Delta Plan Interagency Implementation Committee

One Delta, One Science through implementation of the High-Impact Science Actions

The concept of *One Delta, One Science* envisions an open Delta science community to build a common state of knowledge to inform decisions in the Delta. ***Through joint implementation of the High-Impact Science Actions, DPIIC is improving alignment of multiple agency initiatives with Delta-wide management benefits, while simultaneously creating institutional momentum supporting the culture shift essential for One Delta, One Science.***

DPIIC support of *One Delta, One Science* in April 2014 acknowledges the critical role of science for effective decision-making related to the sustainability of the Sacramento-San Joaquin Delta. The Committee recognized the value and urgency of working together to reduce uncertainties while managing the corresponding risks and making the necessary investments. As a result, DPIIC members requested staff to secure a cross-agency understanding of the priority science needs in the Delta as laid out in the Interim Science Action Agenda, presented to DPIIC in November 2014. The Delta Agency Science Workgroup (Workgroup) was then formed to identify a short list of high-impact, multi-benefit science actions for implementation within the next two years. Upon DPIIC endorsement in May 2015, the Workgroup was directed to initiate implementation on the actions and report back on progress.

> *"We should be asking: What are the highest and most immediate opportunities to utilize the planning and regulatory authorities that are sitting around this table to blend funding commitments and science priority commitments together immediately?"*
> *~ Will Stelle, NOAA (4/9/14)*

The collaborative nature of creating and implementing the endorsed list of science actions is a significant step in altering the way Delta science is managed.
By fostering cross-agency information sharing of Delta science needs through this process, priority themes are elevated and coordination around funding can be improved. Implementation of the high-impact science actions will provide better science to inform key decisions, such as guiding water operations, selecting sites and designs for ecosystem restoration activities, and setting regulations to manage multiple stressors. For example, the Delta Stewardship Council's Delta Science Program facilitated the development of a monitoring framework for the Emergency Drought Barrier and spearheaded the joint funding of four additional study efforts to enhance the regulatory compliance monitoring associated with the barrier at False River. The results of this work, which falls under the High-Impact Science Actions Table 1: Topics 1A and 3H, will feed directly into near-term decisions on drought management and long-term adaptive management considerations in restoration and water management actions at the landscape or watershed scale.

> *"Making [interagency collaboration] a way of doing business in the future is going to be essential for success on so many fronts."*
> *~ Mark Cowin, DWR (5/11/15)*

DPIIC support for joint implementation of the science actions remains essential for success. With implementation still in the early stages, Workgroup discussions will continue to provide guideposts for additional research needs and ways to better support management decisions, laying the foundation for realizing *One Delta, One Science*.

DPIIC's support for *One Delta, One Science*, the establishment of the Delta Agency Science Workgroup, and the identification and implementation of the High-Impact Science Actions meet DPIIC objectives and advance a range of Delta initiatives.

SUPPORTING DPIIC OBJECTIVES – The following objectives identified by the Delta Stewardship Council to guide the Committee's work are being met:

- *Monitor and assess progress of priority actions and agency activities to implement the Delta Plan.*
- *Synthesize interagency activities to improve efficiency and effectiveness, assembling work groups as needed to address specific impediments to progress.*
- *Identify opportunities for integration and leveraging of funding among state and federal agencies.*
- *Build effective policy-science interactions between resource decision-makers and scientists.*
- *Support existing collaborative efforts and interagency agreements that contribute to multi-plan implementation, e.g. Delta Plan, Delta Science Plan, and California Water Action Plan.*
- *Coordinate regulatory actions on significant projects to implement the Delta Plan, as appropriate.*
- *Showcase successes where coordination efforts are effective.*
- *Prioritize transparency and receipt of public stakeholder input.*

SUPPORTING KEY INITIATIVES: The High-Impact Science Action research topics support key policy initiatives and are intended to be designed in a manner that enhances water and natural resources policy and management decisions.

Science Action Topics	**California Water Action Plan** Action	**Delta Plan** Chapter	**Delta Science Plan** Section
Topic 1: Assessing drought-related effects on the Delta	5	3 & 4	4.2 & 4.5
Topic 2: Effectiveness and implications of habitat restoration actions	3 & 4	4	3.2 & 4.2
Topic 3: Science support for management of estuarine and migratory species	3 & 4	4	4.4
Topic 4: Science supporting flood risk reduction and the economies of Delta communities	3 & 8	5 & 7	--

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SUPPORTING OTHER COLLABORATIVE EFFORTS: The High-Impact Science Actions support and enhance existing collaborative efforts such as the Collaborative Adaptive Management Team (CAMT), IEP's Management, Analysis, and Synthesis Team (MAST), the Salmon/Steelhead/Sturgeon Assessment of Indicators by Life Stages (SAIL), the Delta Regional Monitoring Program (Delta RMP), and the California Water Quality Monitoring Council workgroups, to name a few.

APPROACH TO IMPLEMENTATION: Upon endorsement in May 2015, the Workgroup promptly moved ahead with organizing and initiating implementation of the High-Impact Science Actions. Over the past six months, the Workgroup has been used for guidance, to ensure continued multi-agency participation, to refine topics where needed for effectiveness, and in some cases, contributed to the development of work plans. The Workgroup members, their staff, and other interested parties have been essential in maintaining momentum around these priority actions. Implementation efforts on most actions have been progressing, and the Delta Stewardship Council and Delta Science Program are playing an integral coordination role.

Workgroup Implementation Guidance Meetings

June 24 – The Workgroup reviewed all of the science actions and identified next steps and interested agencies to participate in implementation. A key component was to determine where there are/may exist other efforts on similar or related topics in order to avoid duplication, overlap or redundancy. A report on resulting next steps was then sent to Workgroup members for feedback and confirmation.

