MEMORANDUM

TO: SLDMWA Water Resources Committee Members and Alternates

FROM: Scott Petersen, Water Policy Director

DATE: July 6, 2020

RE: Committee to Consider Recommendation to the Board of Directors to Authorize Execution of Agreements with State Water Contractors and Expenditure of up to $109,000 from the Technical Budget to Jointly Fund CAMT Science Studies and Related Expenditures

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BACKGROUND

The Collaborative Science and Adaptive Management Program (CSAMP) is an applied science program specifically designed to inform decisions regarding operations of the State Water Project (SWP) and the Central Valley Project (CVP) and species protection in the Delta. The Program was established in 2013 as an outgrowth of litigation and is intended to provide an alternative where parties can work together to address critical uncertainties and promote common understanding. Since the CSAMP is an outgrowth of litigation over the salmon and Delta smelt biological opinions, the process is focused on the south Delta, the export facilities, and some of the science issues that were at the base of that litigation. Since then, CSAMP's focus has shifted to include looking at actions to recover species and Authority members and staff are working to maintain a balance of operations related and recovery related actions.

CSAMP has a multi-tiered organizational structure comprised of a Policy Group made up of agency directors and top-level executives from public water agencies and non-governmental organizations (NGOs), and the Collaborative Adaptive Management Team (CAMT), which includes designated managers and scientists representing state and federal agencies, water contractors and NGOs to serve as a working group functioning under the direction of the Policy Group. Additionally, there are technical scoping and investigative teams leading discrete actions. The Delta Science Program, the Interagency Ecological Program Lead Scientist, and the lead scientist for the NMFS Southwest Fisheries Science Center are involved as well. Technical teams are formed as needed.

The 2020 CAMT Workplan describes activities and studies to be advanced by CSAMP/CAMT this year, as well as focused facilitation and support to other issues surrounding management questions in the Delta led by other entities.

CAMT Workplan (Exhibit A)

Completed

- Effects of Water Project Operations on salmon behavior and survival
- Review of Delta Smelt Survey Data
- Delta Salmon Rearing Habitat Study

In Progress Activities/Studies

- Delta Smelt Entrainment Studies (Study 1 and 2 complete, Study 3 report in draft)
- Fall Outflow Studies (estimate complete Sep. 2020)
- Delta Smelt Structured Decision Making (currently in Phase 2, looking to fund Phase 3 in fall)
- Coordinated Salmon Science Plan for the Delta (estimate complete Aug. 2020)
- Winter-Run Lifecycle Model Workshops

Discuss and Support

- Delta Smelt Science Plan Implementation
- Resiliency Strategies
- Biological Opinions and Incidental Take Permit Actions
- Reclamation Prize Competition
- Engage Proposition 1 Funded Studies
- Delta Monitoring Reviews
- Seasonal Outflow
- Salmon Entrainment
- Steelhead Monitoring
- Habitat Restoration
- Delta Smelt Propagation

The 2020 CSAMP Budget (Exhibit B) identifies a $1.08 million budget for 2020, with a current funding shortfall of $158,000 for a combination of ongoing technical study and new initiative costs. Traditionally, the Authority and the State Water Contractors have jointly funded expenditures at CSAMP/CAMT including facilitation costs, though facilitation support has shifted to joint funding by Reclamation/DWR this year, with public water agencies prioritizing their expenditures towards science studies to ease contracting challenges that have delayed the performance of some desired work. Additionally, public water agencies have shared costs for technical support for CAMT, including the participation of scientific and technical experts in the development and advancement of desired CAMT studies.

ISSUE FOR DECISION

Whether to recommend to the Board of Directors approval to authorize execution of an agreement(s) with State Water Contractors and expenditure of up to $109,000 from the Technical Budget to jointly fund CSAMP/CAMT technical studies, new initiatives, and the participation of technical experts in CAMT.

RECOMMENDATION

Staff recommends that the Water Resources Committee recommend to the Board to authorize execution of an agreement(s) with the State Water Contractors and expenditure of up to $109,000 from the Technical Budget to jointly fund CAMT/CSAMP technical studies, new initiatives and technical expert participation in CAMT.

ANALYSIS

CSAMP/CAMT plays an important role in the advancement of the scientific body of knowledge around management actions that influence operations of the Central Valley Project and State Water Project. There are three key roles that CSAMP/CAMT plays: 1. Provide a FORUM for communication among the agencies, NGOs and PWAs; 2. Act as a CATALYST to address the most contentious and urgent management relevant science issues; and 3. Timely COMPILE AND DISSEMINATE INFORMATION for decision makers on contentious and urgent science issues.

Specifically, Authority staff is recommending the following expenditures from the Technical Budget:

- Up to $75,000 for Delta Smelt Structured Decision Making Phase 3
- Up to $30,000 to extend the contract with Hanson Environmental for CAMT technical support
- Up to $4,000 to Enhance Decision-Support Predictions for Management Actions to Benefit Delta Smelt

<u>Delta Smelt Structured Decision Making Phase 3 (Exhibit C)</u>

This funding would support management and technical analyses required to conduct Phase 3 for the CSAMP Delta Smelt Structure Decision Making (SDM) project. Technical analyses would include modeling and the application of other analytical tools to evaluate the consequences of proposed management actions for Delta Smelt as well as the evaluation of potential consequences to other resource values including water supply and agriculture. Funding would augment funding provided by SWC, USBR and DWR to support project management and facilitation. USBR, DWR and FWS would also be providing significant in-kind staff commitments to run the Delta Smelt Life cycle model and other analytical tools to evaluate potential actions. All Phase 3 work will be overseen by a CSAMP Structured Decision Making Steering Committee and the findings of the evaluations will be presented to CAMT and the CSAMP Policy Group, and documented in a technical report. Phase 3 is scheduled to occur from September 2020 to September 2021.

<u>CAMT Technical Support (Hanson Environmental)</u>

This funding would support continued CAMT participation by Dr. Charles Hanson through a contract with the State Water Contractors. Dr. Hanson assists in the development of various workplans and products, including Charters, presentations, whitepapers, and other materials to support collaborative science. Related to more general matters, the consultant will provide

delta fisheries investigations and litigation support, assisting with alternative SWRCB flow proposals, and the LTO litigation.

Enhancing Decision-Support Predictions for Management Actions to Benefit Delta Smelt (Exhibit D)

The goal of this proposed work is to develop a path forward to enhance decision-support predictions for management actions to benefit Delta Smelt. Efforts to predict the response of Delta Smelt to changing system conditions and management actions have thus far mostly focused on population status and trends and have largely been based on statistical analysis of long-term monitoring data.

This contract would support management of a series of engagements with experts and CSAMP members to identify and explore potential approaches for the structure and function of an advanced decision-support model that would incorporate system productivity and other factors that could benefit Delta Smelt. SLDMWA funding would be used to augment funding being provided by the Delta Science Program and the State Water contractors to cover Dr. Denise Reed's time to organize and facilitate engagements, including an expert workgroup, and to prepare a draft white paper documenting the outcomes from the effort.

BUDGET IMPLICATIONS

The Board approved $500,000 in this year's Technical Budget for the Science Program. To date, the Board has obligated a total of $75,000 of this funding. Should the Committee recommend to the Board, and the Board act upon this recommendation, that will obligate $109,000 of the remaining $425,000 available for this fiscal year for the Technical Studies/Science Budget, resulting in $316,000 of unobligated funds in this fiscal year's budget.

Exhibit A. 2020 CAMT Workplan Status

	Approach	Priority	Q1	Q2	Q3	Q4	Status
CAMT Technical Studies							
In Progress Activities							
Smelt Entrainment Studies	3	1					Studies 1 and 2 completed. Study 3 report in drafted.
Fall Outflow Study	3	1					In progress – complete Sep 2020
Salmon Rearing Habitat	3	1					Completed – Feb 2020
Delta Smelt SDM	2, 3	1					Phase 1 completed – Aug 2019 Phase 2 in progress – complete Sep 2020 Phase 3 planned for Fall 2020
Coordinated Salmon Science Plan	2, 3	1					In progress – complete Aug 2020
WRLCM Workshops	2	4, 6					Ongoing
Continue to Discuss and Support							
Delta Smelt Science Plan Imp	2	6					Ongoing discussion
Resiliency Strategies	2	2					CSAMP has not engaged directly in any of these actions. DSSP establishes a framework for planning and implementing DS actions. Salmonid subcommittee has compiled information regarding salmon actions and has discussed the need to model.
BiOp and ITP Actions	1, 2	2, 3, 4					Ongoing discussions
USBR Prize Competition	2	6					No activity
Engage Prop 1 Funded Studies	2, 3	4					Salmonid Subcommittee is engaging investigators
Delta Monitoring Reviews	1	5					No coordinated CSAMP engagement to date
Consider Focused Discussions							
Seasonal Outflow	3	2					Discussions occurring outside CSAMP
Salmon Entrainment	3	4					Working on questions and potential studies
Steelhead Monitoring	2	4, 5					Salmonid subcommittee to review USBR proposal
Habitat Restoration	1	2, 3					Need to discuss potential CAMT action(s)
Delta Smelt Propagation	1	2					No CAMT activity

