preliminary Plan. Given the exploratory nature of S6, this targeted approach and limited scope and scale are reasonable.

One exception to the limited scope of the analysis involves the lack of temperature analysis on winter Chinook salmon egg mortality in the upper Sacramento mainstem. Given that the OBAN model found adverse effects of the Plan on winter Chinook salmon eggs due to temperature, and the fact that nearly all winter Chinook spawn in the mainstem Sacramento River, it is unclear why S6 did not address winter Chinook salmon, an Endangered species.

Some of the analyses, such as entrainment of longfin smelt, presented findings in relative terms that were specific to the stressor. This scale is reasonable as a first step, but ultimately the effect of the stressor should be at the population level so that stressor effects can be directly compared and summed for each scenario. Uncertainty is likely to increase when estimating a project level effect, so uncertainty should be discussed. Some of the models provided population level effects and these models are more informative than those that did not.

3. *How well was the vision of the Foundation and Framework (appendix A) applied to the technical appendix / analysis? How consistently was it applied?*

The former Appendix A has been eliminated and some of its content reportedly included in other sections of the BDCP, including Chapter 5. S6 did not attempt to compare the summed effects of S6 versus the PP for the select species and stressors. There were no conclusions or recommendations for whether a Tier 2 analysis should be performed for the S6 Scenario.

4. *How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?*

S6 addresses select concerns related to flow in the delta and upstream spawning areas of Chinook salmon. S6 provides a reasonable first attempt to approximate effects of the flow modifications on select aspects of a few covered species. Additional effort would be needed to fully evaluate the effects of S6. Please see comments above.

5. *Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?*

The S6 report was prepared to address specific concerns raised during a preliminary review of PP effects. Conclusions sections (see Summary) should directly state whether each S6 stressor would have a positive, neutral or negative effect on each species and state the level of certainty in this conclusion, including whether this conclusion was based on opinion or model results. The uncertainty evaluation should include a statement on whether the effect was examined at a local subcomponent level (e.g., spring Chinook in the mainstem Sacramento) or at the population level. The S6 analysis should provide an overall conclusion about the combined effect of all S6 stressors on each species.

The Panel cannot determine whether the stated conclusions are accurate. But the conclusions did reflect available information and they were presented objectively and without apparent bias. However, in the main text, the Conclusions section involving reduced flows below the North Delta Diversion (J.4.2.4) mistakenly stated that only steelhead would be influenced by S6 (note: the summary conclusion section did correctly include Chinook salmon). Adult fall Chinook are also present during October when flows differ significantly during the S6 and PP scenarios.

In the results section, uncertainty was primarily discussed when two models produced conflicting results. Uncertainty evaluation should be expanded to include all evaluations. Typically, the conclusions did not discuss uncertainty.

The report suggested that the Tier 1 findings would be used to determine whether a more extensive Tier 2 analysis would be conducted, but there was no conclusion or recommendation regarding a subsequent Tier 2 analysis.

Models

6. *Were appropriate models used in the technical appendix? If model results conflicted, was this clearly stated and were appropriate interpretations made?*

A formal strategy for developing conclusions from conflicting approaches was not considered in Scenario 6*.* Instead, the analysis simply noted the conflicting results and noted the uncertainty in the outcome*.* In some cases, the relative confidence in findings between conflicting approaches was mentioned*.* However, in others, such as the Particle Tracking Model versus Salvage Density model for longfin smelt, there was no discussion of the quality of the findings.

7. How well are the models and analyses described, interpreted and summarized?

Details of most models were not presented, so potential limitations of the models could not be examined in this report*.* Sometimes limitations of the model were mentioned in the report, but not always*.* Findings were summarized in relatively detailed tables or figures*.* See additional comments above.

Appendix K Effects on Natural Communities, Wildlife, and Plants

Approach and Analysis

The appendix consists entirely of tables. The authors should include text that describes the information provided in each table and how it relates to the Effects Analysis in Chapter 5. One table (5.K-3) is missing and several tables appear to have missing information. References should be cited or reference should be made to Chapter 5 supporting assumptions made in tables (in particular indirect effects distances). Additionally, reference is made to key assumptions found in other Appendices that are not yet completed (e.g., citing Appendix 5.E for Mike21 Model within Table 5.K-1).

1. How well are the proposed analytical tools defined, discussed and integrated?

Methods and assumptions are presented as a table (Table 5.K-1); the analytical tools are not described further in appendix K. In general, it appears the approach was to create GIS databases for impacts, restoration sites, animal and plant distributions, and then overlay impacts ("footprints") on natural communities or particular animal or plant distributions. The authors should identify the GIS database(s) that were used to estimate the coverage of the vegetation types, the date that the database was compiled, the minimum mapping unit, and provide a reference that summarizes the accuracy of the database. In addition, the authors should specify the accuracy of the "footprints" of the BDCP projects that are used to identify the area that will be impacted by the various projects. The authors need to provide more information in the legends and footnotes of the tables so the reader can understand the information in the tables without having to refer to Chapter 5.

