Science to Support Nutrient Management in San Francisco Bay

David Senn
San Francisco Estuary Institute
davids@sfei.org

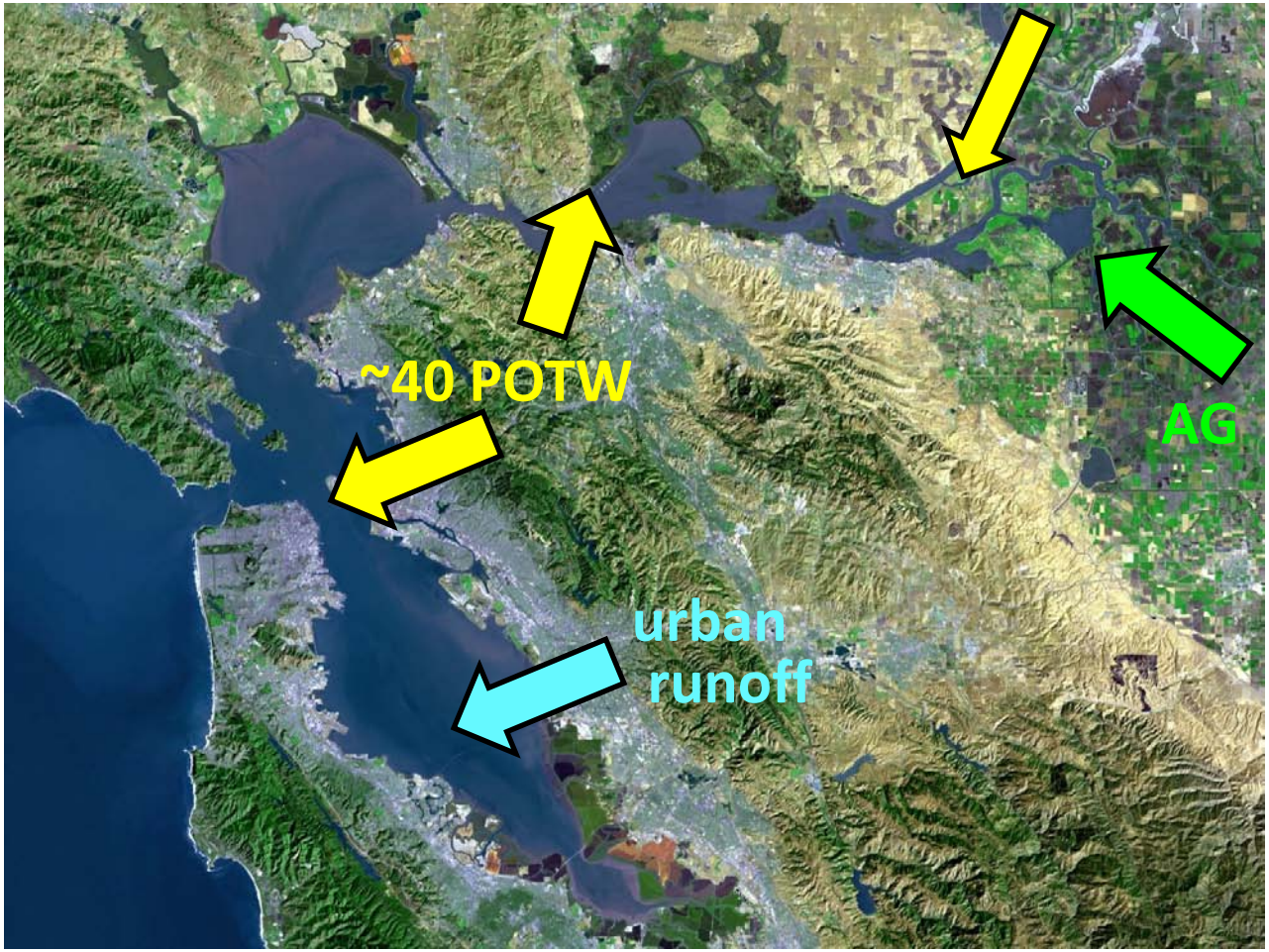
Outline

- Background

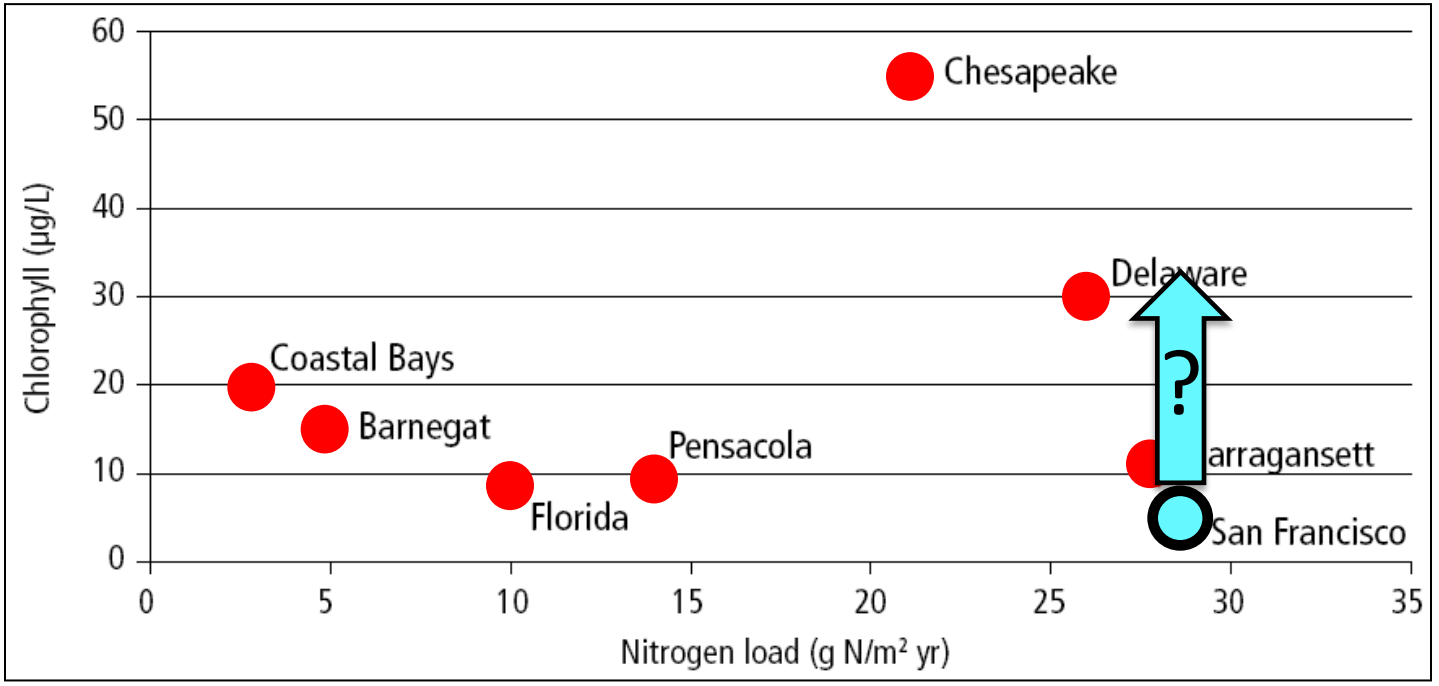
- 2012 Activities
  - Develop Nutrient Science Strategy
  - High priority (funded) projects

Source: C. Benton

San Francisco Bay - Large nutrient loads…



San Francisco Bay Paradox



National Estuarine Experts Workgroup (2010)