CSAMP Approach

1. Forum
2. Catalyst
3. Compile and Disseminate Information

CSAMP 2019-20 Priorities

1. Complete Current CAMT Investigations and Communicate Findings
2. Support Implementation of Resiliency Strategies for Delta Smelt and Sacramento Salmonids
3. Support Additional Near-term, No Regrets Salmon Actions
4. Improve Coordination of Salmonid Research in the Delta and Support Development of an Integrated Central Valley Science Plan for Salmonids
5. Initiate Conversation Regarding Oversight, Guidance, and Feedback on Monitoring Schemes Targeting the Delta's Natural Resources
6. Advance Decision Support Tools

Exhibit B. CSAMP/CAMT Budget *(Draft)*

	Budget	USBR	DWR	PWA	NOAA	DSP	Secured	Unsecured	Comments
CSAMP Management and Facilitation	**$ 410,000**	**$ 250,000**	**$ 160,000**				**$ -**	**$ 410,000**	USBR contract in progress (Bruce sub to Kerns and West). DWR contract delayed
Sponsored Participants	**$ 150,000**		**$ 90,000**	**$ 30,000**	**$ 30,000**		**$ 30,000**	**$ 120,000**	Sam to be funded by DWR and Met (bridge). Rene funded by NOAA
Technical Studies									
In Progress Activities									
Fall Outflow Study	$ 20,000			$ 20,000			$ 20,000	$ -	Estimated balance on existing contract
Smelt Structured Decision Making	$ 310,000	$ 160,000		$ 150,000			$ 60,000	$ 250,000	Compass funded through Sept by USBR (Phase 2). Estimated Phase 3 budget of $250k to be funded by PWAs ($150k for Compass) and USBR ($100k for FlowWest)
Coordinated Salmon Science Plan	$ 20,000	$ 20,000					$ 20,000	$ -	Contract expires in Aug 2020
Winter run Life Cycle Model Workshops	$ 120,000	$ 120,000					$ 120,000	$ -	Placeholder estimate of SWFSC costs. Funded by USBR. No additional funding needed.
New Initiatives									
DSSP Predictive Model Development	$ 50,000			$ 34,000		$ 16,000	$ 28,000	$ 22,000	
Salmon Entrainment	*TBD*						*$ -*	*$ -*	*Need to scope activity - Salmon Sub*
Resiliency Strategies	*TBD*						*$ -*	*$ -*	*Assist with modeling benefits. Need to scope specific activity.*
Habitat Restoration	*TBD*						*$ -*	*$ -*	*Discuss barriers and priorities*
USBR Prize Competition - Aq Veg	*TBD*						*$ -*	*$ -*	*Assume USBR funding. Need to scope specific activity.*
Steelhead Collaborative									*No capital costs*
Engagement with Prop 1 Funded Studies									*No capital costs*
Delta Monitoring Reviews									*No capital costs*
Technical Studies Total	**$ 520,000**	**$ 300,000**	**$ -**	**$ 204,000**	**$ -**	**$ 16,000**	**$ 248,000**	**$ 272,000**	

Summary of CAMT Activity	**Budget**	**USBR**	**DWR**	**PWA**	**NOAA**	**DSP**	**Secured**	**Unsecured**	
Management and Facilitation	$ 410,000	$ 250,000	$ 160,000	$ -	$ -	$ -	$ -	$ 410,000	
Sponsored Participants	$ 150,000	$ -	$ 90,000	$ 30,000	$ 30,000	$ -	$ 30,000	$ 120,000	
Technical Studies	$ 520,000	$ 300,000	$ -	$ 204,000	$ -	$ 16,000	$ 248,000	$ 272,000	
Total	**$ 1,080,000**	**$ 550,000**	**$ 250,000**	**$ 234,000**	**$ 30,000**	**$ 16,000**	**$ 278,000**	**$ 802,000**	

CSAMP 2019-20 Priorities

1. Complete Current CAMT Investigations and Communicate Findings
2. Support Implementation of Resiliency Strategies for Delta Smelt and Sacramento Salmonids
3. Support Additional Near-term, No Regrets Salmon Actions
4. Improve Coordination of Salmonid Research in the Delta and Support Development of an Integrated Central Valley Science Plan for Salmonids
5. Initiate Conversation Regarding Oversight, Guidance, and Feedback on Monitoring Schemes Targeting the Delta's Natural Resources
6. Advance Decision Support Tools

Exhibit C

Process Guidelines

CSAMP Delta Smelt Structured Decision Making Project

Prepared for: CSAMP

Prepared by: Compass Resource Management Ltd.

Version Date: July 18, 2019

Approved by the CSAMP Policy Group on July 22, 2019

Contents

1 Introduction and Project Goals

There are two main goals for this project:

1. Build consensus across CSAMP membership on a portfolio of recommended management and science actions to advance Delta Smelt goals.

2. Support more coordinated management of Delta Smelt, where possible, to integrate three important spheres of activity: science, decision making, and implementation of management actions.

The project will use a Structured Decision Making (SDM) process. SDM is an organized framework for making defensible choices in situations where there are multiple interests, high stakes, and uncertainty. SDM helps people make decisions that are values-based (based on "what matters"), evidence-based (informed by best available information), and transparent (based on clearly communicated reasons and information). SDM is based on well-recognized methods developed in the decision sciences. As a result, it is rigorous, defensible and well-suited for decisions that will be subject to a high degree of technical and public scrutiny.

The project will build on previous SDM processes in the Delta for Delta Smelt and salmon as well as build linkages with the ongoing SDM process for anadromous fish that focuses on management actions in the Central Valley under the *Central Valley Project Improvement Act* (see Appendix 1 for more information on these initiatives).

If this project is successful in demonstrating better methods for collaboration on the technical and policy issues related to water supply and endangered species, then this project could evolve into a more programmatic approach to advancing goals for Delta Smelt and perhaps other endangered species in the Delta in consideration of other important societal goals (e.g., water supply, ecosystem restoration, etc.).

These guidelines describe the two-year SDM process that will be undertaken through this project. The purpose of the guidelines is three-fold:

1. to establish a set of principles that will enable and encourage the effective participation of all participants in the SDM process (Section 2);
2. to set out the steps and components of the SDM process (Section 3); and,
3. to outline the committee structures and work plan (Sections 4 and 5).

The guidelines may be updated as necessary by the SDM Steering Committee (see Section 4.1 for more information).

2 Process Principles

Success in this process will require collective commitment of all participants to the following set of core process principles.

1. **All participants will recognize multiple interests and the need for considering trade-offs in decisions related to water supply, endangered species and other related policy issues.**
   All participants recognize the necessity to strive for an acceptable balance across the economic, social and/or environmental interests of those they collectively represent. They acknowledge that there will be a need to make trade-offs as part of the policy and regulatory decision-making process.

2. **The process will respect and does not alter existing legal rights, authorities and responsibilities.**
   This process is a voluntary process with no decision-making authority to alter existing legal rights, authorities and responsibilities with respect to water supply, endangered species and other related policy issues. Any information and recommendations generated from this process can be applied at the discretion of the appropriate decision-making authority.

3. **Meaningful participation will be facilitated.**
   The intent is for everyone involved to participate in a meaningful way. In practice this means:

   - allowing everyone to clearly state their interests, and participate in the search for good alternatives;
   - developing and providing the information necessary to nurture understanding across all parties; and,
   - committing to an open and transparent sharing of information, perspectives and values.

4. **The process will strive for consensus.**
   The process will strive for but not require consensus among participants in technical and policy matters.

   Striving for consensus on technical matters means that efforts will be made to ensure that all technical committee members can either endorse or accept choices regarding the execution of technical analyses undertaken as part of this process. Striving for consensus on policy matters means efforts will be made to ensure that all members of CAMT and/or the Policy Group (as appropriate) can endorse or accept recommendations emerging from the process (e.g. recommendations to decision makers that could occur throughout the process).

   Areas of consensus and non-consensus (if necessary) will be clearly documented along with the perspectives of each participating party.

5. **All relevant and acceptable information will be used.**
   The process will use all information that is recognized as relevant and acceptable to consider by process participants. Budget, resource and schedule constraints (along with process design considerations) will serve to dictate the opportunity for new information analysis and gathering activities.

   Recognizing that information can come from many sources with varying degrees of detail, efforts will be made to:

   - be thorough and systematic in the documentation of sources;
   - make information transparent and open to review (with the exception of confidential or proprietary information);
   - be explicit about uncertainty; and,
   - document irreconcilable differences of opinion amongst participants.

6. **The process will support decision making under uncertainty on an ongoing basis and improve information over time to inform future decisions.**
   Some technical uncertainties may take years or even decades to resolve. In the meantime, a variety of regular and ad hoc decisions must be made. Throughout, the process must be able to provide information to decision makers that is both useful and honest about its current state of uncertainty.

