Update on Science to Support Nutrient Objectives in California Wadeable Streams

Martha Sutula, SCCWRP

CASA Regulatory Workgroup Meeting, OCSD
October 13, 2016

Caveat for Today's Discussion

- SCCWRP provides scientific support for the State Water Board to assist them in decision-making
  - But we don't get involved in making policy

Context for Today's Meeting

- California State Water Board has been working on two policies for wadeable streams
  - Biointegrity policy
  - Nutrients and Biostimulatory Conditions
- SCCWRP produced a Science Plan to describe technical activities that will support policy decisions on nutrient objectives in wadeable streams
  - In June 2015, an independent Science Panel has reviewed this plan; findings and recommendations are available on the Water Board website
  - Over the past year, we've been working on technical elements described in this plan

Recently Water Board Staff Have Decided to Combine the Two Policies

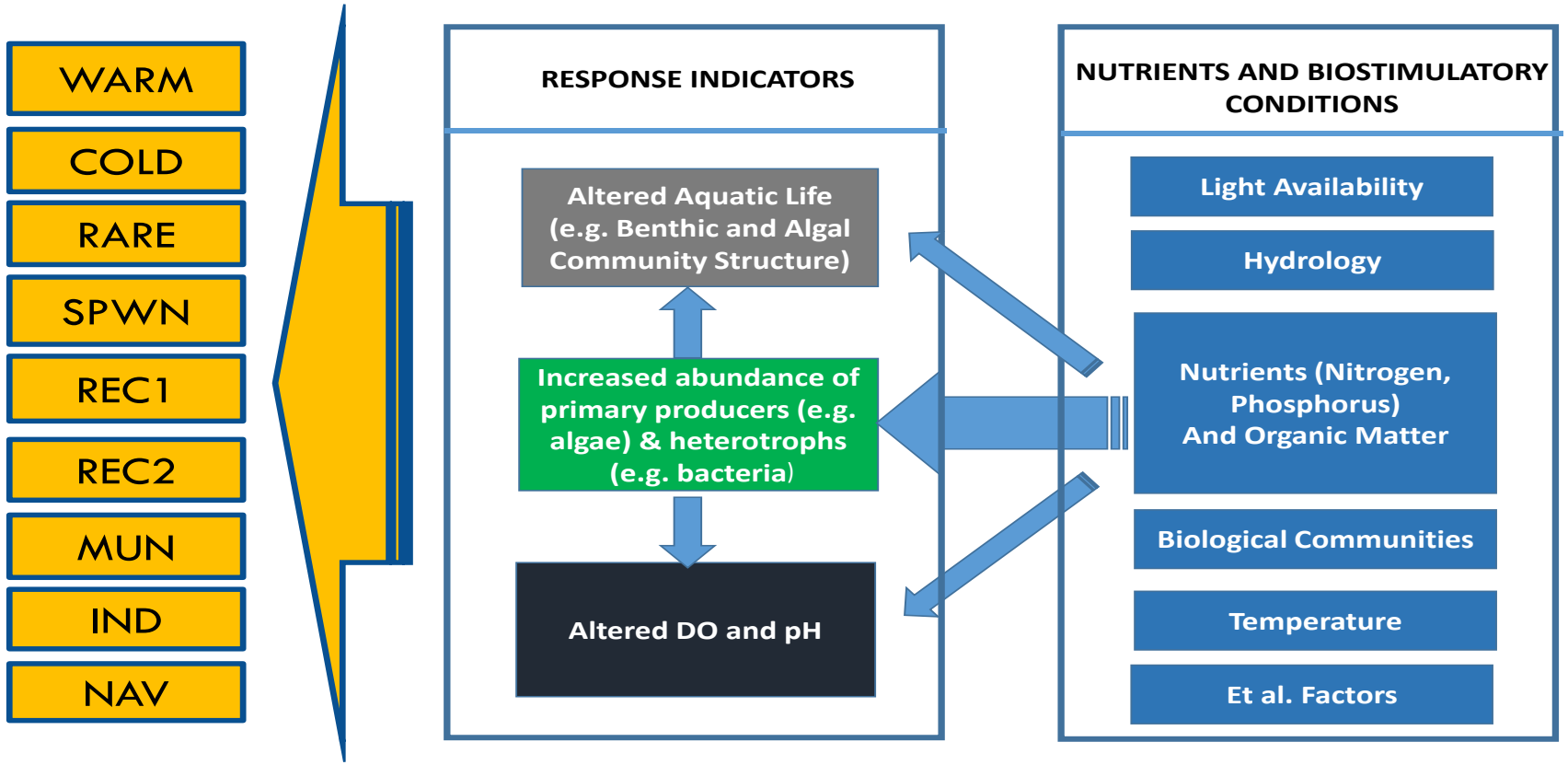
- Water Board press release should be out soon
- Nick Martorano is the project lead
- Jessie Maxfield is the Water Board contact for stakeholder outreach
- Will schedule winter stakeholder meeting, combining nutrients and biointegrity workgroups
  - Update on focus group feedback to the Water Board on nutrients policy
  - Update on technical work elements

Today's Update

- Review and status of technical elements in nutrient science plan
- Touch on other biointegrity technical initiatives as appropriate
- Updated timeline for completion of technical products

Nutrient Numeric Endpoints (NNE) Approach

- Emphasis on response indicators as assessment endpoints
- Multiple lines of evidence
- Model linkage between aquatic life indicators, nutrients and biostimulatory conditions

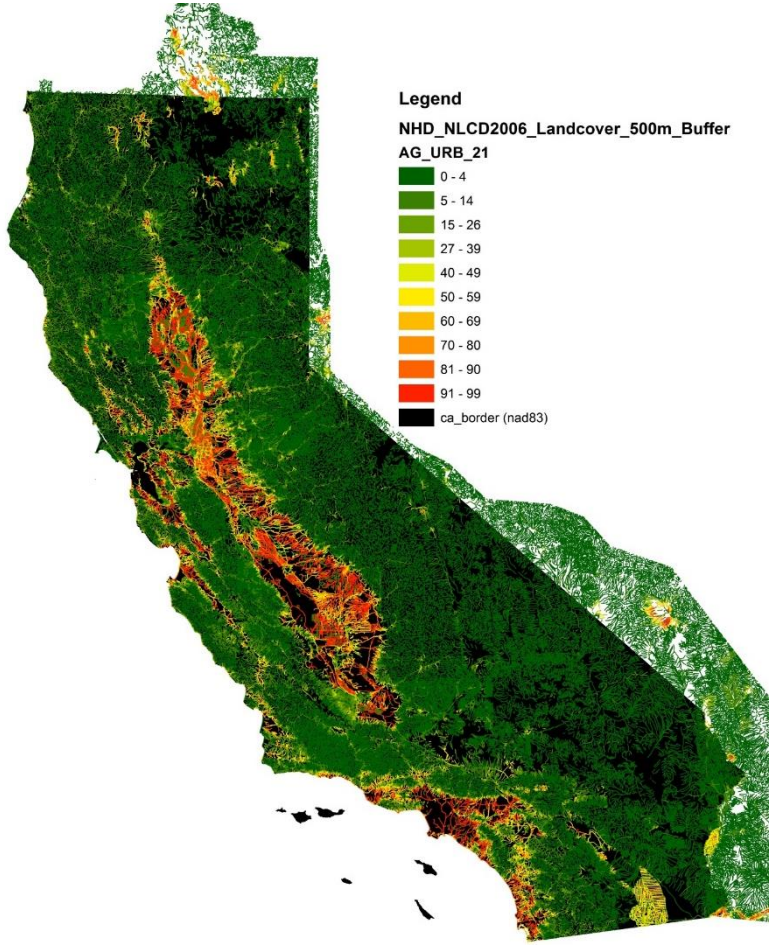


This approach has already been demonstrated in several TMDLs around the State

Challenge: How to Come up with Nutrient Targets that Are Achievable, Given such a Large State??