2. How clear and reasonable is the scale of the analysis?

The scale of the analysis appears to be dictated by the accuracy of the GIS database rather than the biology of the species. In several locations in chapter 5 the authors state that habitat totals included in the tables in Appendix K included habitat patches that may be too small to be occupied. Though this may overestimate the amount of habitat present in the Plan Area and therefore provide a conservative estimate of the amount of habitat that may be lost, it also confounds the analyses. The Panel suggests that the BDCP adopt minimum mapping units that correspond with patch sizes that could be occupied.

The scale of the conservation zones seems appropriate.

3. *How well was the vision of the Foundation and Framework (appendix A) applied to the technical appendix / analysis? How consistently was it applied?*

The vision of the foundation and framework was not consistently applied to the analysis of the effects of the measures on the terrestrial species.

4. *How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?*

Appendix K only provides estimates of the amount of habitat lost or gained for most species. Even this rather simple approach depends on a number of questionable assumptions. One is the assumption that habitat created by restoration is suitable and will be occupied by the species. A key problem with this assumption is that it is based on the ability of the Implementation Office to restore habitat that is suitable for the species, which often is a difficult task. For instance, there are 2,894 acres of riparian habitat in the Plan Area and this has been identified as a key habitat for the riparian brush rabbit. However, at the present time, only a small proportion of that habitat is currently occupied by the species. The Plan states that “At least 1,000 acres of valley/foothill riparian natural community in the reserve system will be maintained as early to mid-successional vegetation with a well-developed understory of shrubs, providing the dense understory required for suitable riparian brush rabbit habitat. Fluvial processes within restored floodplains will further contribute to the maintenance of early-successional habitat suitable for the riparian brush rabbit.” This assumes that the Implementation Office can not only restore suitable habitat for the species but that those sites will be occupied by the species and the correct mix of vegetation can be maintained over the long term. The Panel would like to see more specificity about the vegetation that will be restored (minimum cover of understory shrubs, for instance) and a requirement that a minimum number of acres are actually occupied by the species.

Restoration of tidal wetlands is known to be problematic with respect to species diversity and ecosystem functioning. Analysis of impacts on tidal wetland species, however, is based on permanent losses (due to construction, Table 5.K-9), temporary losses (assuming perfect restoration, Table 5.K-10), and enhanced or restored locations (Table 5.K-11, Table 5.K-13). Given the uncertainty of restoration, and the lack of goals for restoration, and the lack an adaptive management structure and plan, the likelihood of restoration success is quite low. Over the time period of the Plan, none of the ‘restored’ habitats are likely to fully achieve structure and function. There is no discrimination or prioritization involved in the Plan; some habitats are easier to restore than others, some species are easier to enhance that others. For most of the covered plants, for example, the net effect is a net loss of population size due to a) permanent acreage losses; b) “temporary” acreage losses with no specifics for restoration of particular populations.

An additional assumption is that ‘natural community habitat’ equals species-specific habitat. As an example for two of the covered species in tidal wetlands, restored habitat for Delta tule pea and Mason’s Lilaeopsis are extremely overestimated. While these species are tidal wetland species, the Delta tule pea only occupies sites along channels, not randomly within the entire tidal wetland; similarly, the Mason’s Lilaeopsis will only be found in a narrow zone of mudflats or disturbances adjacent to channels at the lowest elevations. Both of those are rather small and narrow sites and a tiny fraction of proposed ‘habitat’ restored. Similar to the brush rabbit example above, rare plant wetland species are often poor dispersers and regardless of habitat created, may not disperse to the site (e.g., Diggory and Parker 2011).

5. *Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?*

Given the lack of information about the quality of the GIS databases, given the poor track record for large-scale restoration projects, given the lack of species-specific applications in many of the covered species, it is difficult to accept the accuracy of their results. Yes, protecting habitat will generally be a good thing (Tables 5.K.12, 14), but only if there is connectivity to other habitats with viable populations. Generally, restoration might be considered a good thing, but not without prioritizing the scale of difficulty, the minimum management efforts required, relocation potentials, and other basic ecological issues.

Uncertainty was not considered when estimating the number of acres of habitat that will be removed or created. Given the uncertain trajectory of habitat restoration efforts, the authors should include minimum and maximum estimates of the amount of habitat that will be created. In the face of uncertainty regarding the ability to restore habitats, the Plan should identify targets for habitat restoration that are well above the amount needed to support a viable population of a target species. Uncertainty similarly was not provided for the quality of the GIS data used for estimating habitats.

Models

6. *Were appropriate models used in the technical appendix? If model results conflicted, was this clearly stated and were appropriate interpretations made?*

The habitat models used in the analysis were very simplistic. For most species, the authors simply used the number of acres of habitat removed or restored to assess impacts of the Plan. In all of those cases, the habitat for a species was based on descriptive assessments of their habitat associations which were then identified in the GIS database. For many species, this approach may be the best that can be done but for high priority species, a more in depth approach is warranted. In two cases (greater sandhill crane and Swainson’s hawk) habitat quality was assessed using HSI models. HSI models are available for four other species (clapper rail, white-tailed kite, least Bell’s vireo, and least tern) but the models were not used in the analyses. The authors should provide justification for why the models were not used for these species. To assess the impacts of the Yolo Bypass Fisheries Enhancement, a model was listed as part of the assumptions, but no other information was provided.

