NMS SCIENCE PLAN UPDATE
1. Nutrient sources, movement, transformations

2. Ecosystem response to nutrients
   – Causing problems?
   – Develop best-possible understanding of dose:response
   – What are protective nutrient levels? (now, future)

3. Identify Management Actions → Protective nutrients levels
NMS Program

10-Year Science Plan

- Monitoring
- Special Studies

- Assessment Framework

- Loads, Management Options

- Modeling
<table>
<thead>
<tr>
<th>Science Plan Advisors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Cloern</td>
</tr>
<tr>
<td>Larry Harding</td>
</tr>
<tr>
<td>Wim Kimmerer</td>
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<tr>
<td>Raphe Kudela</td>
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<tr>
<td>Mark Stacey</td>
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<tr>
<td>Martha Sutula</td>
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</tbody>
</table>
## Management Questions

1. What conditions would be considered a level of impairment that would require regulation/management?

2. Is impairment currently occurring?

3.a To what extent are nutrients causing or contributing to current impairment? Mechanisms/quantitative  
3.b What conditions (e.g., nutrient loads or concentrations) would mitigate impairment?

4.a What potential future impairments warrant pre-emptive management actions?  
4.b What conditions (e.g., nutrient loads or concentrations) would mitigate impairment?

5. What are the contributions of individual nutrient sources to ambient nutrient levels throughout SFB (f(space, time))?  

6. What management actions or load reductions are needed to prevent or mitigate current or future impairment?
Water Board’s goal: ‘Standards within 10 year’

Approximate Timeline for addressing major management questions
- Realistic time for science and process
- Assumes work proceeding in parallel on all fronts.
- ‘Answers’ are reached iteratively, with increasing level of confidence over time.
- Plan not constrained by budget. Targets breadth of issues and timeline

<table>
<thead>
<tr>
<th>First 5 year Watershed Permit cycle.</th>
<th>Second 5-year permit.</th>
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</table>
Science activity over time: organized by Work Category

2012

- Synthesis: CM, SS1, SS2, LSB
- Expert Workshop
- Science Plan External Review
- Program Update / Science Plan Update

2024

- Program Update / Science Plan Update

Ship-based monitoring

Program Design

- Additional analytes
- Moored sensors

Field: characterize condition, ecological interp.

Lab: mechanisms

Field: rates, processes (e.g., for model calibration)

Hydrodynamic

Biogeochemical: Subembayments

Biogeochemical: Subhabitats or special topics

Full Bay

Protective Conditions, AF

- AF v1.0, Existing Data
- Identify protective conditions: other studies

- AF 2.0, New Data
- Habitat characterization or lab experiments (?)

- AF 3.0

Initial Load Estimates

Refined Loads (Delta, watersheds, POTWrs)

Load Reduction Scenarios
NMS Program

10-Year Science Plan

- Monitoring
- Special Studies

- Assessment Framework

- Modeling

San Francisco Bay Nutrient Management Strategy

November 2012
START: Conceptual models, analysis of existing data, synthesis. Develop initial quantitative estimates of what would be considered protective conditions.

Tier 1

Are adverse impacts evident along this pathway (e.g., low DO, HABs, toxins, etc.) in this habitat?

Tier 2

NO

Focus resources on other pathways or other habitats
Continue routine monitoring.

YES, or Likely

Limited monitoring or targeted studies to fill data gaps or address uncertainties

Tier 3

Are nutrients likely causing or contributing to the adverse impacts?

Tier 4

NO

Uncertain, or major data gaps

YES, or Likely

Initial targeted studies (observational, mechanistic, or modeling) to determine if there is a causal link between nutrients and the adverse conditions.

Tier 5

Quantitatively establish thresholds for harmful conditions vs. protective conditions: e.g., habitat field surveys to identify conditions under which indicator organisms prosper (e.g., fish/benthos and DO surveys; controlled experiments with biota such as DO tolerance thresholds, or response to chronic exposure algal toxins)

Mechanistic, observational, or modeling studies to quantitatively establish the dose:response for nutrients, in particular the nutrient loads or concentrations that correspond to protective conditions

Tier 6

Identify potential management scenarios that could mitigate adverse impacts, and estimate costs

Model runs to test management actions, and identify efficacious and cost-effective options

Refine and implement best management option.
Science Plan Peer Reviewers

Walter Boynton
University of Maryland

Jim Hagy
USEPA-ORD
Major Peer Review Comments

• Science program and sequence of studies are appropriate

• Potential improvements
  – Add more effort on fish, benthos and higher trophic levels
  – Confirm the focus on HABs

• $1.4 million budget is not sufficient

• 10-year program will need to be extended
<table>
<thead>
<tr>
<th>Current Funding</th>
<th>NMS Program Costs</th>
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<tbody>
<tr>
<td>$3\text{mill/yr}$</td>
<td>$X/\text{yr}$</td>
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<tr>
<td>$\geq2\text{mill/yr}$</td>
<td>$&gt;$20mill/yr</td>
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</table>

- **RMP**
- **Nutrient Permit**
- **USGS**

- Alternatives Analysis, Management Options
- Basic Science Plan
- Basic Monitoring

