# Item 6 NMS FY18 Funding Discussion

1. Strawman FY18 Program Plan and Budget
   a. Anticipated funding
   b. Core program
   c. Overview of Potential Projects for FY18
   d. Project blurbs
2. Background
   a. Projects funded to date relative to Science Plan priorities
   b. NMS Priority Management Questions, Science Plan
   c. Major Topics and Focus Areas
3. Discussion: As part of the discussion we plan to ask each SC member for their input on a couple questions.
   a. What do SC members see as high priority categories for projects, or specific projects for FY18?
   b. Which projects could you envision your agency being able to support in terms of in-kind contribution or directly funding?

# Strawman FY18 Program Plan

| Anticipated Revenue ($1,000s) | |
|---|---|
| Nutrient Permit | 880 |
| RMP CY2018 * | 500 |
| ***Total Revenue*** | ***1,380*** |
| | |
| **Costs ($1,000s)** | |
| ***1. Core Program*** | |
| *1.1 Monitoring* | |
| Channel Monitoring | 150 |
| Moored sensors | 340 |
| *1.2 Modeling* ** | |
| Core model development and application | 290 |
| *1.3 Program Coordination* | |
| Science Program coordination | 260 |
| Program Management | 70 |
| ***Subtotal - Core Program*** | ***1,100*** |
| ***2. Projects*** | |
| Potential funding available for FY18 Projects (including assumed reserve ~100k) | 200-300 |

* Upper bound estimate
** Several new modeling projects, started in FY17 with additional funding, work underway but are considered FY17 projects and not included here.

# Strawman FY18 Program Plan: Project Alternatives

| | | FY18 Estimated Cost | | Program Area | | | Work Category and/or Type of Activity | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Low | High | Nutrients | DO biomass | Phytos HABs | Monitoring: program expansion | Monitoring: Efficiency, Better Information | Mechanistic study, process, rates | biological indicators, beneficial uses | AF, protective conditions: synthesis, testing, refining | Modeling | Future scenarios |
| Monitoring | Toxins in mussels | $100,000 | $150,000 | | | X | X | | | | | | |
| | Shoal mooring, South Bay | $100,000 | $130,000 | X | X | X | X | | | | | | |
| | imaging flow cytobot, data interp. | $80,000 | $80,000 | | | | | | | | | | |
| | in situ sensor calibration/validation | $50,000 | $200,000 | X | X | X | | X | | | | | |
| | lateral sampling/monitoring, shoals | $50,000 | $100,000 | | | | | | | | | | |
| | DNA based techiques, phytos | $20,000 | $100,000 | | | X | X | X | | | | | |
| Synthesis, incl. AF | | $75,000 | $150,000 | | X | X | | | | | X | | |
| Data management | | $40,000 | $80,000 | X | X | X | | | | | | | |
| HAB investigations | | $50,000 | $200,000 | | | X | | | X | | X | | |
| Coastal export | | $100,000 | $200,000 | | | X | X | | X | | | X | |
| Biological indicators, DO | | $50,000 | $200,000 | | X | | | | | X | X | | |
| Biogeochem field studies | | $100,000 | $300,000 | X | X | | | | X | | | X | |
| Expanded Program Coordination | | $50,000 | $100,000 | | | | | | | | | | |
| Exploring management alternatives | | $50,000 | $100,000 | | | | | | | | | | |
| | Projects subtotal | $915,000 | $2,090,000 | | | | | | | | | | |

Current anticipated for Projects in FY18: $200-300k

NOTE: Developing and implementing the NMS Observation Program (Monitoring) is among our highest priorities over the next several years.

See meeting materials from December 2016 meeting for description or access it at this Link . Also, see supplementary slides in this document