7. *How well are the models and analyses described, interpreted and summarized?*

In Table 5.K-11 data are absent or sketchy for many species. For instance, the column entitled “Total Potential Increase in Species Habitat due to Natural Community Restoration” is filled with dashes for Salt Marsh Harvest Mouse. Given the restoration that will occur in the Suisan Marsh, the Panel would expect that there would be a large increase of habitat for this species from natural community restoration. In addition, there were no acreages listed in the same column for the following species: San Joaquin kit fox, Suisan shrew, California linderiella, Conservancy fairy shrimp, Longhorn fairy shrimp, Midvalley fairy shrimp, Vernal pool fairy shrimp, and Vernal pool tadpole shrimp. The Panel also suggests that the authors should include footnotes describing the headings in the table.

The Mike21 model was used for as the basis for understanding the Yolo Bypass Fisheries Enhancement, but it was apparently described in a missing appendix (5.E) and no basis was provided in Appendix K for multiplier numbers (Table 5.K.1).

Table 5.K-12 also appears to have missing information and the column headings need to be clearly described in footnotes. The following species appear to have missing information: Suisun shrew, California least tern, California linderiella, Conservancy fairy shrimp, Longhorn fairy shrimp, Midvalley fairy shrimp, Vernal pool fairy shrimp, and Vernal pool tadpole shrimp.

CONCLUSIONS

The National Research Council panel cited the absence in that BDCP draft of a viable Effects Analysis as one of the most critical gaps “in the science in the BDCP and the corresponding conservation actions” (NRC 2010). In the Phase 1 review, this Panel summarized that the draft BDCP Effects Analysis does not yet provide the “big picture” necessary to evaluate how the effects of complex hydrodynamic, geophysical and ecological changes in the Bay-Delta are going to be synthetically analyzed as a system to ensure conservation and management of listed species under the Federal Endangered Species Act (ESA) and the California Natural Community Conservation Planning Act (NCCPA), and that ecological processes of the Bay-Delta will be preserved and enhanced under future operations. The Panel remains dubious, in part, because prediction of community responses to large scale changes is often nonlinear and difficult.

- The Effects Analysis should be viewed as a working hypothesis of how the BDCP may affect each of the covered species. Given the uncertainty in the Effects Analysis, a detailed monitoring program and action-specific adaptive management plan is essential to a successful BDCP. Nevertheless, The Panel is encouraged by the effort to rehabilitate many acres of Delta ecosystems.

- Given the extensive, but fragmented and unspecific, content and organization of the Effects Analysis chapters and appendices reviewed in Phase 2, the Panel is hesitant whether the major uncertainties can be addressed, further emphasizing the need for a strong monitoring and adaptive management plan.
- Just how BDCP, much less the Effects Analysis, will be implemented and evaluated is extremely unclear.
- Adaptive management, as a tool to deal with the extensive scientific and technical uncertainties, does not appear to be a well-developed operational component that will enable the Plan to reduce that uncertainty
- Net (cumulative) effects of the Plan and its component conservation measures are poorly developed
- Content of missing appendices could change the Panel’s perceptions and recommendations
- Some critical components of the Plan, e.g., Appendix A climate effects, are not (yet) involved in Panel review

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APPENDIX A

BDCP Effects Analysis Science Review

Panel Members

Nancy Monsen – Delta Hydrodynamics, Stanford University

Dr. Monsen's research has focused on multi-dimensional hydrodynamic modeling of the Sacramento-San Joaquin Delta for the last sixteen years. Her PhD research was based on the TRIM3D hydrodynamic model. She also has consulting experience with the DELFT3d hydrodynamic model. She is a Research Associate in the Environmental Fluid Mechanics Laboratory, part of the Civil and Environmental Engineering Department, at Stanford University. Prior to working at Stanford, she worked for ESA PWA (formerly Philip Williams and Associates) for a year and a half and at the U.S. Geological Survey (Menlo Park, National Research Program) for ten years. Dr. Monsen earned her doctorate in Civil and Environmental Engineering at Stanford University.

