Advancing Riparian and River Restoration in a Time of Uncertainty: Natural Disturbances and Human Induced Stressors Including Drought, Climate Change, Bore Beetle, Fire

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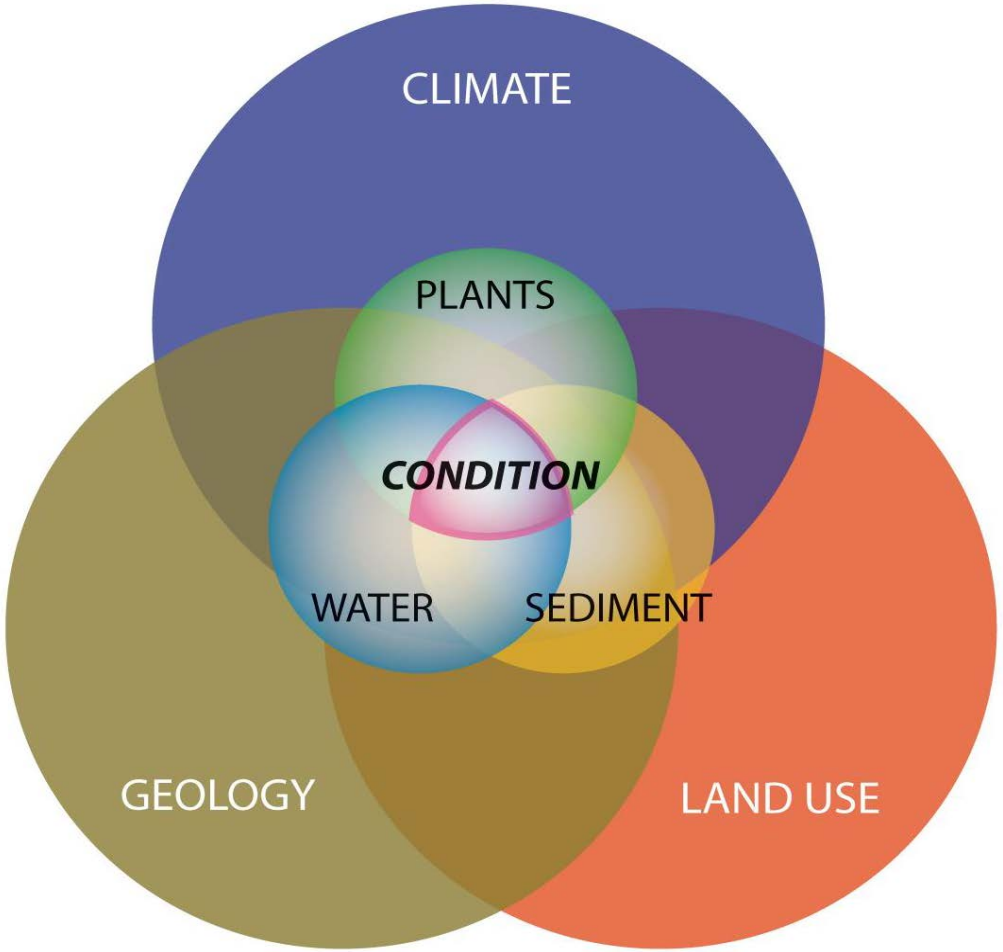
Wetland Condition/ Function is Influenced by Large and Small Scale Drivers