| | | | FY18 Estimated Cost | |
|---|---|---|---|---|
| | | Description | Low | High |
| Monitoring | Toxins in mussels | Continue current mussel sampling and toxin measurements. Possibly pilot the use of deployed mussels and SPATT to improve interpretability | $100,000 | $150,000 |
| | Shoal mooring, South Bay | Install a mooring on eastern shoal in South Bay. Pilot project being conducted in Mar/Apr 2017. High/Low Cost differences related to specific equipment installed and/or level of data interpretation included | $100,000 | $130,000 |
| | imaging flow cytobot, data interp. | An Imaging Flow Cytobot (IFCB) is now being used on USGS cruises. 2 instrument obtained through collaborative grant with UCSC and USGS, one for ship and one for mooring. NMS will inherit IFCBs. Funding would support a scientist to work with IFCB data and develop the program for the purposes of achieving NMS goals. | $80,000 | $80,000 |
| | in situ sensor calibration/validation | The Bay-Delta has numerous independent efforts using moorings/in situ sensors. If, through coordination and data-QA this data can be used by the NMS, it will be an enormous cost-savings. There is little to no coordination among the groups, no standard operation or interacalibration. This project would test the accuracy/precision of in situ sensors (experiments, discrete samples) and begin the development of protocols and partnerships. | $50,000 | $200,000 |
| | lateral sampling/monitoring, shoals | The broad shoals in South, Lower South Bay, San Pablo, and Suisun Bays are areas where conditions are expected to be much different than the deep channel; yet little or no observations take place there. This project will begin developing the NMS approach for shoal sampling. Low cost will focus only in South Bay and limited number of cruises; higher cost will have either more cruises or explore a second subembayment. | $50,000 | $100,000 |
| | DNA based techiques, phytos | Molecular/Genetic techniques (amplicon sequencing, qPCR) for phytoplankton analysis have the potential to achieve one or more of the following: provide more sensitive/precise measurements especially for HABs; augment the NMS phytoplankton/HAB monitoring; improve efficiency. This project will test molecular techniques alongside other current approaches (microscopy, IFCB, pigments). Low cost will involve mostly data collection; high cost will allow for comparison with other methods. If only low cost pursued in FY2018, interpretation could be funded in subsequent year budget. | $20,000 | $100,000 |
| Synthesis, incl. AF | | Analyze and synthesize new or historic data collected through monitoring, including applying this to assessment framework testing, development, or refinement, specific topics to be determined. Low cost will support 0.5 FTE; high cost would support external collaborators/advisors and coordination with stakeholder process. | $75,000 | $150,000 |
| Data management | | A data management plan, and initial implementation, is funded in FY17. This FY18 funding support on-going implementation of the data management plan. Low cost would support ~0.25 FTE, so base level. High cost would allow for bringing a shared staffer (0.5 FTE) on board who could be part of the long-term data management effort, and/or, for example, increased data accessibility (ability for stakeholders and external scientists to independently access and download data) | $40,000 | $80,000 |
| HAB investigations | | To date, the NMS is not pursuing any studies (beyond monitoring) to understand the factors that control HABs or HAB risk in the Bay. Potential studies include those outlined in the FY17 program plan, none of which were funded. | $50,000 | $200,000 |
| Coastal export | | A sizable proportion (e.g. 50% or more, depending on season) of the nutrients that enter SFB exit via the Golden Gate to the coast ocean. The fate of those nutrients, and their effects on the GoF and coastal habitats are poorly known. This project could be either a field investigation (e.g., installing a mooring in the GoF (monitoring), or a ship-based study), analysis of remote-sensed data, or modeling. | $100,000 | $200,000 |
| Biological indicators, DO | | An extensive fish surveying effort has been underway in Lower South Bay, funded currently by San Jose and previously by the salt pond restoration program. The low cost project would allow for expanded interpretation of the fish data to explore DO-related questions (SFEI collaborating with UCDavis/Hobbs). The high cost project would allow include the expanded interpretation, and also allow for additional data collection, either targeted additional fish/benthos sampling, or collection of additional DO data to maximize the alignment between DO data spatial/temporal coverage and fish survey data. | $50,000 | $200,000 |
| Biogeochem field studies | | To date little work has been done in the Bay to measure the rates of important processes (oxygen demond/respiration, denitrification, nitrificaiton, phytoplankton growth, etc.). This data is needed (eventually) both for mechanistic interpretations and for model calibration/validation. This project would be an initial step toward collecting some of the highest priority data, and would need to be part of a multi-year project | $100,000 | $300,000 |
| Expanded Program Coordination | | Continue to support expanded stakeholder engagement, and support expanded strategic planning, fundraising, and coordination/cooperation with other agencies working in the Bay/Delta | $50,000 | $100,000 |
| Exploring management alternatives | | Two major Work Elements of the Nutrient Management Strategy are Control Strategies (i.e., management alternatives) and Regulatory Approaches. Although this work is as important as the within-Bay science, they have received limited attention thus far. This project would continue some of the management alternatives work that began in FY17 (trading approaches, wetland treatment) and also develop a multi-year workplan that identifies the highest priority uncertainties and scenarios and an approach for exploring those issues to inform decisiosn. | $50,000 | $100,000 |
| | | | | |
| | Projects subtotal | | $915,000 | $2,090,000 |

# Focus of NMS activities to date (through FY17)

- Major Emphasis Areas
  - Ship-based monitoring, + subset of necessary additional parameters
  - DO in sloughs in Lower South bay: characterize condition, early mechanistic work
  - Core modeling work (underway for 18 months)
  - Synthesis of existing data
  - Current ambient conditions, assessment framework development
- Limited effort has gone toward…
  - Expanded monitoring
  - Biogeochemistry field studies (rates, model calibration)
  - HABs: mechanisms, causes, effects
  - Future Scenarios
  - Effects of nutrient exports to the coast
  - Directly measuring beneficial uses (e.g., biological endpoints like fish abundance/diversity)
  - Quantifying nonpoint source nutrient loads

# Studies identified in Science Plan to be undertaken in FY16-FY18 (Table 5.7 from Science Plan)

Circles to left qualitatively indicate the actual rate of effort (or rate of funding) in FY16-17 relative to what's needed.

Symbols indicate level of alignment between project and focus aea and subembayment

● Directly aligned

◉ Moderately aligned

○ Limited alignment

| | Project | Cost/yr ($1000s) | Start Date | Length (yr) | Program Area Focus | | | | | | | Subembayment Focus | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2.1 | 2.2 | 3.1 | 3.2 | 3.3 | 4 | LSB | SB | CB | SPB | SUI |
| 1 | On-going ship-based monitoring. Costs for basic analytes | 100 | Jul 2015 | 3+ | ● | ● | ● | ● | ● | ● | ◉ | ● | ● | ● | ● | ● |
| 2 | Measure new analytes, core monitoring: pigments, toxins , bivalves/biota | 100 | Jul 2015 | 3+ | ● | ● | ● | ● | ● | ◉ | | ● | ● | ● | ● | ● |
| 3 | Moored sensor monitoring | 250 | Jul 2015 | 3+ | ● | ● | ● | ◉ | ◉ | ○ | ○ | ● | ● | ◉ | ◉ | ◉ |
| 4 | DO in margin habitats | 250 | Jul 2015 | 3 | ● | ● | ● | ◉ | ◉ | | | ● | ● | | ○ | ○ |
| 5 | Modeling | 450 | Jul 2015 | 3+ | ● | ● | ● | ◉ | ◉ | ● | ◉ | ● | ● | ● | ● | ● |
| 6 | Load estimates (incl. hydrological modeling for watersheds) | 150 | Sep 2015 | 3 | ● | ◉ | ◉ | ◉ | ◉ | ◉ | ○ | ● | ● | ● | ● | ● |
| 7 | Statistical analysis of phytoplankton composition, toxin data, and physical/chemical factors | 150 | Sep 2015 | 2 | ● | | | ● | ● | | | ● | ● | ● | ● | ● |
| 8 | Lower South Bay and South Bay integrated investigation: processes, field measurements | 300-600 | Sep 2015 | 3 | ● | ● | ● | ● | ● | ○ | ○ | ● | ● | ○ | ○ | ○ |
| 9 | Interpretation of pigment, toxin, nutrient, and physical/chemical condition in LSB | 60 | Jul 2015 | 1 | ● | ● | ● | ● | ● | | | ● | ● | ○ | ○ | ○ |
| 10 | Identifying protective DO levels FY17 project P.3 | 200 | Sep 2015 | 2 | | ● | ● | | | | | ● | ● | ● | ● | ● |
| 11 | Identifying protective toxin levels for SFB habitats FY17 project P.4 | 100 | Sep 2015 | 2 | | | | ● | ● | | | ● | ● | ● | ● | ● |
| 12 | Identifying protective food quality for SFB | 50 | Jan 2016 | 2 | | | | | ● | | | ● | ● | ● | ● | ● |
| 13 | Workshop: science needs and experiments for phytoplankton comp, food quality, NH4 inhibition | 50 | Sep 2015 | 1 | | | | ● | ● | ● | ◉ | ○ | ○ | ○ | ● | ● |
| 14 | Continued data synthesis: identify protective conditions, develop/test/refine AF indicators | 100 | Jan 2016 | 2 | | | | ● | | | | ● | ● | ● | ● | ● |
| 15 | Monitoring Program: analysis of existing data to refine/optimize program | 100 | Sep 2015 | 2 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 16 | Science Program Management | 100 | Jul 2015 | 3 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | Total | 3,000 | | | | | | | | | | | | | | |

