Transportation and Stormwater

Development of a Stream Restoration and Protection Prioritization Tool

Vicki Kalkirtz (City of San Diego)
Clint Boschen (Tetra Tech) and Jerry Diamond (Tetra Tech)

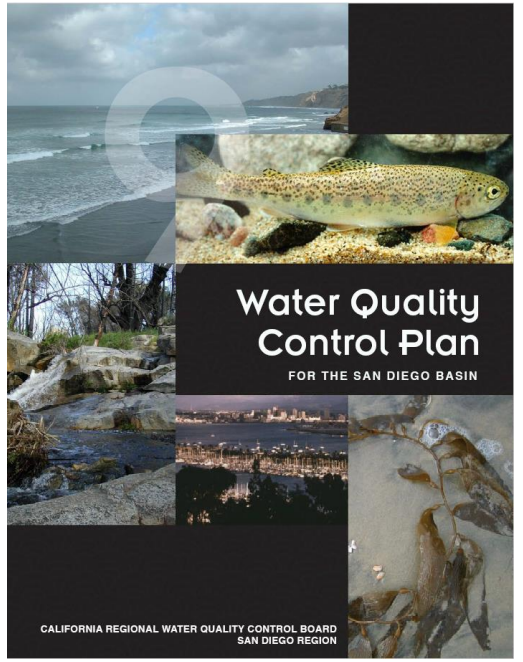
THINK BLUE

TETRA TECH

The City of SAN DIEGO

Background

- Increasing focus on Biological Integrity
  - Previous reliance on chemical measures
  - Recent scientific advancements
  - Improved assessment of ecosystem health
- Regulatory drivers
  - San Diego Water Board – developing numeric Biological Objectives
  - State Water Board – Biostimulatory/Biointegrity project
- Ongoing challenges
  - Complexity of stream ecosystems
  - Development of appropriate objectives
  - Causal assessments
  - How to prioritize implementation?



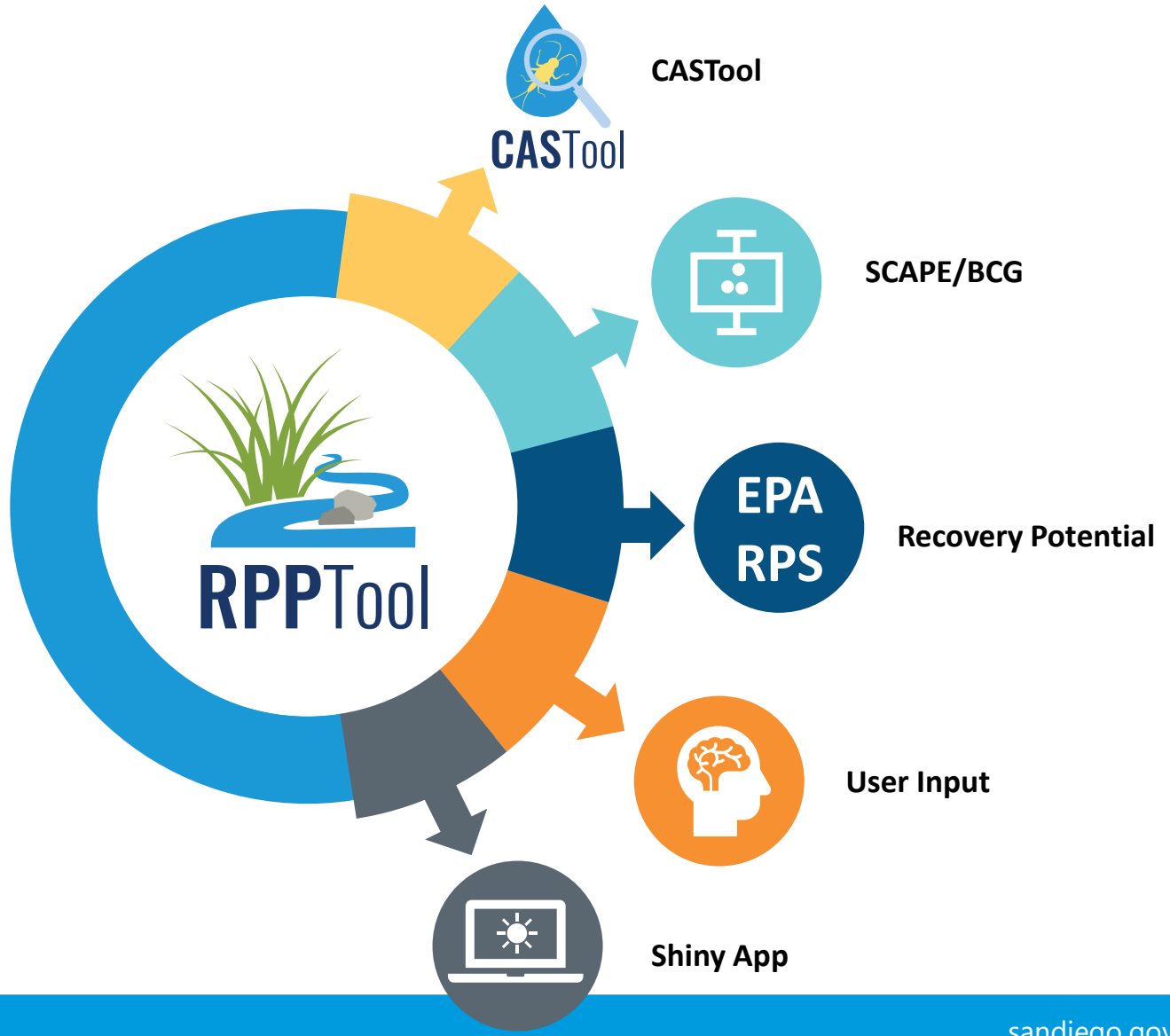
Why develop a Restoration and Protection Prioritization (RPP) Tool?

- Many streams in southern California are in fair or poor biological condition
  - Which are highest priority for restoration?
- Some unimpaired streams may be vulnerable to future impacts
  - Which are highest priority for protection?
- City and other stakeholders are interested in identifying which streams will benefit most from restoration or protection
- Provides multiple co-benefits

RPP Overview

Goals:

- Identify high priority sites for restoration or protection
- Support decision-making and cost-effective use of City resources
- Share with other agencies and stakeholders
- Support Biological Objectives implementation



Key Considerations

Differences

Restoration

- Subject to stressors causing biological degradation
- Desired biological condition not met
- Often located in close proximity to human land uses
- Preference for sites that are amenable to ecological lift via BMPs or other means