August 26 - Workgroup members and interested stakeholders were invited to refine Table 2 research topics for the Sea Grant Delta Science Fellows Request for Applications and learn about how to be Community Mentors.

October 5 –The Workgroup met to evaluate implementation progress and to further develop certain actions requiring additional Workgroup input. Where necessary, some science actions required reassessment and adaptation in order to ensure alignment with agency science needs.

The following implementation report includes:

- ***Status Summary of High-Impact Science Actions*** - A brief synopsis of progress to date on all actions.

- ***Individual Action Reports*** - Each action, identified by corresponding table number, is described with a problem statement, an approach to address the problem, progress to date, estimated timeline, associated agencies and organizations, and related projects underway/soon-to-be funded. Where needed, additional information is provided.

WORKGROUP NEXT STEPS: With sustained DPIIC support, the Workgroup will continue to implement the science actions, engage additional stakeholders, and work to collectively address any issues impacting progress, i.e., funding challenges.

ADVANCING *ONE DELTA, ONE SCIENCE*: In the coming year, the Delta Science Program will initiate development of the full Science Action Agenda and will look to the Workgroup for input and guidance. The Workgroup dynamics of identifying Delta-wide priorities that move beyond agency-specific needs will be valuable in establishing criteria for prioritization, e.g., relevance to management needs and feasibility of funding.

The Science Action Agenda, based on the most current knowledge distilled through the 2016 State of Bay Delta Science update, is a key component of the *One Delta, One Science* concept that advances system-wide understanding for current policy and management decisions and builds the innovative science infrastructure and capacity needed to provide decision support in the future.

Status Summary of High-Impact Science Actions

	Topic	Status			
		Awaiting (additional) Workgroup input	Initiated/ Initial discussions in place	Being scoped by interested entities	Implementation underway
Table 1: High-Impact Science Actions That May Be Addressed By Rapid-Response Implementation					
1A	***Drought effects synthesis*** *Conduct a technical review of current reports concerning the drought to identify what is known about effects of the drought as well as to determine gaps in knowledge and topics not covered in past synthesis efforts. Using results from the review conduct a "lessons learned" workshop and create a set of metrics to monitor key indicators of drought impacts.*		✓	✓	O
1B	***Real-time decision support tool evaluation*** *Evaluate tools supporting real-time operations, monitoring, reporting, data management, and accessibility of data.*		✓	✓	O
2C	***Restoration design synthesis*** *Synthesize established knowledge about designing effective habitat restoration projects in the Delta.*		✓	✓	O
2D	***Pre-restoration monitoring*** *Enhance current and promote additional monitoring efforts in the Delta and Suisun Marsh to gather pre-restoration data.*		✓	✓	
2E	***Northeast Delta landscape vision*** *Develop the landscape vision and decision support framework for the Northeast Delta pilot effort.*		✓	✓	
3F	***Shasta Reservoir temperature forecasting*** *Conduct follow-up work to improve collaborative temperature modeling of cold water forecasting for Shasta Reservoir releases into the Sacramento River.*		✓	✓	
3G	***Salmon life-cycle model review*** *Peer-review of the Southwest Fisheries Science Center's winter-run Chinook salmon life-cycle model.*		✓	✓	●
3H	***Resources and mechanisms to fund collaborative research*** *Identify the process, mechanisms and resources to fund research identified by various efforts such as Salmon/Steelhead/Sturgeon Assessment of Indicators by Life Stages (SAIL), the Interagency Ecological Program's Management, Analysis, and Synthesis Team (MAST), the Collaborative Adaptive Management Team (CAMT), and Delta Regional Monitoring Program (Delta RMP).*		✓		●
4I	***Economic analysis of flood control methods*** *Consolidate the current state of knowledge regarding economic analysis of the potential to reduce flood damage through strategic levee setbacks and expanding wetland and floodplain acreage.*	✓	✓		
Table 2: Longer Term Implementation Mechanisms - Proposal Solicitation/Delta Science Fellows					
Sea Grant Delta Science Fellows request for applications			✓	N/A	O
Research topics for Proposition 1 proposal solicitations			✓		O
Multi-agency proposal solicitation		✓	✓		

O – early stages of implementation ● – well underway

Delta Agency Science Workgroup
2015-2016 High-Impact Science Actions Report

Topic 1: Assessing drought-related effects on the Delta

Table 1 **Science Action** **1A**	*Conduct a technical review of current reports concerning the drought to identify what is known about effects of the drought as well as determine gaps in knowledge and topics not covered in past synthesis efforts. Using results from the review conduct a "lessons learned" workshop and create a set of metrics to monitor key indicators of drought impacts.*
Problem Statement	Understanding the implications of the full range of drought effects on ecosystem functions and responses is important to support development of future management actions and to identify additional research needs to fill remaining knowledge gaps. Although several topic- and species-specific drought synthesis reports exist related to the Delta, none provide a broad assessment of drought impacts and responses.
Approach to Address the Problem	Planning for synthesis of "lessons learned" from the drought which may include a workshop or workshops addressing the response of science and management to both the current and past droughts with a focus on ecosystem response to the Delta. The format of this synthesis effort is still under development (please see "Progress to Date") but one possibility is a workshop(s) to serve as a venue that brings managers and scientists together to discuss remaining management gaps as well as the needed changes and available science to support these gaps.
Outcome	A document that captures information highlighted in the aforementioned synthesis in a format useful for both scientists and managers. The document would provide both entities with information needed to react quickly to system changes and to better respond to future droughts. Scientists may find the document useful for understanding system resiliency, how to adjust monitoring methods including when, what, and how long to monitor, and identifying the scientific information most useful in support of management actions.
Progress to Date	On October 5, the Delta Agency Science Workgroup discussed potential next steps for implementation and agreed that Delta Science Program staff may solicit interested members to participate in planning a workshop, or series of workshops (or other synthesis approach). During these meetings the planning group will provide input regarding a focused theme, workshop charge, format, and number of workshops.
Estimated Timeline	Convene planning team November 2015 – January 2016
Related Projects Underway/Soon to be Funded	The Delta Science Program has facilitated the development of a monitoring framework for the Emergency Drought Barrier and spearheaded the joint funding of four additional study efforts to enhance the regulatory compliance monitoring associated with the installation and removal of the barrier at False River. As new information from these studies becomes available, findings could be compiled and synthesized in a form that will complement this overall effort.