## *How are we doing?*

**Take home:** NMS projects for FY16-17 have been well-aligned with the Science Plan recommendations, working within current funding levels. Some activities (previous slide)

Since this table originally only includes activities for FY16-18, some major activities, slated to begin after FY18, were not included.

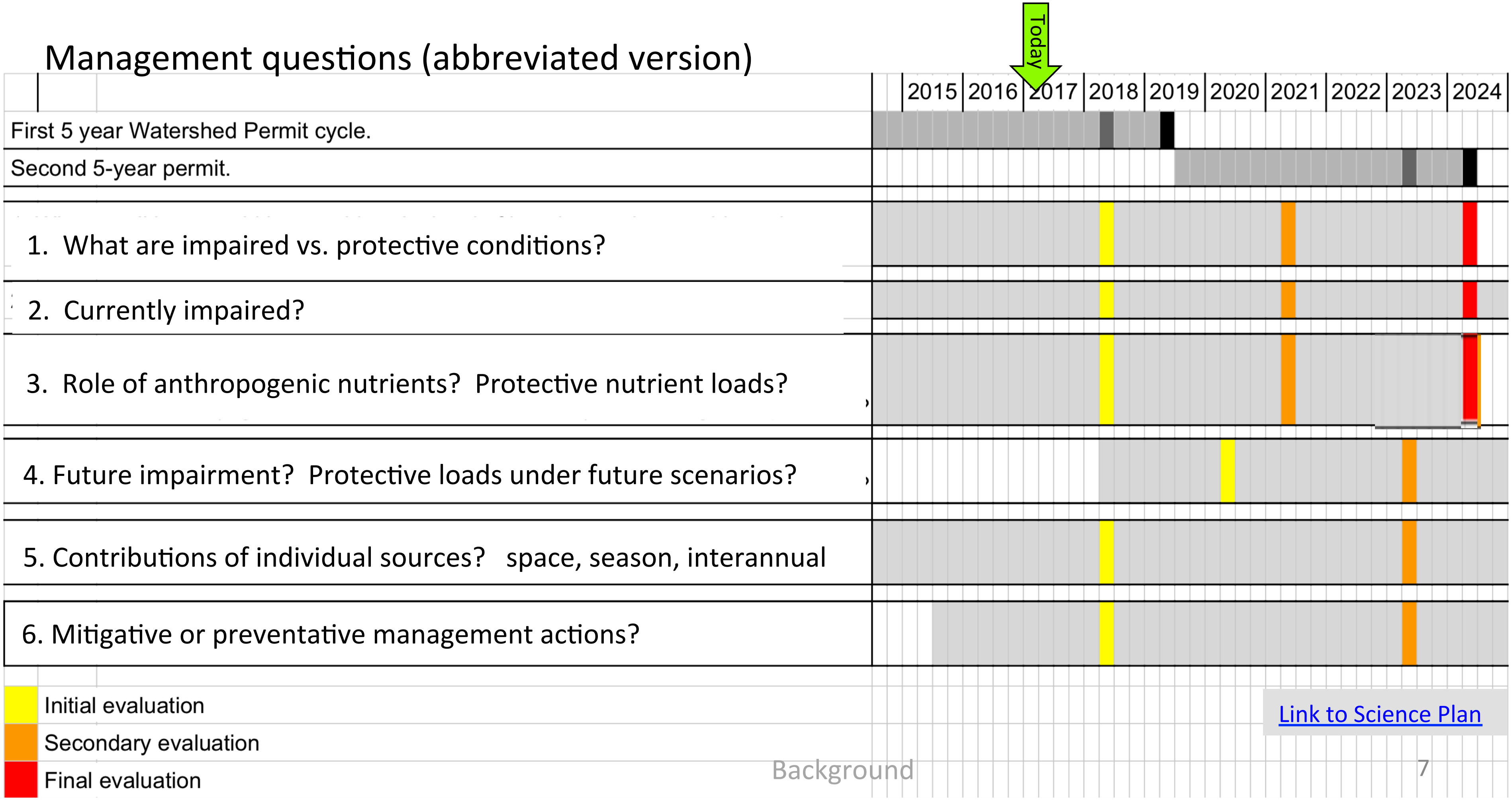
Some priorities and cost estimates have evolved since this table was originally developed (mid-2015). Several examples are included at bottom.

- Expanded monitoring program: design, implementation, and funding stability
- On-going data analysis, and synthesis
- Coastal exports: nutrient fate and effects
- Biological surveys: fish, benthos, DO
- Exploring management alternatives
- Future Scenarios

# Key Assumption for Science Plan v1.0: Water Board's goal of 'Standards by 2024'

Approximate Timeline for addressing major management questions, laid out in Science Plan (when plan development began ca. 2015)

- Realistic time for science and process, and realistic assessment of work that is needed.
- Assumes work proceeding in parallel on all fronts.
- 'Answers' are reached iteratively, with increasing level of confidence over time (yellow, orange, red below)
- Plan not constrained by budget – it aims to illustrate the work that's needed to answer questions within the available time-frame.
- As a result…There has been limit prioritization among proposed activities to fit within current budget.




