

SF Bay Nutrient Projects Update

- 1) Goals of discussion
- 2) Overview of nutrient-related work in the Bay
- 3) Status Update
 - schedule/outlook of current projects
- 4) Overview of Priority Projects in 2013

David Senn
SFEI
June 28, 2012

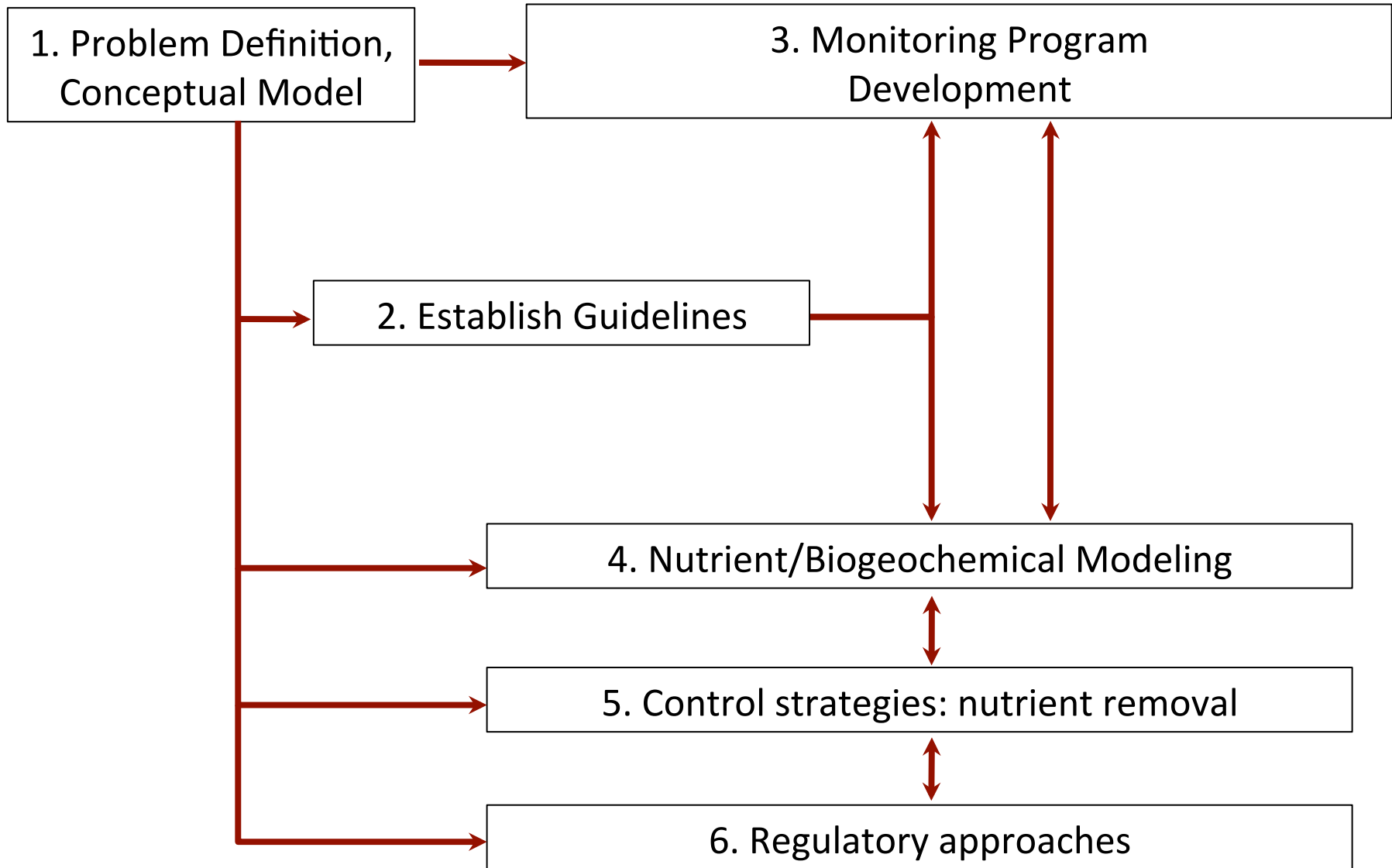
Discussion Goals

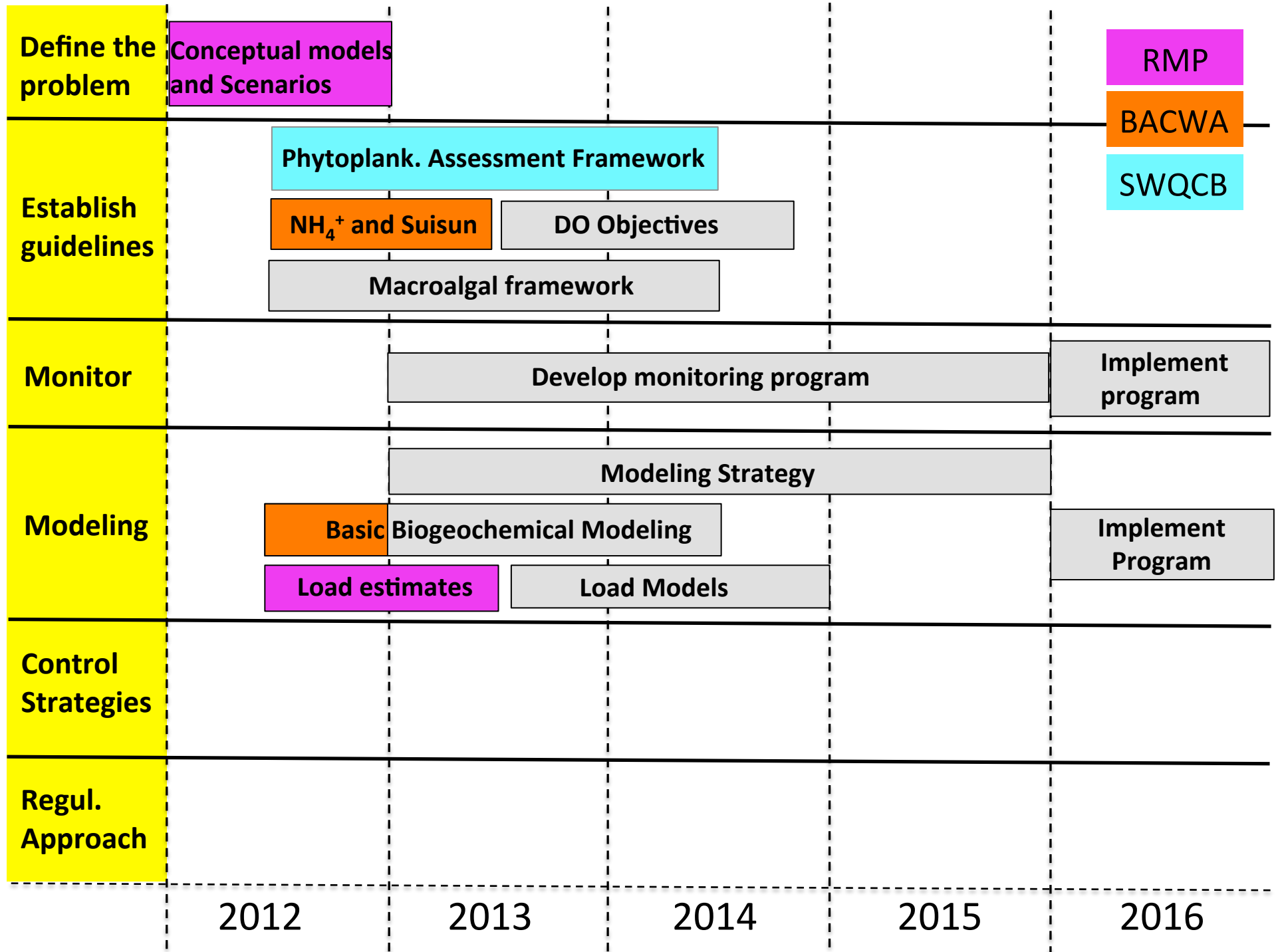
- Status update on BACWA-funded (and RMP?) projects
- Discuss problem areas related to...
 - Reporting
 - Coordination and Nutrient Strategy umbrella...
 - Information exchange and overview
 - Decision-making
- ...and...
- Identify steps along a path to address problems

Some Steps/Solutions

- Improved reporting and communication
- Building a big but nimble umbrella
- Approach for coordinating with efforts outside current strategy
 - continue plugging in to major/important efforts
 - official engagement – institutional agreements?
- Cast broad net for funding opportunities

Draft Nutrient Strategy

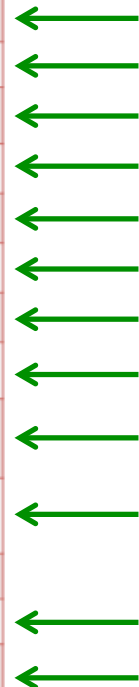




	2011	2012	2013	2014	2015
Nutrient Strategy		125k BACWA			
Suisun synthesis		90k BACWA			
Biogeochemical and Hydrodynamic Modeling		228k BACWA + RMP	100k RMP	?	?
Assessment Framework, NNE	100k RWQCB	115k RWQCB	200k RWQCB		
Conceptual Model		80k RMP			
Loading study		20k RMP	30k RMP		

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Conceptual Model		80k RMP			
Loading study		20k RMP	30k RMP		
Stormwater monitoring		30k RMP			
POTW Effluent Characterization		350k POTWs+BACWA	700k POTWs+BACWA	350k POTWs+BACWA	
Suisun/SWAMP phytopl., TIE	>300k CCCSD=200k; RWQCB=100k; SFCWA = ?	~750k CCCSD=450k; RWQCB = 100k; SFCWA = 200k?			
Suisun/Zooplankton		~100k SFCWA	250k SFCWA = 160k CCCSD (?) = 90k		
Effluent modeling		70k CCCSD			
RMP future funds			170k	300k	TBD
Monitoring Program	700k USGS=590k; RMP 110k	700k USGS=640k; RMP 110k	700k USGS=640k; RMP 110k	700k USGS=640k; RMP 110k	700k USGS=640k; RMP 110k
Other – IEP, DSP, SFCWA		~1000k	~1000k		
Total	\$1.2 mill	\$3.0 mill	\$3.2 mill	\$1.4 mill	\$700k

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Total	\$1.2 mill	\$3.0 mill	\$3.2 mill	\$1.4 mill	\$1.1 mill



- Already actively working to maximize synergies and leverage between RMP and BACWA programs, and USGS
- IEP - submitting a concept proposal to IEP
- SFCWA – reviewer of proposals, planning nutrient workshop
- Key researchers – highly engaged
- Need to “officially” link with IEP, SFCWA, others

Status updates

- Budget/funding
- Strategy development (BACWA)
- Suisun Bay work (BACWA)
- CM (RMP)
- Loading (RMP)
- Stormwater nutrients (RMP)
- Assessment framework (RWQCB)
- Biogeochemical modeling (BACWA)

Budget update (calendar year)