- **Delta IEP**
- **$>$25mill/yr**

- **Chesapeake**
<table>
<thead>
<tr>
<th>CORE PROGRAM</th>
<th>Cost</th>
<th>Cumulative Total</th>
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<tbody>
<tr>
<td>C.1 Channel Monitoring</td>
<td>152700</td>
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<tr>
<td>C.2 Basic Modeling</td>
<td>265200</td>
<td>417900</td>
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<tr>
<td>C.3 Moored sensor / DO/biogeochem</td>
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<tr>
<td>C.4 Data Analysis / Synthesis</td>
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<td>C.5 Science Program Coordination</td>
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<td>C.6 Program management</td>
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**Core Program subtotal**: 1063220

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<tr>
<th>PROJECTS</th>
<th>Cost</th>
<th>Cumulative Total</th>
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<tr>
<td>P.1 Monitoring Program Development</td>
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<td>P.2 Vertical DO profiles in sloughs/creeks</td>
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<td>1198755</td>
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<td>P.3 Approach to DO/habitat characterization</td>
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<td>P.4 Toxin in mussels</td>
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<tr>
<td>P.5 Remote Sensing, Feasibility/Model calibration/validation</td>
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<td>P.6 HABs lab/field investigation</td>
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<td>P.7 Modeling, Suisun</td>
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<td>P.8 Modeling, Scenarios...HABs, coupling with coast, ...</td>
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<td>2031758</td>
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<td>P.9 Modeling slough/creeks/ponds</td>
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<td>P.10 Fish/benthos Field investigations for DO, augmenting Hollister model</td>
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<td>P.11 Data Management</td>
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<td>P.12 Program review</td>
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**Projects subtotal**: 1204828

**Total**: 2268048
Program Coordination FY16-17 Workplan
SF Bay Nutrient Management Strategy
NMS Program Planning Objectives:

1. Continue directing Science Program: grow, improve efficiency

2. Expand and enhance stakeholder engagement and program management. Strategically build program: FUNDRAISE, PARTNERSHIPS

3. Build and direct new technical program: Alternatives Analysis, Policy Analysis
   a. Economic Analysis of Implementation Alternatives
   b. Policy approaches
   c. Multiple benefits

4. Manage NMS process: Steering Comm, Planning SubComm

5. Pro-active and Transparent Program
   a. Learn from other estuaries
   b. Do it “right”...Genuine joint fact finding, unbiased science, external review
San Francisco Bay Nutrient Management Program

Core Activities / Program Areas

- Program Coordination
- Alternatives Analysis
- Science Program
- Program Management
San Francisco Bay Nutrient Management Program

Program Coordination

- Strategic program development and growth
- Pursue external resources: federal and state grants, coordination and in-kind funding from state/federal agencies
- Stakeholder engagement
- Manage NMS SC, PS, and other subcommittees
- Facilitation

Started...
- Fundraising Plan. Goals:
  - $250k ‘new’ money
  - $250k real match
  - Path to major partnerships
Coordinated Technical Program

Bay Science ←→ Alternatives Analysis

Alternatives Analysis work conducted in a similar manner as Science Program (expert advisors, external collaborators, guided by SC)

Work proceeds through...
- Hands-on technical work by NMS staff
- Directing Teams of Expert Collaborators and Technical Advisors

San Francisco Bay Nutrient Management Program

Technical Program

Program Coordination
- Stakeholder engagement
- NMS SC/PS management
- Fundraising
- External Review
- Facilitation

Alternatives Analysis
- Implementation Plans
- Economic analysis
- Policy analysis

Science Program
- Monitoring
- Modeling
- Special studies
- Assessment

Program Management
San Francisco Bay Nutrient Management Program

**Program Coordination**
- Stakeholder engagement
- NMS SC/PS management
- Fundraising
- External Review
- Facilitation

**Alternatives Analysis**
- Implementation Plans
- Economic analysis
- Policy analysis

**Science Program**
- Monitoring
- Modeling
- Special studies
- Assessment

**Program Management**
- Project management
- Deliverables tracking
- Scheduling, budgets, reporting, contracts

- Consistent, reliable project management
- Efficiency: Leverage SFEI/RMP program management practices and tools
- Single point of contact for all financials and deliverables
San Francisco Bay Nutrient Management Program

Alternatives Analysis

- Yr1: Case studies from other estuaries: trading, multi-benefits, policies.
- Yr1: Multi-year work plan for evaluating management alternatives and policy approaches
<table>
<thead>
<tr>
<th>Project Tasks</th>
<th>Anticipated Completion</th>
<th>Estimated Additional Cost (FY2016-2017)</th>
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</thead>
<tbody>
<tr>
<td><strong>Task 1: Program Coordination</strong></td>
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<tr>
<td>Task 1.1: Stakeholder engagement and outreach</td>
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<tr>
<td>Task 1.2: Fundraising, strategic partnerships</td>
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<td>Task 1.3: NMS SC and PS coordination, and facilitation</td>
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<td><strong>Task 2: Program Management</strong></td>
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<tr>
<td>Task 2.1: Financial management and reporting, deliverable tracking</td>
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<tr>
<td>Task 2.2: Other Program management activities</td>
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<tr>
<td><strong>Task 3: Alternatives Analysis</strong></td>
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<tr>
<td>Task 3.1: Case study white paper</td>
<td>Draft: Oct 2016 Final: Jan 2017</td>
<td>$25,000</td>
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<td>Task 3.2 Develop Alternative Analysis 5-year workplan, including convening technical advisory group, stakeholder input</td>
<td>Draft: Dec 2017 Final: Mar 2017</td>
<td>$25,000 (includes $10k for honoraria)</td>
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<tr>
<td>Task 3.3 Implement Alternative Analysis workplan</td>
<td>FY2018-on-going</td>
<td>$0</td>
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