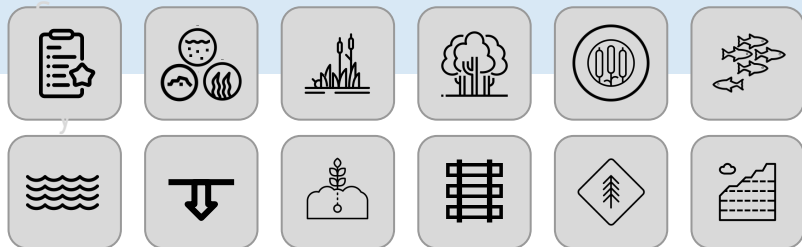
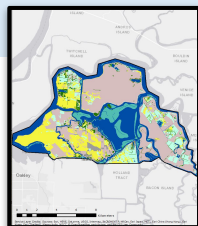
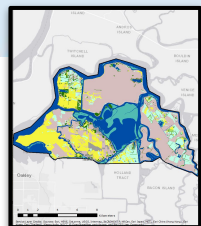


DELTA LANDSCAPES SCENARIO PLANNING TOOL

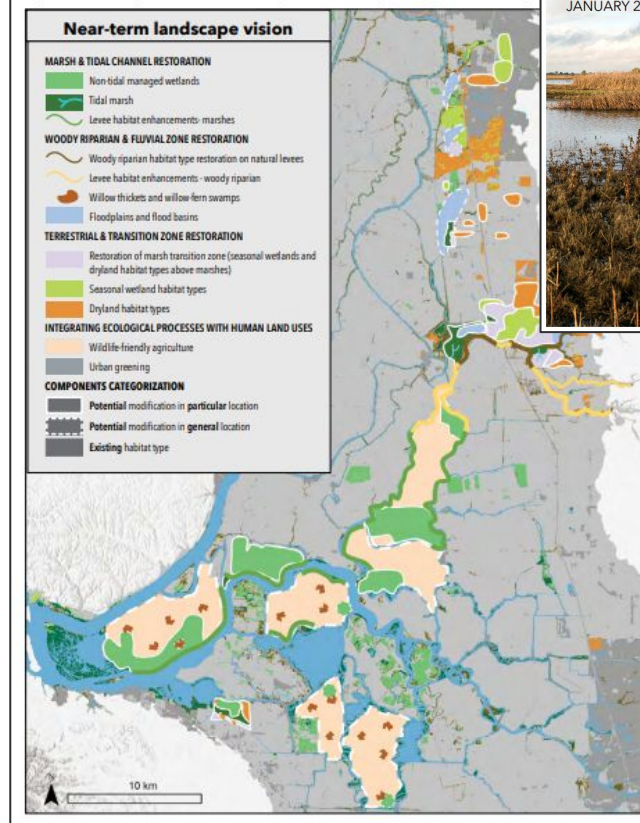


Problem statement

Stakeholders needed simple, standardized tools for restoration planning and adaptive management

- Need a tool to evaluate opportunities, impacts, tradeoffs, and project progress across
 - multiple benefits
 - different management options
 - variable landscape potential

Figure 3.3. Example near-term landscape vision for supporting desired ecosystems

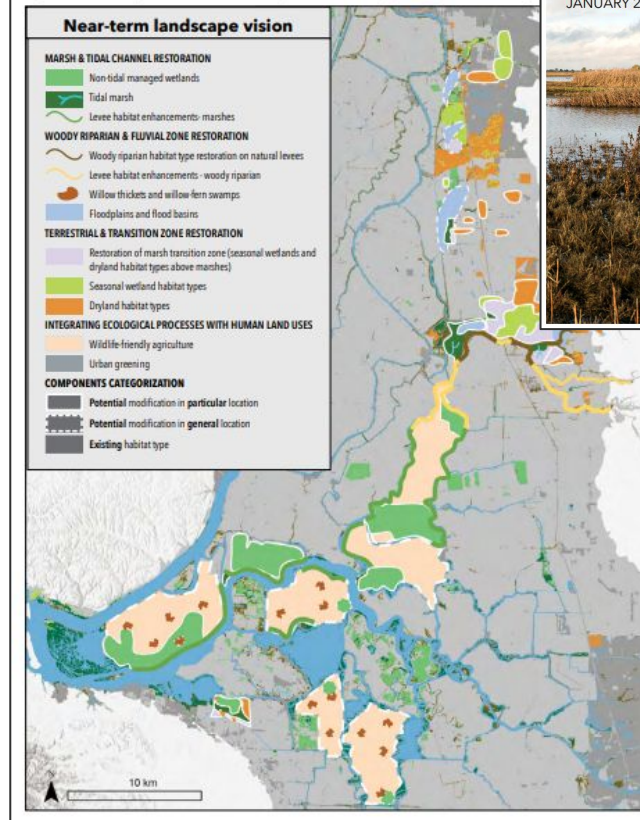


Problem statement

Regional restoration planning

- Need a simple and standardized way to
 - construct restoration scenarios
 - evaluate restoration scenarios
 - analyze cumulative impacts of multiple projects

Figure 3.3. Example near-term landscape vision for supporting desired ecosystems



Delta Public Lands Strategy

Guidance for Conservation and Sustainability
Across the West, Central, and Northeast Delta
JANUARY 2019



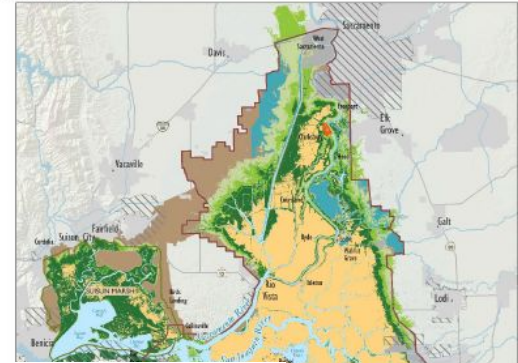
Regional restoration planning

Implementing the **Delta Plan**

- Need a tool to promote & assist compliance with policies
- Need a way to anticipate & measure the impacts of actions on performance measures

Restore Habitats at Appropriate Elevations

- ER P2 - The Sacramento-San Joaquin Delta and the Suisun Marsh, as defined in Water Code Section 85058. Habitat restoration must be carried out consistent with Appendix 3, which is Section II of the Draft Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (California Department of Fish and Wildlife 2011). The elevation map attached as Appendix 4 should be used as a guide for determining appropriate habitat restoration actions based on an area's elevation. If a proposed habitat restoration action is not consistent with Appendix 4, the proposal shall provide rationale for the deviation based on best available science.



APPENDIX E – PERFORMANCE MEASURES FOR THE DELTA PLAN

Appendix E Performance Measures for the Delta Plan

RESTORATION
SUISUN BAY

Problem statement

Regional restoration planning

Implementing the Delta Plan

Proposal evaluation

- Need a simple way to evaluate landscape-level impacts of proposed projects (for both applicants and reviewers)
- Need a means to help set objectives (identify key metrics and expected outcomes)

Delta Conservancy- Prop 1 Solicitation (2019)
setting clear objectives not just best practice, but a requirement

The screenshot shows the website for the Sacramento-San Joaquin Delta Conservancy. The main heading is "Proposition 1 Ecosystem Restoration and Water Quality Grant Program Full Proposal Solicitation Now Closed". Below this, there is a paragraph explaining the solicitation period and a link to the "Cycle 4 Timeline". The timeline chart shows the following schedule:

Action	2018				2019					
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Concept Proposal Solicitation	Active									
Concept Proposal Review		Active								
Full Proposal Solicitation			Active							
Full Proposal Evaluation				Active						
Board Approval					Active					

Below the timeline, there are links for "Cycle 4 Application Materials" and "Full Proposal Materials". The application materials include "Cycle 4 Grant Guidelines (pdf)", "Cycle 4 Checklist (Word)", and "FAQs - updated 12/13/2018". The full proposal materials include "Full Proposal Application Instructions - For Planning Projects (Word) - updated 11/8/2018", "Full Proposal Application Instructions - For Implementation Projects (Word) - updated 11/8/2018", and several attachments (Attachment 1-7) related to financial management, consultation, and budget tables.

On the right side of the website, there are sections for "Important Documents" (Final Cycle 4 Grant Guidelines, Strategic Plan, 2019 Implementation Plan) and "Quick Links" (Delta Conservancy eNewsletter, NEW Delta eNewsletter, Facebook, Twitter).