	Budgeted	Q1+Q2
<i>Task 1</i> PM	39k	~10k
<i>Task 2</i> Strategy Coordination	115k	~40k
<i>Task 3</i> Modeling	117k	0
<i>Task 4</i> Suisun Synthesis	80k	~22k
Total	350k	~72k

Budget update (calendar year)

	Budgeted	Q1+Q2	Q3	Q4	Anticipated Year-End Balance
<i>Task 1</i> PM	39k	~10k	12k	12k	5k
<i>Task 2</i> Strategy Coordination	115k	~40k	30k	45k	0
<i>Task 3</i> Modeling	117k	0	0	0	117
<i>Task 4</i> Suisun Synthesis	80k	~22k	40k	18k	0
Total	350k	~72k	90k	75k	122k

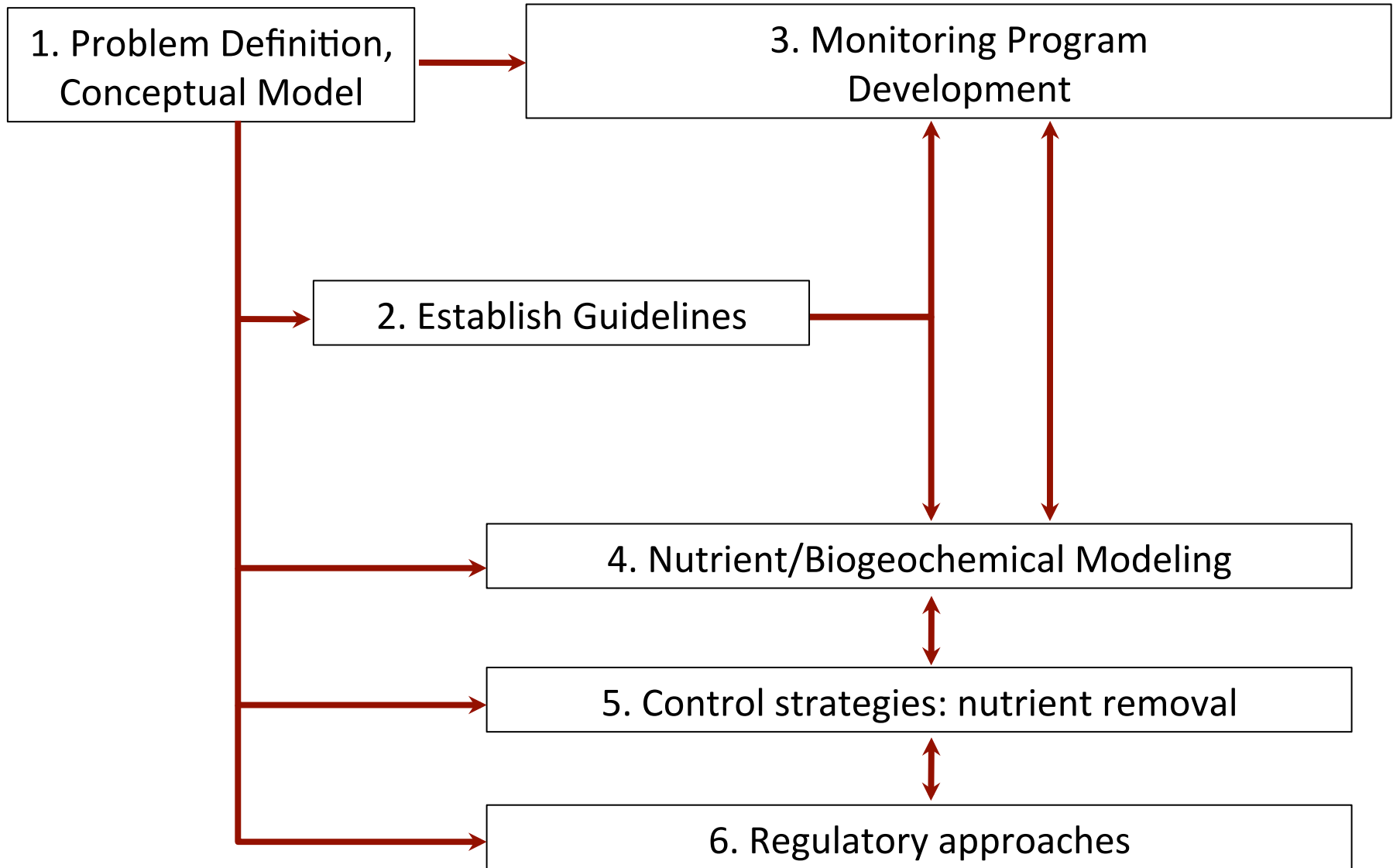
Task 2: Nutrient Strategy Coordination (BACWA)

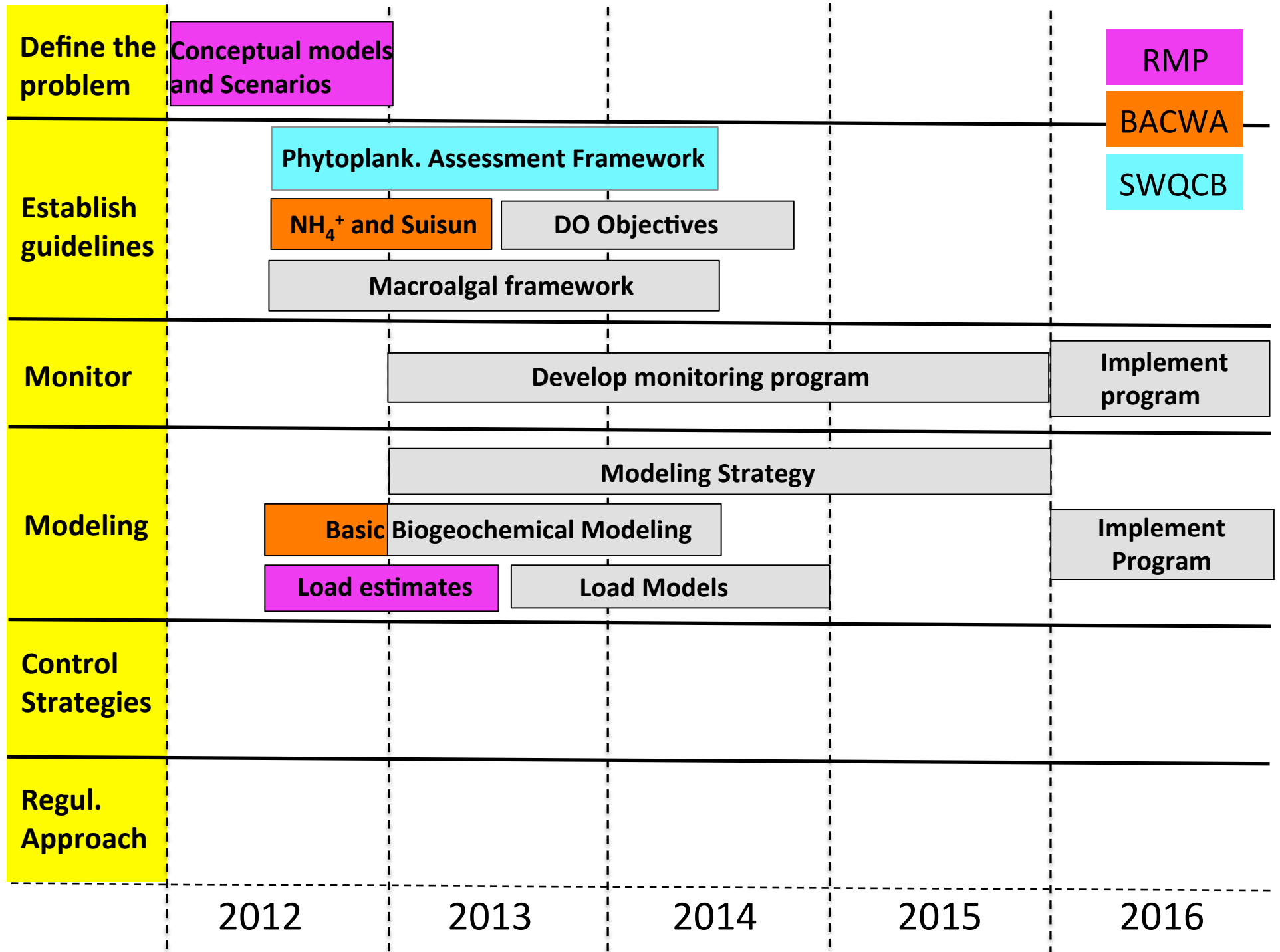
	Q1 2012	Q2 2012	Q3 2012	Q4 2012
Coordination	[Grey shaded area]			
Nutrient Strategy		draft	comments	funding plan (?)
SAG meetings				
Website				
External Review				2013

Task 2: Nutrient Strategy Coordination (BACWA)

	Q1 2012	Q2 2012	Q3 2012	Q4 2012				
Coordination	[Grey bar]							
Nutrient Strategy	[Grey bar]	draft	comments	funding plan (?)	draft	comments	[Grey bar]	final
SAG meetings		[Red bar]		[Red bar]			[Red bar]	
Website		[Grey bar]	[Red bar]	[Grey bar]			[Grey bar]	
External Review				[Grey bar]			[Grey bar]	2013

Draft Nutrient Strategy





Focus of 2012 SAG meetings

March 29

- Overview of and feedback on Nutrient Strategy
- SAG roles, governance

June 22

- Science/funding priorities for 2013
- Comments on strategy

Key comments on strategy

- General agreement that overarching Bay Nutrient Strategy is worthwhile
- Support for use of load-response models
- Need for external review of strategy and work elements (in particular modeling and assessment framework)
- Mismatched timing of strategy goals and permit requirements
- Need for financial and funding picture/prioritization

Focus of 2012 SAG meetings

March 29

- Overview of and feedback on Nutrient Strategy
- SAG roles, governance

June 22

- Science/funding priorities for 2013
- Comments on strategy

Next meeting: Sep/Oct 2012

- Update on conceptual model and other projects
- Updates on SAG roles, governance

Task 2: Nutrient Strategy Coordination (BACWA)

	Q1 2012	Q2 2012	Q3 2012	Q4 2012			
Coordination	[Grey bar]						
Nutrient Strategy		draft	comments	funding plan (?)	draft	comments	final
SAG meetings		[Red bar]		[Red bar]			
Website		[Grey bar]	[Red bar]	[Grey bar]			
External Review				[Grey bar]	[Yellow bar]	2013	