Greg Ruggerone – Anadromous Fish

Dr. Ruggerone is senior scientist for anadromous fisheries studies and brings 30 years of experience in anadromous fisheries ecology and management to Natural Resources Consultants (NRC). He has investigated population dynamics, ecology, and management of Pacific salmon in Alaska and the Pacific Northwest since 1979. He was the Project Leader of the Alaska Salmon Program, University of Washington, from the mid-1980s to early 1990s where he was responsible for conducting and guiding research at the Chignik and Bristol Bay field stations, preparing salmon forecasts, and evaluating salmon management issues. Most of his research involves factors that affect survival of salmon in freshwater and marine habitats, including climate shifts, habitat degradation, predator-prey interactions, and hatchery/wild salmon interactions. He is currently a member of the Columbia River Independent Scientific Advisory Board and the Independent Scientific Review Panel. He recently served as the fish ecologist on the Secretary of Interior review of dam removal on the Klamath River. During the past six years, he has evaluated salmon fisheries throughout the North Pacific for sustainability using guidelines developed by the Marine Stewardship Council. Dr. Ruggerone received a Ph.D. in Fisheries from University of Washington in 1989. (http://www.nrccorp.com/staff/staff_ruggerone.htm)

Charles Simenstad – Pelagic/Native Fish

As a Research Professor at the School of Aquatic and Fishery Sciences, University of Washington, Prof. Charles ("Si") Simenstad investigates shallow-water community and food web structure, and restoration ecology, of estuarine and coastal marine ecosystems along the Pacific Northwest coast, from San Francisco Bay, the Oregon and Washington coasts, Puget Sound, and Alaska. Ecosystems that have especially attracted his interests include: coastal marshes, mudflats and eelgrass of Pacific Northwest estuaries; nearshore, kelp-dominated shores of the Aleutian Islands, Alaska, and Puget Sound, Washington; and the complex estuarine wetlands of San Francisco Bay-Delta. Much of his recent research is involved in the Columbia River estuary, where he is particularly intrigued by ecological processes associated with estuarine turbidity maxima and the importance of brackish marshes and forested wetlands to the resilience of juvenile Pacific salmon. Much of this research has focused on the role of ecosystem structure and change, and the associated ecological (e.g., food web) interactions that are regulated by strong ecological interactions (e.g., keystone species such as sea otters), natural disturbance, or sensitivity to anthropogenic effects, such as wetland alteration. Si has also become increasingly interested in large-scale interactions across landscapes that alter fundamental ecosystem structure and processes at local scales, such as river flow diversion and regulation influences on estuarine communities and food webs, and the strategic planning of ecosystem restoration and preservation at different scales (http://fish.washington.edu/people/simenstd/)."

John Skalski – Fishery population dynamics and modeling

Dr. Skalski is a Professor of Biological Statistics in the School of Aquatic & Fishery Sciences, College of the Environment, at the University of Washington. He is also an adjunct professor in Quantitative Ecology and Resource Management and Wildlife Sciences, and an instructor in the Center for Quantitative Sciences. His expertise is in sampling theory, parameter estimation, mark-recapture theory, and population dynamics. His research focuses on the development of sampling methodology, field designs, and statistical tests for human-induced and natural effects on organismic and ecological systems. He is the statistician in charge of survival compliance testing at all 13 major hydroprojects in the Snake-Columbia River system. He has authored or coauthored over 100 technical reports on salmonid survival studies and over 40 peer-reviewed articles on tagging studies. Dr. Skalski is a member of the American Statistical

Association, The Wildlife Society, and the American Fisheries Society. He is also a Certified Wildlife Biologist through The Wildlife Society.

Alex Parker – Aquatic Ecology/Food Webs

Research scientist at the Romberg Tiburon Center, Adjunct Prof in Biology at SFSU and Santa Clara University. PhD work (College of Marine Studies, U Delaware) on microbial biogeochemistry in the Delaware Estuary, contirubted to a 30+ year dataset on nutrients and phytoplankton). Additional research in polar ecosystems and equatorial Pacific.

Tom Parker, Plant Communities

Thomas Parker is Professor of Ecology and Evolution at San Francisco State University who studies the ecology and evolution of plant communities, focusing on their dynamics. Current research includes the effects of climate change on tidal wetlands of the San Francisco Bay-Delta, and the ecology and evolution of *Arctostaphylos* species in chaparral and other communities (http://bio.sfsu.edu/people/v-thomas).

T. Luke George, Terrestrial Ecology

Dr. George has been a faculty member in the Department of Wildlife at Humboldt State University since 1991. He specializes in the design, implementation, and analysis of demographic, population monitoring, and habitat selection studies of terrestrial vertebrates. His recent work has focused on estimating demographic parameters and modeling habit selection of threatened and at risk species including the San Clemente sage sparrow, northern spotted owl, greater sage grouse, and tricolored blackbird. Dr. George assisted with the development of a population viability analysis (PVA) of the San Clemente sage sparrow and has served as an advisor on PVAs of Western snowy plovers and San Clemente loggerhead shrikes. He has conducted research on habitat selection and space use of Steller's jays and common ravens in Redwood National and State Parks and has advised state and federal agencies on strategies to reduce nest predation by corvids on marbled murrelets, Western snowy plovers, and other threatened and endangered species in California.