Science Action 1A: List of Documents for Drought Synthesis

Title (Year)	Document type	Agency/Organization*
A 2000 year record of Sacramento-San Joaquin river inflow to San Francisco Bay estuary, California	Journal article	UC Berkeley, Stanford, Lawrence Berkeley
Assessment of 2013-2014 Drought Effects on the Sacramento-San Joaquin Delta Aquatic Ecosystem (2015)	Synthesis report	IEP MAST, CDFW Drought Operations Team
Brood Year 2013 Winter-run Chinook Salmon Drought Operations and Monitoring Assessment	Monitoring Report	USBR, DWR, CDFW, USFWS, NOAA
California's Most Significant Droughts: Comparing Historical and Recent Conditions (2015)	Synthesis Report	DWR
California's Water (2015)	Policy Briefs	PPIC
Central Valley Project and State Water Project Drought Contingency Plan January 15, 2015-September 30, 2015 (2015)	Report	USBR, DWR, USFWS, NMFS
Documents related to TUCP and 2008 FWS/2009 NMFS BiOps	Collection of documents	USBR
Economic Analysis of the 2015 Drought for California Agriculture	Report	UC Davis, Center for Watershed Sciences
Cyanobacteria Science Workgroup white paper	White Paper	
What if California's Drought Continues?	Web report	PPIC
California's Drought of 2007-2009: An Overview (2010)	White paper	DWR
USGS Drought Impacts webpage	Website	USGS
Dry Years: Political and other effects on California Delta	*San Francisco Estuary and Watershed Science* Journal article	Gerald Meral

*Please refer to Attachment 1 for list of abbreviations.

Topic 1 - Assessing drought-related effects on the Delta

Table 1 **Science Action** **1B**	*Evaluate tools supporting real-time operations, monitoring, reporting, data management, and accessibility of data.*
Problem Statement	Rapid delivery of information regarding the current state of the system is needed to allow management to react quickly to escalating situations such as the current drought. Although some tools exist that support "real-time" data access and analysis (e.g., CEDEC, CEDEN), improvements can be made to display and communicate timely information to guide decision-making. In addition, there is a need for more cooperative efforts in managing large-scale operations involving real-time data collection and assessment to streamline data processing and sharing.
Approach to Address the Problem	1. Develop a governance framework and implementation plan to execute key recommendations in the recently published report *Enhancing the Vision for Managing California's Environmental Information*. This will involve conducting an inventory of the organizations pursuing data sharing initiatives and associated tools these groups are using, and developing a synthesis report that provides an overview of current tools that support monitoring, reporting, and data accessibility. This report will identify remaining gaps and implementation challenges that can lead to specific recommendations for best approaches to improve data access, methods to streamline data synthesis, and integrate complementary efforts. These recommendations will then be incorporated into the forthcoming Science Action Agenda. 2. A Delta Collaborative Analysis and Synthesis (DCAS - *see* Delta Science Plan, p. 39) effort to assess new monitoring approaches and update current ones based on regulatory needs and landscape-scale effectiveness. This will also include a detailed agenda and list of experts to be included in the DCAS planning and implementation, including development of evaluation requirements. 3. Joint pilot studies to investigate appropriate locations to install monitoring equipment to test their efficacy and applying available visualization tools to display this data in an accessible format for managers and decision-makers. Note: As Science Action 1B aims to enhance real-time data accessibility, processing, sharing, and visualization, it also supports Science Action 2E (*Develop the landscape vision and decision support framework for the Northeast Delta pilot effort*), which plans to utilize real-time data analysis and visualization tools to complete sub-regional planning and to ensure best available science and adaptive management are components of the landscape vision.
Outcomes	1. Implementation of key recommendations in the recently published *Enhancing the Vision for Managing California's Environmental Information*. 2. A unified monitoring approach to leverage current efforts while also bringing together agencies involved in monitoring various aspects of the Delta including water, habitat, and biota. 3. Joint evaluation of operations that will reduce redundancies and help streamline real-time data processing and sharing, and also enhance communication mechanisms to inform managers and decision-makers in a short period of time.

Progress to Date	The Delta Science Program has contacted various groups that are currently synthesizing and evaluating different data management/accessibility tools including the California Water Quality Monitoring Council (CWQMC), its pertinent workgroup members, and participants involved in California EcoRestore round tables. The next step is to assemble a group to begin developing an implementation plan regarding data management, accessibility, and reporting, based on the vision and roadmap outlined in the Data Summit White paper, *Enhancing the Vision for Managing California's Environmental Information*. This concept of an implementation plan has been presented to the CWQMC and has received supportive comments. The Delta Science Program has allocated funds to assemble a task force to work on a governance framework, to inventory and assess other organizations pursuing data sharing initiatives, and to develop an implementation plan that integrates various data sharing efforts, noting differences in subject matter, audience, and purpose. The Delta Science Program is also poised to lead a scoping effort, in close collaboration with USGS, USEPA, and others, to allocate resources toward a DCAS effort, beginning in 2016, on assessing new monitoring approaches responsive to today's and tomorrow's anticipated management needs. Lastly, the Delta Science Program has developed a prototype information-sharing and decision-support website to facilitate rapid decisions on finalizing scopes of work and funding contributions to the Emergency Drought Barrier enhanced monitoring effort.	
Estimated Timeline	November 2015 - November 2016	
Associated Agencies and Organizations	California Water Quality Monitoring Council Department of Water Resources CA Department of Technology CA Digital Library San Francisco State University	Strategic Growth Council USGS USEPA NASA Ames UC Davis U.S. Fish and Wildlife Service