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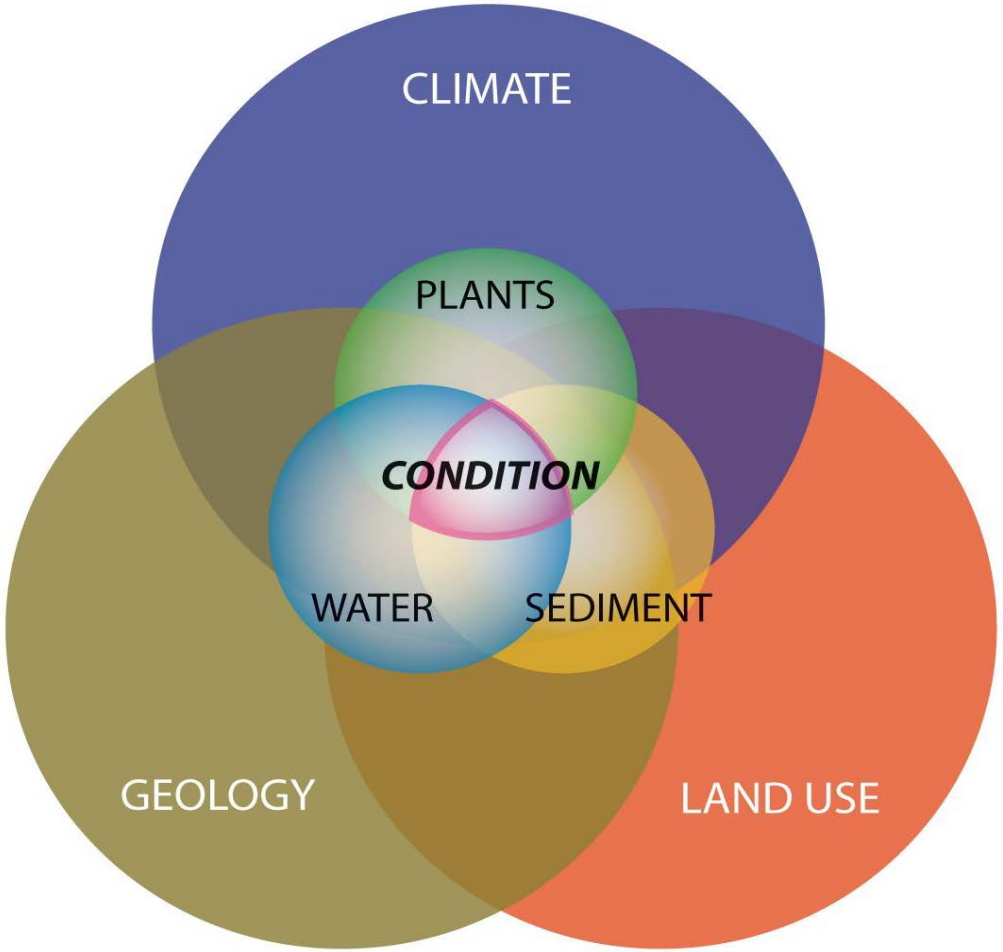
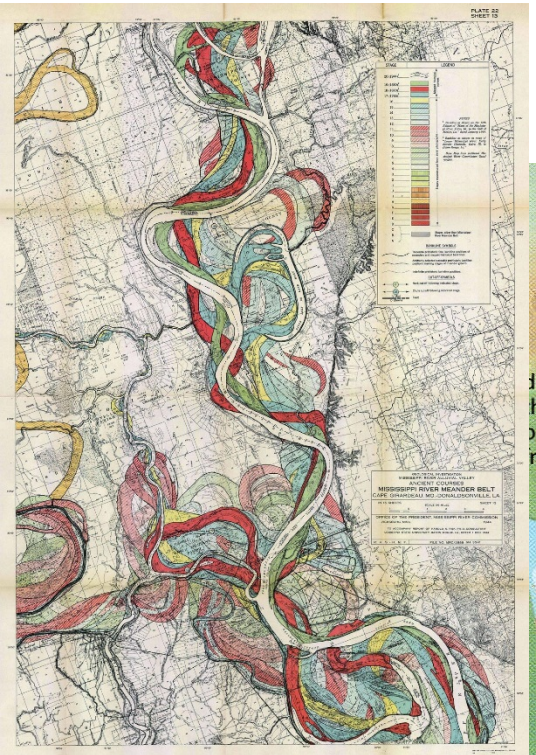
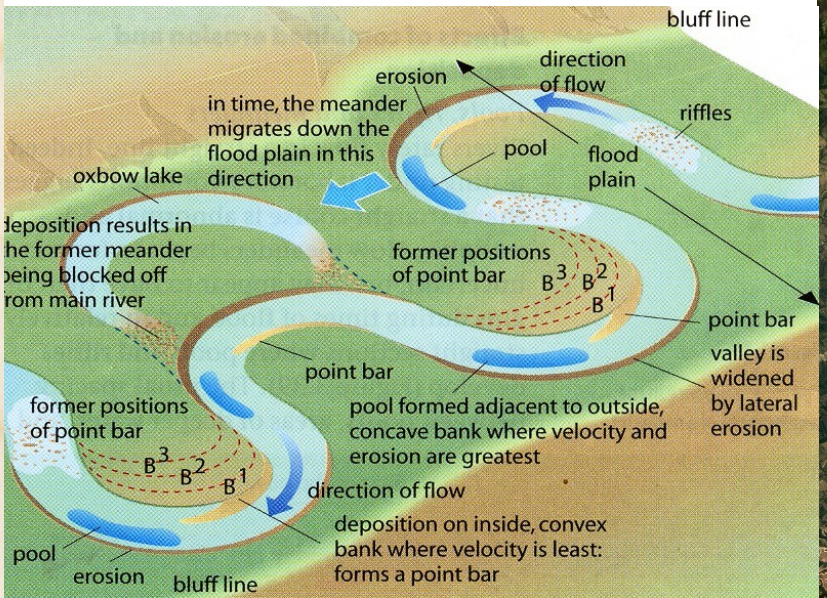
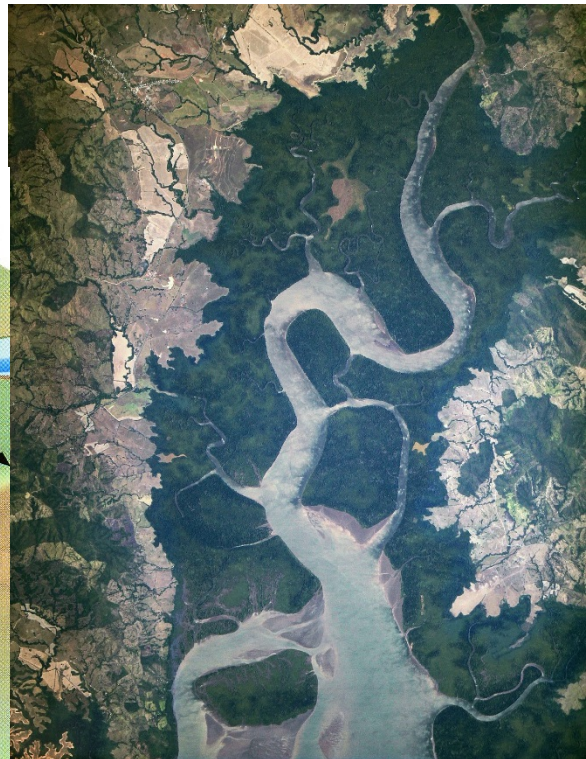


Nothing is Static

Nothing is Static: Restoration is Built on the Principle of Change, with One of the Goals of Maximizing Ecological Processes to Facilitate Self-Sustaining Dynamic Systems







Change Happens in Incrementally and in Punctuated Events

Disturbances: consequence of natural phenomena that measurably affect conditions in the field (natural)

