CRAM Technical Bulletin and QA/QC Plan

CALIFORNIA CRAM

Using CRAM (California Rapid Assessment Method) To Assess Wetland Projects As an Element of Regulatory and Management Programs

Technical Bulletin

Produced by:

CALIFORNIA WETLAND MONITORING WORKGROUP

California Wetland Monitoring Workgroup

October 13, 2009

Available at:
www.waterboards.ca.gov/mywaterquality/monitoring_council/wetland_workgroup
www.cramwetlands.org

Selected Components of CRAM Technical Bulletin

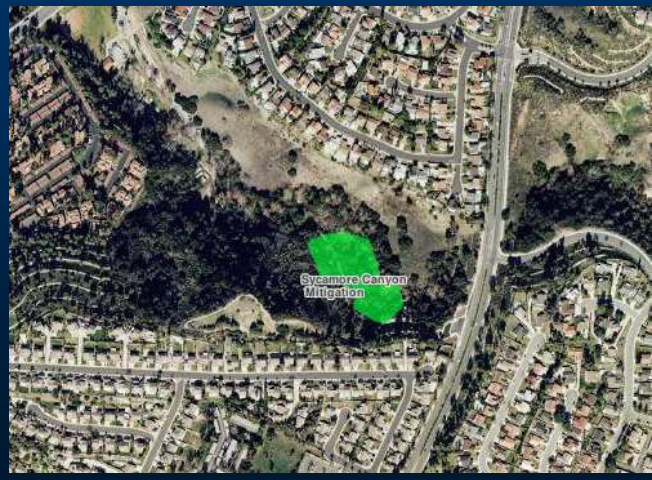
- Appropriate and inappropriate uses
- Modification of the Method
- Requirements for Practitioners
- Submission of CRAM scores
- How to interpret a CRAM score
- Quality assurance measures

Appropriate Uses of CRAM: Ambient Assessment and Monitoring

- Ambient assessment of wetland condition
  - watershed, regional, state
- Monitoring of ecological reserves, mitigation banks, wildlife refuges, etc.

Appropriate Uses of CRAM: Project Assessment

- Pre-project conditions at impact, mitigation, or restoration sites
- Unauthorized (enforcement) actions
- Project performance/success, Compliance with mitigation targets
- Comparison of proposed alternatives for restoration planning



Inappropriate Uses of CRAM

- Jurisdictional determinations
- Focused/endangered/threatened spp. monitoring
- Substitute for Level 3 monitoring
- Compliance with water quality objectives
- Assessment of wetland mechanisms/processes
- Assessment of wetland values
- “Designing projects to the metric”

Agencies Retain Discretion on Specific Applications

Modification of the Method

- All Attributes should be assessed and reported when conducting assessments
- Under no circumstances should a module be modified by a practitioner
- Additional L2 or L3 assessments may be used to augment CRAM, but should never be hybridized with the method

Requirements for Practitioners

- CRAM is relatively rapid but it is not necessarily easy to apply
- complete at least one 3-day CRAM training course
- teams of at least two trained practitioners, preferably with complementary expertise
- Trained practitioners will be notified via email of CRAM updates to maintain familiarity with new versions

Submission of CRAM Scores

- Once completed, a CRAM assessment should be submitted online via cramwetlands.org, it should include:
  - Fully completed CRAM data sheet
  - Completed stressor checklist
  - Map of the AA
  - Timing of the assessment
  - Names of all assessors

Interpretation of CRAM Scores

- Scores based on internal reference standard
  - Best achievable condition statewide
  - Scores range from 25-100
- Ability to compare CRAM scores
  - Project-Ambient
  - Project-Project
  - Projects-Reference
- Detecting changes in wetland condition over time
- *Precision = 10 pts./Overall scores; 5 pts./Attribute score*

Scientific Meaning of CRAM Scores

- CRAM Index Score represents overall condition, functional capacity, or “health.”
  - It does not represent any particular function or set of functions (that’s Level 3).
- Analogous to:
  - Apgar Scores (new born infant health)
  - Dow Jones Industrial Average (DOW)
  - Gross National Product (GNP
  - Grade Point Average (GPA)

Scientific Meaning of CRAM Scores

- Identical Index or AA Scores can be derived from different Attribute Scores
  - Must refer to Attribute Scores and sometimes Metric Scores to interpret Index Scores
  - 10-point precision target

Landscape - Buffer	Hydrology	Physical Structure	Biotic Structure	Index Score
50	35	72	68	56
68	50	35	72	56

Scientific Meaning of CRAM Scores

- Each Attribute Score represents a suite of expected functions
  - e.g., Landscape and Buffer Attribute represents ecological connectivity at landscape scale, ability of buffer to mediate external stressors, etc.
  - e.g., Hydrology Attribute for riverine wetlands represents recharge, peak stage reduction, water quality maintenance, etc.

Scientific Meaning of CRAM Scores

- As Attribute Scores decrease, associated functional capacity expected to also decrease.
  - Stressor checklist plus Metric Scores helps identify possible causes for low Attribute Scores
  - Level 3 is required to validate relationship between Attribute scores and function or stress

Programmatic Interpretation of CRAM Scores

- Programs provide meaning to CRAM Scores
  - CWA 305(b) “status and trends”
  - CWA 404: “functional lift”
  - 401/WDR: “performance standards”
  - Ca Conservation Policy “no-net-loss in quality”

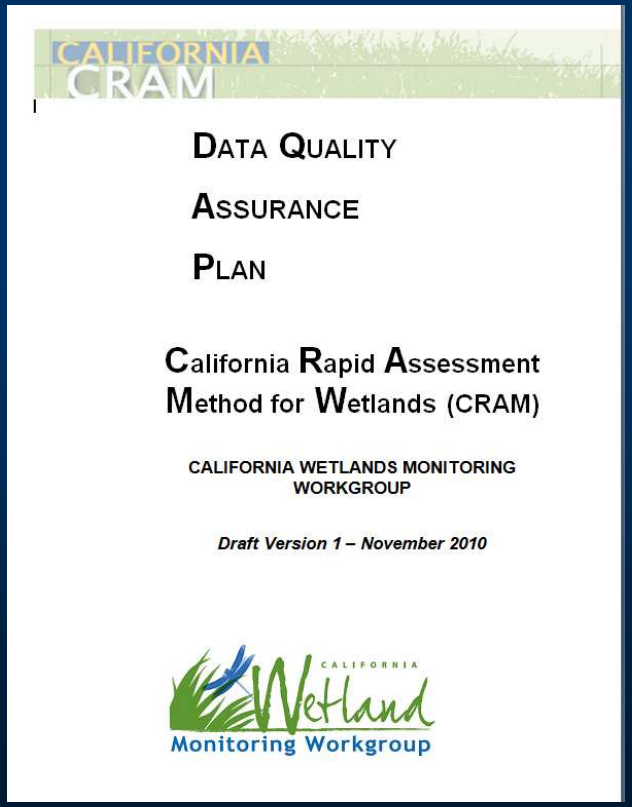
CRAM Quality Assurance

- Minimal requirements for all submitted CRAM assessments
- Regional Audit teams will assist with QA, training, and difficult wetlands
  - Independent review of a small percentage of all CRAM assessments

CRAM QA/QC Plan

(in development)

- Minimum reporting requirements
- Audit process
- Training
- Intercalibration



CRAM

Application and Case Studies

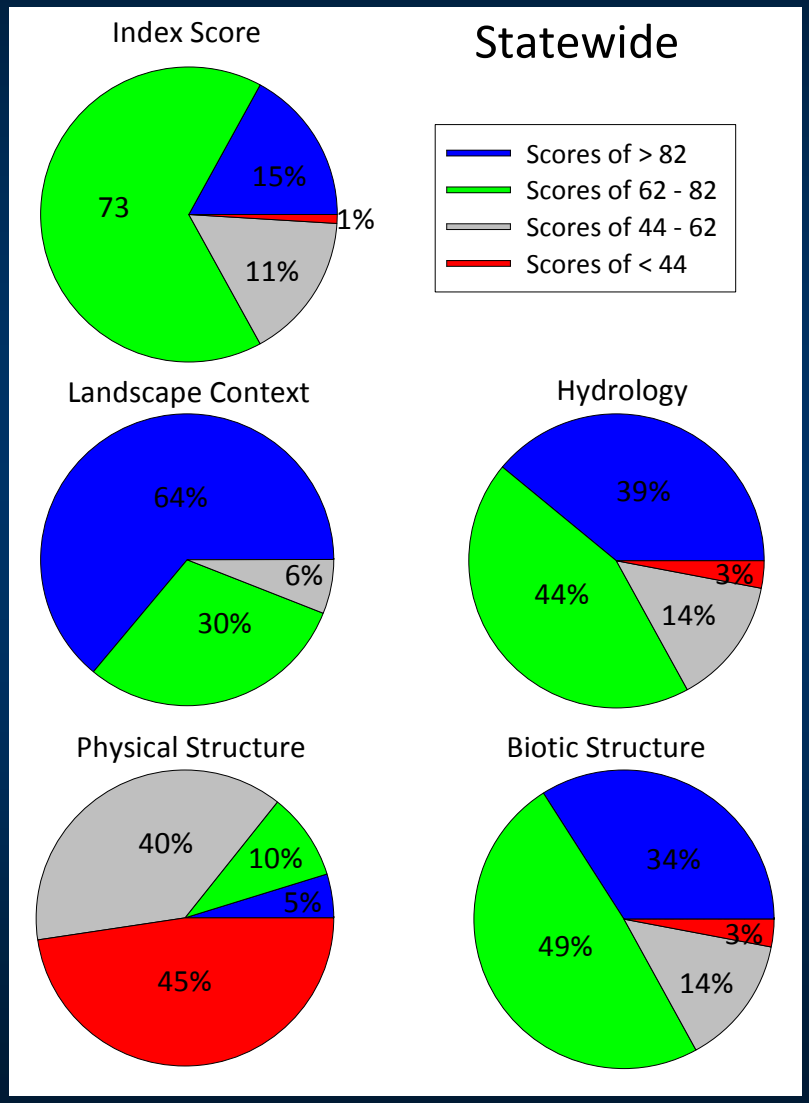
How is CRAM being Used?

- Statewide assessments
  - Perennially tidal estuaries
  - SWAMP Perennial Stream Assessment (PSA)
  - SWAMP Reference Condition Management Program (RCMP)
- Regional assessments
  - Stormwater Monitoring Coalition (SMC)
- Watershed Assessments
  - San Gabriel River Monitoring Program

Statewide Condition Assessment of California's Estuarine Wetlands

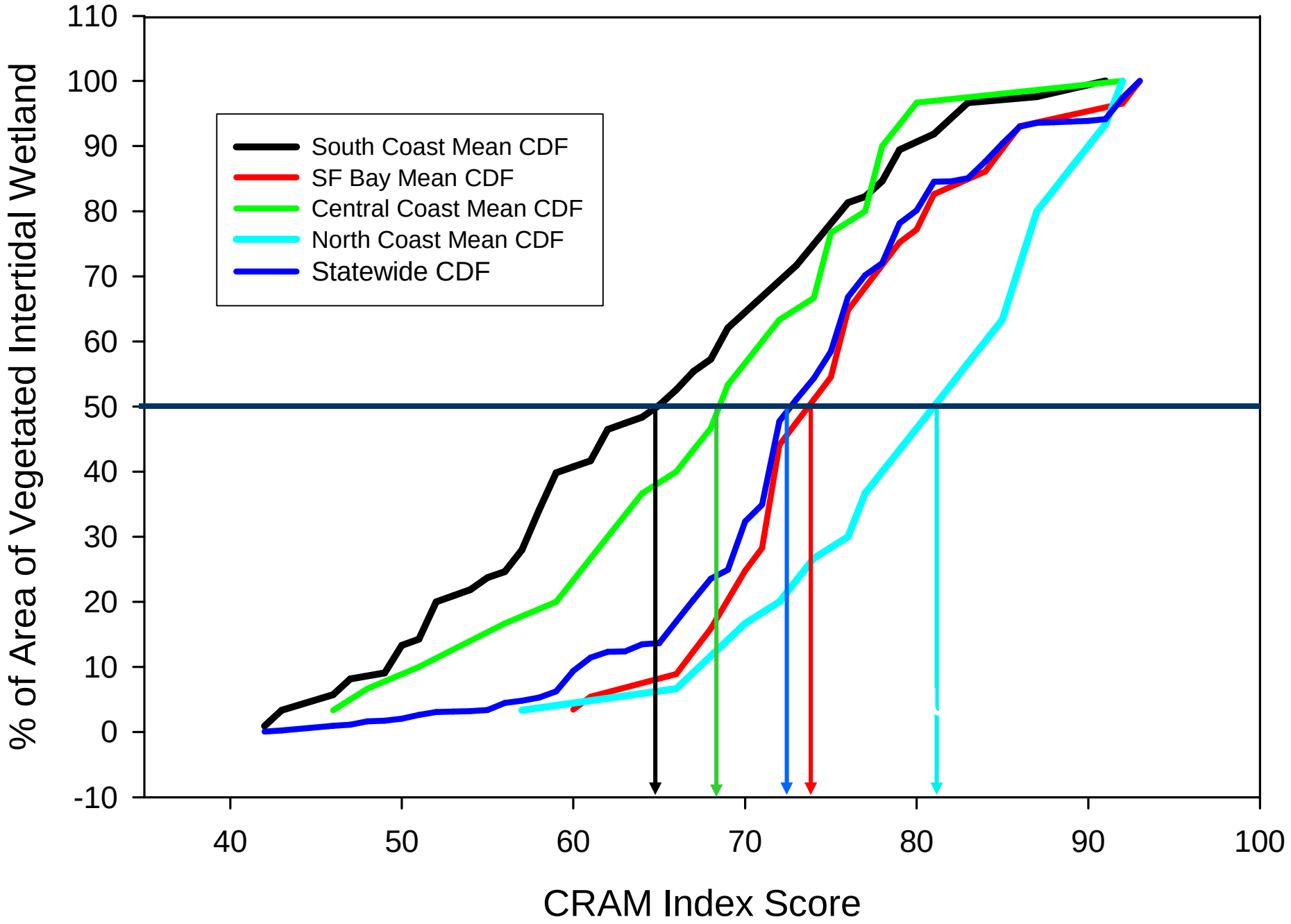
- Focus on four coastal regions
- Perennially tidal saline estuaries targeted
- 150 sites probabilistically selected
- Used CRAM to assess condition