3 Process

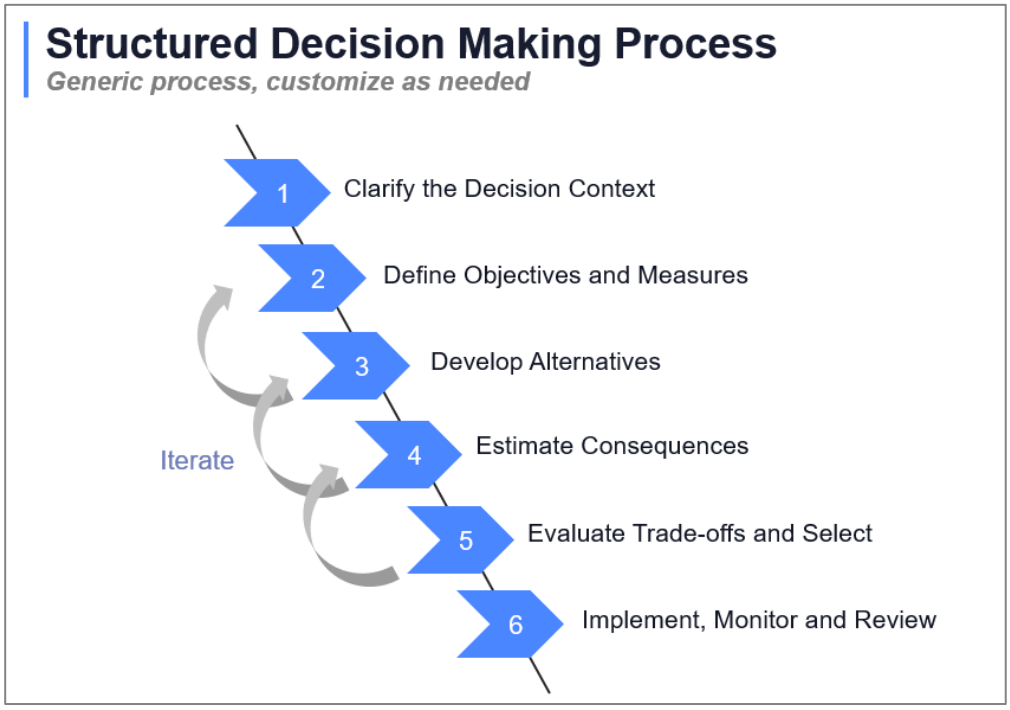
The process will apply a structured decision making approach (Figure 1):

1. **Clarify the Decision Context** – what's the decision, who's the decision maker, what's in and out of scope, and how should the process be structured?
2. **Define Objectives and Measures** – what are the decision objectives and the specific performance measures that will be used to identify and compare alternatives?
3. **Develop Alternatives** – what are the alternative actions or strategies that could be taken to address the objectives?
4. **Estimate Consequences** – how well are the alternatives expected to address the objectives and what are the key uncertainties?
5. **Evaluate Trade-offs and Select** – what are the key trade-offs and which alternatives deliver the best balance across multiple objectives?
6. **Implement, Monitor and learn** – how can the decision be implemented in a way that promotes learning over time and provides opportunities to revise management actions based on what is learned?

Structured Decision Making, or SDM, is an organized approach to identifying and evaluating alternatives and making defensible choices in difficult decision situations. SDM is designed to deliver insight to decision makers about how well their objectives may be satisfied by alternative courses of action, how risky some alternatives are relative to others, and what the core trade-offs or choices are. SDM is designed to engage stakeholders, technical experts and decision makers in a decision process that is both analytical and deliberative, using best practices in decision making.

The goal of an SDM process here will be to identify and explore core trade-offs, inform committee deliberations, and ultimately achieve consensus recommendations on management and science actions for Delta Smelt.

Figure 1: SDM Process



An SDM process is designed to make complex choices more explicit, better informed, more transparent and more efficient. It does this by:

- **structuring the process** – clear steps (a road map) and well-defined roles for stakeholders, decision makers and technical experts help keep the decision process on track;
- **structuring judgments** – by decomposing and simplifying complex judgments, it helps experts, stakeholders and decision makers think clearly about complex problems and make better and more transparent judgments;
- **directly addressing what matters** – even when what matters is hard to quantify using conventional scientific and economic methods;
- **linking analysis and consultation** – co-operation on technical investigations enhances organizations' ability to discuss policy-related issues;
- **providing a sound technical basis for decisions** – SDM is based on rigorous evaluation of the consequences of proposed alternatives and emphasizes the development of a strong decision-relevant information base including economic, environmental and socio-economic analyses;
- **providing an explicit values-basis for decisions** – in contrast to other approaches, SDM does not purport to be objective or value-free. It explicitly incorporates the values of stakeholders and decision makers in a structured and transparent way;
- **exposing trade-offs** – trade-offs are at the core of difficult decisions and, again in contrast to other approaches, SDM addresses them directly;
- **exploring creative solutions** – by emphasizing the search for joint gains and exposing the nature and magnitude of residual trade-offs, the quality of the solutions is improved;
- **clarifying uncertainty and risk tolerances**– SDM helps people deal clearly and consistently with uncertainty, explore risk tolerances, make judgments about acceptable levels of risk and precaution, and find creative ways to manage residual uncertainties.

The process laid out in these guidelines essentially follows steps 1 through 5 of the SDM process (see Figure 1) in order to reach recommendations on how to best advance Delta Smelt goals. The steps are meant to be iterative rather than followed in a strict sequence. The idea is that with each iteration, the quality of information for a decision improves. For example, a preliminary structuring of objectives and measures could be good enough to start the process of identifying preliminary alternatives, which in turn could lead to refinement of the objectives and measures. At some point, the objectives, measures, and alternatives are determined to be good enough to begin the analytical process of estimating consequences, which in turn can lead to adjustments in how measures and alternatives are defined and re-estimation of the consequences.

The following sections describe these 5 steps in greater detail. Step 6 links the decision making process to the implementation of decisions and science activities that will allow for adaptive management. The Delta Smelt Science Plan (described in more detail in Appendix 1) will be a complementary tool for fulfilling the adaptive management functions of Step 6.

3.1 Clarify the Decision Context

The first step is to clearly establish the process and clarify the decision context. This involves:

- Defining the scope and bounds for the process and decision(s) to be made,
- Identifying the constraints within which the process will be undertaken, and
- Clarifying the roles and responsibilities of all participants.

Process and Decision Scope

The overall process scope is aimed toward developing an ongoing, living strategy to advance Delta Smelt goals that all CSAMP members support. This strategy will identify a portfolio of management and science

actions that are believed to be best for achieving Delta Smelt goals within a rolling planning window. The specific format of this strategy that best suits CSAMP and the Delta's institutional context will be established within this process, and the process will be open to different forms that this strategy could take.[1] In recognition of the vulnerable population levels of Delta Smelt, the implementation or advancement of management actions for Delta Smelt (e.g., North Delta Food Web AM Projects, Suisun Marsh Salinity Control Gates Operation, Franks Tract, etc.) is expected to continue while this strategy is developed.

The scope as defined above was developed through an SDM Scoping Project undertaken by Compass in the Fall of 2018.[2] In the Spring of 2019, CAMT and the Policy Group considered the expansion of the scope to include management actions for other species (e.g. management actions to benefit salmon in the Delta). At its May 1, 2019 meeting, the Policy Group decided to keep the scope of this SDM process focused on Delta Smelt management actions.

CSAMP is not a decision-making body, but many CSAMP members are continually making decisions related to Delta Smelt management and science, for example:

- Which actions should be implemented for Delta Smelt?
- Should current actions be adjusted or replaced?
- Which science activities should be prioritized?
- Should CSAMP support, challenge or oppose a specific management action that is being implemented by others?

These types of decisions could be informed by the existence of a strategy that identifies priority management and the science actions that could be implemented via various agencies or programs. For example, some actions could be implemented directly by the California Natural Resources Agency through updates to their Delta Smelt Resiliency Strategy or via through new government and stakeholder partnerships. Actions could also be adopted as mitigative and/or beneficial actions that are required through regulatory processes (such as through updates to the Biological Opinion on the Coordinated Operations of the Central Valley Project and State Water Project). CSAMP's membership includes organizations that could decide to implement Delta Smelt management actions, as well as key stakeholders that would be consulted in the implementation of these actions. Through engaging CSAMP's membership in this SDM process, the probability that effective and implementable solutions become available increases.

Process Resources and Constraints

Human resources and time are the two main constraints for this SDM process and the level of information gathering, analysis, and engagement that will be possible within this process.

The SDM process as described in these Process Guidelines will be completed within two years. A work plan is provided in Section 5 that outlines the sequencing of steps in the two-year SDM process. Generally, the first year will focus on the Delta Smelt-related components of the SDM process including the identification of management actions and/or portfolios of management actions to advance Delta Smelt goals. Some work on developing approaches to other key objectives such as water supply could also take place in the first year. The second year will focus on populating a complete consequence table to evaluate the management actions identified in the previous year, deliberate on the trade-offs and

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[1] For example, one format for the strategy could be a formal 5-year Delta Smelt Strategic Plan that CSAMP works to implement and updates periodically. Another format could be that the totality of information, tools and collaborative groups and processes created through the SDM process continues to inform decisions on an ongoing basis as necessary.