Problem statement

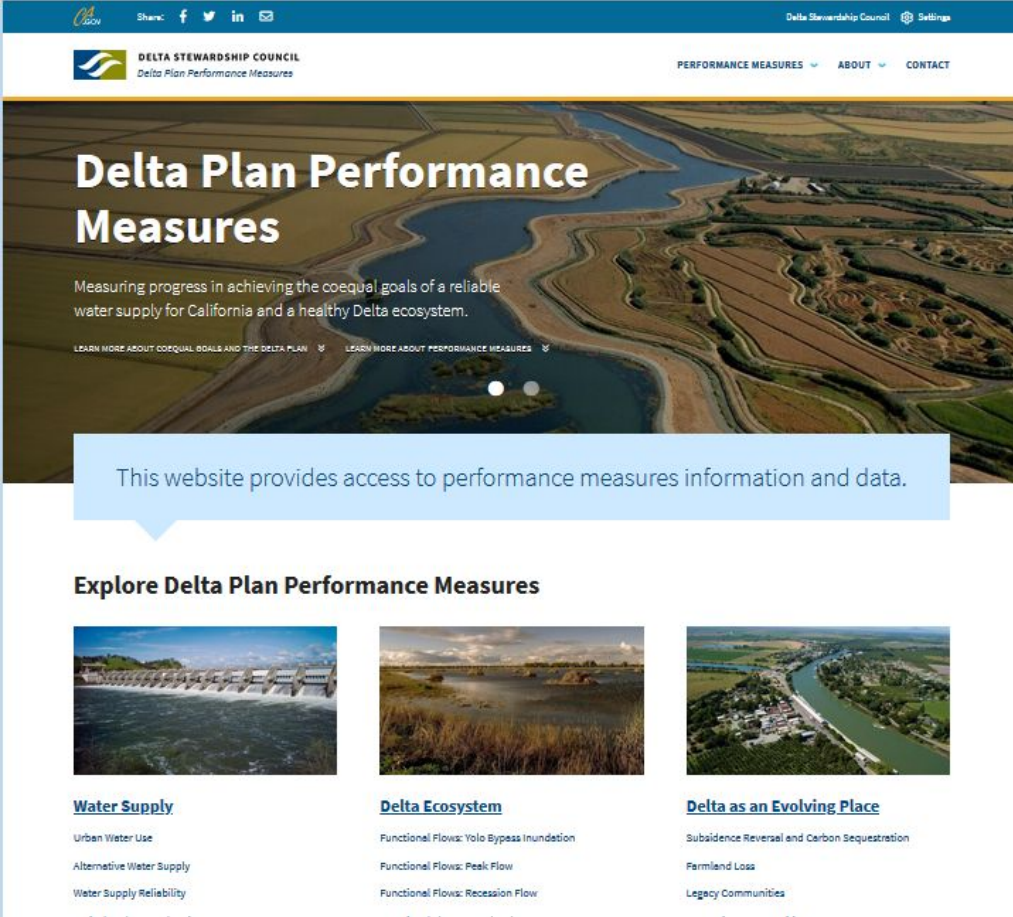
Regional restoration planning

Implementing the **Delta Plan**

Proposal evaluation

Project tracking

- Need a tool that can help measure actual progress & performance as projects are implemented (how does landscape actually develop?)



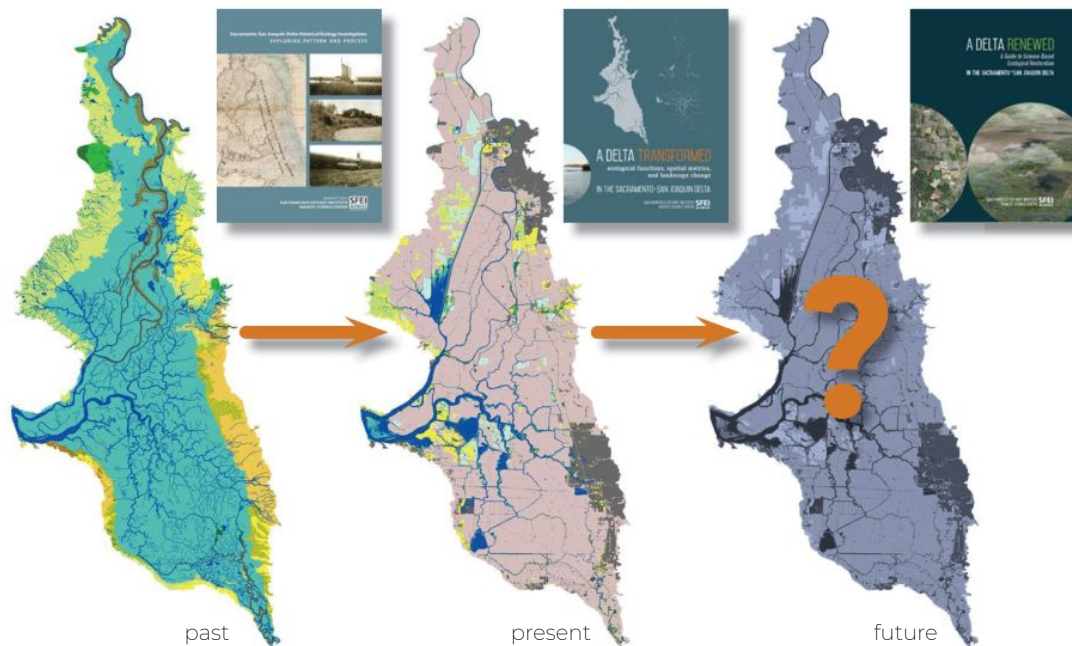
The screenshot shows the Delta Stewardship Council website. The header includes the organization's name and logo, along with navigation links for 'PERFORMANCE MEASURES', 'ABOUT', and 'CONTACT'. The main content area features a large aerial photograph of a river delta with the title 'Delta Plan Performance Measures'. Below the title is a sub-headline: 'Measuring progress in achieving the coequal goals of a reliable water supply for California and a healthy Delta ecosystem.' There are two links: 'LEARN MORE ABOUT COEQUAL GOALS AND THE DELTA PLAN' and 'LEARN MORE ABOUT PERFORMANCE MEASURES'. A light blue callout box contains the text: 'This website provides access to performance measures information and data.' Below this, there is a section titled 'Explore Delta Plan Performance Measures' with three columns of content:

- Water Supply**
 - Urban Water Use
 - Alternative Water Supply
 - Water Supply Reliability
- Delta Ecosystem**
 - Functional Flows: Yolo Bypass Inundation
 - Functional Flows: Peak Flow
 - Functional Flows: Recession Flow
- Delta as an Evolving Place**
 - Subsidence Reversal and Carbon Sequestration
 - Fermland Loss
 - Legacy Communities

Project background

The Delta Landscapes Project

How Do We Create A Desirable, Healthy Ecosystem in the Future Delta?



funded by CDFW

Goals and tenets of this approach:

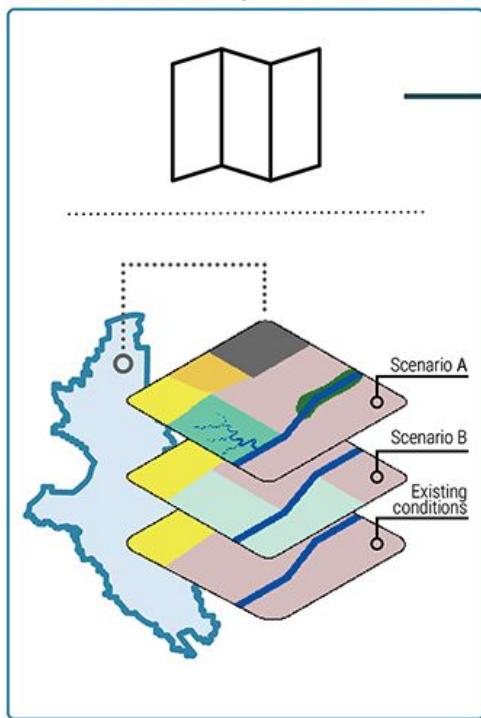
- Help us to think at the **landscape-scale**
- Emphasize **process-based** restoration of desired **ecosystem functions**
- Help us to think **holistically**
 - Benefit multiple species guilds
 - Benefits to people
 - Watershed connections
- Help us to think **large-scale and long-term**
 - Learn from past to inform future
 - Climate change resilience

