

# Analysis of Proposed Change Point of Diversion and the No Injury Rule

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Report of Ed Whitelaw

Prepared for:  
California Water Impact Network

**ECONorthwest**  
ECONOMICS • FINANCE • PLANNING

The Washburne Building  
72 W Broadway  
Suite 206  
Eugene, OR 97401  
541.687.0051

## I. QUALIFICATIONS

I am professor emeritus of economics at the University of Oregon, where I continue to teach in the economics department and the Robert Clark Honors College. I founded ECONorthwest (ECONW) in 1974. ECONW provides analysis in economics, finance, planning, and policy evaluation to businesses and governments. I am now founder and president of FION!, which is subcontracting to ECONW on this matter. I received a Ph.D. in economics from the Massachusetts Institute of Technology. I have testified on economic matters in administrative, legislative and Congressional hearings, and in courts. Exhibit CWIN-4 contains a copy of my vita, which summarizes my experience.

## II. ASSIGNMENT

For the *Hearings on the Petition to Change the Point of Diversion (California Waterfix)*, counsel for the California Water Impact Network asked ECONW and FION! to analyze<sup>1</sup> California Department of Water Resources' and U.S. Bureau of Reclamation's (together, the "Petitioners") claims that the proposal would not injure other legal users of water.

Herein, I state my opinions and describe the analysis on which I base my opinions. In my work on this matter, I have relied on my general training, experience, and knowledge in economics. Throughout this report, I use "we," "our," and "us" to refer to my colleagues and me.<sup>2</sup> In their work on this matter, they have worked under my direction.

## III. SUMMARY OF OPINIONS

Here and throughout this report I summarize our conclusions and my opinions based on the evidence we have assembled on this matter to date.<sup>3</sup> If we encounter new information, we will consider it as possible reason for modifying our conclusions and my opinions, either to reinforce or reverse them.

In summary, I find that the Petitioners failed to evaluate whether their proposal would injure other legal users of water. They failed to follow professional standards for analysis or utilize sound methods of analysis. Their proposal to rely on adaptive management also suffers from fatal errors.

## IV. Context

In their Petition for Change, the Petitioners seek authorization from the State Water Resources Control Board ("SWRCB") to add three points of diversion to their water rights for the State Water Project and the Central Valley Project. Petitioners propose to locate these new points of

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<sup>1</sup> Definition, "analyze": to examine carefully and critically <<http://www.dictionary.com/browse/analyze?s=t>>. Definition, "critical" adjective form: involving skillful judgment as to truth, merit, etc.; judicial <<http://www.dictionary.com/browse/critically?s=t>>

<sup>2</sup> These colleagues include Winston Hovekamp, Kristin Lee, Ralph Mastromonaco, Sarah Reich, and Ryan Sherrard.

<sup>3</sup> The text and footnotes of this report identify the documents I have reviewed and relied upon in forming my opinions in this matter.

diversion on the Sacramento River between Clarksburg and Courtland.<sup>4</sup> Petitioners also propose to divert water from the Sacramento River at these new points of diversion into a proposed twin-tunnel conveyance system (“the twin tunnels”). The twin tunnels would transport water under the Delta to the existing State Water Project and Central Valley Project conveyance infrastructure south of the Delta.<sup>5</sup>

A necessary condition for the Petitioners to prevail, as we understand, is for them to persuade the SWRCB that their proposed change would not injure other legal users of water. Part 1 of the California WaterFix Hearings before the SWRCB focuses on the effects of the proposed changes on human uses of water. The SWRCB stated it will also consider effects on “human uses that extend beyond the strict definition of legal users of water, including flood control issues and environmental justice concerns.”<sup>6</sup>

## V. Analysis

In this section I summarize our analysis of the Petitioners’ claims.

### A. Changes in Points of Diversion Must Meet the “No Injury” Rule

As we understand, the SWRCB may approve a petition to change a point of diversion only if, among other conditions, the proposed change would not “injure any other legal users of water.” This condition has become known as the “no injury” rule.<sup>7</sup> We understand further that the burden rests with the *Petitioners* to show the proposed change meets the “no injury” rule.<sup>8</sup>

In the matter at hand, the Petitioners propose changes to water diversion in the Delta. The Delta region houses and hosts a variety of legal users, e.g., farmers, municipal water providers, subsistence fishers, recreational users and others.<sup>9</sup> As we understand, the no injury rule requires that the Petitioners show that none of these users would be harmed by the Petitioners’ proposal.