APPENDIX B

Scope of Work

DELTA SCIENCE PROGRAM
INDEPENDENT SCIENCE REVIEW
Bay-Delta Conservation Plan Effects Analysis

Technical Appendices and Chapter 5: Effects Analysis

SCOPE and Charge to Reviewers

BACKGROUND

The Bay Delta Conservation Plan (BDCP) is being prepared by the California Department of Water Resources and the United States Bureau of Reclamation with the cooperation of state and federal agencies, and other interest groups. The BDCP is being developed to satisfy the Federal Endangered Species Act (ESA) and the California Natural Community Conservation Planning Act (NCCPA). When complete, the BDCP will provide the basis for issuing ESA and NCCPA permits for operations of the state and federal water projects. The plan would be implemented over 50 years. The BDCP Planning Agreement has the following planning goals:

- Provide for the conservation and management of Covered Species within the Planning Area;
- Preserve, restore and enhance aquatic, riparian and associated terrestrial natural communities and ecosystems that support Covered Species within the Planning Areas through conservation partnerships;
- Allow for projects to proceed that restore and protect water supply, water quality, and ecosystem health within a stable regulatory framework;
- Provide a means to implement Covered Activities in a manner that complies with applicable State and federal fish and wildlife protection and laws, including CESA and FESA, and other environmental laws, including CEQA and NEPA;
- Provide a basis for permits necessary to lawfully take Covered Species;
- Provide a comprehensive means to coordinate and standardize mitigation and compensation requirements for Covered Activities within the Planning Area;
- Provide a less costly, more efficient project review process which results in greater conservation values than project-by-project, species-by-species review; and
- Provide clear expectations and regulatory assurances regarding Covered Activities occurring within the Planning Area.

The BDCP Working Draft was released November 18, 2010 without a detailed effects analysis. The effects analysis, a critical component for the BDCP, is intended to provide the best scientific assessment of the likely effects of BDCP actions on the species of concern and ecological processes of the Bay-Delta system. The effects analysis will, out of necessity, rely heavily on the application of models to quantify the likely results of the plan. These will include conceptual, numerical, hydrodynamic, operational, and species models. The BDCP effects analysis is being conducted and documented through Chapter 5: Effects Analysis and a series of technical appendices centered around common stressors or groups of similar effects. The draft appendices reviewed in Phase 1 of the Effects Analysis review included; the Conceptual Foundation and Analytical Framework Appendix (Foundation and Framework) and the Entrainment Technical Appendix. The Foundation and Framework described the high-level vision, purpose, and regulatory foundation for the effects analysis. It also provided an overview of the proposed methods to accomplish the analysis. In the most recent drafts of the BDCP Effects Analysis, the Foundation and Framework (originally Appendix A) concepts have been incorporated into Chapter 5: Effects Analysis. The draft technical appendices for Chapter 5: Effects Analysis include:

- **Appendix 5.B: Entrainment.** A synthesis of the relevant analyses related to entrainment of the covered fish.
- **Appendix 5.C: Flow, Passage, Salinity, and Turbidity.** A synthesis of the effects of BDCP actions on flow in the Delta and effects, in turn, on fish passage, salinity, turbidity, dissolved oxygen, and temperature.
- **Appendix 5.D: Contaminants.** A synthesis of the effects related to metals and pesticides.
- **Appendix 5.E: Habitat Restoration.** An analysis of the potential effects of proposed habitat restoration on physical parameters that, in turn, affect covered fish.
- **Appendix 5.F: Biological Stressors on Covered Fish.** An assessment of biological factors that affect the covered fish such as predation, food supply, and submerged aquatic vegetation.
- **Appendix 5.G: Fish Life-cycle Models.** A description of four life-cycle models: 1 for delta smelt, 2 for winter-run Chinook salmon, and 1 for spring-run Chinook salmon.
- **Appendix 5.H: Aquatic Construction Effects.** An assessment of the effects on fish from construction and maintenance of new conveyance facilities.
- **Appendix 5.J: Scenario 6 Comparison.** A comparison of the effects on fish between the current preliminary proposal operations and the operations of Scenario 6, which are the alternative operating criteria proposed by the California Department of Water Resources (DWR); the California Department of Fish and Game (DFG); the U.S. Bureau of Reclamation (Reclamation); the U.S. Fish and Wildlife Service (FWS); and the National Marine Fisheries Service (NMFS; collectively the Five Agencies).
- **Appendix 5.K: Effects on Natural Communities, Wildlife, and Plants.** An assessment of the effects of BDCP actions on all of the non-fish covered species and associated natural communities.

Phase 2 of the review will cover all of the above technical appendices and the draft Chapter 5: Effects Analysis, which integrates the results of all of the technical appendices. Appendices 5.E: Habitat Restoration and 5.G: Fish Life Cycle Models will not be reviewed at this time.

INDEPENDENT SCIENCE REVIEW PANEL

The BDCP participants requested an initial independent scientific review of 1) the draft Foundation and Framework, and 2) the draft Technical Appendix on Entrainment to assess their scientific soundness. An Independent Science Review Panel (Panel) initially convened to review the Foundation and Framework to ensure it was of sufficient robustness and scientific quality to serve its intended purposes, and reviewed the Entrainment Technical Appendix as an example of the application of the conceptual understanding, methods and analyses discussed in the Foundation and Framework.