[Link to Science Plan]()

# Questions as presented in the Science Plan (long form…)

**Table 2.1** Management questions targeted by the NMS Science Plan

| |
|---|
| 1. What conditions in different SFB habitats would indicate that beneficial uses are being protected versus experiencing nutrient-related impairment? |
| 2. In which subembayments or habitats are beneficial uses being supported? Which subembayments or habitats are experiencing nutrient-related impairment? |
| 3.a To what extent is nutrient over-enrichment, versus other factors, responsible for current impairments?<br>3.b What management actions would be required to mitigate those impairments and protect beneficial uses? |
| 4.a Under what future scenarios could nutrient-related impairments occur, and which of these scenarios warrant pre-emptive management actions?<br>4.b What management actions would be required to protect beneficial uses under those scenarios? |
| 5. What nutrient sources contribute to elevated nutrient concentrations in SFB subembayments or habitats that are currently impaired, or would be impaired in the future, by nutrients? |
| 6. When nutrients exit SFB through the Golden Gate, where are they transported and how do they influence water quality in the Gulf of Farallones or other coastal areas? |
| 7. What specific management actions, including load reductions, are needed to mitigate or prevent current or future impairment? |

Link to Science Plan

# Science Program Structure: Major Program Areas, Work Categories

**Table 2.2** Science Plan structure

| **Major Program Areas** | **Work Categories** |
|---|---|
| 1. Nutrients (loads, cycling/transformations) | A. Synthesis<br>B. Monitoring<br>C. Special Studies<br>D. Modeling (current conditions)<br>F. Identify Protective Conditions<br>F. Modeling condition under plausible future scenarios |
| 2. High biomass and low dissolved oxygen | |
| 2.1 Deep subtidal | |
| 2.2 Shallow margin habitats | |
| 3. Phytoplankton community composition | |
| 3.1 HABs/toxins | |
| 3.2 Food quality (due to N:P, NH4, etc.) | |
| 4. Low productivity | |
| 5. Program-wide Activities | |
| 5.1 Monitoring | Future monitoring program design, including considerations of science requirements, logistics, institutional agreements, and funding |
| 5.2 Modeling | Base model development, model documentation, model maintenance |
| 5.3 Protective Conditions/Assessment Framework | Iteratively refine framework based on new data. |
| 5.4 Program Management | Science communication, stakeholder engagement, coordination among projects, fundraising |