Summary of Statewide Estuarine Condition



- Statewide ambient survey results:
  - 15% of State's estuarine marsh acreage is in the top quartile of CRAM scores
  - Physical structure condition lowest Attribute throughout state

Cumulative Distributions of CRAM Scores



SWAMP Perennial Stream Assessment (PSA)

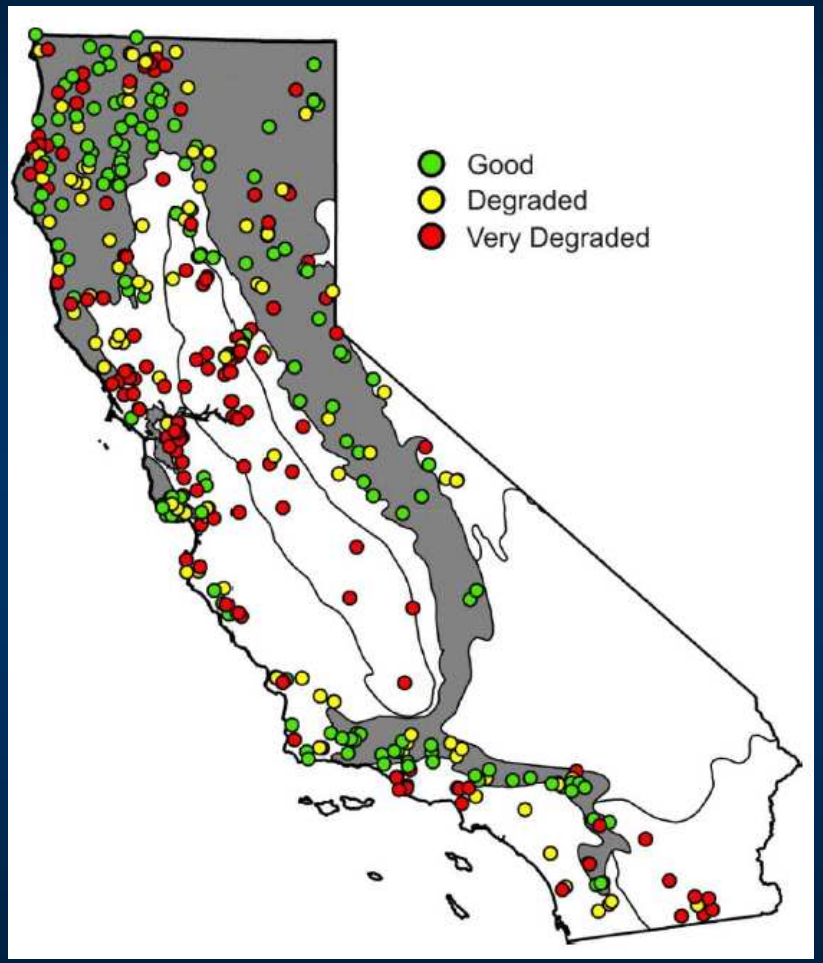
Multiple metrics:

CRAM

Biotic (benthic macroinvertebrates, algae)

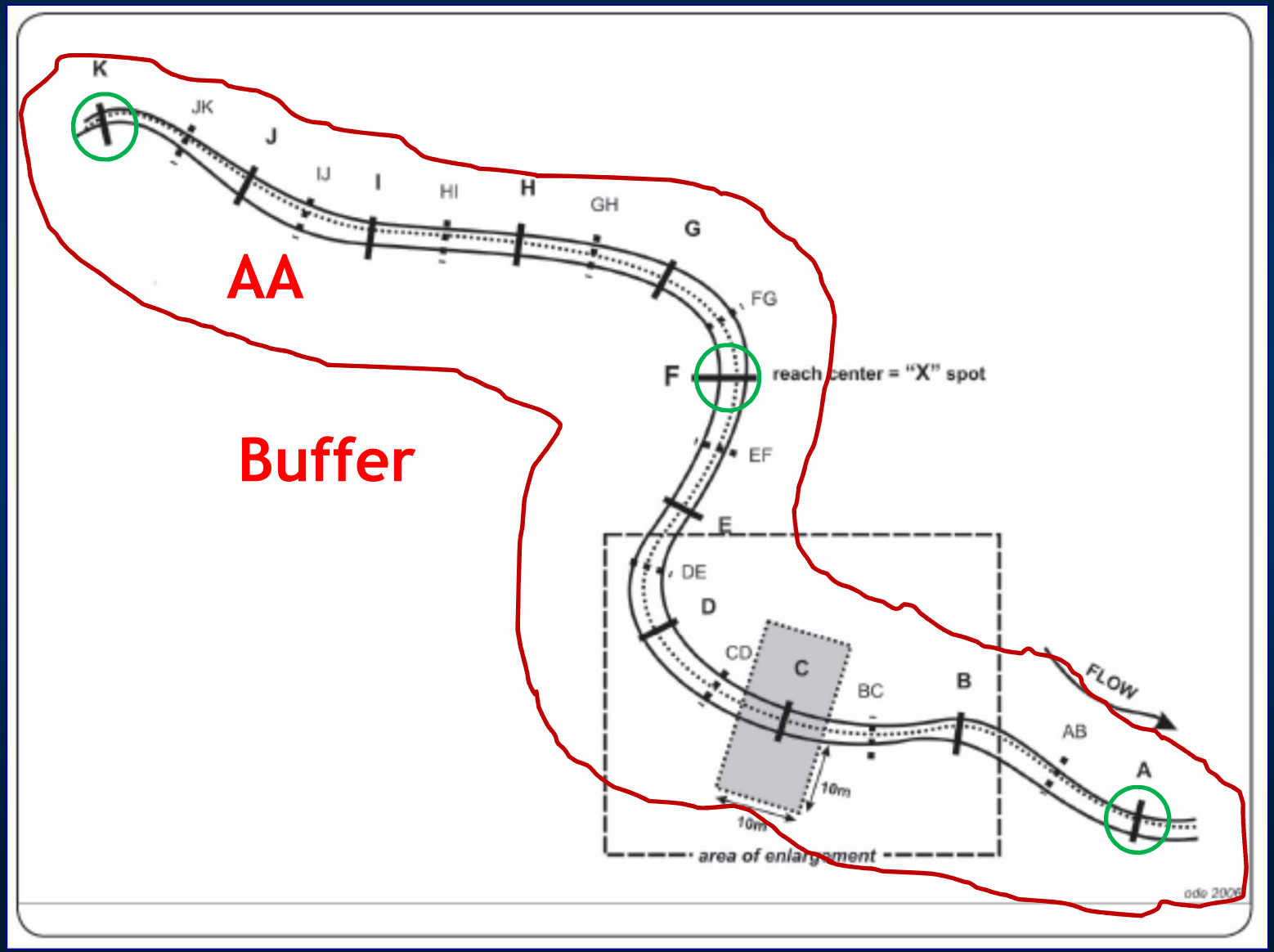
Physical Habitat

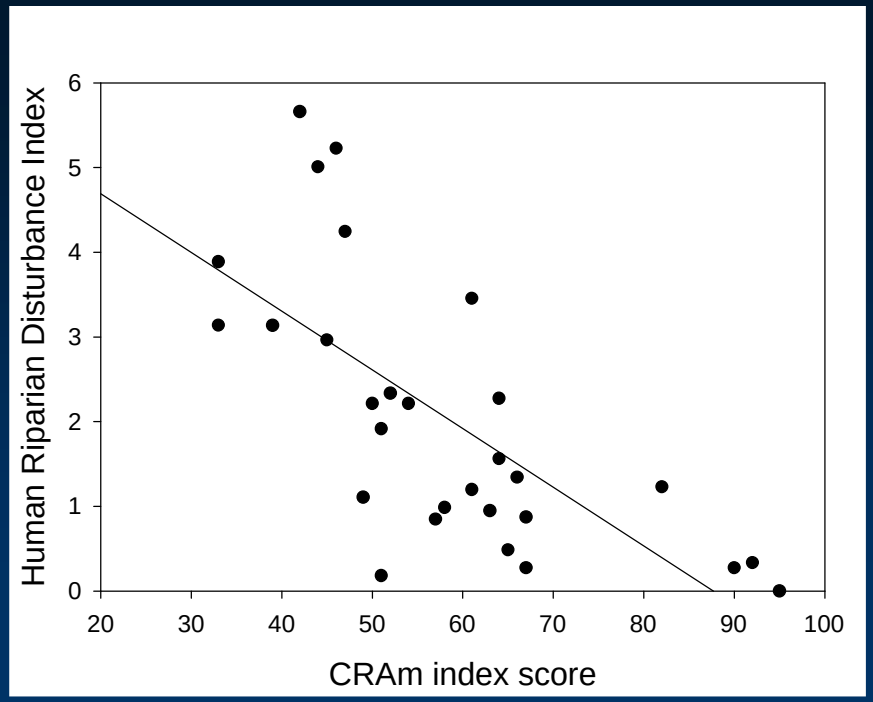
Water Chemistry

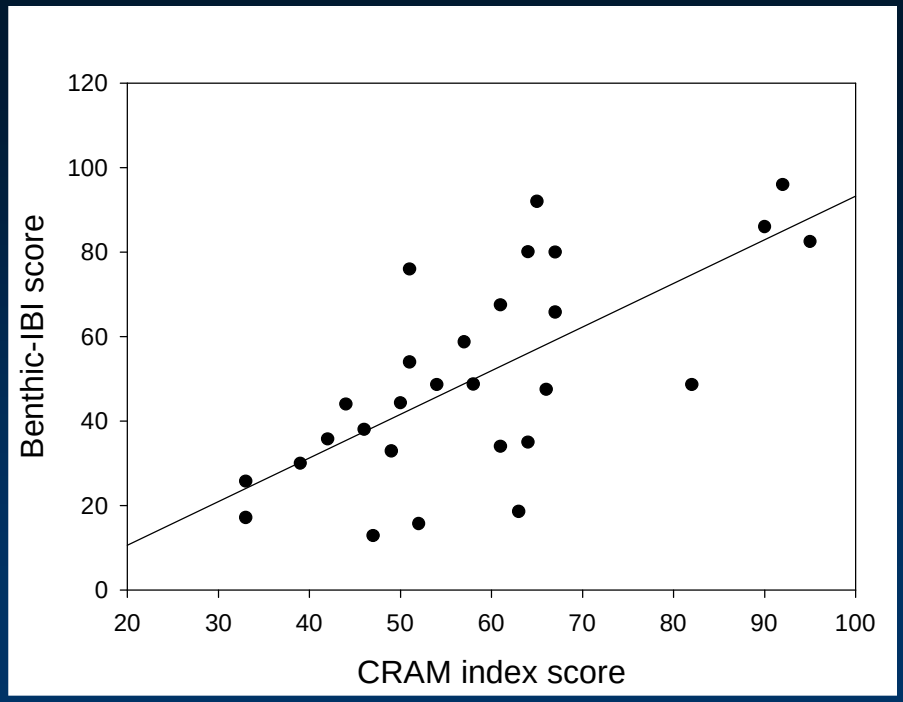


Monitoring since 2000-CRAM added in 2008

Joint CRAM and IBI Assessments







CRAM / IBI Correlations

CRAM Index

(p<.0001, R2=.471)

Physical Structure

(p<.0001, R2=.433)

Biotic Structure

(p<0001, R2=.434)

CRAM / Riparian Disturbance

CRAM index

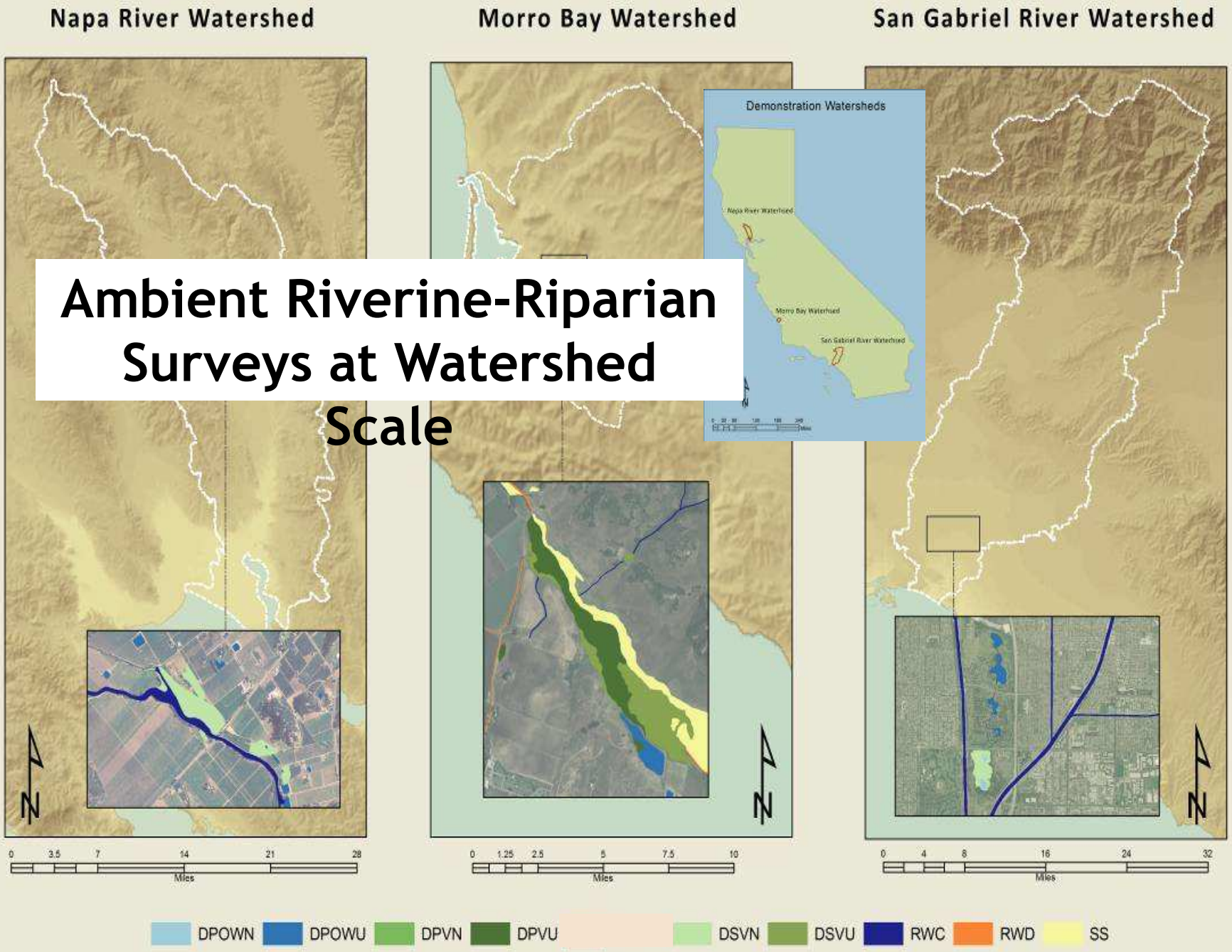
(p<.0001; r2=.480)

