

Reimagining the San Joaquin River Using the EcoFIP Framework to Reconnect Floodplains

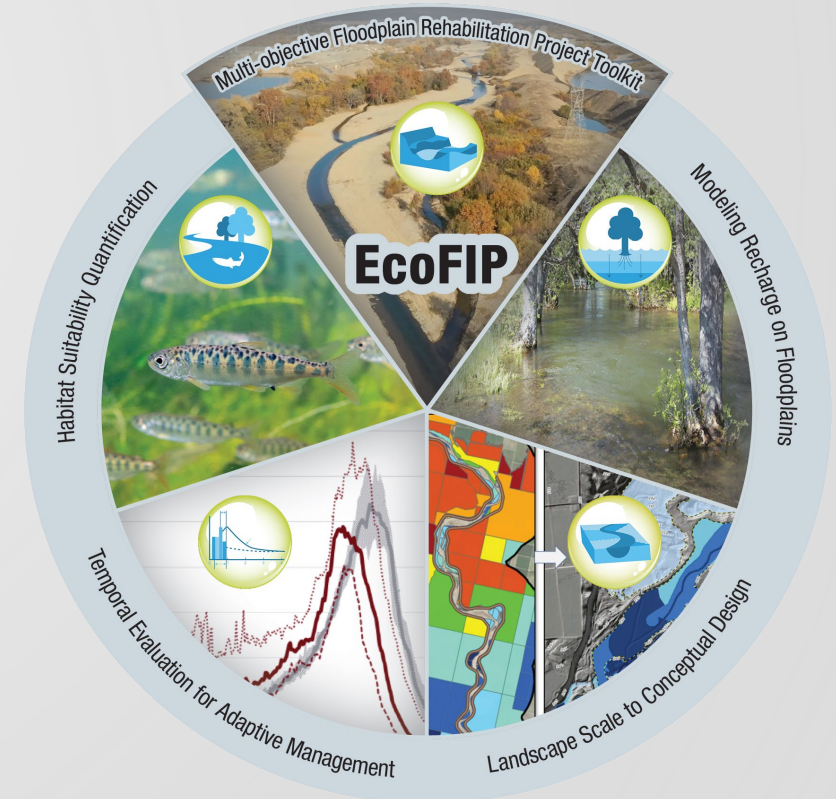


Jacobs

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California Department of Water Resources

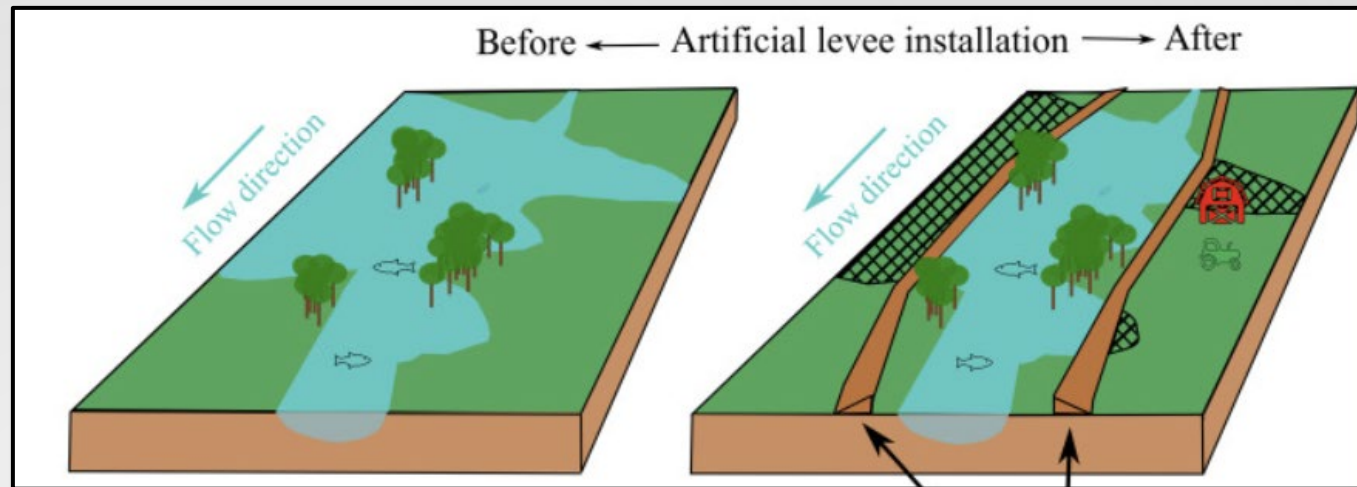


The cost of physical river alteration in California

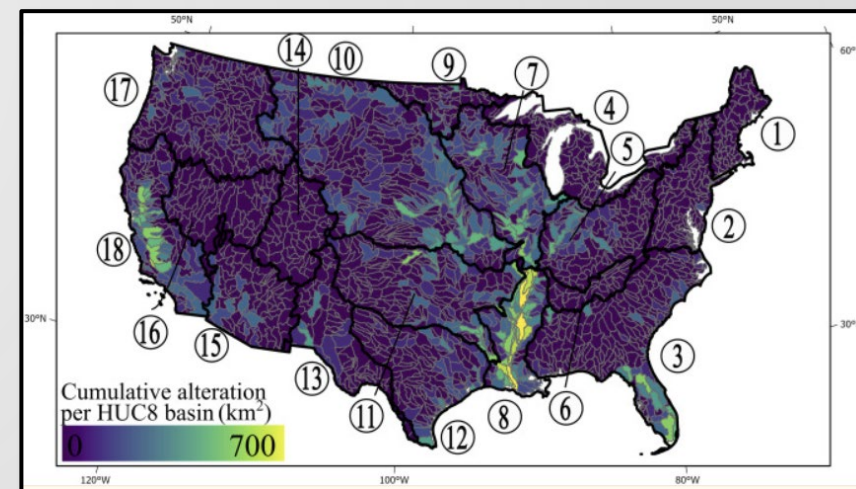
- *Levees disconnect rivers from their floodplains, preventing periodic inundation and ecological connectivity*
- *Over 1,000 miles of levees line rivers in the California Central Valley*



RD 348, Sacramento



Knox et al., 2022, Sci Adv 8(25)



Knox et al., 2022, Sci Adv 8(25)

Jan. 12, 2023

The California Floods

The way the state managed its water in the past has worsened today's flooding — and missed an opportunity to reduce future vulnerabilities.