DELTA LANDSCAPES SCENARIO PLANNING TOOL

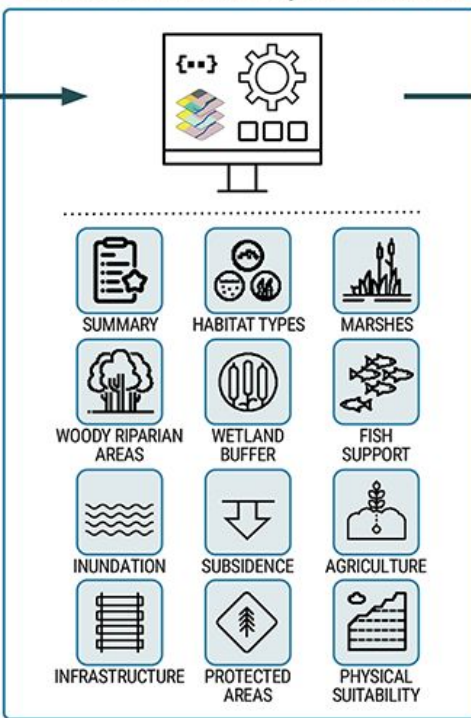
*A standardized, science-based tool
for analyzing and comparing Delta
land-use scenarios.*

funded by DSC

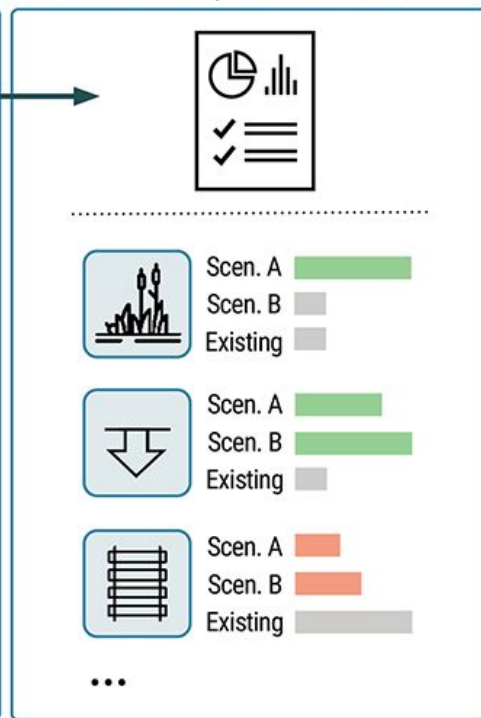
Alternative land-use
scenarios are input into the tool



The tool evaluates
scenarios with analysis modules

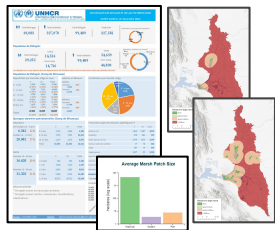


The tool outputs
detailed report & data files



Tool outputs

Tool outputs



Reports can compare up to 3 scenarios (plus historical & modern)

Hist. vs. Mod. vs. EcoRestore

Delta Landscapes Scenario Planning | maps.californiawetlands.net/dlspt/projects/ecorestore/report/results.html

Landscape Scenario Summary (DRAFT)

SELECT MODULE: **Marsh Habitat** | Print Report

3.2 - Modern

Each individual marsh patch mapped with a single color

3.3 - EcoRestore

Each individual marsh patch mapped with a single color

Marsh patch size

Large wetland patches support more habitat complexity, greater species diversity, and larger wildlife populations than smaller marsh patches. However, small marsh patches provide important ecological value as well, particularly in areas where they can serve as "stepping stones" providing ecological connectivity between large patches. Historically, the average size of marsh patches in this area of analysis was 4,494 ha, today the average is 3.5 ha. In EcoRestore the average marsh patch size is 8 ha. Maps 1-3 of this section identify marsh patches in the historical Delta, the modern Delta, and EcoRestore.

Marshes that are greater than 100 ha are more likely to support high densities of marsh birds (Spautz and Nur 2002; Spautz et al. 2006) and marshes greater than 500 ha are more likely to support dendritic channel networks (SFEI-ASC 2014), although other factors including hydrology and habitat quality are also important. EcoRestore would increase the number of large patches greater than 100 ha by 10 and would increase the number of large patches greater than 500 ha by 3.

Marsh patch size metrics

	Historical	Modern	EcoRestore
Number of large patches (>100 ha)	14	3	13
Number of large patches (>500 ha)	11	1	4
Average marsh patch size	4,494 ha	3.5 ha	8 ha
Maximum marsh patch size	110,527 ha	719 ha	1,336 ha
Total area of large patches (>100 ha)	192,475 ha	1,122 ha	6,064 ha
Total area of large patches (>500 ha)	191,962 ha	719 ha	3,664 ha

Number of large marsh patches (>100 ha)

Scenario	Number of large marsh patches (>100 ha)
Historical	14
Modern	3
EcoRestore	13

Tool modules: Summary



Goal: Rapidly compare scenarios to historical/current conditions & to each other across all modules.

Primary analyses:

- Synthesis across modules and comparison among scenarios

Key output:

- Summary table

Considerations:

- Value judgements?

- Scenario positively affects metric (relative to current conditions)
- Scenario does not alter metric
- Scenario negatively affects metric (relative to current conditions)
- ★ Indicates which scenario most improves each metric (all metrics will be marked with stars if only evaluating one scenario)

	Historical	Modern	Scenario A	Scenario B	Scenario C
Marsh habitat					
Patch size: number of large marsh patches (>100 ha)	1	0	1	2	2
Patch size: number of large marsh patches (>500 ha)	1	0	0	0	0
Patch size: average marsh patch size	55,266 ha	2.9 ha	8 ha	7 ha	8 ha
Patch size: maximum marsh patch size	110,527 ha	44 ha	403 ha	275 ha	335 ha
Patch size: total area of large patches (>100 ha)	11,210 ha	0	403 ha	397 ha	483 ha
Patch size: total area of large patches (>500 ha)	11,210 ha	0	0	0	0
Patch nearest neighbor distance: average distance to nearest large marsh patch (>100 ha)	0.073 km	15 km	3.6 km	3.2 km	3.0 km
Network connectivity: probability that randomly placed marsh birds (Black Rails) can reach each other via dispersal	36%	2.25x10 ⁻³ %	3.79x10 ⁻³ %	3.61x10 ⁻³ %	3.80x10 ⁻³ %
Core to edge area ratio	10 : 1	0.085 : 1	0.95 : 1	0.93 : 1	1.2 : 1

Tool modules: Marsh habitat



Goal: Analyze key metrics re. the marsh network and its ability to support marsh wildlife.

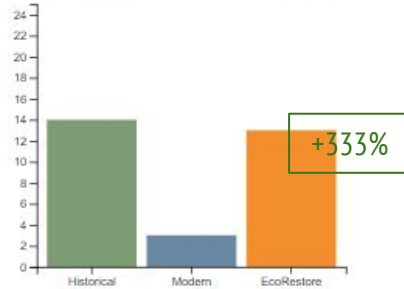
Primary analyses:

- Marsh patch size
- Marsh connectivity
- Marsh shape

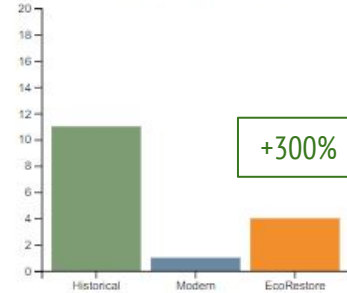
Key output:

- Shapefile of marsh patches

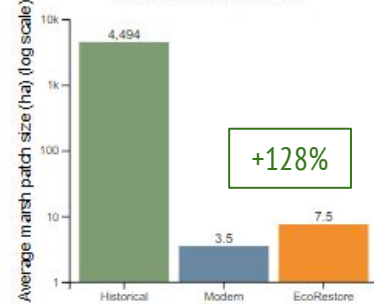
Number of large marsh patches (>100 ha)



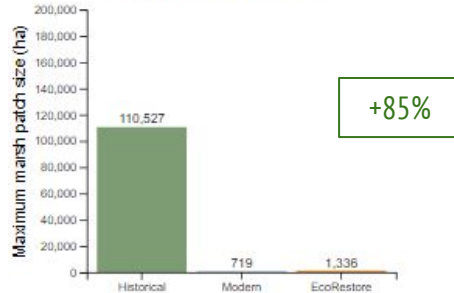
Number of large marsh patches (>500 ha)



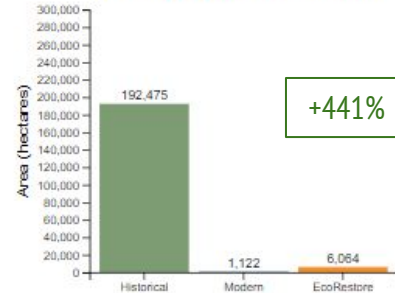
Average marsh patch size



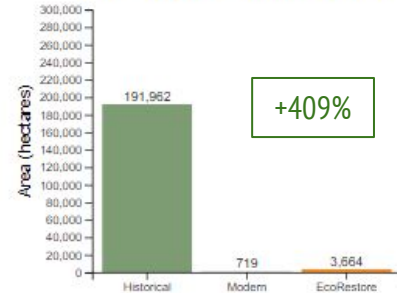
Maximum marsh patch size



Total area of large marsh patches (>100 ha)



Total area of large marsh patches (>500 ha)



A Delta Renewed: example landscape configuration guidance

LANDSCAPE CONFIGURATION & SCALE GUIDELINES

4

Tidal marshes should be as large as possible

Though small marshes have some value, marshes should be as large as possible since the functions they support increase with size. For example, marshes as small as 1 ha can support some California Black Rails, but the density of rails is maximized once marshes reach approximately 100 ha in size. Blind channel length also increases disproportionately with marsh island area;¹⁵ marshes larger than most that exist today are likely needed to maintain long, multi-order channel networks (see pp. 52-55).