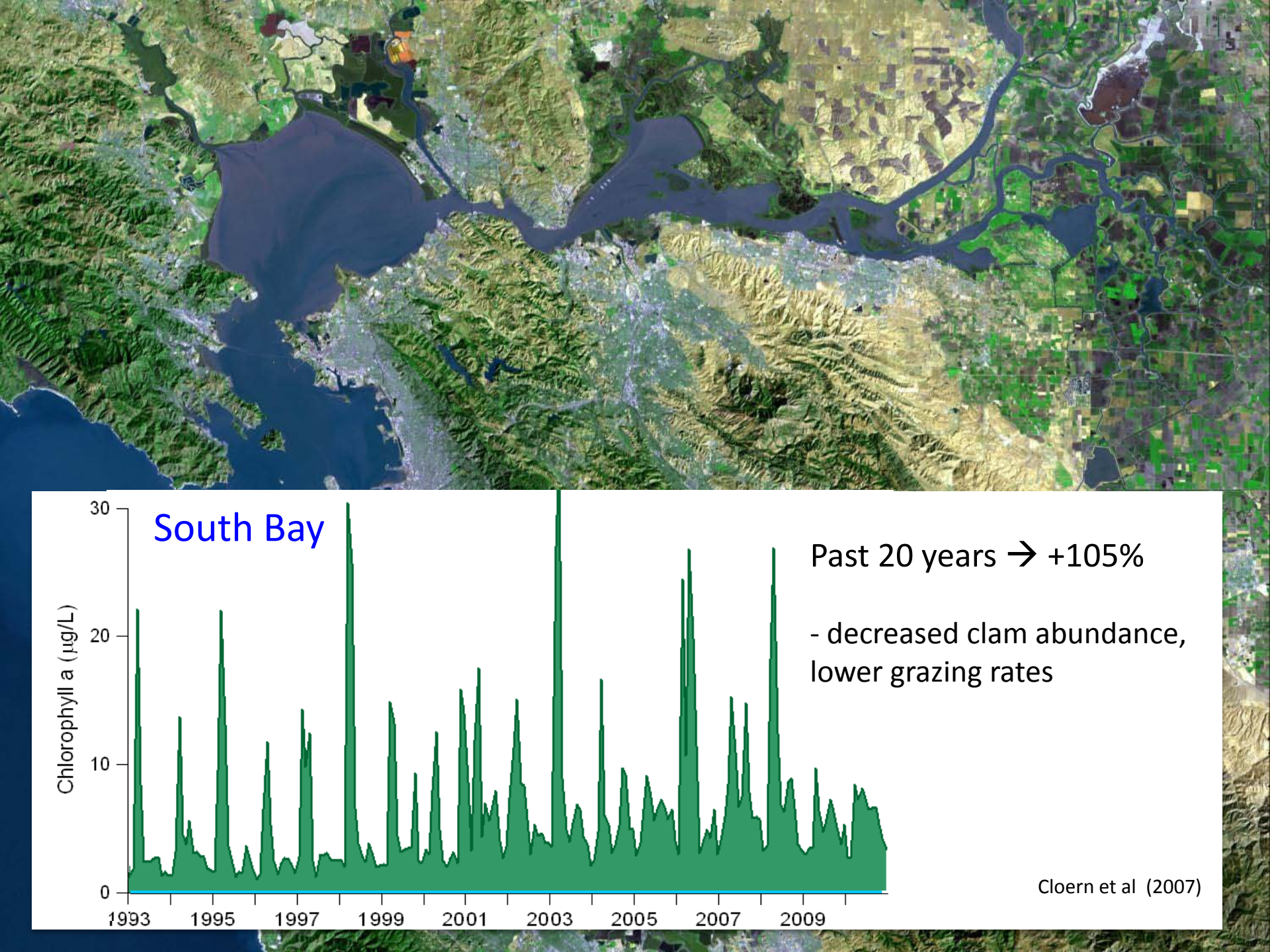
Resilience of San Francisco Bay

1) High turbidity

2) Strong tidal mixing

3) Filter-feeding clams

} Subject to change?

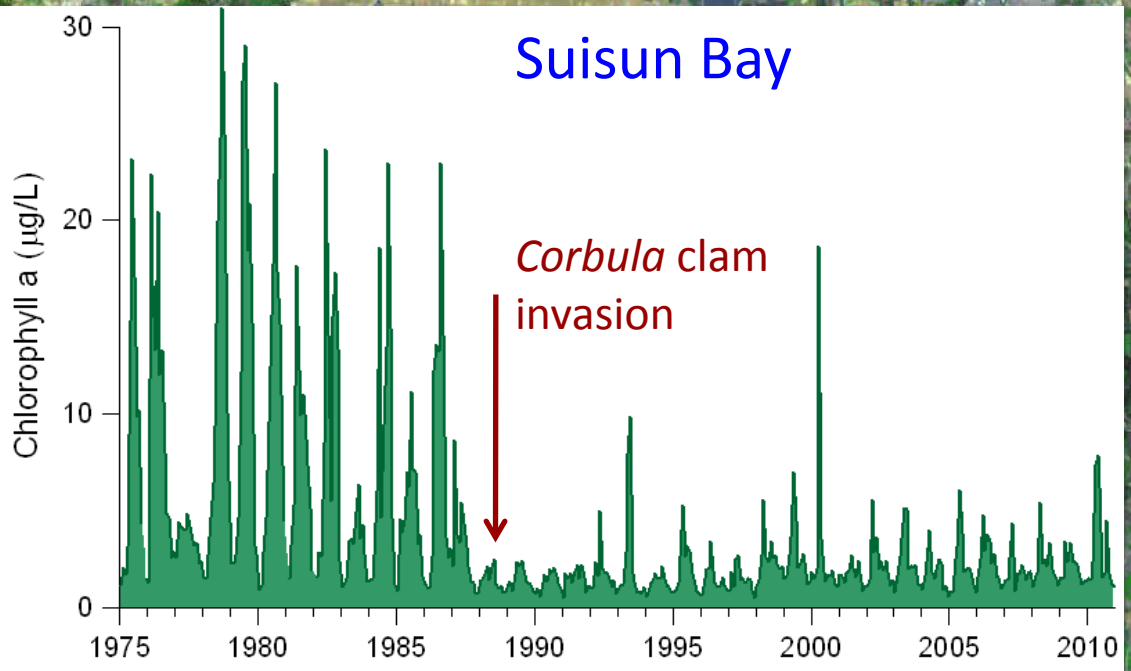

South Bay
Chlorophyll a (µg/L)
30
20
10
0
1993
1995
1997
1999
2001
2003
2005
2007
2009
Past 20 years → +105%
- decreased clam abundance, lower grazing rates
Cloern et al (2007)

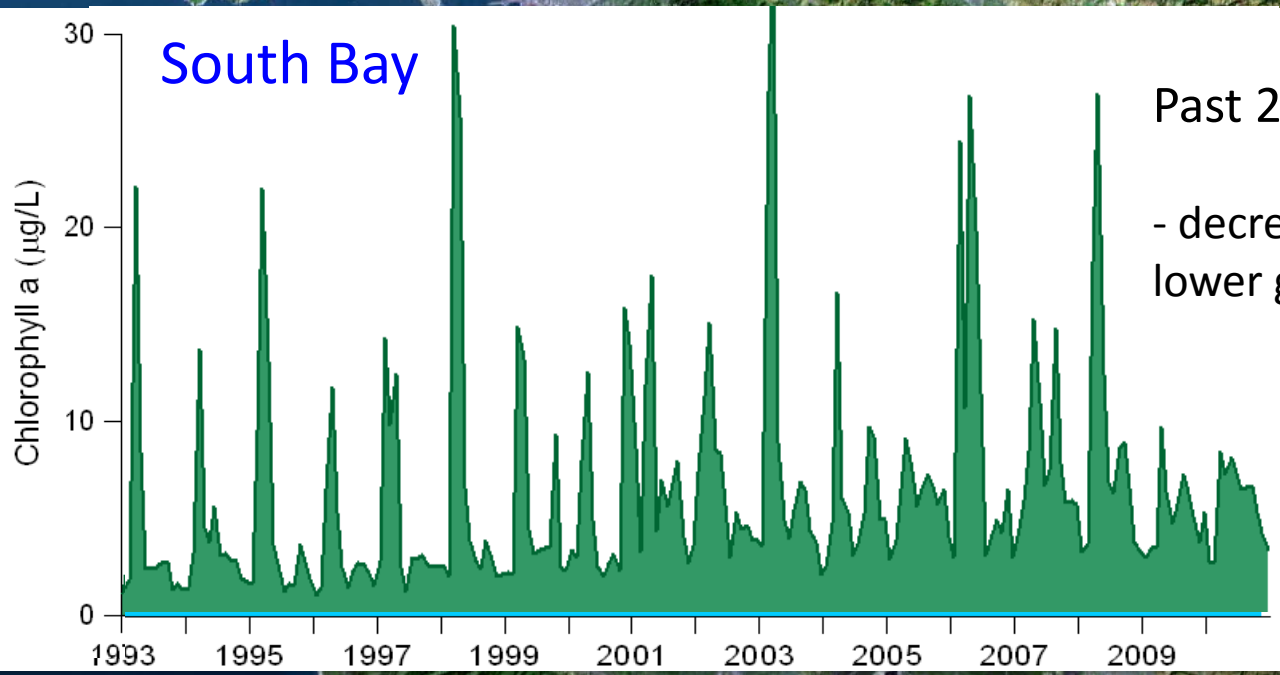
- low Chl-a → food limitation

- Past 20 yrs → +32%

Source: J. Cloern, USGS

- NH_4^+ impacts
  - impairing primary production?
  - toxicity to copepods?