Flooding after Levee Breaches on the Cosumnes River
Photo Credit Hector Amezcua, MBR / Associated Press

2023: A Winter of Floods

Multi-benefit restoration projects can help, but require advanced planning and coordination



This drone image shows where the Pajaro River levee breached near Murphy Crossing Road. Photo: Alfredo Torres

Featured News Local News

Newsom signs bill to fast-track Pajaro Levee work

By: TODD GUILD October 14, 2023

Register Pajaronian – October 14th, 2023



Encyclopedia Britannica

The San Joaquin River: A Hydrologic History

Before and after: gravel mining on the Upper San Joaquin

Gravel mining
commences in
and near river

Levee construction

Friant Dam
built

1900

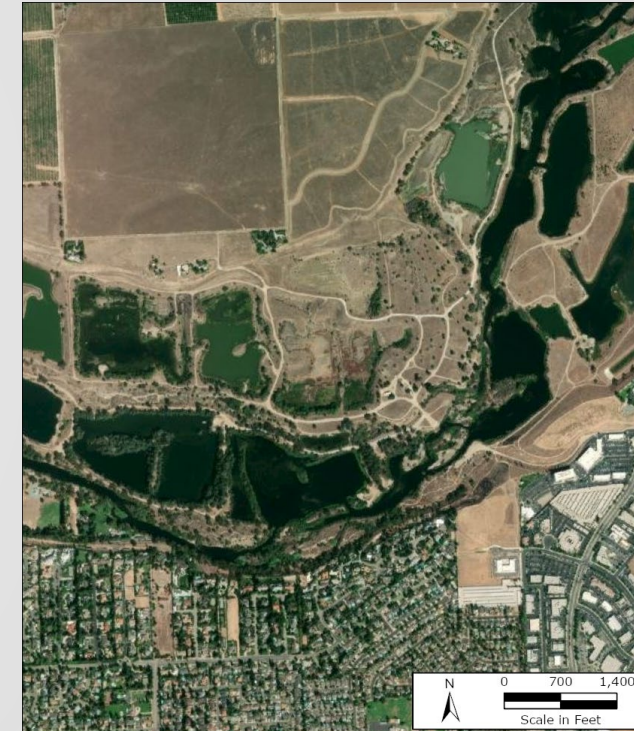
1942

Present

Today: a rigid,
vulnerable, and
ecologically-
degraded system



1950



2022

EcoFIP: Ecological Floodplain Inundation Potential

- Toolkit for identification, screening, and designing **multi-benefit** floodplain rehabilitation projects
- Multiple benefits:
 - Groundwater recharge benefits (e.g., aquifer conditions, base flow, groundwater-dependent ecosystems)
 - Ecosystem benefits (e.g., salmonid habitat)
 - Flood-risk reduction
 - Climate change adaptation (responding to "weather whiplash")