Topic 2 – Effectiveness and Implications of habitat restoration and actions

Table 1 **Science Action** **2C**	*Synthesize established knowledge about designing effective habitat restoration projects in the Delta.*
Problem Statement	Given the considerable time needed to plan and execute successful restoration projects, there is a critical need to plan and implement projects in an integrated, consistent, and systematic way. This is especially the case now with the initiation of California EcoRestore (EcoRestore), which calls to coordinate and advance at least 30,000 acres of critical habitat restoration in the Sacramento-San Joaquin Delta over the next four years.
Approach to Address the Problem	1. Developing comprehensive analyses that support restoration by supporting synthesis workshops that address specific aspects of Delta restoration (e.g., primary production, methylmercury) and a workshop focused on an overall evaluation of Delta restoration projects. These synthesis efforts could help to provide a list of specific knowledge gaps and emerging design principles for Delta habitat restoration. This information can then be used to adaptively guide the design and management of habitat restoration efforts. 2. Formation of an Interagency Adaptive Management Integration Team (IAMIT) to support information sharing and coordination of adaptive management and restoration-related activities. The IAMIT will include representatives of EcoRestore, the Fish Restoration Program, IEP Tidal Wetland Monitoring Project Work Team, CWQMC wetlands monitoring workgroup, Delta Conservancy, and agencies planning and implementing restoration projects. The IAMIT may serve as the planning committee for the Delta Restoration Synthesis Workshop and for the annual Adaptive Management Forum as called for in the Delta Science Plan and Delta Independent Science Board's draft Adaptive Management Review Report. As mentioned in 2D (*Enhance current and promote additional monitoring efforts in the Delta and Suisun Marsh to gather pre-restoration data*), the IAMIT is also anticipated to play a key role in working with the Interagency Ecological Program (IEP) Tidal Wetland Monitoring Project Work Team and the CA WQMC Wetlands Monitoring Workgroup to develop a regional habitat restoration monitoring, evaluation and reporting program for all restoration projects. In addition, the synthesis efforts outlined in this action will contribute to developing a Delta-wide vision of regional ecological potential and thereby supports 2E (*Develop the landscape vision and decision-support framework for the Northeast Delta pilot effort*).
Outcome	Synthesis documents of established knowledge about designing effective habitat restoration projects in the Delta. The documents will highlight the lessons learned from past projects and provide recommendations for habitat restoration design guidelines and evaluation methods with an adaptive management focus.
Progress to Date	1. Synthesis efforts o *Primary Productivity and Food-Web synthesis effort (late October 2015).* This synthesis effort, spearheaded by the San Francisco Estuary Institute-Aquatic Science Center (SFEI-ASC) and funded jointly by the Delta Science Program and USGS, will provide a multidisciplinary synthesis of our

	understanding of historical and modern primary production in the Sacramento-San Joaquin Delta based on existing information and expertise from a diverse group of scientists. o *Revisiting the 2003 Mercury Strategy (January and May 2016)*. The USGS, Delta Conservancy, and Delta Science Program are collaboratively planning a series of workshops to update the state of knowledge since the release of the 2003 Mercury Strategy. The synthesis, produced by the workshop's expert panel, will provide insights for restoration planning and design. The effort will be jointly funded by CDFW and the Delta Science Program. o *Delta Restoration Workshop*. Delta Science Program staff members have begun compiling lessons learned from constructed restoration projects, including individual levee-related habitat enhancement/mitigation projects. These lessons learned documents could feed into a comprehensive synthesis on effective habitat restoration project design resulting from the synthesis workshop. 2. Interagency Adaptive Management Integration Team. Currently, the Delta Science Program is reaching out to partners to participate on the IAMIT.	
Estimated Timeline	The Delta Science Program intends to initiate the IAMIT by the end of 2015. The primary productivity workshop is scheduled for late October 2015 with a report targeted for completion in March 2016. The Mercury Strategy update workshops are scheduled for January and May 2016 with a report date not yet determined.	
Associated Agencies and Organizations	CA WQMC CDFW Delta Conservancy Delta Science Program DWR EcoRestore Interagency Ecological Program/IEP Tidal Wetland Monitoring Project Work Team	Resource Management Associates State and Federal Contractors Water Agency SFEI-ASC University of Georgia University of South Carolina University of Washington USGS Virginia Institute of Marine Science
Outstanding Issues	The IAMIT will require participation from agency staff, and the availability of participants may be limited. In addition, the IAMIT will have many activities from which to consider and prioritize including planning the annual Adaptive Management Forum, coordinating development of a comprehensive habitat restoration monitoring, evaluation and reporting framework, and planning a Delta Restoration Workshop.	