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Cloern et al (2007)

Need for a Bay-Wide Nutrient Strategy

- Nutrient objectives on the horizon: Nutrient Numeric Endpoint (NNE)

- Consensus among scientific community: Bay conditions are changing
  - increasing chl-a, harmful algal blooms, other roles of NH_4^+ (?)

- No regionally-administered water quality monitoring program
  - uncertain future for USGS research program (40 yr record)

- Early-draft Nutrient Strategy – Sep. 2011, RMP Nutrient Workgroup

Key Management Questions

Is there a nutrient problem, and how is it defined?

- Now? Future? Under what scenarios?

Most important sources, pathways, and processes?

What loads can be assimilated without impairing beneficial uses?

What are appropriate guidelines for identifying a problem?

- assessment framework and monitoring

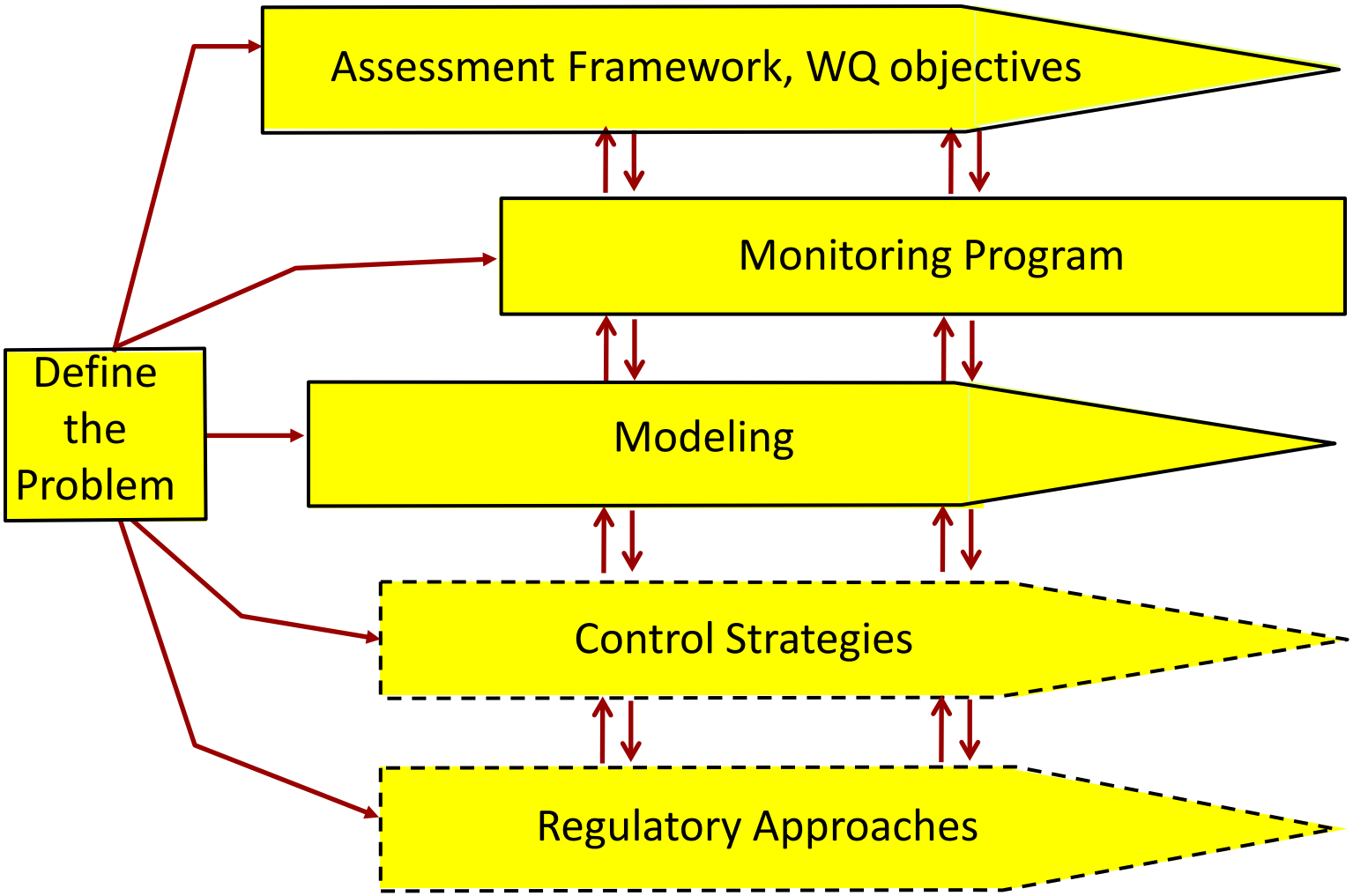
Nutrient Work in 2012

- Develop Nutrient Science Strategy
  - "Final" draft – November 2012
  - Communication: stakeholder meetings, website, list-serve

Nutrient Work in 2012

- Develop Nutrient Science Strategy
  - "Final" draft – November 2012
  - Communication: stakeholder meetings, website, list-serve
- Begin work on high priority (funded) projects
  1. Define the problem: Conceptual models and scenarios
  2. Assess nutrient loads and sources
  3. Numeric modeling: Suisun Bay, South Bay
  4. Suisun Bay: potential impacts of nutrients and NH_4^+
  5. Phytoplankton assessment framework

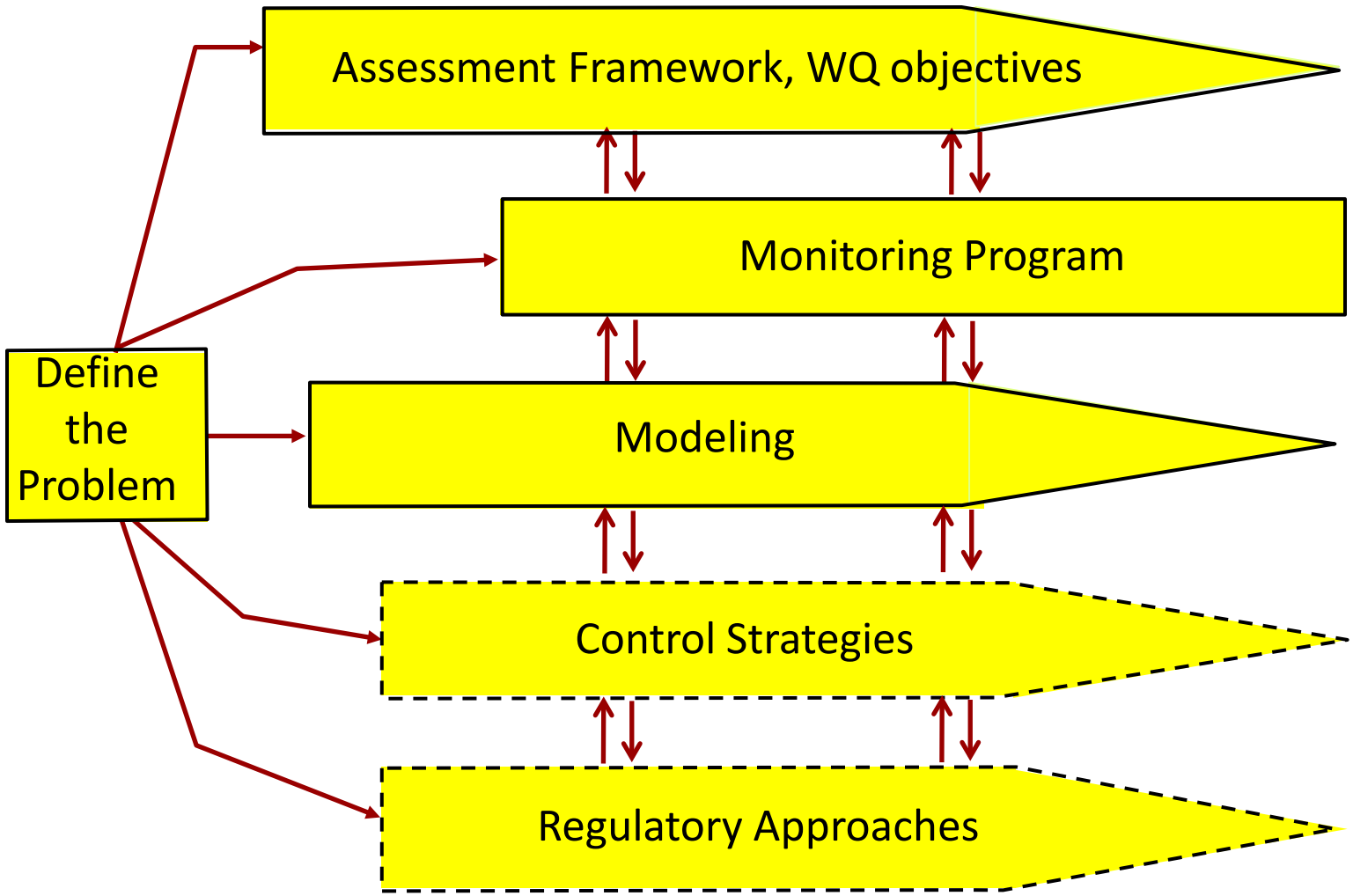
Draft Nutrient Strategy (Sep 2011)