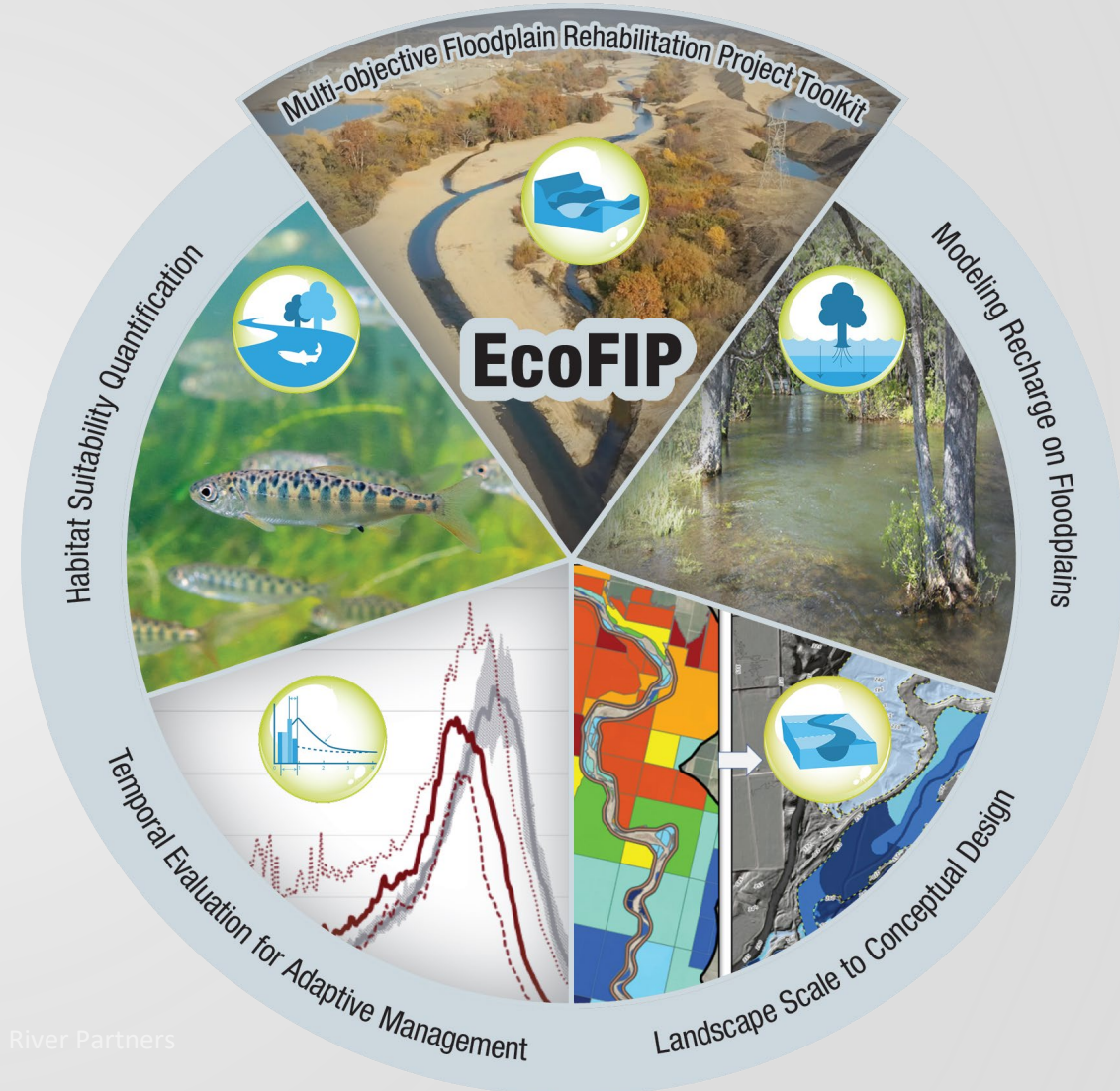
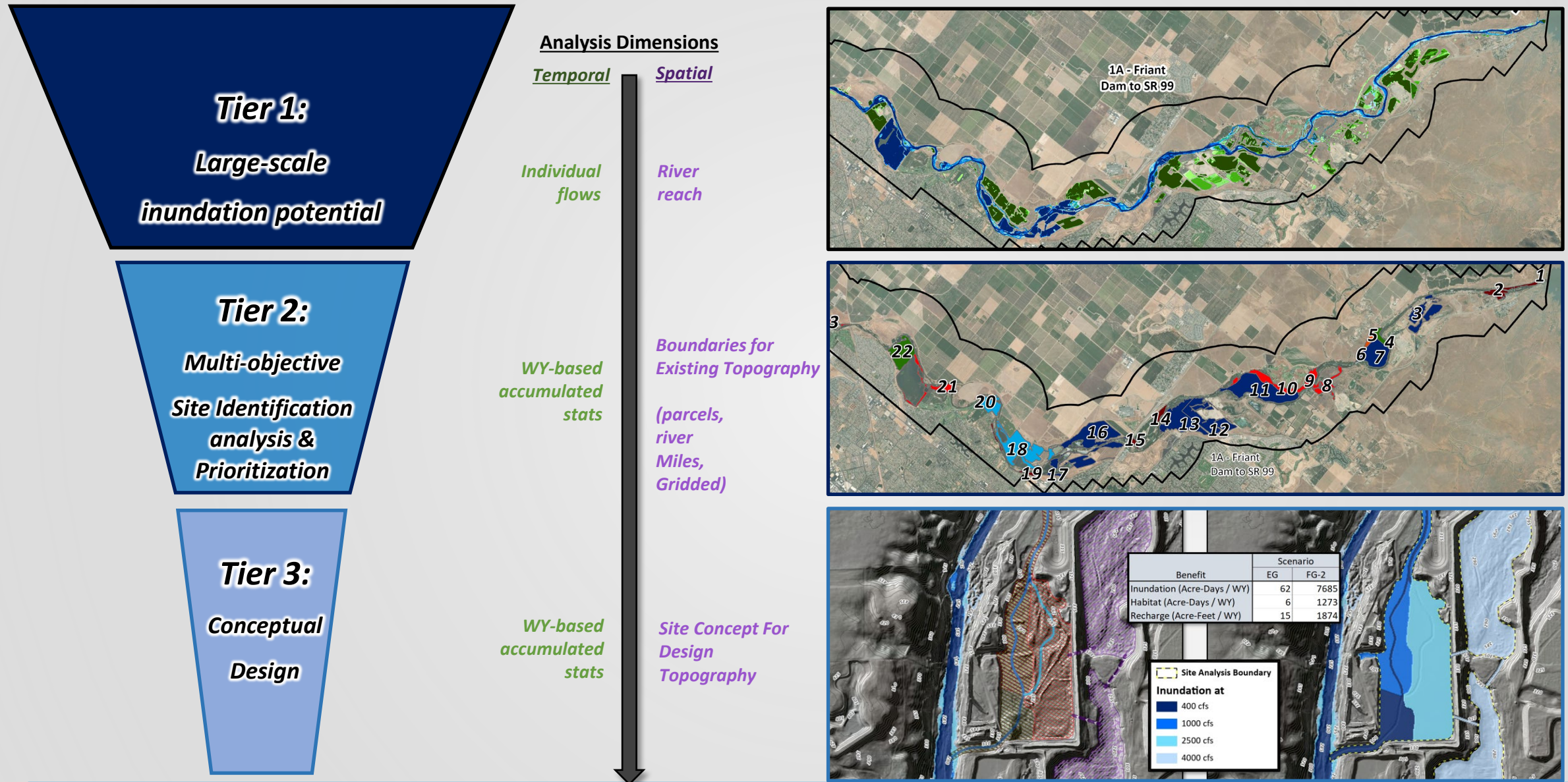
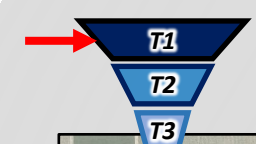


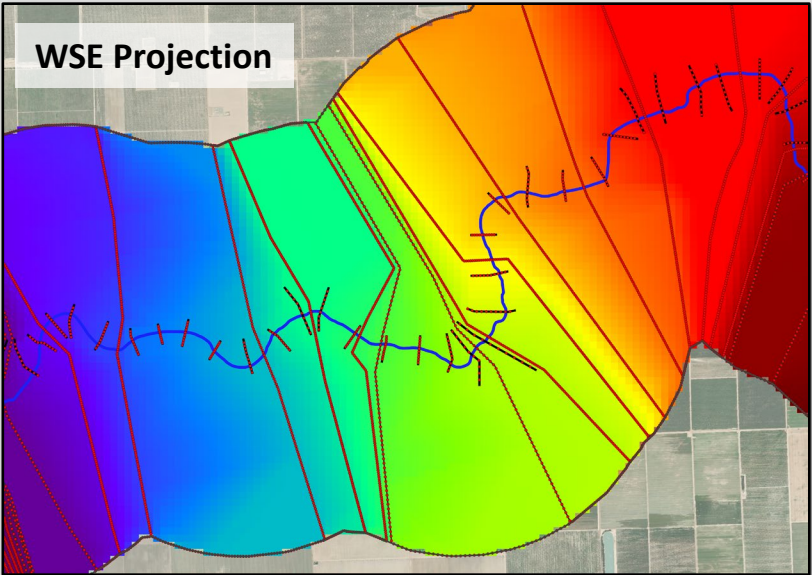
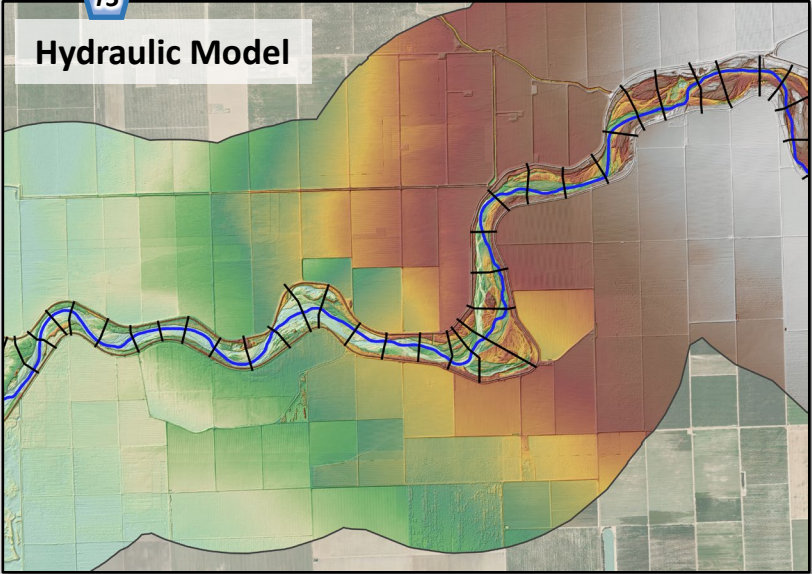
Photo Credit: River Partners

