May 2021

Science Action Agenda Draft Management Needs

2022-2026 SAA Update

Public Review Draft

Delta Science Program

DELTA STEWARDSHIP COUNCIL

Updating the Science Action Agenda

The Delta Science Program is updating the Science Action Agenda (SAA), a collaboratively-developed document that prioritizes and aligns science actions for the Sacramento-San Joaquin Delta (Delta) to meet management needs, for 2022-2026. The SAA is used to guide science funding—over $36 million has been awarded during the lifespan of the 2017-2021 SAA—and is updated every four to five years.

The Delta Science Program organized the 65 Top Delta Management Questions from 2020 into the six draft Management Needs below. Feedback is welcome to ensure that the Management Needs accurately reflect overarching and pressing gaps in management that are critical to achieving policy or regulatory objectives. Please send any comments, questions, or feedback on the draft Management Needs to SAA@deltacouncil.ca.gov by **COB Monday, June 7, 2021**.

The final short list of Management Needs will shape the July 13-14, 2021 Science Actions Workshop and update to the SAA. Workshop registration is now open.

2022-2026 SAA Draft Management Needs

The 65 Top Delta Management Questions (MQs) are organized into the following six draft Management Needs:

1. **Improve coordination and integration of large-scale experiments, data collection, and evaluation across scales and institutions** (8 MQs)
2. **Enhance monitoring and model interoperability, integration, and forecasting** (5 MQs)
3. **Expand multi-benefit approaches to managing the Delta as a social-ecological system** (18 MQs)
4. **Build and integrate knowledge on social processes and human behavior to support effective and equitable management** (11 MQs)
5. **Acquire new knowledge and synthesize existing knowledge of interacting stressors to support species recovery** (16 MQs)
6. **Assess and anticipate climate change impacts to support successful adaptation strategies** (7 MQs)

Tables 1 through 6 list the MQs organized within each draft Management Need. The below network diagram links the MQs, draft Management Needs, and relevant management themes used in the development of the 65 Top Delta Management Questions (Figure 1).