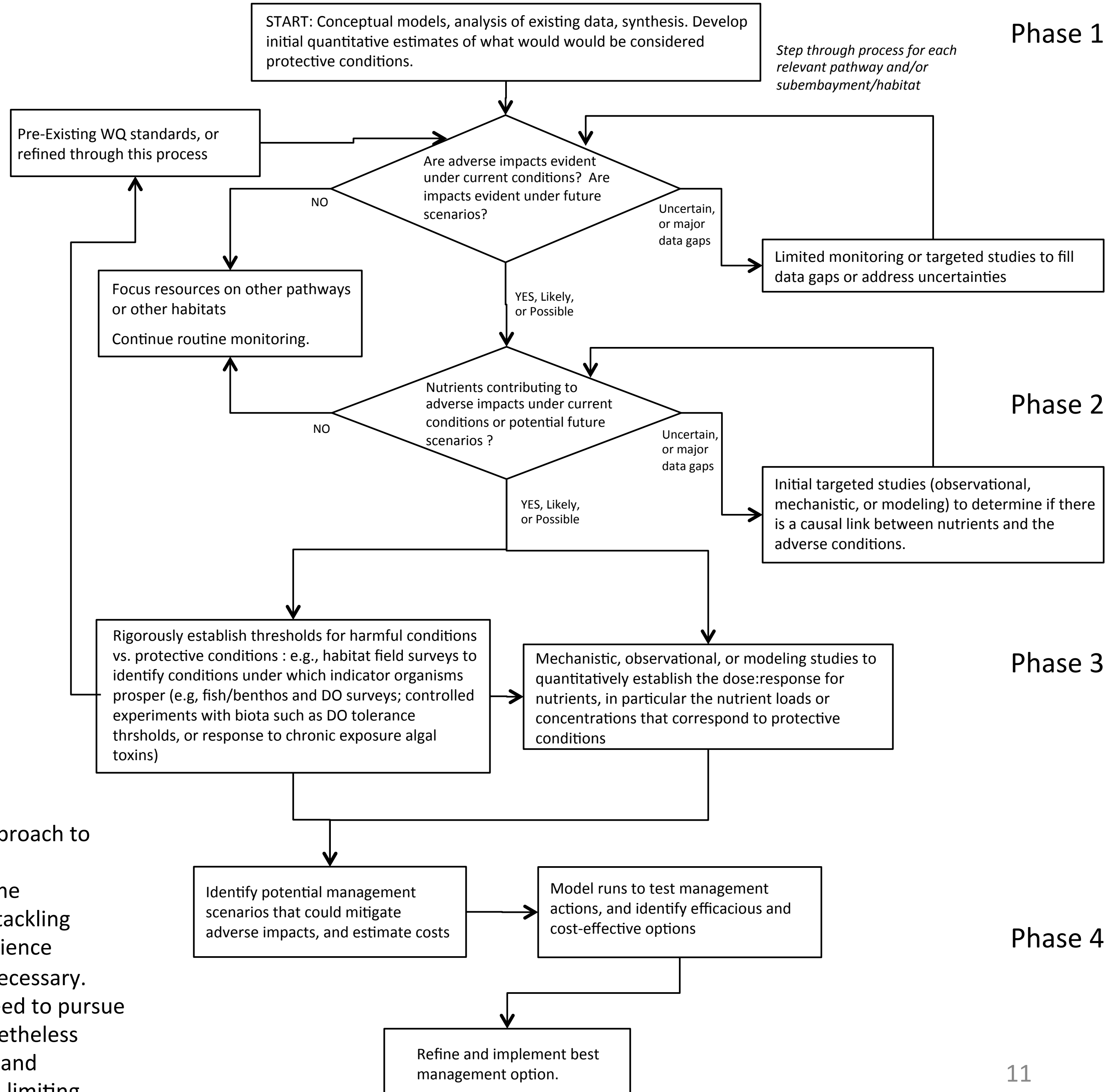
Link to Science Plan

# Work Categories and types of Activities (projects and core program)

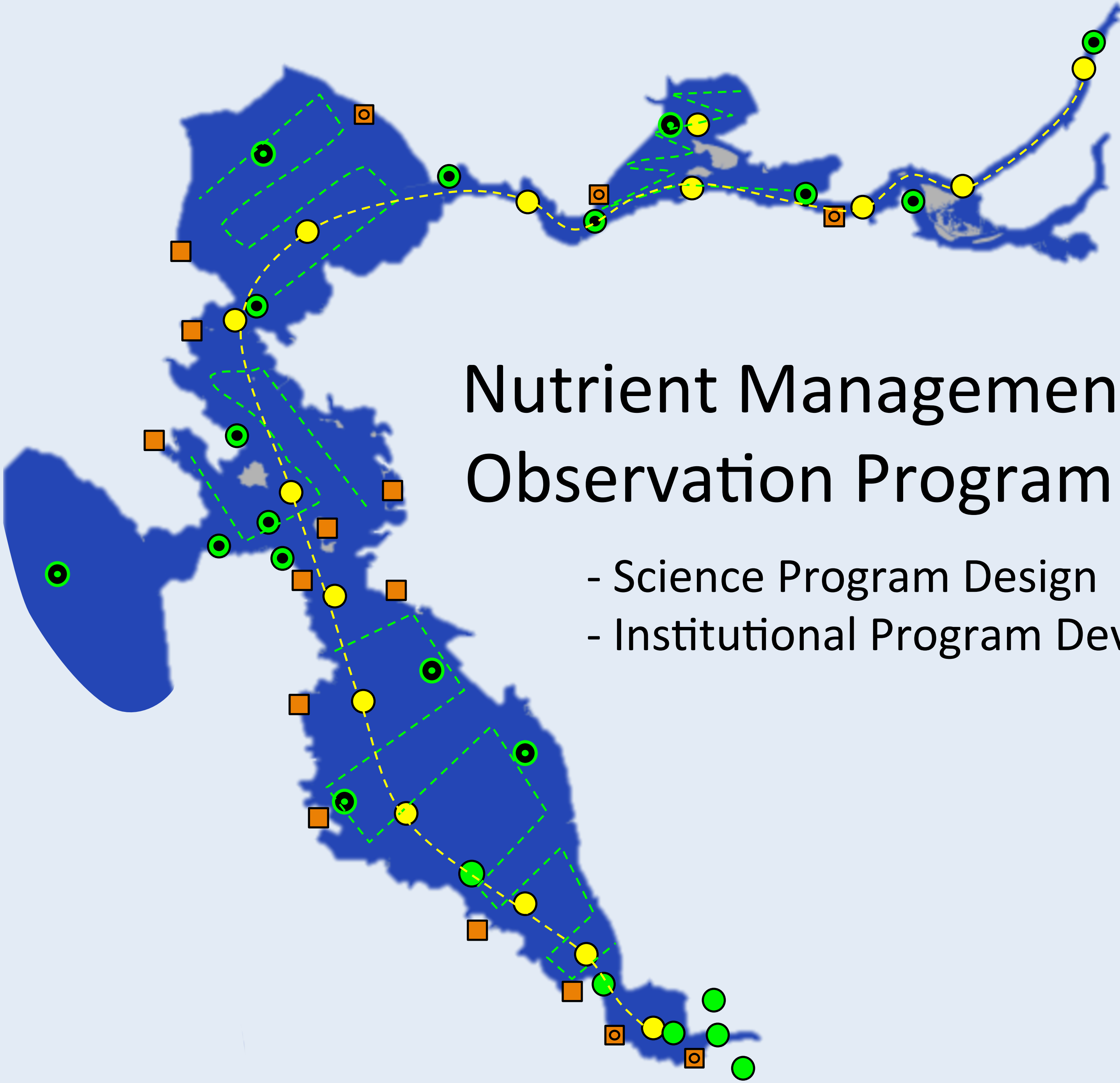
**Table 2.3** Work Categories within the Major Program Areas

| Work Categories | Types of activities |
|---|---|
| A. Synthesis | • Analyzing/synthesizing new results from past studies, developing conceptual models, etc., to identify science needs<br>• Analyzing/synthesizing new data from monitoring and special studies to inform next steps in science plan implementation<br>• Workshops to identify highest priority science questions and experiments |
| B. Monitoring | • Current ship-based monitoring, Bay-wide…nutrients, phytoplankton biomass, phytoplankton composition, physical observations (salinity, temperature, SPM, etc.)<br>• Moored sensors…biogeochemical data, physical data (T, salinity, stratification, velocities, etc.)<br>• Future monitoring program design: data analysis and expert input on spatial/temporal resolution, blend of ship-based vs. fixed-station continuous monitoring, new measurements, etc. |
| C. Special Studies | • Field investigations to<br>○ measure biogeochemical processes: e.g., primary production, nutrient transformations (water column, benthic), DO consumption (water column, benthic)<br>○ collect physical observations (T, sal, velocities, light levels) to quantify mixing, transport, and stratification<br>○ study processes or test hypotheses at the ecosystem-scale (e.g., factors that influence HABs or toxin production)<br>• Mechanistic studies in the laboratory<br>• Pilot studies related to monitoring program development, including data analysis |
| D. Modeling | • Biogeochemical (Water Quality) and hydrodynamic model development and application to quantitatively explore:<br>○ Transport of nutrients and biomass<br>○ Growth of phytoplankton, grazing by pelagic and benthic grazers, growth of different types of phytoplankton<br>○ Nutrient and organic matter biogeochemical transformations and losses<br>○ Hydrodynamics, effect of physics (e.g., stratification) on env'l processes |
| E. Identify Protective Conditions | • Levels of DO, chl, and toxins, or characteristics of phytoplankton assemblages that are protective of beneficial uses<br>• Identify the beneficial uses potentially impacted by nutrients. In the case of aquatic life uses, specifically identify the organisms to be protected.<br>• Literature review to identify these levels, modeling (trophic transfer, HAB or toxin bloom size)<br>• Nutrients, loads or concentrations that will protect beneficial uses. |
| F. Future scenarios | • Identify high priority environmental change scenarios to test<br>• Identify load reduction or management scenarios.<br>• Simulate ecosystem response under future scenarios |