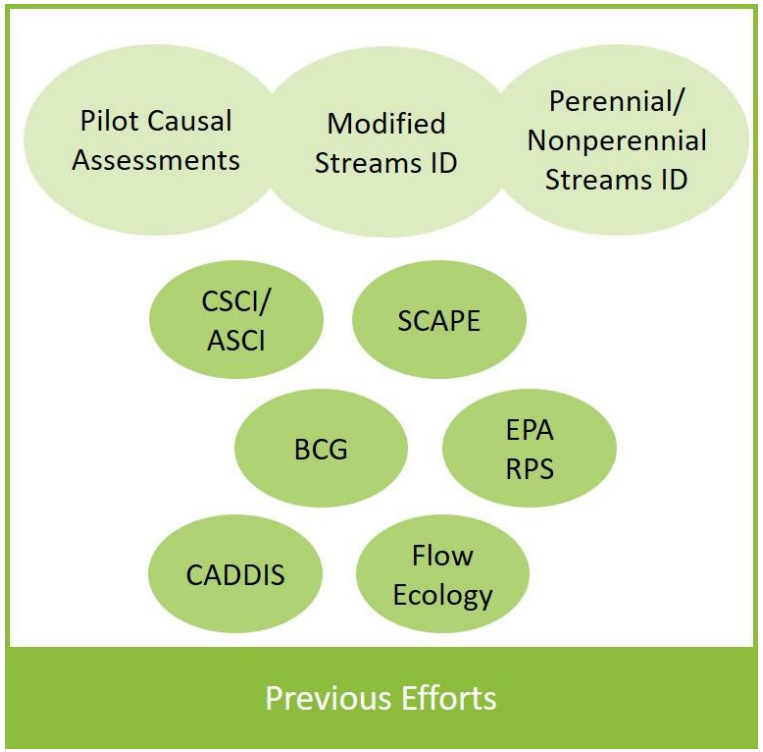
Protection

- Vulnerable to stressors
- Achieves at least minimum desired biological condition
- Generally located in areas with lower human pressures
- Preference for sites that are vulnerable to land use changes and other stressors

Similarities

- More stakeholder interest in the watershed → Higher priority for management actions
- Co-benefits (e.g., ecosystem services) can be gained via management actions → More reasons to restore or protect stream
- Connectivity of aquatic life habitats up and downstream → Greater ecological lift over a larger catchment

Building the Foundation



THINK BLUE

CASTool Design

Highlights:

- Rapidly identify potential stressors and rule out unlikely ones
- Identify major lines of evidence for use in more detailed causal assessments
- Iterate over many sites at once
- Focus effort where it's needed

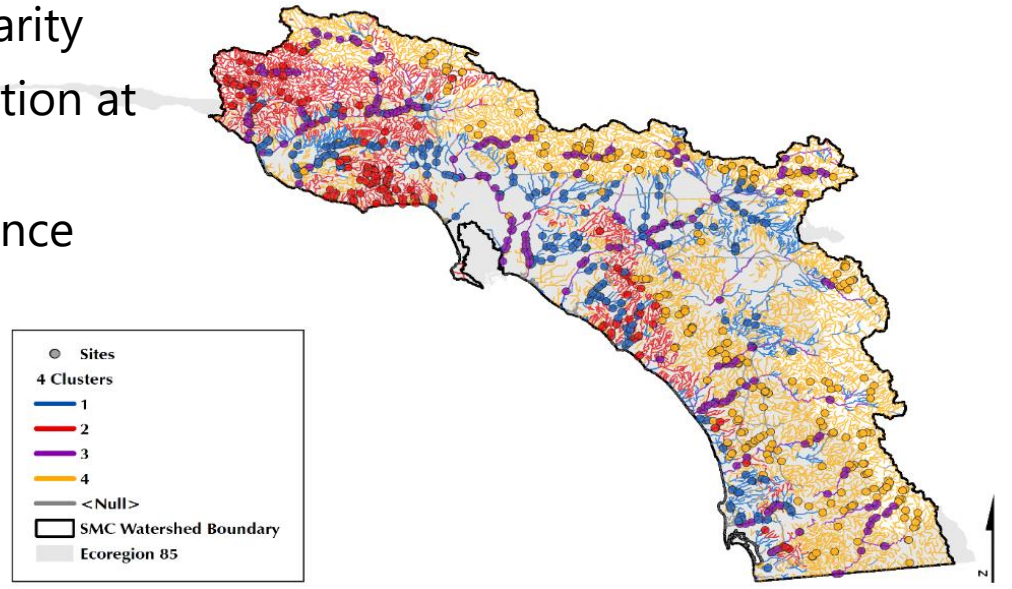
Key Components

Input Data

- Stressors
  - Water chemistry
  - Physical habitat metrics and index
  - Flow ecology metrics (modeled)
- Responses
  - Benthic macroinvertebrates
  - Algae

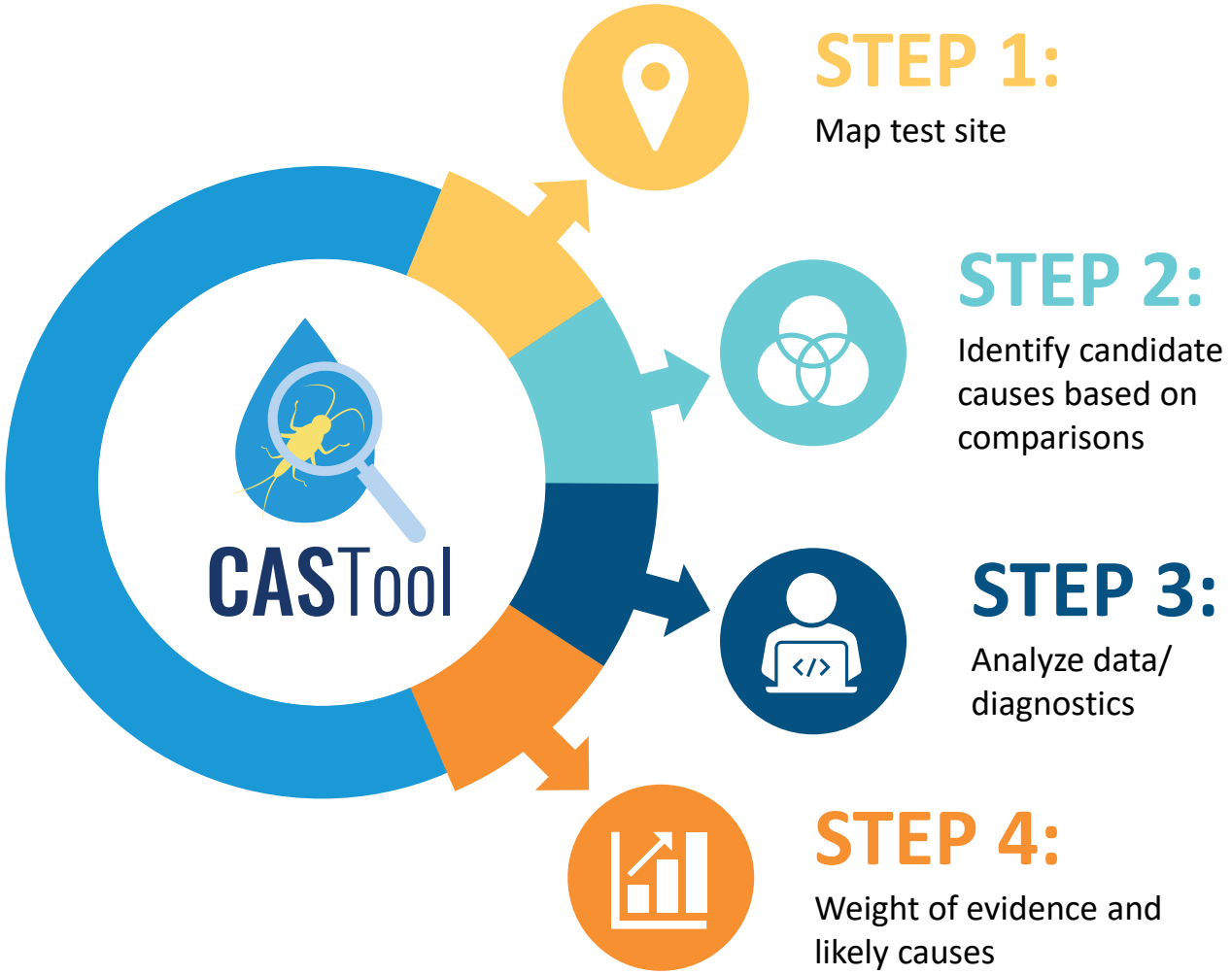
Output Data

- Comparator Sites
  - Clustered by natural characteristics
  - Refined by expected benthic macroinvertebrate similarity
- Potential stressors for evaluation at each site
- Results for each line of evidence
- Overall weight of evidence