GOAL:

Beneficial Use Protection

Draft Nutrient Strategy (Sep 2011)



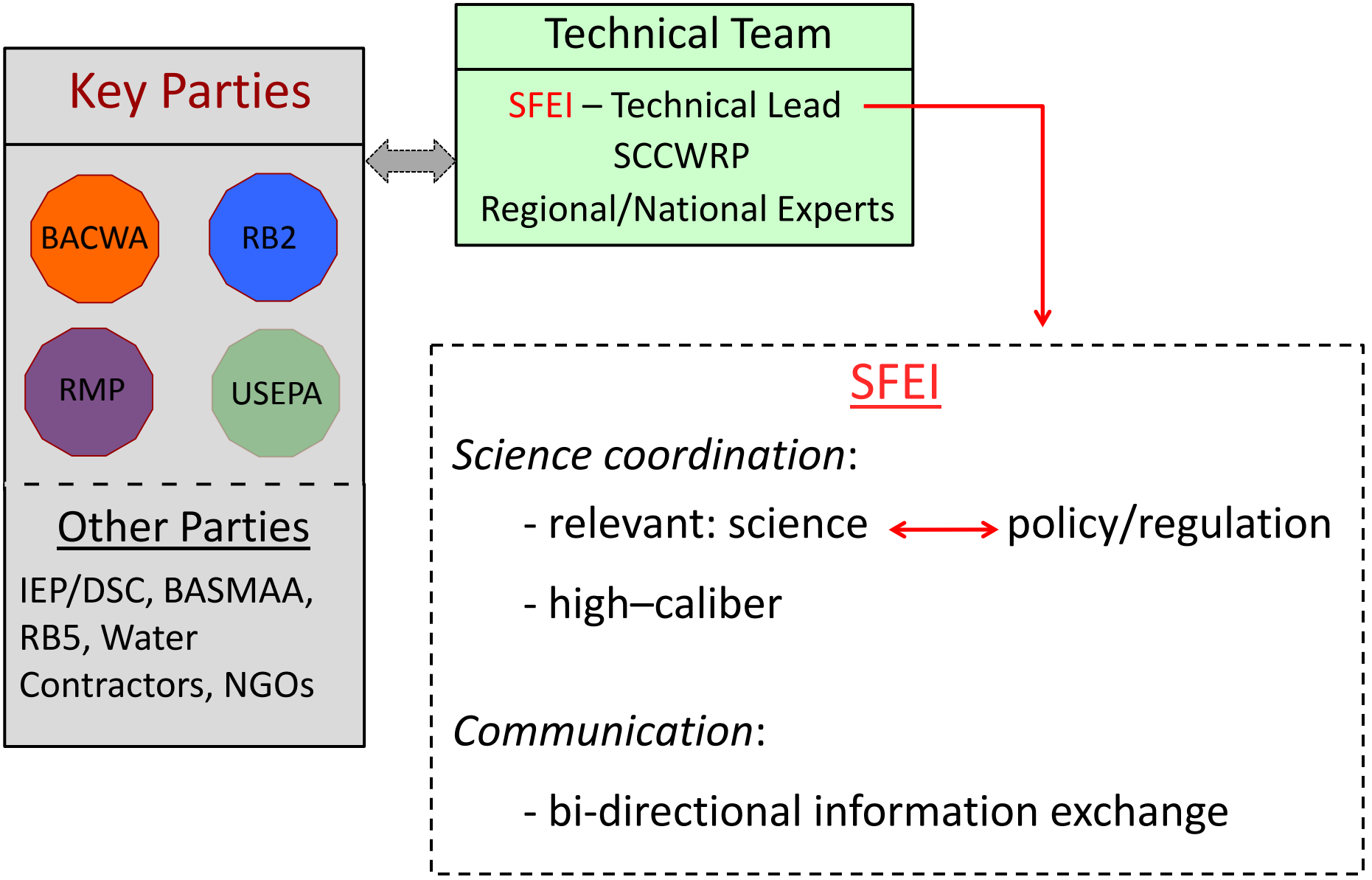
GOAL:

Beneficial Use Protection

Bay Entities with nutrient interests

RB2, USEPA, BACWA, Regional Monitoring Program (RMP), USACE, BASMAA, Interagency Ecological Program (IEP), Delta Stewardship Council, Water Contractors, NGOs