Link to Science Plan

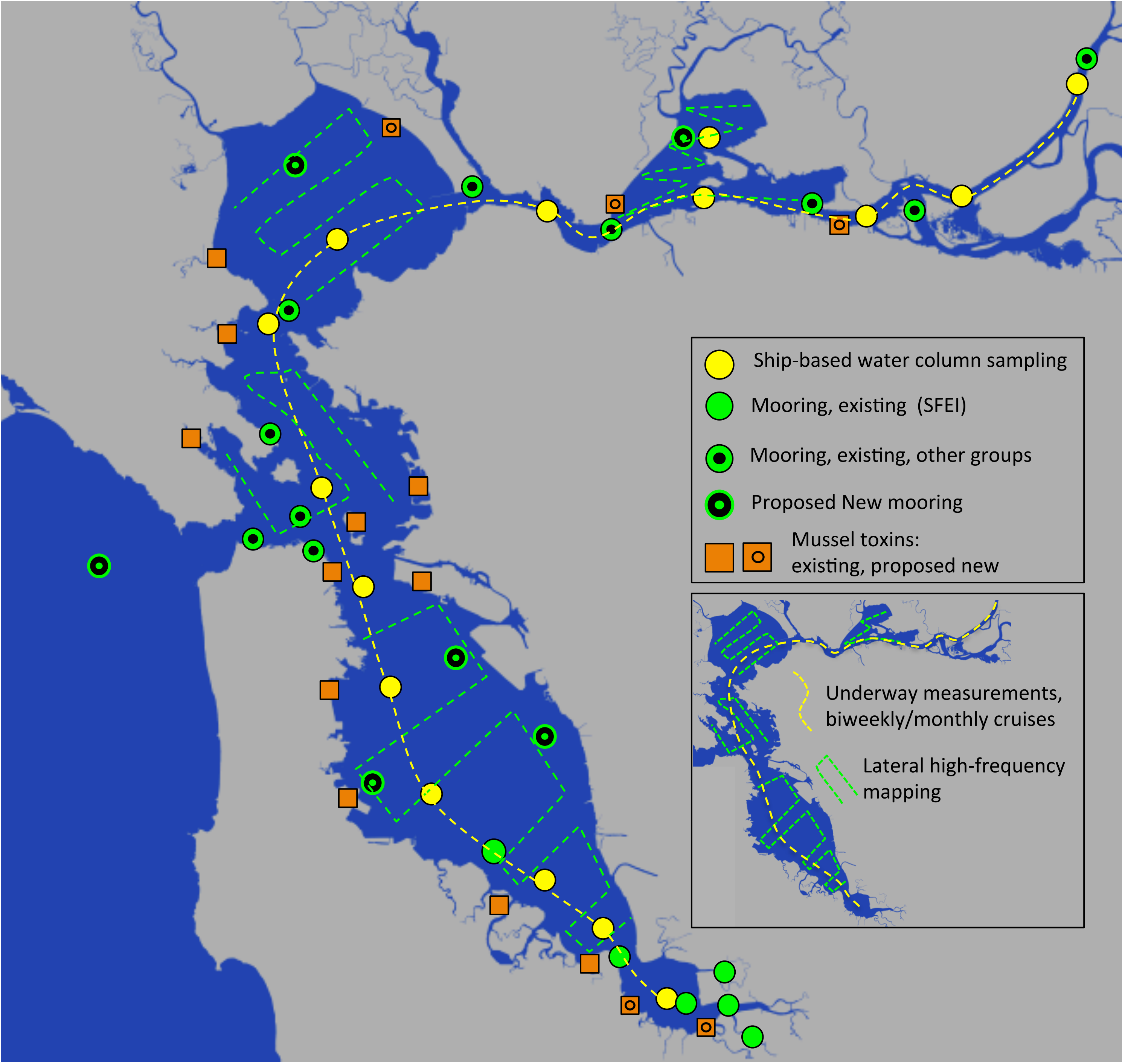



Revised from NMS Science Plan: Phased approach to pursuing science questions and addressing uncertainties. In an ideal world, with no time constraints, work would proceed in series, tackling increasingly complex and costly topics or science investigations only as that work becomes necessary. Given NMS time constraints, though, we need to pursue topics in parallel. But these Phases can nonetheless serve as guideposts to help sequence work and prioritize between projects when funding is limiting.



# Nutrient Management Strategy Observation Program (NMSOP)

- Science Program Design
- Institutional Program Development



Ship-based water column sampling
Mooring, existing (SFEI)
Mooring, existing, other groups
Proposed New mooring
Mussel toxins:
existing, proposed new
Underway measurements,
biweekly/monthly cruises
Lateral high-frequency
mapping

**Ship-based sampling, Basic: biweekly to monthly cruises**

Profiles: CTD, DO, chl, OBS, PAR

Underway: $PAR_{surface}$ , salinity, T , D, chl, OBS, $F_v$ / $F_{m,}$ SPATT

Discrete:
- $NO_{3+2}^-$, $NH_4^+$, o-$PO_4$, TN, TP, TDN
- DO, chl-a, pheo, SSC
- phyto-pigments
- microscopy + IFCB
- PTOX (DA, MCY, SAX)

***Advanced:***

- SUNA-NO3: CTD, underway
- Productivity
- DOC+POC, BOD
- $pCO_2$ , *p*H*:* CTD, underway

**Biological sampling, toxins**

***Basic:***
- native bivalves, biweekly
- toxins: DA, MCY, SAX
- basic WQ parameters

***Advanced:***
- other toxins: OA, others.
- co-deployed SPATT
- deployed mussels

**Moorings**

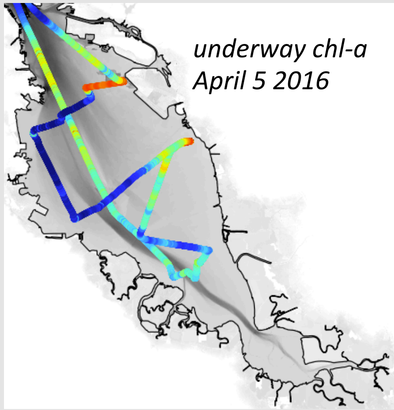
***Basic:***
- Single depth,
- CTD, DO, chl, turbidity, fDOM