Ecological Floodplain Inundation Potential (EcoFIP)

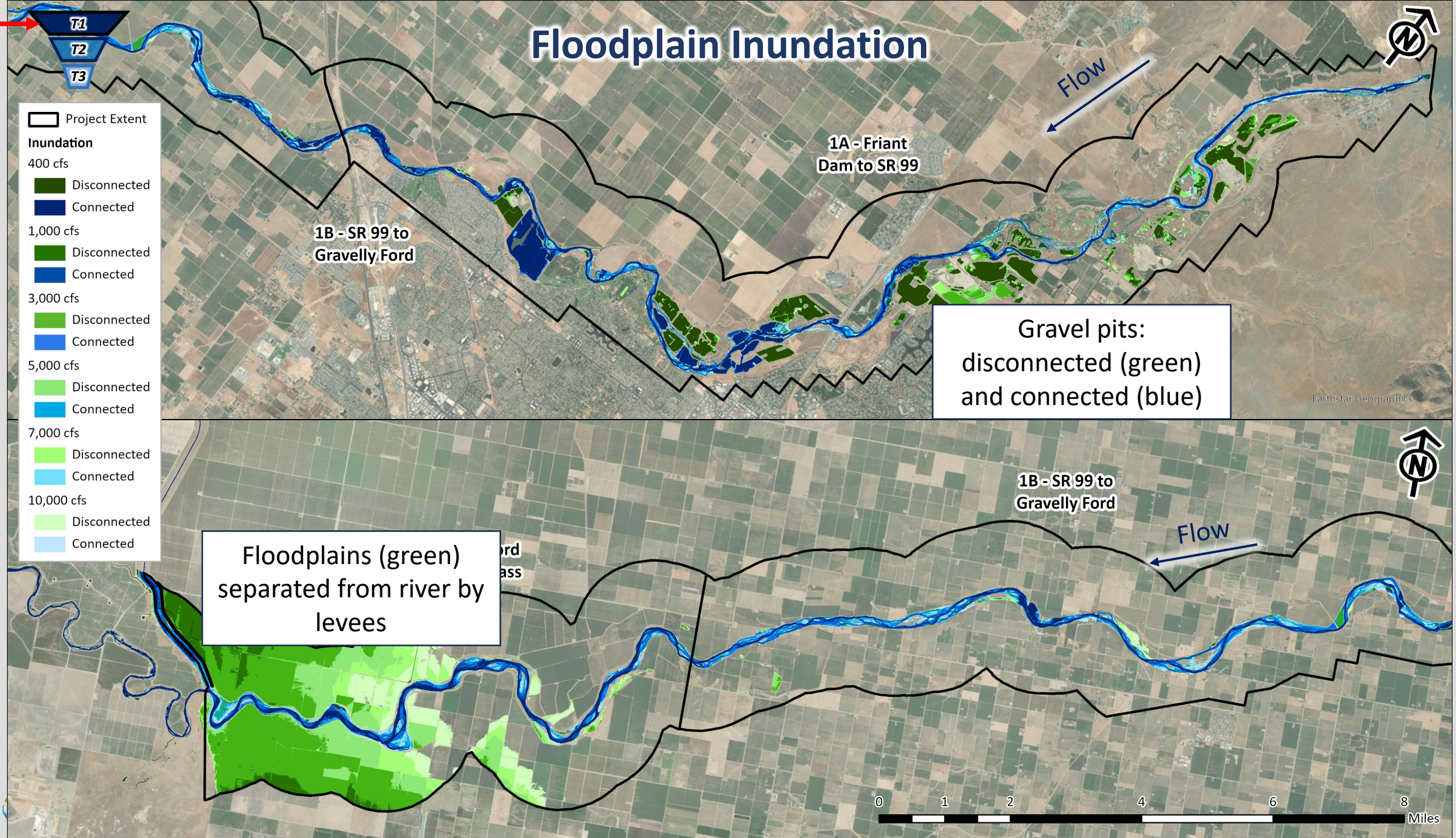
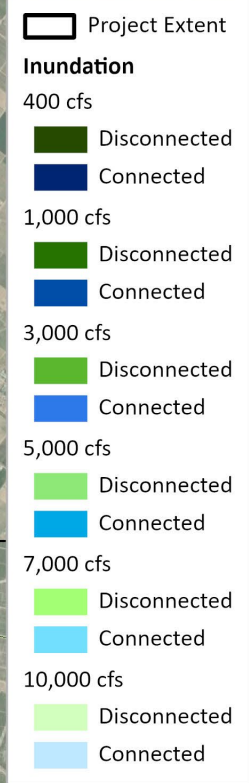


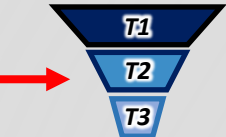


Large-scale Inundation Potential



Floodplain Inundation





Site Rating Curves

- Flow vs. Inundated Area
 - Connected and Disconnected Inundation
- Flow vs. Weighted Usable Area (WUA)
 - Connected and Disconnected Inundation

Used to simulate long-term hydrologic records with the tool without the need for long hydraulic model simulations as inputs



Floodplain Inundation 2009-2022

Project Extent

Levees

Parcel Avg WY

Accumulation

Inundation (Days)

< .05

0.05 - 5

5 - 10

10 - 50

50 - 100

> 100

1B - SR 99 to
Gravelly Ford

1A - Friant
Dam to SR 99

WY Acre-days of inundation / Acre Parcel Size (Days Inundation)

1A - Friant
Dam to SR 99

1B - SR 99 to
Gravelly Ford

2A - Gravelly Ford
to Chowchilla Bypass

Habitat Suitability 2009-2022

Project Extent

Levees

Parcel Avg WY
Accumulation
Suitable Habitat
(Days)