[2] The results of this scoping project are documented in Compass' proposal for this SDM process.

uncertainties in the consequence table, and seek consensus recommendations on management and science actions.

'Seeking consensus' is done through facilitated discussions, aided with formal structured preference assessment methods as required (see Section 3.5 for more information). While consensus is sought where appropriate in an SDM process, it is not mandatory. If consensus is not reached, the process will turn to identifying further work that could help resolve differences of opinion in the future.

The human resources available to support this project is a mix of staff from CSAMP's membership and consultants. CSAMP's membership will provide staff to participate in the committees as outlined in Section 4. The consultants that will support this project are:

- **Compass Resource Management** specializes in running multi-stakeholder collaborative SDM processes. Compass will [if proposal currently before the Bureau is accepted] lead the design and implementation of the SDM process and will facilitate the CSAMP committees established to support the process.

- **FlowWest** specializes in water and ecological engineering, science and technology. They will provide technical support for the SDM process that includes data compilation, data visualization through web-based platforms, and support for developing numerical tools to facilitate analysis related to fisheries performance, mitigation actions and habitat restoration.

- **Kearns & West** specializes in supporting collaborative initiatives, strategic communications and digital collaboration. They will [if proposal currently before the Bureau is accepted] provide secretariat support for the SDM process (support for documenting meetings and communication materials as necessary) and facilitation and coordination support for events that engage beyond CSAMP's membership.

The budgets for these consultants are provided by the Bureau of Reclamation.

At this time, none of the consultants identified to support this project are experts in Delta Smelt biology, ecosystem sciences, and fish and ecosystem process modeling. Unless other consulting resources are added to the project, expertise in these areas will be provided through CSAMP's membership through their participation on technical committees where they will provide direction and review for the data gathering and technical analysis activities undertaken by Compass and FlowWest. As well, the Fish and Wildlife Service (FWS) will contribute a Delta Smelt modeler to support modeling the effects of management actions on Delta Smelt.

The time constraints for the SDM process can be modified through a decision by the SDM Steering Committee. The human resource constraints are subject to modification through the individual decisions of those CSAMP members providing human resources.

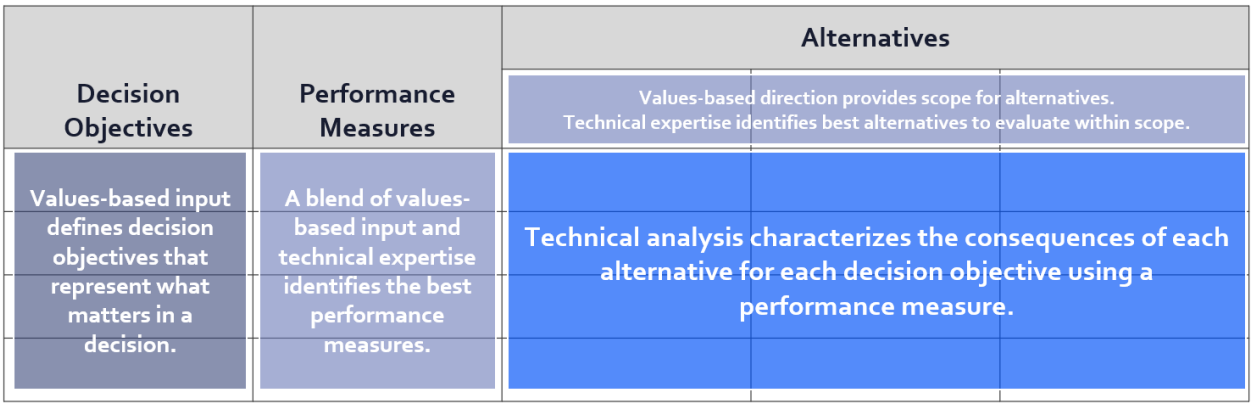
Roles and Responsibilities

Section 4 describes the roles and responsibilities of the different committees that will participate in the SDM process. There are two types of committees that will participate – *decision-making committees* and *technical committees.* Decision-making committees will be making values-based judgements on scoping decisions within the SDM process and on recommendations informed by the content produced via the SDM process. Values-based judgements take into account objective factors – such as the technical analysis that characterizes the performance of alternatives on decision objectives, in order to make subjective judgments – such as the relative importance of the trade-offs at stake in a decision for a particular place and time. Technical committees will be making evidence-based judgements and contributions with respect to the technical analysis done through the SDM, which encompasses the identification of candidate management actions to benefit Delta Smelt and the characterization of the

performance of these management actions against the decision objectives. In the development of the consequence table, the values-based and technical judgements interact as described in Figure 2.

Decision-making committees include CSAMP's Policy Group, CSAMP's Collaborative Adaptive Management Team (CAMT), and the newly formed CSAMP SDM Steering Committee which will include a subset of members of the Policy Group and CAMT and will report to the Policy Group. A Delta Smelt Technical Working Group may be the only technical committee established in the first year of the project. Other technical committees – for example, for water supply or for broader ecosystem considerations may be formed in the second year of the project, though this is subject to discussion.

Figure 2: Illustrative Consequence Table



3.2 Define Decision Objectives and Measures

The core of SDM is a set of well-defined objectives and performance measures (PMs). Together they define "what matters" about the decision, drive the search for creative alternatives, and become the criteria for comparing alternatives.

Decision Objectives

In simple terms, objectives (in the sense of the term as used in the decision sciences, referred to here as 'Decision Objectives') reflect the things that matter, or the felt needs of people affected by a decision. Clear decision objectives only need to state the subject of importance and the direction of preference (e.g., maximize habitat). The process for developing sound objectives begins with simple brainstorming, followed by the use of two key structuring tools:

- Objectives hierarchies that group objectives by category and organize sub-objectives that provide a fuller description, and
- Means-ends diagrams that visually show the relationship between policy / management alternatives (means) at one end and fundamental objectives (ends) at the other. These are useful for developing a conceptual understanding of a system, for helping separate interests (objectives) from positions (means), and for identifying potential evaluation criteria.

A good set of decision objectives is **complete** (all the things that matter are included), **concise** (no double counting), **sensitive** to or affected by the alternatives under consideration, viewed as **relevant** by all participants in the process, and **understandable** to both a technical and non-technical audience.

Based on previous SDM processes that have evaluated management actions for Delta Smelt, a preliminary list of decision objectives for this SDM process is provided in Table 1. Each decision objective will likely need further definition through identifying one or more sub-objectives that further specify what is important to consider. Such a table will require review once candidate management actions for Delta

Smelt have been identified to ensure the list of decision objectives reflects CSAMP's views on the issues important to consider in forming preferences across those candidate management actions. The SDM Steering Committee will make refinements to these decision objectives as necessary throughout the SDM process and will consult with the Policy Group and CAMT if the refinements are deemed to be significant enough in nature.

The decision objective for Delta Smelt will be further refined based on CSAMP's goal statement(s) for Delta Smelt, which will be developed at the beginning of the SDM process. These goal statements will articulate what CSAMP, as a collaborative body, is striving for in relation to Delta Smelt, which will provide a common purpose and direction for all participants in the SDM process.

Table 1: Preliminary Decision Objectives

Decision Objective	Preferred Direction of Change
Delta Smelt	↑
Salmon	↑
Aquatic ecosystem integrity	↑
Water supply reliability	↑
Water quality for in-Delta water supply	↑
Agricultural output	↑
Management cost	↓
Other *– will emerge from understanding the effects of the specific management actions being evaluated.*	

Note that having a decision objective for water supply reliability and agricultural output results in some redundancy or double counting because one reason that water supply reliability is important is because it is a factor in agricultural output. The solution is not as simple as choosing one or the other because water supply reliability represents the importance of water supply for other water uses beyond agricultural use, such as municipal and industrial use. This could be addressed in a number of ways and refinements will be considered by the SDM Steering Committee as part of the SDM process.

Performance Measures

Performance measures are defined for each sub-objective. Collectively, the performance measures represent the information that decision makers will have for choosing among policy alternatives; they should cover all the important aspects of the decision.

They are used to:

- compare alternatives accurately and consistently;
- expose trade-offs including trade-offs among different degrees of uncertainty;
- generate productive discussion about better alternatives;
- prioritize information needs; and,
- communicate the rationale for and improve the transparency of decisions.

It can be a challenge to define good performance measures that are widely agreed upon by stakeholders, experts and decision makers. However, the investment pays off in streamlined decision making, for two principal reasons:

- because data, modeling and expert judgment processes are focused on producing decision-relevant information; and,
- because large numbers of very complex options can be consistently and efficiently evaluated by multiple decision makers.

Like decision objectives, PMs should be complete, concise, sensitive, relevant and understandable. In addition, useful PMs will be:

- **Credible**, meaning that they are widely recognized as a reliable indicator of the effects of an alternative on a decision objective;
- **Unambiguous**, meaning different people will interpret the effects on the decision objectives in the same way
- **Practical**, meaning predictive tools can be developed within the resources available; and,
- **Indicative of effects** on multiple decision objectives, so that one PM can act as a surrogate for others (e.g., umbrella species, etc.).