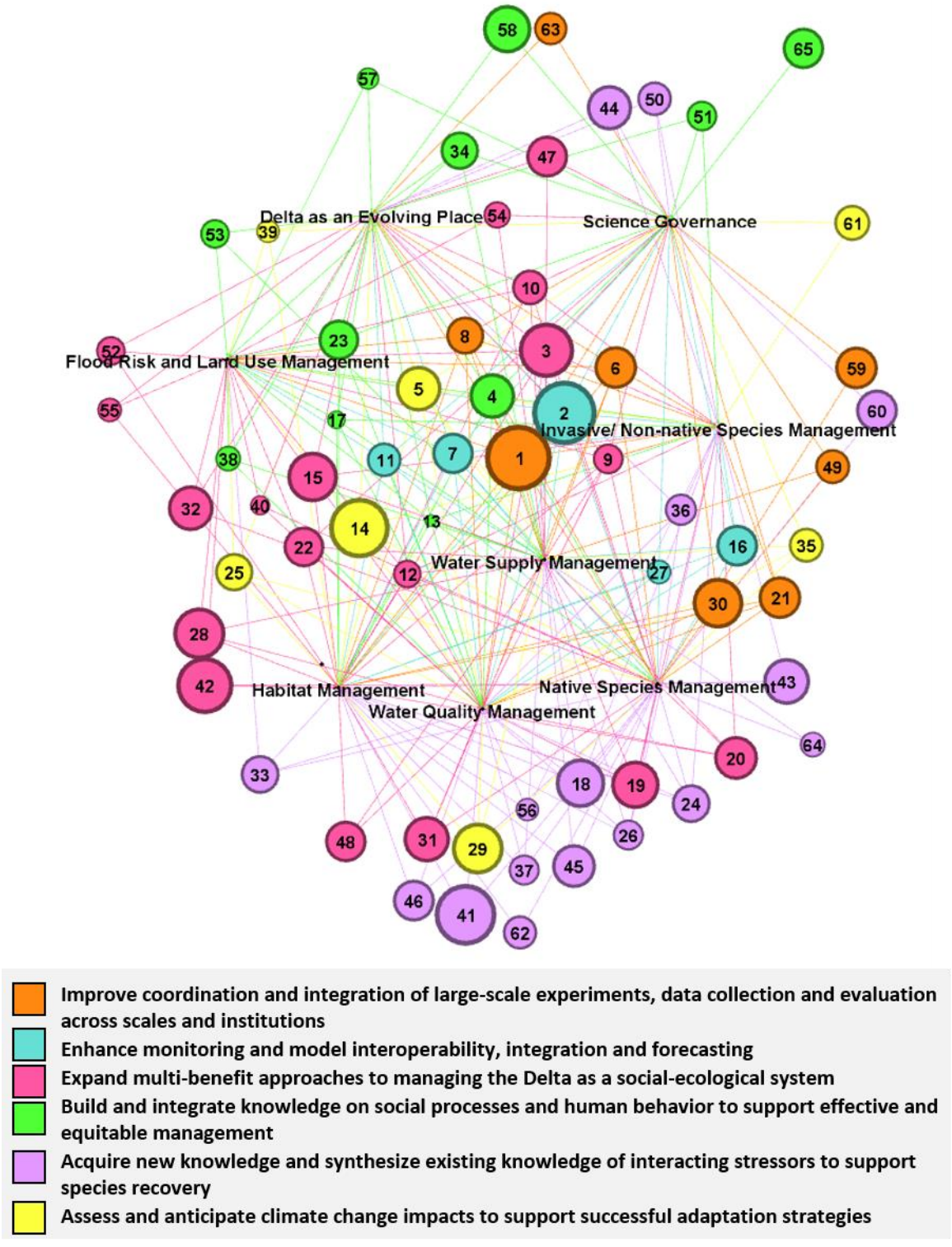

Figure 1. Network visualization shows how the 65 Top Delta Management Questions relate to eight key management themes (Delta as an Evolving Place, Flood Risk and Land Use Management, Habitat Management, Invasive/ Non-native Species Management, Native Species Management, Science Governance, Water Quality Management, and Water Supply Management). Nodes are colored by Management Need and scaled by the weighted average from the Management Questions development process.

Approach

The Delta Science Program staff developed the draft Management Needs based on the 65 Top Delta MQs following a modified content analysis approach.

Management Needs were inductively developed through an iterative process of coding MQs by key management themes, and combining similar key management themes to come up with cross-cutting Management Needs. Four Delta Science Program scientists then independently sorted MQs into draft Management Needs. Discrepancies in how MQs were categorized were discussed, and further reviewed by five members of the Delta Science Program leadership team. For MQs with high levels of disagreement in terms of which Management Needs it should be placed under, multiple rounds of discussion occurred until consensus on categorization was reached. Finally, wording for draft Management Needs was reviewed to ensure category label appropriately encompassed all MQs included.

The description of each draft Management Need includes the connections to the 2019 Delta Science Plan objectives and progress made on the 2017-2021 SAA.

Next steps

Public comments will be considered in finalizing the Management Needs for the upcoming July 13-14, 2021, Science Actions Workshop and the 2022-2026 SAA. The focus of the workshop will be to identify Science Actions that are most responsive to the final Management Needs. Registration is now open.

Visit the Delta Stewardship Council's SAA webpage or contact SAA@deltacouncil.ca.gov for any questions or to learn more about the Management Needs and SAA update.

Table 1. Management questions informing Management Need One: '**Improve coordination and integration of large-scale experiments, data collection, and evaluation across scales and institutions.**' This Management Need focuses on uncertainty around collaboration and coordination of large-scale experiments, adaptive management, and data collection needs. Addressing Management Need One will help further Delta Science Plan objectives #2, #4, and #5 (Coordinate and integrate Delta science in a transparent manner; Manage and reduce scientific conflict; Support effective adaptive management) and build on progress made in Action Areas 2 (Capitalize on existing data through increasing science synthesis) and 4 (Improve understanding of interactions between stressors and managed species and their communities) of the 2017-2021 SAA.