***Advanced:***
- SUNA-NO3, PAR, ADCP, IFCB
- multiple depths

**Lateral mapping**

*Basic:*
- Monthly
- SpC, T, DO, chl, turbidity, fDOM, SUNA-NO3

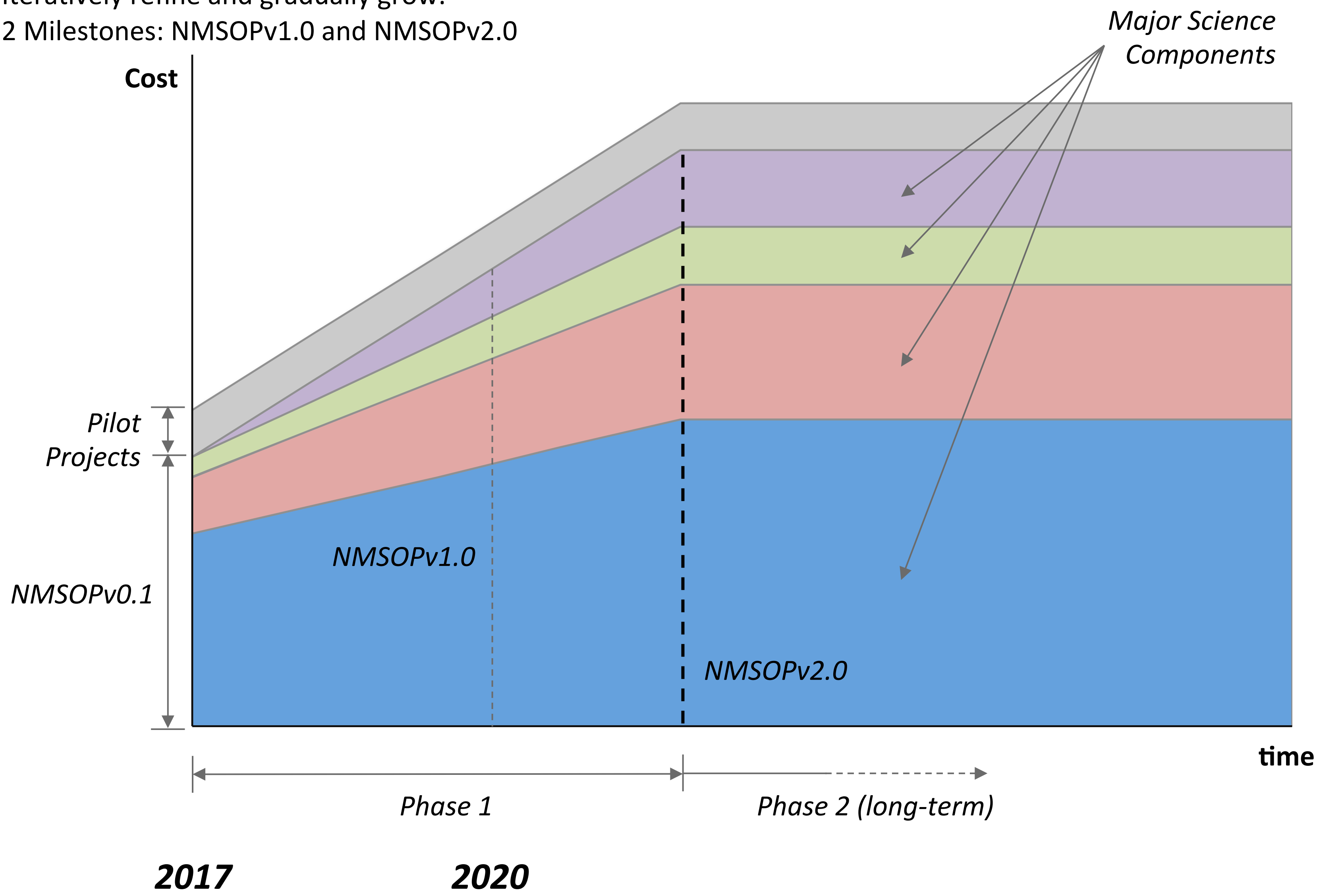
*Advanced:*
- Additional parameters, e.g., pigments, $H_2O$ isotopes, NH4.