Three kinds of PMs are commonly used:

- ***Natural*** PMs are those that directly describe outcomes that matter – such as the change in Delta Smelt abundance.
- ***Proxy*** PMs are indirect indicators of something that matters but is difficult to measure directly. For example, one could use the habitat of a fish species as a proxy for the abundance of the fish species if there is confidence that we understand the relationship between habitat and abundance.
- ***Constructed Scales*** are a third kind of performance measure, which are particularly useful for describing important but hard-to-measure effects. They are also useful when decisions have to be made quickly and efficiently, using the expertise of staff or local experts rather than quantitative models or analyses.

With each iteration of the SDM process, performance measures are often refined to improve their characterization of decision objectives across the set of alternatives being evaluated. Selection of performance measures for this SDM process will consider performance measures used in other SDM processes such as the CVPIA SDM Process, the Compass SDM Delta Smelt Demo Project, and the DSP-Bureau Delta SDM Rapid Prototyping Project (see Appendix 1). Technical committees will be responsible for drafting performance measures and they will be approved by the SDM Steering Committee.

3.3 Develop Alternatives

Alternatives are different ways of achieving CSAMP's Delta Smelt goals and that can be expected to result in different trade-offs across the decision objectives. Developing good alternatives is an iterative task. In initial phases, alternatives will be composed of different types of individual management actions that are believed to provide benefits for Delta Smelt. This may evolve, to the extent that it is seen as useful, into packaging multiple management actions together into alternative portfolios for comprehensive evaluation across all decision objectives.

Scope of Alternatives

In-scope management actions for this process include **any flow or non-flow management actions that advance Delta Smelt goals and objectives.** This would include management actions such as Delta Smelt food production, predation control, aquatic weed control, tidal wetland/marsh restoration, outflow augmentation, limits on pumping rates, reduction of contaminants etc. Within this scope, the SDM Steering Committee may recommend further limitations on the types of management actions that are relevant to consider in the SDM process to make most efficient use of time and resources. Within the boundaries set by the SDM Steering Committee, the Delta Smelt TWG would be responsible for identifying a set of potentially effective detailed management actions. This could include both 'existing' management actions for DS (i.e., ones that have been identified in existing strategies, regulations, etc.) and 'new' actions that have not yet formally been proposed.

Process for Identifying Alternatives

The Delta Smelt TWG will identify candidate management actions through the development of influence diagrams and associated supporting material that describe the hypothesized linkages between Delta Smelt decision objectives and sub-objectives and management actions. These investigations can be helpful in articulating and communicating the main mechanisms through which particular actions are hypothesized to function, and they allow for transparent and informed discussion about the nature of uncertainty, and the nature of the evidence base that guides interpretations of cause and effect.

The process of developing these diagrams is similar in approach to an "effects analysis"[3]. The development of these diagrams would serve as an organizing framework to engage the Delta Smelt TWG to do the following:

- Compare quantitative and conceptual modelling approaches and identify key hypotheses that are likely to be relevant to Delta Smelt population dynamics at various life stages (and which possibly might vary spatially and in different hydrological situations).
- Identify hypothesized mechanisms most in need of further investigation, such as those:
    1) that are strongly suspected to be relevant to smelt survival (i.e., could be alone, or in combination, a limiting factor at some point in the lifecycle or under some conditions)
    2) for which meaningful management actions potentially exist to remedy
- For each hypothesis of high interest, examine the available evidence and undertake modeling as needed to develop a common understanding of functional relationships or to identify research activities that could help resolve or reduce key uncertainties.

Outreach to experts outside of the Delta Smelt TWG could be performed as necessary to seek input and review of the influence diagrams and supporting material.

Based on these influence diagrams and the coarse-level evaluation of the management actions to characterize the approximate magnitude of benefits to Delta Smelt, the Delta Smelt TWG will recommend sets of alternatives for evaluation across all decision objectives. These alternative sets should be:

- **Value-focused**, meaning that they are explicitly designed to address the fundamental values or ends of the decision - the "things that matter" or "felt needs", as defined by the objectives and the performance measures;
- **Technically sound**, meaning that in developing alternatives for achieving the objectives, the process has drawn on the best available information about cause and effect relationships and has designed creative and diverse alternatives based on sound analysis;
- **Clearly and consistently defined**, meaning that all alternatives are defined to a sufficient and consistent level of detail using logically consistent assumptions, and that a base case against which all alternatives can be compared has been clearly established;
- **Small in number and high in quality**, meaning that poor (dominated) alternatives have been eliminated and those remaining have been refined to incorporate new ideas and joint gains;
- **Comprehensive and mutually exclusive**, meaning that individual management actions are combined into complete packages, and that the packages are directly comparable;
- **Able to expose fundamental trade-offs**, meaning that they emphasize rather than hide difficult but unavoidable value-based trade-offs and present real choices.

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[3] Murphy D.D., and Weiland, P.S. (2014). "Science and structured decision making: fulfilling the promise of adaptive management for imperiled species". *Journal of Environmental Studies and Sciences.* Published online: 26 February 2014. DOI 10.1007/s 13412-014-0165-0.

Generating good alternatives is a source of important insights both from a technical perspective and a values perspective.

3.4 Estimate Consequences

This step integrates the previous two, where estimated consequences of the alternatives are presented in terms of the decision objectives and performance measures using available knowledge and predictive tools. The assignment of consequences is an analytical task. It does not involve the assessment of value-based judgments about the relative importance of those consequences or the identification of a preferred alternative (which occurs in next step). It is expected that in this process this step will be undertaken by scientists, water engineers, economists and other specialists as required (either within technical committees or via external contracts as required).

There are, in a social and ecological context, inevitably more uncertainties than budgets and timelines can address. An important task will be to identify those uncertainties most critical to decision making; prioritizing and scoping studies accordingly, and ensuring an honest exploration of key risk factors. An important principle for ensuring decision quality and for managing project timelines and budgets is a commitment to **decision-relevant** information.[4]

Data collection and analysis resources should be allocated across the performance measures in proportion to the extent to which they are expected to contribute useful information for the deliberation of trade-offs and reaching consensus on recommendations. Expert judgment must be considered as a means of filling data gaps, making best efforts toward elicitation protocols, bias avoidance, treatment of uncertainty, documentation and peer review.

Proposed studies should be scoped to deliver information that is directly relevant to the decision process; in most cases this will be by improving the estimates of impacts with respect to stated objectives and performance measures, or in some cases, by identifying which criteria are most relevant. Models must be designed as decision aids, not as overly complex models of ecological or economic systems.

Ultimately, objectives, performance measures and alternatives will be linked in a consequence table (Figure 3). A consequence table is a succinct summary matrix illustrating the performance of each alternative on each objective. It exposes key trade-offs among objectives across the alternatives under consideration.

Figure 3: Illustrative consequence table

Decision Objectives	Performance Measures	Alternatives		
		1	2	3
Delta Smelt				
Salmon				
Water supply reliability				
etc.				

[4] Decision-relevant information is distinguished by its direct relevance to the decisions at hand, helping to improve the understanding of how actions perform against objectives, helping to expose key trade-offs and describe key uncertainties. It comes in many forms – empirical data, model predictions, expert judgements, etc.

3.5 Evaluate Trade-offs and Select

Developing a Delta Smelt strategy will necessarily involve evaluating trade-offs and uncertainties and making values-based choices. These trade-offs will be exposed and efforts will be made to gain an understanding of how committee members view them.

The SDM process requires that committee members offer explicit opinions about which alternative(s) is/are preferred based on their own values and their understanding of the values of those affected. This can be done holistically by reviewing the trade-offs in the consequence table and assigning ranks or preferences to the alternatives directly.

Alternatively, structured preference assessment methods for more explicitly weighting the performance measures, making trade-offs, and scoring and ranking the alternatives may be used.[5] These methods can be used to focus deliberations on productive areas and maintain a performance-based dialogue. Structured methods can help participants to explore their own trade-offs, learn about the values and choices of others, and systematically record the range of preference opinions for policy/decision makers to review.

At a minimum, an emphasis on deliberative quality requires that participants involved at this stage should be expected to:

- demonstrate an understanding of the decision scope and context, how it is related to other decisions, why the problem matters, and for whom the consequences are most relevant;
- demonstrate an understanding of the performance measures, the alternatives and the key trade-offs among the alternatives;
- demonstrate an understanding of key uncertainties and their impact on the performance of the alternatives;
- articulate their preferences for the alternatives in terms of the trade-offs that are presented in the consequence table.

While consensus is sought where appropriate in an SDM process, it is not mandatory. Areas of agreement and disagreement among participants and the reasons for disagreement will be fully documented. To the extent that there is a difference between the views of technical specialists and the views of non-technical stakeholders, these differences and the reasons for them will also be highlighted.

[5] The most appropriate methods will be designed once the nature of the trade-off evaluation task is fully defined.

4 CSAMP Committee Structure for SDM Process

A committee structure will be established to support the SDM process that will integrate new committees with CSAMP's current standing committee structure. A priority will be placed on achieving a balanced representation of all interests on all committees involved in the SDM process.