Nutrients in San Francisco Bay

Home

Motivation

Initiative Goal

Partners

Projects

Project Documents

Events

Links

Bibliography

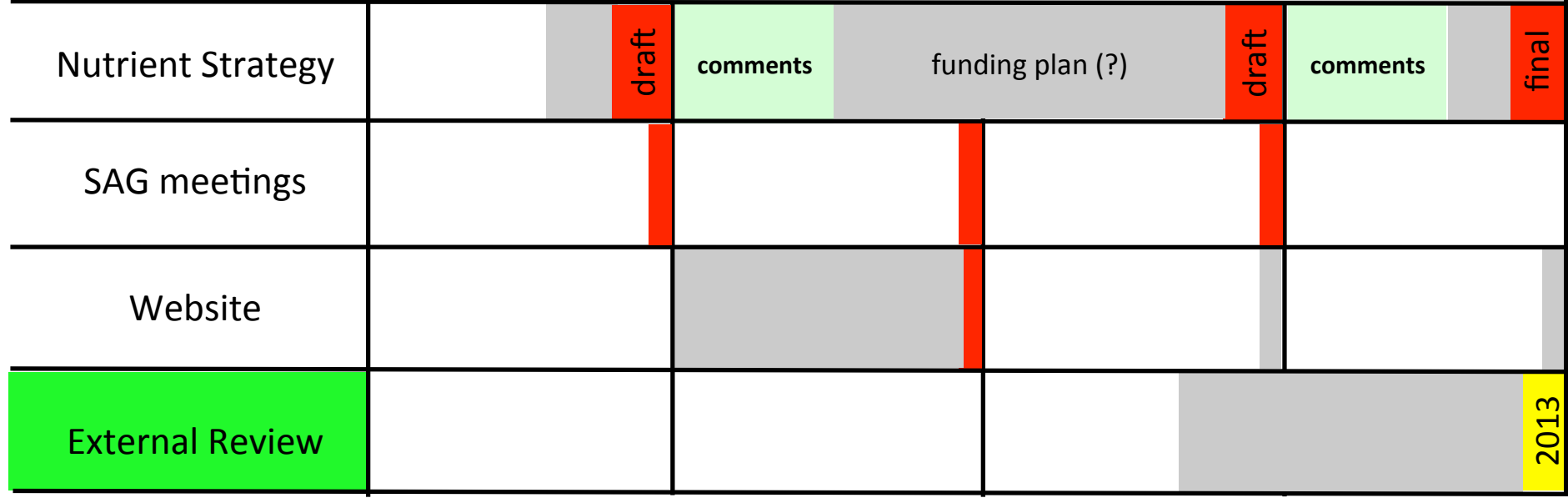
Research and Synthesis to Inform Nutrient Management in San Francisco Bay



The San Francisco Bay Nutrient Science and Management Strategy is a regional initiative for developing the science needed for informed decisions about managing nutrient loads and maintaining beneficial uses within the Bay. [San Francisco Bay Nutrient Strategy partners](#) include federal and state agencies, local governments, non-profit organizations, and academic institutions.

Task 2: Nutrient Strategy Coordination (BACWA)

	Q1 2012	Q2 2012	Q3 2012	Q4 2012
Coordination	[Grey bar]			
Nutrient Strategy		draft	comments	funding plan (?)
SAG meetings				
Website				
External Review				2013



Task 4. Synthesis of science supporting management decisions in Suisun Bay (BACWA)

Complex management questions

- Pelagic Organism Decline
- Phytoplankton and zooplankton
 - Decreased abundance
 - Different community composition
- Multiple contributing factors (IEP 2010)
 - flows/withdrawals
 - invasive species
 - potential links to nutrients, with specific focus on NH_4^+

Task 4. Synthesis of science supporting management decisions in Suisun Bay (BACWA)

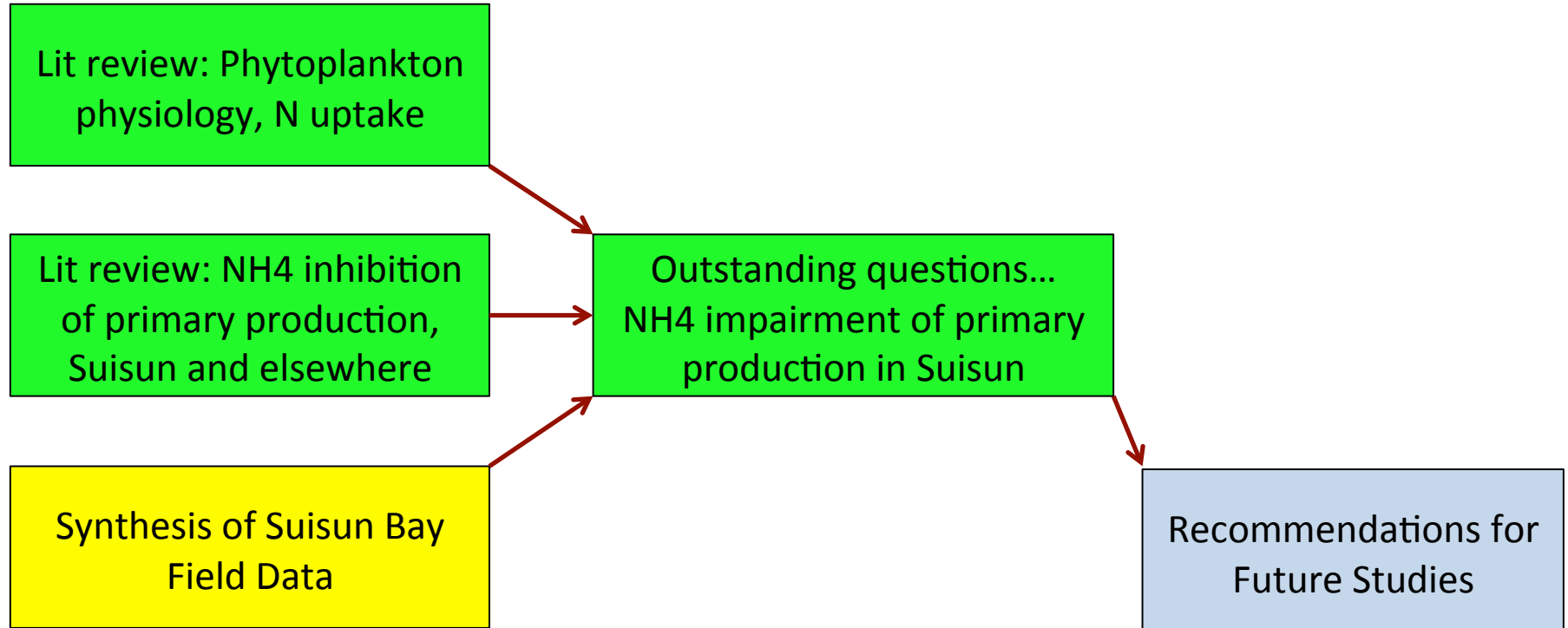
Goals

- Synthesis – Nutrient/ NH_4^+ role in...
 - altered phytoplankton community composition?
 - low primary production rates?
 - copepod toxicity
- Contributions of CCCSD discharge (and others?) to ambient NH_4
- Internal processes: Nutrient fate and transport
- Data gaps and future studies

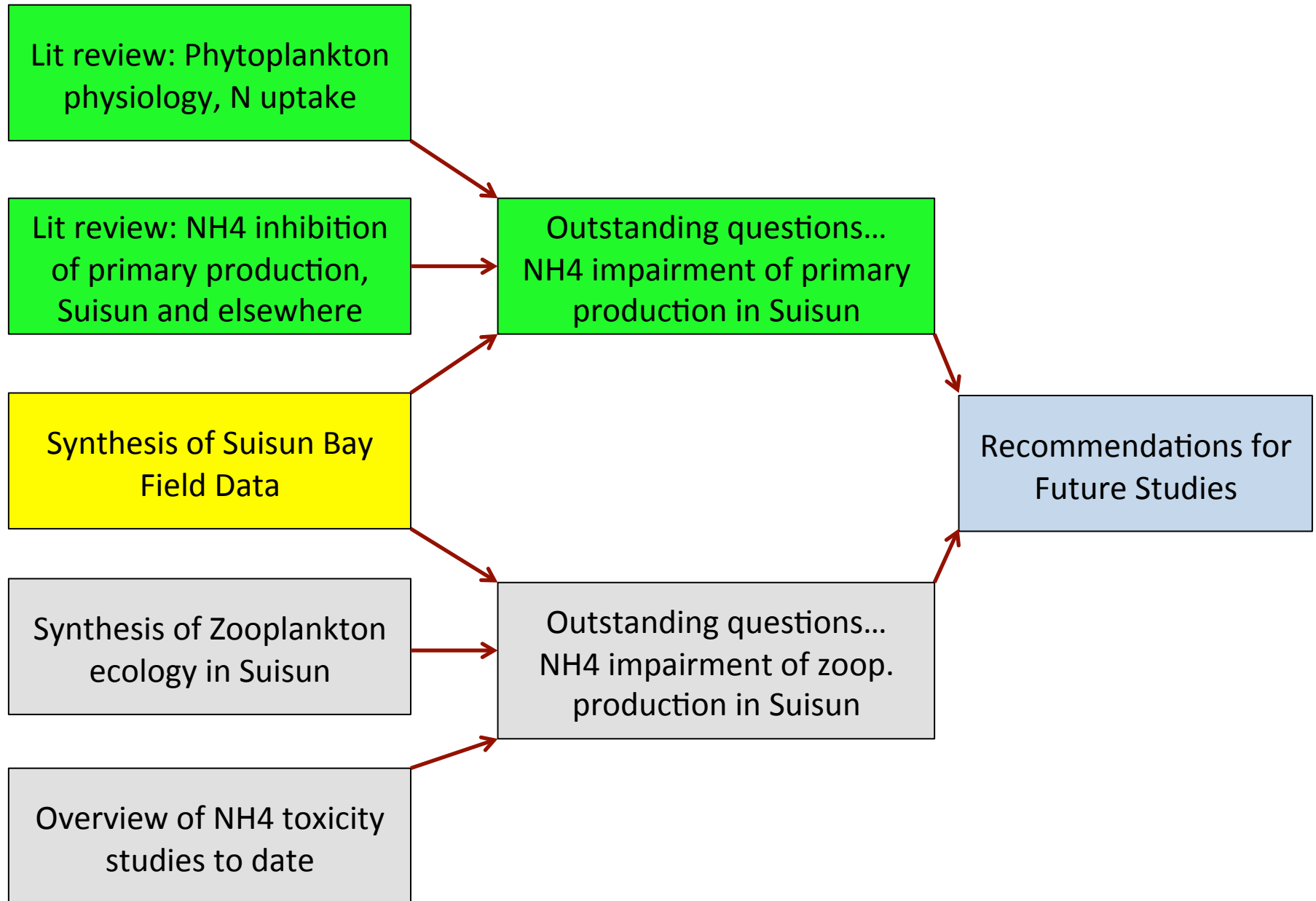
Task 4 Deliverables

- Synthesis Report and Study Plan (2012)
 - Summarizes existing knowledge related to beneficial use impairment from NH₄
 - Describes recently completed or on-going studies
 - Identifies additional studies and persistent knowledge gaps

Approach



Approach



Task 3: Suisun Synthesis (BACWA)