Physical structure

(p<.0001; r2=.526)

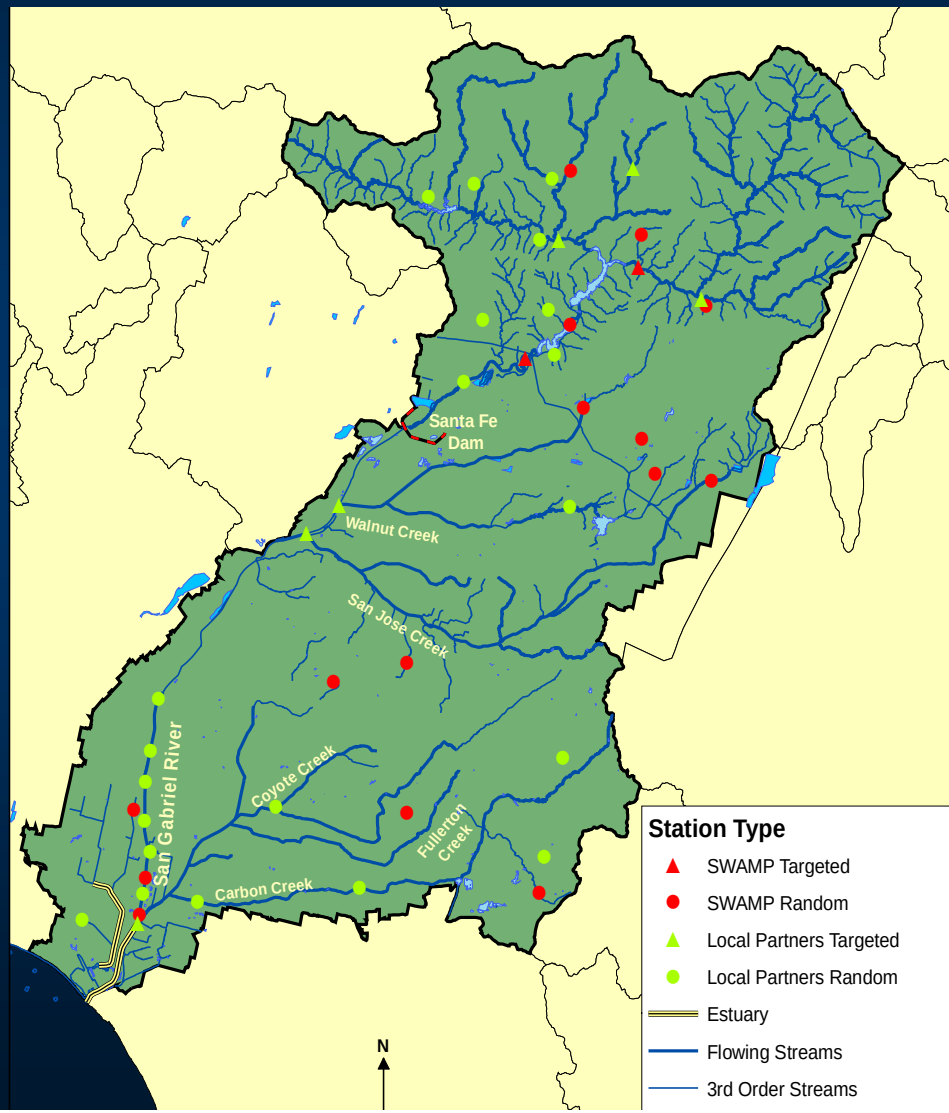
Biotic structure

(p<.0001, r2=.505)


Napa River Watershed
Morro Bay Watershed
San Gabriel River Watershed
Demonstration Watersheds
Napa River Watershed
Morro Bay Watershed
San Gabriel River Watershed
Ambient Riverine-Riparian Surveys at Watershed Scale
N
0 3.5 7 14 21 28
Miles
0 1.25 2.5 5 7.5 10
Miles
0 4 8 16 24 32
Miles
DPOWN
DPOWU
DPVN
DPVU
DSVN
DSVU
RWC
RWD
SS

Multi-metric Assessment of Watershed Condition

- Probabilistic sampling of 30 “ambient sites”
- Targeted sampling at key confluence points
- Multiple metrics (Levels 2 & 3)
  - CRAM
  - Water chemistry
  - Bioassessment
  - Toxicity



Solek *et al.* 2011. Demonstration of an integrated watershed assessment using a three-tiered assessment framework. Wetlands Ecology and Management 19(5):459-474.

San Gabriel River
Regional Monitoring Program
Annual Report
2009

Prepared by:

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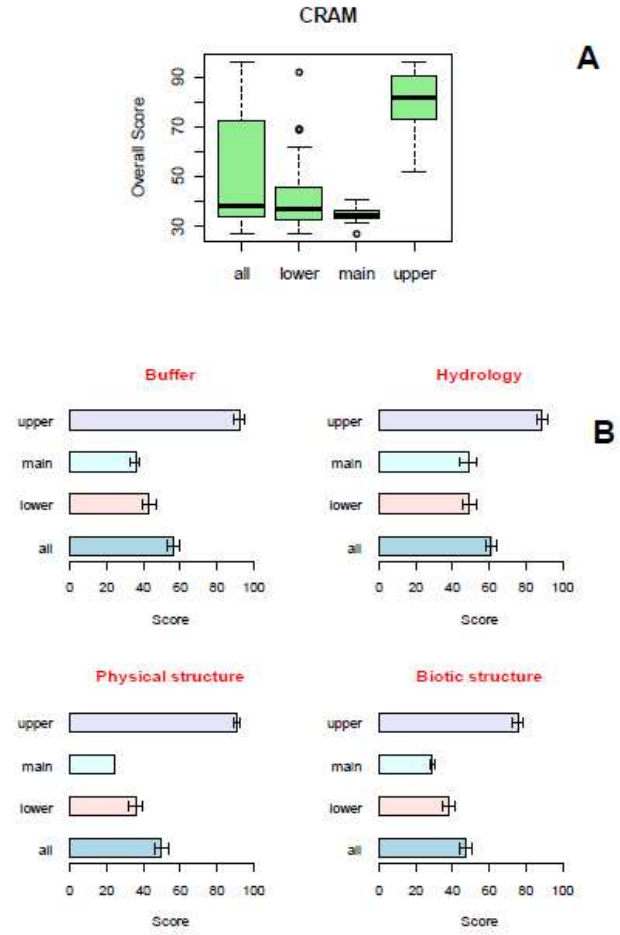


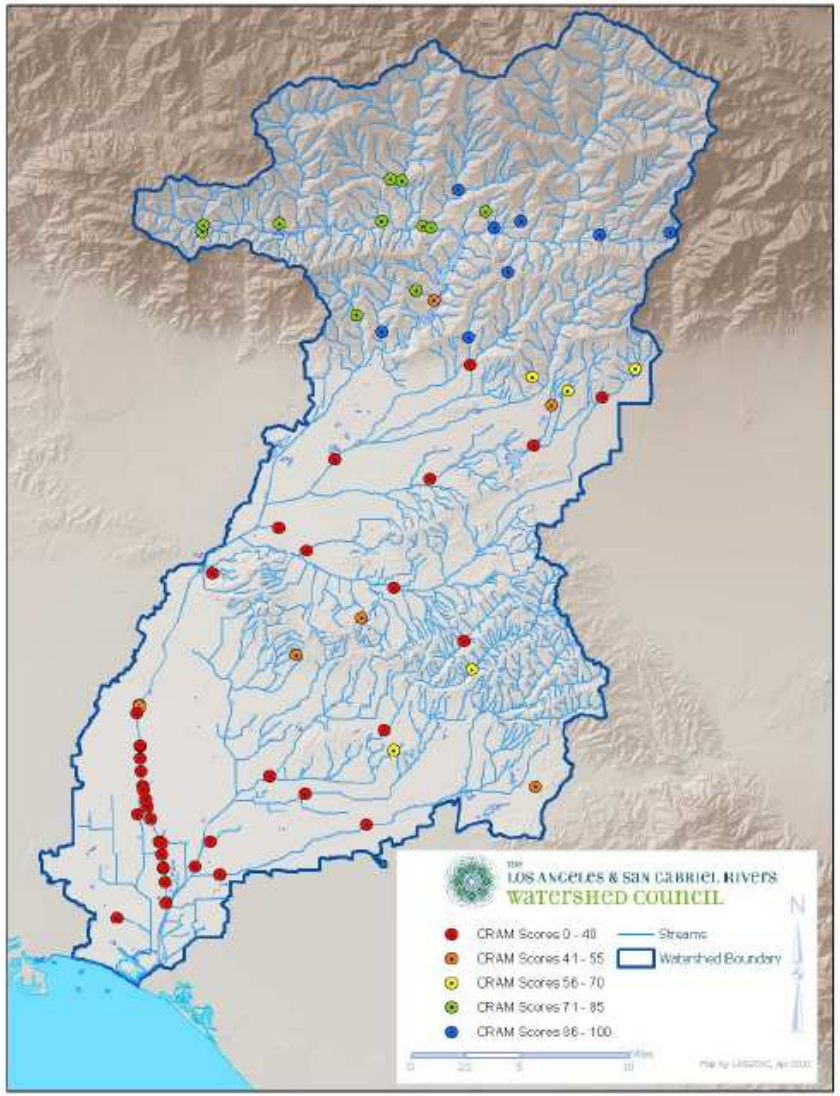


Figure 13. CRAM scores at random and target sites from 2005 to 2009. Color scale represents worst (red) to best (blue) scores.

Ambient Condition as Context for Site Conditions

How is CRAM being Used?

- Program evaluation
  - Compensatory mitigation – 404/401 CWA
    - Development
    - Energy (solar, power transmission)

Program Evaluation

Evaluate the compliance and wetland condition of compensatory wetland mitigation projects associated with Section 401 Water Quality Certifications throughout California

An Evaluation of Compensatory Mitigation Projects Permitted Under Clean Water Act Section 401 by the California State Water Quality Control Board, 1991-2002.

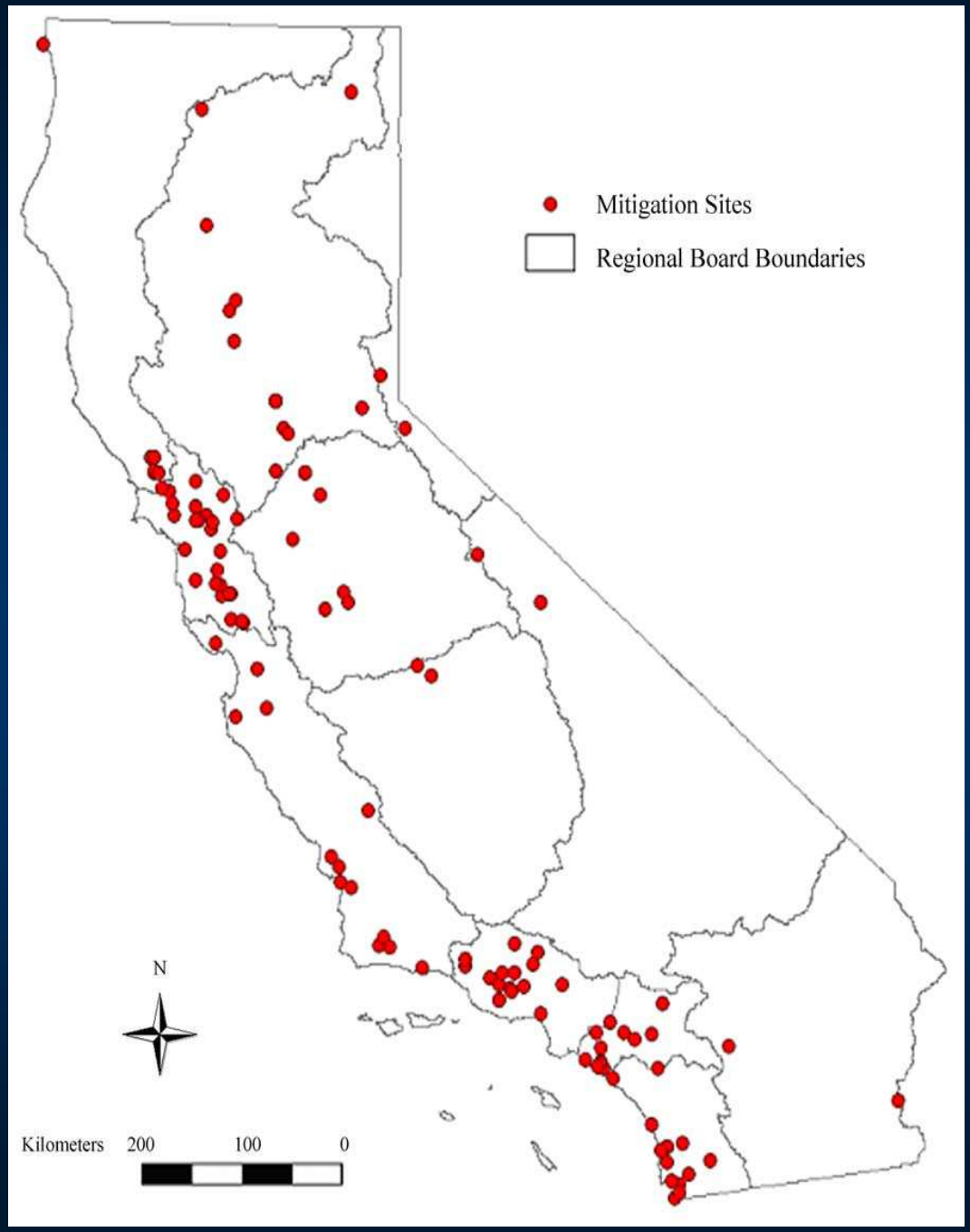
Richard F. Ambrose[1]
John C. Callaway[2]
Steven F. Lee[1]