4.1 Decision-making Committees

SDM Steering Committee

A small SDM Steering Committee with core members from the Policy Group and alternates/observers from CAMT will provide direction for the implementation of this project. This group will be a sub-committee of the Policy Group and will have representatives from federal agencies, state agencies, NGOs, and water contractors. Their key role is to provide timely direction to the SDM process on an as needed basis. Areas where direction is expected to be needed include:

- articulation of CSAMP's Delta Smelt goals;
- scope-related decisions that affect tasks and timelines in consideration of available budget and human resources (e.g., deciding which decision objectives and management actions to investigate and at what level of effort to investigate them);
- formation of new technical committees or task groups;
- updates to the Process Guidelines; and,
- direction to Compass on products and decisions that should be brought to the broader CAMT and Policy Group for input and/or direction.

The estimated time commitment for this group is three 1-hour meetings in the first 2 months, then meeting as necessary to provide direction (not more than once every 6 weeks).

The members for the SDM Steering Committee are identified in Table 2. This committee membership can be adjusted as necessary by decision of the Policy Group.

Table 2: SDM Steering Committee membership

Core Member	Organization
Cindy Messer	DWR
Gary Bobker	The Bay Institute
Steve Arakawa	MWD
Dan Castleberry	FWS
Dave Mooney	Bureau
Carl Wilcox	DFW
Note: Other participants that may attend meetings as alternates for the core members or as observers include: John Callaway (Delta Science Program), Frances Brewster (Santa Clara Valley Water and CAMT co-chair), Sam Luoma (CAMT NGO rep and CAMT co-chair), Michael Roberts (Natural Resources Agency), Kaylee Allen (FWS), Erik Loboschefsky (DWR), Lynda Smith (MWD).	

CAMT and Policy Group

A key goal of the SDM process is to build consensus across CSAMP's membership on a portfolio of management and science actions to advance Delta Smelt goals. CAMT and the Policy Group comprise CSAMP's membership and will be the two key committees that Compass engages to build consensus on values-based questions related to the development of a Delta Smelt strategy. The SDM Steering Committee will play a key role in providing advice to Compass on how and when to engage CAMT and the Policy Group to best serve the goal of building consensus. This engagement will be done on a periodic and

as-needed basis. Short project-related updates and discussions will be communicated through the standing meetings of these committees. Special workshops will be scheduled to facilitate more in-depth review and discussion of the information produced through the SDM process.

4.2 Technical Committees

In the first year of the SDM process, at a minimum, a Delta Smelt Technical Working Group (Delta Smelt TWG) will be established. Additional technical committees will be established as needed by decision of the SDM Steering Committee. This emphasis on Delta Smelt reflects both the complexity and importance of this issue in this decision context as scoped. In the second year of the SDM process, other technical committees will be established as necessary to support the evaluation of all decision objectives. These technical committees will report to the SDM Steering Committee and will have representatives from federal agencies, state agencies, NGOs, and water contractors. The membership on technical committees will need to strike a balance between having adequate representation of CSAMP member interests, sufficient expertise for the tasks of the technical committee, and a manageable number of members to facilitate scheduling, more in-depth discussions and quicker input on technical matters.

The process for deciding on membership of a technical committee is as follows:

- Each CAMT representative has the option to identify one technical representative.
- CAMT co-chairs will review the proposed membership for the committee and will approve membership or suggest adjustments as necessary to support the success of the committee in serving the needs of the SDM process – namely achieving the appropriate balance between representation, expertise, and having a manageable number of participants.

There are currently 13 CAMT representatives, meaning that there could be as many as 13 members on technical committees. Ideally, technical committees would be kept to a size of 8 to 10 to make the running of the committee manageable and efficient. Where possible, CAMT members are encouraged to team up to select representatives.

Technical committees will be able to use a range of options to fill any expertise gaps that are identified within the human resource and budget constraints as identified in Section 3.1. Examples of these options include workshops that engage experts more broadly, independent reviews of methods or analyses and/or inviting guest experts to committee meetings as necessary to contribute to a specific conversation.

Delta Smelt Technical Working Group

The members of the Delta Smelt TWG will be listed in Table 3 once selected. The selection of TWG members will follow the review and approval of these Process Guidelines by the Policy Group (expected in July/August 2019).

The key responsibilities for the Delta Smelt TWG are:

- Provide direction to Compass, FlowWest, and FWS Delta Smelt modeler on Delta Smelt-related technical work;
- Review materials that will be discussed at TWG meetings and be prepared to engage in discussion on these materials;
- Periodically contribute to completing work tasks (e.g., technical analyses, technical reviews).

The estimated time commitment for this TWG is 4 hours per month for meetings with variable time spent on pre- and post- meeting work tasks (as feasible/time allowing).

Table 3: Delta Smelt TWG Membership

Delta Smelt TWG Member (TBD)	CAMT Representative(s)	Interest group

5 Work Plan

The schedule in Figure 4 outlines how the SDM process will proceed in line with the time constraints as established in Section 3.1.

The plan is to primarily focus the first year on the Delta Smelt-related components of the SDM process including the identification of management actions and/or portfolios of management actions to advance Delta Smelt goals. This will allow for focused information gathering and deliberation on Delta Smelt-related science and analytical tools that are relevant to the SDM process. The key tasks in this first year that will set up work for the second year are:

- development of CSAMP-supported goal statements for Delta Smelt
- definition of Delta Smelt Decision Objectives and Performance Measures
- identification of candidate management actions, including portfolios of actions, for further refinement and evaluation in Phase 3
- development of influence diagrams connecting Delta Smelt goals, objectives, management actions, and the lines of evidence supporting or refuting effect hypotheses
- testing of analytical tools/models for Delta Smelt and documentation of the strengths and weaknesses of available tools
- input/advice on future modeling needs for Delta Smelt
- definition of the other decision objectives for evaluation based on the candidate management actions identified.

The second year will focus on populating a complete consequence table to evaluate the management actions identified in the previous year, deliberate on the trade-offs and uncertainties in the consequence table, and seek consensus recommendations on management and science actions. Key tasks for the second year are:

- definition of performance measures for all other decision objectives
- identification and/or development of methods to assess the performance of decision objectives on candidate management actions
- completion of a consequence table to summarize the performance of all candidate management actions and/or portfolios of management actions against the decision objectives
- facilitated deliberations among CSAMP members to strive toward consensus on a recommended strategy for Delta Smelt that includes priority management and science actions
- documentation of areas of agreement and disagreement related to Delta Smelt management and science actions and recommendations for further work to resolve these differences

Figure 4: SDM Process Work Plan

	Year 1												Year 2											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Delta Smelt SDM Components*																								
Goals: Development of CSAMP-supported goal statements for Delta Smelt.																								
SDM Steps 2 to 4 for Delta Smelt SDM components: define Delta Smelt objectives and performance measures (PMs); explore consequence estimation methods; identify, evaluate and screen candidate management actions to advance Delta Smelt goals and objectives.																								
Finalize Steps 2 to 4 (for Delta Smelt) and Document: Prepare draft and final reports to document the above work on Delta Smelt-related SDM components.																								
Set-up for comprehensive evaluation: (1) Identify complete set of decision objectives (2) set up work plan and other technical committees.																								
Comprehensive Evaluation of Candidate Management Actions																								
SDM Steps 2 to 4 for all other decision objectives: Define decision objectives, performance measures and identify analytical methods for estimating performance measures for all decision objectives.																								
Step 4 - Estimate Consequences: Undertake necessary analysis to characterize consequences and uncertainties for all alternatives.																								
Step 5 - Trade-offs: Round 1 deliberation of consequence table.																								
Steps 3 and 4 - Alternative refinement and estimate consequences: update consequence table as necessary to support deliberation.																								
Step 5 - Trade-offs: Round 2 deliberation of updated consequence table.																								
Documentation: Prepare draft and final reports on the outcomes of the SDM process: consensus recommendations on management and science actions for Delta Smelt, detailed summary of all work done through the 2-year SDM process.																								