Water Board Staff are considering the following approach:

- Establish a set of "default" assessment endpoints and nutrient numeric targets that apply statewide
- Where interest exists, allow stakeholders flexibility to work with Regional Board to develop watershed-specific nutrient targets
- Can also consider treating waterbodies in developed landscape (e.g. modified channels) separate from those in natural landscapes



Science Plan Elements: Focused on "Statewide Defaults"

1. Conduct and synthesize science supporting development of numeric guidance for wadeable streams

    1.1 Establish a conceptual model linking response indicators to beneficial use support, nutrient and stream biostimulatory conditions

    1.2 Identify response indicators representative of wadeable stream beneficial use

    1.3 Determine the numeric range of stream nutrient and response indicators that correspond to attainment of beneficial use

    1.4 Support policy discussions on "Channels in developed landscapes"

2. Implementation plan technical support

Stream Eutrophication Conceptual Model

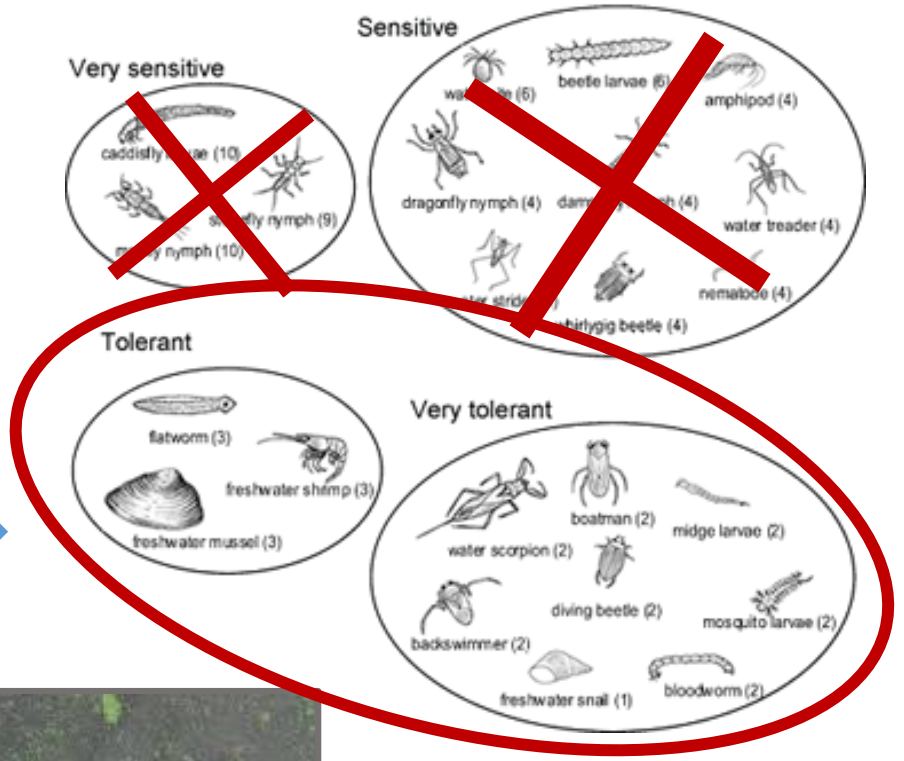
↑ **N, P**

nutrient enrichment

excessive growth of primary producers (algae and/or higher plants)

shifts in algal community composition

*also **directly** impact food webs*



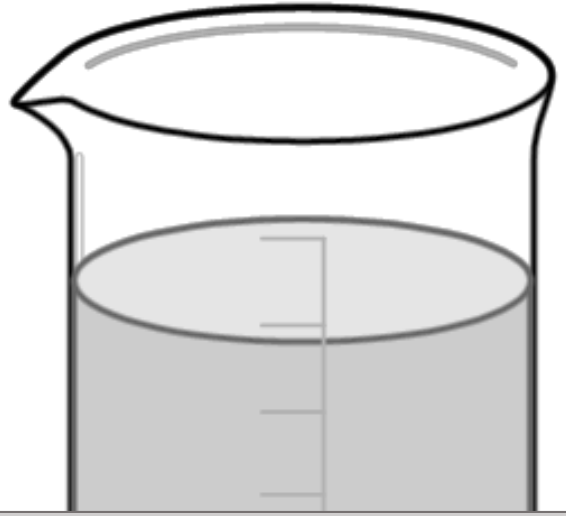
from multiple standpoints, eutrophication alters aquatic life

Eutrophication Response Pathways: Relationships with **Multiple** Beneficial Use Types

Beneficial Use	Altered Aquatic Life Diversity	Altered Food Web	Unaesthetic Blooms	*Water Quality*: Reduced DO	*Water Quality*: Algal Toxins *et al.* Metabolites	*Water Quality*: Increased Turbidity
COLD	X	X		X	X	X
WARM	X	X		X	X	
SPWN	X	X		X	X	
MIGR	X	X		X	X	
RARE	X	X		X	X	

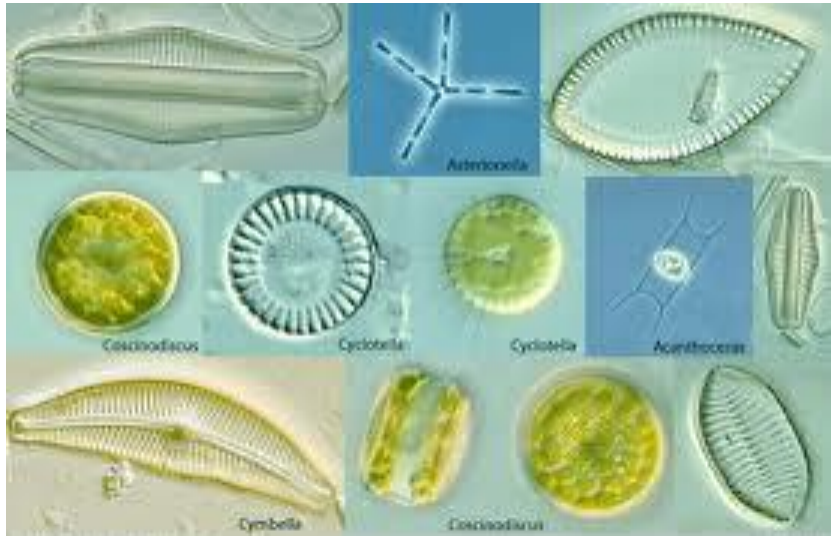
adapted from Tetra Tech (2006)