Joint Fact-Finding – Science for Nutrient Management



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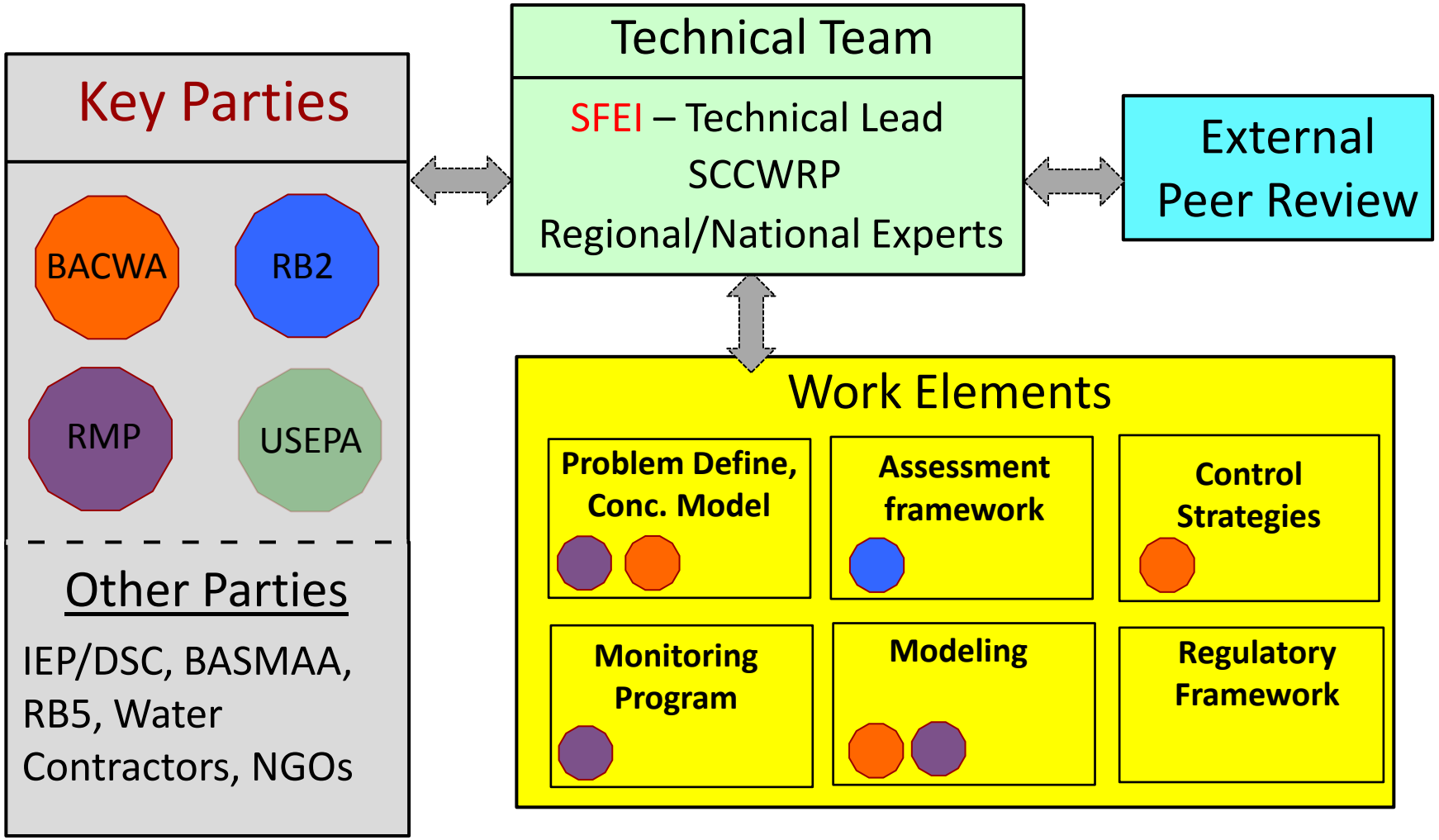
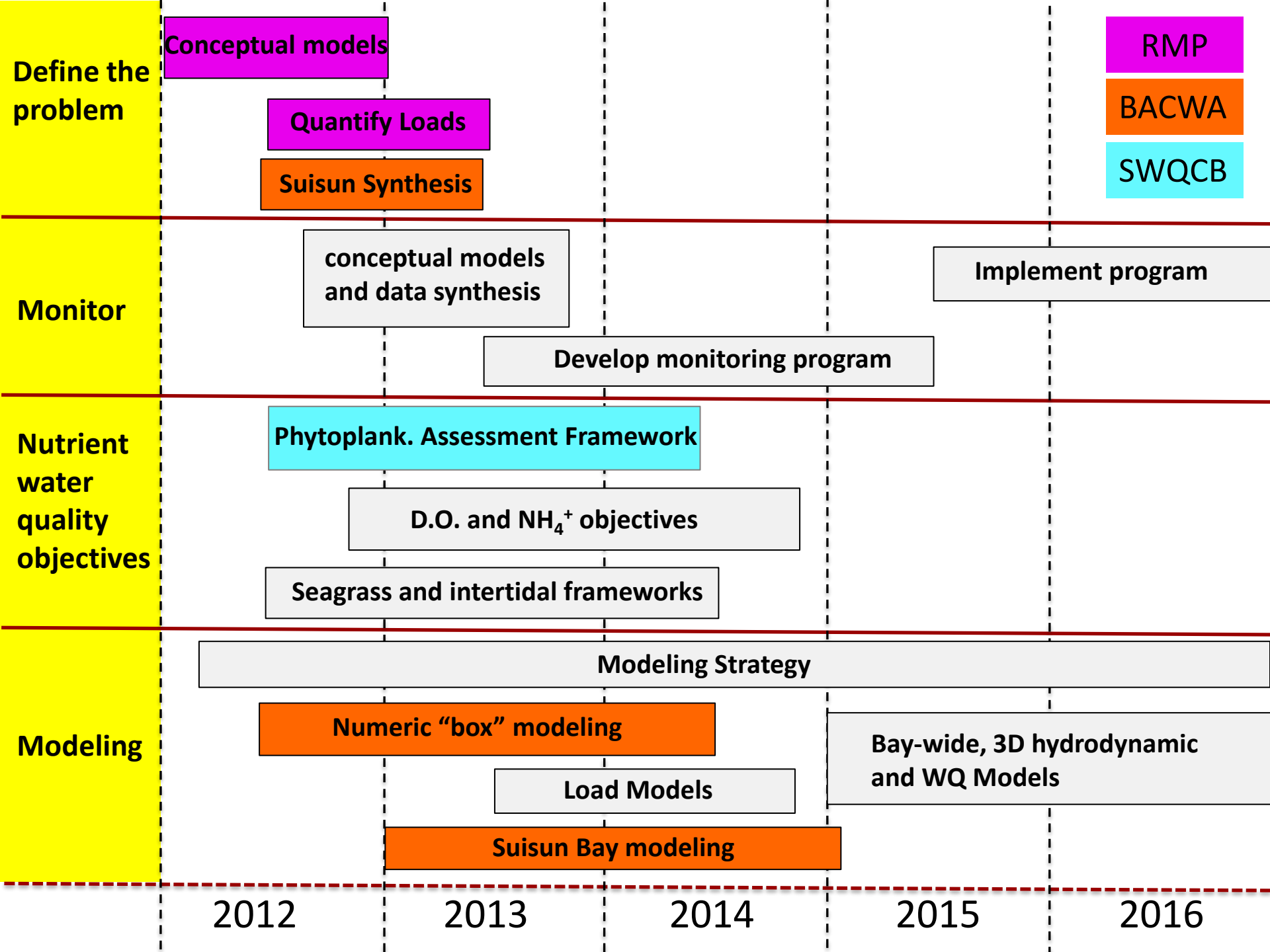


2012

- Develop Work Elements, scopes, timelines
- Funding plan
- Communication: website, list-serve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Bay-wide, 3D hydrodynamic and WQ Models
RMP
BACWA
SWQCB
2012
2013
2014
2015
2016

1. Problem Definition: Conceptual Models, Scenarios

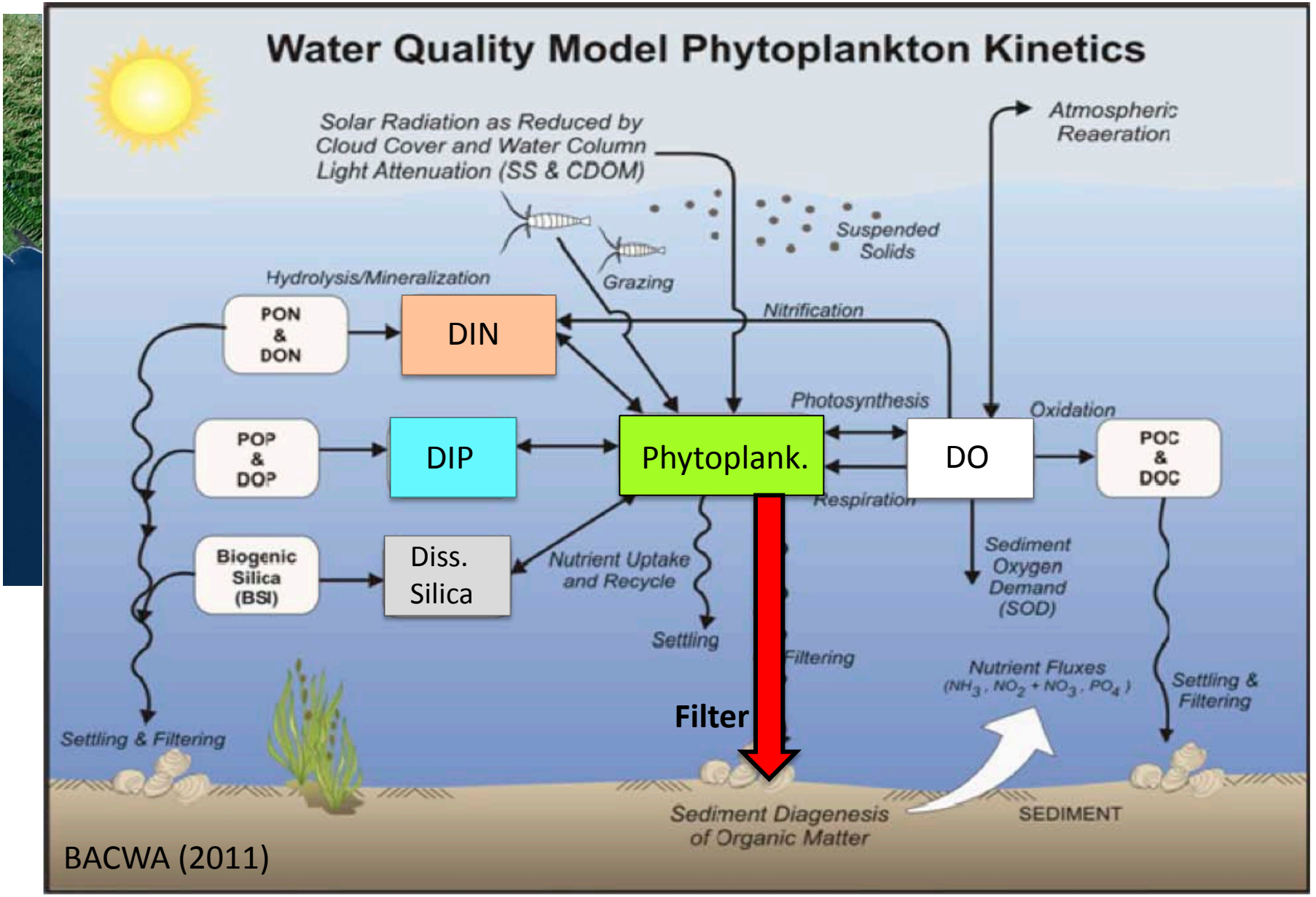
(2012) RMP

What problems, or future scenarios are most concerning?

What information do we need to evaluate these scenarios?

How do we detect current problems or the onset of future problems?