We also understand that the SWRCB has defined the term “injury” to include reductions in the quantity or quality of water relied on by other legal users of water.<sup>10</sup> That is, the no injury rule requires that none of the other legal users of water in the Delta would be negatively affected by the proposed change in diversion. In economic terms, injury would materialize as increases in cost or decreases in benefit. For example, the change in point of

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<sup>4</sup> California WaterFix Hearing Exhibit No. SWRCB-1.

<sup>5</sup> [http://cms.capitoltechsolutions.com/ClientData/CaliforniaWaterFix/uploads/CWF\\_FastFacts4.pdf](http://cms.capitoltechsolutions.com/ClientData/CaliforniaWaterFix/uploads/CWF_FastFacts4.pdf)

<sup>6</sup> [http://www.waterboards.ca.gov/waterrights/water\\_issues/programs/bay\\_delta/california\\_waterfix/docs/021116phc\\_ruling.pdf](http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/docs/021116phc_ruling.pdf) (at pg. 10)

<sup>7</sup> [http://www.waterboards.ca.gov/waterrights/water\\_issues/programs/water\\_transfers/docs/watertransferguide.pdf](http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_transfers/docs/watertransferguide.pdf)

<sup>8</sup> [https://govt.westlaw.com/calregs/Document/IB8D2EE30D45A11DEA95CA4428EC25FA0?viewType=FullText&originContext=documenttoc&transitionType=CategoryPageItem&contextData=\(sc.Default\)](https://govt.westlaw.com/calregs/Document/IB8D2EE30D45A11DEA95CA4428EC25FA0?viewType=FullText&originContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default))

<sup>9</sup> See, for example, the testimony of Bill Jennings, Exhibit CSPA-2.

<sup>10</sup> [http://www.waterboards.ca.gov/waterrights/water\\_issues/programs/water\\_transfers/docs/watertransferguide.pdf](http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_transfers/docs/watertransferguide.pdf)

diversion would lead to higher costs for farmers or municipalities in the Delta region if they would have to cope with decreases in water quality or quantity.

## B. Petitioners Fail to Heed the “No Injury” Rule

Again, as we understand, it is the Petitioners’ burden to show that the proposed change would meet the “no injury” rule. Based on our review of Petitioners’ testimony submitted in this matter, we find they failed to show the proposed change would meet the rule. To be clear, they failed because they provided no analysis of the effects of their proposal on the other legal users of water in the Delta region.

In short, to address the rule’s requirement to show that the proposal would spare all legal users of water from injury, the Petitioners should have described the proposal’s causal sequence of effects and substantiated the underlying explanations of the effects. They also should have substantiated the risks and uncertainties associated with these effects. Moreover, they should have evaluated these effects on all of the other legal users in the Delta region.

We find, however, no evidence that they evaluated the effects of their proposal on even one—let alone all—legal users of water in the Delta region. We find no analysis, for example, of the proposal’s effects on a farm legally using water to raise asparagus. What would be the probabilities associated with increases or decreases in the quantities or quality—e.g., the salinity—of water flowing to the farm? And if the probabilities were unknown, what would the farm do to cope with the uncertainties?<sup>11</sup>

Rather than analyze and report their proposal’s effects on other legal users of water, the Petitioners simply assert—without substantiating—that they meet the no injury rule. Specifically, they claim their proposal would not significantly change the probability or frequency of exceeding the D-1641 Delta water-quality standards. Their claim misses the point, namely, demonstrating compliance with the D-1641 standards is not sufficient to address injury to other legal users of water. For example, the D-1641 standards fail to cover all aspects of quality or quantity conditions that might injure other legal users of water.<sup>12</sup> Consider the Petitioners’ own testimony about their proposal effecting potential changes in water quality that could injure water users.<sup>13</sup> The Petitioners should have analyzed these effects on the other legal users of water. In the next subsection, I describe the applicable professional standards to such an analysis.