Key elements of the eutrophication conceptual model are embedded in the Surface Water Ambient Monitoring Program (SWAMP) wadeable streams program…



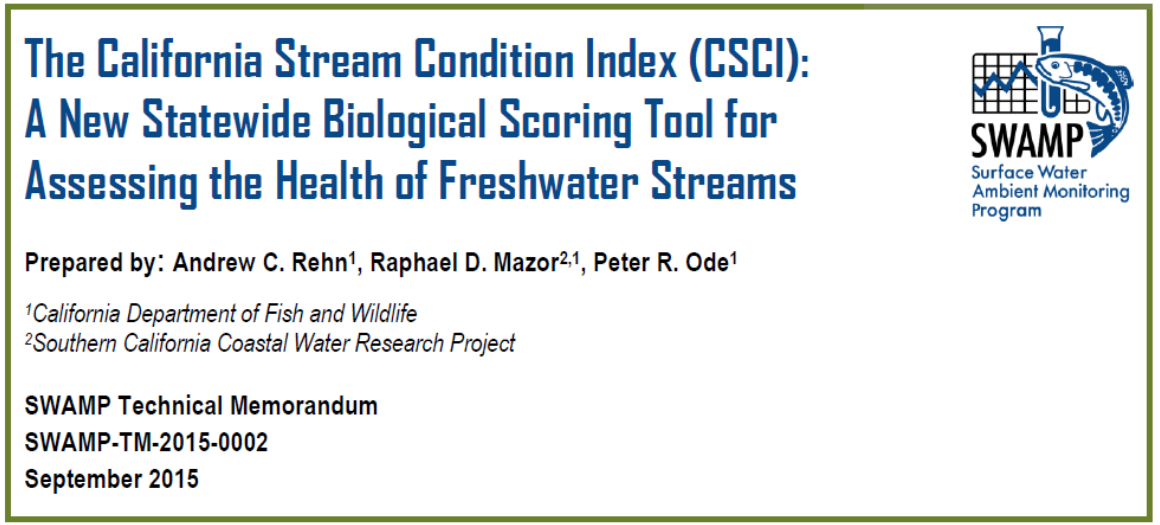
Includes sampling for:

- Benthic macroinvertebrates
- Algal taxonomy
- Stream physical habitat
- Basic water chemistry



The State is Adding to its Algae as a Statewide Scoring Tool

- Already have a scoring tool for benthic macroinvertebrates (CSCI)
  - Water Board staff have already considered how to it in biointegrity policy



The California Stream Condition Index (CSCI): A New Statewide Biological Scoring Tool for Assessing the Health of Freshwater Streams

SWAMP Surface Water Ambient Monitoring Program

Prepared by: Andrew C. Rehn[1], Raphael D. Mazor[2,1], Peter R. Ode[1]

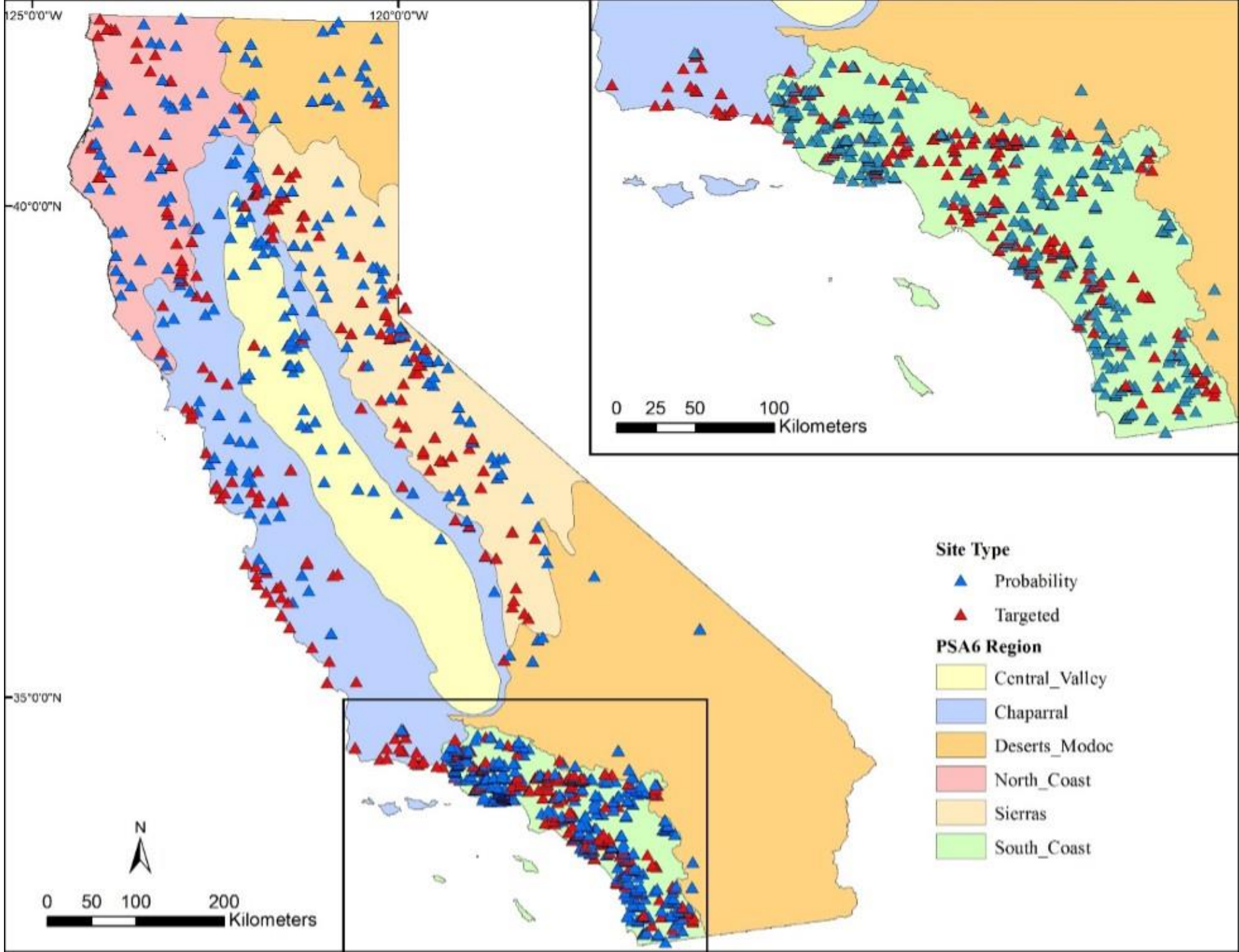
[1]California Department of Fish and Wildlife
[2]Southern California Coastal Water Research Project