1. Problem Definition: Conceptual Models, Scenarios

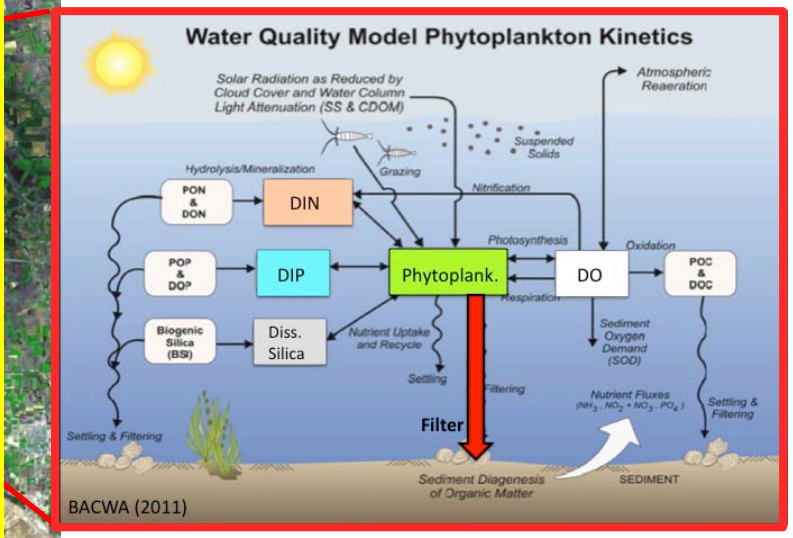


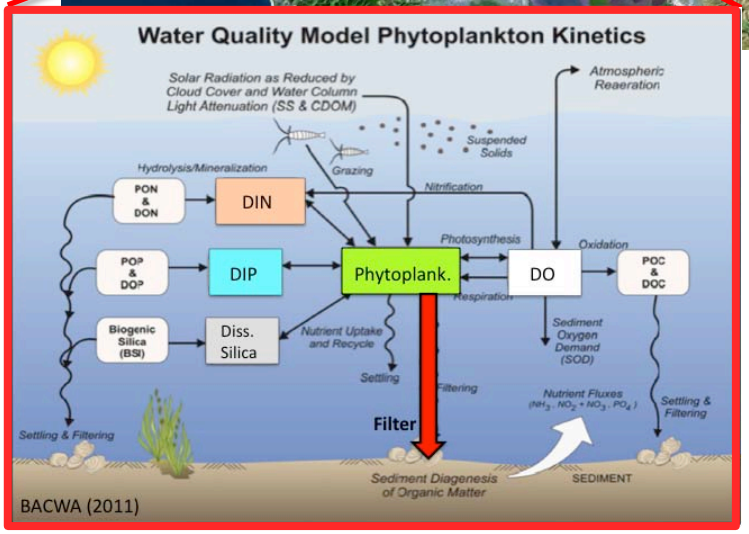
BACWA (2011)

1. Problem Definition: Conceptual Models, Scenarios

Example Scenarios

- 1% per year decrease in sediment load
- decreased clam abundance
- changing nutrient loads, NH4:NO3, N:P:Si
- drought conditions
- climate change effects



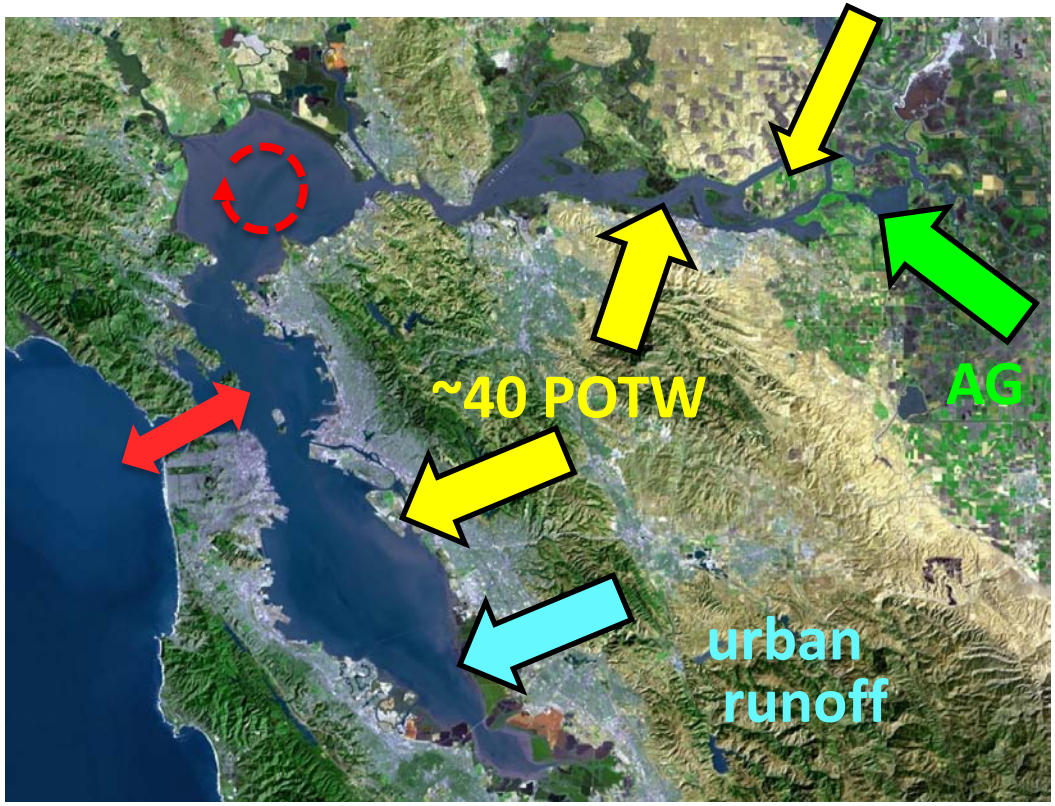


Outcomes

- 'Consensus' statement on nutrient outlook for the Bay
- Critical knowledge gaps
- Science plan to address gaps
- Monitoring prog. recommendations

2. Assess Nutrient Loads to the Bay

(2012-2013) RMP



Very Rough Numbers

	Tons DIN/yr
Bay POTWs	18,000
SacRegional	5,000
Sac+SJ Rivers (Agriculture*)	5,000
Urban runoff**	1,000

Space/time will be important

- Assess major nutrient loads (and composition)
- Characterize variations in space and time
- Identify major uncertainties and data gaps, future work

*Kratzer et al. (2011)

**Gluchowski and McKee (2011)

3. Numeric Models: Suisun Bay, South Bay

BACWA

(2012-2014)

Staged approach to modeling

Build upon conceptual models

Model Technical Advisory Group

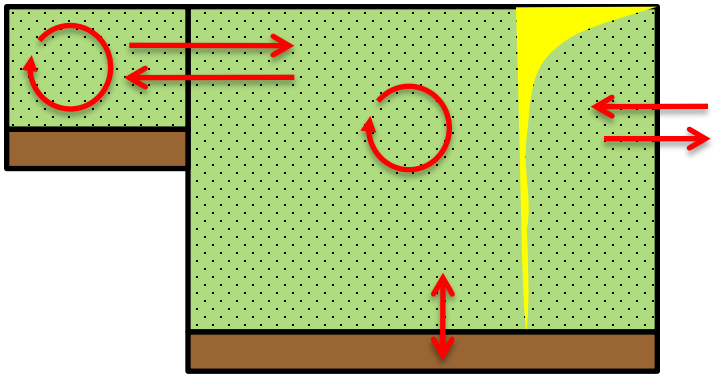
- scope of work
- processes to model (and how)
- platform

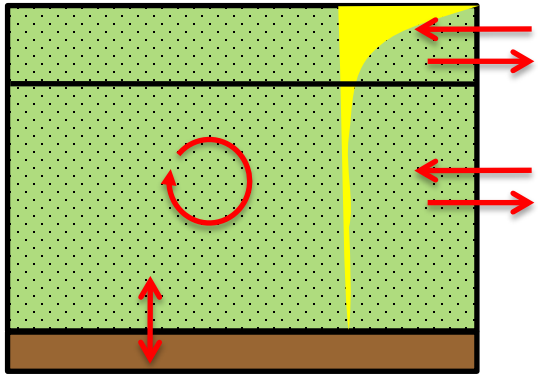
2-year study

- Assess relative importance of key processes/drivers
- Sensitivity analysis, identify critical uncertainties and data gaps
- Characterize system response (e.g., chl, O_2) under future scenarios

3. Numeric Models: Suisun Bay, South Bay

BACWA





- flow, tidal exchange (t_{res})
- light limitation
- benthic grazing
- potential inhibition of PP by NH_4^+
- budgets: transformations, sources, and sinks