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<sup>11</sup> Not incidental, uncertainty and risk are not synonyms. As Frank Knight put it, “[Uncertainty] is something distinctly not of [risk’s] character; and there are far-reaching and crucial differences [between the two].” In the matter at hand, this difference in kind and not in degree matters (Knight, F. H. 1921. *Risk, Uncertainty, and Profit*. Houghton Mifflin, Boston & New York. Pg. 19-20).

<sup>12</sup> See, for example, the testimony of Bill Jennings, Exhibit CSPA-2.

<sup>13</sup> For example, according to Figure CL1 in Exhibit DWR-513, average chlorine concentrations at the Contra Costa Canal for at least one modeled scenario exceed that of the No-Action Alternative in 8 of the 12 months. (Exhibit DWR-513, p. 4). In addition, Dr. Nader-Tehrani admits that, “At Contra Costa Canal the results are mixed.” (DWR-66, p. 6).

## C. Professional Standards for Analyzing the Petitioners' Claims

Economics proffers a set of powerful tools for analyzing policy issues such as the one at the heart of this matter: whether the Petitioners' proposed change in point of diversion would injure other legal users of water. Such effects—*injury, harm, damages, losses or the like*—manifest themselves in economics as costs, or, more precise, opportunity costs.<sup>14</sup> In this section we describe the professional standards for evaluating projects by analyzing, for example, injuries to legal users of the water in the Delta region.

The bulk of ECONorthwest's work since 1974, when I founded it,<sup>15</sup> has been in economic consulting and the rest in providing analysis and expert testimony for trials and administrative hearings.

1. Economic consulting: We've developed and applied various methods of analysis, steeped in the scientific method<sup>16</sup> and complemented by the tools of policy analysis developed in the U.S. in the 1960s.
  - a. With-Without: Any credible economic analysis of the effects of some action, e.g., changing a point of diversion, going to a movie, involves comparing conditions with the action to conditions without the action, while—this is the challenge—ensuring all other conditions remain equal between the two scenarios.<sup>17</sup>
  - b. Uncertainty and Risk: "Uncertainty" and "Risk" are terms of art in economics, and even here in economics, there's occasional confusion, as we show in Section V.D.2 below.<sup>18</sup> Since these terms play an important role in this report, I present their definitions here.

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<sup>14</sup> In economics, the term of art underlying "cost" is "opportunity cost." The "opportunity cost" of any action (or even of any thought) is the benefit forgone by taking that action (or having that thought). See practically any economics textbook. It's the basis for Harvard economist Alvin Hansen's famous line, "There's no such thing as a free lunch." It's also the basis for the line on the University of Oregon economics department's T-shirt, "Learning that nothing in life is free ... Priceless." Definition, "term of art": "a word or phrase that has a specific or precise meaning within a given discipline or field and might have a different meaning in common usage" Source: <<http://www.dictionary.com/browse/term-of-art?s=t>>

<sup>15</sup> <http://www.econw.com/>

<sup>16</sup> [https://en.wikipedia.org/wiki/Scientific\\_method](https://en.wikipedia.org/wiki/Scientific_method). For our purposes here, Wikipedia's description serves well.

<sup>17</sup> In mathematics, this is called taking a partial derivative. "In mathematics, a partial derivative of a function of several variables is its derivative with respect to one of those variables, with the others held constant ..." Source: <[https://en.wikipedia.org/wiki/Partial\\_derivative](https://en.wikipedia.org/wiki/Partial_derivative)>

<sup>18</sup> An accurate and almost precise description of the two terms is, "Risk is measurable and uncertainty is not." But this is cryptic, i.e., featuring brevity and a bit of mystery. Frank Knight, as a graduate student at Cornell University, proffered his insight in a pamphlet. Later, as a University of Chicago economist, published his classic, *Risk, Uncertainty and Profit* (1921). Houghton Mifflin.