SWAMP Technical Memorandum
SWAMP-TM-2015-0002
September 2015

- SWAMP is now funding the development of an ALGAL stream condition index (ASCI)
  - Provisional tool by spring 2017
  - Based on traditional taxonomic methods, but will transition to molecular approach

Technical team has robust dataset for analysis

Available data from combined surveys (>2,000 wadeable stream reaches)



Elements of the Science Plan

1. Conduct and synthesize science supporting development of numeric guidance for wadeable streams

   1.1 Establish a conceptual model linking response indicators to beneficial use support, nutrient and stream co-factors

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2. Implementation plan technical support

Response Indicators Linked to Beneficial Use Attainment

Routinely Monitored

- *Altered Aquatic Diversity and Food Webs*
  - benthic macroinvertebrates- CSCI
  - algae & cyanobacteria- ASCI
- *Organic matter accumulation*
  - Benthic chl-a
  - ash-free dry mass
- *Unaesthetic Blooms*
  - macroalgal percent cover

Not Routinely Sampled

- *Altered Water Quality*
  - dissolved oxygen; pH
  - algal toxins

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" Determine the numeric range of stream nutrient and response indicators that correspond to attainment of beneficial uses"

Challenge:

The State of California has not adopted quantitative goals for any of the available stream biotic indices (based on bugs and algae).

DETERMINE THE NUMERIC RANGE OF STREAM NUTRIENT AND RESPONSE INDICATORS THAT CORRESPOND TO ATTAINMENT OF BENEFICIAL USES

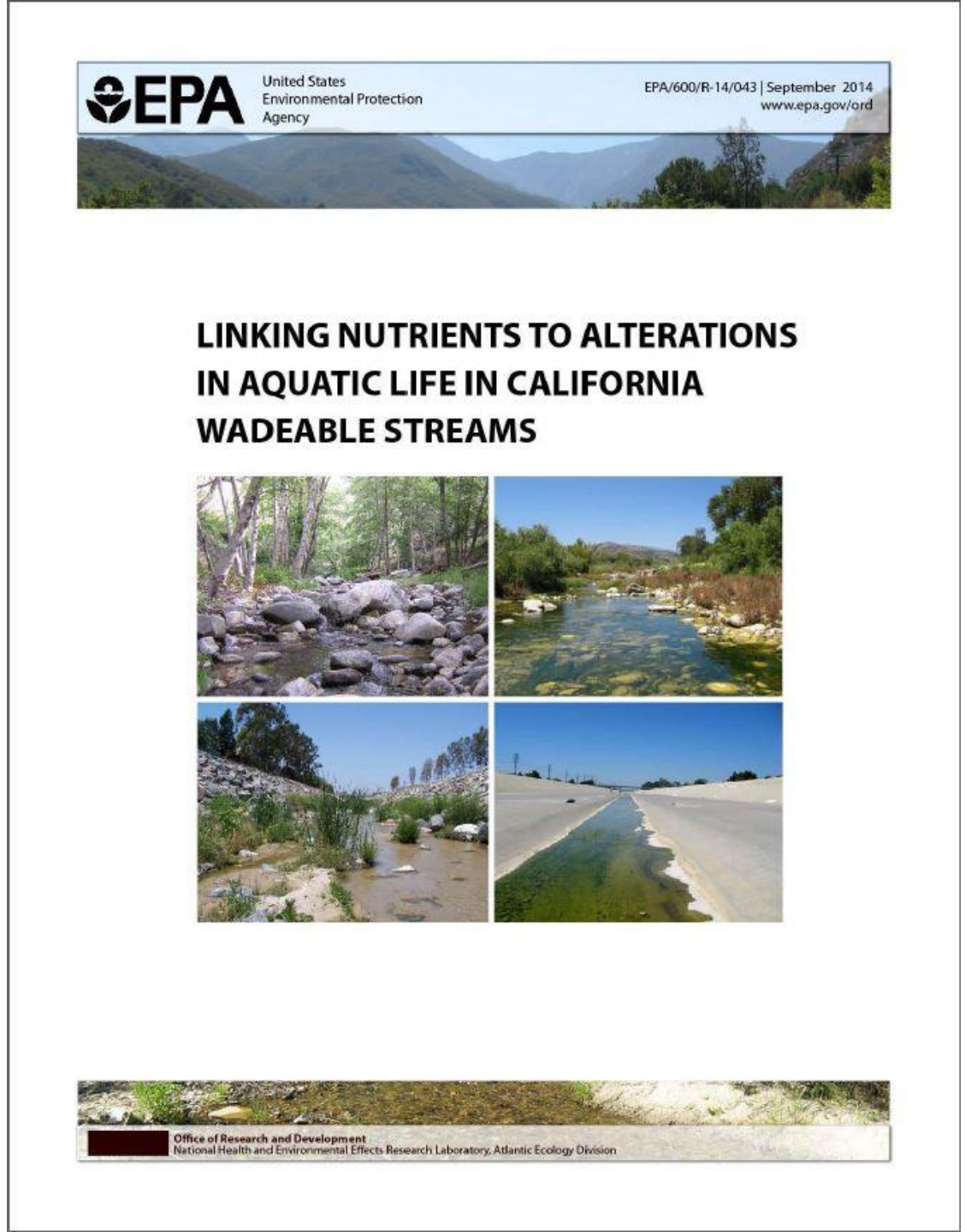
- Determine nutrient and biomass **thresholds** of effects on aquatic life response indicators

- Estimate levels of algal abundance and nutrient concentrations associated with attainment of a quantitative "goal" based on a **Reference percentile**

- Develop a **Biological Condition Gradient (BCG)** to link nutrients/biomass to stream ecological condition

Published EPA-ORD Study provides One Line of Evidence to Support Policy Decisions on Thresholds