Topic 2 – Effectiveness and Implications of habitat restoration and actions

Table 1 **Science Action** **2D**	*Enhance current and promote additional monitoring efforts in the Delta and Suisun Marsh to gather pre-restoration data.*	
Problem Statement	In order to evaluate the success of an ongoing or completed restoration project, pre-restoration data is needed for comparison purposes. Such pre-project monitoring efforts in support of an adequate adaptive management plan are rare or nonexistent.	
Approach to Address the Problem	Utilize the Interagency Adaptive Management Integration Team (IAMIT) to expand and complement the monitoring framework being developed by the Interagency Ecological Program (IEP) Tidal Wetland Monitoring Project Work Team (TWMPWT) to cover other habitat types and focal issues besides fish (*see* Progress to Date for further discussion), and to cover evaluation and reporting of monitoring data information. This coordinated framework will be used to identify the data and information needed before and after restoration construction to evaluate and report restoration progress.	
Outcome	A Delta habitat monitoring, evaluation, and reporting framework outlining baseline monitoring needed to obtain a statistically valid assessment of pre-restoration baseline for all habitat types and post-construction performance over time of individual restoration projects in a landscape context.	
Progress to Date	The IEP TWMPWT has contributed significantly to this effort; however, this work group is focused primarily on the objectives and habitat types under the Fish Restoration Program (FRP; i.e., tidal wetlands). As part of the EcoRestore effort, discussions are currently taking place regarding the expansion of the effort into a larger umbrella group to cover other restoration objectives and habitats such as riparian areas and floodplain habitats and taking advantage of the compensatory mitigation monitoring guidance of the U.S. Army Corps' South Pacific Division and the U.S. EPA's coordinated environmental monitoring and reporting framework. As mentioned in 2C, the Delta Science Program will coordinate the formation of an Interagency Adaptive Management Integration Team (IAMIT) to help implement the coordinated framework, while also supporting information sharing, coordination of activities, and planning for various adaptive management and restoration-related efforts.	
Estimated Timeline	The IEP TWMPWT is scheduled to have a draft framework that identifies hypotheses and information gaps to inform restoration monitoring programs incorporating recommendations from a second round of pilot sampling gear testing that will take place in the Winter of 2016. The Delta Science Program will initiate the IAMIT by the end of 2015.	
Associated Agencies and Organizations	CA Water Quality Monitoring Council Wetland Monitoring Workgroup CDFW Delta Conservancy Delta Science Program	DWR EcoRestore State and Federal Contractors Water Agency
Outstanding Issues	See issues from 2C above.	

Topic 2 – Effectiveness and Implications of habitat restoration and actions

Table 1 **Science Action** **2E**	*Develop the landscape vision and decision-support framework for the Northeast Delta pilot effort.*
Problem Statement	Adaptive management has rarely been successfully applied in the Delta at the project or regional scale. At present, Delta restoration planning, the first phase of the adaptive management process lacks an effective and expeditious way to apply the best available science to the complex task of reconnecting land and water for native species recovery.
Approach to Address the Problem	The Northeast Delta Landscape Restoration Framework (Framework) will fill this gap in restoration planning by making the best available science actionable — implementing advanced analytical tools, scientific knowledge base, and interdisciplinary expert collaboration—for the task of reconnecting land and water for native species recovery and ecosystem resilience. The project responds to the Governor's EcoRestore initiative that calls for 30,000 acres of ecosystem restoration in the Delta. The Framework embodies the best available science by integrating advanced analysis tools with input from both stakeholder and science experts. Ultimately, the Framework supports co-development of broadly acceptable landscape restoration strategies with flood protection, the agricultural economy, and heritage values of the Delta as an evolving place. Key steps in the Framework include: • Implement Data Analytics, Decision Support, and Visualization Tools • Develop a Vision of Regional Ecological Potential • Develop Multibenefit Alternatives and Facilitate Decisions The framework effort will utilize components from both science actions 1B (*Evaluate tools supporting real-time operations, monitoring, reporting, data management, and accessibility of data)* and 2C *(Synthesize established knowledge about designing effective habitat restoration projects in the Delta)*. Science Action 1B supports this effort as the concept of the framework is founded on the expectation of rapid data access and real-time analysis of information in support of the planning effort. The pilot study of restoring the McCormack-Williamson Tract will involve synthesis of established knowledge to inform restoration design for this area, similar to the efforts outlined in 2D. These sub-regional syntheses are expected to inform Delta-wide concepts of effective restoration projects.
Outcome	A vision and decision-support framework that will offer an adaptive roadmap for management of restoration progress in the Northeast Delta, which includes the Delta Plan's Cosumnes-Mokelumne Priority Habitat Restoration Area.
Progress to Date	Initial progress includes developing a detailed proposal and seeking support for funding from the Delta Conservancy Board.
Estimated Timeline	The target for initiating the Northeast Delta Restoration Framework effort is early 2016.
Associated Agencies and Organizations	Delta Conservancy San Francisco Estuary Institute-Aquatic Science Center Delta Stewardship Council/Delta Science Program The Nature Conservancy (TNC) Intelligent Ecosystem Institute
Outstanding Issues	This effort is currently waiting for funding approval from the Delta Conservancy Board.

Related Projects Underway/Soon to be Funded	Restoration of the McCormack-Williamson Tract by Department of Water Resources and TNC.

Topic 3 - Science support for management of estuarine and migratory species

Table 1 **Science Action** **3F**	*Conduct follow-up work to improve collaborative temperature modeling of cold water forecasting for Shasta Dam releases into the Sacramento River.*
Problem Statement	Major losses of winter-run Chinook salmon eggs and fry in the past due to management errors in cold water release have been traced to inadequate temperature models. Given the ongoing drought and its effects on storage and temperature of cold water pools, improvements in modeled temperature scenarios for both Lake Shasta and the Sacramento River are critical. The U.S. Bureau of Reclamation (USBR) currently utilizes a 1D model (HEC-5Q) to model and manage water temperatures for both the Sacramento River and Shasta Reservoir. Because Shasta Reservoir is a 2D system (i.e. temperature varies vertically and horizontally), concerns remain regarding the ability of the one-dimensional reservoir model to estimate temperature profiles adequately (2014 LOBO Review). National Marine Fisheries Service (NMFS) staff, funded by the USBR, has developed a Decision Support Tool (DST) to support current temperature management. The DST, based on the NMFS River Assessment for Forecasting Temperature (RAFT) model, was used to support 2015 temperature management. The DST will be updated in spring 2016 with the 2D Shasta Reservoir temperature model (CE QAL W2) linked to the RAFT model. The updated DST will be utilized to augment temperature management in 2016. More monitoring and modeling is needed to include Keswick Reservoir in the DST; currently the RAFT model extends upstream to Keswick Reservoir excluding a 17 km stretch of the Sacramento River below Shasta Reservoir. The timelines for 1) the USBR to move from the current 1D model to the 2D NMFS model and 2) inclusion of Keswick Reservoir in the DST are uncertain.