Risk: “A context in which an event occurs with some probability or where the size of the event has a probability distribution”<sup>19</sup>

Uncertainty: “A situation in which the likelihood of an event occurring is not known at all. That is, no probability distribution can be attached to the outcomes.”<sup>20</sup>

- c. Policy Analysis 101<sup>21</sup>: The basic version involves three models: Descriptive model (How things are). Normative model (How things should be). Prescriptive model (How to get from where we are to where we’d like to be).
  - d. Relevant Market, Relevant Product, and Relevant Geography: These are terms of art at the intersection of economics and litigation, especially in antitrust litigation. They serve to identify the market, product, and geography relevant to a particular good or service, e.g., water or the flow of ecosystem services from a river, lake, reservoir or estuary.
2. Analysis and Testimony for Trials and Hearings: In environmental matters, we almost always find ourselves trying to find a language in common between the attorneys and the natural scientists. In these matters, we have engaged in litigation-support off and on for decades. At the intersection of economics and litigation are professional standards peculiar to California. They offer general principles of admissibility of evidence in trials, analogous to principles the SWRCB marshals to consider the Petitioners’ proposals to change the point of diversion.

*People v. Kelly* (*People v. Kelly*, 17 Cal.3d 24, 130 Cal.Rptr. 144 (Cal., 1976))  
pg. 148, General Principles of Admissibility:

1. The reliability of the method must be established, usually by expert testimony.
2. The witness furnishing such testimony must be properly qualified as an expert to give an opinion on the subject.
3. The proponent of the evidence must demonstrate that correct scientific procedures were used in the particular case.

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<sup>19</sup> Pearce, D.W., ed. 1992. *The MIT Dictionary of Modern Economics*, 4<sup>th</sup> ed. Boston: MIT Press. p. 378. See also Frank Knight (cited above), *Risk, Uncertainty and Profit* (1921). Houghton Mifflin pp. 19-20 and his Ch. 7.

<sup>20</sup> Pearce, D.W., ed. 1992. *The MIT Dictionary of Modern Economics*, 4<sup>th</sup> ed. Boston: MIT Press. p. 438. See also Frank Knight (cited above), *Risk, Uncertainty and Profit* (1921). Houghton Mifflin pp. 19-20 and his Ch. 7.

<sup>21</sup> “Policy Analysis 101” is not a term of art in economics (or in any other discipline that I know). I coined the term (though not the concept) decades ago in class, when I improvisationally cobbled together what I saw as the models I saw underlying solving problems and resolving issues. As for sources, they are here, there and everywhere. My favorite is “If we could first know where we are, and whither we are tending, we could then better judge what to do, and how to do it.” Abraham Lincoln, 1858. “House Divided” speech, State Capitol, Springfield, Illinois.

As we make clear in the remainder of the report, the Petitioners have heeded neither the first nor the third of the Kelly principles.

## D. ADAPTIVE MANAGEMENT

In Section V, Subsection A above, I describe what the SWRCB requires before it will approve a petition to change a point of diversion, namely, it requires said Petitioners to show the proposal will not violate the “No Injury” rule. In Section V, Subsection B, I describe that the Petitioners fail to show—in fact fail even to attempt to show—that their proposal would not violate the “No Injury” rule. That is, they did not show that their proposal would not “injure any other legal users of water.” They have proposed instead to rely on adaptive management.

Their proposal to rely on adaptive management suffers from four fatal errors, any one of which is sufficient to render their proposal to use adaptive management irrelevant to the matter at hand. First, their Adaptive Management Plan ignores the “other legal users of water.” Second, the Petitioners don’t understand “uncertainty,” neither the concept nor its consequences and they compound this gap in their knowledge by assuming, implicitly and incorrectly, risk neutrality among the other legal users of water. Third, they ignore the state of the science in developing adaptive management programs. By doing so, they fail to proffer a program likely to produce successful outcomes given ecological and institutional factors at play in the Bay-Delta. Fourth, they fail to detail a sufficient, long-term funding plan for their Adaptive Management Program.