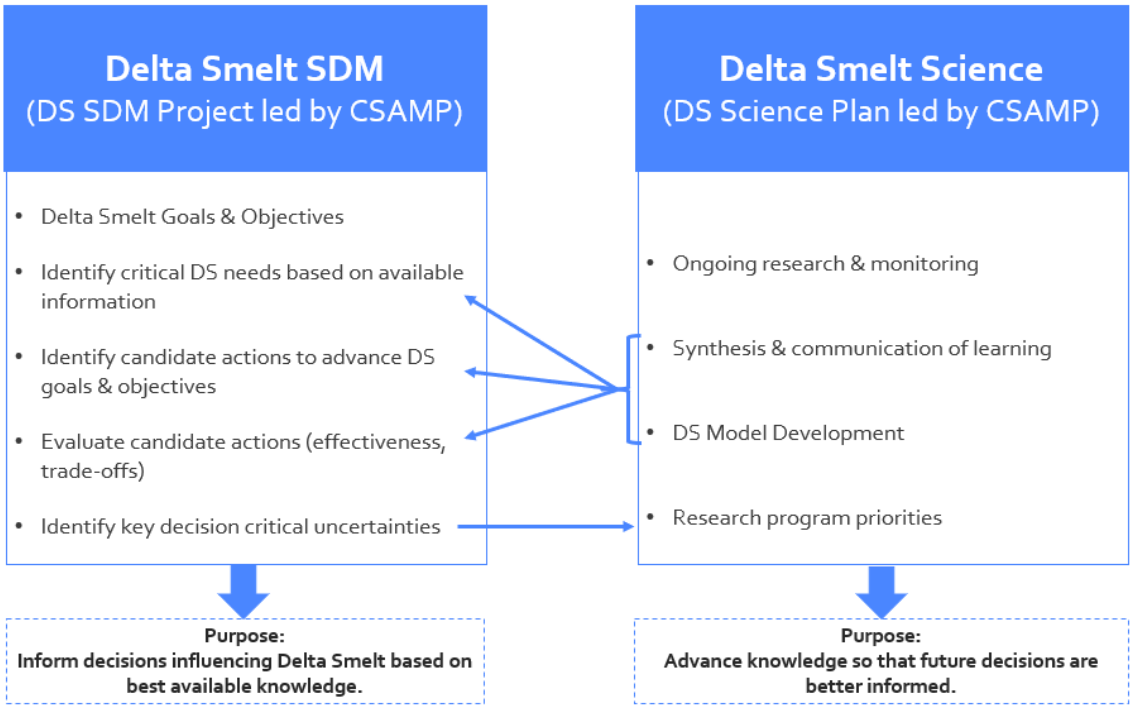
*Note: While the bulk of the effort (e.g 80-90%) in this first year will go towards Delta Smelt SDM Components, Compass may also (time/resource permiting and with direction from the SDM Steering Committee) advance other components of the SDM process (e.g. definition of water supply decision objectives and sub-objectives).

Appendix 1 - Links to other initiatives

Delta Smelt Science Plan

In March 2019, CSAMP finalized the *Science Plan to Assess the Effects of Ambient Environmental Conditions and Flow-related management actions on Delta Smelt,* or "Delta Smelt Science Plan (DSSP)". This plan was prepared by Dr. Denise Reed, who worked with CAMT and the Delta Smelt Scoping Team (DSST) to develop the plan. The implementation of the DSSP and the SDM process are complementary to each other, with linkages as shown in Figure 5. Generally, the implementation of the DSSP is expected to produce new information and tools to support more informed decisions on Delta Smelt management actions. As applicable, the SDM process will apply any new information and tools generated by the DSSP to identify and evaluate Delta Smelt management actions. In turn, the SDM process will identify key decision-critical uncertainties that could inform future research priorities for the DSSP.

Figure 5: Linkages between the Delta Smelt SDM and Delta Smelt Science Plan



CVPIA Adaptive Resource Management (ARM) / SDM Process

Enacted in 1992, the Central Valley Project Improvement Act (CVPIA), Title 34 of Public Law 102-575, added the mitigation, protection, restoration, and enhancement of fish and wildlife as authorized purposes of the Central Valley Project, CA. The federal agencies responsible for implementing the CVPIA (the U.S. Bureau of Reclamation, "Reclamation," and the U.S. Fish and Wildlife Service, "Service") began undertaking anadromous fish restoration actions in partnership with the U.S. National Marine Fisheries Service (NMFS) and the State of California represented by the Department of Fish and Wildlife (DFW) and

the Department of Water Resources (DWR), collectively an interagency "Core Team" and others. Fish restoration actions under the CVPIA benefit Chinook Salmon (fall-run, winter-run, spring-run), steelhead, and sturgeon.

In 2015, a revised approach was adopted by the Core Team for prioritizing and implementing the anadromous fish-related provisions under the CVPIA.[6] The revised approach is referred to as "Adaptive Resource Management" (ARM), which is described as the application of the scientific method to natural resource management involving an iterative application of structured decision making (SDM). The approach includes the development of Decision-Support Models (DSMs) that support the prioritization of management actions that have the highest probability of achieving biological objectives for wild populations of native anadromous fish. A Science Integration Team (SIT) is the main group that implements this approach. SIT reports to the Core Team.

CVPIA Annual Work Plan Process

On an annual basis, the Core Team and SIT uses the ARM/SDM approach and DSMs to recommend priorities that will guide the awarding of funds to fish restoration actions. The priorities are released each year in a Technical Memorandum along with a Call for Project Proposals. Project proposals are submitted to the Core Team by stakeholders and watershed groups and anadromous fish program staff. The Core Team evaluates these proposals and successful proposals are included in the Annual Work Plan (AWP). A subset of the priorities from the *Fiscal Year 2020 Call for Project Proposals*[7] is shown in Figure 6.

Potential Linkages to the CSAMP Delta Smelt SDM Project

While the decision context for the CSAMP Delta Smelt SDM Project is different than the decision context for the allocation of CVPIA funds for anadromous fish, the CSAMP Delta Smelt SDM Project can likely benefit from the SIT's decision support models and their accumulated knowledge related to characterizing the effects of management actions on anadromous fish. Other coordination opportunities might include the co-development of alternatives that would be analyzed by both the CSAMP Delta Smelt SDM project and the CVPIA ARM/SDM process and/or the development of joint consequence tables. Early in the first year of the CSAMP Delta Smelt SDM Project, Compass and FlowWest will work with the Delta Smelt TWG and the SIT to identify where and how the CVPIA ARM/SDM process can be coordinated with the CSAMP Delta Smelt SDM Project.

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[6] See following document for background on the new approach that was implemented in 2015 and is still ongoing (with some adaptations): U.S. Fish and Wildlife Service. 2015. A Central Valley Project Improvement Act implementation plan for fish programs. Prepared for the U.S. Fish and Wildlife Service and Bureau of Reclamation under the direction of the Central Valley Project Improvement Act Core Team. Sacramento, California. 83 pages. https://www.usbr.gov/mp/cvp/docs/A-CENTRAL-VALLEY-PROJECT-IMPROVEMENT-ACT-IMPLEMENTATION-PLAN-FOR-FISH-PROGRAMS-July-22-2015-Public-Draft.pdf

[7] Can be downloaded from: https://www.usbr.gov/mp/cvpia/docs/fy2020-cvpia-call-project-proposals.pdf

Figure 6: Subset of priorities identified for the Fiscal Year 2020 Call for Project Proposals (note: there are also priorities for sturgeon and monitoring that are not shown here)

All Chinook Runs
Increase perennially inundated juvenile habitat, Sacramento River above the American River confluence
Increase seasonally inundated juvenile habitat at 2 yr freq, Sacramento River above American River confluence
Increase spawning habitat, Upper Sacramento River
Keep juveniles out of central Delta
Adaptively manage juvenile habitat restoration to allow the evaluation of the effect of habitat restoration on wild juvenile Chinook salmon survival in the Sacramento River
Increase access to juvenile rearing habitat in Sutter and Yolo Bypasses
Maintain spawning habitat in the CVP streams
Winter-run Chinook Salmon
Improve adult and juvenile passage on Battle Creek
Increase flows through increasing base flows and/or reducing water diversions on Battle Creek
Increase access to non-natal tributaries to open up habitat in Upper and Upper Mid Sacramento Aug-March
Spring-run Chinook Salmon
Increase base flows year round to target benefits to multiple life stages, Deer Creek
Increase base flows year round to target benefits to multiple life stages, Mill Creek
Pulse flows, Upper Sacramento River Oct-Dec (until May in dry- below normal years)
Increase spawning habitat, Stanislaus River
Fall-run Chinook Salmon
Increase in rearing habitat in the Central Delta, Delta
Increase spawning habitat, Feather River
Increase perennially inundated juvenile habitat, Lower San Joaquin
Increase perennially inundated juvenile habitat, Stanislaus River
Pulse flows, Mokelumne River Late April early May
Steelhead
Increase access to spawning habitat, Battle Creek
Adaptively manage tributary flows, habitat, and/or temperatures to increase the frequency of anadromy

Delta SDM Rapid Prototyping Project and SDM Delta Smelt Demo Project

The CSAMP Delta Smelt SDM Project will build on the efforts of two previous SDM projects:

(1) the Delta SDM Rapid Prototyping Project sponsored by the Delta Science Program and the Bureau, and completed in March 2019; and,
(2) the SDM Delta Smelt Demo Project sponsored by CSAMP, completed in January 2018 and undertaken by Compass in close collaboration with a Technical Working Group composed of representatives from a subset of CSAMP member organizations.

The consequence tables produced by both of these projects are provided in the figures below for quick reference. Explanations of the alternatives, decision objectives and analytical methods involved in the development of these consequence tables can be found in the summary reports for these projects.[8] The recommended prioritization of Resiliency Strategy actions that resulted from the SDM Delta Smelt Demo Project is provided in Table 4 for reference.

[8] Contact Compass (srudd@compassrm.com) and the DSP (Ben.Geske@deltacouncil.ca.gov) to get a copy of these reports.