Approach to Address the Problem	A co-chaired NMFS – USBR technical workgroup has been formed, "that will identify the shortcomings with the existing modeling tools and will make recommendations about short-term fixes to the current tool or defer changes to a new model" (2015 Shasta Temperature Management Plan). The co-chaired technical workgroup will also identify and plan for a subsequent independent peer review of these models.
	
	Additional steps include:
	1. Contact NMFS and USBR staff and determine what is needed and the timeline for USBR to act upon the suggestion in the 2014 Long-term Operations Biological Opinion (LOBO) review to move from a 1D model to 2D model.
	2. Determine if current efforts address issues identified in the 2014 LOBO review
	  a. What are the planned outputs of the USBR-NMFS co-chaired technical working group and independent peer review?
	  b. Will the outputs in 2a. address issues identified in the 2014 LOBO review and address topics in the upcoming 2015 LOBO review?
	  c. What are the topics to be addressed in the 2015 LOBO review?

Outcome	An independent peer-review of current and proposed models addressing their accuracy and recommendations for alternative tools to support temperature management is needed.

Progress to Date	An independent peer review of current and proposed models addressing their accuracy and recommendations for alternative tools to support temperature management is needed. Calibration and validation data have not been published for the 1D Shasta Reservoir model. Calibration and validation data have been published for the RAFT model and 2D Shasta Reservoir model.
Estimated Timeline	Communication with NMFS and USBR staff, pending timely responses, should be completed by December 2015.
Associated Agencies and Organizations	Delta Science Program NMFS USBR State Water Resources Control Board
Outstanding Issues	1. More information is needed on: a) Intended output of the NMFS-USBR technical workgroup, and b) Timeframe for the independent science review indicated in the 2015 Shasta Temperature Management Plan. 2. The timeline for the USBR to move from the current 1D model to the 2D NMFS model is uncertain.
Related Projects Underway/Soon to be Funded	2015 annual LOBO review

Topic 3 - Science support for management of estuarine and migratory species

Table 1 Science Action **3G**	*Peer review of the Southwest Fisheries Science Center's winter-run Chinook salmon life-cycle model*
Problem Statement	In April 2011, at the request of the National Marine Fisheries Service (NMFS), the Delta Science Program convened an independent review panel to provide general recommendations on how NMFS should proceed with further incorporating life-cycle modeling (LCM) of Chinook salmon in assessing the biological effects of the Central Valley Project and State Water Project operations on the long-term viability of ESA-listed salmon. In June 2011, the review panel produced a report, Rose et al. 2011, "Salmonid Integrated Life Cycle Models Workshop: Report of the Independent Workshop Panel". The panel concluded that no existing LCM 'off-the-shelf' would meet NMFS' needs and recommended NMFS create its own salmonid life-cycle model tailored expressly for its purposes. Thus, Southwest Fisheries Science Center (SWFSC) with the funding support of USBR developed a winter-run LCM and published the report, Hendrix et al., 2014 "Life cycle modeling framework for Sacramento River winter-run Chinook salmon" in a peer-reviewed journal last year. Recognizing that the model would be used to make a variety of management decisions with wide-ranging implications, SWFSC sought an independent technical review of the model.
Approach to Address the Problem	The SWFSC submitted a proposal to the Office of Science and Technology's Center for Independent Experts (CIE) and received funding for a panel review of the NMFS winter-run life-cycle model.
Outcome	A scientifically robust salmon life-cycle model to inform decisions to adapt water operations and restoration actions.
Progress to Date	• Review is scheduled for November 5 and 6, 2015. • Terms of Reference and three panelists are being finalized. • Panelists are charged with technical evaluation of the LCM and responsiveness of model to the recommendations in the Rose et al. 2011 report.
Estimated Timeline	• Nov. 5, 2015 - Interactive presentations by modelers and panelists • Nov. 6, 2015 - Panel workday and report writing • December 2015 – Final report to SWFSC
Associated Agencies and Organizations	University of Southern California UC Santa Barbara USGS USFWS Northwest Fisheries Science Center DWR USBR NMFS-Central Valley Office CDFW
	Several technical workshops and webinars have been open to the public and stakeholders and have been well attended.
Related Projects Underway/Soon to be Funded	Life-cycle model development for spring-run and fall-run Chinook salmon is currently being funded by USBR.