< 0.05

0.05 - 5

5 - 10

10 - 50

50 - 100

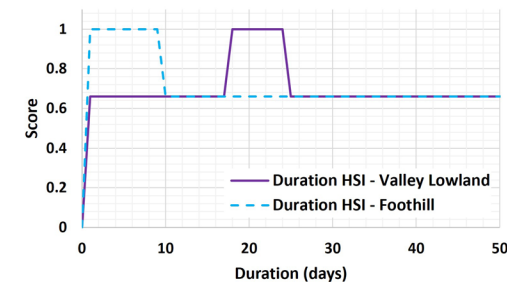
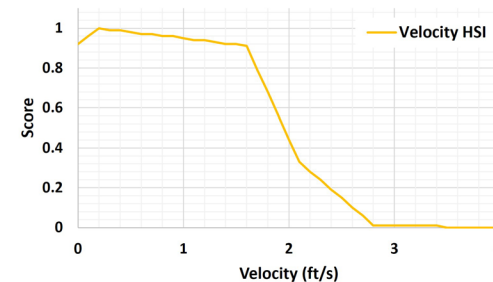
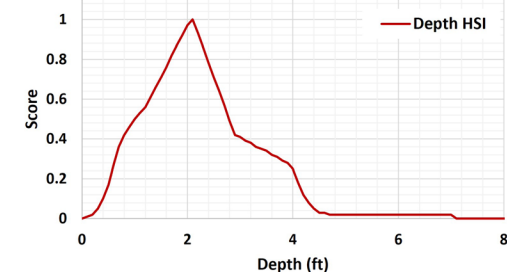
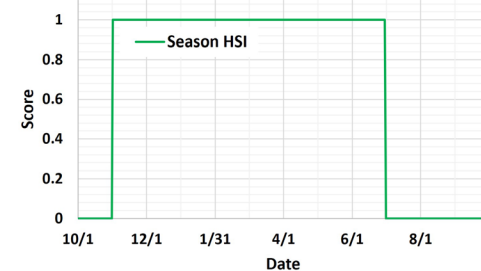
>100

1B - SR 99 to
Gravelly Ford

1A - Friant
Dam to SR 99

WY Acre-days of suitable habitat / Acre Parcel Size (Days Suitable Habitat)

2A - Gravelly Ford
to Chowchilla Bypass



Average Water Year Recharge 2009-2022



Project Extent

Levees

Parcel Avg WY Accumulation Recharge (ft)

| |
|---------|
| > 5 |
| 5 - 10 |
| 10 - 15 |
| 15 - 20 |
| 20 - 25 |
| > 25 |

1B - SR 99 to Gravelly Ford

1A - Friant Dam to SR 99

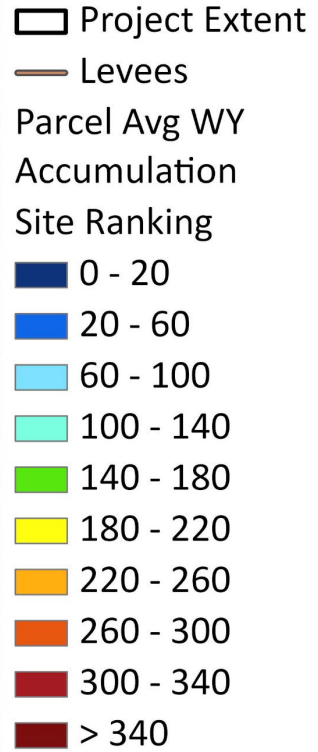
Days of inundation are multiplied by limiting recharge rates based on average K_{sat} (ft/day). The total volume of recharge is limited in a WY by the storage volume (acre-ft).

1A - Friant Dam to SR 99

1B - SR 99 to Gravelly Ford

2A - Gravelly Ford to Chowchilla Bypass

Ranking



1B - SR 99 to
Gravelly Ford

1A - Friant
Dam to SR 99

Datasets of Suitable Habitat and Recharge are normalized and combined using their geometric mean. The “best” sites are then ranked from low to high.

1A - Friant
Dam to SR 99

1B - SR 99 to
Gravelly Ford

2A - Gravelly Ford
to Chowchilla Bypass

Identify, Evaluate, and Prioritize Restoration Concept Locations

Project Extent

Levees

Priority Sites

Average Score
(1-3)

1

1.3

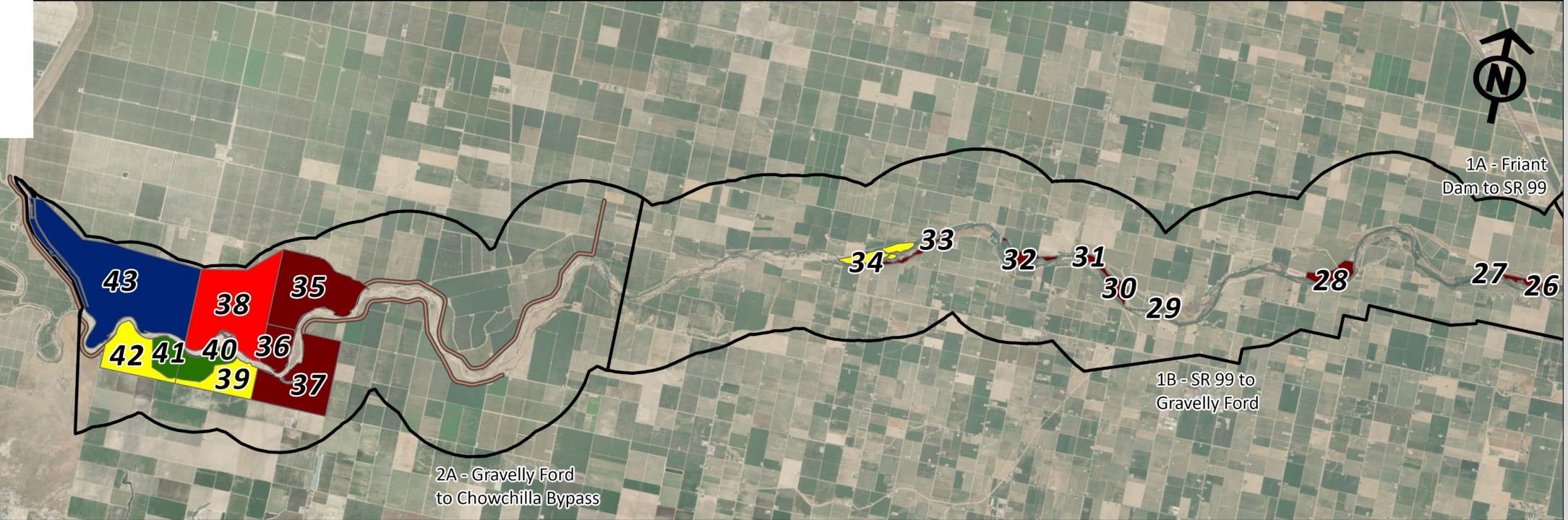
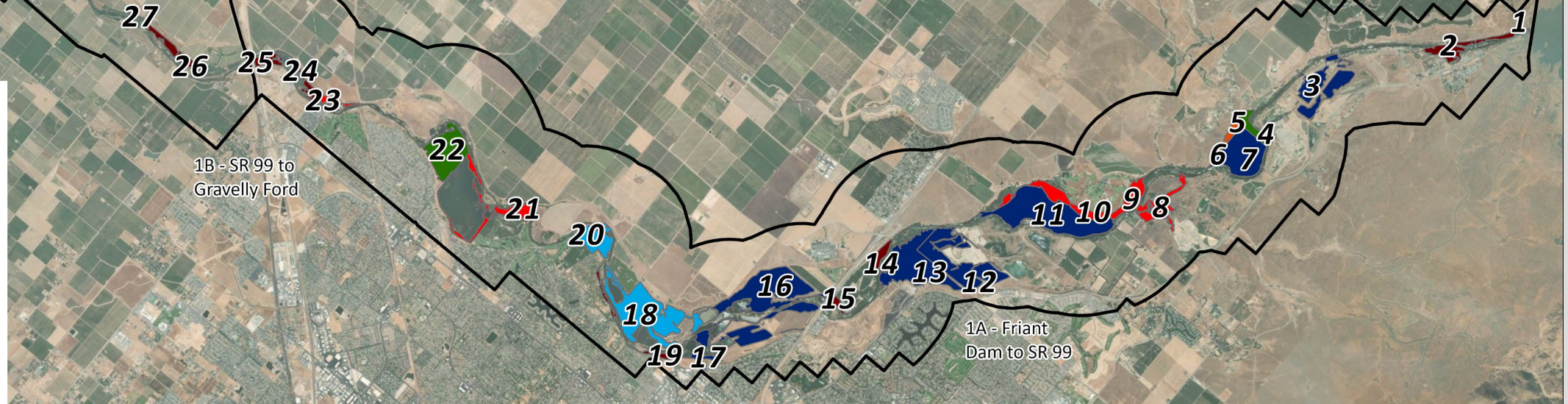
1.7