3. Numeric Models: Suisun Bay, South Bay

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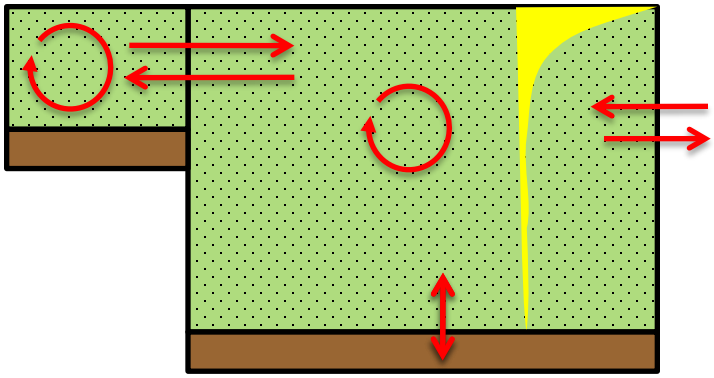

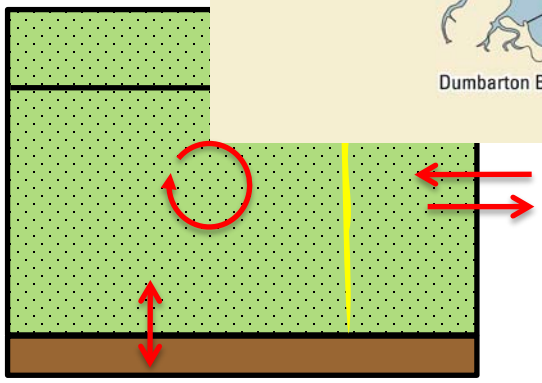

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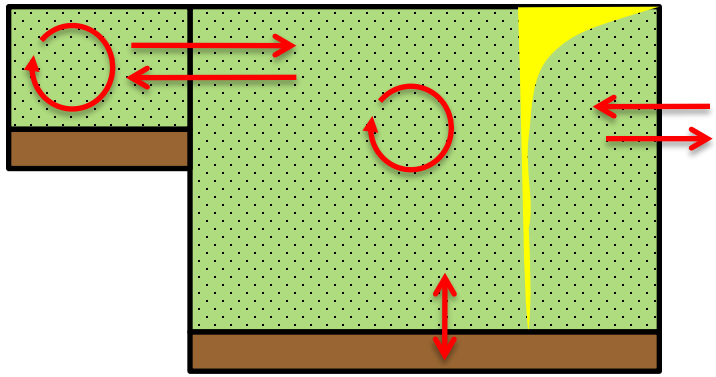
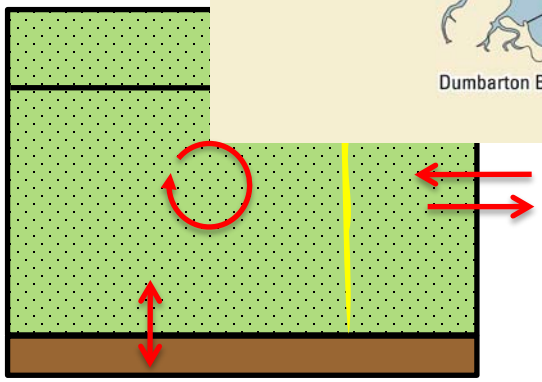




Outcomes

- Key inputs to advanced modeling
- Relative importance of processes
- Uncertainty/sensitivity analysis
- Knowledge/data gaps
  → field studies, monitoring
- Narrowing scenarios of concern

4. Suisun Bay: evaluating potential impacts of nutrients and NH_4^+

(2012-2015)

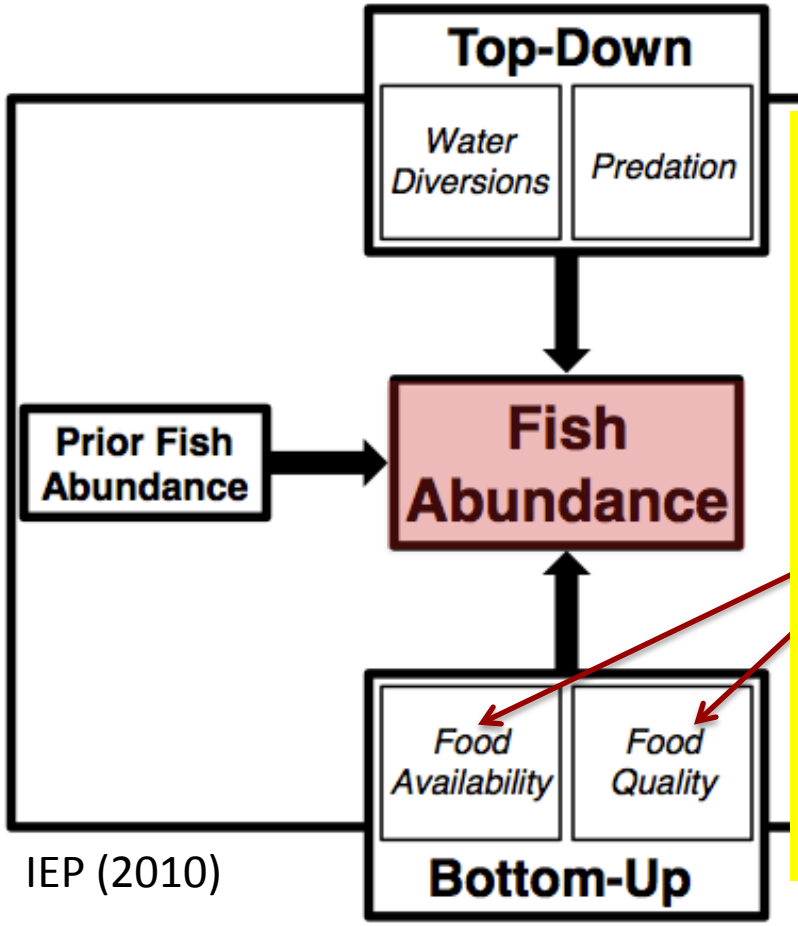
Complex management questions

- Pelagic Organism Decline (POD)
- Phytoplankton and zooplankton
  - Decreased abundance
  - Different community composition
- Potential links to nutrients, with specific focus on NH_4^+

4. Suisun Bay: evaluating potential impacts of nutrients and NH_4^+

(2012-2015)

"Multiple Drivers…"



IEP (2010)

Outcomes

- Synthesis – Nutrient/NH_4^+ role in…
  - altered phytoplankton community composition?
  - low primary production rates?
  - copepod toxicity
- Data gaps and future studies
- Modeling…
  - 2013+…contribution of Suisun dischargers

5. Phytoplankton Assessment Framework

SWRCB-FUNDED

(2012-2013)

Phytoplankton: leading candidate indicator for assessment of Bay eutrophication

What are the precise measures of phytoplankton that we need to assess ? Biomass ? Assemblage? Harmful algal species?

What are the appropriate thresholds for regulatory action?

What kind of monitoring data are needed to make an assessment?