[1]University of California, Los Angeles
[2]University of San Francisco

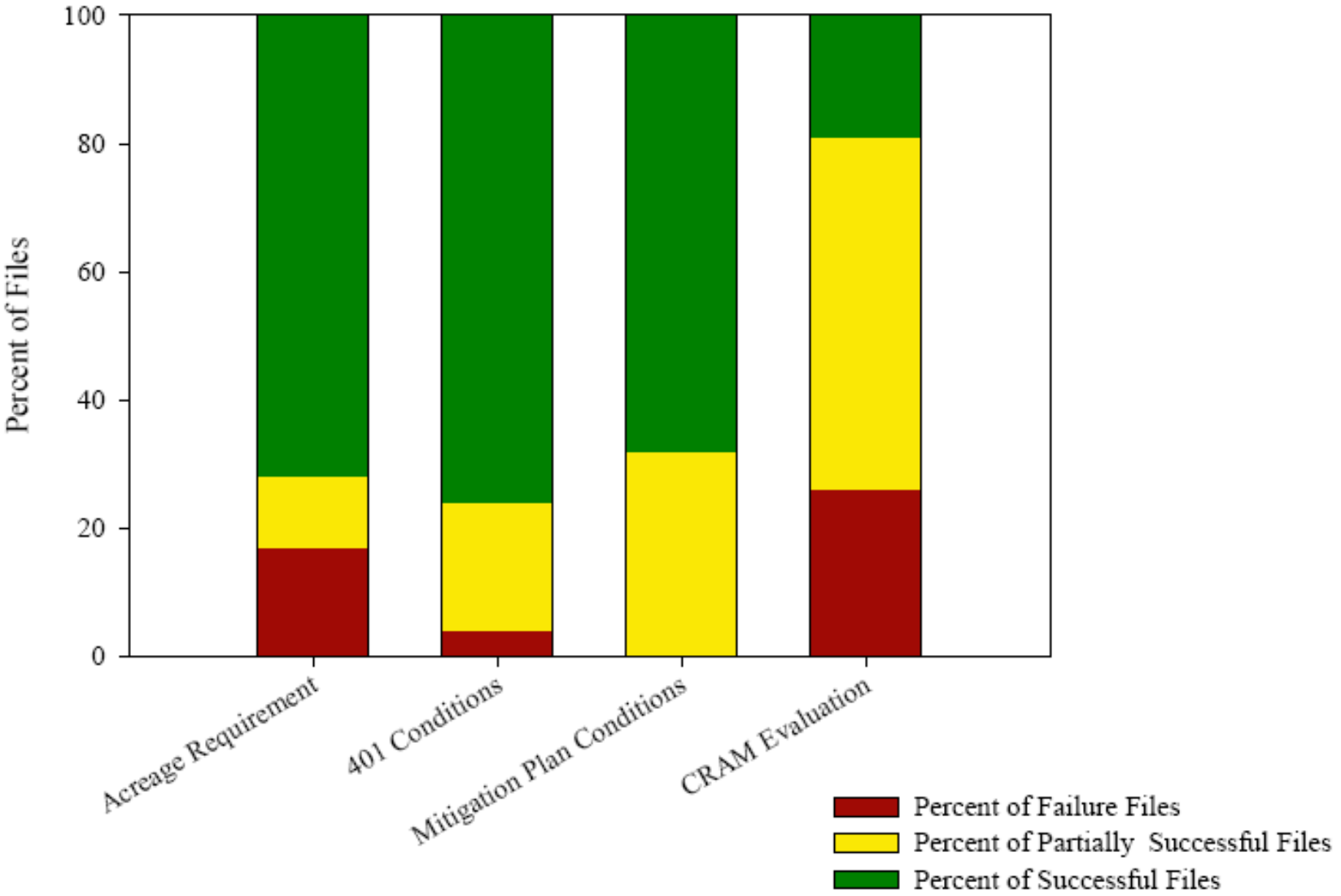
Prepared for:
California State Water Resources Control Board

August 2006

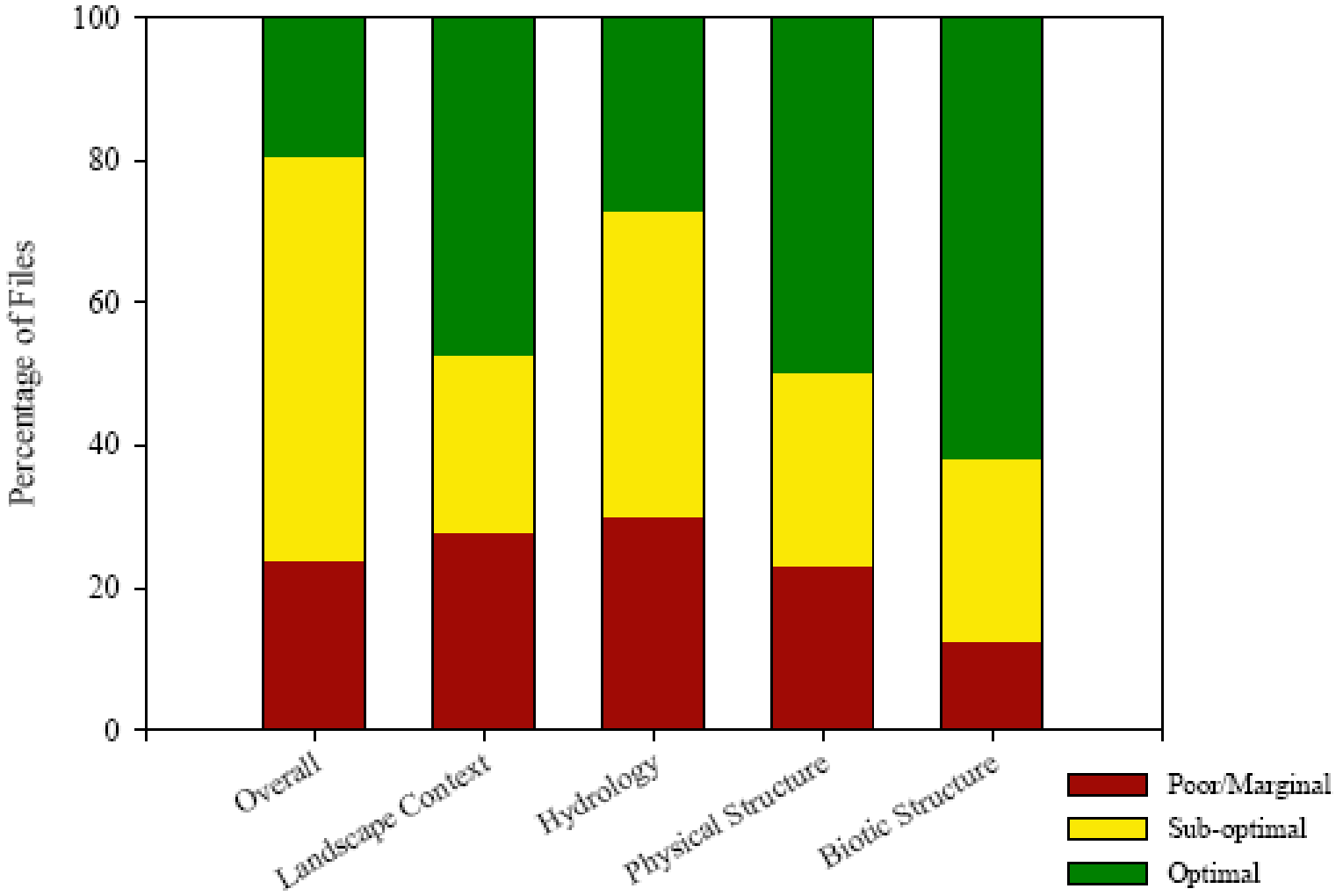
- 204 mitigation sites
- Review permit files for compliance
- Evaluate condition using CRAM



Successful Mitigation??



Condition of Mitigation Sites

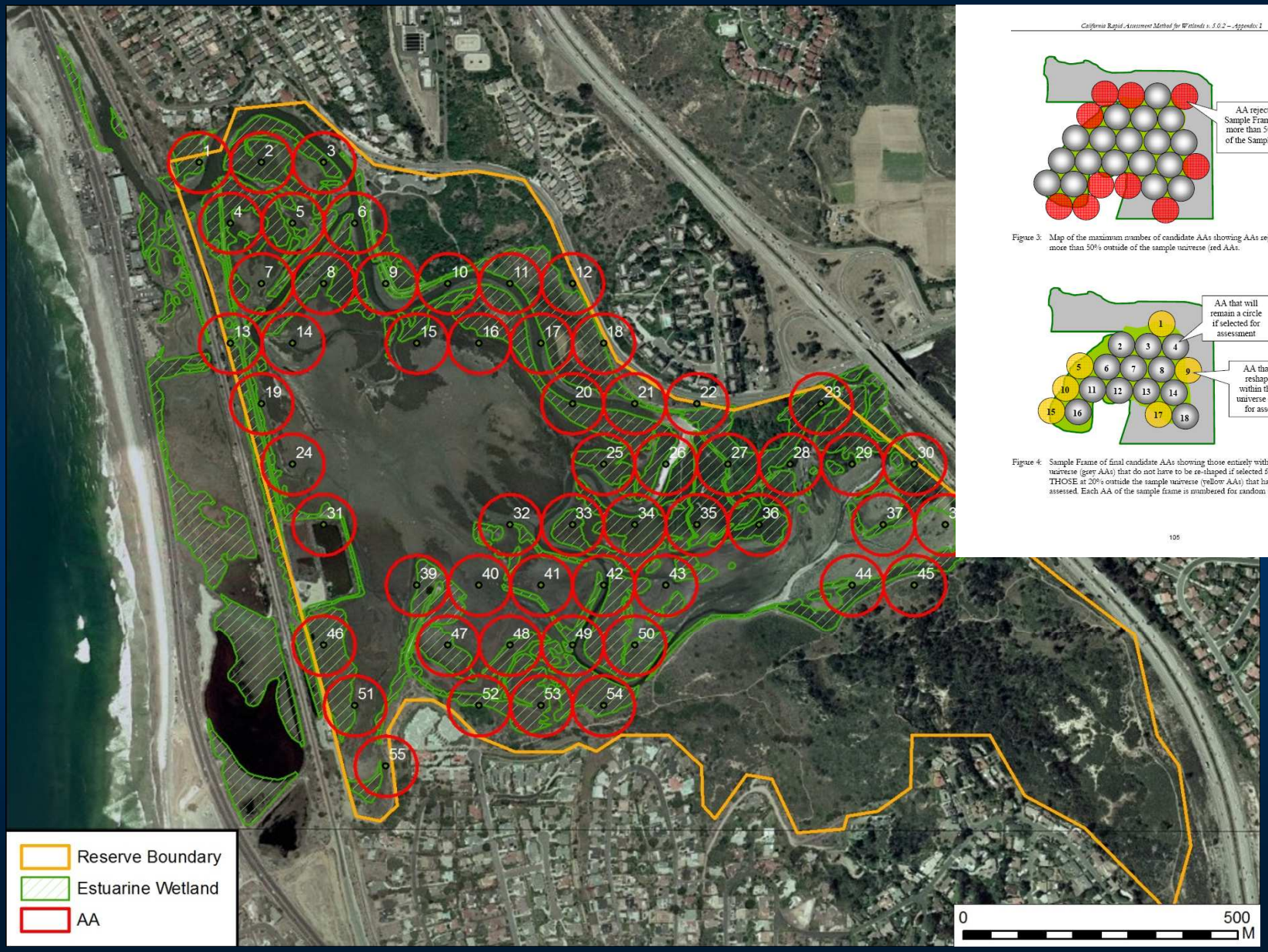


Project Impact Assessment Using CRAM

- Approach depends on objective of project

- Approaches include:
  - Assess all impacts
  - Sequential comparison
  - Probabilistic survey
  - Targeted survey
  - Hybrid

Sequential Comparison



California Rapid Assessment Method for Wetlands v. 5.0.2 – Appendix 1

Figure 3: Map of the maximum number of candidate AAs showing AAs rejected for being more than 50% outside of the sample universe (red AAs.