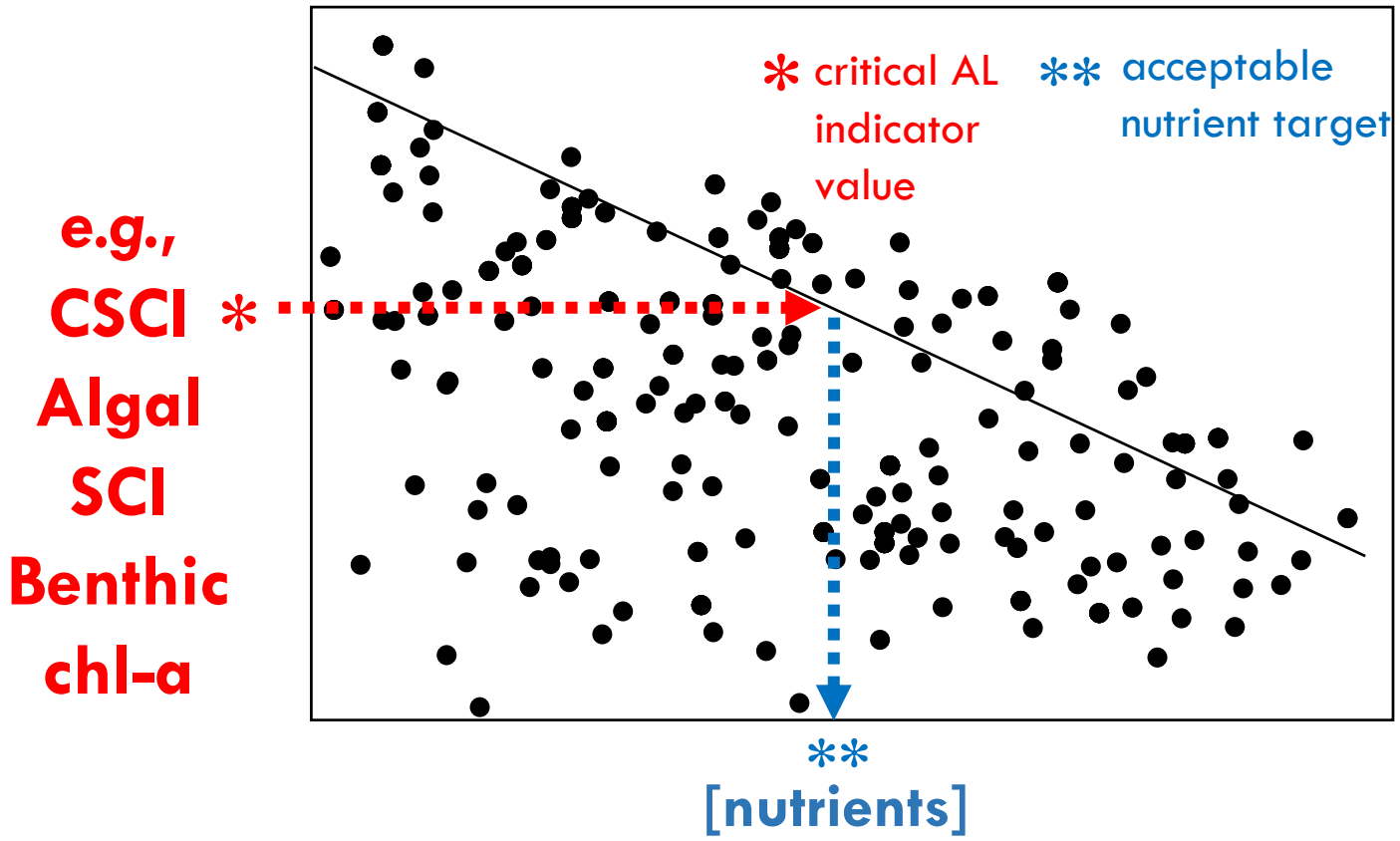
Fetscher, A.E., M. Sutula, A. Sengupta, and N.E. Detenbeck. Linking nutrients to alterations in aquatic life in California wadeable streams. U.S. Environmental Protection Agency, Washington, DC (NTIS EPA/600/R-14/043), 2014.



Apply Regional Percentile of Reference Sites Condition to Regression Models

The goal for a stream biotic index (based on deviation from Reference) can then be interpolated to a nutrient or algal abundance level

Like the ORD study, Reference-based nutrient targets are low (<< 1 mg/L TN and <<0.1 mg/L TP

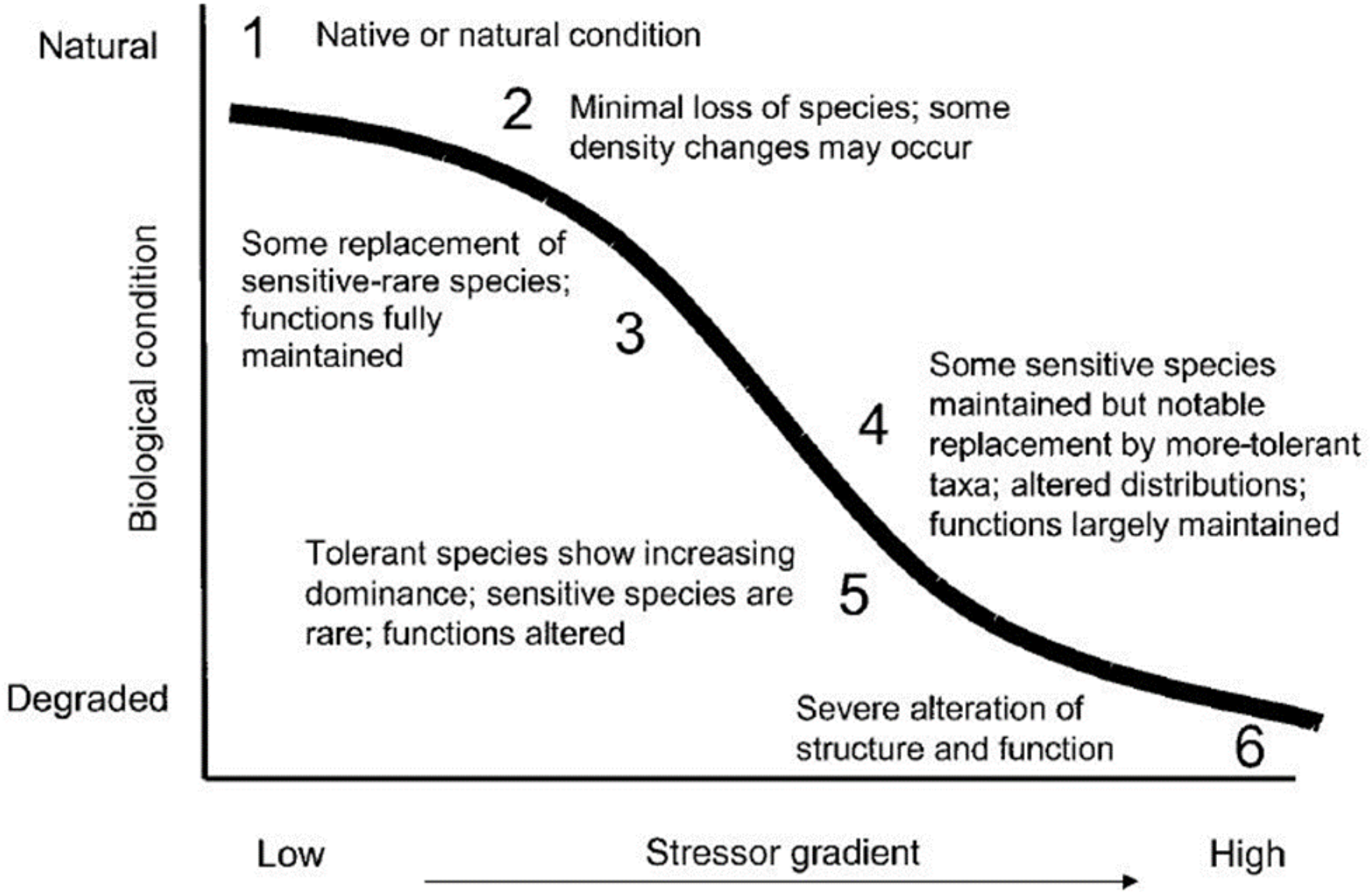


Stakeholders received presentation last fall, interim draft report complete, but will be updated with larger dataset and released in spring 2017