Improve coordination and integration of large-scale experiments, data collection, and evaluation across scales and institutions (top MQs sorted by number of relevant themes and weighted average)	
1	How can large-scale experiments (e.g., pulse flows, aquatic vegetation removal) be coordinated among stakeholders and implemented to test conceptual model assumptions and hypotheses and to inform future management?
6	How can collaborative science efforts (e.g., Collaborative Adaptive Management Team, Interagency Ecological Program, Integrated Modeling Steering Committee) and decision-support tools be better supported, communicated, and integrated into management processes to inform science-based decisions?
8	What institutional structures are required to support the full integration of social science into the Delta science enterprise?
21	What fundamental aquatic and terrestrial environmental datasets that could improve project planning, evaluation, and regional synthesis across the system are missing, out of date, or not consistently collected, and what are the best ways to analyze that data?
30	How can funding for long-term terrestrial and aquatic monitoring and adaptive management be secured to support Delta management?
49	How can data availability, analysis, and communication be improved to minimize the effects of CVP and SWP water operations to ESA-listed species and improve water supply reliability?
59	What are critical elements or approaches to collaborative development of hatchery genetic management plans to ensure they serve to enhance wild salmon viability?
63	What key psychological, social, and structural barriers inhibit institutional learning, coordination across diverse stakeholders and agencies, and collaborative management in the Delta?

Table 2. Management questions informing Management Need Two: '**Enhance monitoring and model interoperability, integration, and forecasting.**' This Management Need focuses on uncertainty around existing modeling, monitoring, and tools to forecast and respond to changes in the system and effectively inform management. Addressing Management Need Two will help further Delta Science Plan objective #1 (Strengthen science-management interactions) and build on progress made in Action Areas 2 (Capitalize on existing data through increasing science synthesis) and 5 (Modernize monitoring, data management, and modeling) in the 2017-2021 SAA.

Enhance monitoring and model interoperability, integration, and forecasting (top MQs sorted by number of relevant themes and weighted average)	
2	How can monitoring efforts be better designed, facilitated, integrated, and standardized to achieve status and trend monitoring objectives (e.g., for aquatic and terrestrial species), and to fit the scale of management actions, timing of ecosystem processes, and climate change challenges?
7	How can the Delta science enterprise integrate new tools and real-time forecasting and observations into decision-making for water and ecosystem management?
11	How can models and tools necessary to integrate water supply, groundwater, and flood management be supported and developed in order to evaluate scenarios for SGMA implementation, climate change adaptation, and management of the Delta for the coequal goals?
16	What abiotic and biotic metrics and integrated models (e.g., hydrodynamic with fish life-cycle models, conceptual models) are needed to assess how exports and flow influence fish viability, behavior, entrainment, and predation?
27	What water quality data (e.g., contaminant bioavailability and toxicity, nutrients, water temperature) should be prioritized to add to Delta ecosystem models in order to evaluate future ecosystem and management changes?

Table 3. Management questions informing Management Need Three: '**Expand multi-benefit approaches to managing the Delta as a social-ecological system.**' This Management Need focuses on uncertainty in managing the Delta as a holistic system and how to assess tradeoffs and achieve multi-benefit objectives. Addressing Management Need Three will help further Delta Science Plan Delta Science Plan objectives #2, #5, and #6 (Coordinate and integrate Delta science in a transparent manner; Support effective adaptive management; Maintain, communicate, and advance understanding of the Delta) and build on progress made in Action Areas 1 (Invest in assessing the human dimensions of natural resource management decisions) and 3 (Develop tools and methods to support and evaluate habitat restoration) in the 2017-2021 SAA.

Expand multi-benefit approaches to managing the Delta as a social-ecological system (top MQs sorted by number of relevant themes and weighted average)	
3	How can we achieve floodplain inundation for species recovery, improved ecological processes, and flood control while balancing needs for agriculture, recreation, and other human uses?
9	How might additional diversion conveyance facilities in the Delta affect operational flexibility, water supply and quality, and ecosystems?
10	In what ways do different management actions (e.g., restoration, water operations, levee maintenance) affect the risk of species invasions or spread, and what best management practices can minimize that risk?
12	How are the ecosystem services and disservices distributed across the Delta, and what are the drivers of this distribution?
15	How can factors (e.g., water flow and residence time, turbidity, water temperature, nutrient concentrations) be managed to encourage productivity in lower trophic food webs while also preventing harmful algal blooms, taste and odor issues, and macrophyte growth?
19	What management actions in non-wet years including flow and non-flow actions (e.g., salinity barriers, spring/summer flows, habitation restoration), individually and in combination, can provide similar ecological benefits to wet year flows?
20	What are the tradeoffs to native species and ecosystems among the management actions intending to address the impacts of increased temperature?
22	How do water quality and the multiple elements that contribute to water quality change under different management scenarios, and where is coordinated monitoring needed?
28	How do management actions (e.g., source control practices or managed flows) and habitat type influence nutrients, carbon, contaminants, and sediment fluxes in the Delta?
31	How and why do zooplankton communities and primary productivity change with environmental factors, flow actions, and over space and time?
32	How do we monitor and evaluate ecosystem restoration outcomes (e.g., for species recovery and ecosystem services), including benefits, detriments, and landscape-scale effects?