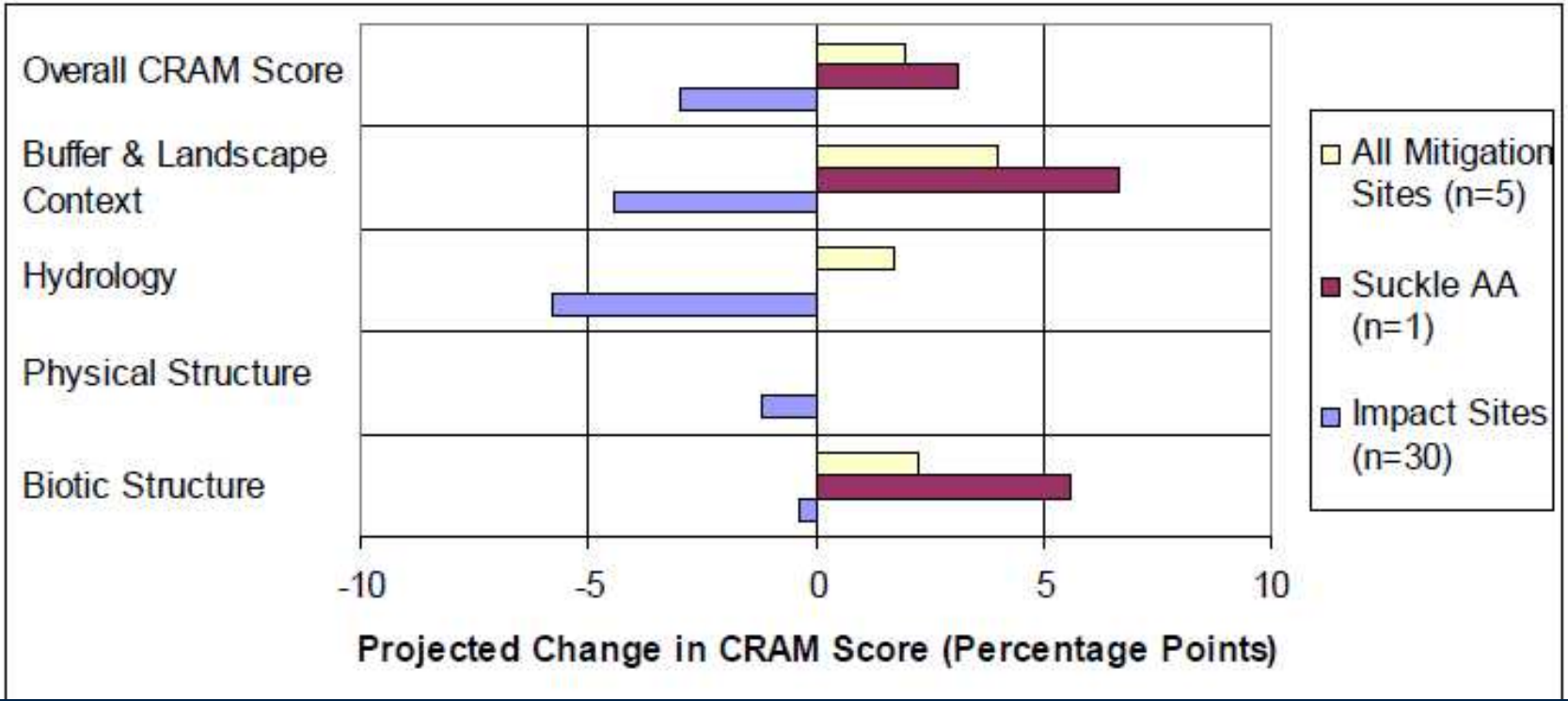
Figure 4: Sample Frame of final candidate AAs showing those entirely within the Sample universe (grey AAs) that do not have to be re-shaped if selected for assessment, and THOSE at 20% outside the sample universe (yellow AAs) that have to be reshaped if assessed. Each AA of the sample frame is numbered for random selection.

105

Probabilistic Survey

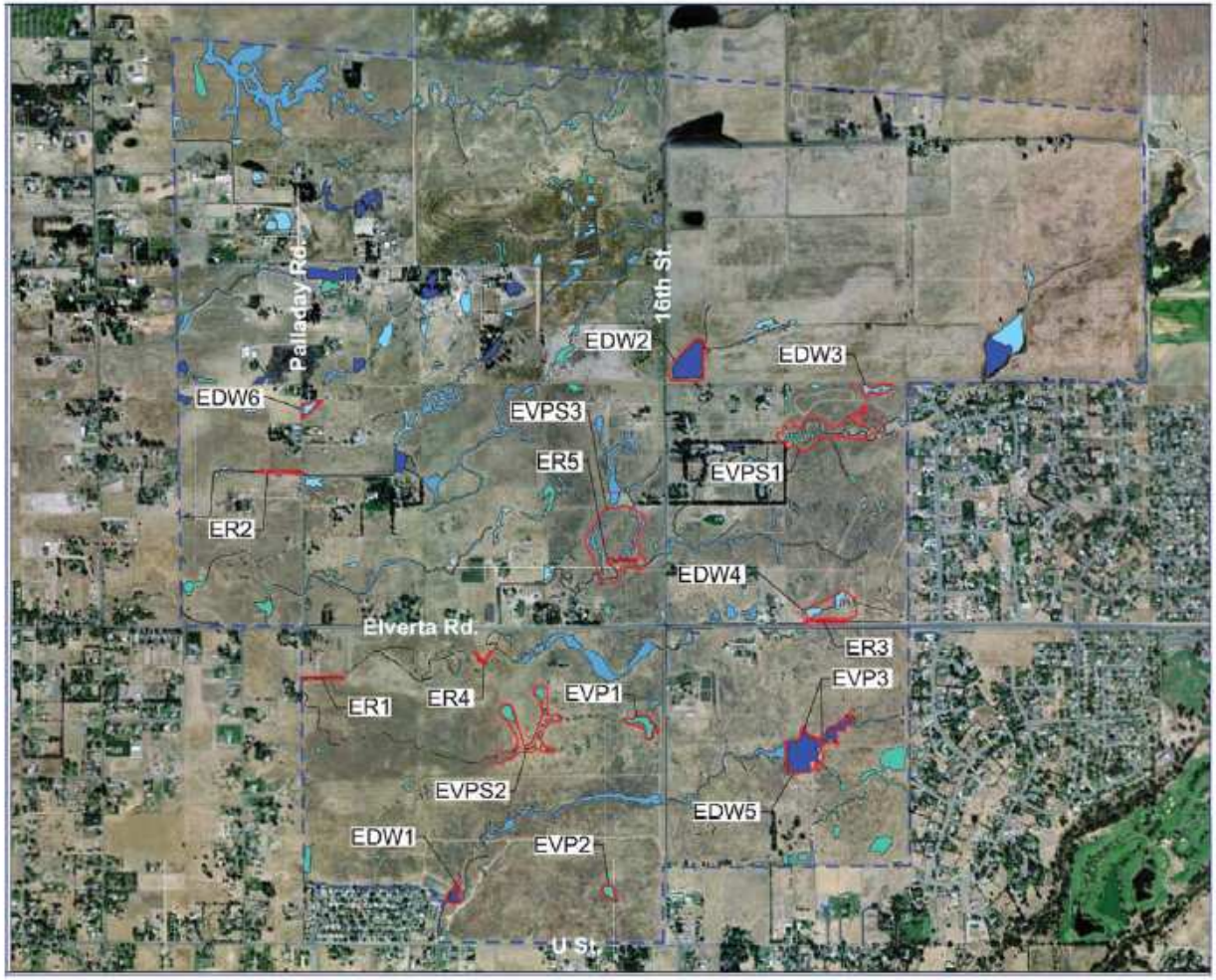
- 25 sites probabilistically selected + targeted sites
- Used Riverine CRAM to assess condition

CRAM Data Reporting



Targeted Survey

Use targeted approach when there is only one or few impact sites, each of which can only have one or two AAs.



Legend

EDW - Elverta Depressional Wetland
ER - Elverta Riverine
EVP - Elverta Vernal Pool
EVPS - Elverta Vernal Pool System
Specific Plan Boundary

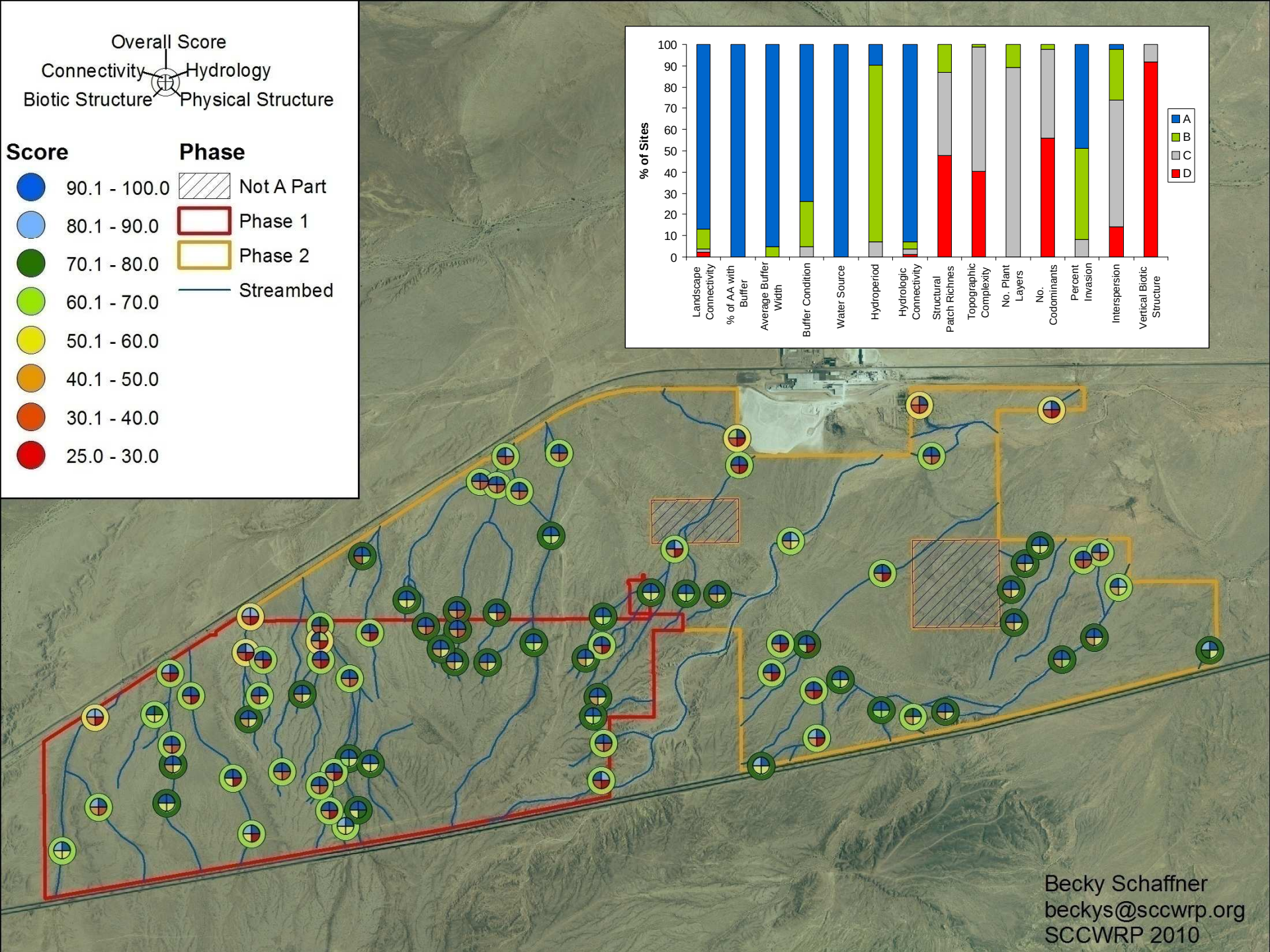
Wetlands Delineation Key

- Channel
- Ditch
- Pond
- Seasonal Wetland
- Seep
- Vernal Pool
- Wetland Swale

Figure 1. Assessment Area locations for the Elverta Specific Plan Site. Additional information for these AAs is presented in the Technical Appendix, including photopoint locations, photos, AA data sheets, and stressor checklists.

Not To Scale

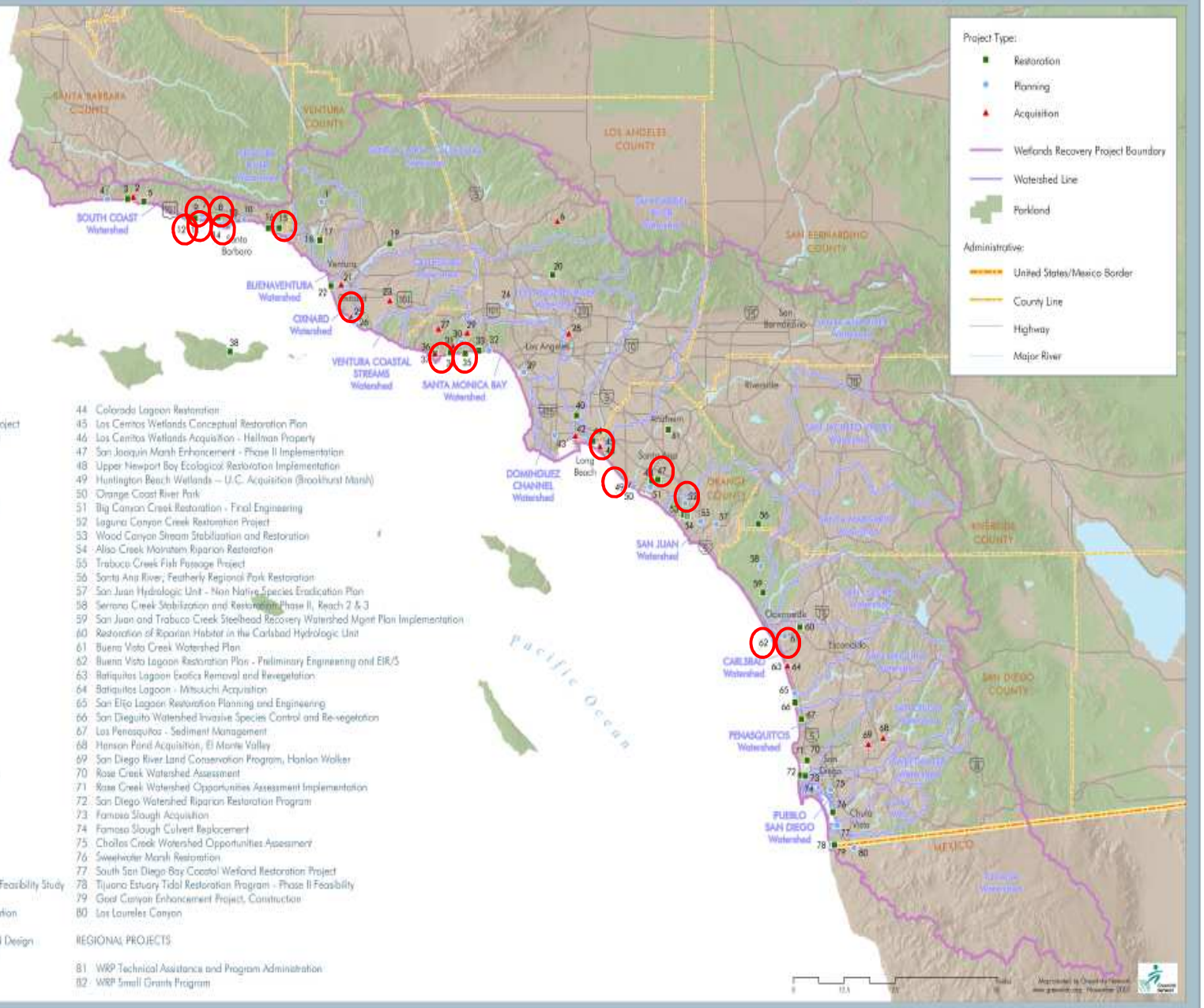
N


Overall Score
Connectivity
Hydrology
Biotic Structure
Physical Structure
Score
90.1 - 100.0
80.1 - 90.0
70.1 - 80.0
60.1 - 70.0
50.1 - 60.0
40.1 - 50.0
30.1 - 40.0
25.0 - 30.0
Phase
Not A Part
Phase 1
Phase 2
Streambed
% of Sites
100
90
80
70
60
50
40
30
20
10
0
Landscape Connectivity
% of AA with Buffer
Average Buffer Width
Buffer Condition
Water Source
Hydroperiod
Hydrologic Connectivity
Structural Patch Richnes
Topographic Complexity
No. Plant Layers
No. Codominants
Percent Invasion
Interspersion
Vertical Biotic Structure
A
B
C
D
Becky Schaffner
beckys@sccwrp.org
SCCWRP 2010

How is CRAM being Used?