- **Flood**
- **Fire**
- **Drought**
- **Landslide**
- **Disease**
- **Pests**

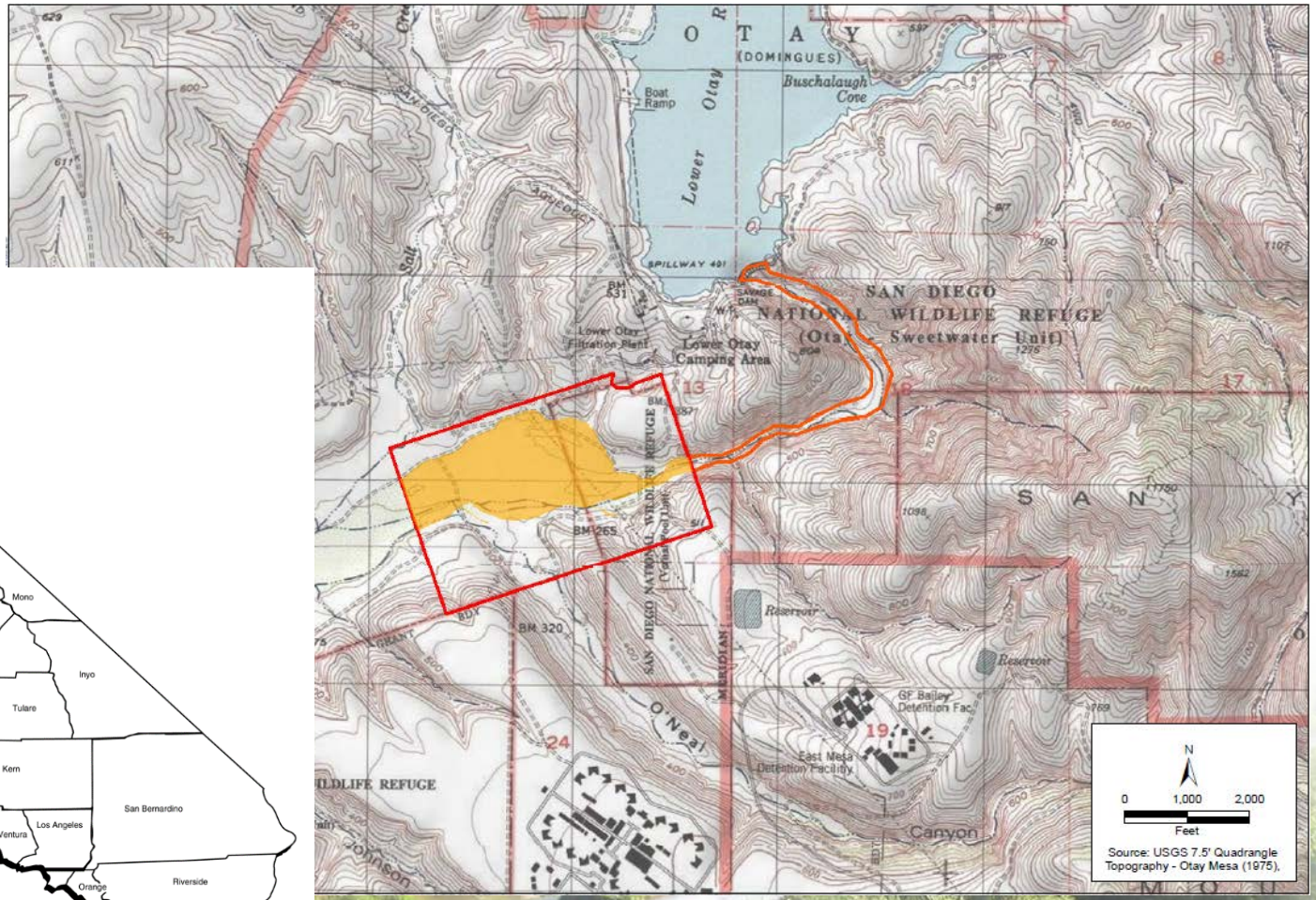
Stressors: consequence of anthropogenic events or actions that measurably affect conditions in the field (human induced)

- **Fire**
- **Flood**
- **Invasive Species (plants and animals)**
- **Human Use**
- **Chemicals, organic matter, sediment**

Share Challenges Faces Two Large Scale Riverine Mitigataion Projects

1. Otay River Restoration Project and Mitigation Bank, San Diego CA (300 acres)
   - **Implementing first phase**
   - **Developing mitigation bank for future phases**
2. Upper Santa Ana River Habitat Conservation Plan and Mitigation Bank, San Bernardino and Riverside CA (4 sites, 20-100's acres)
   - **Evaluating opportunities and constraints, developing crediting strategy**

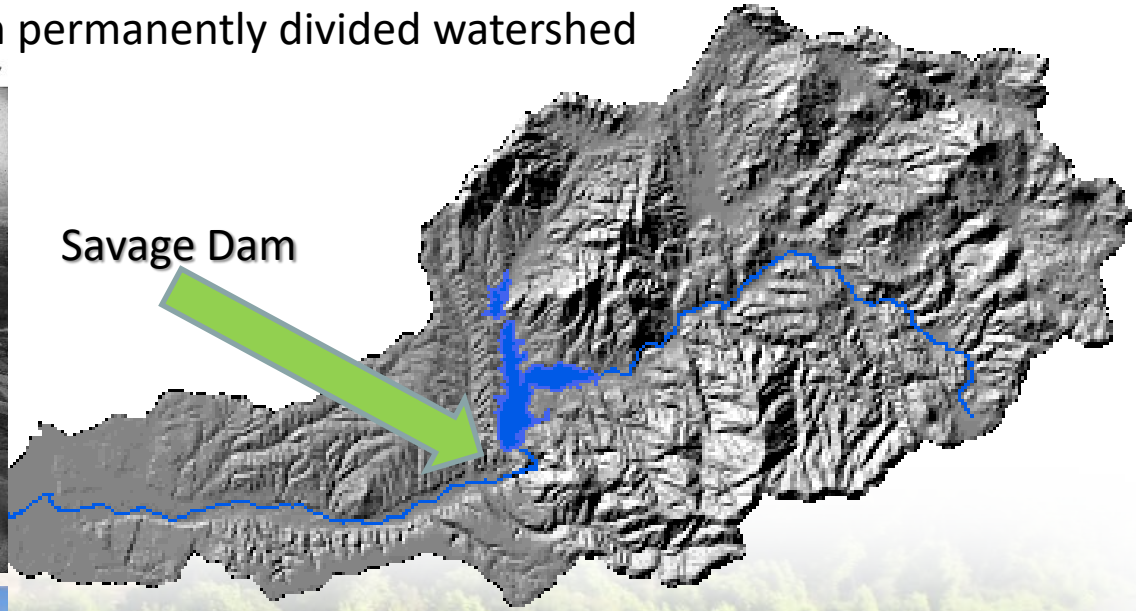
Otay River Restoration Project



Why Restoration is Needed?

- 1917 flood destroyed original dam
- Historical channel and primary floodplain wiped out
- Deposited substantial sand in lower floodplain (project area)
- Construction of Savage Dam permanently divided watershed