DEVELOP A BIOLOGICAL CONDITION GRADIENT (BCG) MODEL

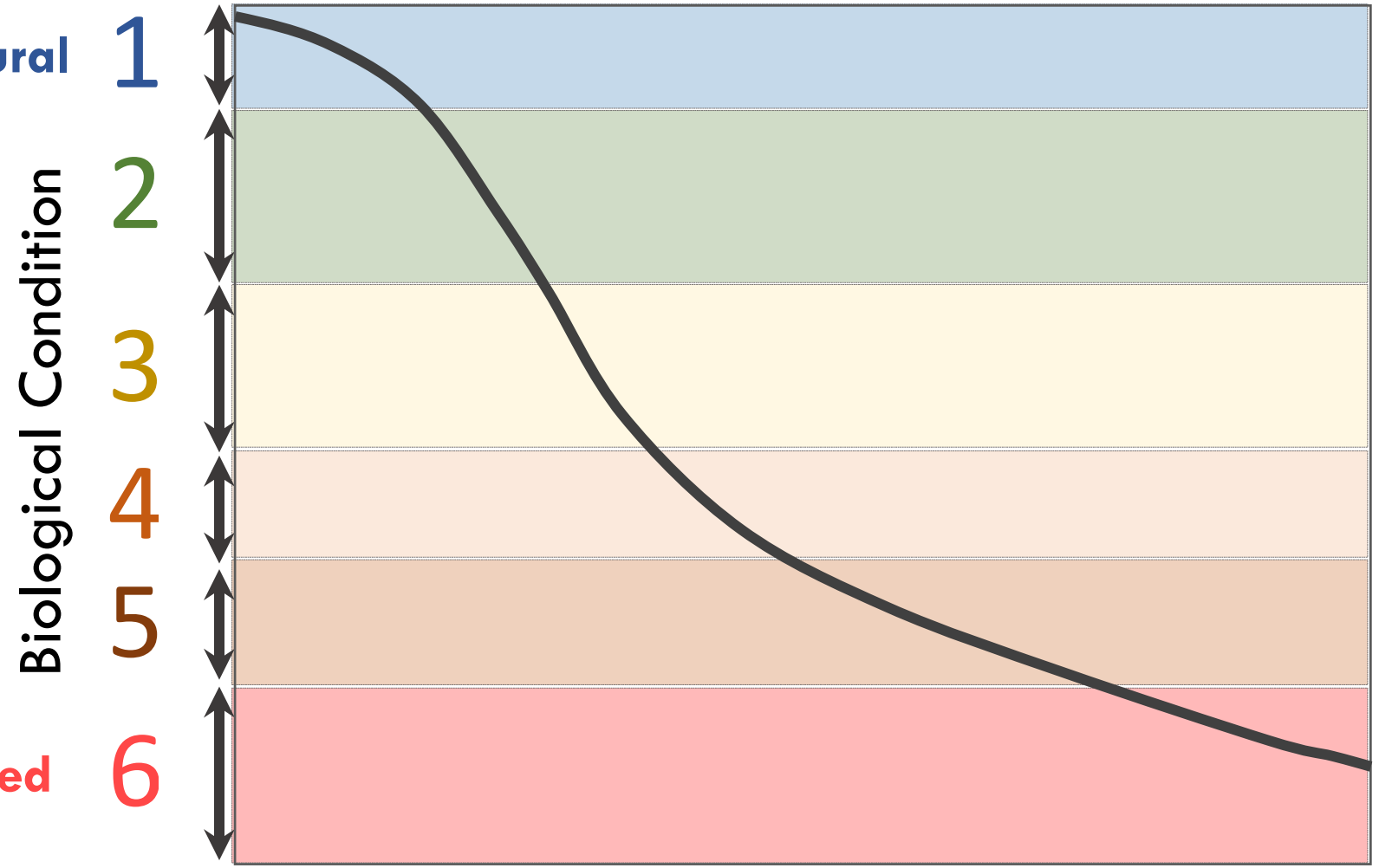
The Biological Condition Gradient:

- *as stress increases, community composition changes in predictable ways (e.g., disappearance of rare-sensitive species; replacement with tolerant subset)*



Davies and Jackson (2006)