Provided landscape configuration guidance related to each strategy

Reference values

<1 ha = 1 marsh patch size for Tricolored Blackbird nesting¹⁶

1 ha = minimum marsh patch size for California Black Rail occupancy¹⁷

100 ha = minimum marsh patch size for maximum Black Rail density¹⁸

500 ha = approximate marsh area for a full channel network (based on historical landscape)¹⁹

4,494 ha = average historical patch size (SD = 17,956)²⁰

4 ha = average modern patch size (SD = 24)²¹

110,527 ha = maximum historical patch size²²

749 ha = maximum modern patch size²³

e.g., How large should marshes be?

• 2 ha = minimum patch size for Black Rails

● 100 ha = minimum patch size to support maximum density of Black Rails

● 500 ha = patch size for full channel networks.

● 4,500 ha = average historical patch size

Grey background circle shows the maximum historical patch size (110,500 ha)

Tool modules: Woody riparian habitat



Goal: Analyze the extent & patch size of woody riparian habitats for their ability to support riparian wildlife

Primary analyses:

- Total area
- Patch size

Key output:

- Shapefile of riparian patches

Considerations:

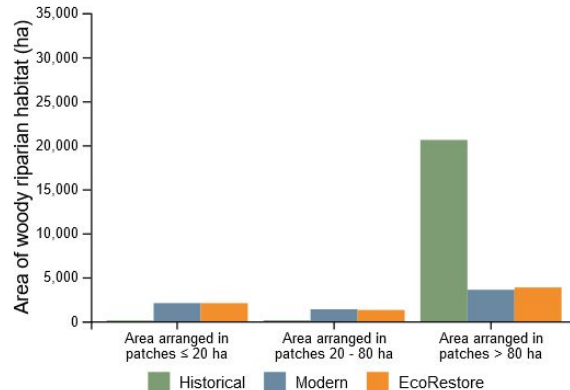
- Add riparian width?

Woody riparian habitat patch size

Large riparian patches likely support more habitat complexity, greater species diversity, and larger wildlife populations than smaller patches. Historically, the average patch size of woody riparian habitat in this area was **867 ha**. In the modern Delta the average woody riparian patch size is **6 ha**. EcoRestore would increase the average size of woody riparian patches to **7 ha**. Historically, **99.0%** of woody riparian habitat was found in patches larger than 80 ha (the minimum size researchers have defined as optimal to support the state-listed Western Yellow-billed Cuckoo in California; [Laymon and Halterman 1989](#)). In the modern Delta, **51.0%** of woody riparian habitat is found in patches larger than 80 ha. EcoRestore would increase this percentage to **53.4%**. The table and chart below also quantify the percentage of woody riparian habitat arranged in patches at least 20 ha in size, which is deemed "marginal" habitat for cuckoos (patches smaller than 20 ha are considered "unsuitable").

Woody riparian patch size distribution

Total woody riparian area (hectares) arranged in patches	Historical	Modern	EcoRestore
≤ 20 ha	94 ha (0.45%)	2,068 ha (29%)	2,066 ha (29%)
20 - 80 ha	113 ha (0.54%)	1,368 ha (19%)	1,289 ha (18%)
> 80 ha	20,604 ha (99%)	3,582 ha (51%)	3,845 ha (53%)



Tool modules: Fish support



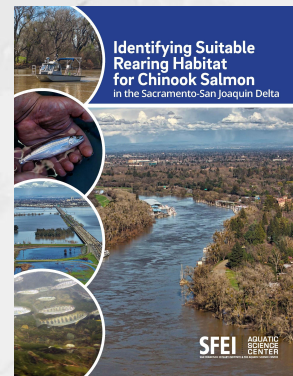
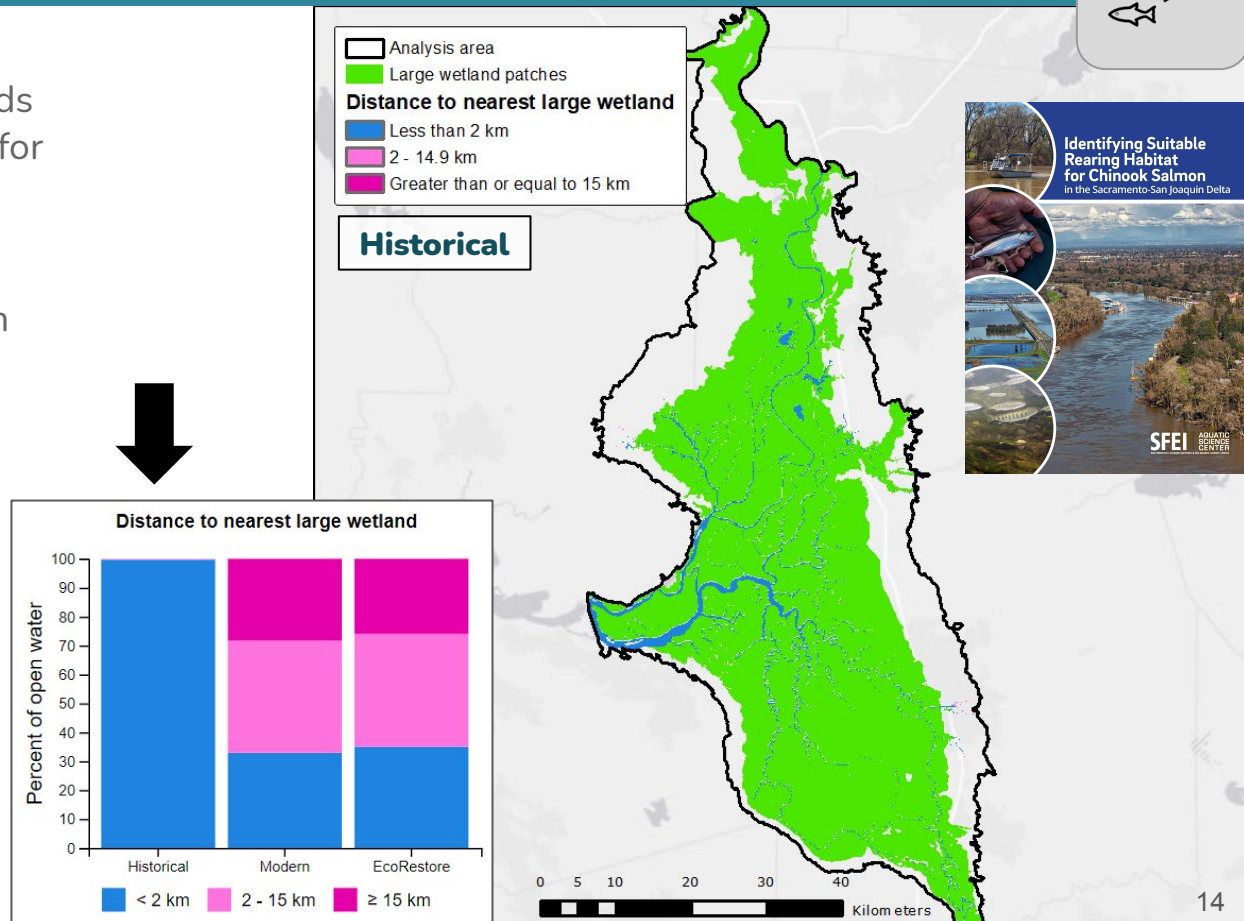
Goal: Highlight changes to wetlands and open water that affect support for fish in the Delta