Figure 7: Consequence Table produced in the DSP-Bureau Delta SDM Rapid Prototyping Project

Percent change from baseline

Scenario	Fall Run	Winter Run	Spring Run	Delta Smelt	NOD Deliveries	SOD Deliveries	Crop revenue	Irrigated crop area	Average water use
Add adults	0	0	0	63.48	0	0	0	0	0
Add eggs	0	0	0	48.70	0	0	0	0	0
Bioacustic barrier	7.91	0.66	2.46	0	0	0	0	0	0
No IE 61d Pulse	1.23	-12.77	0.35	-13.29	0.11	4.8	0.16	0.39	0.77
No IE 7day Pulse	1.24	-12.65	0.27	-14.43	0.13	4.82	0.17	0.39	0.77
No notch baseline	0	0	0	0	0	0	0	0	0
OMR 1250	1.17	-0.83	0.09	7.77	-0.39	-9.42	-0.5	-0.98	-1.53
OMR 5000	-0.77	0.17	0.28	2.82	0	3.96	0.16	0.28	0.49
Preferential pumping CVP	-1.02	0	0	0	0	0	0	0	0
Proposed Yolo Notch	86.06	0.8	6.51	3.39	0	0	0	0	0.02
Pulse Q Colusa Drn Food	44.96	1.14	2.08	46.42	0.05	0.11	0	0	0.01
Trap and haul San Joaquin	0.94	0	0	0	0	0	0	0	0
X2 May_Aug at Chipps	-2.52	91.96	-0.84	1.67	-5.12	-6.06	-0.33	-0.56	-0.87
X2 May_Aug at Confl	0.33	-16.34	-0.93	3.88	-1.47	-1.81	-0.1	-0.19	-0.29
X2 May_June at Chipps Jul_Aug at Confl	-1.08	-22.2	0.36	1.07	-3.52	-3.35	-0.2	-0.32	-0.48

Figure 8: Consequence Table produced in the Compass Delta Smelt SDM Demo Project

	Units	1. Aq. Wd. Control	2. N. Delta Food	3. Out-flow Aug.	4. SMSCG	5. Sed. Supp.	7. Roar. River	8. SM Drain Flood	9. Fish Salv.	10. Storm water	11. Rio Vista	12. Hab. Rest.	13. Franks Tract
DS growth	% change	12%	34%	0%	0%	7%	1%	34%	1%	0%	n/a	7%	1%
DS survival	% change	11%	13%	0%	0%	7%	1%	11%	1%	0%	n/a	3%	1%
DS spawning/recruitment	-3 to +3	2.4	0.0	0.6	0.4	0.8	0.8	1.6	0.0	1.5	n/a	2.4	1.2
DS resiliency	-3 to +3	2.8	1.6	1.2	1.4	2.2	0.8	1.4	0.2	0.9	1.3	2.8	1.2
DS learning	-3 to +3	2.2	2.1	1.4	2.1	2.2	1.4	2.0	0.6	1.6	3.0	2.6	1.6
Salmon	-3 to +3	2.3	0.1	1.0	0.0	0.3	0.8	1.0	0.0	1.8	0.3	2.3	1.3
Other native spp	-3 to +3	2.7	2.0	1.7	1.3	1.0	0.7	1.0	0.3	1.7	0.3	3.0	1.3
Other ecological	-3 to +3	3.0	1.3	1.7	1.3	0.7	1.0	1.7	0.3	1.7	0.0	3.0	1.7
Cost/year	$ million	$2.3	$4.2	$46.5	$9.7	$3.8	$0.2	$2.5	$0.9	$7.0	$6.5	$17.9	$17.5
WQ for in-Delta diversions	-3 to +3	0	0	0	0	0	0	0	0	1	0	0	0
Navigation	-3 to +3	3	0	0	0	0	0	0	0	0	0	0	-1
Fishing / waterfowl hunting	-3 to +3	0	0	0	0	0	0	0	0	0	0	0	-2
Non-consumptive recreation	-3 to +3	3	0	0	0	0	0	0	0	0	0	3	3

<<<==Larger adverse impact		Small adverse impact	No effect	Small benefit	Larger benefit===>>>	

Certainty in how ecological effects are characterized:

- More certain
- Less certain

Table 4: Recommended Prioritization of Resiliency Strategy actions through the SDM Delta Smelt Demo Project (see Report for additional details)

Action	Rationale for being in this category
Continue as planned	
North Delta Food Web	• High food and survival benefit, low cost
Wetland Flood and Drain Ops	• High food and survival benefit, low cost
DS Habitat Restoration	• Long term habitat benefits, despite higher costs
Rio Vista Research Station / FTC	• High learning, despite higher costs; • Also potential for population augmentation (not evaluated in this exercise)
Suisun Marsh Salinity Control Gates	• Uncertain benefit but low cost* and learning potential
Roaring River Food Production	• Lower benefit but low cost, synergy with managed wetlands
Investigate Further	
Sediment Supplementation	• Turbidity benefits and costs moderate • Hurdles include permitting and sourcing sediment
Aquatic Weed Control	• Many ecological benefits at moderate cost • Questions about: feasibility at large scale and managing risks
Spring/Summer Outflow Augmentation	• Action cost is relatively high • Initial bioenergetics modeling shows low benefit, however other potentially important pathways remain unexplored, and substantial uncertainties exist regarding the fish distribution response to the action
Stormwater Management	• Specific benefits poorly understood, high cost if land is purchased
Franks Tract	• Modest benefits / high cost and negatives to stakeholders • May be other pathways to explore
Reconsider	
Spawning Habitat Augmentation by adding sand	• Adding sand unlikely to make effective spawning habitat
Adjust Fish Salvage Operations in Summer and Fall	• Likely minimal benefit

Exhibit D. Delta Smelt Decision Support scope

Enhancing Decision-Support Predictions for Management Actions to Benefit Delta Smelt: Developing a Path Forward

Summary

This work furthers one of the focal areas of the Science Plan to Assess the Effects of Ambient Environmental Conditions and Flow-Related Management Actions on Delta Smelt'– the need to predict the potential consequences of taking a management action. While structured processes have been developed enabling assessment of the outcomes of management actions using conceptual models, models which can provide quantitative predictions of effects enable ready comparison with the documented effects of actions.

Efforts to predict the response of Delta Smelt to changing system conditions and management actions have thus far mostly focused on population status and trends and have largely been based on statistical analysis of long-term monitoring data The Delta Smelt Life Cycle Model can be used to quantitatively evaluate the effects of abiotic and biotic factors on Delta Smelt recruitment and life-stage specific survival. However, its focus is on population level effects and it may not be able to detect effects of management actions that do not result in a change in the population. Many of the ongoing or planned actions also shift or alter conditions in the Delta in ways that models based on analysis of historical data may not encompass. Short-term or localized effects, while potentially beneficial, may also be missed.

The 'unexploited potential' for using multi- dimensional models to advance understanding of complex coupled physical–biological dynamic has been recognized in the Delta, and a solid foundation exists for furthering such work in support of management to benefit Delta Smelt. The Rose et al.[1] spatially explicit, individual-based population model of Delta Smelt follows the reproduction, growth, mortality, and movement of individuals over their entire life cycle using daily values of water temperature, salinity, and densities of six zooplankton prey types (estimated from field data). Since its development, there has been increasing application of detailed hydrodynamic models to predict changes in abiotic conditions including velocity, water temperature and suspended sediment. In addition, particle tracking models have recently been used to examine the effects of potential behaviors of Delta Smelt in response to abiotic conditions on their distribution and have been used in combination with field data to simulate proportional movement of zooplankton from productive to less productive regions of the estuary. Measurement of Delta Smelt vital rates (growth and movement), diet and condition on many individual Delta Smelt (>1000) collected since 2011 also provide a heretofore unused data set for validation of Delta Smelt modeling.

The goal of the proposed work is to develop a path forward to enhance decision-support predictions for management actions to benefit Delta Smelt. Further work could involve development of a scope of work for enhancement work including milestones and benchmarks, and resource needs, both expertise and financial.

Step 1. Expert Workgroup.

A small expert workgroup will be convened to discuss 'the art of the possible' and identify potential approaches for the structure and function of the decision-support model. The workgroup would be convened by Denise Reed, and the following experts have agreed to participate: Shawn Acuña, Larry Brown, Ed Gross, Wim Kimmerer, Lisa Lucas and Kenny Rose. Reed will work through CAMT to identify 2-3 agency scientists to contribute. **Product:** A Draft 'White Paper' describing potential options for enhanced decision support.

Step 2. Refining Options.

The draft white paper will be discussed with both modelers and managers. CAMT, or a subgroup of CAMT, will be the vehicle for receiving management feedback (to be organized through DiGennaro). Consideration of cost and operational issues in the draft White Paper will also allow those interested in moving to work forward to see what would be needed in terms of resources. The IMSC, or a subgroup of IMSC, will be the vehicle for receiving feedback from other modelers (to be organized with Delta Science Program staff). **Product**: Revised White Paper and identification of preferred approach for further development.

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[1] Rose, K. A., Kimmerer, W. J., Edwards, K. P., & Bennett, W. A. (2013). Individual-Based Modeling of Delta Smelt Population Dynamics in the Upper San Francisco Estuary: II. Alternative Baselines and Good versus Bad Years. *Transactions of the American Fisheries Society*, *142*(5), 1260–1272. https://doi.org/10.1080/00028487.2013.799519