2

2.3

2.7

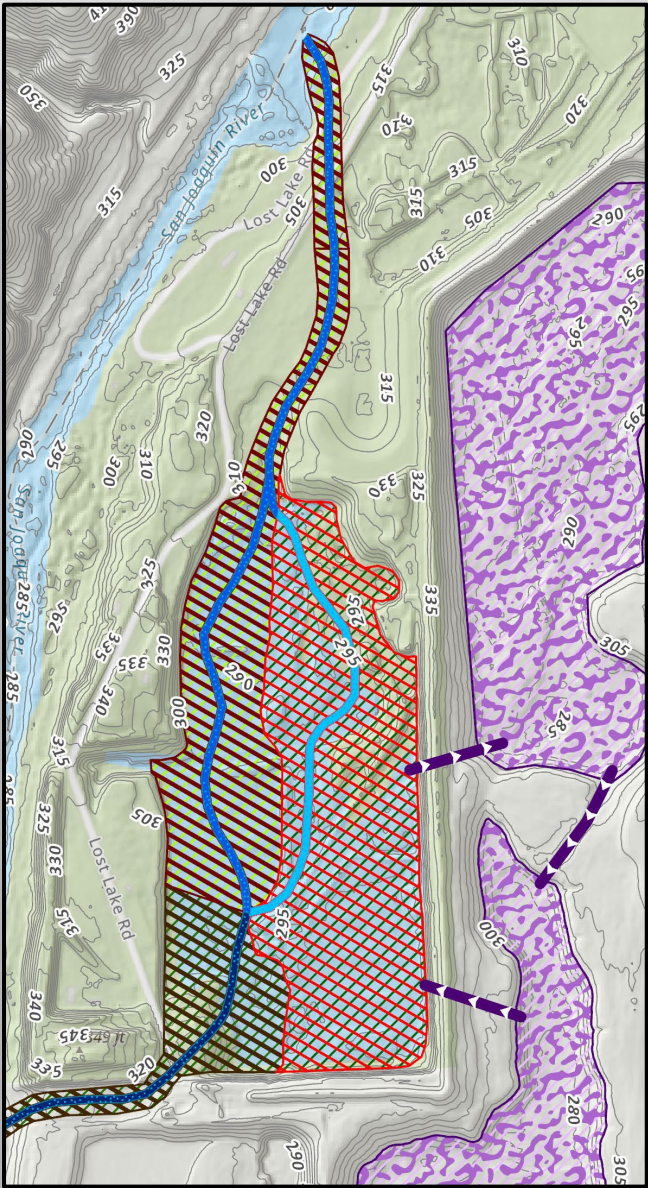
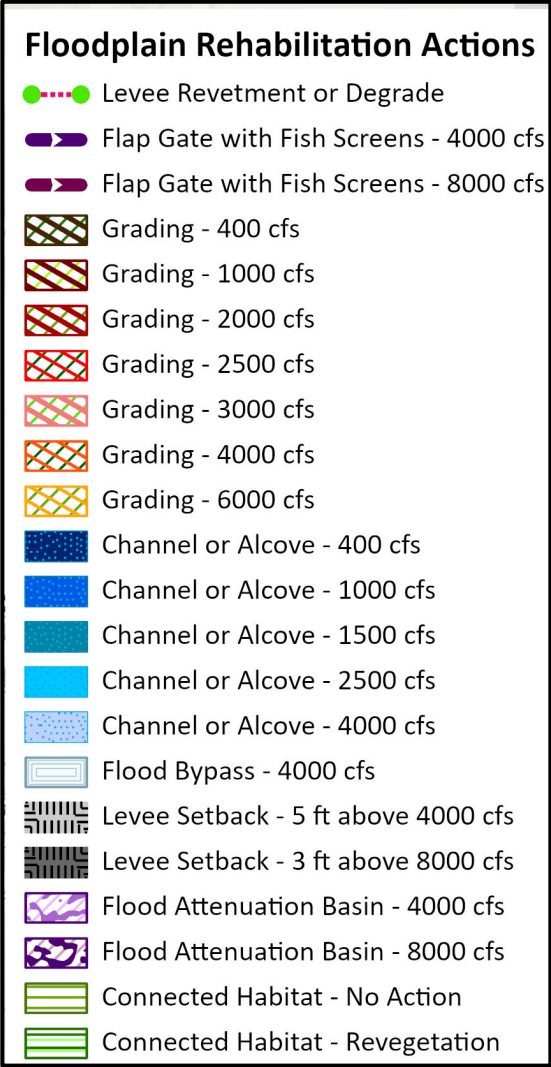
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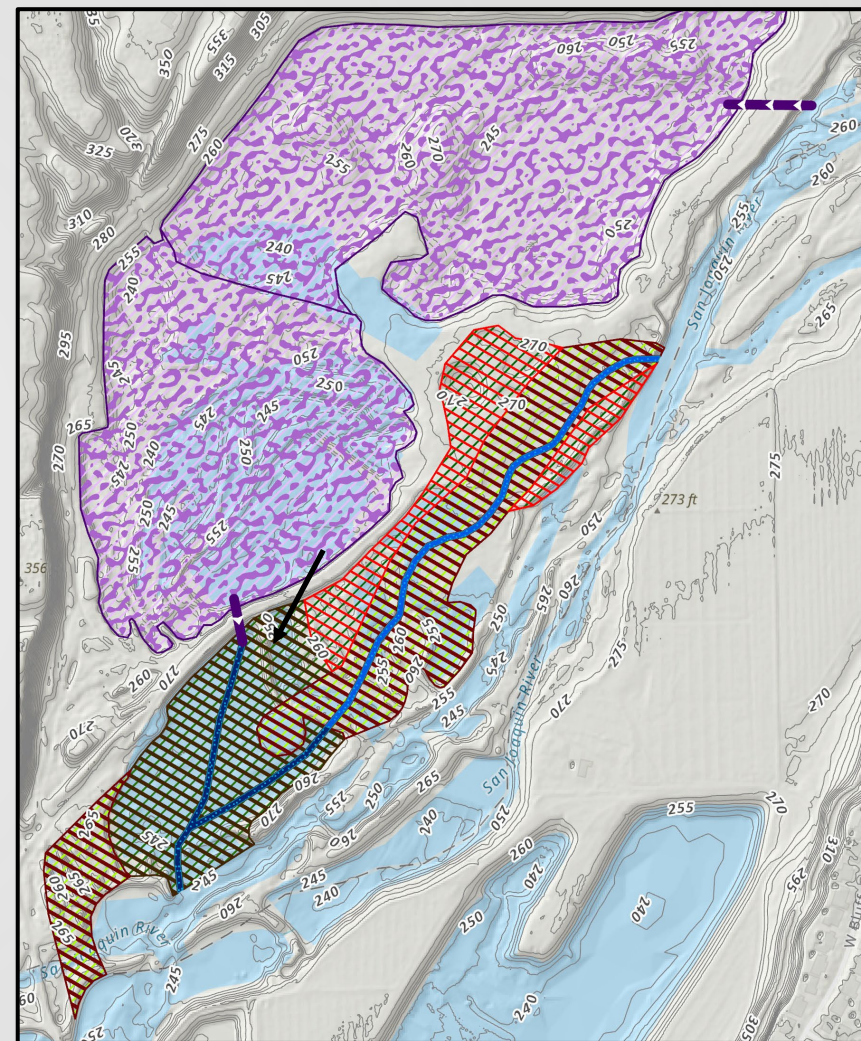
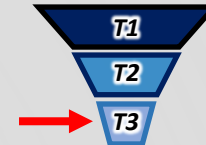
Floodplain Rehabilitation Actions Library