Following the initial review of the Foundation and Framework the panel will review the completed draft Chapter 5: Effects Analysis and associated technical appendices.

The BDCP participants also requested that the same Panel be available to reconvene if there are substantial changes to the Effects Analysis as the BDCP is developed.

EFFECTS ANALYSIS PURPOSE AND SCOPE

The purpose of the Effects Analysis is to synthesize all of the analyses contained in the technical appendices and integrate the results. The intent of the Effects Analysis is to provide the best scientific assessment of the likely effects of BDCP actions on the species of concern and on ecological processes in the Bay-Delta system. BDCP Chapter 5: Effects Analysis will include summaries of the technical appendices.

TIMELINE

October 2011
The Panel convened in Sacramento to discuss the Foundation and Framework and Entrainment Technical Appendix and made initial recommendations.

November 2011
Phase 1 Panel report completed.

April/ May 2012
The Panel reconvenes in Sacramento to discuss BDCP Chapter 5: Effects Analysis and the technical appendices. The Foundation and Framework and Entrainment Technical Appendix will have been revised based on comments from the Panel’s Phase 1 review and state and federal fish and wildlife agencies. The remaining appendices, although new to the Panel, will have also been revised to incorporate fish and wildlife agencies comments.

June 2012
Interim Panel report completed.

General Statement of Work – Phase 2
The Panel will address the work in stages.

1. The panel will review and analyze the reports and background materials related to the BDCP Effects Analysis in the context of the questions presented in the Charge to the Panel.
2. The panel will attend a technical meeting spanning three days in Sacramento, California, to discuss the review materials.
3. The panel will prepare an interim report of its findings on materials received as of April 2, 2012 with respect to the questions posed in the Charge. Each panelist will assist in conceptualizing, writing, and editing the oral and written reviews by responding to the issues and questions identified in the Charge.

Tasks to Be Accomplished by the Panel

Task 1: Read the review materials and supporting information identified in the Charge.

Task 2: Phase 2 Review Meeting

Task 2a: Participate in and offer professional insights during the meeting spanning three days to be held in Sacramento, California.

Task 2b: Contribute to the coordinated development of preliminary findings and assessments to be presented at the meeting.

Task 3: Draft initial recommendations

Task 4: Participate in the coordinated development of an interim Panel report that responds to the issues and questions identified in the Charge.

Additional Tasks for Panel Chair and Lead Author

One member of the panel will be selected to be the chair and one member will be selected to act as lead author.

Task 5: The Panel Chair will coordinate communications within the panel during the review process, lead the deliberations of the panel during the meetings, and organize the work of the panel.

Task 6: The Lead Author will develop the structure of the panel's reports, assemble individual panel contributions into the panel's reports and format and edit panel reports.

Deliverables and Timeline

Task 1: April 30, 2012
Read and review materials as identified in the Charge.

Task 2a and 2b: April 30 – May 2, 2012
Attend and participate in a panel meeting in Sacramento, CA.

Task 3: May 1, 2012
Present preliminary findings and recommendations at the meeting.

Task 4: June 2, 2012
Interim review report, co-authored by all panel members, is due.

Guidelines for reports:
Reports are expected to directly address the questions identified in the Charge. Format for reports is at the discretion of the Panel; however, it is requested that reports contain a concise executive summary and a table of contents if they are lengthy.

Representatives and Contact Information

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Location of Work

Location for Tasks 1, 4, 5, and 6 are at the Contractor's discretion. Contractor will provide all necessary working space, equipment and logistical support. No travel or per diem will be reimbursed for Tasks 1, 4, 5, and 6.
Tasks 2 and 3 will be carried out in Sacramento, California. The DSP will provide meeting space, computer equipment, and logistical support. Travel and per diem will be reimbursed for Task 2.

Exhibit A, Attachment 1

Charge to the Delta Science Program Independent Review Panel for Phase 2 of the BDCP Effects Analysis Review

The Panel will be charged with assessing the scientific soundness of Chapter 5: Effects Analysis and many of the associated technical appendices. Appendices 5.E: Habitat Restoration and 5.G: Fish Life Cycle Models will not be reviewed at this time. The Panel will make recommendations for how these might be improved with respect to achieving their stated goals. Specific attention will be given to the following questions:

Chapter 5: Effects Analysis

Goals, Purpose, Objectives and Scope

1. How well does the Effects Analysis meet its expected goals?

Completeness, Structure and Effectiveness of Description

2. How complete is the Effects Analysis; how clearly are the methods described?
3. Is the analysis in the Effects Analysis reasonable and scientifically defensible? How clearly are the roll-up results conveyed in the text, figures and tables?

Approach and Analysis

4. Does the Effects Analysis integrate an appropriate suite of analyses? Were appropriate analyses used?
5. How well is uncertainty addressed? How could communication of uncertainty be improved?
6. How well does the Effects Analysis describe how conflicting model results and analyses in the technical appendices are interpreted?
7. How well does the Effects Analysis link to adaptive management and associated monitoring programs?