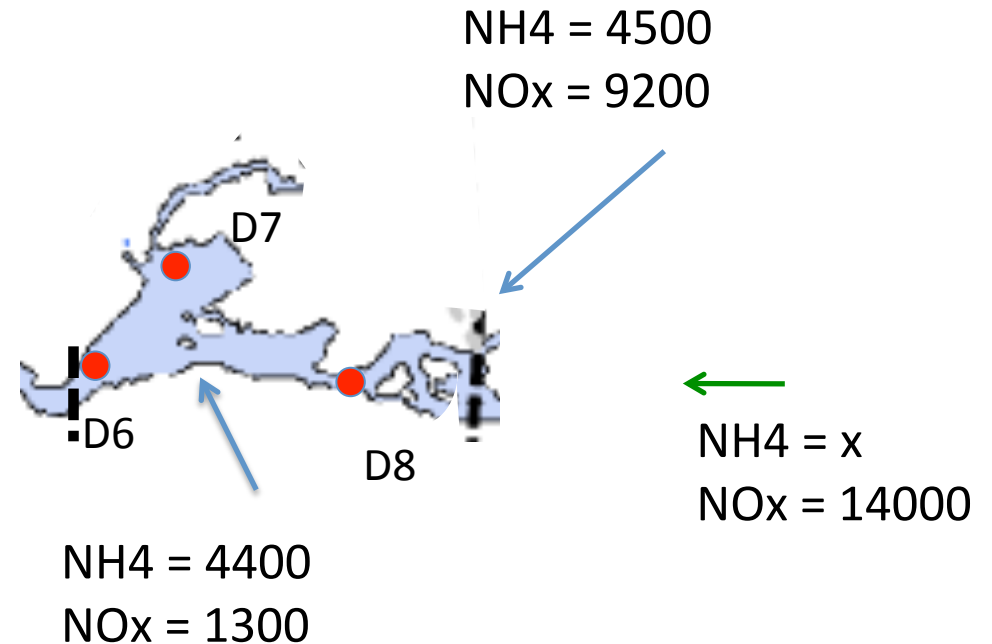
	Q1 2012	Q2 2012	Q3 2012	Q4 2012
Field data		SFEI		
NH4 inhibition synth			SFEI	*
N uptake by phyto			consult./SFEI	draft
Zooplankton synth.			Kimmerer/SFEI	comment
Zooplankton tox.			SFEI/consult.	final
Phyto. questions				→
Zoop. questions				→
Recommended studies				→
External Review				2013

Task 4 Deliverables

- Synthesis Report and Study Plan (2012)
 - Summarizes existing knowledge related to beneficial use impairment from NH₄
 - Describes recently completed or on-going studies
 - Identifies additional studies and persistent knowledge gaps

- Assessment of potential effects on diatoms and copepods from elevated NH₄ (2013)
 - Lifecycles of diatoms and copepods
 - Summarize available info. regarding potential impacts of NH₄
 - Identify critical info gaps, proposes studies to address gaps

Initial Synthesis Work...



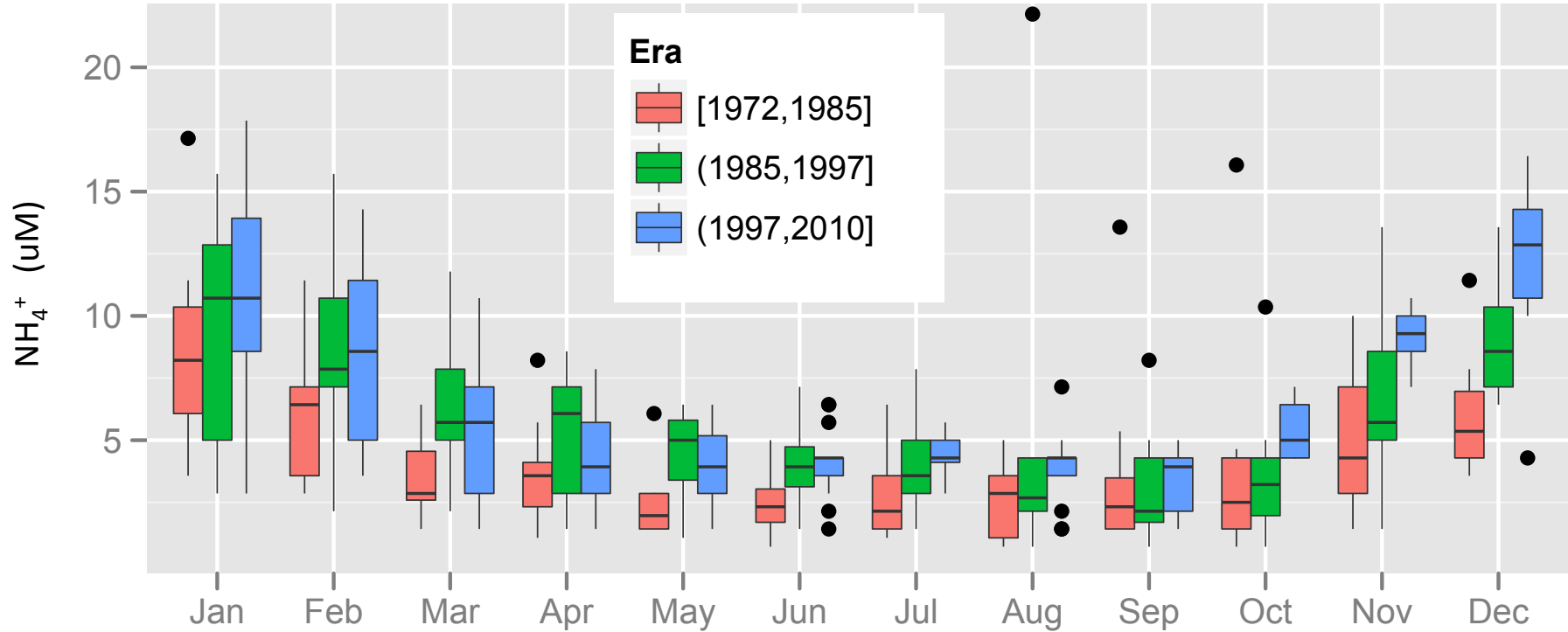
How do concentrations vary spatially and seasonally?

- long-term monitoring
- intensive sampling efforts (e.g., SWAMP)

How have concentrations changed with time?

Interesting observations from coarse budgets?

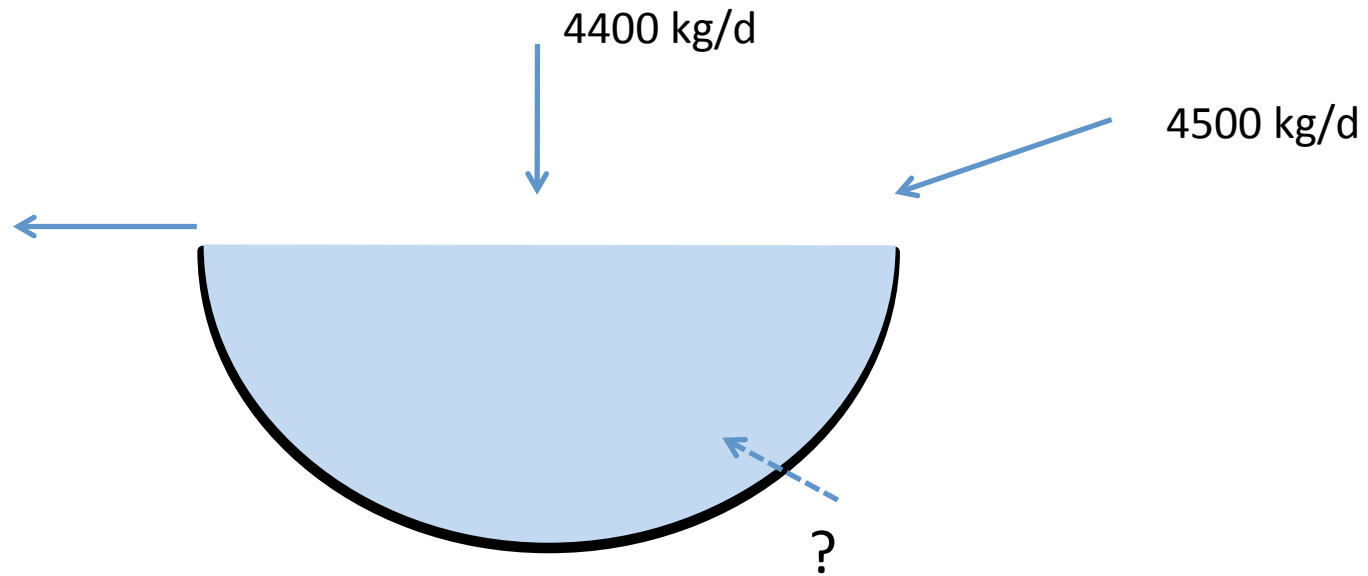
NH₄⁺ - D7 (Grizzly Bay)



- Pronounced seasonality (2-3x)

- Substantial increase in NH₄ (up to >2.5x) over past 25 years in certain months

Suisun NH₄⁺ Mass Balance - Summertime (Jun-Aug)

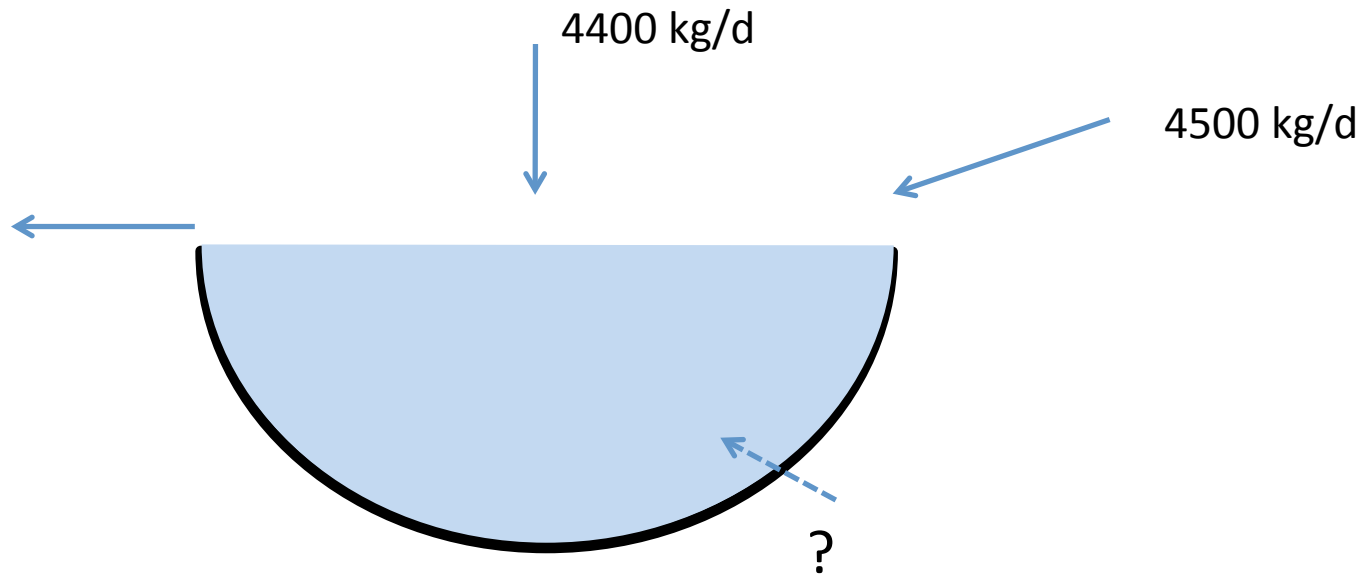


$$V \cdot \frac{dC}{dt} = \sum M_{in,i} - M_{out} - k_{loss} \cdot C \cdot V$$

Assumptions:

[NH ₄]	~	3 uM
Q _{river}	~	200 m ³ s ⁻¹
Q _{tidal}	~	70 m ³ s ⁻¹
V _{avg}	~	500 x 10 ⁶ m ³

Suisun NH₄⁺ Mass Balance - Summertime (Jun-Aug)



$$M_{out} = (Q_{river} + Q_{tide,out}) \cdot C$$

$$= 970 \text{ kg d}^{-1} \sim 15\%$$

$$k_{loss} \sim 0.3 \text{ d}^{-1}$$

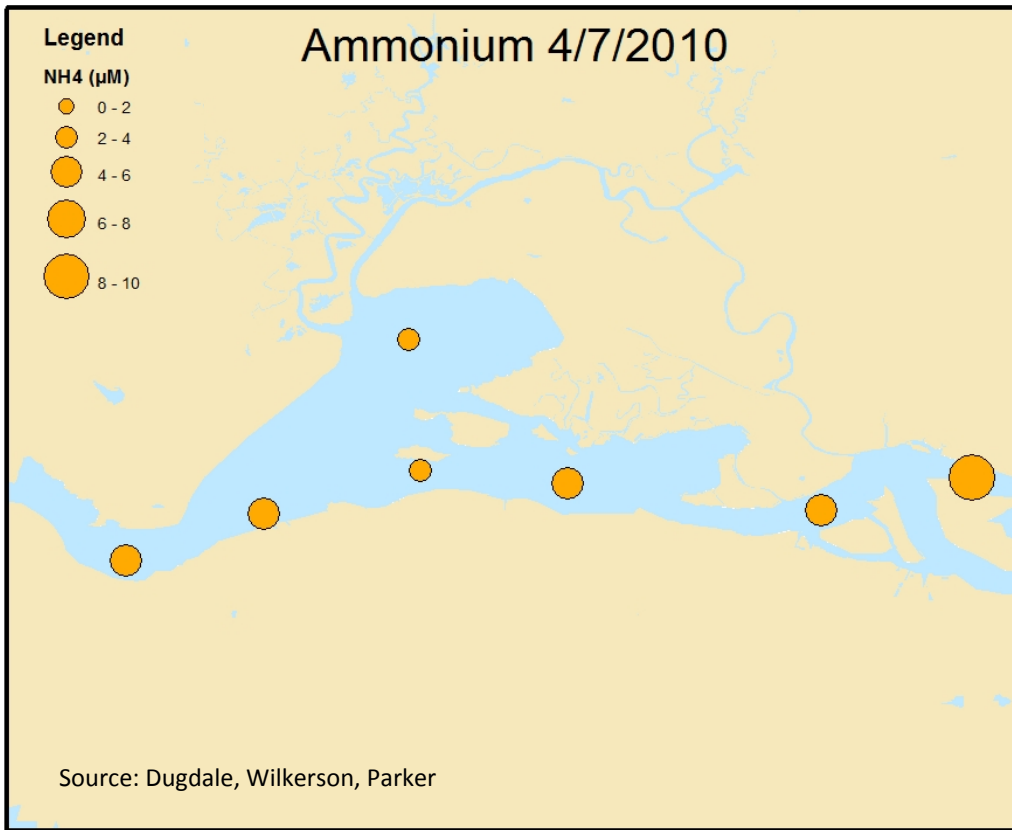
$$M_{loss} = k_{loss} \cdot C \cdot V$$

$$= 7900 \text{ kg d}^{-1} \sim 85\%$$

nitrification or algal uptake

Assumptions:

[NH ₄]	~	3 uM
Q _{river}	~	200 m ³ s ⁻¹
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V _{avg}	~	500 x 10 ⁶ m ³



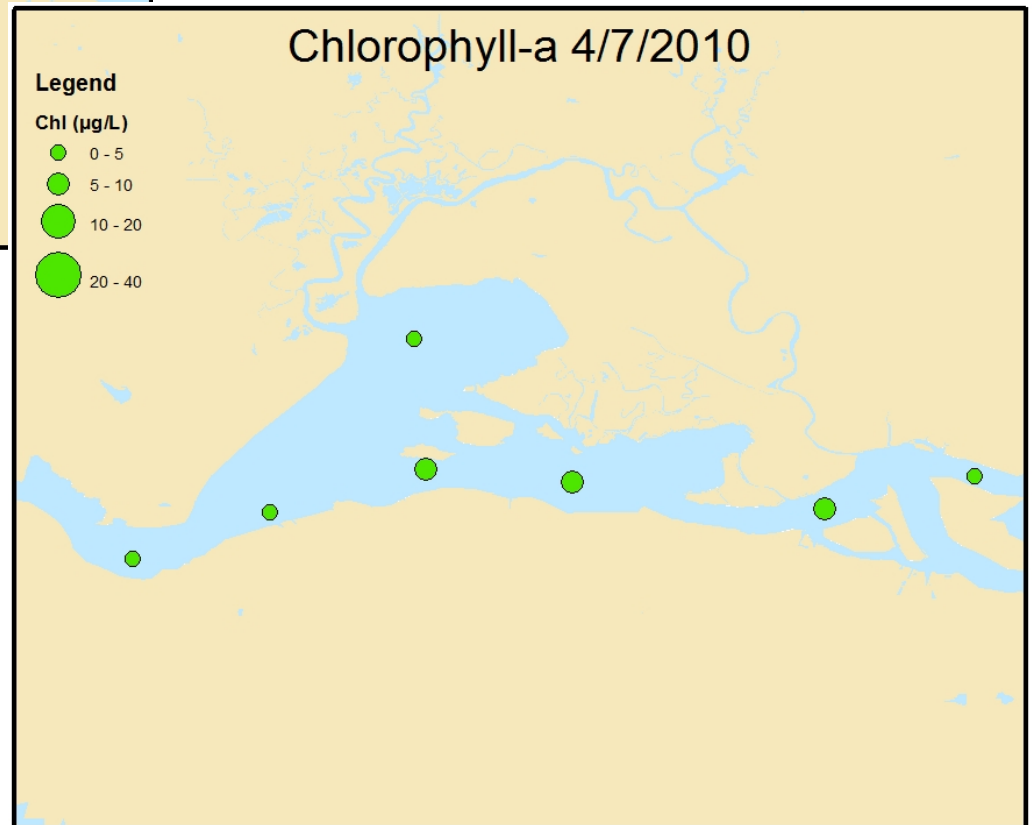
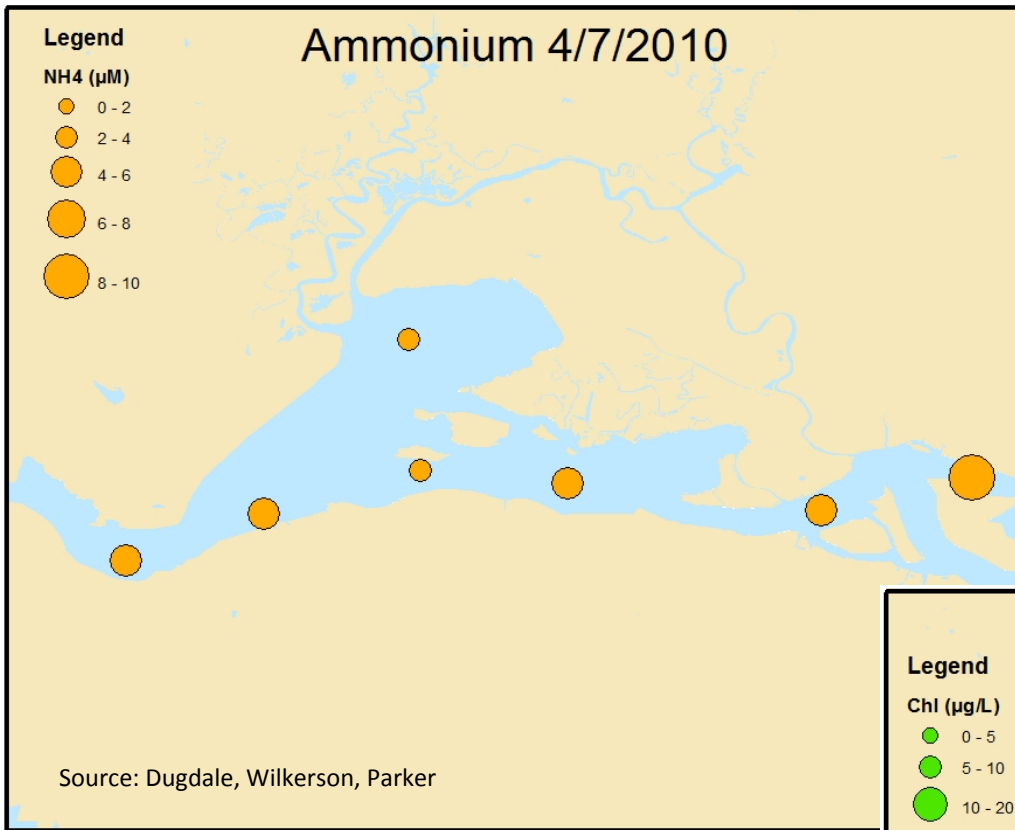
'High' spatial/temporal resolution data