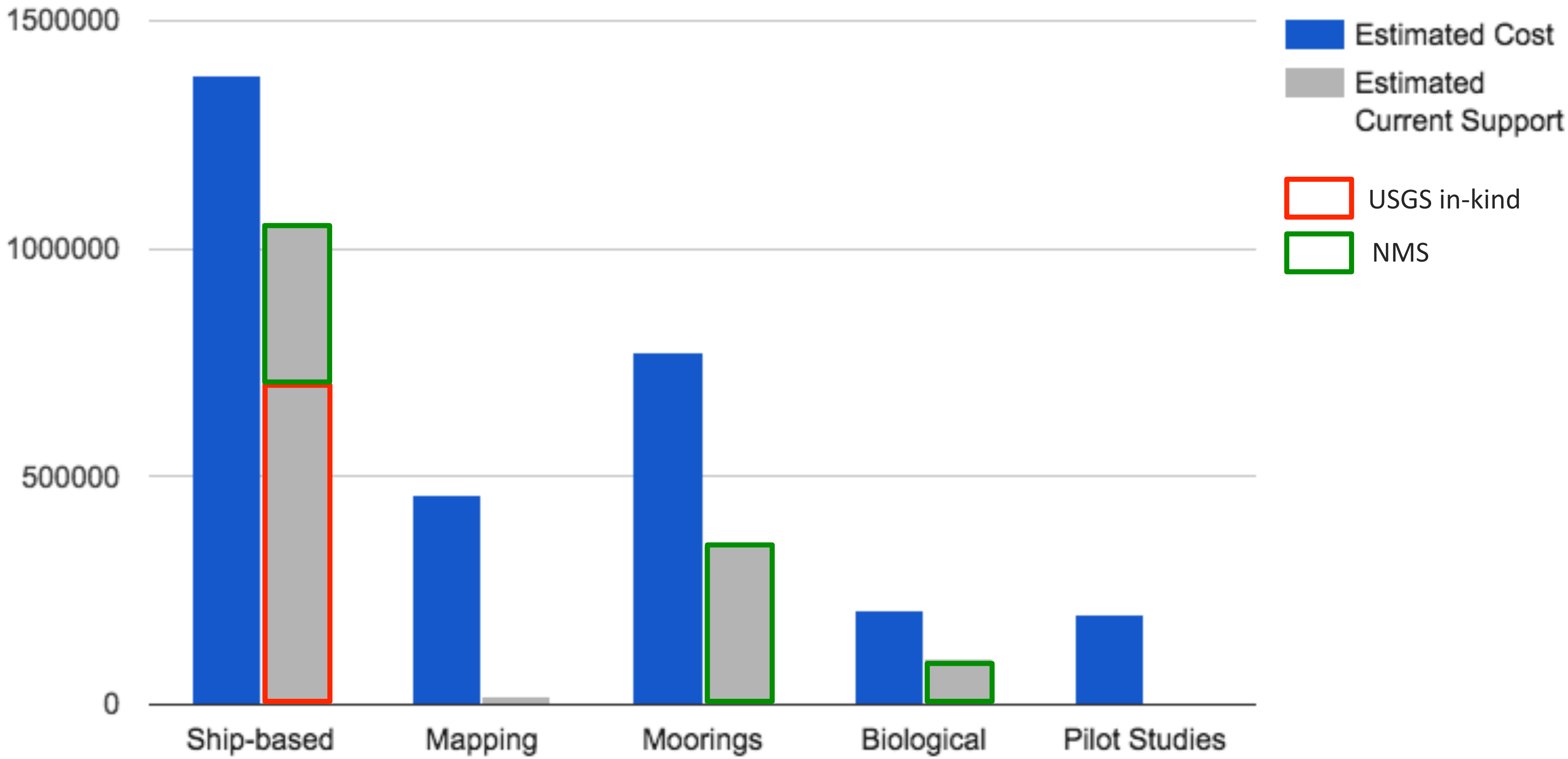
# Nutrient Management Strategy Observation Program (NMSOP)

Approach:

- *Strawman* Program Design based on what we know now
- Test
- Iteratively refine and gradually grow.
- 2 Milestones: NMSOPv1.0 and NMSOPv2.0



# NMSOPv1.0 Estimated Cost = $3.4 mill/yr *

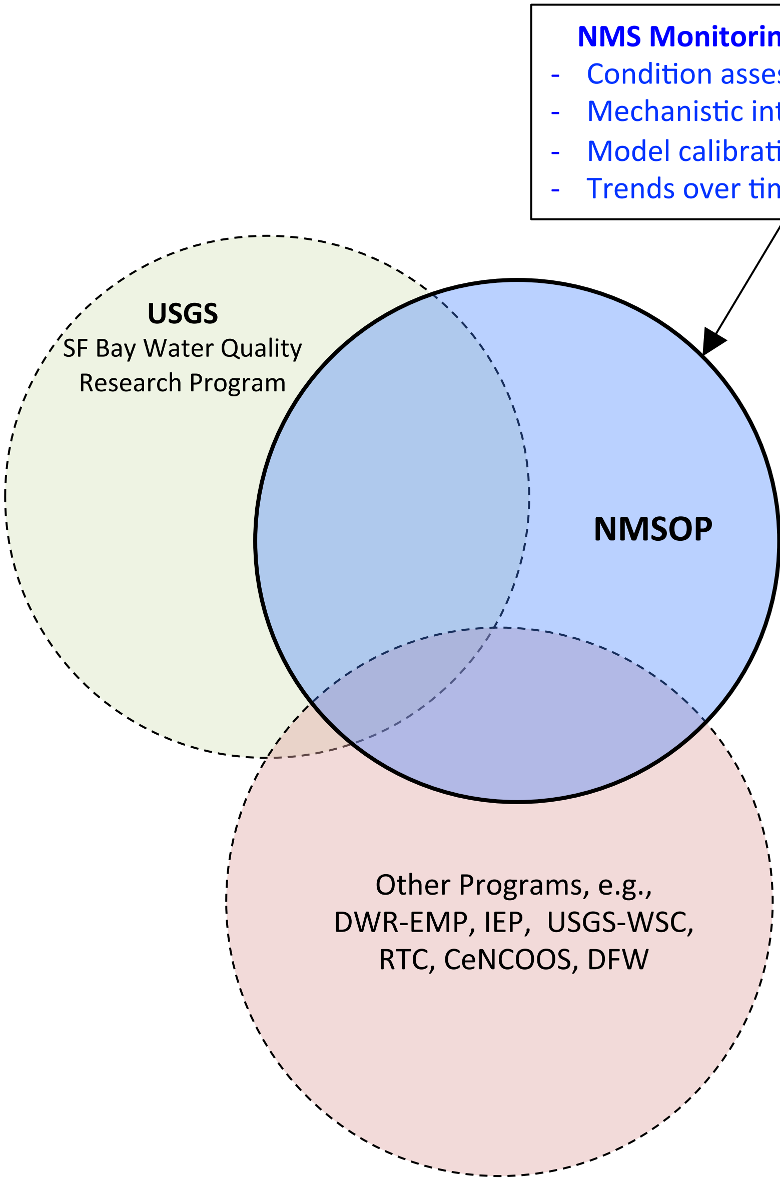



Still a fairly basic program

- No benthos
- No rate processes (yet)

*NMSOPv2.0 estimated cost ~$4.0mill/yr

# Major (and necessary?) Assumption




- NMSOP's implementation will involve major and sustained partnerships with other Bay-Delta science and monitoring programs
- Shared 'infrastructure'

Requires…

- Inter-program and inter-agency coordination and collaboration
- Sustained, consistent, reliable