5. Phytoplankton Assessment Framework

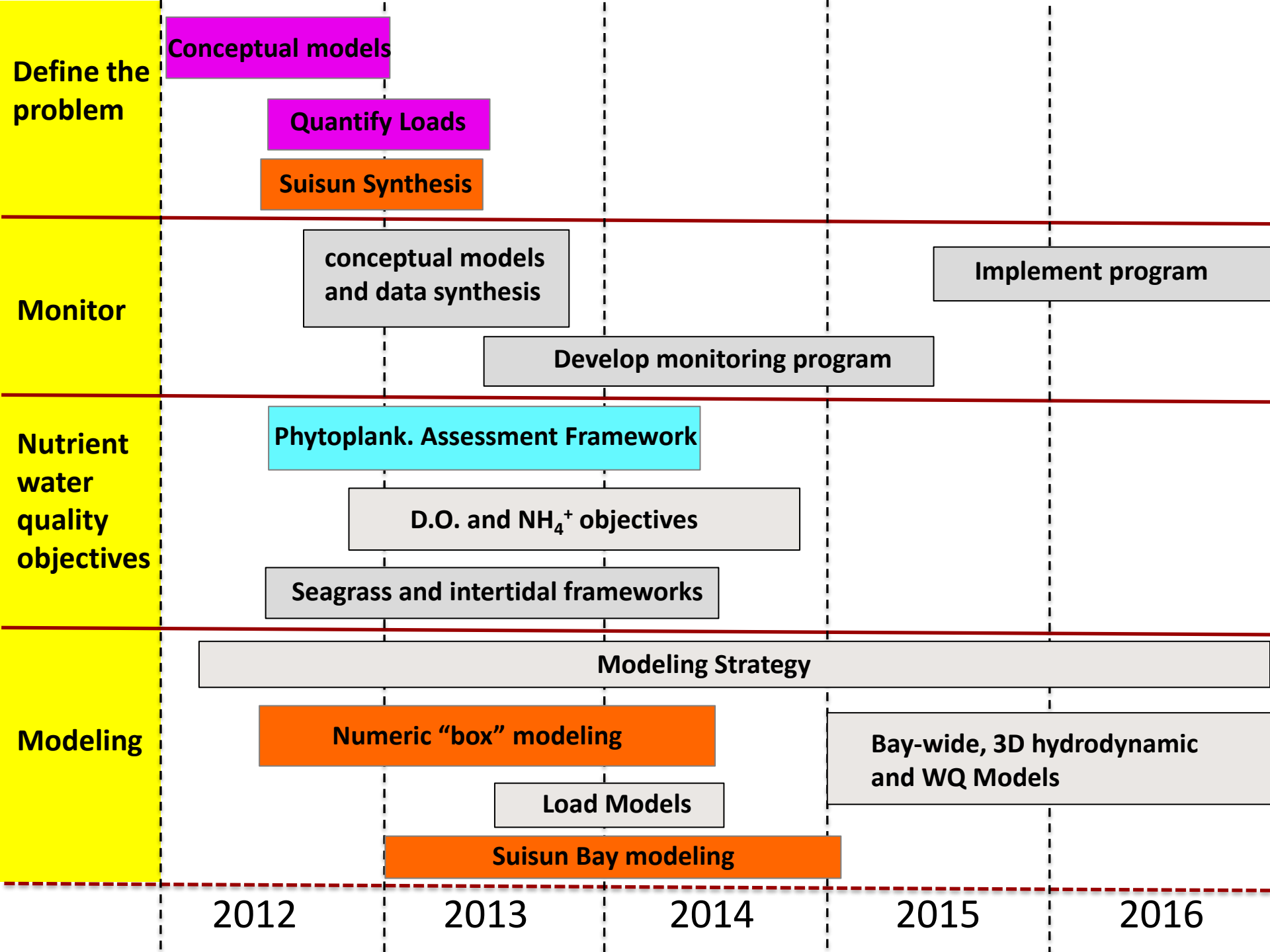
SWRCB-FUNDED

(2012-2013)

Phytoplankton: leading candidate indicator for assessment of Bay eutrophication

<u>Outcomes</u>

- Transparent decision framework to determine whether regulatory action is required
- Numeric targets that can be used to inform decisions on load and waste load allocations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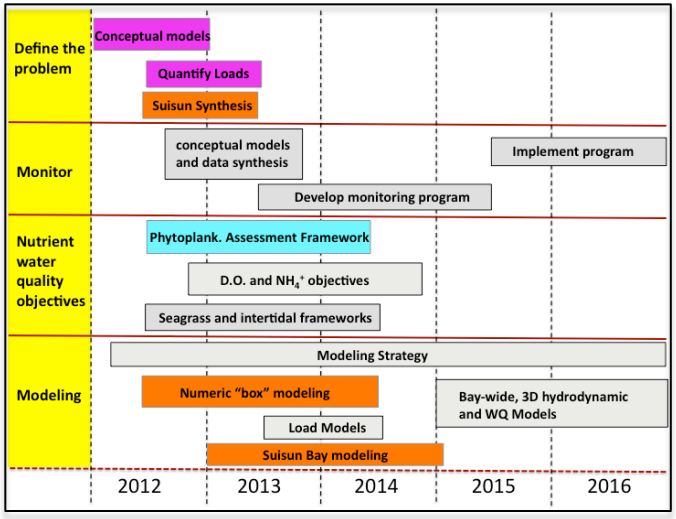
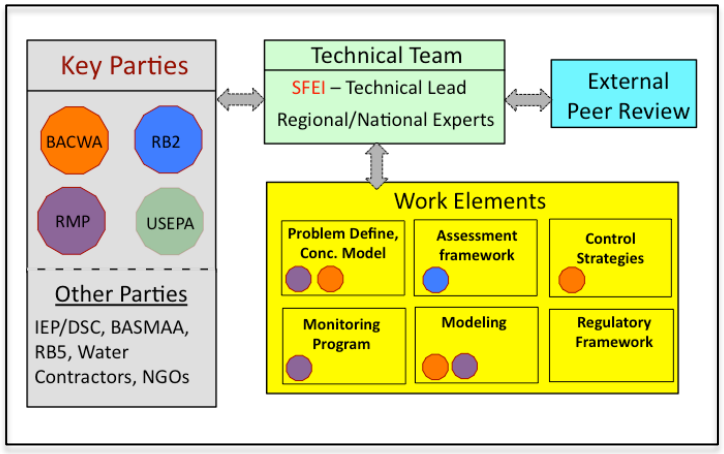


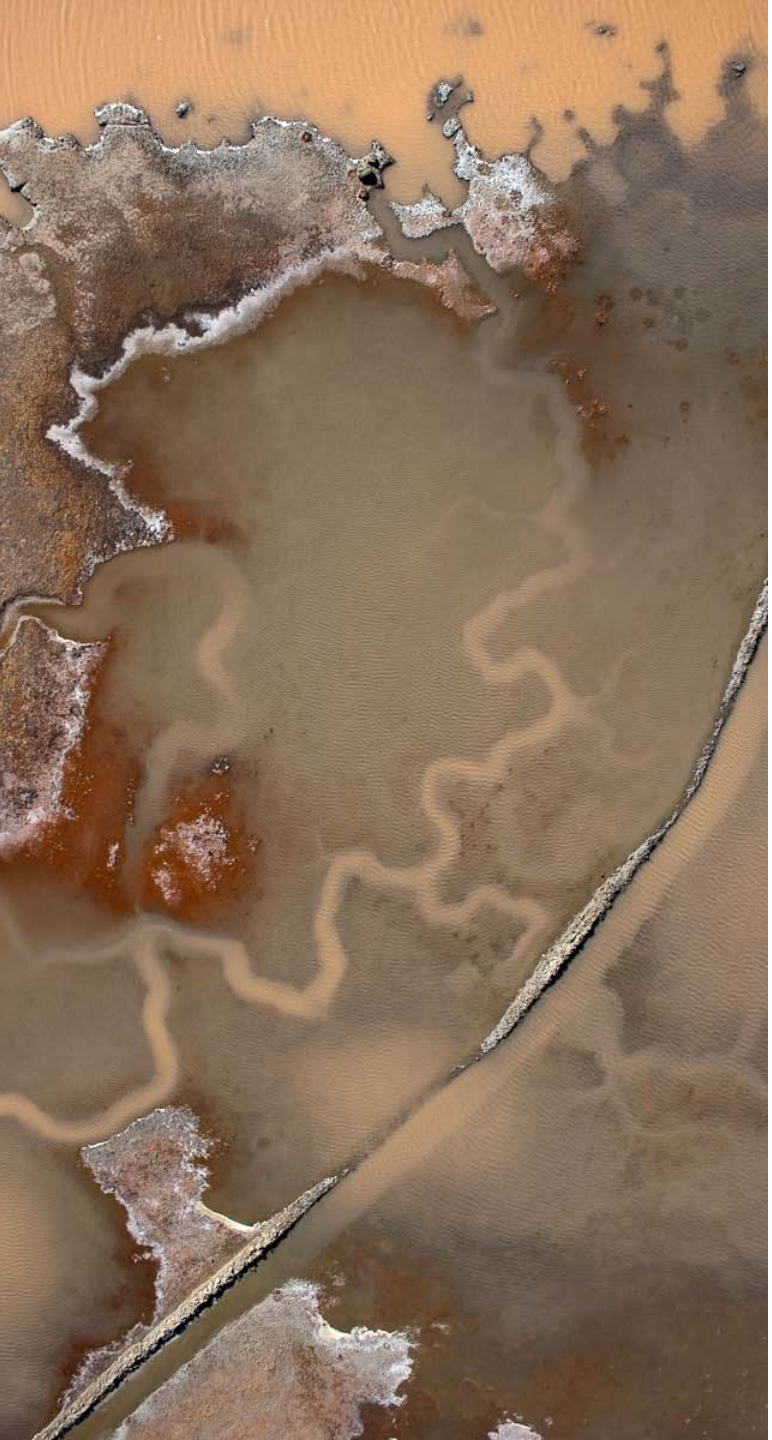
Lots of work in 2012 and beyond

Science ⟷ Management/Regulatory Decisions



Work Plan details being developed and refined

- Regional Board
- BACWA and its member agencies
- other stakeholders



Acknowledgements:

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BACWA – A Chastain, M Connor, J Kelly, B Horenstein, BACWA Board

SFRWQCB – N Feger, T Mumley

RMP Nutrient Workgroup

SFEI –M Sedlak, J Davis, R Allen, L McKee, R Hoenicke,

J Cloern (USGS), R Dugdale (SFSU), A Mueller-Solger (IEP)

Source: C. Benton