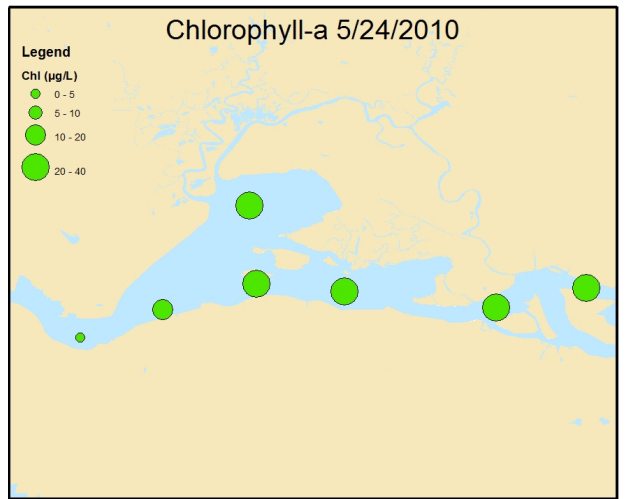
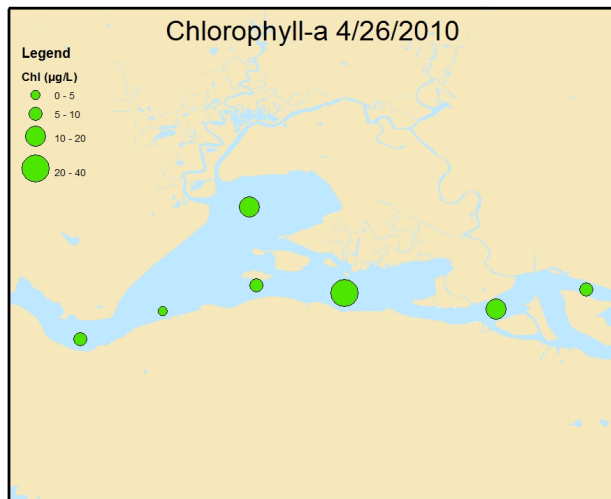
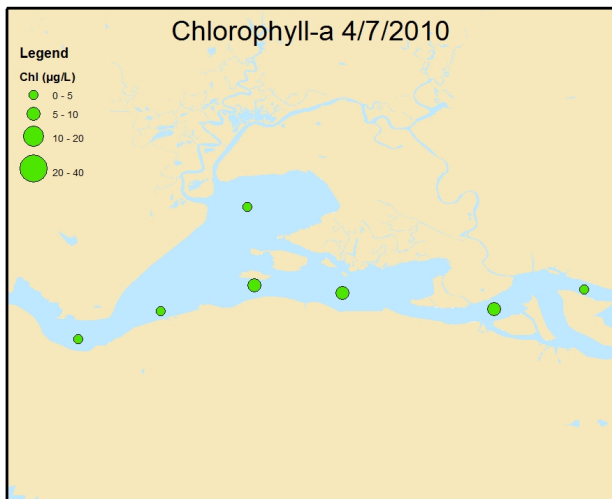
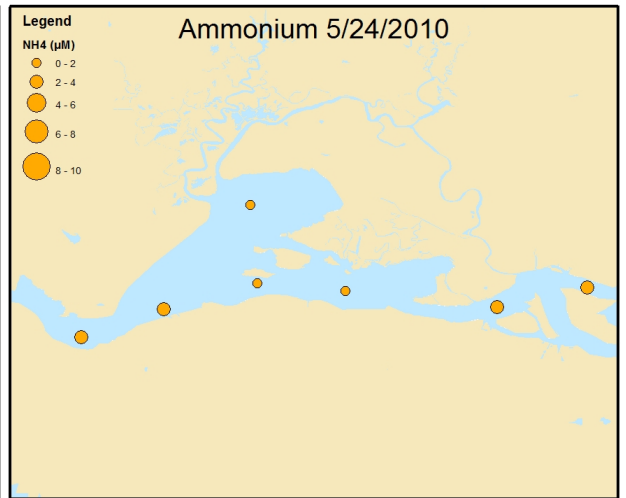
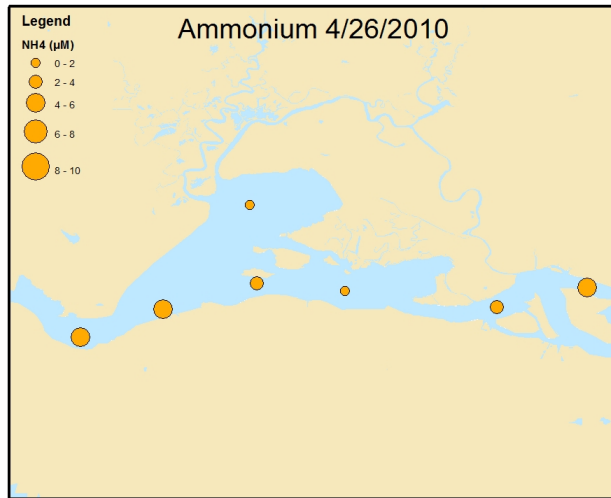
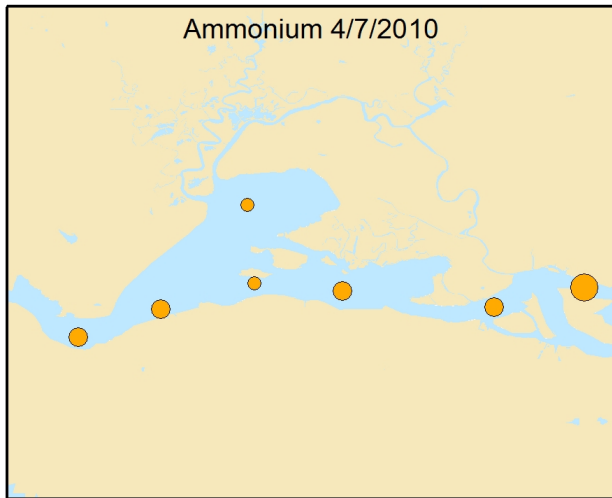
SWAMP/Suisun – 2010, 2011, 2012

(RWQCB, CCCSD, SFCWA)

Other – 1999-2003

NH₄, chl, NO₃, PO₄, sal., T...



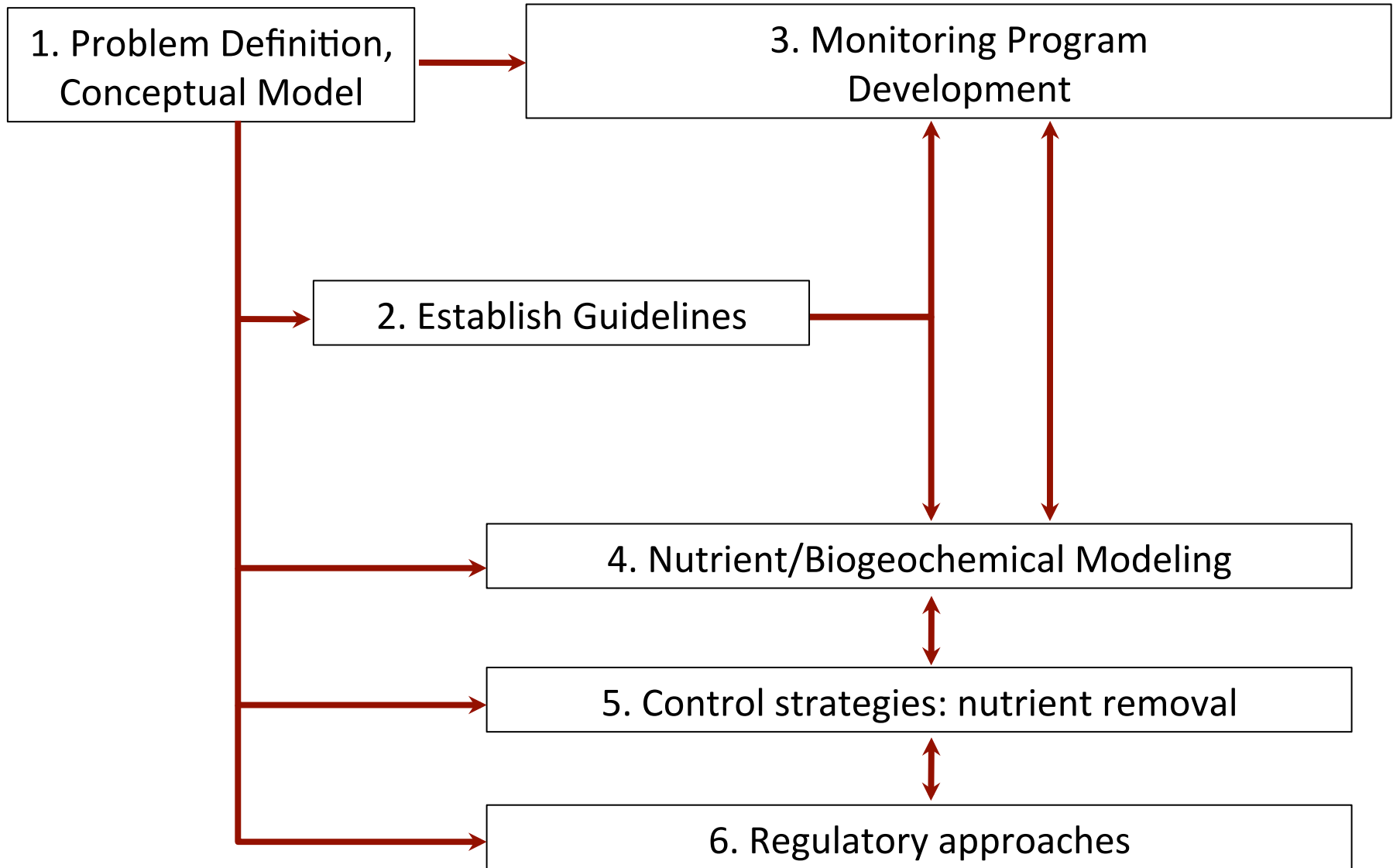


Source: Dugdale, Wilkerson, Parker

Comparison with potential impairment thresholds

- Copepods: *Pseudodiaptomus* (Teh et al. 2011)
 - Suisun ambient [NH₄]
 - 15-50x lower than LC50
 - 1.8-6x lower than LOEL (0.36 mg N/L)
- Phytoplankton primary production
 - Suisun ambient [NH₄] generally > 4 uM (0.056 mg/L) inhibition threshold throughout most of the year
- Up to 2x spatial variability in [NH₄] during summer months

Draft Nutrient Strategy



Status updates

- Budget/funding
- Strategy development (BACWA)
- Suisun Bay work (BACWA)
- CM (RMP)
- Loading (RMP)
- Stormwater nutrients (RMP)
- Assessment framework (RWQCB)
- Biogeochemical modeling (BACWA)

Biogeochemical Modeling: Suisun and South Bay

Cost: \$300k (\$117k BACWA 2012 + ~150 RMP + ??)

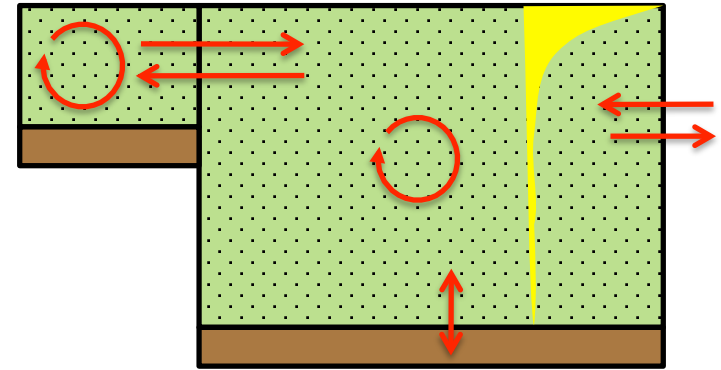
PI: D Senn

Collaborators/Technical Team: Cloern (USGS), Dugdale (RTC), others

Objective: Develop biogeochemical models for...