Primary analyses:

- Marsh area and marsh to open water ratio
- **Connectivity of large wetlands along fish migration corridors**
- Channel edges
- Water temperature

Key output:

- Image file of distance to nearest wetland



Tool modules: Fish support



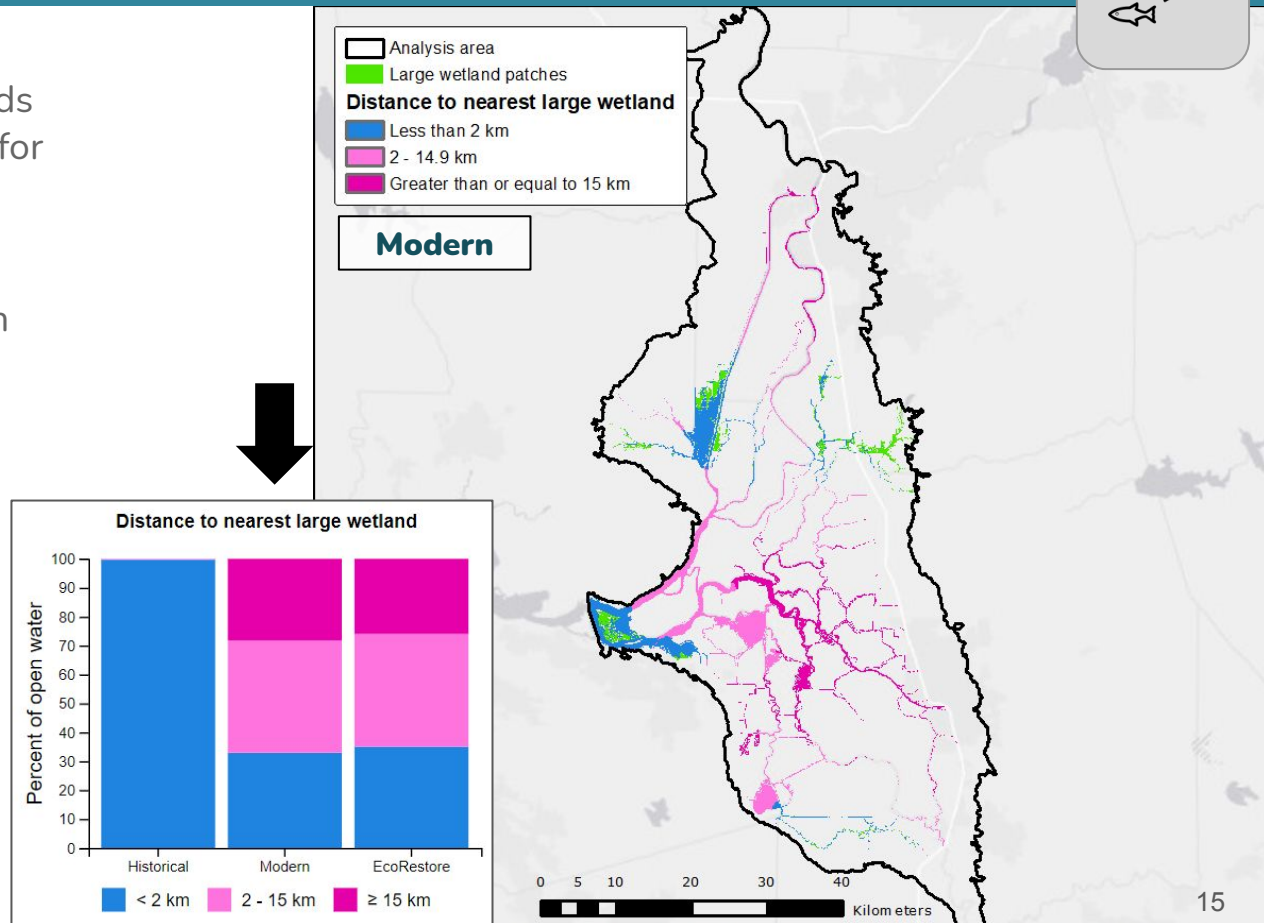
Goal: Highlight changes to wetlands and open water that affect support for fish in the Delta

Primary analyses:

- Marsh area and marsh to open water ratio
- **Connectivity of large wetlands along fish migration corridors**
- Channel edges
- Water temperature

Key output:

- Image file of distance to nearest wetland



Tool modules: Fish support



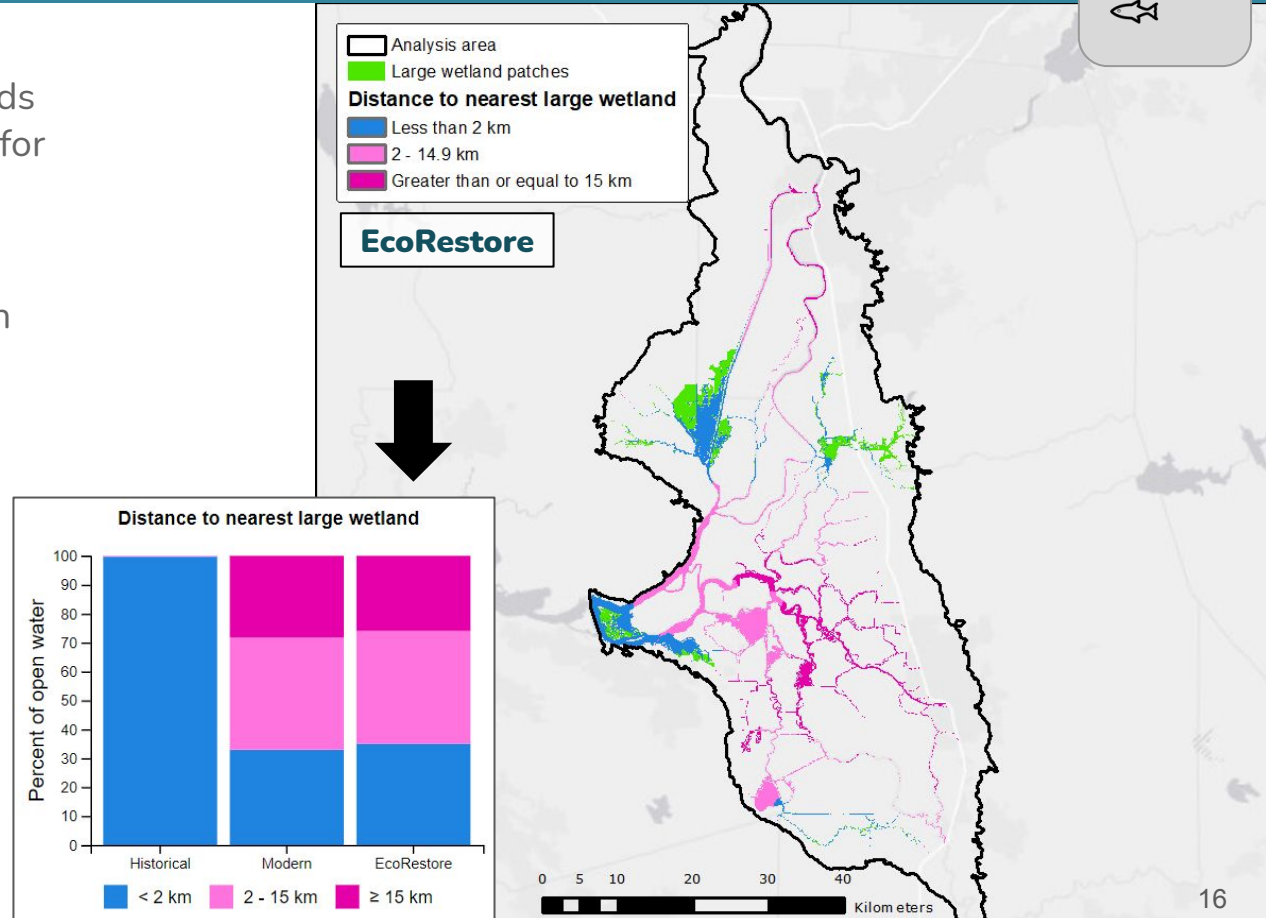
Goal: Highlight changes to wetlands and open water that affect support for fish in the Delta

Primary analyses:

- Marsh area and marsh to open water ratio
- **Connectivity of large wetlands along fish migration corridors**
- Channel edges
- Water temperature

Key output:

- Image file of distance to nearest wetland



Tool modules: Subsidence

Goal: Summarize what portion of subsided lands are covered by land uses that halt subsidence & how it might take to reach sea level in different areas via reverse subsidence.