Technical Appendices
For each technical appendix:

Approach and Analysis

1. How well are the proposed analytical tools defined, discussed and integrated?
2. How clear and reasonable is the scale of analysis?
3. How were the methods and vision of the Foundation and Framework modified based on the panels comments and how well are they applied in the technical appendices/analyses? How consistently are they applied?
4. How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?
5. Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?

Models

6. Were appropriate models used in the technical appendices? If model results conflicted, was this clearly stated and were appropriate interpretations made?
7. How well are the models and analyses described, interpreted and summarized?

REVIEW MATERIALS

- Draft Chapter 5: Effects Analysis
  - Appendix 5.B: Entrainment
  - Appendix 5.C: Flow, Passage, Salinity, and Turbidity
  - Appendix 5.D: Contaminants
  - Appendix 5.F: Biological Stressors on Covered Fish
  - Appendix 5.H: Aquatic Construction Effects
- Appendix 5.J: Scenario 6 Comparison
- Appendix 5.K: Effects on Natural Communities, Wildlife, and Plants

SUPPORTING INFORMATION

- Draft Responses to Delta Science Program Review Panel Report on BDCP Effects Analysis - November 2011
- Highlights of the BDCP (December 2010) (http://resources.ca.gov/docs/Highlights_of_the_BDCP_FINAL_12-14-10_2361.pdf)
- BDCP Working Draft (2010) (http://baydeltaconservationplan.com/BDCPPlanningProcess/ReadDraftPlan/ReadDraftPlan_copy1.aspx)
- NRC 2011 Panel Report - A Review of the Use of Science and Adaptive Management In California's Draft Bay Delta Conservation Plan (http://www.nap.edu/openbook.php?record_id=13148&page=33)
- Science Advisors Draft Report on BDCP Goals and Objectives for Covered Fish Species (http://baydeltaconservationplan.com/Libraries/2011_Working_Groups/6-16-11_Draft_Final_BDCP_G_O_Science_Advisors_Report.sflb.ashx)
- Regulatory Framework for the BDCP Effects Analysis Relating to Species and Habitat Covered by the Plan and Incidental Take Permits
- Rationale for Five Agency Proposed Alternative BDCP Initial Project Operations Criteria
- Draft BDCP Chapter 1: Introduction
  - Appendix 1.A: Evaluation of Species Considered for Coverage
- Draft BDCP Chapter 3: Conservation Strategy (and relevant appendices)
  - Section 3.1 and 3.2 – Introduction and Methods
  - Section 3.3 – Biological Goals and Objectives

- Sections 3.4 and 3.5 – Conservation Measures and Important Regional Actions
- Section 3.6 - Adaptive Management and Monitoring Program
  - Appendix 3.A: Background on the Process of Developing the BDCP Conservation Measures
  - Appendix 3.C: Avoidance and Minimization Measures
  - Appendix 3.D: Natural Community And Covered Species Habitat Existing Condition—Acreages by Conservation Zone

- Draft BDCP Chapter 4: Covered Activities and Associated Federal Actions
- Draft BDCP Chapter 6: Plan Implementation

Exhibit A, Attachment 1

Charge to the Delta Science Program Independent Review Panel for the Phase 1 of the BDCP Effects Analysis Review

The Panel will be charged with assessing the scientific quality of the Foundation and Framework and the Entrainment Appendix. The Panel will make recommendations for how these might be improved with respect to achieving their stated goals. Specific attention will be applied to the following questions:

Conceptual Foundation and Analytical Framework

1. How well are the purpose and scope of the Foundation and Framework defined and described?
8. How well will the Foundation and Framework, as designed, meet its major goals?
9. How effectively does the Foundation and Framework describe the key elements of the ecological context of the BDCP? (details of the ecological context are found in Chapter 2 of the plan)
10. Are the Foundation and Framework internally consistent and scientifically valid?
11. How well does the Foundation and Framework provide an approach for analyzing the effects of BDCP?
12. Does the Foundation and Framework adequately describe how quantitative and conceptual models will be used? Is the approach integrated, reasonable and scientifically defensible?
13. How well is the approach to analyze individual covered activities, including all conservation measures, as well as the cumulative impacts of a comprehensive strategy described?
14. How well does the proposed Framework integrate analysis at various spatial and temporal scales?
15. How well does the Foundation and Framework articulate how best available science will be defined, assembled, summarized and integrated into the analysis?
16. How clearly does the Foundation and Framework identify baseline(s) or other reference points (e.g., goals and objectives) for the effects analysis?
17. How well does the Foundation and Framework describe how uncertainty will be addressed? How could it be improved?
18. How well does the Foundation and Framework describe the link between the adaptive management and the associated monitoring program and the effects analysis?