A highly visual tool:

If you can see it, you can believe it...
And if you can believe it, you can build it!



Restoration Concept Examples: Lost Lake



Conceptual Figure Only – Not for Distribution

Site 16 – 1937 Imagery



Site 16 – 2022 Imagery



Conceptual Figures Only – Not for Distribution

Floodplain Rehabilitation Actions

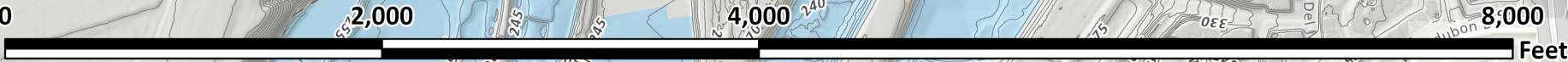
- Levee Revetment or Degrade
- Flap Gate with Fish Screens - 4000 cfs
- Flap Gate with Fish Screens - 8000 cfs
- Grading - 400 cfs
- Grading - 1000 cfs
- Grading - 2000 cfs
- Grading - 2500 cfs
- Grading - 3000 cfs
- Grading - 4000 cfs
- Grading - 6000 cfs
- Channel or Alcove - 400 cfs
- Channel or Alcove - 1000 cfs
- Channel or Alcove - 1500 cfs
- Channel or Alcove - 2500 cfs
- Channel or Alcove - 4000 cfs
- Flood Bypass - 4000 cfs
- Levee Setback - 5 ft above 4000 cfs
- Levee Setback - 3 ft above 8000 cfs
- Flood Attenuation Basin - 4000 cfs
- Flood Attenuation Basin - 8000 cfs
- Connected Habitat - No Action
- Connected Habitat - Revegetation

Lost Lake Rehabilitation Concept

Conceptual Figure Only – Not for distribution

| Concept Area (Ac) | Grading Area (Ac) | Woody Veg Disturbance (Ac) | Revegetation Area (Ac) |
|-------------------|-------------------|----------------------------|------------------------|
| 209 | 66 | 18 | 61 |

| Symbol | Habitat Type | Area (acres) |
|--------|--|--------------|
| | Grading - 400 cfs | 20 |
| | Grading - 1000 cfs | 28 |
| | Grading - 2500 cfs | 13 |
| | Channel or Alcove - 400 cfs | 2 |
| | Channel or Alcove - 1000 cfs | 3 |
| | Flood Overflow Basin - 4000 cfs | 142 |
| | Flap Gate with Fish Screens - 4000 cfs | 1 |



Existing Ground

Final Ground (conceptual)

| Benefit | Scenario | |
|-----------------------------|----------|-------|
| | EG | FG-2 |
| Inundation (Acre-Days / WY) | 6827 | 13395 |
| Habitat (Acre-Days / WY) | 748 | 1800 |
| Recharge (Acre-Feet / WY) | 1526 | 3304 |