Lines of Evidence

- Spatial/temporal co-occurrence
- Stressor-response relationships for comparator sites
- Temporal sequence
- Stressor-response relationships from other SMC sites
- Species tolerance to fine sediment or high ionic strength (conductivity, TDS)



CASTool Reporting

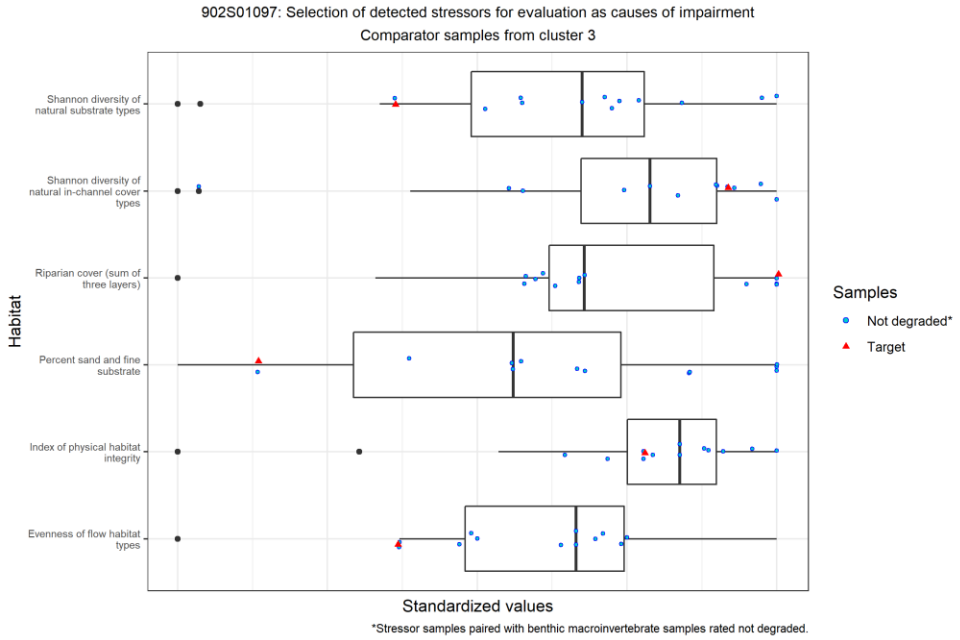
Weight of Evidence

Overall Findings

Summarized weight of evidence data are found in the file '902S01097_BMI_WoE_ExecSumm
the'Results/902S01097/BMI/WoE' folder. More detailed weight of evidence data are found in t
'902S01097_BMI_WoE_ScoresTable.tab' in the'Results/902S01097/BMI/WoE' folder.

Scores for each line of evidence and overall weight of evidence, weighted by numi
indicates that all evaluated lines of evidence for all observed stressors in the grou
evidence score of -1 indicates that all evaluated lines of evidence for all observed

SiteID	Degraded	Group	Stressor_Samples	Stressors	Overall_WoE	TS_Inside
902S01097	No	Habitat	1	2	1.000	0
		Ions	1	1	1.000	0



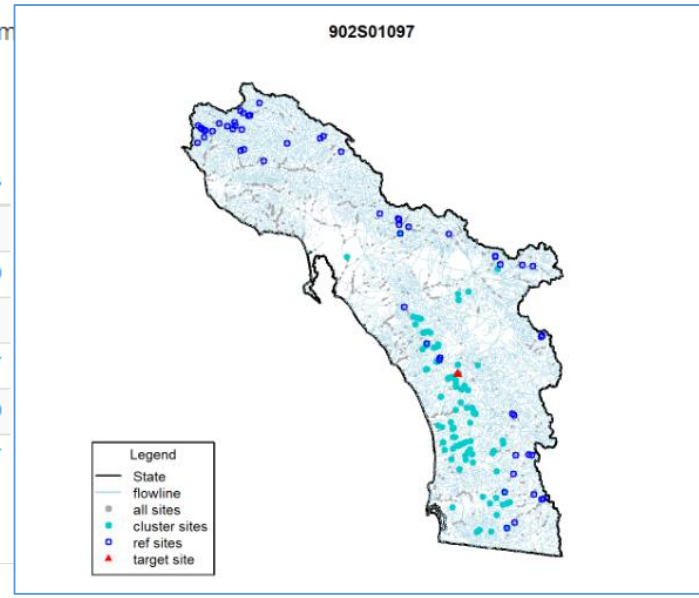
Comparator Site Information

Additional comparator site info, including a list of comparator sites and sam
folder.

Number of sites by type, group, and quality.

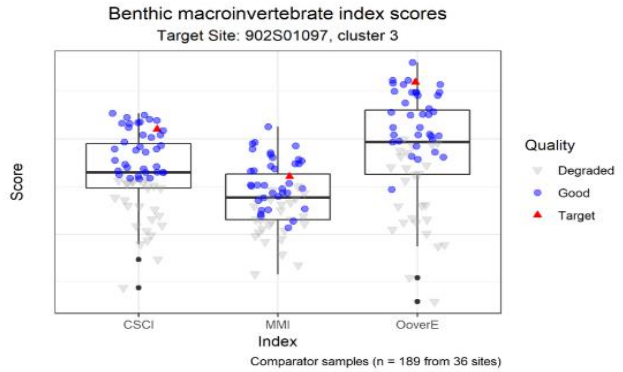
Group	Quality	ComparatorSamples	ClusterSamples	AllSamples
All	All qualities	51	113	1141
	Degraded	30	51	550
	Not degraded	21	62	591
Better than	All qualities	2	12	197
	Degraded	0	0	0
	Not degraded	2	12	197

All 35 comparator sites have >95% expected biological similarity.