Expand multi-benefit approaches to managing the Delta as a social-ecological system

(top MQs sorted by number of relevant themes and weighted average)

40	What source control actions for contaminants (e.g., mercury, selenium, personal care products, or other emerging contaminants) would reduce health impacts to both fish and consumers of fish in the Delta?
42	What are best management practices for levees and floods to create or enhance habitat along Delta and Suisun Marsh channels, river corridors, and riparian zones?
47	How is the cumulative implementation of SGMA, though local projects and strategies, likely to impact inflows to and through the Delta, exports from the Delta, and achievement of the coequal goals?
48	What are the interactions between flow and aquatic and tidal habitat, and how do other stressors influence those interactions (e.g., contaminants, other water quality changes, climate change problems)?
52	What management actions should be prioritized to address seismic risk to the integrity of the Delta's levee system?
54	How do storms impact the tradeoff between reservoir operations, Flood-Managed Aquifer Recharge, and other management decisions related to water supply?
55	What land management actions maximize benefits for sequestering carbon, reducing or reversing subsidence, and reducing flood risk?

Table 4. Management questions informing Management Need Four: '**Build and integrate knowledge on social processes and human behavior to support effective and equitable management.**' This Management Need focuses on uncertainty in understanding social processes in the Delta that are critical for effective management and how to effectively engage communities and utilize social science to inform and strengthen management decisions. Addressing Management Need Four will help further Delta Science Plan Delta Science Plan objectives #2, #5, and #6 (Coordinate and integrate Delta science in a transparent manner, Support effective adaptive management; Maintain, communicate, and advance understanding of the Delta) and build on progress made in Action Area 1 (Invest in assessing the human dimensions of natural resource management decisions) in the 2017-2021 SAA.

Build and integrate knowledge on social processes and human behavior to support effective and equitable management (top MQs sorted by number of relevant themes and weighted average)	
4	How can environmental justice principles, values of Delta communities, and traditional ecological knowledge be incorporated into the Delta science enterprise to support management activities and policy decision-making in the Delta?
13	How are costs and benefits of economic development and ecosystem management distributed across Delta communities?
17	How and why do risk perceptions related to climate and environmental changes vary across the Delta's diverse human communities?
23	What factors would effectively motivate landowners to create managed wetlands or cultivate rice to stabilize land subsidence and reduce carbon emissions?
34	How do patterns of Delta water use and adoption of technologies influence reliance on water exports, water use efficiency, access to new water sources, and likelihood of adopting additional conservational measures or technologies (e.g., water recycling and potable reuse)?
38	What are the water supply issues faced by disadvantaged communities within the Delta watershed, and how can they equitably be addressed?
51	What social, cultural, and political factors must be understood to design and implement effective invasive species management plans?
53	What type/category of investments by urban and agricultural water suppliers are achieving the greatest reduction in water demand?
57	What aspects of the Delta are integral to the values, beliefs, and practices of different human communities, how have those values, beliefs, and practices changed over time?
58	What factors drive the extent to which different Delta communities trust scientists, management agencies, and other stakeholders in the Delta, and what are the most effective approaches for earning and/or building trust?
65	What factors explain how information is communicated and used in Delta decision-making processes?

Table 5. Management questions informing Management Need Five: '**Acquire new knowledge and synthesize existing knowledge of interacting stressors to support species recovery.**' This Management Need focuses on uncertainty in native species recovery, including critical and interacting stressors. Addressing Management Need Five will help further Delta Science Plan Delta Science Plan objectives #3 and #4 (Enable and promote science synthesis; Manage and reduce scientific conflict) and build on progress made in Action Areas 2 (Capitalize on existing data through increasing science synthesis) and 4 (Improve understanding of interactions between stressors and managed species and their communities) in the 2017-2021 SAA.