Topic 3 - Science support for management of estuarine and migratory species

Table 1 **Science Action** **3H**	*Identify the process, mechanisms, and resources to fund research identified by various efforts such as Salmon/Steelhead/Sturgeon Assessment of Indicators by Life Stages (SAIL), the Interagency Ecological Program's Management, Analysis, and Synthesis Team (MAST), the Collaborative Adaptive Management Team (CAMT), and Delta Regional Monitoring Program (Delta RMP).*
Problem Statement	With the current drought and changing environment, both water supply and endangered species in the Delta are in critical condition. Collaborative efforts such as SAIL, MAST, CAMT, and the Delta RMP are specifically designed to identify knowledge gaps and are important tools for identifying and conducting high priority research to inform management actions intended to protect key species and habitat. A formalized process to fund relevant research efforts would contribute to streamlining implementation of research projects.
Approach to Address the Problem	Develop a well-defined methodology for funding research to streamline the process for funding entities. Continue efforts to identify and align funding for high-priority science supporting collaborative synthesis efforts.
Outcome	An addendum to the Delta Science Plan appendices that describes a range of funding mechanisms and the appropriate use of each. This information is intended to provide funding agencies with guidance in targeting the most optimum funding mechanism to support various research efforts. Funding opportunities with a focus on research identified by the collaborative efforts listed above.
Progress to Date	The Delta Science Program has taken steps to develop processes for consistent and streamlined funding of science by drafting an addendum to the Delta Science Plan. The addendum will provide a well-defined methodology for a range of funding mechanisms including an outline of the review process and estimated timeframes for implementation. The "Directed Action" mechanism specifically acknowledges the value of collaborative science efforts for identifying high priority science actions. To ensure the best possible scientific information is provided to guide management and policy decisions, the Science Program has also developed a related document that summarizes the procedures addressing conflict of interest. The purpose of this document is to clearly define measures to ensure that funding decisions are unbiased and fair. This set of documents is scheduled to be presented to the Delta Stewardship Council in 2015.
Estimated Timeline	Work will continue on implementation of high priority science needs as they arise.
Associated Agencies and Organizations	All DPIIC agencies and collaborative science initiatives.
Outstanding Issues	• Selection and prioritization of projects for limited funding. • Identification of available funding. • Consistency of research funding methods and decisions across agencies.
Related Projects Underway/Soon to be Funded	Funding of the CAMT proposal and workshop reviews appears likely. The Delta Science Fellows Request for Applications (RFA) is out and will meet some Delta science needs. The Delta Science Program has recently demonstrated the Directed Action funding mechanisms through identification, review, and funding of four research proposals investigating the effects of the Emergency Drought Barrier. These four projects went from concept to "boats on the water" in less than three months.

Topic 4 – Science supporting flood risk reduction and the economies of Delta communities

Table 1 **Science Action** **4I**	*Consolidate the current state of knowledge regarding economic analysis of the potential to reduce flood damage through strategic levee setbacks and expanding wetland and floodplain acreage.*
Problem Statement	Past economic analyses of levee changes have focused primarily on impacts rather than offsetting benefits. There is a need to synthesize current information and identify knowledge gaps and research recommendations on economic impacts of wetland and floodplain restoration and levee setback management to inform upcoming decision points regarding levee modification and the Delta Levees Investment Strategy.
Approach to Address the Problem	REVISION: At the October 5 Workgroup meeting, it was agreed that this topic needs further group discussion to ensure it will be relevant and valuable to a majority of participating agencies. Development should include a specific meeting with stakeholders and other interested parties for more comprehensive discussion. Review of existing cost-benefit calculations should be a primary consideration, per Workgroup direction, as well as potentially identifying an alternative approach to conduct economic analyses of environmental engineering projects.
Progress to Date	Shortly after DPIIC endorsement in May, a conference call with the Delta Conservancy, Delta Protection Commission, Delta Stewardship Council, and Delta Science Program was held in June 2015 to review the genesis of this science action and aim to better understand the Workgroup's intent around this "Delta As Place" research topic in order to determine appropriate next steps. The general agreement was that further discussion by the Workgroup would be necessary before moving forward with any effort to implement. In the interim, staff would monitor progress of the Delta Levees Investment Strategy (DLIS) as it could inform the Workgroup's discussion on 4I when revisited. In a separate effort to refine the topics of Table 2 in preparation for the Delta Science Fellows Request for Applications (RFA), changes to the wording of Topic 4 and the addition of several research topics under it were offered up by interested Workgroup members and received group input and support. (*See* Refined Topics for Sea Grant Delta Science Fellows RFA, p. 17) These topics are related to Table 1 Action 4I, but address more collective interest for research at this time.
Estimated Timeline	Place on HOLD; await applications of the Delta Science Fellows for Topic 4 research topics.
Associated Agencies and Organizations	Delta Conservancy, Delta Protection Commission, Delta Stewardship Council and Delta Science Program, Department of Water Resources, Army Corps of Engineers, and others.
Related Projects Underway/Soon to be Funded	*See* Refined Topics for Sea Grant Delta Science Fellows RFA, p. 17.

Table 2

The science actions listed in this table include those having a broader scope and those that are appropriate for near-term initiation in the form of a proposal solicitation or Delta Science Fellows request for applications. Research initiated through the above-mentioned funding mechanisms will also serve to support those science actions in Table 2 that are more appropriate to address at an institutional level. The Delta Agency Science Workgroup, with particular leadership from the Delta Science Program, has considered or applied the following three methods to execute Table 2 topics:

1. **Sea Grant Delta Science Fellows 2015 Request for Applications (initiated)**
   On Aug. 26, 2015, interested members of the Delta Agency Science Work Group and others, including representatives from the State and Federal Contractors Water Agency, Sacramento County Regional Sanitation District (Regional San), NASA – Jet Propulsion Laboratory, and NASA Ames Research Center, met to further refine the science actions listed in Table 2 for inclusion in the Delta Science Fellows Request for Applications (RFA).

   Topics 1 through 4 were further clarified and refined. In particular, Topic Area 4 (*Science supporting the enhancement and protection of the cultural, recreational, natural resources, and agricultural values of the Delta*) was substantially augmented based on comments made by the Delta Protection Commission and Department of Water Resources. Comments made at this meeting were integrated into the draft table and then reviewed by the Delta Stewardship Council/Delta Science Program Lead Scientist Dr. Cliff Dahm. Dr. Dahm made further revisions to ensure that the Delta Science Fellows RFA would be relevant for a broad range of prospective applicants.

   Several agency attendees indicated an interest in serving as community members and several others indicated an interest in potentially funding proposals of interest to them. Please see below for the list of finalized priority research topics that was distributed with the RFA.