BMI RESULTS

Biological Index Distributions



RPPTool

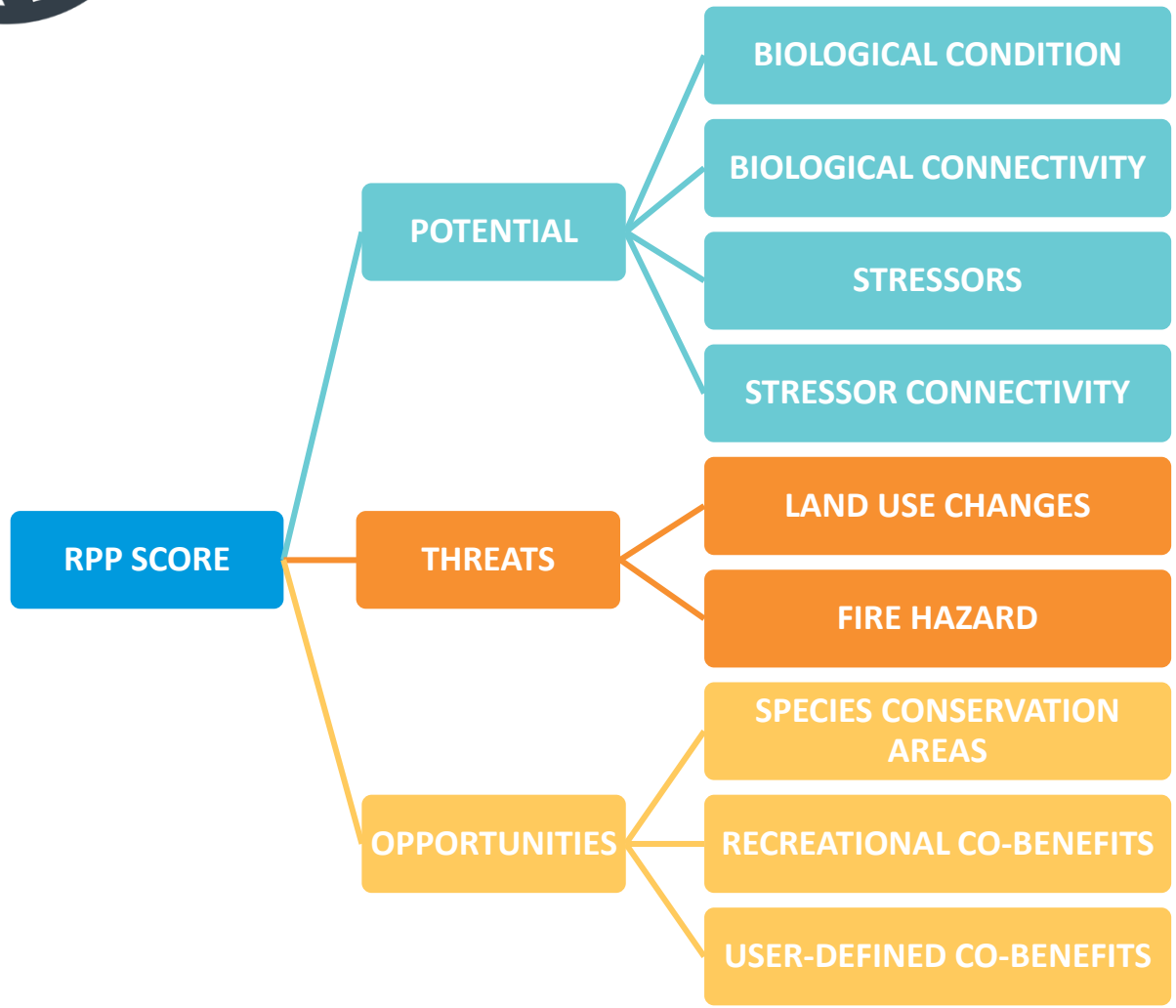
THINK BLUE

RPPTool Design

Highlights:

- Modeled after EPA's RPS tool, but built with more specific data and analyses for the SMC region
- Considers connectivity of target reach to better quality reaches nearby for ecological lift potential
- Utilizes similar scoring methods and user-friendliness
- Interacts with the CASTool results
- R/Shiny-based to better mesh with other regional tools and user friendliness

RPPTool Design



RPP Score based on similar components used in EPA's Recovery Potential Tool:

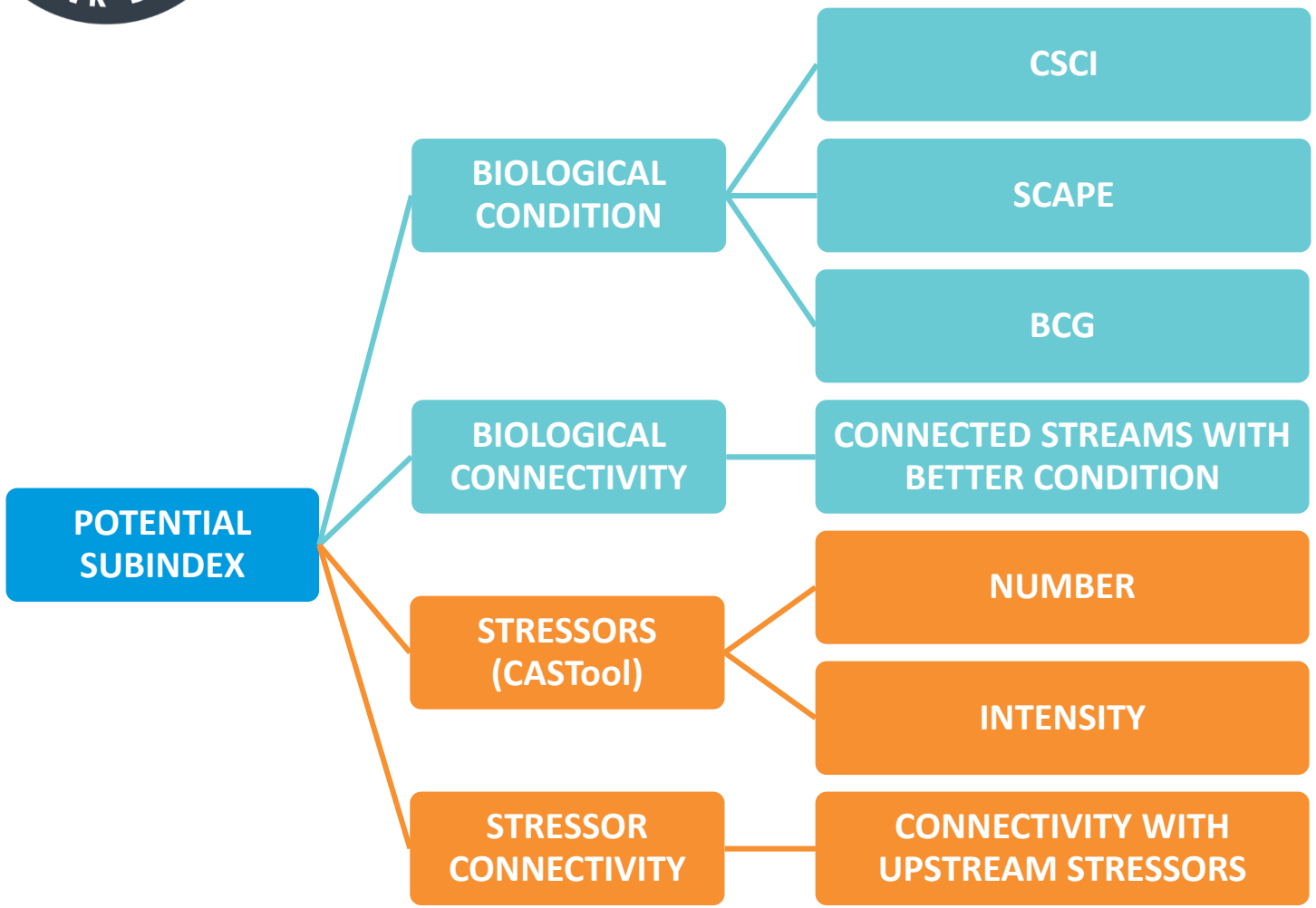
- Potential for ecological lift
- Current or future threats
- Opportunities – synergies with on-going activities or planned actions

- **RPPTool built using California-specific data and tools, especially for SMC region**

How are the components used?