### 1. Petitioners’ Proposed Adaptive Management Plan Ignores Other Legal Users of Water

Petitioners’ reliance on adaptive management does nothing to prevent injury to other legal users of water. Specifically, the focus of Petitioners’ adaptive management program is on species protection—not on other legal uses of water such as municipal and agricultural use. As we understand, the Petitioners’ plan centers on adjusting operational criteria to account for potentially unforeseen impacts on critical habitat and sensitive biological resources, in the name of compliance with state and federal species protection mandates. For example, in Jennifer Pierre’s testimony she describes the Adaptive Management Program largely as a program to adjust operations based on issues related to managing species—there is no mention of adjusting operations to address any effects on other legal users of water.<sup>22</sup> Likewise, Pierre references the adaptive management plans and programs detailed in other related documents, which again focus on species management and not other issues relevant to the other legal users of water.<sup>23</sup>

Based on our review of the Petitioners’ plan, we conclude that the proposed adaptive management program is not at all designed to help Petitioners meet the no injury rule. Their

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<sup>22</sup> Testimony of Jennifer Pierre, Exhibit DWR-51, pp. 14-17.

<sup>23</sup> Testimony of Jennifer Pierre, Exhibit DWR-51, pp. 14-17.

plan fails to set goals or objectives, monitor effects, or adjust operational criteria in the event the project adversely affects or threatens to affect other legal users of water.

## 2. Petitioners' Proposed Adaptive Management Plan Fails to Fully Incorporate Uncertainty and Risk

The Petitioners fail to fully incorporate uncertainty and risk into their models. For example, when the Petitioners incorporate climate change into their CALSIM and DSM models, they reduce 112 different, climate-change scenarios from 112 to 5. In their CALSIM/DSM modeling, however, the Petitioners used only one of the five climate-change scenarios. They do the same in all operational scenarios (Boundary 1, Boundary 2, H3, and H4). That is, they didn't use the five different scenarios that span the range of possibilities for alternatives other than 1A in the 2013 Draft EIS/EIR.<sup>24</sup> Eventually, going forward in the 2015 Recirculated Draft EIS/EIR, they used the modeling results of Alternative 4 from 2013 in place of a full analysis of Alternative 4A, the California WaterFix.<sup>25</sup> That is, to repeat, the Petitioners ignored the various climate-change scenarios (Q1-Q4) when modeling the California WaterFix.<sup>26</sup>

On August 2<sup>nd</sup>, 2016 the Petitioners released the Biological Assessment for the California WaterFix. In it, the Petitioners confirm that the modeling results depend upon climate-change scenarios. They state, for examples, "Shasta storage and operations ... Predicted river flows ... Predicted exports are very sensitive to ... "the conditions specific to the climate scenario selected."<sup>27</sup> Unexpected and inexplicable, though, they ignore the other climate scenarios.<sup>28</sup>

Omitting the uncertainty driving climate change's effects on hydrology and sea-level rise means the Petitioners have ignored the basic, mainstream economics of the links—the causal chain—from climate change through the Petitioners' proposed California WaterFix to the resulting injury suffered by other legal users of water.

They compounded their error by assuming implicitly the other legal users of water are risk neutral. But as economist Peter Hazell found, "Agricultural production is generally a risky process, and considerable evidence exists to suggest that farmers behave in risk-averse ways."<sup>29</sup>

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<sup>24</sup> Bay-Delta Conservation Plan EIR/EIS, Appendix 5A Modeling Technical Appendix, Nov 2013. Page 5A-A71

<sup>25</sup> Bay-Delta Conservation Plan Recirculated EIR/EIS, Appendix B, July 2015. Page B-3

<sup>26</sup> Testimony of Armin Munevar, Page 13, Line 23; SWRCB-4 Appendix 5A, Page 5A-A64, Lines 15 – 24; Biological Assessment for the California Water Fix, Appendix 5A, Page 5.A-3. SWRCB-104; Bay-Delta Conservation Plan EIR/EIS, Appendix 5A Modeling Technical Appendix, Nov 2013. Page 5A-A71

<sup>27</sup> Biological Assessment for the California WaterFix. Appendix 5.A. Attachment 1, Page 1 – 2. July 2016. SWRCB-104

<sup>28</sup> Biological Assessment for the California WaterFix. Appendix 5.A. Attachment 1, Page 3. July 2016. SWRCB-104

<sup>29</sup> Peter B. R. Hazell. (1982). Application of Risk Preference Estimates in Firm-Household and Agricultural Sector Models. *American Journal of Agricultural Economics*, 64(2), 384-390. Retrieved from <http://www.jstor.org/stable/1241153>. For the definitions of the terms of art, "risk neutral" and "risk-averse," see the next page.