   Brief timeline of events
   - Sept. 21, 2015: The Request for Proposal published. (https://caseagrant.ucsd.edu/fellowships/delta-science-fellowship?utm_source=newsletter&utm_medium=email&utm_campaign=dsf15)
   - Nov. 18, 2015 at 4:00 p.m. (PDT): Applications due.
   - Oct. 8, 2015: Informal webinar.
   - Mid-December 2015: Proposals distributed to the independent scientific review panel.
   - Mid-January 2016: Independent review panel to rank proposals.
   - Early February 2016: Delta Lead Scientist and California Sea Grant to agree on proposals to be funded.
   - Mid-February 2016: Recipients notified and asked to accept or decline the award.
   - Early April 2016: Awards issued.
   - May-June 2018: Final research reports/results submitted to Delta Science Program and California Sea Grant.

2. **Research topics for Proposition 1 proposal solicitations (in discussion)**
   - The California Department of Fish and Wildlife (CDFW) has published its proposal solicitation notice for fiscal year 2015-2016. Research topics in this proposal incorporate Table 2 Science Actions 1-3 and associated topic areas of the High Impact Science Actions. The Delta Science Program is prepared to participate in CDFW's selection process of high scoring proposals. Depending on available funds, the Science Program may help support additional proposals to those funded by CDFW.

3. **Multiagency Proposal Solicitation (under development)**
    - A joint proposal solicitation was identified as a way to implement many of the science actions and topics listed in Table 2. A multiagency proposal solicitation offers several benefits including a larger pool of resources and a more streamlined process through the use of one standardized independent peer review method. Although the Science Program is primed to commit funds to include in such a proposal solicitation, support from additional agencies is needed to fund an effective number of proposals.

Delta Science Fellows 2015 Priority Research Topics – refined from Table 2

1. Assessing the effects of drought on the Delta
i. Investigate effects of drought-induced changes in flow and other physical parameters of the Delta, including impacts on species habitat, food web dynamics, survival, and migration patterns and follow these responses through time (e.g., wetter conditions).
ii. Using physical and biological data, advance both conceptual and computational models that assess and integrate effects of changes in flow, fish entrainment at water export facilities, water quality, food web dynamics, contaminants, and habitat on juvenile fish as a function of the drought.
iii. Investigations of the physiological effects of drought on fish.
2. Effectiveness and implications of habitat restoration actions
i. Understand the effectiveness of wetland habitat restoration of subsided Delta islands on subsidence reversal, carbon sequestration, and water quality.
ii. Assess the effectiveness of wetland habitat restoration on food web dynamics and fish condition and survival.
iii. Synthesize information from existing decision support tools (e.g., EcoAtlas, My Water Quality Portals, etc.) to provide an overview of current approaches to habitat restoration at a regional scale and identify remaining information gaps.
3. Develop decision support tools for management of estuarine and migratory species
i. Develop innovative approaches for describing, determining, and predicting abundance, survival, temporal and spatial distribution of fish and fish habitat. These new tools may include real-time tracking devices, airborne and satellite remote sensing, adjustments to monitoring, survey technologies, and design. Examples of existing tools that serve various purposes include Bay-Delta Live, California Estuary Portal, CARI, and CRAM.
ii. Improve existing tools (dashboards such as California Estuaries Portal, real-time data networks such as Bay-Delta Live and EcoAtlas) by developing capabilities for predictive modeling of alternative regulatory and operational actions to support Delta water management.
iii. Investigate how monitoring results can be utilized for tactical forecasting and predictions of impacts of water management on fish.
4. Science supporting the enhancement and protection of the cultural, recreational, natural resource, and agricultural values of the Delta
i. Assessment of invasive aquatic vegetation effects on boating, recreation, water operations, habitat, economic and natural resources, and management (social, economic, and ecological studies).
ii. Identify the infrastructure sectors where improvements would most efficiently advance a sustainable, resilient Delta economy (other than levees and boating).
iii. Investigate the effects of changing climate patterns and understudied faults east of the coastal ranges and their potential effect on seismic activity and flood risk in the Delta including perception and preparedness within the Delta.
iv. Assess the economic and environmental sustainability and viability of consolidated islands (polders), expanded waterways, and setback levees.

Attachment 1: List of abbreviations

CAMT: Collaborative Adaptive Management Team
CDEC: California Data Exchange Center
CDFW: California Department of Fish and Wildlife
CEDEN: California Environmental Data Exchange Network
CIE: Center for Independent Experts
CWQMC: California Water Quality Monitoring Council
DCAS: Delta Collaborative Analysis and Synthesis
Delta RMP: Delta Regional Monitoring Program
DST: Decision Support Tool
DWR: Department of Water Resources
IAMIT: Interagency Adaptive Management Integration Team
IEI: Intelligent Ecosystem Institute
IEP: Interagency Ecological Program
LCM: Life-Cycle Model
LOBO: Long-term Operations Biological Opinion
MAST: Management, Analysis, and Synthesis Team
NASA: National Aeronautics and Space Administration
NMFS: National Marine Fisheries Service
NOAA: National Oceanographic and Atmospheric Administration
PPIC: Public Policy Institute of California
RAFT: River Assessment for Forecasting Temperature
SAIL: Salmon/Steelhead/Sturgeon Assessment of Indicators by Life Stages
SFCWA: State and Federal Contractors Water Agency
SFEI-ASC: San Francisco Estuary Institute-Aquatic Science Center
TNC: The Nature Conservancy
TWMPWT: Tidal Wetland Monitoring Project Work Team
USBR: U.S. Bureau of Reclamation
USEPA: U.S. Environmental Protection Agency
USFWS: U.S. Fish and Wildlife Service
USGS: U.S. Geological Survey