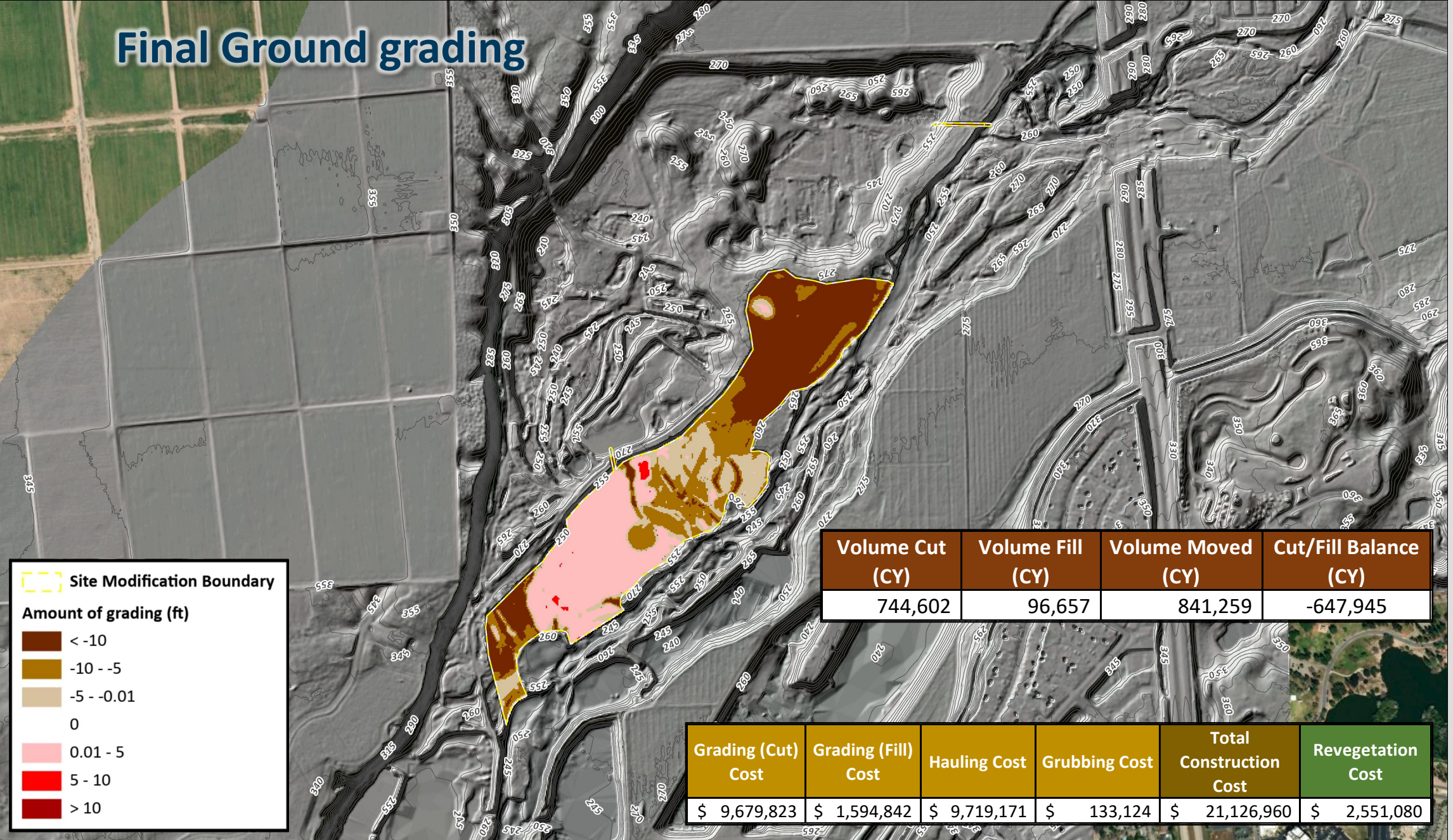
Site Analysis Boundary

Inundation at

- 400 cfs
- 1000 cfs
- 2500 cfs
- 4000 cfs

Conceptual Figures Only – Not for Distribution

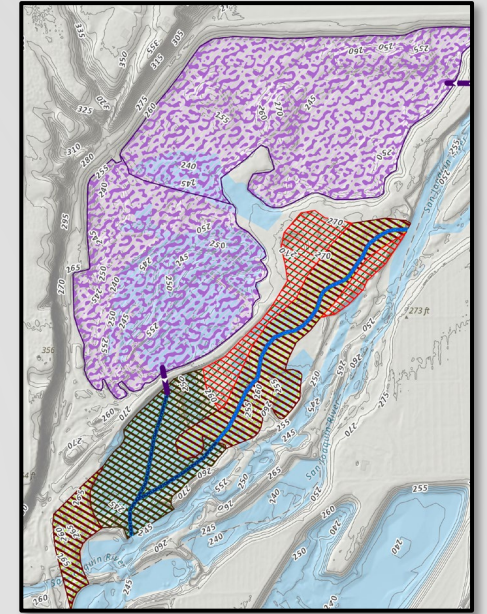
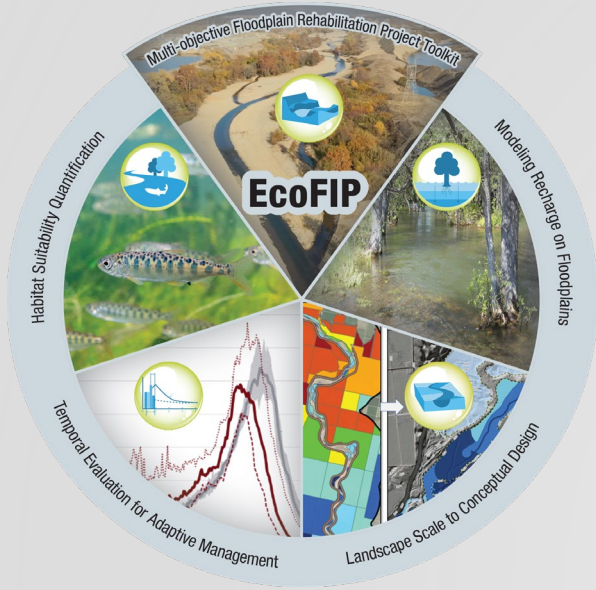
Final Ground grading



Next Steps

- **Constantly Updating Toolkits With New Functionality and Applications**
 - ☐ Riparian recruitment tool
 - ☐ Integrating With Groundwater Models
 - ☐ Flood Attenuation Basins and Pond Filling Dynamics
 - ☐ Adding metrics for additional habitats or species
- **Data Visualization and Reporting**
 - ☐ San Joaquin River Story Map for Phase I is out!
 - <https://storymaps.arcgis.com/stories/7e657bc93bda4117928b351e59a2bb6b>
 - ☐ San Joaquin River Phase 2-3, and additional locations in 2024
- **Success Is Measured by Implementation!**





Questions?

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