- Restoration Effectiveness
  - Southern CA Wetland Recovery Project
  - Central Coast State-funded restoration projects

2008-2010 Wetland Recovery Project Work Plan



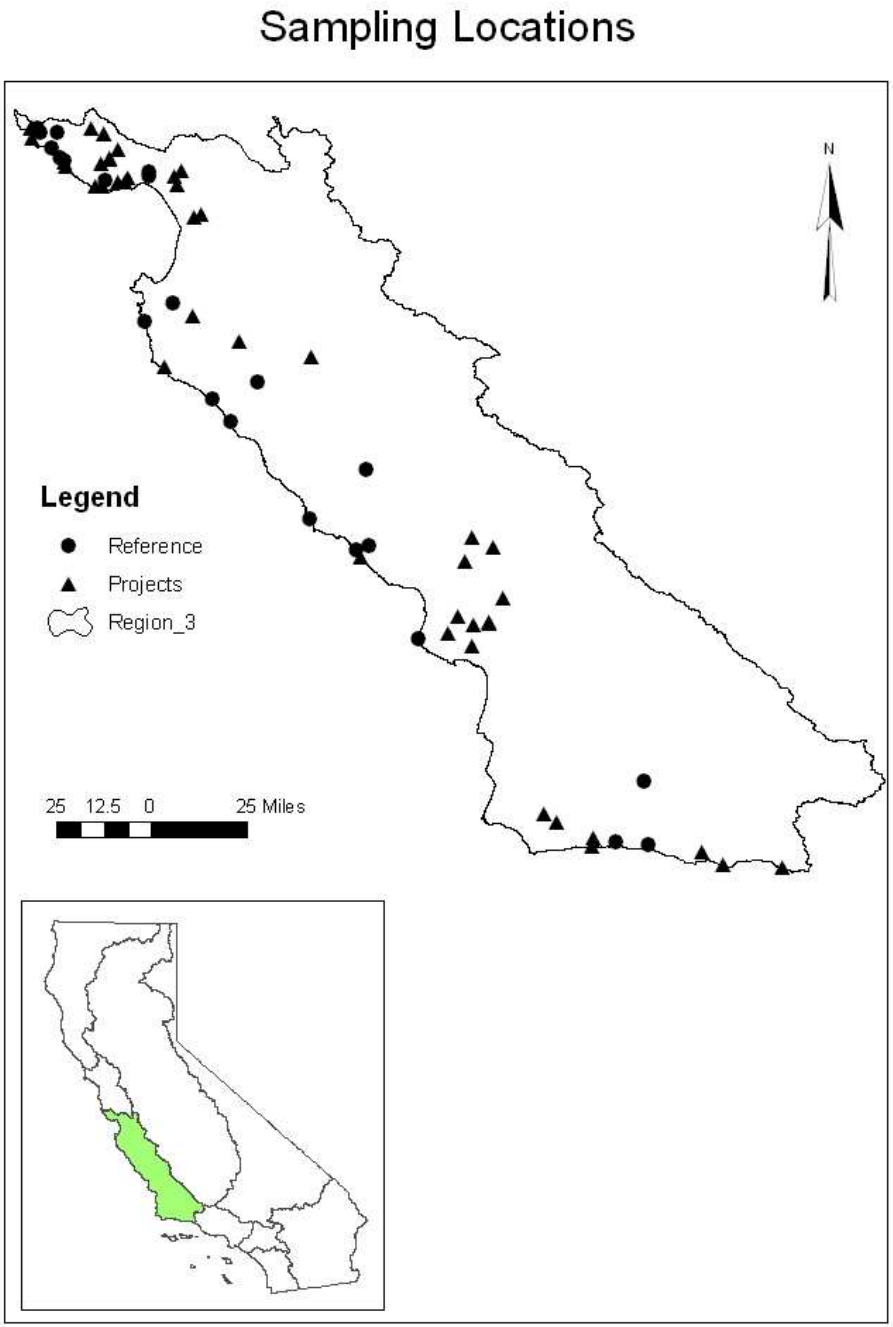
LISTED FROM NORTH TO SOUTH

1 Matilija Dam Removal Engineering and Design
2 Baron Ranch Acquisition
3 Arroyo Hondo Creek Steelhead Habitat Enhancement Project
4 Gaviota State Park Watershed Restoration/Enhancement
5 Lower Refugio Creek Restoration
6 Santa Clara River White Rock Lake Acquisition
7 Maria Ygnacio Fish Passage Project
8 Arroyo Burro Creek Arundo Removal Project
9 Goleta Slough Tidal Restoration Demonstration Project
10 Montecito Creek Fish Passage
11 Western Goleta Slough Wetland Restoration Project
12 Devereux Slough Restoration
13 Mission Creek Steelhead Passage Project
14 Arroyo Burro Restoration at Las Positas
15 Carpinteria Creek Restoration Project
16 Carpinteria Salt Marsh, Basin 1 Implementation
17 Ventura River Parkway
18 Ventura River Arundo Removal Project
19 Hedrick Ranch Nature Area Restoration Project
20 Arundo Removal North San Fernando Valley
21 Santa Clara River Parkway Acquisitions
22 Santa Clara River Estuary McGrath State Beach
23 Lower Conejo Creek Acquisition
24 Sepulveda Basin Plan
25 Ormond Beach Wetlands Acquisition, Part 2
26 Ormond Beach Wetlands Restoration Plan
27 La Sierra Riparian Acquisition
28 Los Angeles River Revitalization - Taylor Yard Acquisition
29 Cold Creek Riparian Acquisitions, Part 2
30 Upper Malibu Creek Feasibility Study (Bindge Dam)
31 Santa Monica Bay Watershed Acquisitions
32 Topanga Creek Restoration Program
33 Los Flores Creek Restoration
34 Solstice Creek Steelhead Access Implementation
35 Malibu Lagoon Restoration and Enhancement
36 Zuma Canyon Restoration and Steelhead Enhancement Feasibility Study
37 Solstice Canyon Acquisitions
38 Prisoners Wetland and Lower Canada del Puerto Restoration
39 Ballona Wetlands Restoration Planning
40 DeForest-Dominguez Wetlands Restoration Planning and Design
41 Santiago Creek Arundo Control and Habitat Restoration
42 Lower Los Angeles River Acquisitions
43 Machado Lake Habitat Restoration Project
44 Colorado Lagoon Restoration
45 Los Cerritos Wetlands Conceptual Restoration Plan
46 Los Cerritos Wetlands Acquisition - Hellman Property
47 San Joaquin Marsh Enhancement - Phase II Implementation
48 Upper Newport Bay Ecological Restoration Implementation
49 Huntington Beach Wetlands – U.C. Acquisition (Brookhurst Marsh)
50 Orange Coast River Park
51 Big Canyon Creek Restoration - Final Engineering
52 Laguna Canyon Creek Restoration Project
53 Wood Canyon Stream Stabilization and Restoration
54 Aliso Creek Mainstem Riparian Restoration
55 Trabuco Creek Fish Passage Project
56 Santa Ana River, Featherly Regional Park Restoration
57 San Juan Hydrologic Unit - Non Native Species Eradication Plan
58 Serrano Creek Stabilization and Restoration Phase II, Reach 2 & 3
59 San Juan and Trabuco Creek Steelhead Recovery Watershed Mgmt Plan Implementation
60 Restoration of Riparian Habitat in the Carlsbad Hydrologic Unit
61 Buena Vista Creek Watershed Plan
62 Buena Vista Lagoon Restoration Plan - Preliminary Engineering and EIR/S
63 Batiquitos Lagoon Exotics Removal and Revegetation
64 Batiquitos Lagoon - Mitsuchi Acquisition
65 San Elijo Lagoon Restoration Planning and Engineering
66 San Dieguito Watershed Invasive Species Control and Re-vegetation
67 Los Penasquitos - Sediment Management
68 Hanson Pond Acquisition, El Monte Valley
69 San Diego River Land Conservation Program, Hanlon Walker
70 Rose Creek Watershed Assessment
71 Rose Creek Watershed Opportunities Assessment Implementation
72 San Diego Watershed Riparian Restoration Program
73 Famosa Slough Acquisition
74 Famosa Slough Culvert Replacement
75 Chollas Creek Watershed Opportunities Assessment
76 Sweetwater Marsh Restoration
77 South San Diego Bay Coastal Wetland Restoration Project
78 Tijuana Estuary Tidal Restoration Program - Phase II Feasibility
79 Goat Canyon Enhancement Project, Construction
80 Los Laureles Canyon

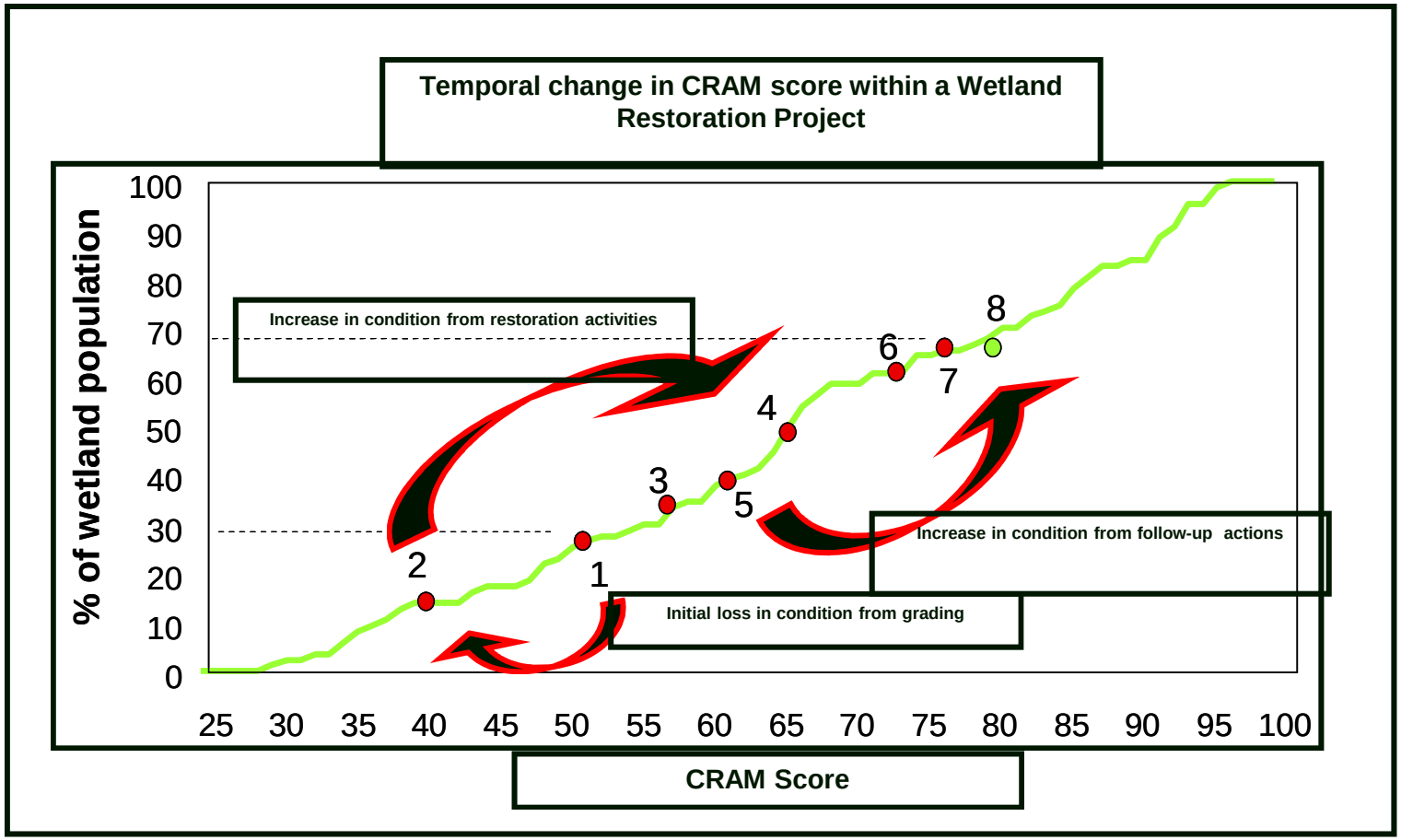
REGIONAL PROJECTS

81 WRP Technical Assistance and Program Administration
82 WRP Small Grants Program

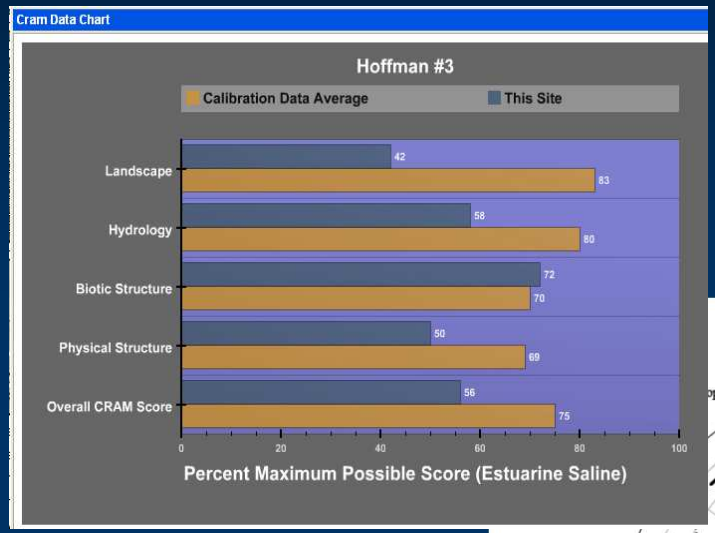
Evaluating Restoration Success Compared to Reference Sites