- Quantitative data synthesis and nutrient budgets
- Assessing relative importance of key processes/drivers
- Sensitivity analysis, identify critical uncertainties and data gaps
- Characterizing response (e.g., chl, O₂) under future scenarios
- Inform monitoring program and special studies

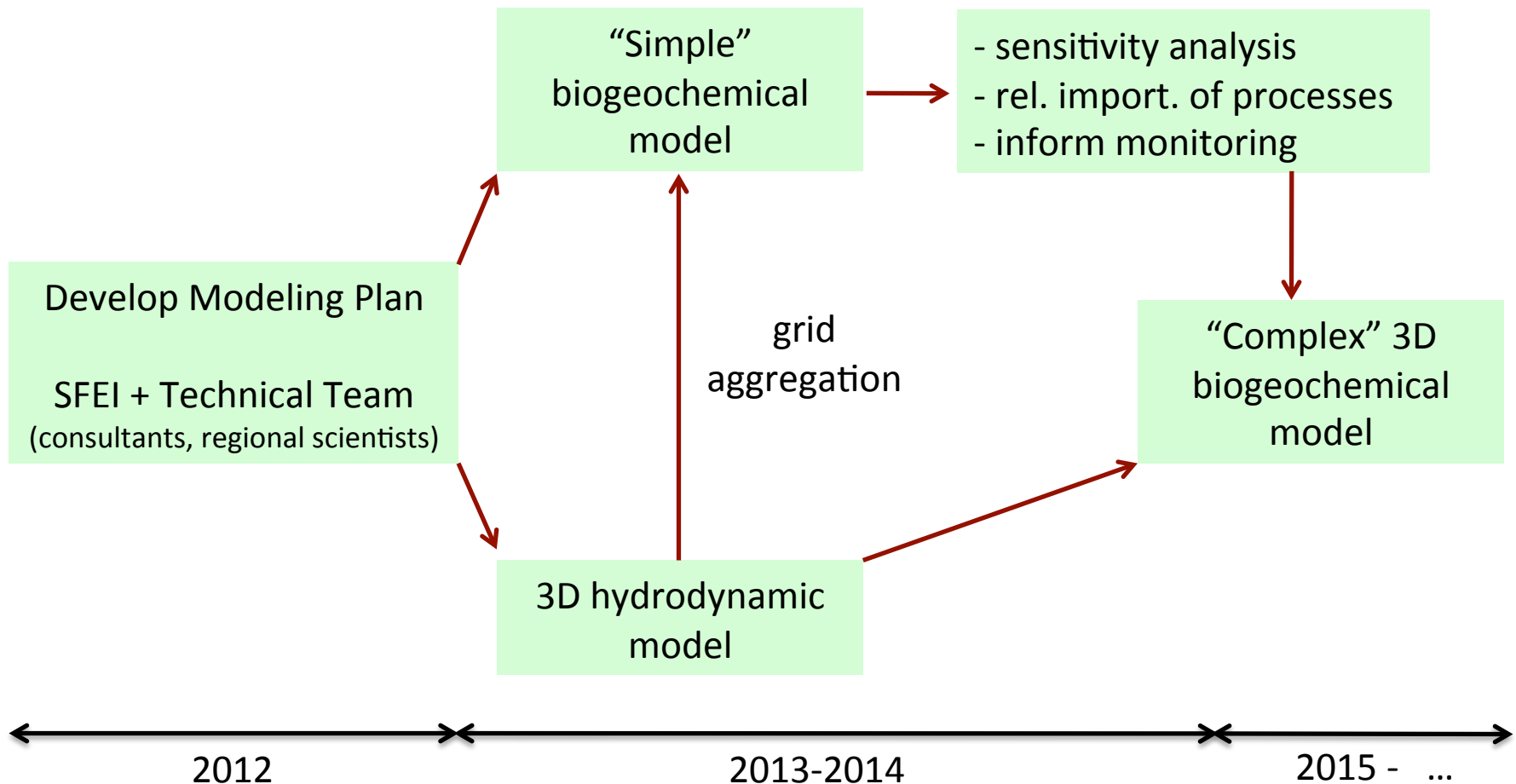
Biogeochemical Modeling: Suisun and South Bay



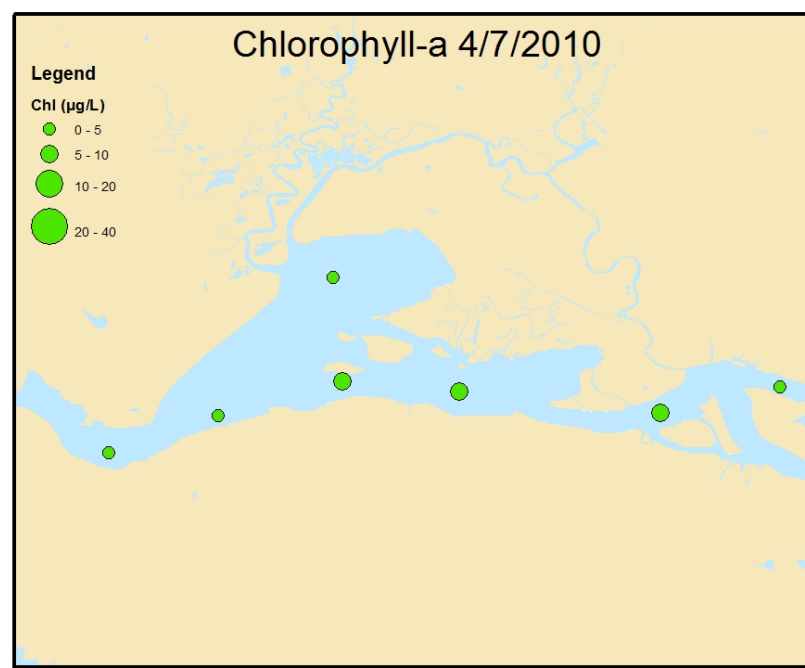
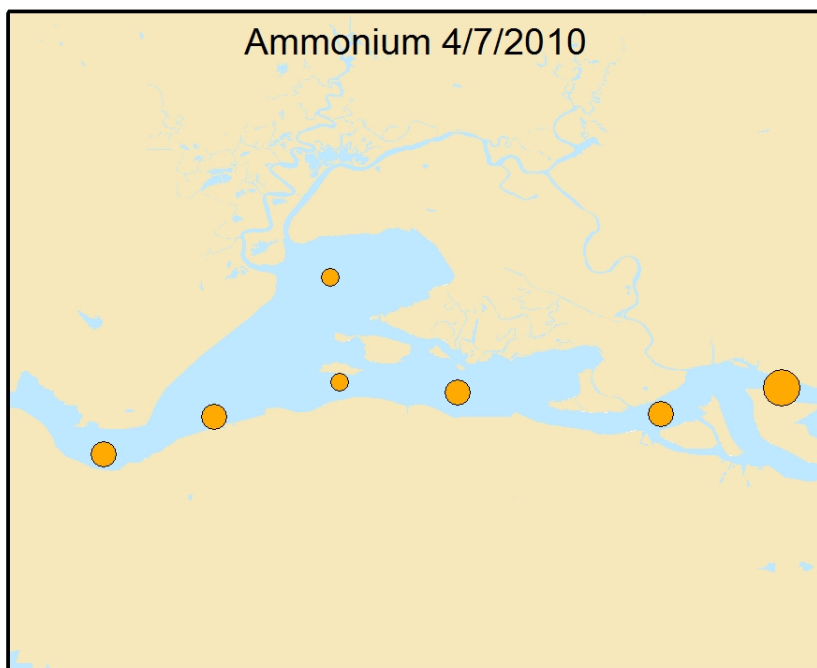
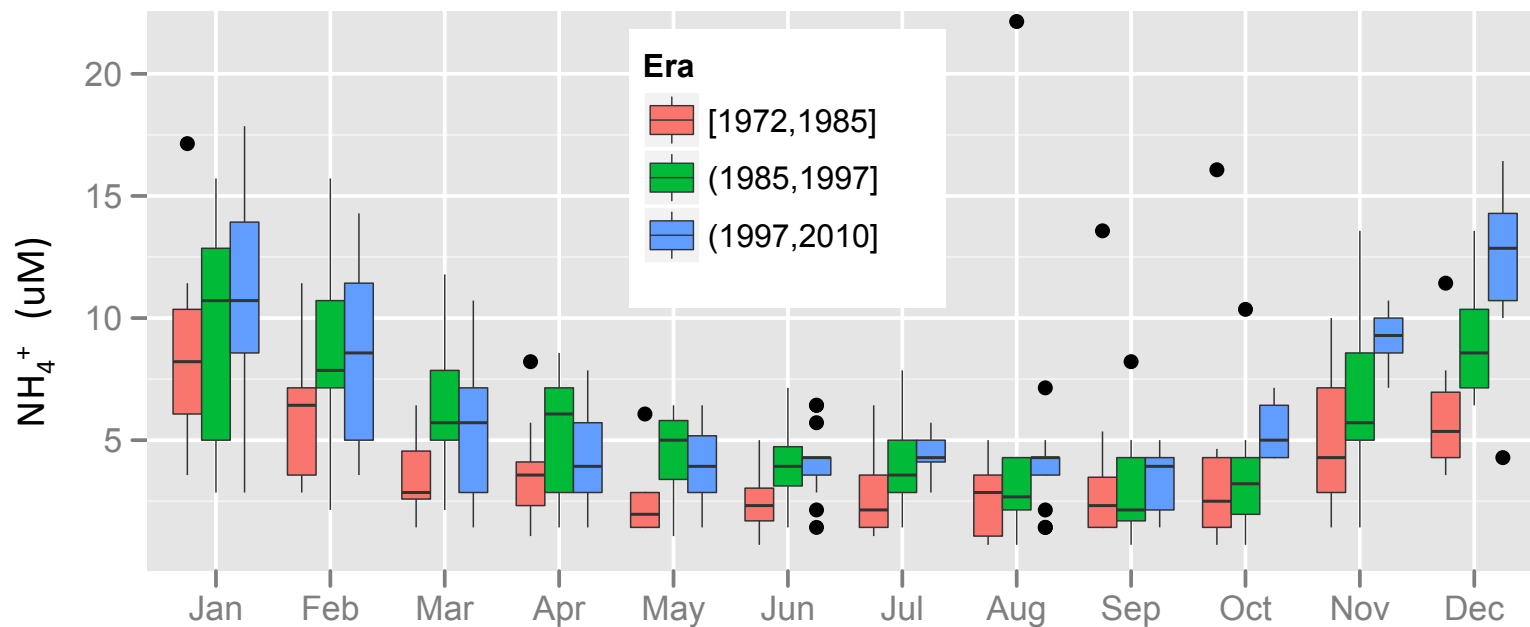
- flow, tidal exchange (t_{res})
- light limitation
- benthic grazing
- potential inhibition of PP by NH_4^+
- budgets: transformations, sources, and sinks