San Diego Historical Society

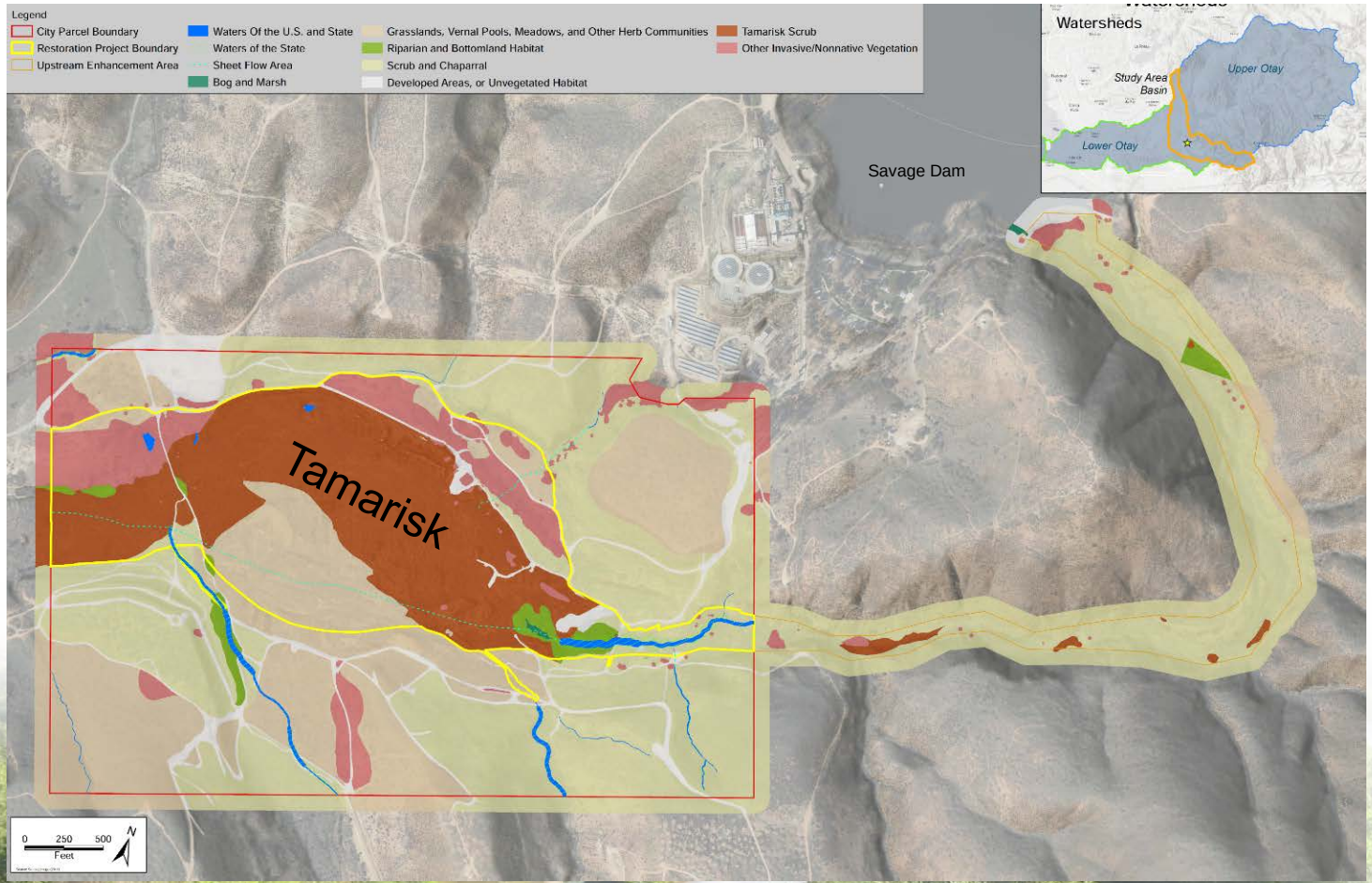


What Do You Do With All That Sand? Mine it of course!!

- Two decades (60s & 70s) of sand and gravel mining
- Inadequate flow with cutoff watershed for river to self-repair channel

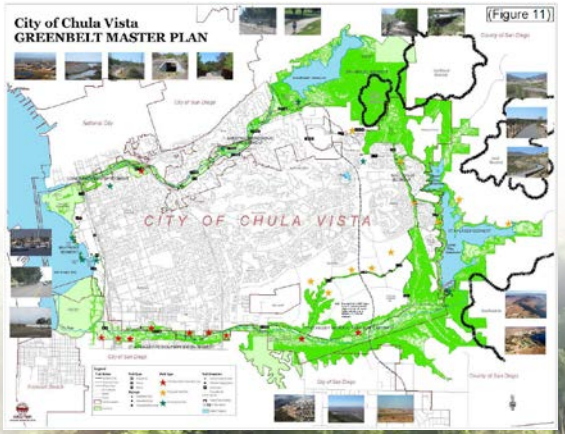
No Restoration or Reclamation…

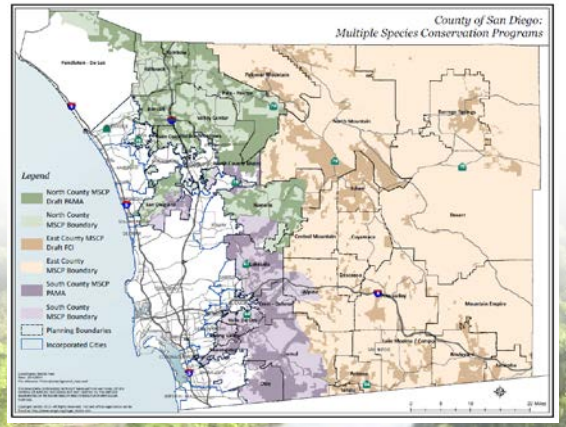
- Invasive species, primarily tamarisk, overrunning parcel
- Considered a critical path for all other projects downstream

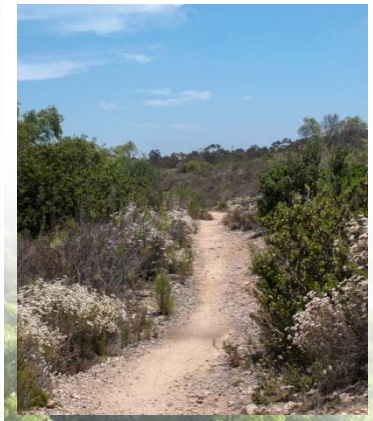


Multiple Uses and Objectives

- Otay MSCP Preserve
- Threatened and Endangered Species
- Current and Future Trail Users
  - Pedestrians, Mountain Bike, Equestrian
- Border Patrol
- Otay Water District (waterlines)
- SDGE (gas and overhead electric)