- **Potential** – Influenced by current stressor and landscape constraints
  - ***If fewer landscape constraints or fewer/easier to manage stressors***
- **Threats/Vulnerability** – Future developed land use; fire risk
  - ***If high projected population growth; high risk of fire***
- **Opportunity** – Elements that support restoration or protection actions
  - ***If more stakeholder interest; WQIPs; co-benefits***

Potential Subindex



Greater potential for ecological lift if:

- *Expected* biological condition is better than the *observed* condition at a site
- Lower stressor influence
  - More stressors or more intense stressors = lower potential
- Biological and stressor conditions in nearby reaches are better than the target reach

Threats Subindex

- Major threats to biological condition in the SMC region:
  - Future population growth and urbanization
    - Projected change in developed land cover
  - Fire Hazard
    - Likelihood of fire over the next 30- to 50-years
- Increasing development or risk of fire at a site = lower chance of successful restoration efforts

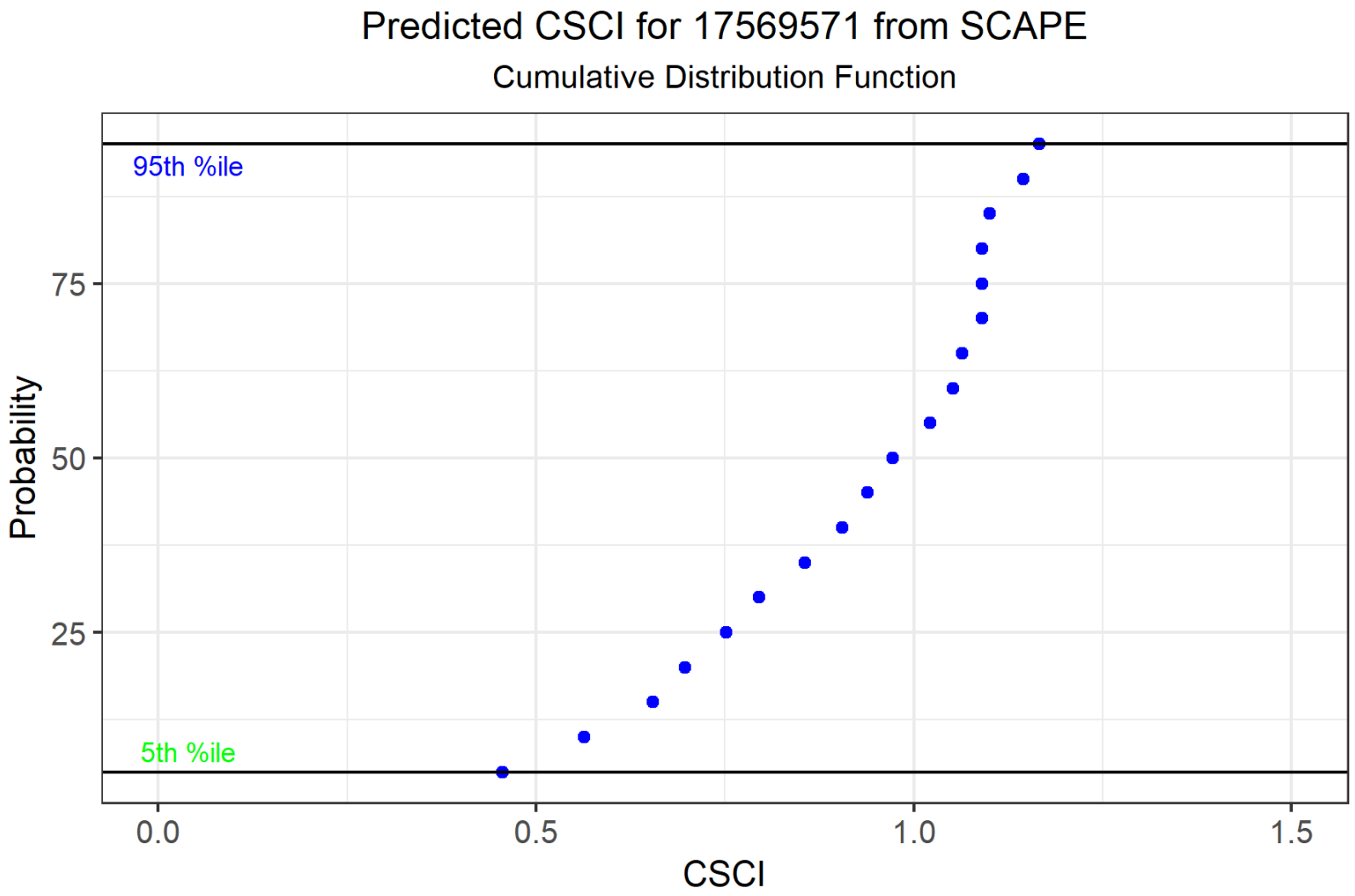
Opportunities Subindex

- Protection or restoration efforts can be enhanced if associated with:
  - Available ecological co-benefits
  - Available recreational co-benefits
  - Synergies with other user objectives:
    - WQIPs
    - Socio-economic benefits
- Greater opportunities = greater chance of success with restoration or protection efforts