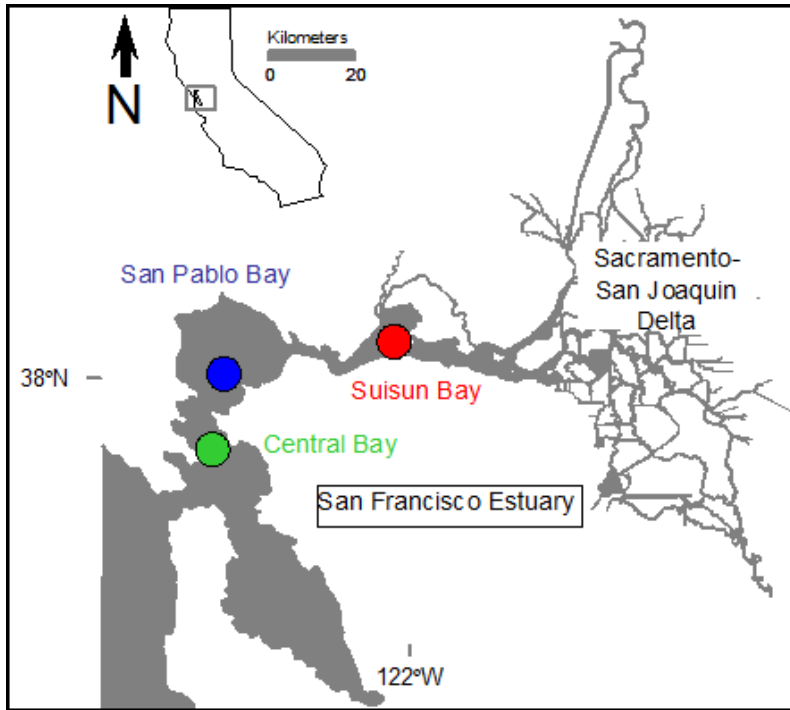
Biogeochemical Modeling: Suisun and South Bay

- Leverage \$200k+ in RMP modeling funds
- Select model platform with institutional support (e.g., USGS)

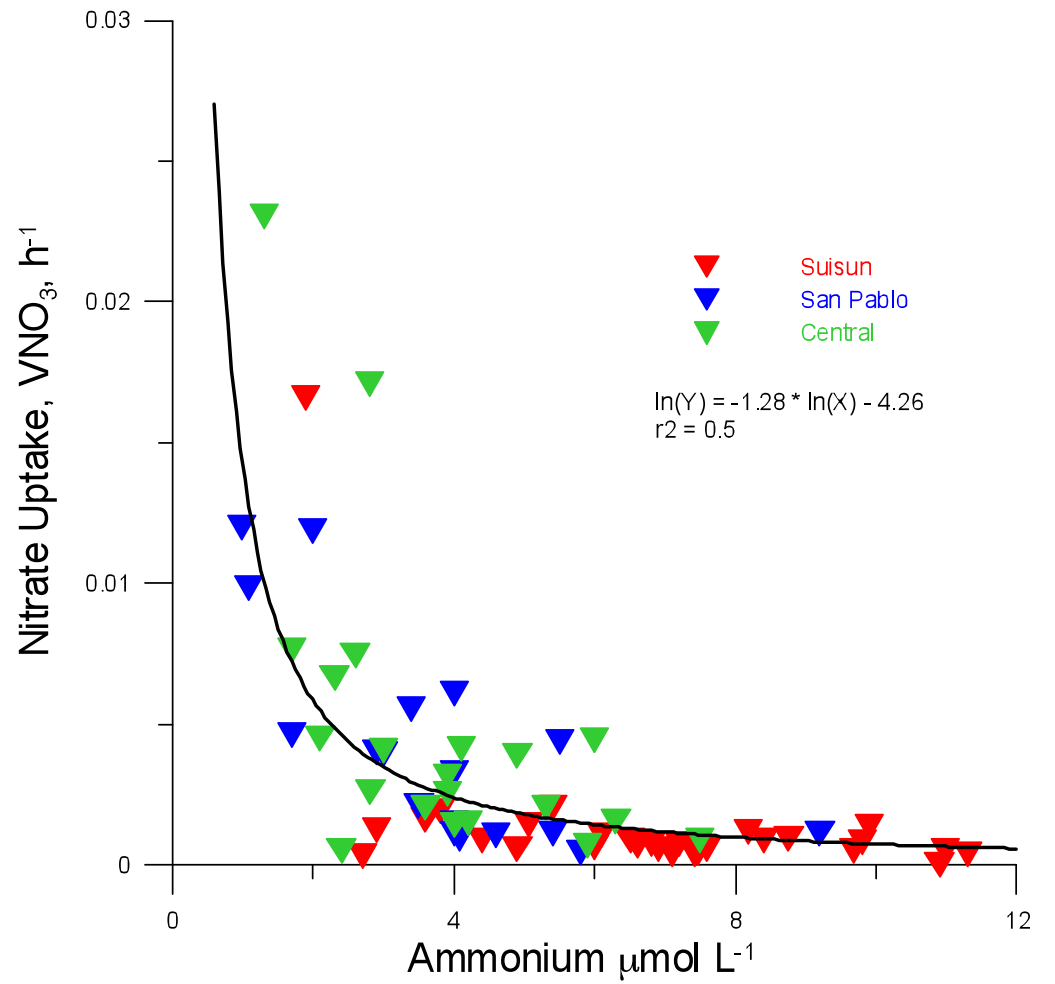


NH₄⁺ - D7 (Grizzly Bay)





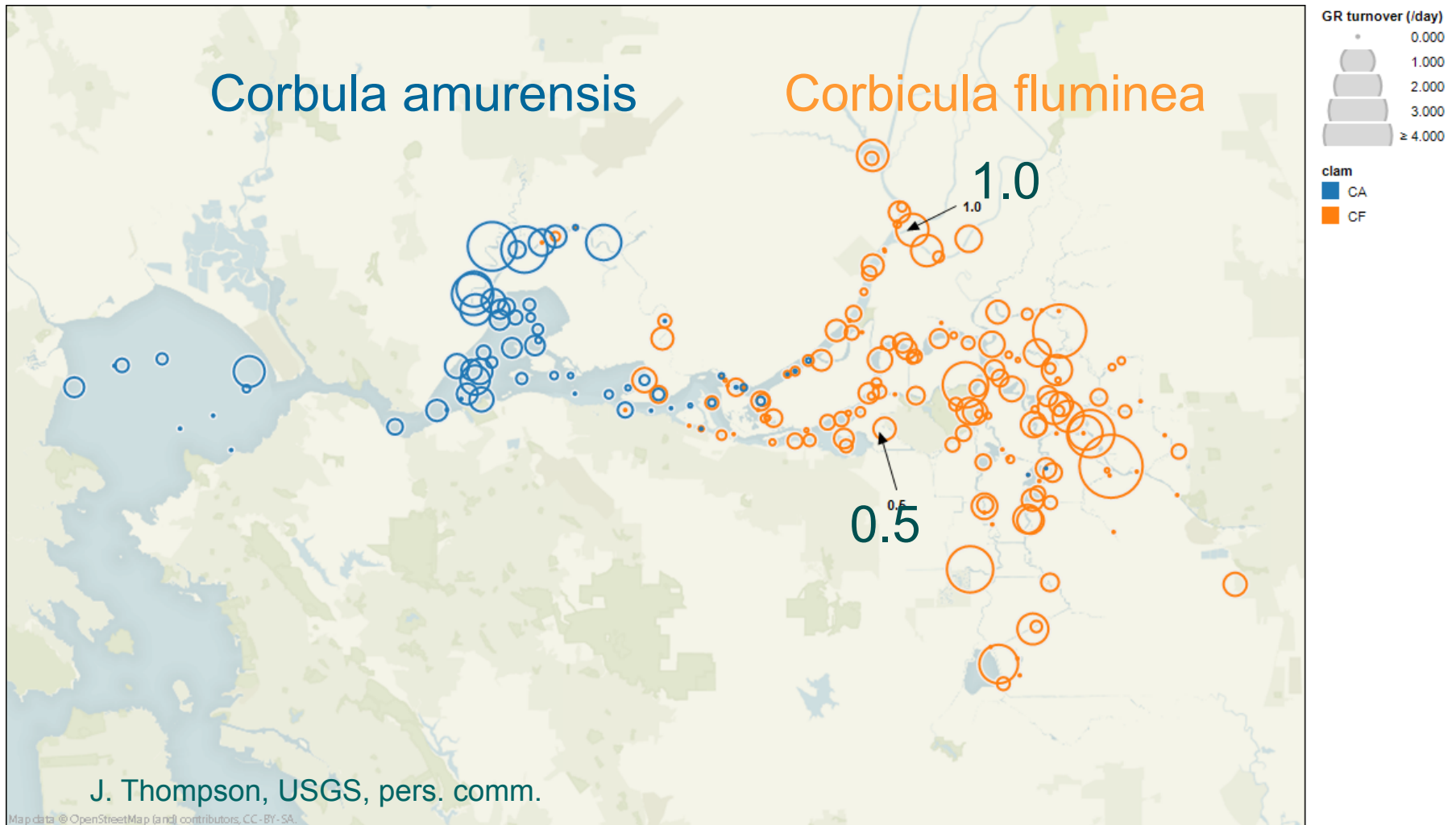
Evidence of NH₄ inhibiting NO₃ uptake



Dugdale et al., 2007

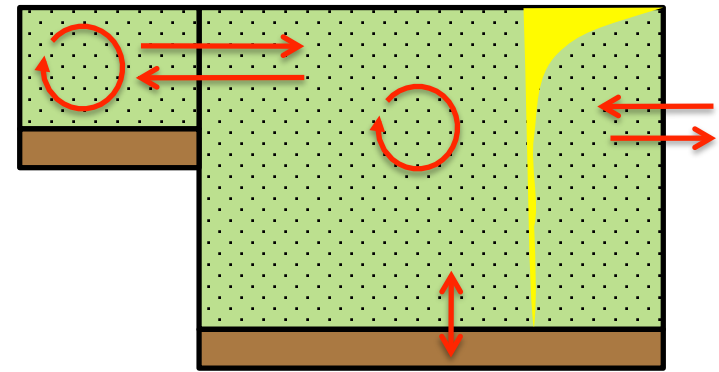
Turnover by grazing clams (d^{-1})

Example: May 2010



source: Kimmerer et al. 2011

Biogeochemical Modeling: Suisun and South Bay



P = phytoplankton biomass

$$V \frac{dP}{dt} = + M_{in} - k_{flush} P V - k_{graze} P V + \alpha_{light} \alpha_{NH4} k_{grow-max} P V$$

$$\alpha_{light}, \alpha_{NH4} < 1$$

Goals

- Provide status update on BACWA-funded and RMP projects
- Discuss problem areas related to...
 - Reporting
 - Coordination and Nutrient Strategy umbrella...
 - Information exchange and overview
 - Decision-making
- ...and...
- Identify steps along a path to address problems

Some Steps/Solutions

- Improved reporting and communication
- Creating a big but nimble umbrella
- Approach for coordinating with efforts outside current strategy
 - continue plugging in to major/important efforts
 - official engagement – institutional agreements?
- Cast broad net for funding opportunities
 - IEP
 - EPA
 - State
 - NSF