Primary analyses:

- Current extent of subsided lands
- **Extent of subsidence halting land uses**
- Approximate time to reach sea level with subsidence reversal wetlands

Key outputs:

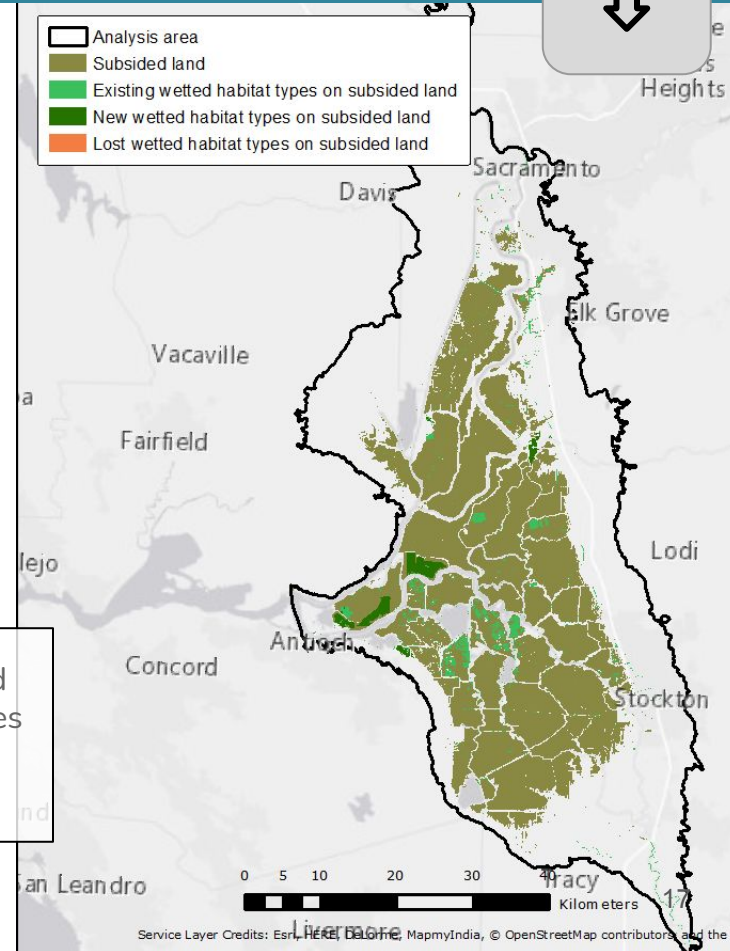
- Maps, text, charts, and shapefiles

Considerations:

- Rice not captured

Subsided area covered by wetted habitat types

- **4%** Modern
- **6%** Ecoreserve



Tool modules: Agriculture



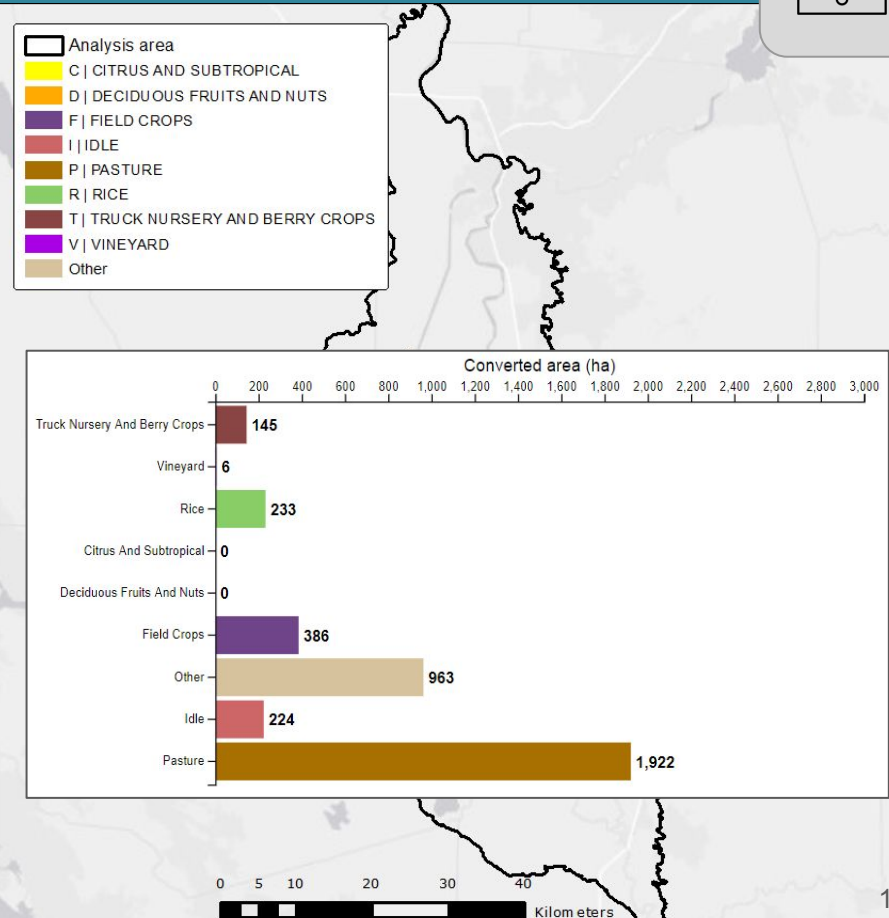
Goal: Analyze the extent of agriculture and impacts due to alternative land use scenarios

Primary analyses:

- Extent of agriculture
- **Change by crop type**
- Change by farmland grade

Key outputs:

- Maps, text, charts, and shapefiles



Tool modules: Infrastructure



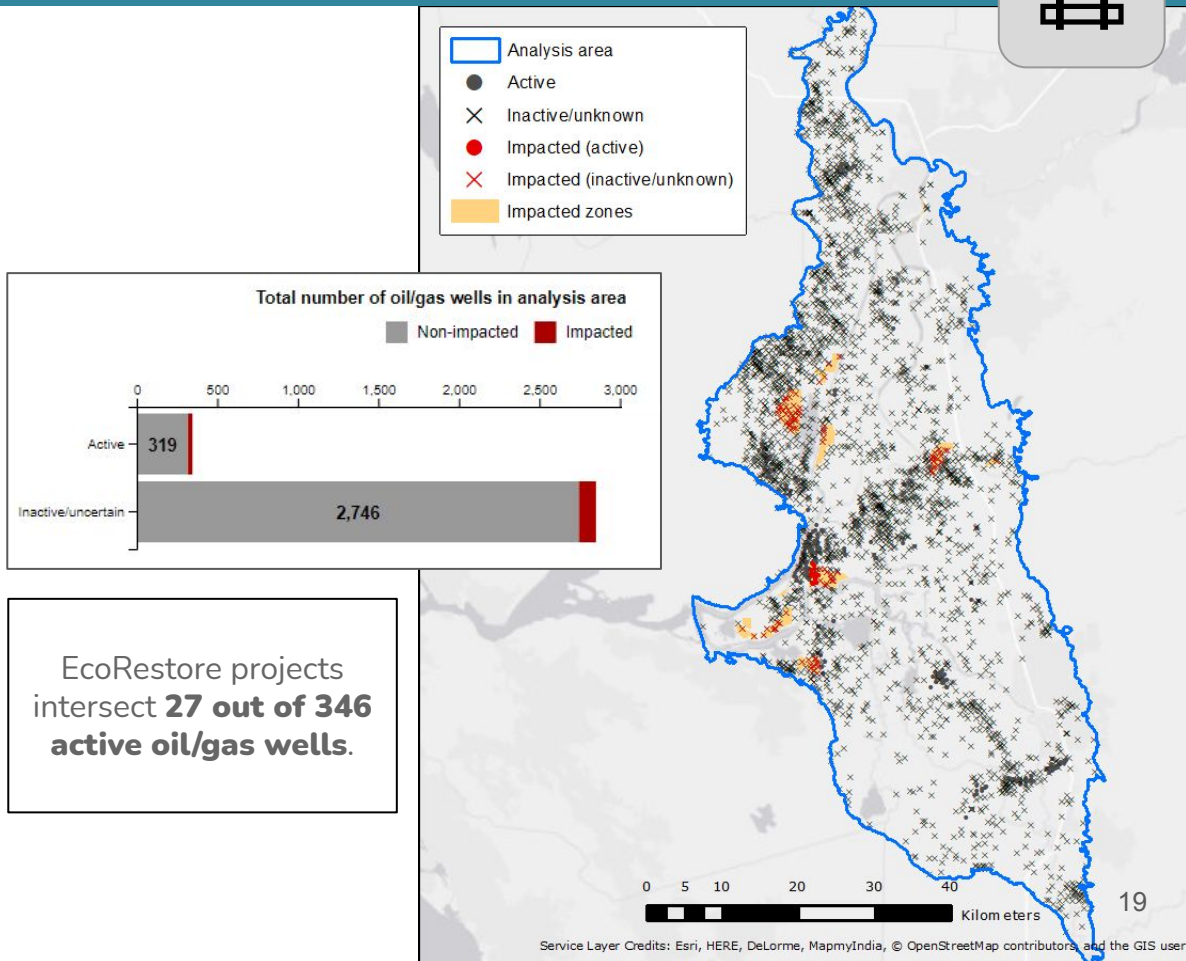
Goal: Identify infrastructure that could be impacted by alternative land use scenarios because they are proximal to modified areas