Suppose a farmer is risk-neutral, as the Petitioners implicitly assume. And suppose further she faces a 50% chance that salinity will increase 10 units and a 50% chance that salinity will decrease 10 units.<sup>30</sup> Then the risk-neutral farmer is indifferent between the two outcomes. But if she is risk-averse, then preference for the decrease in salinity replaces indifference. Losses hurt more than equivalent gains. That is, the risk-averse farmer is injured.

Rather than compare and contrast “best case” and “worst case” climate-change scenarios, as they should have, the Petitioners have compared operational outcomes of the no-action alternative that are “similar” to the outcomes of the California WaterFix under the central climate-change scenario. This is a fundamental error that renders this part of the Petitioners’ analysis of their proposal irrelevant.

- a. The Petitioners’ explicit mishandling of the term, “uncertainty,” and their implicit mishandling of the terms “risk,” “risk aversion” and “risk neutrality” are both confused and confusing. Furthermore, their mishandling of all four terms is severe enough to render their Proposed Adaptive Management Plan irrelevant not only to serve their customers with their proposed California WaterFix but also to show—were they to try to show—the SWRCB that their proposal would not injure other legal users of water. To understand their fatal errors requires understanding the meaning of these four terms of art in economics.
- b. I address and define “risk” and “uncertainty” above in Section C (Professional Standards). Consider the definitions of risk aversion and neutrality below.
  - i. Risk aversion: A risk-averse individual “...prefers a certain given income to a risky income with the same expected value.”<sup>31</sup>
  - ii. Risk neutrality: A risk-neutral individual “... is indifferent between a certain income and an uncertain income with the same expected value.”<sup>32</sup>

### 3. Petitioners’ Proposed Adaptive Management Plan Ignores the State of the Science on Adaptive Management

The Petitioners’ Adaptive Management Plan fails to incorporate elements necessary for success. According to some researchers, including panels of scientists convened through the National Academy of Sciences, adaptive management is an imperfect approach that fails more often than it succeeds:

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<sup>30</sup> We assume here that the relationship between salinity and its effects on agricultural production is linear.

<sup>31</sup> Pindyck, R.S. and D.L. Rubinfeld. 2013. *Microeconomics*, 8th ed. Boston: Pearson. p. 166

<sup>32</sup> Pindyck, R.S. and D.L. Rubinfeld. 2013, p.166. Incidental, a risk-loving individual “...prefers an uncertain income to a certain one...”

*“Despite numerous attempts to develop and implement adaptive environmental management strategies, many of them have not been successful... most of the more than 100 adaptive management efforts worldwide have failed primarily because of institutional problems that include lack of resources necessary for expanded monitoring; unwillingness of decision makers to admit and embrace uncertainties in making policy choices; and lack of leadership in implementation.”<sup>33</sup>*

*“Since its initial introduction and description, adaptive management has been hailed as a solution to endless trial and error approaches to complex natural resource management challenges. However, its implementation has failed more often than not. It does not produce easy answers, and it is appropriate in only a subset of natural resource management problems.”<sup>34</sup>*

*“Adaptive management approaches and applications have been the subject of multiple National Academies of Science reports and there is a clear consensus that its implementation in environmental restoration does not always meet the original intent of the methods...”<sup>35</sup>*

*“Questions remain... about the ways in which adaptive ecosystem management can influence the planning process and how it would be implemented. The progress of a particular case study, the South Florida/Everglades ecosystem restoration initiative, suggests that the design and practice of adaptive ecosystem management have yet to fulfill the intellectual challenge.”<sup>36</sup>*

*“The implementation of adaptive management has proven to be difficult. Despite attempts to integrate adaptive management into land management in the United States (e.g., Williams et al., 2009), Australia, and elsewhere, these programs are often adaptive management programs in name only and never reach fruition or meet expectation (Allan and Curtis, 2005).”<sup>37</sup>*

*“Since its inception in the late 1970’s, adaptive management approaches have been applied to hundreds of resource systems around the world. Yet, there are very few cases where the adaptive assessment led to adaptive management, defined as the design and execution of explicit experiments to resolve key resource uncertain ties (Johnson 1999, Gunderson et al. 2006).”<sup>38</sup>*