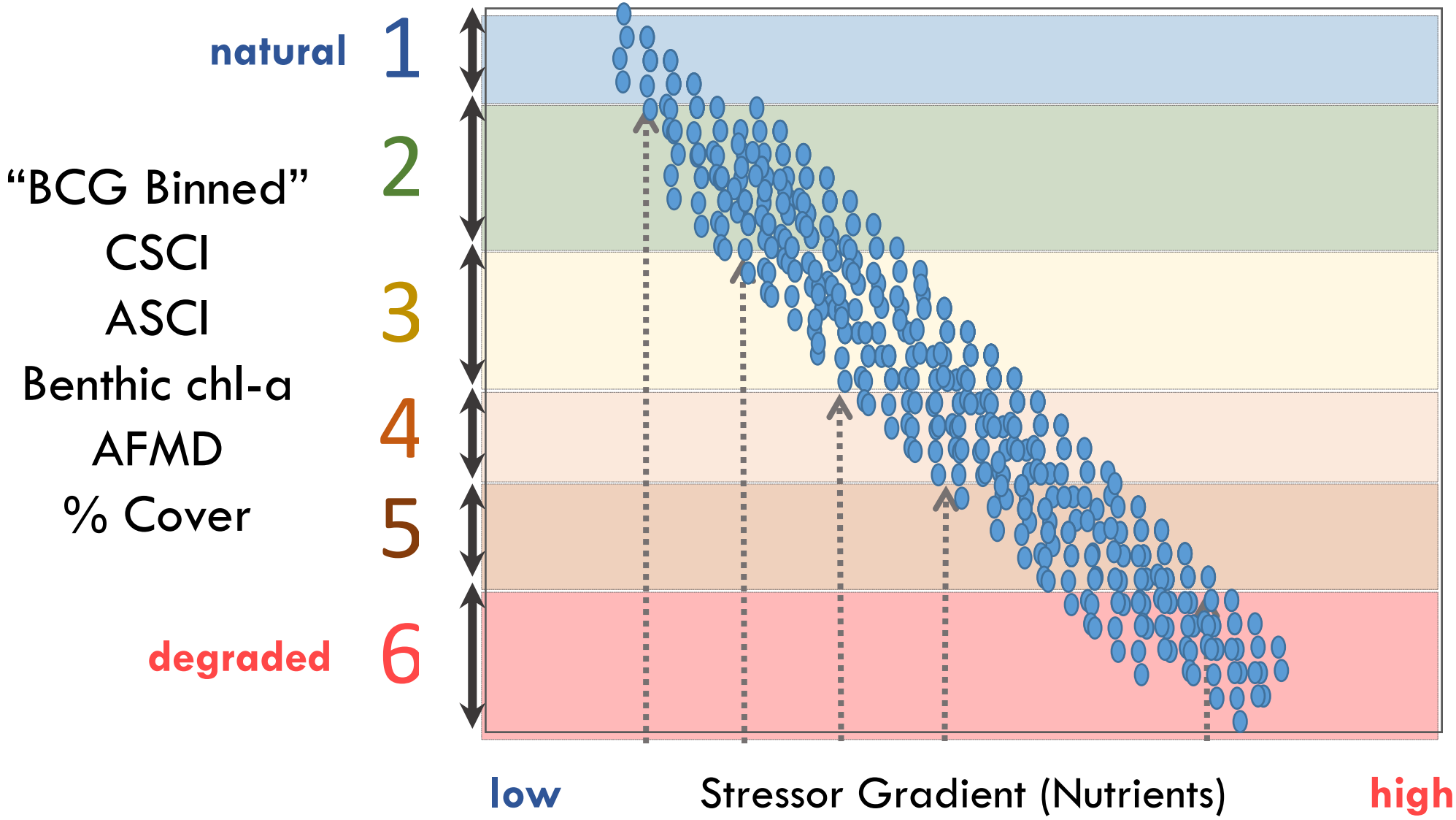
BCG Development



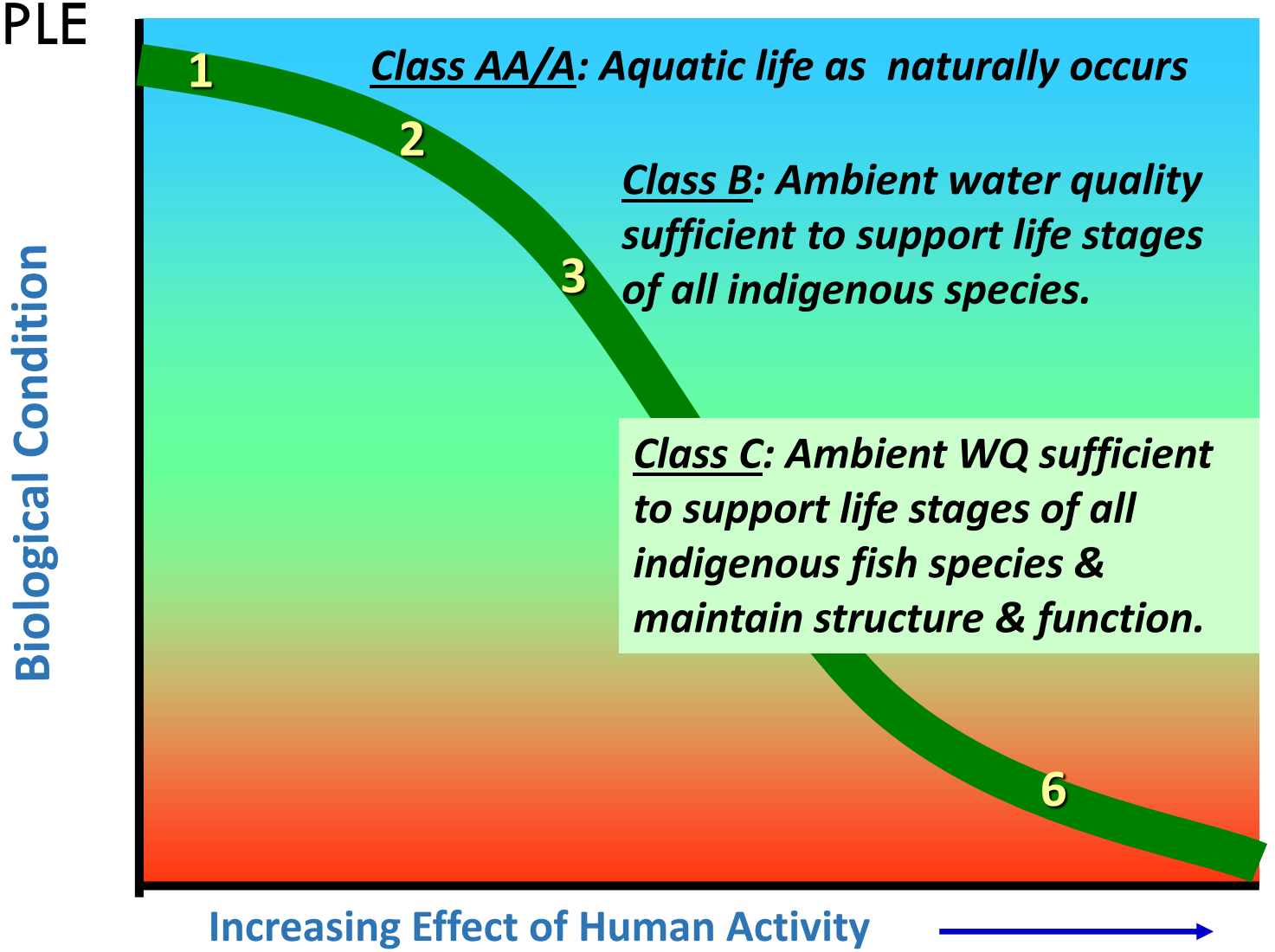
Experts use community composition information to develop BCG condition bins

Crosswalk to Response Indices or Indicators (CSCI, ASCI, benthic chla, AFDM, %Cover)

Develop Regression Relationships between "BCG Binned" Response Indicators and Stressor (Nutrients)



Potential Uses of the BCG: Designated Aquatic Life Uses- Maine Example



STATUS OF BCG DEVELOPMENT

- Recruited 16 invertebrate and algal ecologists as experts
- Scheduled 2 workshops to develop model
  - December 1-2, 2016, January 10-11, 2017
- Two principle products
  - BCG report (identify BCG binned thresholds associated with CSCI, ASCI, and organic matter metrics (e.g. benthic chla, etc.)
  - Synthesis report
    - Conceptual model
    - Rationale for indicator selection
    - Synthesis of nutrient values associated with BCG bins, compared to statistical thresholds (EPA ORD report) and reference approaches

Timing and Format for Products

- Stakeholders already reviewed work plan for project (Fall 2015)
- Recruited 16 invertebrate and algal ecologists as experts
- Scheduled webinars and 2 workshops to develop model
  - December 1-2, 2016, January 10-11, 2017
- Two principle products- Summer 2017
  - BCG report (identify BCG binned thresholds associated with CSCI, ASCI, and organic matter metrics (e.g. benthic chla, etc.)
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Why "Channels in Developed Landscapes?" Guiding Principles

- Defining "Modification" a policy rather than a science question
- Developed is easier to define than modified
  - —May be more accurate
- Simple preferred over complex
  - —Reproducible and easy to understand
- Easy to define expectation (science) but hard to define achievability (policy)
- Decisions on technical approach should be tied to optimizing relationship with biology