Acquire new knowledge and synthesize existing knowledge of interacting stressors to support species recovery (top MQs sorted by number of relevant themes and weighted average)	
18	What are the impacts of existing and changing environmental factors (abiotic and biotic), in combination with other stressors, on the overall viability of all life stages of native species?
24	Where, and under what conditions (e.g., habitat, water temperature, trophic interactions, flow, including at known hotspots), do we find increased predation pressure on native aquatic species in the Delta, and can those conditions be altered to reduce this pressure?
26	What is the relative magnitude of temperature-dependent mortality of juvenile salmonids compared to other sources of mortality, and what are the interactive effects of multiple stressors on mortality?
33	What are the sources, exposure pathways, and impacts of contaminant mixtures on all life stages of native fish species and their food sources in the Delta?
36	What degree of control keeps invasive populations at a level that allows for desired and cost-effective management outcomes (e.g., boating access, fish habitat, food production)?
37	What are the population effects of water operations, migration barriers, flow, and temperature on spawning distribution, migration, recruitment, behavior, life history, and production of understudied native species (e.g., White and Green Sturgeon)?
41	How does restoration in key tributaries and the Delta (e.g., wetland habitat) affect food web dynamics and at-risk species recovery, diversity, distribution, and trends?
43	How do invasive species (e.g., plants, invertebrates) influence tidal marsh ecosystem functions critical to ESA-listed species recovery?
44	What are successful frameworks for early detection and rapid response (including integrated control strategies) to new invaders and what are the opportunities for improving prevention, monitoring, reporting, and control within the Delta?
45	How can upper watershed flows and access for native aquatic migratory species be increased?

Acquire new knowledge and synthesize existing knowledge of interacting stressors to support species recovery

(top MQs sorted by number of relevant themes and weighted average)

46	How do microbial communities (e.g., bacteria, picoplankton, and microzooplankton) contribute to trophic interactions in the SF Bay-Delta, and what monitoring efforts are needed to understand their role in the estuarine food web?
50	What new species are likely to invade regions of the Delta, and what are the most important vectors of invasive species introductions beyond ship-mediated transport to target for prevention and outreach?
56	How do biological invasions interact with biogeochemical factors (e.g., nutrients, microbes, organic carbon, salinity)?
60	What information is needed to develop robust juvenile production estimates (JPEs) for listed salmonids in each of the Central Valley rivers, and how should JPEs be used to achieve salmon recovery?
62	How do growth and survival of wild juvenile Chinook salmon and steelhead vary across the Delta watershed's multiple habitat types?
64	By which direct and indirect mechanisms do export facilities and their related management practices affect the fate of native species that enter the south Delta?

Table 6. Management questions informing Management Need Six: '**Assess and anticipate climate change impacts to support successful adaptation strategies.**' This Management Need focuses on uncertainties around climate change impacts (e.g., to invasive species management, public health and safety, native species management, and water operations). Addressing Management Need Six will help further Delta Science Plan Delta Science Plan objectives #1 and #6 (Strengthen science-management interactions; Maintain, communicate, and advance understanding of the Delta).

Assess and anticipate climate change impacts to support successful adaptation strategies (top MQs sorted by number of relevant themes and weighted average)	
5	How will projected environmental changes in the Delta impact human communities, and how can these impacts be communicated and incorporated into proactive, effective, and equitable Delta management decisions?
14	How will land use changes, sea level rise, and climate change impact the long-term resilience of critical Delta ecosystem services and native species?
25	How can ecological conditions and processes that support self-sustaining natural communities and benefits to public health, safety, and recreation be enhanced to support resilience to climate change?
29	What are the effects of extreme climatic conditions (e.g., drought, atmospheric rivers) on food web dynamics and aquatic and terrestrial species habitat, survival, and migration patterns?
35	How should carry-over storage targets be reevaluated and changed in light of climate change projections and modified biological objectives?
39	How and why are different human communities in the Delta currently adapting or not adapting to climate change, and what are the barriers communities face to adaptation?
61	How will invasive species management approaches need to adapt to climate change?