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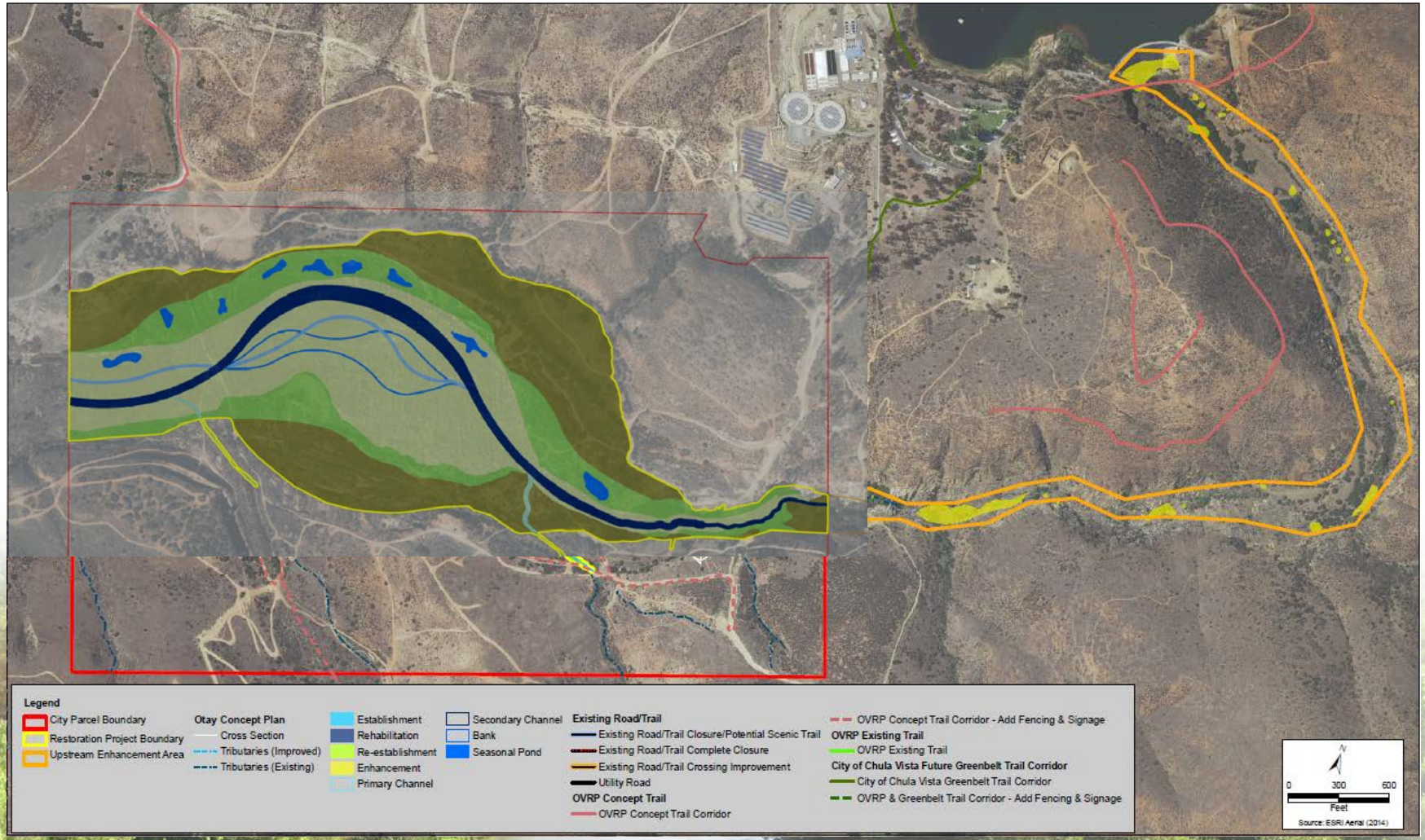
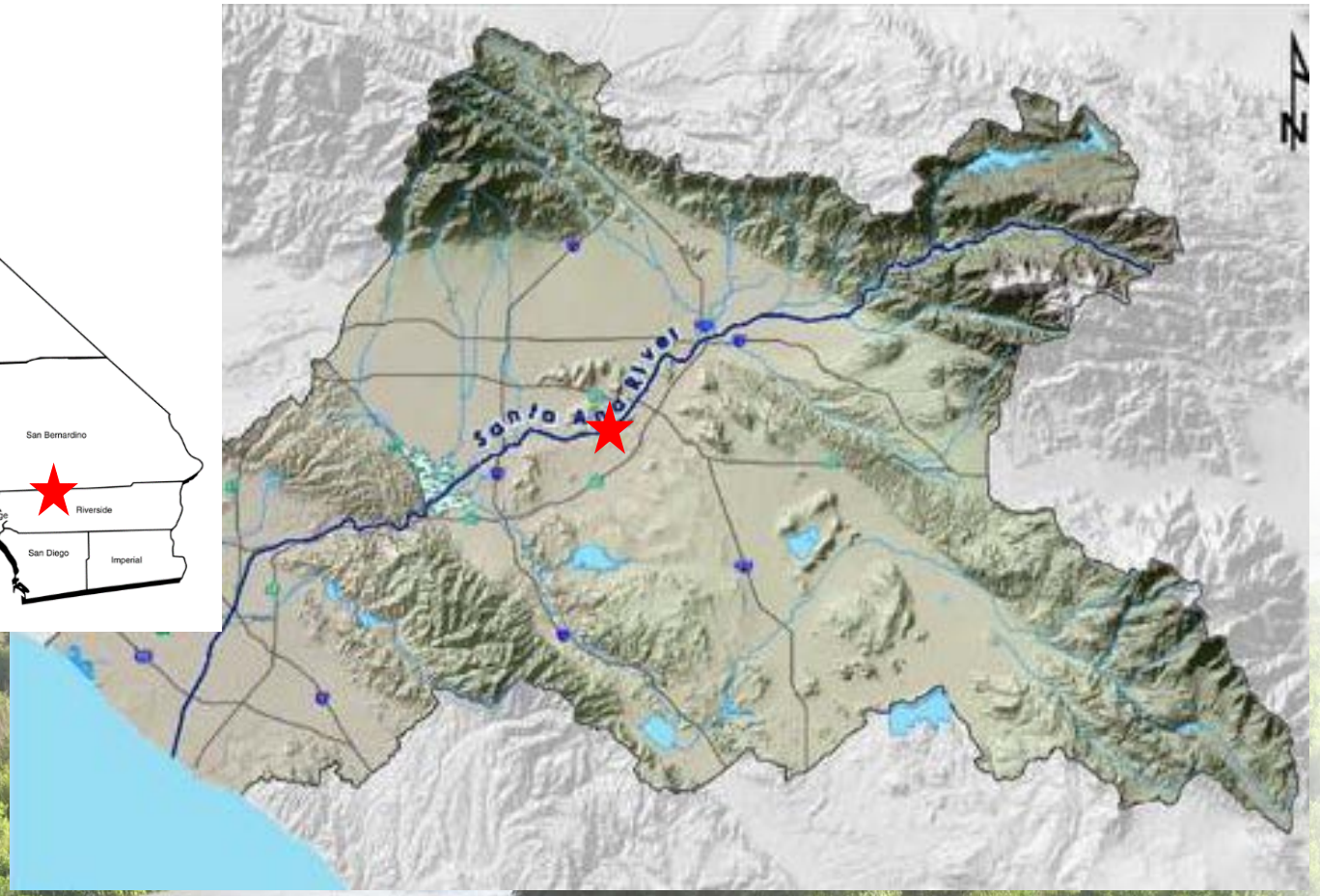