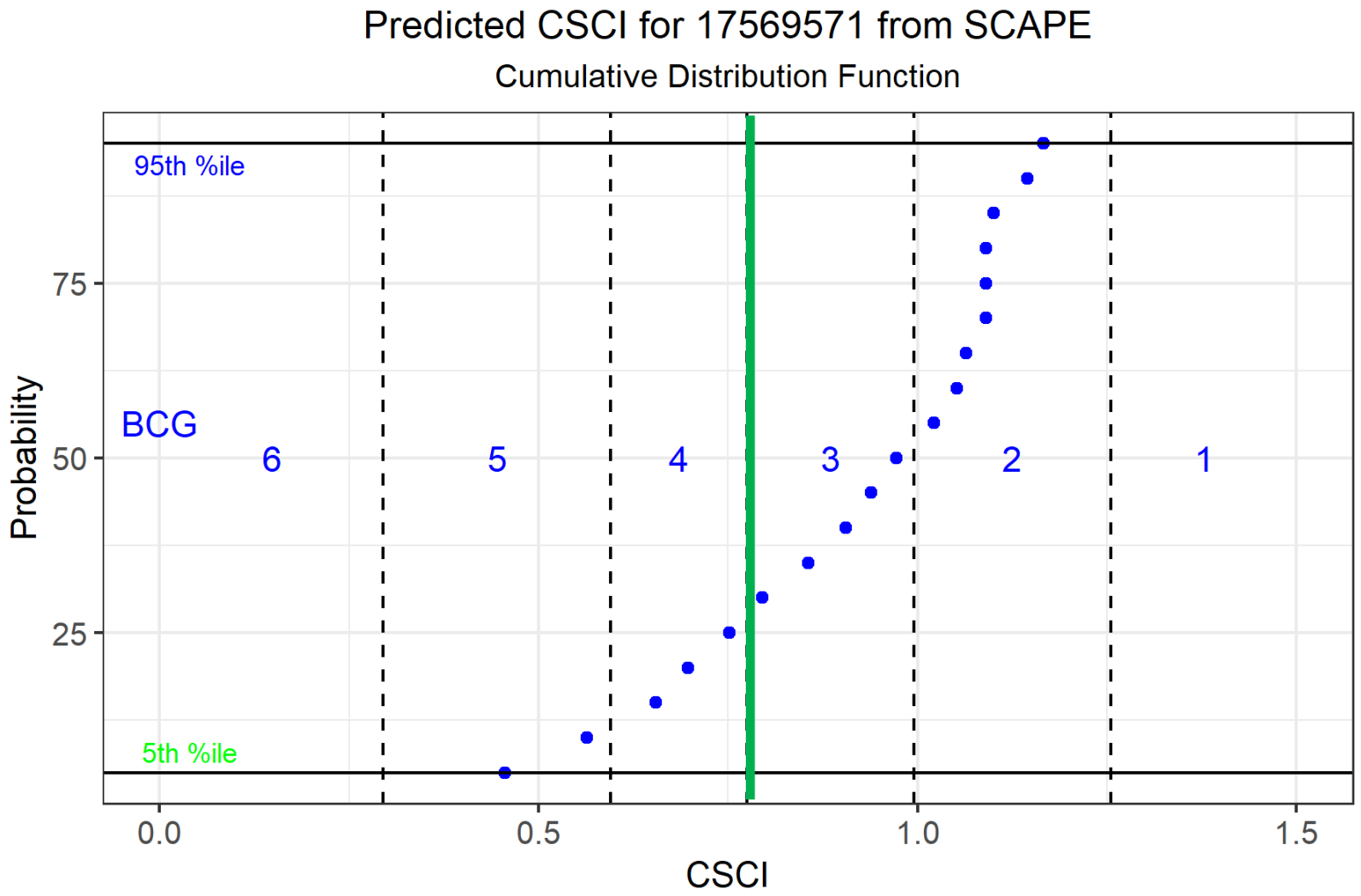
Potential for Ecological Lift

- **Stressor intensity (from CASTool)**
  - Higher score = few stressors or stressors of lower concern (lower weighted normalized value)
- **Expected lift (from SCAPE/predicted biological condition and BCG)**
  - Higher score = greater potential for restoration (site could be much better) or protection (site could be prevented from getting worse)
- **Connectivity (Landscape context)**
  - Biology
    - Higher score = better biological quality upstream or both up and downstream
  - Stressors
    - Higher score = fewer stressors or stressors of lower concern from upstream contributing to target reach (**from CASTool**)

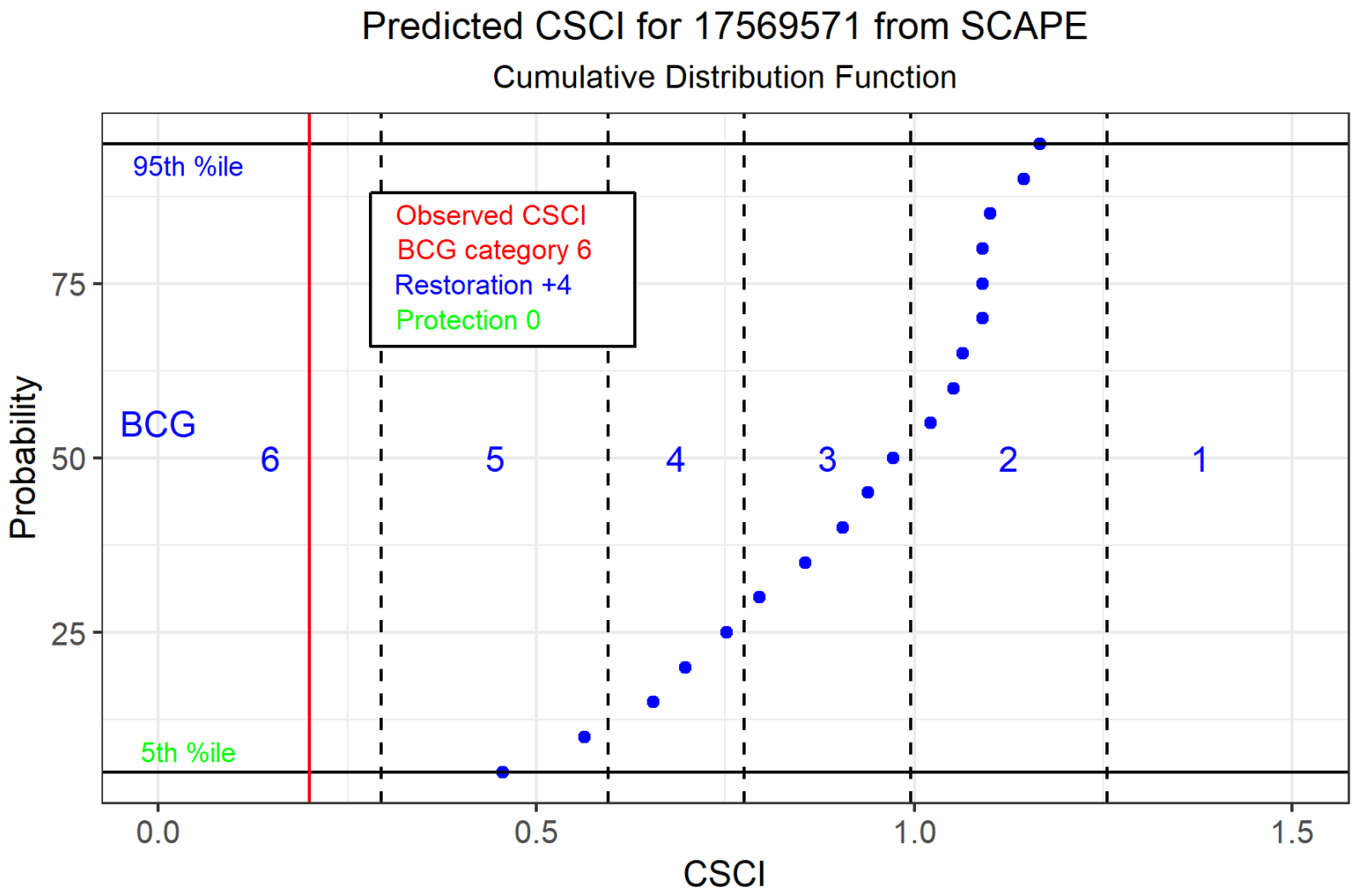
Determining Biological Condition Potential Based on SCAPE



Add Biological Condition Gradient (BCG)



Determining Potential for Ecological Lift



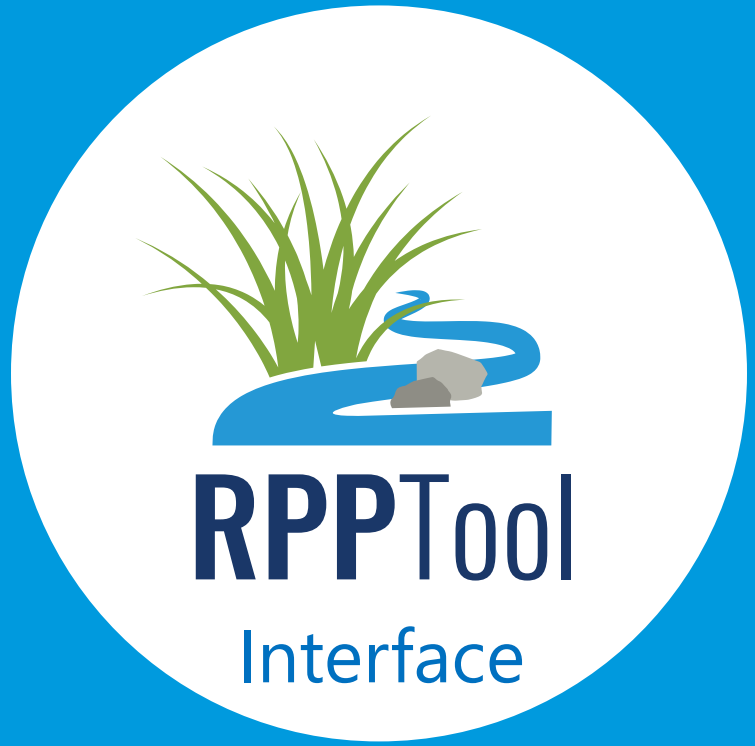
Biological Connectivity Example

Potential for ecological lift depends in part on the stressor and biological conditions in nearby reaches

- RPPTool compares target reach conditions to up and downstream reaches
- Better conditions nearby = higher likelihood of restoration success