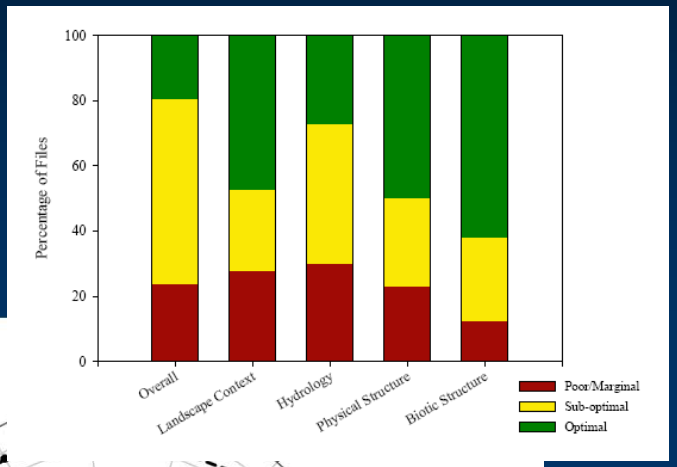


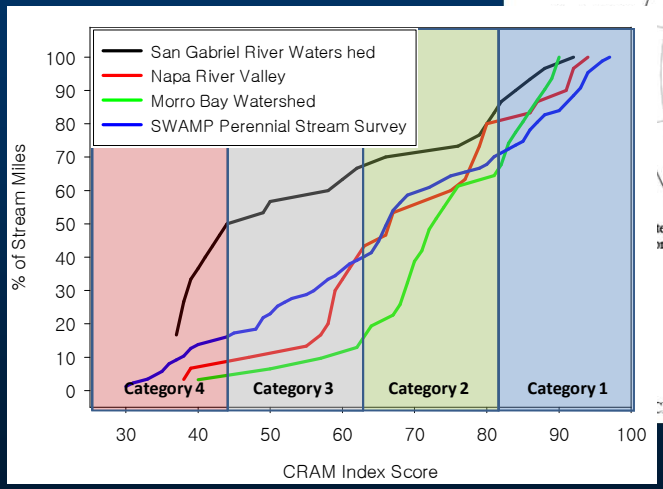
Monitoring CRAM Scores Over Time

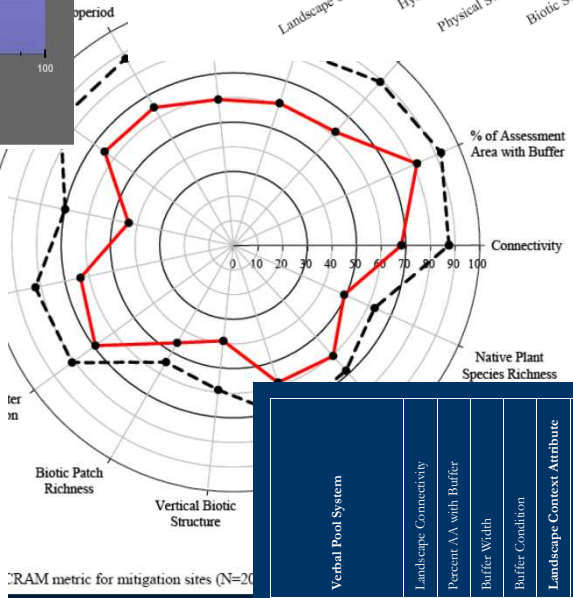


Alternative Ways to Present Results



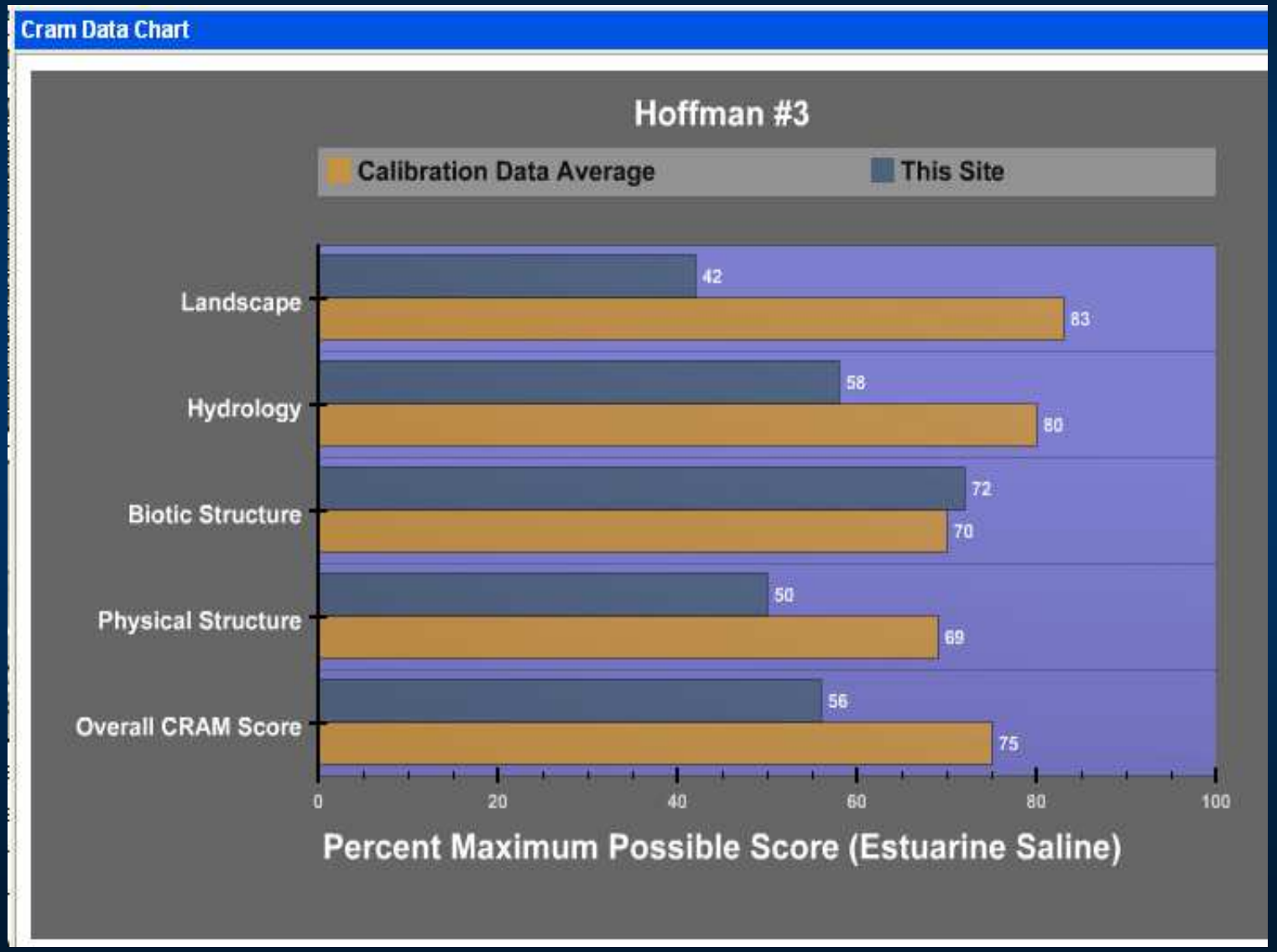




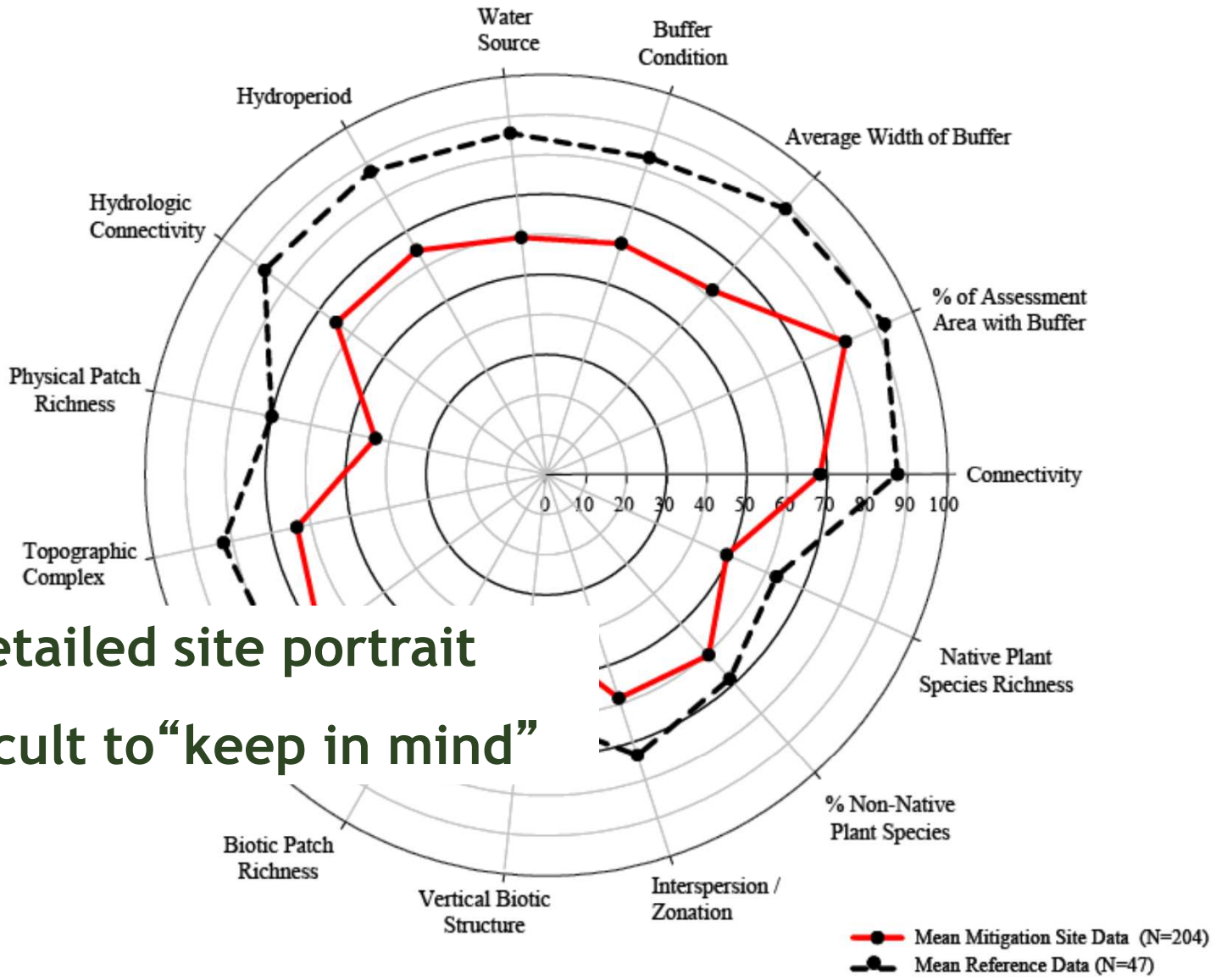


Verbal Pool System	Landscape Connectivity	Percent AA with Buffer	Buffer Width	Buffer Condition	**Landscape Context Attribute**	Water Source	Hydroperiod	Hydrologic Connectivity	**Hydrology Attribute**	Structural Patch Richness	Topographic Complexity	**Physical Structure Attribute**	Organic Matter Accumulation	Plant Co-Dominance	Percent Invasion	Horizontal Interspersion	**Biological Structure Attribute**	**System Score**
Werre Ranch 1	12	12	12	9	**94**	12	12	12	**100**	9	11	**83**	9	11	11	10	**85**	**90**
Werre Ranch 2	12	12	9	9	**90**	12	9	9	**83**	12	9	**88**	9	10	10	10	**81**	**85**
Werre Ranch 3	12	12	12	9	**94**	12	12	12	**100**	12	9	**88**	9	11	11	10	**86**	**92**
Average System Score as Overall Site Score																		**89**

Table of Attribute and Index Scores for 1 Site



Spider Diagram for All Scores at 1 Site



- Detailed site portrait
- Difficult to"keep in mind"

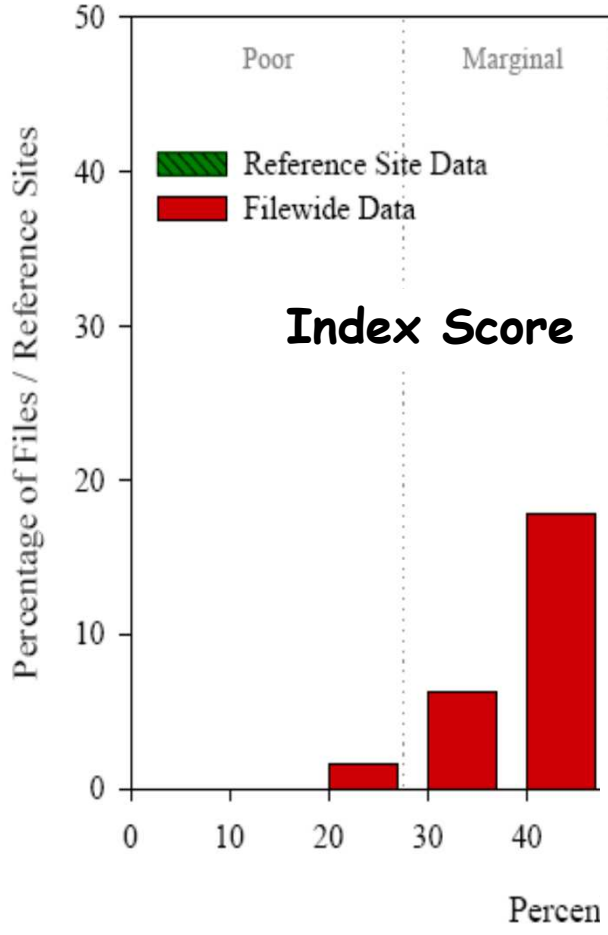
Figure 46. Mean percentage scores for each CRAM metric for mitigation sites (N=204) and reference sites (N=47).