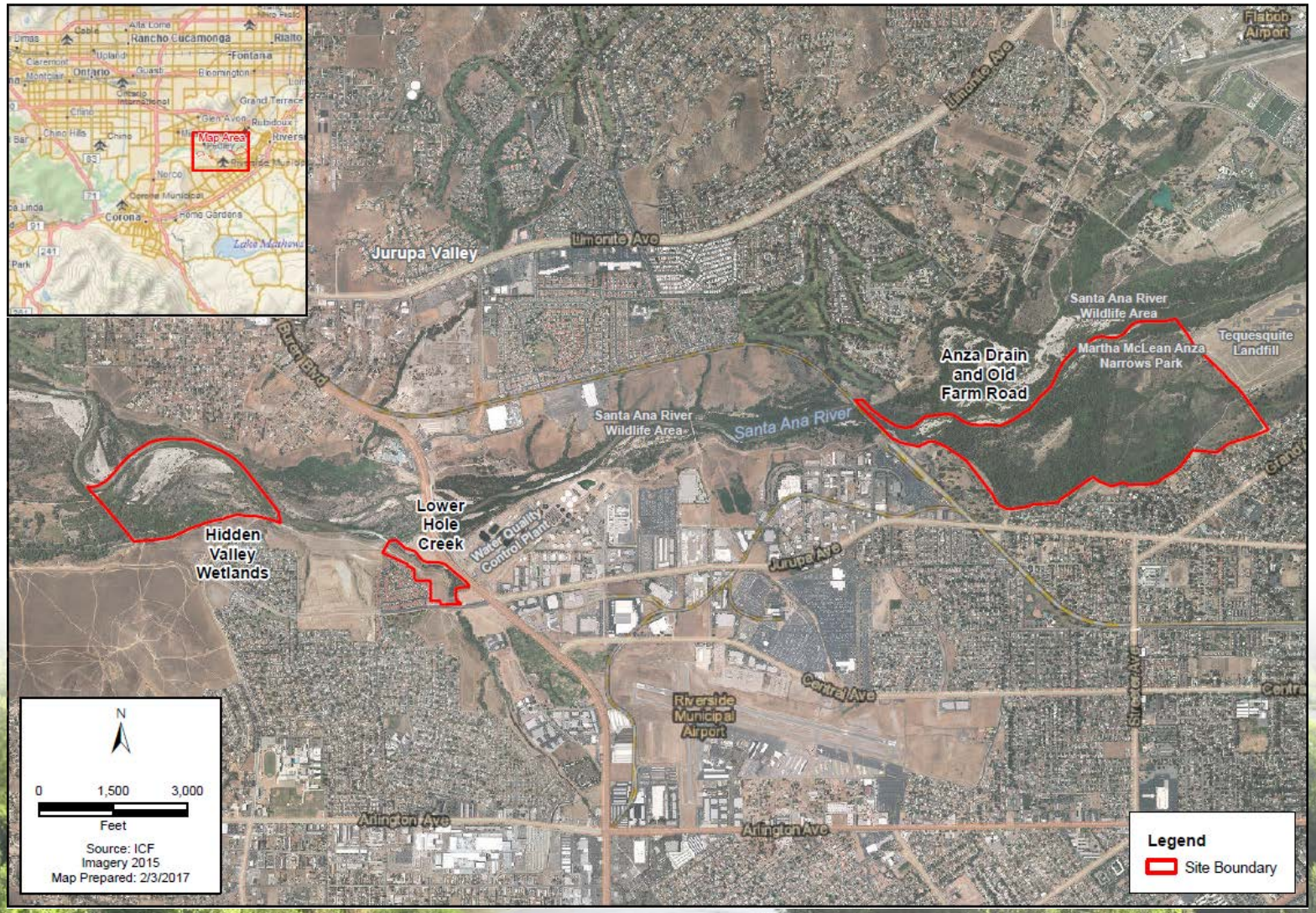
Upper Santa Ana River (SAR) Opportunities and Constraints for Tributary Restoration Sites



Project Background

- Increasing demands for water supply trigger water management activities and impacts
- Initiating early implementation of environmental compliance and conservation measures to minimize impacts and facilitate permitting:
  - Development and implementation of the Upper SAR Habitat Conservation Plan (HCP) for species impacts
  - Development of a compensatory mitigation permitting strategy (wetland bank or other) for impacts to aquatic resources
  - Creation of an environmental compliance framework for CEQA/NEPA requirements
- Identified and developed preliminary restoration designs for four sites
- Current design focused on Santa Ana Sucker
- Evaluate opportunities to benefit additional HCP covered species and create wetland mitigation credits