This long history of lackluster results has led adaptive management researchers to dissect past failures, identify what went wrong and why, and propose strategies to improve the probability

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<sup>33</sup> Panel to Review California's Draft Bay Delta Conservation Plan; Water Science and Technology Board; Ocean Studies Board; Division on Earth and Life Studies; National Research Council (NRC). 2011. *A Review of the Use of Science and Adaptive Management in California's Draft Bay Delta Conservation Plan*. National Academies Press. Pg. 38

<sup>34</sup> Allen, C.R. and L.H. Gunderson. 2011. “Pathology and Failure in the Design and Implementation of Adaptive Management.” *Journal of Environmental Management* 92(2011): 1379-1384.

<sup>35</sup> Convertino, M., C.M. Foran, J.M. Feisler, L. Scarlett, A. LoSchiavo, G.A. Kiker, and I. Linkov. 2013. “Enhanced Adaptive Management: Integrating Decision Analysis, Scenario Analysis and Environmental Modeling for the Everglades.” *Scientific Reports*. October 11.

<sup>36</sup> Milon, J.W., C.F. Kiker, and D.J. Lee. 2011. “Adaptive Ecosystem Management and the Florida Everglades: More than Trial-and-Error?”

<sup>37</sup> Allen and Gunderson 2011

<sup>38</sup> Gunderson, L.H. 2015. “Lessons from Adaptive Management: Obstacles and Outcomes.” In Allen and Garmestani, eds. *Adaptive Management of Social-Ecological Systems*. Pg. 28.

that adaptive management programs will lead to positive management outcomes.<sup>39</sup> Several observations from the literature indicate that the social and ecological conditions in the Bay-Delta present challenges to effective implementation of adaptive management:

*“Adaptive management is a poor fit for solving problems of intricate complexity, high external influences, long time spans, high structural uncertainty and with low confidence in assessments (Gregory et al., 2006)(e.g., climate change).”<sup>40</sup>*

*“[T]he presence of highly controversial risks, management problems characterized by extended temporal or spatial scales, or high structural uncertainty have been judged to predispose to the likelihood of an unsuccessful application of AM.”<sup>41</sup>*

*“In some contexts, the use of adaptive management is flatly inappropriate. Promises of future adaptive management cannot justify authorizing environmentally damaging activities unless those harms will in fact be reversible.”<sup>42</sup>*

*“Adaptive management is perhaps too often seen as the only way forward for wicked social-ecological problems, such as presented by the management of stressed and over-appropriated watersheds that transcend multiple jurisdictions... These are not the ideal situations for the application of adaptive management, because replication is not possible and experiments are highly constrained by entrenched management, engineering, economic and social systems.”<sup>43</sup>*

From the large body of adaptive management critiques and assessments, researchers have developed prescriptions for designing and implementing adaptive management more effectively.<sup>44</sup> Researchers have outlined specific steps in adaptive management planning that Petitioners have not taken, and elements that Petitioners have not incorporated into plans presented thus far:

*“When used, adaptive management programs must be carefully designed to maximize the benefits of learning and minimize the costs of flexibility. Key elements of a good adaptive management program include clearly articulated goals and plans for learning, enforceable commitments to revise management decisions, and assured funding for the lifetime of the plan.”<sup>45</sup>*

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<sup>39</sup> Allen and Gunderson 2011; Chaffin and Gosnell. 2015. “Chapter 6: Measuring Success of Adaptive Management Projects.” In Allen and Garmestani, eds. *Adaptive Management of Social-Ecological Systems.*; Doremus, H. et al. 2011. *Making Good Use of Adaptive Management.* Center for Progressive Reform. White Paper #1104. April.

<sup>40</sup> Allen and Gunderson 2011

<sup>41</sup> Rist, L. et al. 2013. “A New Paradigm for Adaptive Management.” *Ecology and Society* 18 (4): 63.