Approaches for Identifying and Mapping Channels in Developed Landscape

Three Approaches to Identifying and Mapping Channels

- Direct observation
- Extrapolation from monitoring programs
- GIS modeling

Of these, GIS approach can provide comprehensive coverage sufficient to support policy discussions

Mapping Channels in Developed Landscapes

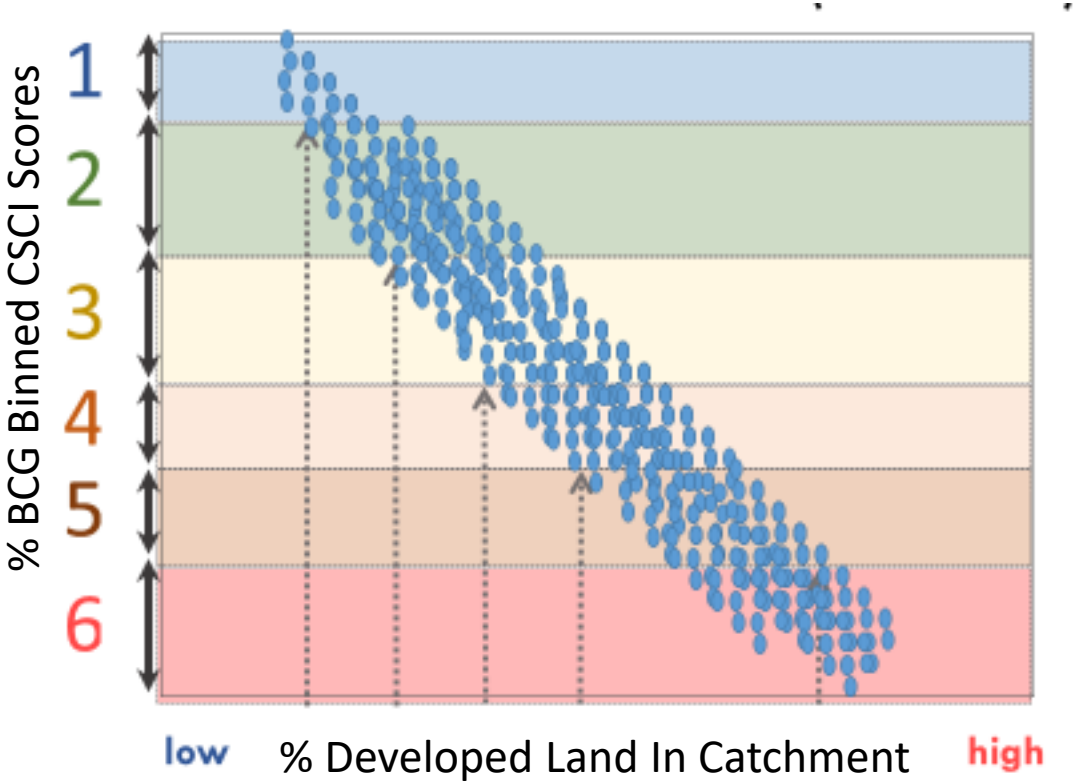
- **What it is –** technical approach that could be used to categorize streams based on land use/land cover activities
  - Can accommodate simple rules-based classification, easily modified with different input data or thresholds
  - Intended to support policy discussions

- **What it isn't –** a proposal for thresholds or classification variables to be specified in policy

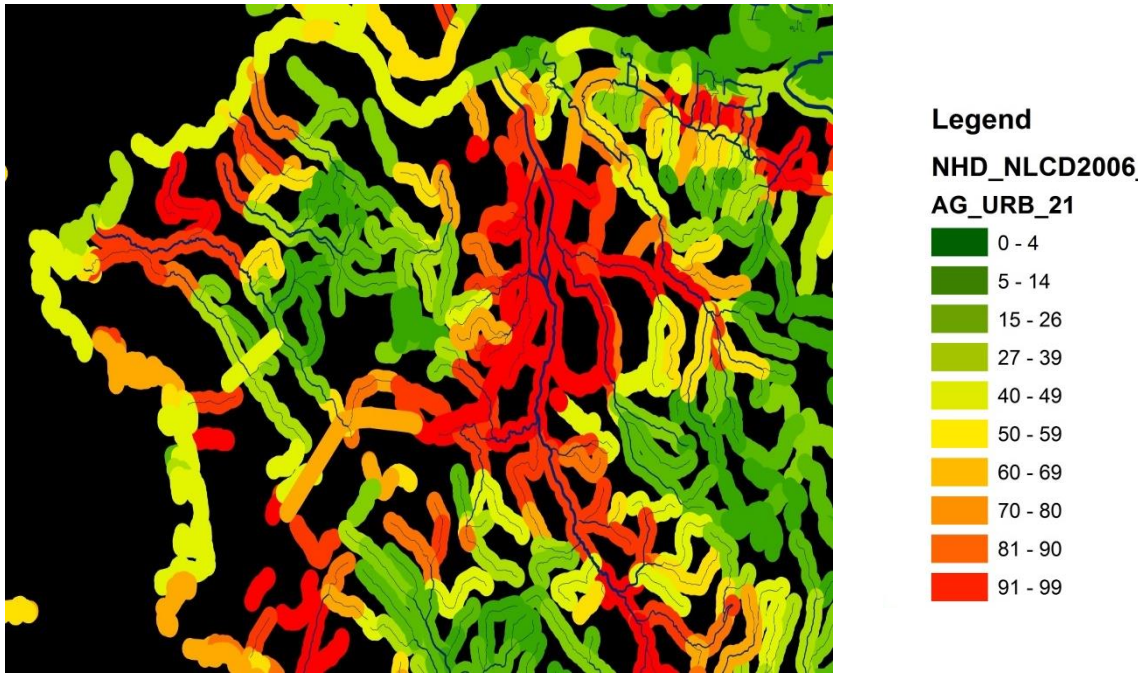
Channels in Developed Landscapes--Approach

1. Develop method to map channels (heavily grounded in existing approaches to define catchment land use influencing CSCI)
2. Develop key graphics showing how CSCI scores vary as a function of % developed
3. Show how maps of channels in demonstration watersheds will change as a function of changes in threshold of % developed.
4. Use key graphics and maps to support stakeholders discussions

Example



% urban + code 21 for each NHD segment



Approximate Timing of Products

- November 2016– Release of workplans for:
  - Algal SCI development
  - Channels in Developed landscapes
- December 2016– Stakeholder meeting with oral presentations on algal SCI & channels in developed landscapes work plans, update on BCG
- February 2017- Stakeholder webinar with oral presentation on channel in developed landscapes
- May 2017 –Stakeholder meeting with oral presentation on BCG project findings, Algal SCI, synthesis
- July 2017 Draft BCG Report, Draft Algal SCI report/manuscript, Draft Synthesis

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Options for Direct Collaborations with CASA

- More frequent briefings
- Collaborate on improve Water Board awareness/education on implementation options to consider
  - Wastewater technology limits
  - Improved monitoring technology
  - Options for nutrient trading
- Collaborative research projects
  - Demonstration watersheds

Questions? Comments?

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