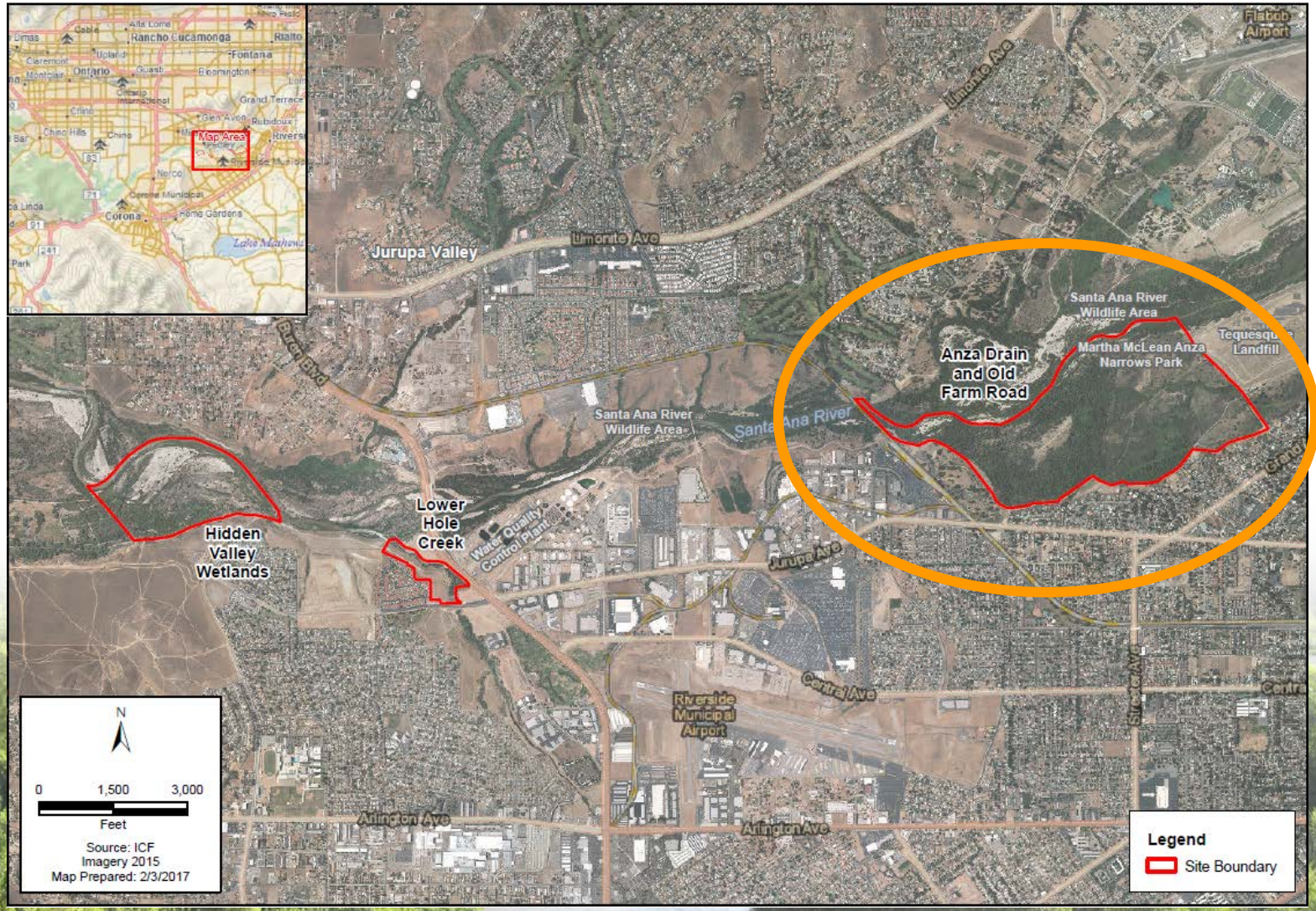
Restoration Site Locations



Opportunity Evaluation Method Top-Down Approach

- Multiple objectives including species and aquatic resource credits
- High level evaluation of site conditions to identify ecological restoration opportunities within the existing land use constraints
  - Consider historical ecology and current site conditions
- Refined ecological restoration opportunities to maximize benefits for Covered Species with prioritization given to Santa Ana sucker
- Further evaluate and refine to address other Covered Species habitat needs and additional opportunities to restore Aquatic Resources

Anza Drain/Old Farm Road



Identified Opportunities

- ADOF-1: Restore Anza Drain
- ADOF-2: Excavate and Revegetate Anza Drain Bank
- ADOF-3: Restore Old Farm Road Drainage
- ADOF-4: Restore Alkali Meadow in the outer floodplains
- ADOF-5: Restore Riparian and Floodplain Habitat
- ADOF-6: Expand Active Floodplain and Riparian Habitat and Establish Oxbow
- ADOF-7: Control Invasive Wildlife Species
- ADOF-8: Limit Human Disturbance

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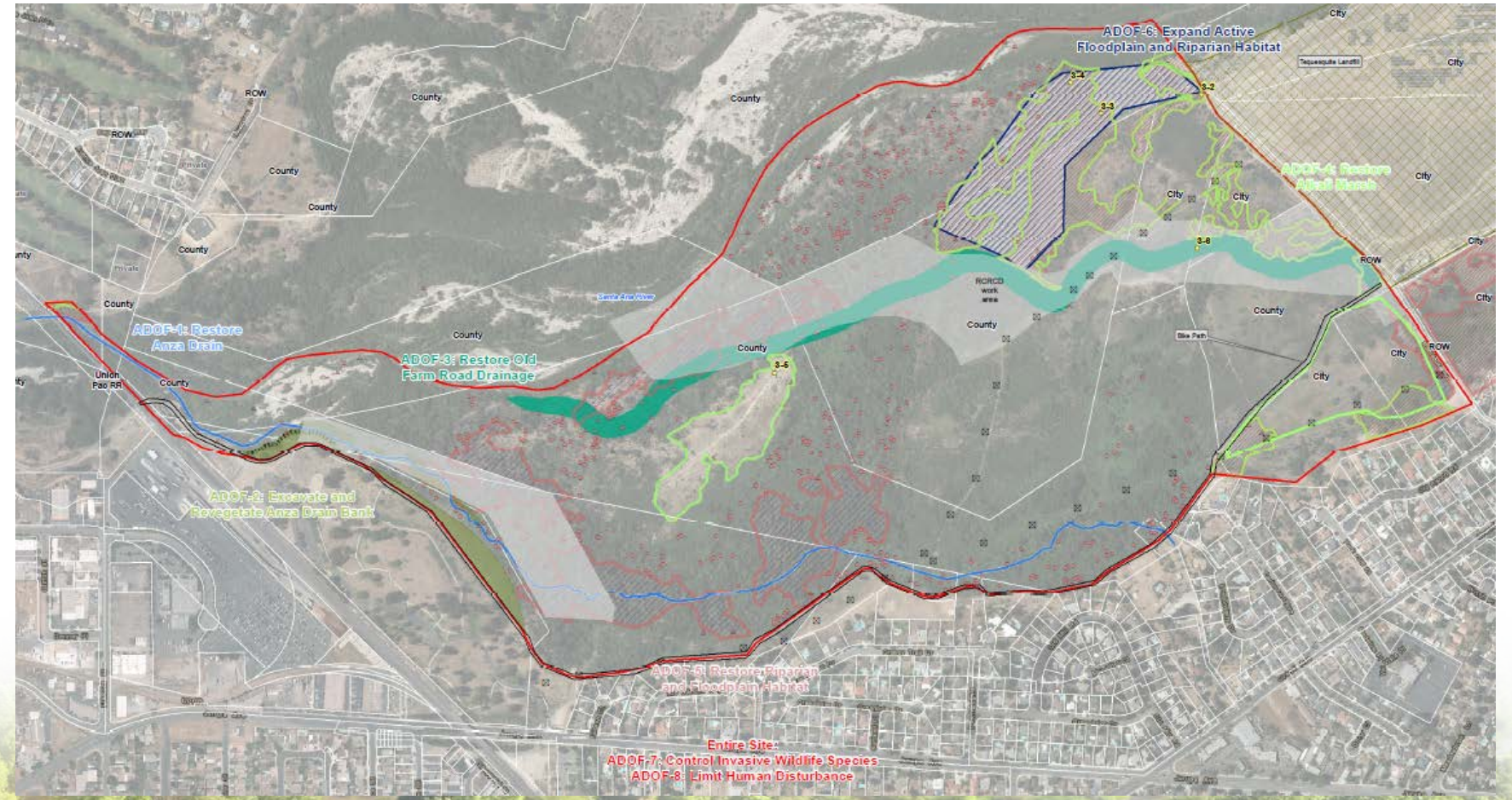