<sup>42</sup> Doremus, H. et al. 2011, Pg. 14

<sup>43</sup> Allen and Gunderson 2011 Pg. 1384

<sup>44</sup> See, for example, Rist et al., 2013; Allen and Garmestani 2015;

<sup>45</sup> Doremus, H. et al. 2011, Pg. 14

*“In cases of very high value resources, very high uncertainty, or very sharp political conflict over management choices, managers should seek independent peer review of both the model and the analysis of prospects for learning.”<sup>46</sup>*

The Petitioners’ framework fails to reflect and incorporate the state of the science on adaptive management as reflected in the literature, rendering the potential utility of adaptive management in the Delta at best ineffectual. Scientific reviewers of the Petitioners’ adaptive management program designs agree, and their conclusions have changed remarkably little as the BDCP and CWF programs have evolved:

*“Fundamental changes are needed in how adaptive management is organized and managed in the Delta. This should begin with a unified understanding of adaptive management: what it is and what it is not; what it requires in resources; what it needs in organizational, operational, and regulatory flexibility; and when it is appropriate and when it is not.”<sup>47</sup>*

*“The lack of a substantive treatment of adaptive management in the Current Draft [partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS) for BDCP/California WaterFix] indicates that it is not considered a high priority or the proposers have been unable to develop a substantive idea of how adaptive management would work for the project.”<sup>48</sup>*

*“[T]he application of adaptive management to a large-scale problem like the one that exists in California’s Bay-Delta will not be easy, quick, or inexpensive. The panel concludes that the BDCP needs to address these difficult problems and integrate conservation measures into the adaptive management strategy before there can be confidence in the adaptive management program. In addition, the above considerations emphasize the need for clear goals and integrated goals, which have not been provided by the draft BDCP.”<sup>49</sup>*

*“It is clear from documents reviewed by Advisors (Appendix C) that efforts to develop an Adaptive Management Program (AMP) for BDCP are in their early stages. The documents show progress toward defining the elements of an AMP but lack several elements essential to effective adaptive management.”<sup>50</sup>*

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<sup>46</sup> Doremus, H. et al. 2011, Pg. 9

<sup>47</sup> Delta Independent Science Board. 2016. *Adaptive Management in the Sacramento-San Joaquin Delta: How it is Used and How it can be Improved*. Final report. Pg. 33.

<sup>48</sup> Delta Independent Science Board. 2015. *Final Delta ISB comments on the partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS) for BDCP/California WaterFix*. September 30. Pg. 5

<sup>49</sup> Panel to Review California's Draft Bay Delta Conservation Plan; Water Science and Technology Board; Ocean Studies Board; Division on Earth and Life Studies; National Research Council (NRC). 2011. *A Review of the Use of Science and Adaptive Management in California’s Draft Bay Delta Conservation Plan*. National Academies Press. Pg. 6

<sup>50</sup> Dahm, C. et al. 2009. Independent Science Advisors’ Report on Adaptive Management. Pg. ii.

We see no evidence that the Petitioners proposal addresses these challenges, overcomes the pitfalls other adaptive management programs of similar scale and scope, and reflects the standards of reliability and correct scientific procedure as called for by *People v. Kelly*.

#### 4. Petitioners' Proposed Adaptive Management Framework Lacks a Sufficient, Long-term Funding Plan

Petitioners correctly identify stable funding as a necessary condition for success in adaptive management:

*"B. Adaptive Management Resource Needs. The key issue is whether existing efforts, individually and collectively, have enough capacity – both in terms of staff capacity and senior researcher capacity, and have stable funding to ensure a long-term scientific basis to support successful adaptive management decision making that is relevant to project operations now and in the future."*<sup>51</sup>

Critically, however, the section of the Adaptive Management Framework addressing Funding (Section VII. Funding) remains blank, with a note "To be added."<sup>52</sup> This does not inspire confidence that Petitioners fully understand the critical importance of a long-term funding plan of sufficient scale and scope required to support the data collection and monitoring, analysis, experimental development, and implementation efforts required to effectively execute adaptive management in the Bay-Delta context.<sup>53</sup>

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<sup>51</sup> DWR-117, Pg. 3

<sup>52</sup> DWR-117, Pg. 15

<sup>53</sup> See, for example, Medema, W. B.S. McIntosh, and P.J. Jeffrey. 2008. "From Premise to Practice: A Critical Assessment of Integrated Water Resources Management and Adaptive Management Approaches in the Water Sector." *Ecology and Society* 13(2): 29.