Primary analyses:

- Roads and railways
- Energy infrastructure
- Water diversions
- Levees

Key outputs:

- Maps, text, charts, and shapefiles



Tool modules: Protected areas



Goal: Identify protected areas & how they overlap with proposed land use modifications

Primary analyses:

- Protected areas extent and ownership
- Protection status and land use

Key outputs:

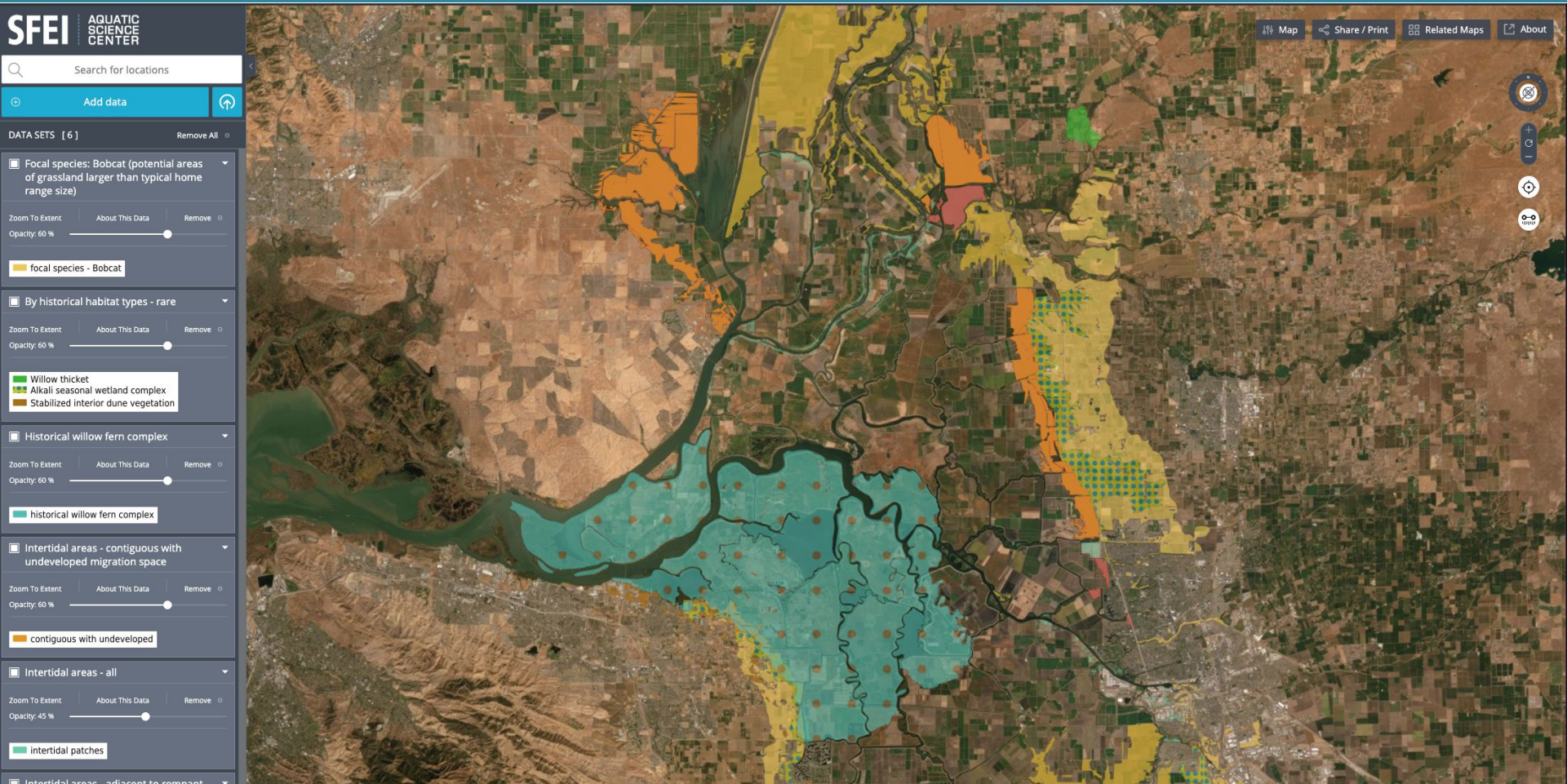
- Maps, text, charts, and shapefiles



		Area (ha)
Area of protected areas under fee title or easement		50,903
Area by protected type	Fee title	34,441
	Easements	21,277
	Both	4,857
Area by owner (fee title)	The Nature Conservancy	5,313
	United States Fish and Wildlife Service	889
	Other Regional, County, & City	3,104
	East Bay Regional Park District	1,058
	Other NGOs	989
	Other Federal	409
	Other State	1,020
	United States Bureau of Land Management	829
	California Department of Fish and Wildlife	10,806
	California Department of Water Resources	7,746
California Department of Parks and Recreation	2,277	



Interactive webmap



Current DSC-funded updates

New analysis modules based on DSC and other stakeholder priorities:

- **Carbon** (funded in part by CDFW)
 - Carbon storage
 - Subsidence/accretion
 - Methane
 - Carbon market revenue
- **Economics**
 - Agricultural revenue and costs
 - Other costs or benefits (reconnaissance)
- **Wetland resilience** (Funded by CDFW)
 - SLR scenarios and tidal marsh resilience

Expanded spatial coverage to include the full Legal Delta and Suisun

Technical improvements:

- Reduce advanced licence dependencies to increase access
- Update CA Protected Areas Database (with GreenInfo Network)
- Integrate with EcoAtlas

Outreach to potential users through training materials, presentations, workshops, and targeted follow-ups

Outreach: DSC Adaptive Management Forum 2021

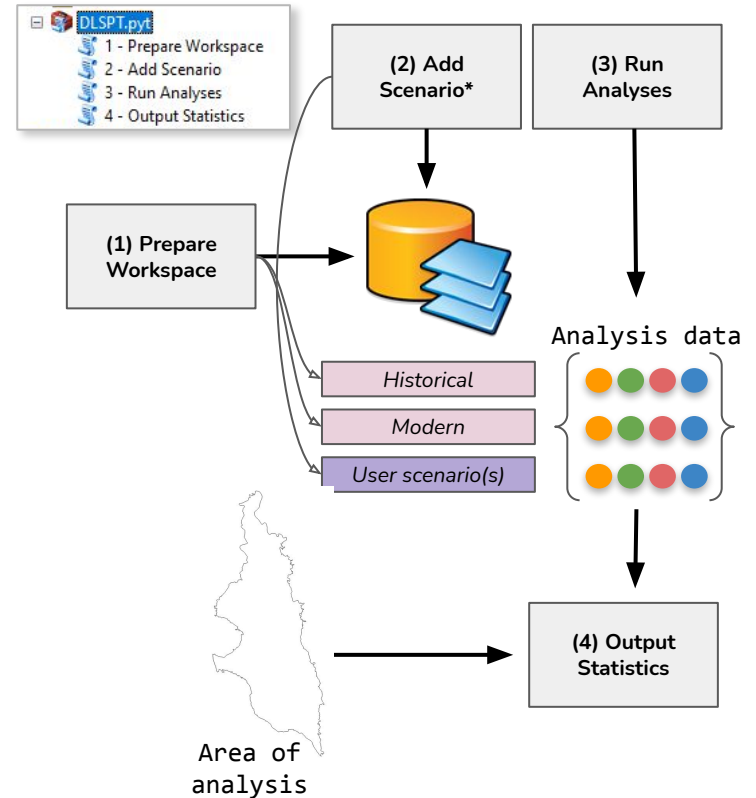
Two DLSPT training workshops

Program

- Introduction to the tool
- Scenario design and running the tool
- Interpreting tool results (Franks Tract Futures pilot scenarios)
- Breakout discussions and Q&A