Lets Talk About Issues, Old and New

Issue 1: Water Resources

- Long-term Water Storage
  - Reducing groundwater elevations downstream of dam
  - Changing frequency of floodplain scouring events
  - Change restoration design, no reference or historical reference
- Water Conservation
  - Increased impervious service and no site discharge requirements per MS4 permits can starve dryer systems, in particular first order streams
- Cost Increases
  - With extended drought conditions come increased cost (extended time and rates)
  - Need to plan accordingly and look for opportunities to maximize
- Water Infrastructure

Issue 2: Invasive Plant Species

- Outcompete native vegetation for resources
- Limit habitat for wildlife
- Increase flooding by choking waterways
- Increase fire burn frequency and intensity
- Habitat type conversion
- Directly draws down water

Issue 3: Human Use

- Approved Uses
  - Trails
    - Pedestrians, bike, equestrian
    - Bird watching
  - Utilities
  - Border Patrol
- Unauthorized Activity
  - Homeless encampments
  - Pot farms
  - Trails
  - Off road vehicles
  - Dumping (trash and other material)

Issue 4: Invasive Wildlife

- Wild Boar
- Brown-headed cowbird (*Molothrus ater*)
- Bull frog (*Lithobates catesbeianus*)
- Argentine ants (*Linepithema humile*)
- Turtles (i.e. red-eared sliders)
- Fish (too many to name)
- Feral cats
- Polyphagous Shot Hole Borer (PSHB) beetle (*Euwallacea* sp.)

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Polyphagous Shot Hole Borer (PSHB)

- Originated in Southeast Asia, likely transported via shipping containers
- Acts a vector for the Fusarium dieback disease which destroys a trees capability to transport water and nutrients
- Symbiotic relationship, beetle farms fungus and in turn transports the fungus
- Limb death, whole tree death, and mass canopy destruction possible
- Currently within the San Diego, Los Angeles, San Bernardino, Orange, and Riverside counties
- Beetle is polyphagous, has the ability to use many different sources of food.
- As it is a generalist has an extensive list of potential host tree species in California, initially found in avocado trees

EXTERNAL SIGNS + SYMPTOMS

Attack symptoms, a host tree's visible response to stress, vary among host species. Staining (C, D), sugary exudate (E), gumming (F, G), and/or frass (H) may be noticeable before the tiny beetles (females are typically 1.8-2.5 mm long). Beneath or near these symptoms, you may also see the beetle's entry/exit holes (B), which are ~0.85 mm in diameter. The abdomen of the female beetle can sometimes be seen sticking out of the hole.

Species pictured: C. California sycamore, D. White alder, E. Avocado, F. Titoki, G. Chinese flame tree, H. Red willow

INTERNAL SYMPTOMS

Fusarium euwallaceae causes brown to black discoloration in infected wood. Scraping away bark over the entry/exit hole reveals dark staining around the gallery (I), and cross sections of cut branches (J) show the extent of infection. Advanced infections eventually lead to branch dieback (K).

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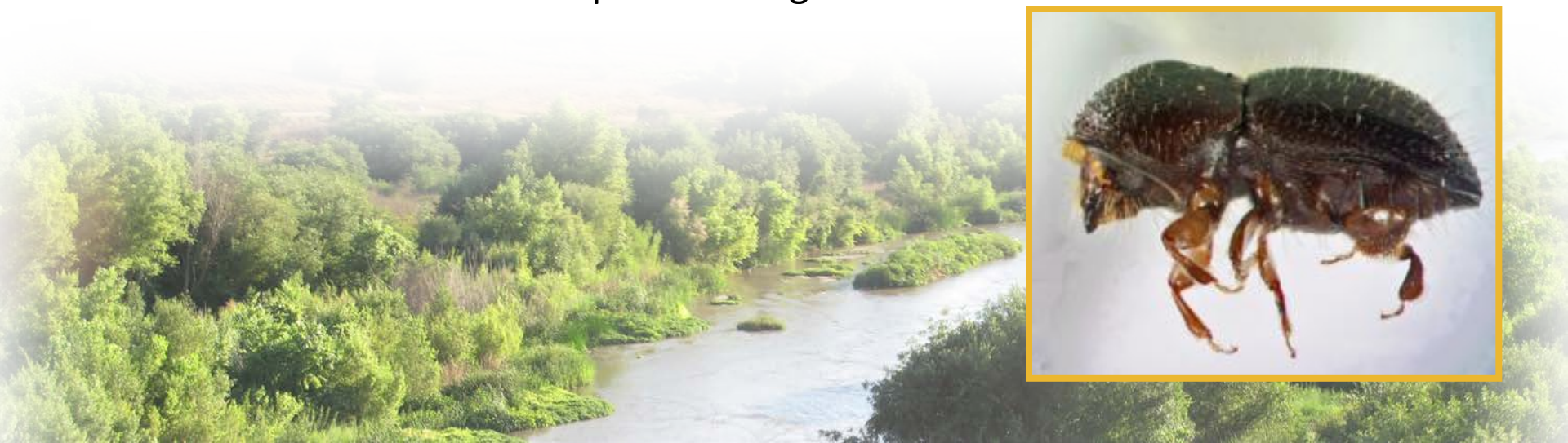
Polyphagous Shot Hole Borer (PSHB)

- Appears to targets natives more than nonnatives/invasive trees
- Triggers hesitation in removal of nonnatives even if they are less than ideal for the system
- USFWS expressed concern the risks to large scale restoration projects that are removing tamarisk (a low quality host) and restoring native riparian habitat (a high quality host)
- Multiple regulatory agencies and funding sources have suggested a “Pause” is restoration while we figure things out
- Stopping only allows the beetle to get ahead of us
- As a region we need to strategically move forward to ensure that riparian habitat continues to remain

PSHB Next Steps

- Lots of research going on (UC Riverside)
- Practitioners
  - Work at regional level to learn as a group
  - Include monitoring plans for restoration project and land management areas
  - Develop management plan (short and long term)
  - Consider funding research
  - Include cost for adaptive management



Thank you!