User Flexibility

- Identify data time period
- Run with/without CASTool results
- Weight the subindices differently
- Weight individual stressors based on relative importance
- Change the size of the landscape area for connectivity analyses
- Add points for headwater reaches
- Add points for reaches having high potential ecological lift



THINK BLUE

Shiny Application

- Web browser interface to R functions
- Can be run from the web or via a local computer with R installed
  - From the web – currently developing weblinks
  - Using the Shiny function to launch a web browser and run the app locally

Mapping / Site Selection

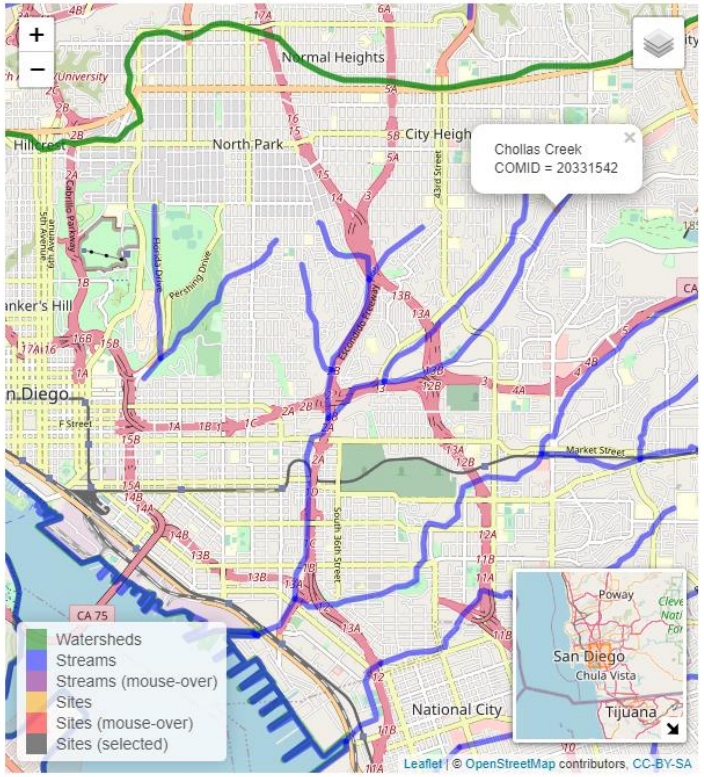
Restoration and Protection Potential (RPP) | Disclaimer | **Map, Stations** | Map, Reach | RPP-Calc | HELP

The map can take up to 10 seconds to load. Please be patient.

Use the button (or the map) to select a Station ID.

Select Station ID:

After choosing a Station ID click the stream reach to get the Reach ID (COMID) for use with the RPP-Calc tab analysis.



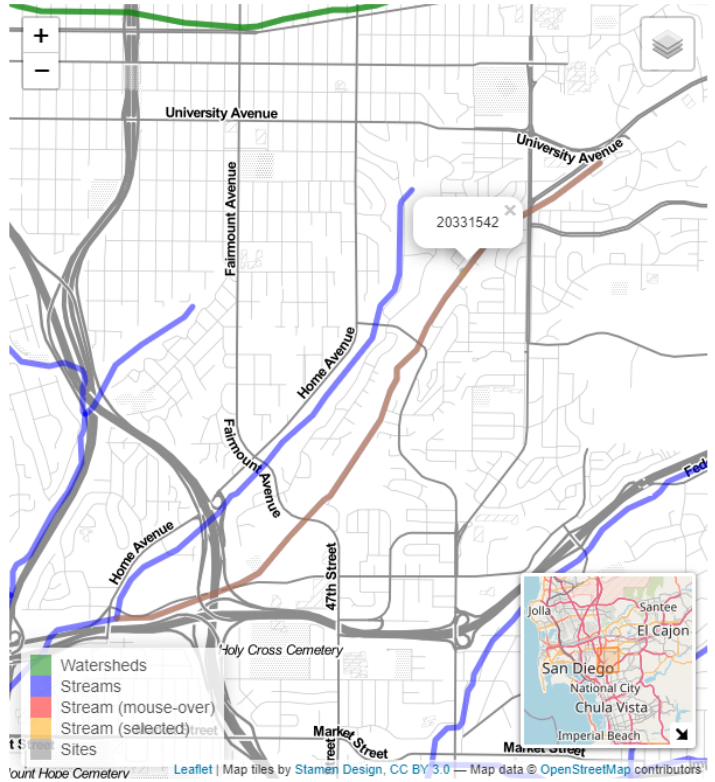
Restoration and Protection Potential (RPP) | Disclaimer | Map, Stations | **Map, Reach** | RPP-Calc | HELP

The map can take up to 60 seconds to load. Please be patient.

Use the button (or the map) to view a COMID on the map.

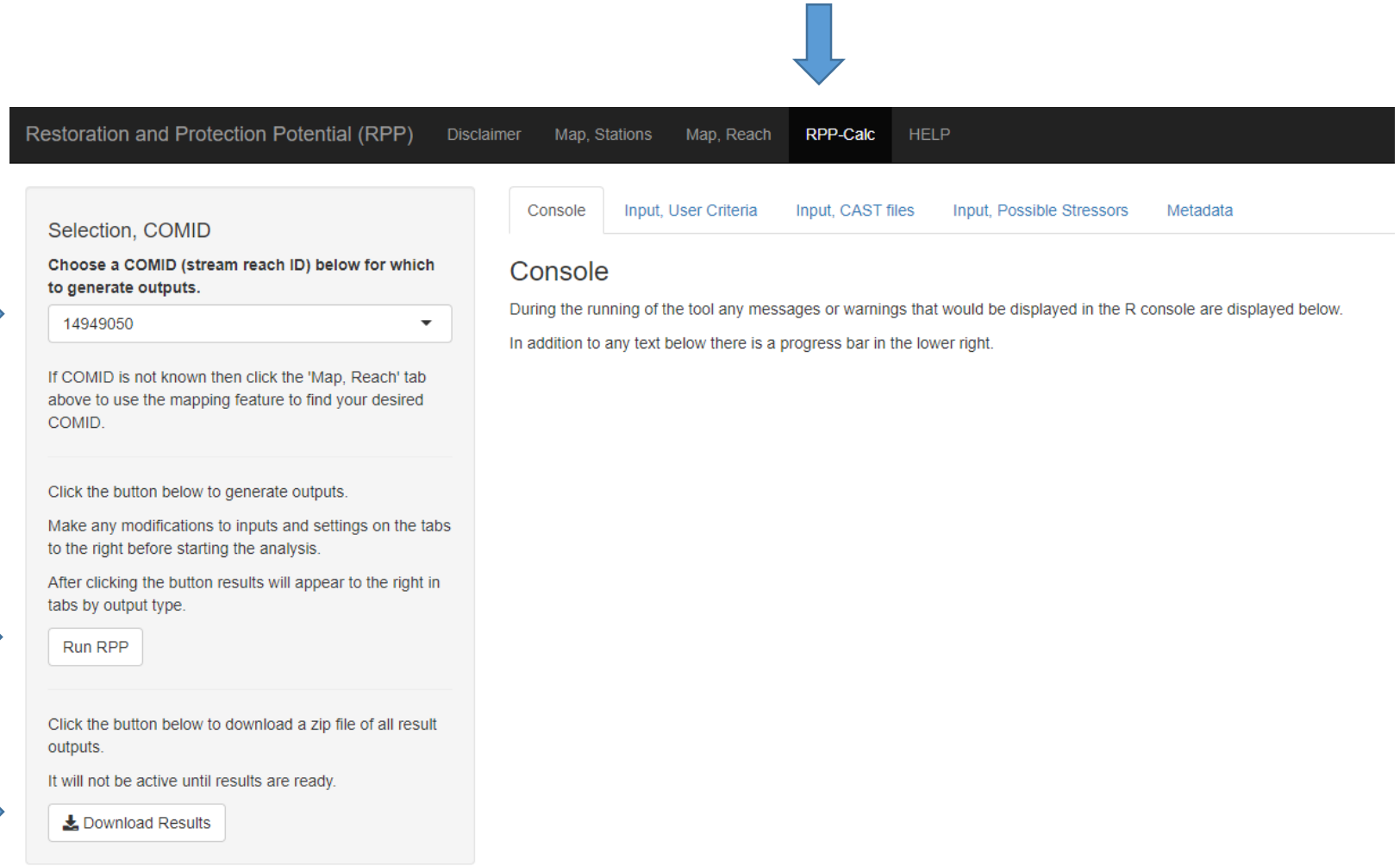
Select COMID:

20331542



Shiny Home Page

Select CAST file location.



Select location.

Run.

Download results.

User Input Criteria

Console | Input, User Criteria | Input, Possible Stressors

User-Defined Input Criteria

Default criteria are specified below.

User Inputs

Connectivity distance (km)

5

Use HW bonus?

Use BCG bonus?

Use downstream reaches?

Maximum year

2020

Minimum year

2008

Console | Input, User Criteria | Input, Possible Stressors

Weights for Possible Stressors

Weights	Description	Count
0	Exclude	1.00
1	Default	23.00
2	Double Count	1.00

Reset all weights to '1'

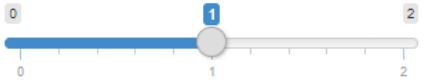
Use weights from user import.

Weights, Stressors

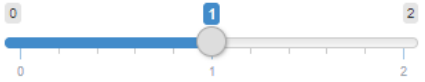
Evenness of flow habitat types

Index of physical habitat integrity

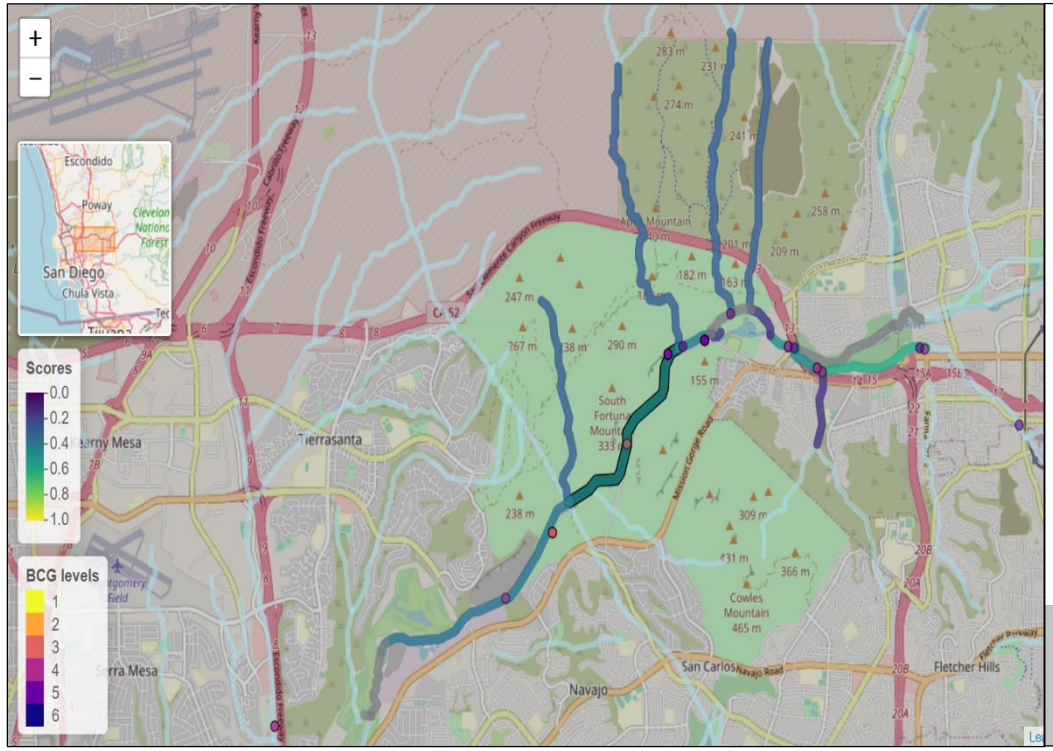
Riparian cover (sum of three layers)



Wet-season maximum mean monthly streamflow (m3/s)



RPPTool Report



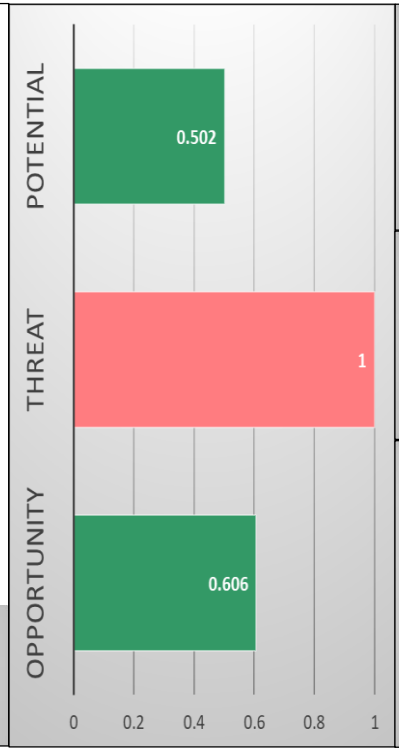
San Diego River

Reach: 20331434

Site(s):

SMC04134
(32.83894, -117.04535)
907SDSDR9
(32.82874, -117.05243)

Protection Index



SiteID	COMID	CSCI	Predicted or Observed	Index Type	RPP Index	Potential Subindex	Biological Condition Indicator	Biological Connect.	Stressor	Stressor Connect.	Threat Subindex	Planned Develop	Fire Hazard	Opportunity Subindex	Recreation	MSCP	NASVI	User-applied
SMC04134 907SDSDR9	20331434	0.78	Observed	Protection	0.703	0.502	0.333	0.0123	0.671	0.99	1	0	NA	0.606	0.919	NA	0.292	NA
907S02774	20333052	0.69	Observed	Restoration	0.592	0.52	0	0.173	0.906	1	1	0	NA	0.255	0.0728	NA	0.437	NA
NA	20333068	0.57	Predicted	Restoration	0.419	0.333	0.333	NA	NA	NA	0.431	0.147	0.991	0.494	0.279	0.263	0.436	1

Potential Applications

JRMP, WQIPs & Annual Reports

5-Year CIP Outlook

Expenditure Plan

Municipal Waterways Maintenance Plan

Integrated Drainage Engineering Analysis

Watershed Asset Management Plan

City Services

Thank you!

Vicki Kalkirtz
City of San Diego
VKalkirtz@sandiego.gov
(858) 541-4326; (619) 727-3587

Clint Boschen
Tetra Tech
Clint.Boschen@sandiego.gov
(858) 609-1625; (703) 593-1803

Jerry Diamond
Tetra Tech
Jerry.Diamond@tetratech.com
(410) 902-3145; (443) 244-0861

THINK BLUE

The City of SAN DIEGO