Participation

- Over 60 people from 25 organizations
- Participation from managers and staff
- Strong interest in restoration (also recreation, agriculture, fish, habitat)



Outreach: DSC Adaptive Management Forum

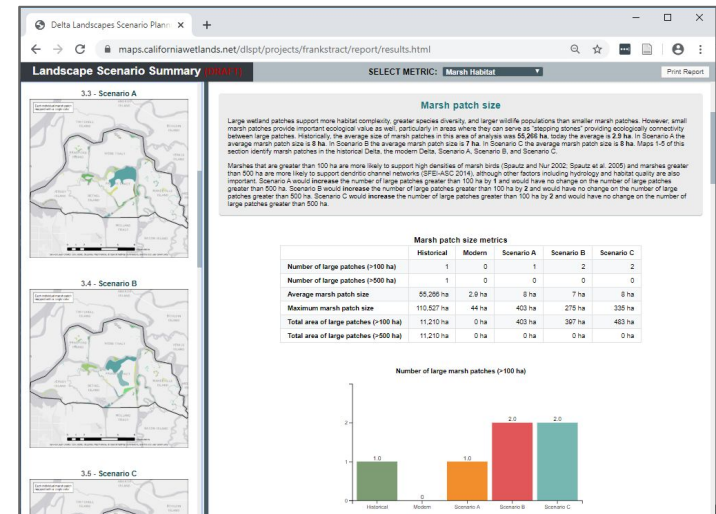
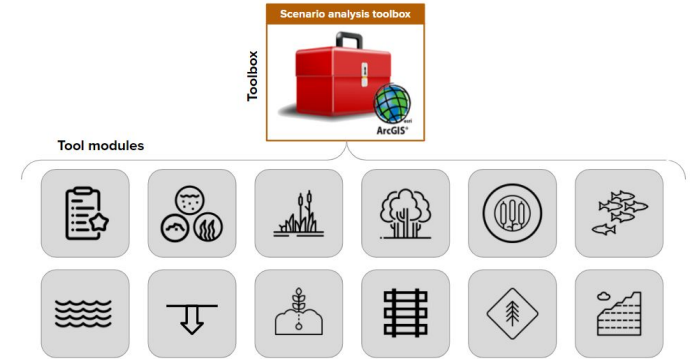
Workshop outcomes and reflections

- High level of participant interest and engagement in module and scenario development (economic, human-dimensions, social, carbon, wildlife-friendly agriculture, recreation)
- Interest in linkage with other efforts (Delta Adapts, integration with Delta Science Program work, use in project alternatives analyses)
- Participants envision using the tool to evaluate funded projects, evaluating project alternatives and trade-offs, assessing habitat benefits for fish, and helping with adaptation planning
- Ongoing technical support a high priority to encourage tool use

Continued outreach efforts will focus on expanding and understanding the active user base

Delta LSPT current work

- New modules
 - Carbon/GHG (partly CDFW funded)
 - Economics
 - Recreation
- Full Legal Delta and Suisun Expansion
- Track landscape change (2002 - 2016 VegCAMP)
- Integrate with EcoAtlas - use to create baseline scenarios
- Outreach



Envisioned Uses

Conversations to Date

- Evaluate proposals for funding
- Plan restoration design alternatives (project-scale)
- Track progress toward Delta Plan performance measures (landscape-scale)

The Big Vision

- An inclusive tool to design a resilient, just, sustainable Delta
- DLSPT is a tool
 - to manage at the system scale
 - trade off functions over space in a multi-benefit framework

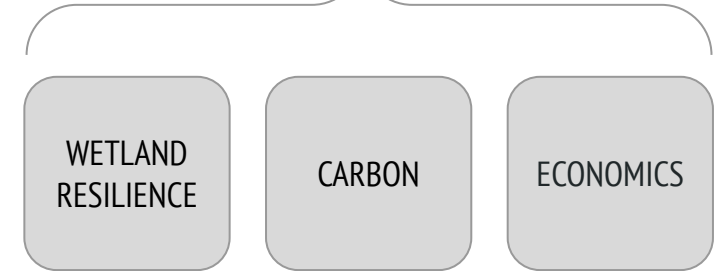
In-progress updates to the DLSPT

New analysis modules

1. Carbon module
 - Estimate carbon storage and methane flux using existing models and data
 - Report time-dependent results
 - Explore potential carbon market revenue
2. Economics module
 - Incorporate agricultural revenue and costs from DAP model (UC Merced)
 - Explore other economic factors to include in the tool
3. Wetland resilience module



New tool modules



In-progress updates to the DLSPT

Technical improvements

- Update tool for ArcPro/Python3
- Reduce advanced licence dependencies
- Update CA Protected Areas Database (with GreenInfo Network)
- Integrate DLSPT with EcoAtlas Project Tracker

```
117 years_to_slr = os.path.join(_dir_gdb_data, "Subsidence_years_to_rising_sea_level_via_wetlar
118
119 # parameters for inundation
120 inundation_layer = os.path.join(_dir_gdb_data, "Inundation_delta_regularly_inun
121 inverse_liberty_island_erase = os.path.join(_dir_gdb_data, "Inundation_inverse_liberty_isla
122 hydrologically_connected = os.path.join(_dir_gdb_data, "Inundation_hydrologically_conne
123
124 # parameters for fish support
125 temp_20C_novmay = os.path.join(_dir_gdb_data, "Fish_support_temp_20C_15days_NovMay")
126 temp_24C_junoct = os.path.join(_dir_gdb_data, "Fish_support_temp_24C_15days_JunOct")
127 temp_27C_junoct = os.path.join(_dir_gdb_data, "Fish_support_temp_27C_15days_JunOct")
128
129 # parameters for agriculture
130 crop_type_layer = os.path.join(_dir_gdb_data, "Agriculture_crop_type")
131 crop_type_field = "Crop_type"
132 fmpmp_layer = os.path.join(_dir_gdb_data, "Agriculture_fmmp_type")
133 fmpmp_type_field = "farm_type"
134
135 # parameters for infrastructure
136 roads_layer = os.path.join(_dir_gdb_data, "Infrastructure_delta_roads")
137 road_type_field = "RTTYP"
138 rail_layer = os.path.join(_dir_gdb_data, "Infrastructure_rail")
139 rail_owner_field = "ROM_OWNER"
140 wells_layer = os.path.join(_dir_gdb_data, "Infrastructure_delta_oil_gas_wells")
141 well_status_field = "WellStat_1"
142 gaslines_layer = os.path.join(_dir_gdb_data, "Infrastructure_delta_gas_pipelines")
143 tlines_layer = os.path.join(_dir_gdb_data, "Infrastructure_delta_transmission_lines")
144 water_diversions_layer = os.path.join(_dir_gdb_data, "Infrastructure_delta_water_diversions")
145
146 # parameters for protected areas
147 pareas_feetitle_layer = os.path.join(_dir_gdb_data, "Protected_area_CPAD_2019")
148 feetitle_agency_field = "Agency_Map"
149 pareas_easements_layer = os.path.join(_dir_gdb_data, "Protected_area_CCED_2018")
150 easements_agency_field = "Agency_map"
```


Outreach: DSC Adaptive Management Forum

The 2021 Adaptive Management Forum included two 2-hour training workshops for potential DLSPT users

Program:

- Introduction to the tool
- Scenario design
- Running the tool
- Interpreting tool results (Franks Tract Futures pilot scenarios)
- Breakout Groups
- Q&A
- Follow-up and user support

Participation:

- 119 registered
- 65 different organizations

Outreach: DSC Adaptive Management Forum

Understanding the DLSPT user base: 15 participants responded to a pre-workshop survey

Management concerns:

- Restoration (all 15)
- Recreation (6)
- Agriculture (5)
- Fish (5)
- Habitat/species (3)

Tool applications:

- Management decisions (13)
- Funding decisions (5)
- Regulatory compliance (3)

Primary (planned) mode of using the tool:

- Interpreting outputs (10)
- Creating/planning land-use change scenarios (6)

Goals for the workshop:

- Familiarize themselves with the tool
- Understand the tool's capacity and assumptions
- Learn how to connect to an economic module of Delta agriculture

Questions?