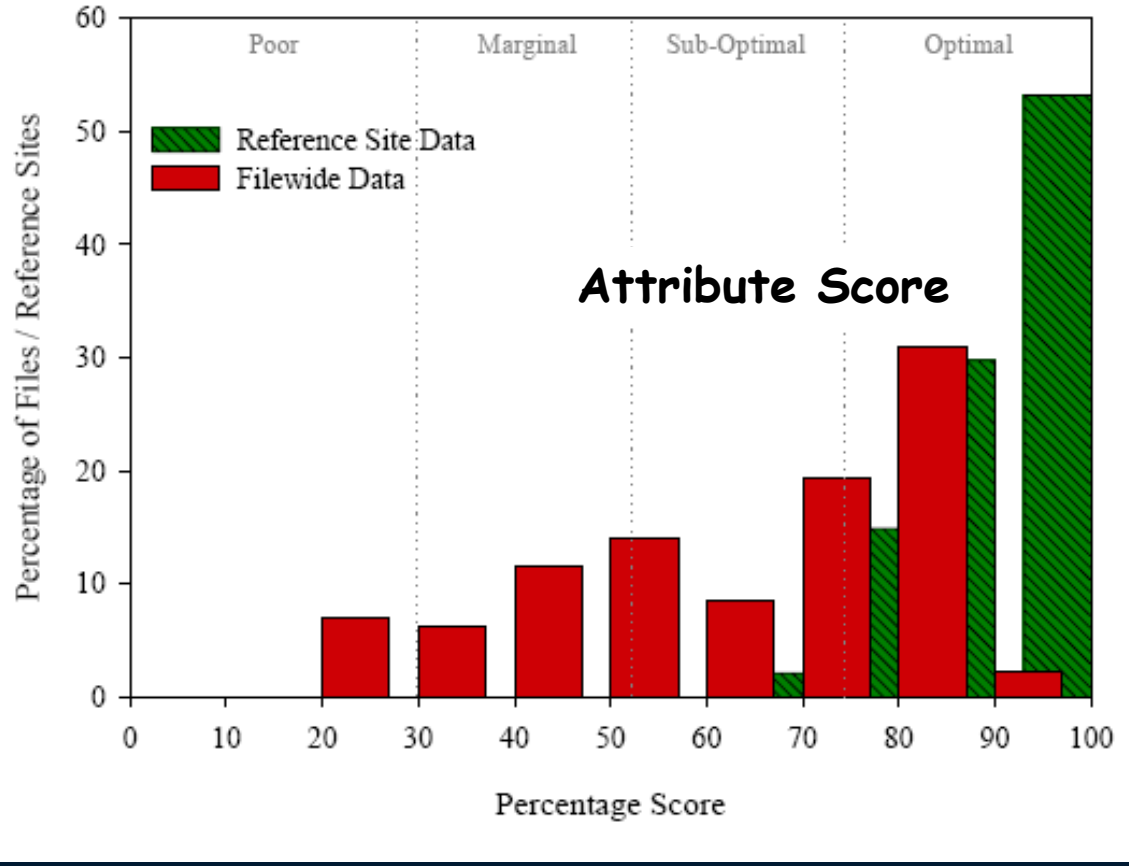
Table of All Scores for 3 Sites

Verbal Pool System	Landscape Connectivity	Percent AA with Buffer	Buffer Width	Buffer Condition	**Landscape Context Attribute**	Water Source	Hydroperiod	Hydrologic Connectivity	**Hydrology Attribute**	Structural Patch Richness	Topographic Complexity	**Physical Structure Attribute**	Organic Matter Accumulation	Plant Co-Dominance	Percent Invasion	Horizontal Interspersion	**Biological Structure Attribute**	**System Score**
Werre Ranch 1	12	12	12	9	**94**	12	12	12	**100**	9	11	**83**	9	11	11	10	**85**	**90**
Werre Ranch 2	12	12	9	9	**90**	12	9	9	**83**	12	9	**88**	9	10	10	10	**81**	**85**
Werre Ranch 3	12	12	12	9	**94**	12	12	12	**100**	12	9	**88**	9	11	11	10	**86**	**92**
Average System Score as Overall Site Score																		**89**

- Obvious component of text report
- Not useful for maps and other graphics

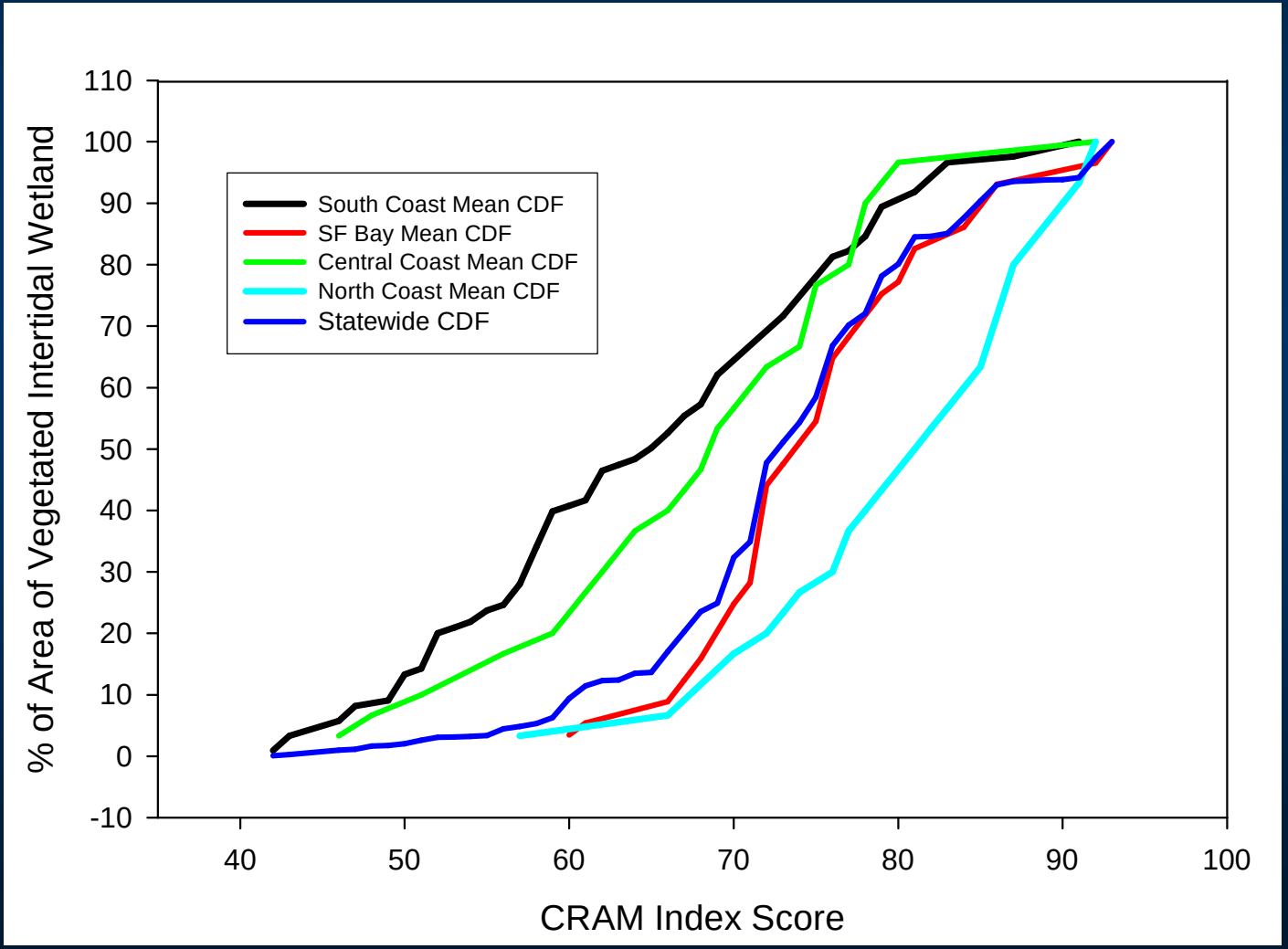
Histograms of Many Sites Compared to Reference Sites (Index Scores or Individual Attribute Scores)





Landscape Profiles

Regional or Watershed CFDs of Ambient Condition



California Wetlands Portal and Project Tracking

www.CaWaterQuality.net

.GOV CALIFORNIA WATER QUALITY MONITORING COUNCIL

Home | Safe to Drink | Safe to Swim | Safe to Eat Fish | Ecologic Health | Stressors & Processes | Contact Us

My Water Quality - hosted by the Surface Water Ambient Monitoring Program (SWAMP)

GOVERNOR SCHWARZENEGGER
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- Cal/EPA
- The Resources Agency
- About the California Water Quality Monitoring Council
- State & Regional Water Boards
- Web Portal Partners
- Monitoring Programs, Data Sources & Reports
- Water Quality Standards, Plans and Policies
- Regulatory Activities
- Enforcement Actions
- Research

- About SWAMP
- SWAMP Tools

SWAMP
Surface Water Ambient Monitoring Program

Welcome to My Water Quality

This web portal, supported by a wide variety of public and private oraganizations, presents California water quality monitoring data and assessment information from a variety of perspectives that may be viewed across space and time.

IS OUR WATER SAFE TO DRINK?

Safe drinking water depends on a variety of chemical and biological factors regulated by a number of local, state, and federal agencies. More >>

IS IT SAFE TO SWIM IN OUR WATERS?

Swimming safety of our waters is linked to the levels of pathogens that have the potential to cause disease. More >>

IS IT SAFE TO EAT FISH AND SHELLFISH FROM OUR WATERS?

Aquatic organisms are able to accumulate certain pollutants from the water in which they live, sometimes reaching levels that could harm consumers. More>>

ARE OUR AQUATIC ECOSYSTEMS HEALTHY?

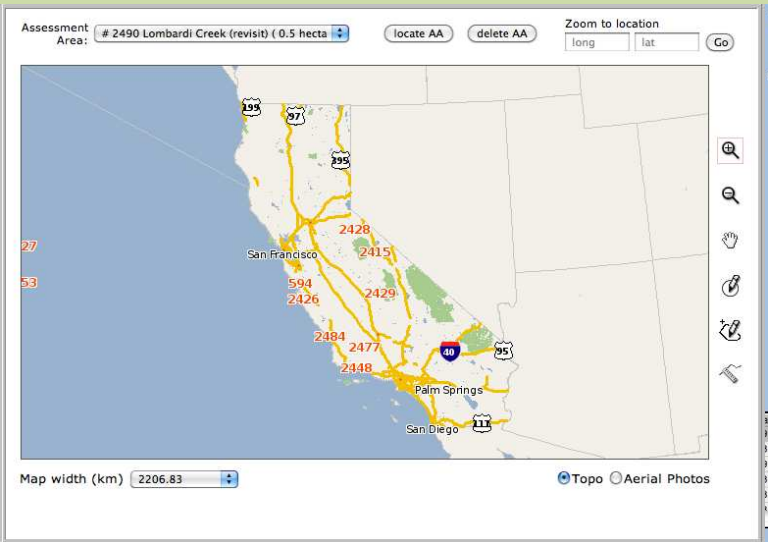
The health of fish and other aquatic organisms and communities depends on the chemical, physical, and biological quality of the waters in which they live. More>>

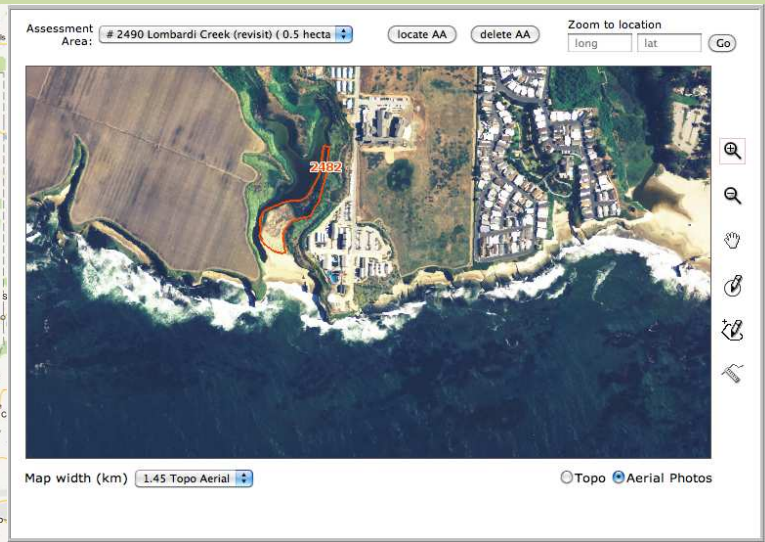
WHAT STRESSORS AND PROCESSES AFFECT OUR WATER QUALITY?

Benefical uses of our waters are affected by emerging contaminants, invasive species, trash, global warming, acidification, pollutant loads, and flow. More>>

CRAM Information Technology Training

(eCRAM)





What is eCRAM?

- Web-based, open-source
- Data management and transfer
- Standard formatting
- Depository for CRAM scores
- Web-based viewer for CRAM results
- Runs online on CRAM website

Open Source Engineering

- MapServer
  - Open source GIS development environment for building spatially-enabled internet applications
- PostgreSQL
  - Open source enterprise-class relational database that runs on all major operating systems
- Non-proprietary Script
  - All custom programming available on request

Getting Started

- www.cramwetlands.org
- Register
- Interactively upload CRAM data directly from the field (e.g., via iPAD) or upload data from completed field forms using PC/laptop