19. Does the Foundation and Framework describe the appropriate suite of models that should be used?
20. How well does the Foundation and Framework describe how conflicting model results and analyses will be interpreted in the technical appendices?
21. How complete is the Foundation and Framework; how clearly is it described?
22. How well are the methods described to synthesize effects at the species, population, and ecosystem levels? (Note: The description of the "Effects Analysis" methods are still in development and will not be included in the Framework in time for this review. Additional details may be provided during the consultant presentation at the first workshop.)

Technical Appendix

1. How well are the proposed analytical tools defined, discussed and integrated?
2. How clear and reasonable is the scale of analysis?
3. How well are the models and analyses interpreted and summarized?
4. How well was the vision of the Foundation and Framework applied in the technical appendix/analysis (i.e., the Entrainment Appendix)? How consistently was it applied?
5. How well did the technical appendix evaluate the effects of potential BDCP conservation measures on the specified variable(s)?
6. Were the appropriate models used in the technical appendix? Were model results interpreted correctly? If model results conflicted, were appropriate interpretations made?
7. How rigorous of an analysis did the technical appendix provide for evaluating the effects of potential BDCP conservation measures on the specified variable(s)?
8. Were the conclusions drawn from the results accurate and did these conclusions appropriately consider scientific uncertainty?

REVIEW MATERIALS

- Working Draft Conceptual Foundation and Analytical Framework Appendix
- Working Draft Entrainment Technical Appendix

SUPPORTING INFORMATION

- Highlights of the BDCP (December 2010) (http://resources.ca.gov/docs/Highlights_of_the_BDCP_FINAL_12-14-10_2361.pdf)
- BDCP Working Draft (2010) (http://baydeltaconservationplan.com/BDCPPlanningProcess/ReadDraftPlan/ReadDraftPlan_copy1.aspx)

- NRC 2011 Panel Report - A Review of the Use of Science and Adaptive Management In California's Draft Bay Delta Conservation Plan (http://www.nap.edu/openbook.php?record_id=13148&page=33)
- Science Advisors Draft Report on BDCP Goals and Objectives for Covered Fish Species (http://baydeltaconservationplan.com/Libraries/2011_Working_Groups/6-16-11_Draft_Final_BDCP_G_O_Science_Advisors_Report.sflb.ashx)
- Regulatory Framework for the BDCP Effects Analysis Relating to Species and Habitat Covered by the Plan and Incidental Take Permits

APPENDIX C

Delta Science Program Independent Science Review:

Bay Delta Conservation Plan (BDCP) Effects Analysis Review – Phase 2

April 30, 2012 – 8:30 a.m. – 4:30 p.m.

May 1, 2012 – 2:00 p.m. – 4:30 p.m.

Park Tower 2nd Floor Conference Center
980 Ninth Street
Sacramento, CA 95814

AGENDA

Order of agenda and listed times are approximate and subject to change.

Day 1: April 30, 2012 – (8:30 a.m. – 4:30 p.m.)

I. Introduction

8:30 – 8:45 Welcome Remarks (Dr. Peter Goodwin, Delta Science Program Lead Scientist)

II. BDCP Effects Analysis Presentations

8:45 – 9:15 Fish Agency Perspectives on Independent Science Review

9:15 – 9:25 Overview and purpose of BDCP Effects Analysis Presentations (David Zippin, ICF International)

9:25 – 9:45 Technical Appendix Status and Update (Jennifer Pierre, ICF International)

9:45 – 10:00 Ecosystem, Landscape, and Natural Community Effects (Jennifer Pierre, ICF International)

10:00 - 10:15 Break

10:15 – 12:00 Covered Fish Species Net Effects

- General Methods (Chip McConnaha, ICF International)
- Delta smelt and Longfin smelt (Marin Greenwood, ICF International / Chuck Hanson, Hanson Environmental Inc.)

- Salmonids (Chip McConnaha, ICF International)

12:00 – 1:00 Lunch

1:00 – 1:45 Covered Fish Species Net Effects (continued)

- Splittail (Chip McConnaha, ICF International)
- Sturgeon and Lamprey (Rick Wilder, SAIC)

1:45 – 2:15 Terrestrial Species Net Effects, General Methods, Covered Wildlife and Covered Plants (Ellen Berryman, ICF International)

2:15 – 2:30 Break

III. Discussion

2:30 – 4:15 Panel and Presenter Question and Answer Period

IV. Public Comment on the Science Review

4:15 – 4:30 Public Comment on the Science Review

Public comment will be limited to 3 minutes per speaker. Comments must be relevant to the science review.

4:30 p.m. Adjourn

Day 2: May 1, 2012 – (2:00 p.m. – 4:30 p.m.)

I. Recommendations from the Review Panel and Discussion

2:00 – 3:00 Panel Presents and Discusses its Initial Findings and Recommendations with Presenters from the Previous Day

3:00- 3:15 Break

3:15 – 4:15 Panel and Presenter Discussion Continued

II. Public Comment on the Science Review

4:15 – 4:30 Public Comment on the Science Review

4:30 p.m. Adjourn