Joint fact-finding – Collaboration to Manage Nutrients in the San Francisco Bay

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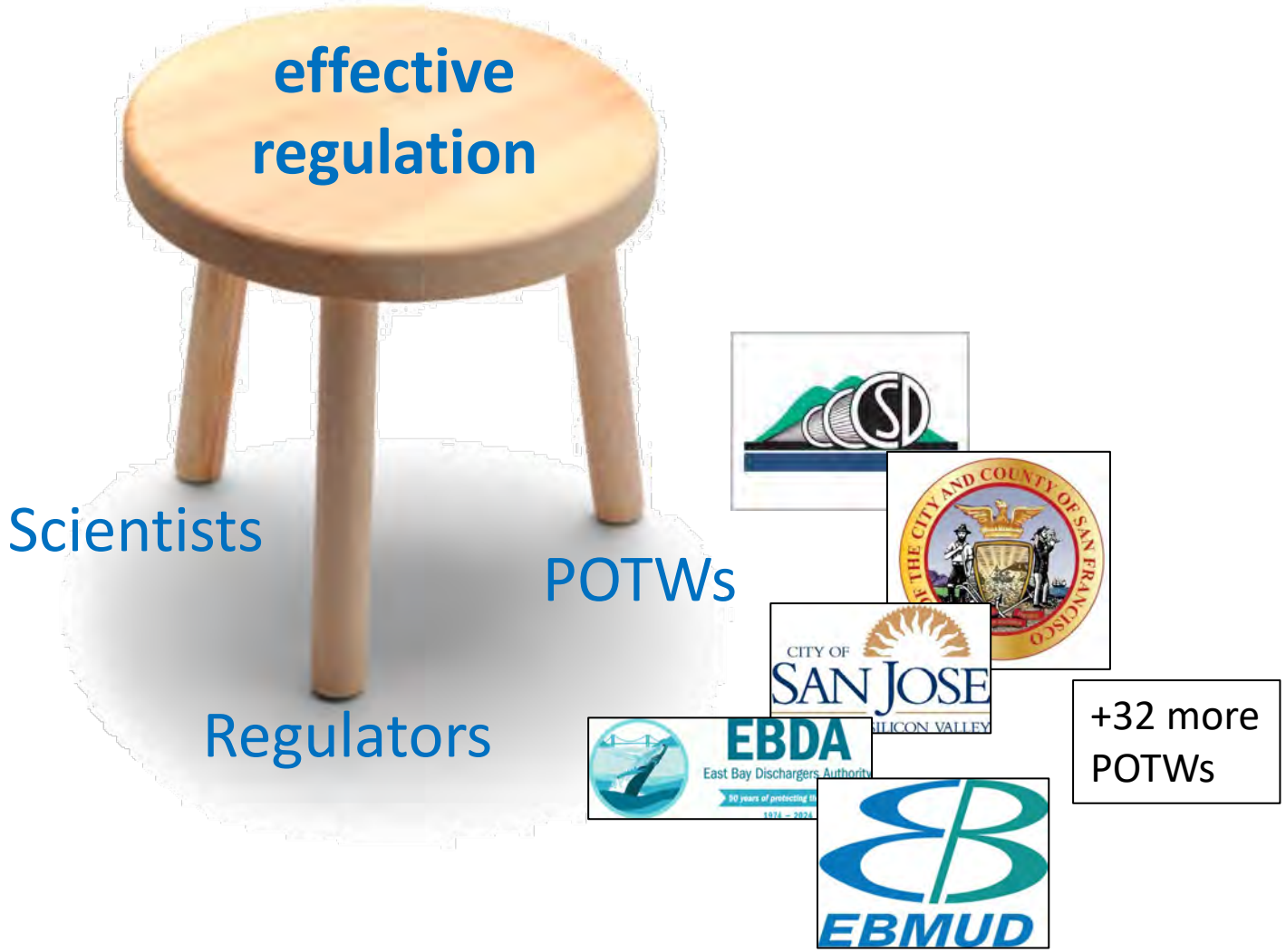
May 18-20, 2026

CASA/Clean Water SoCal Nutrient Management

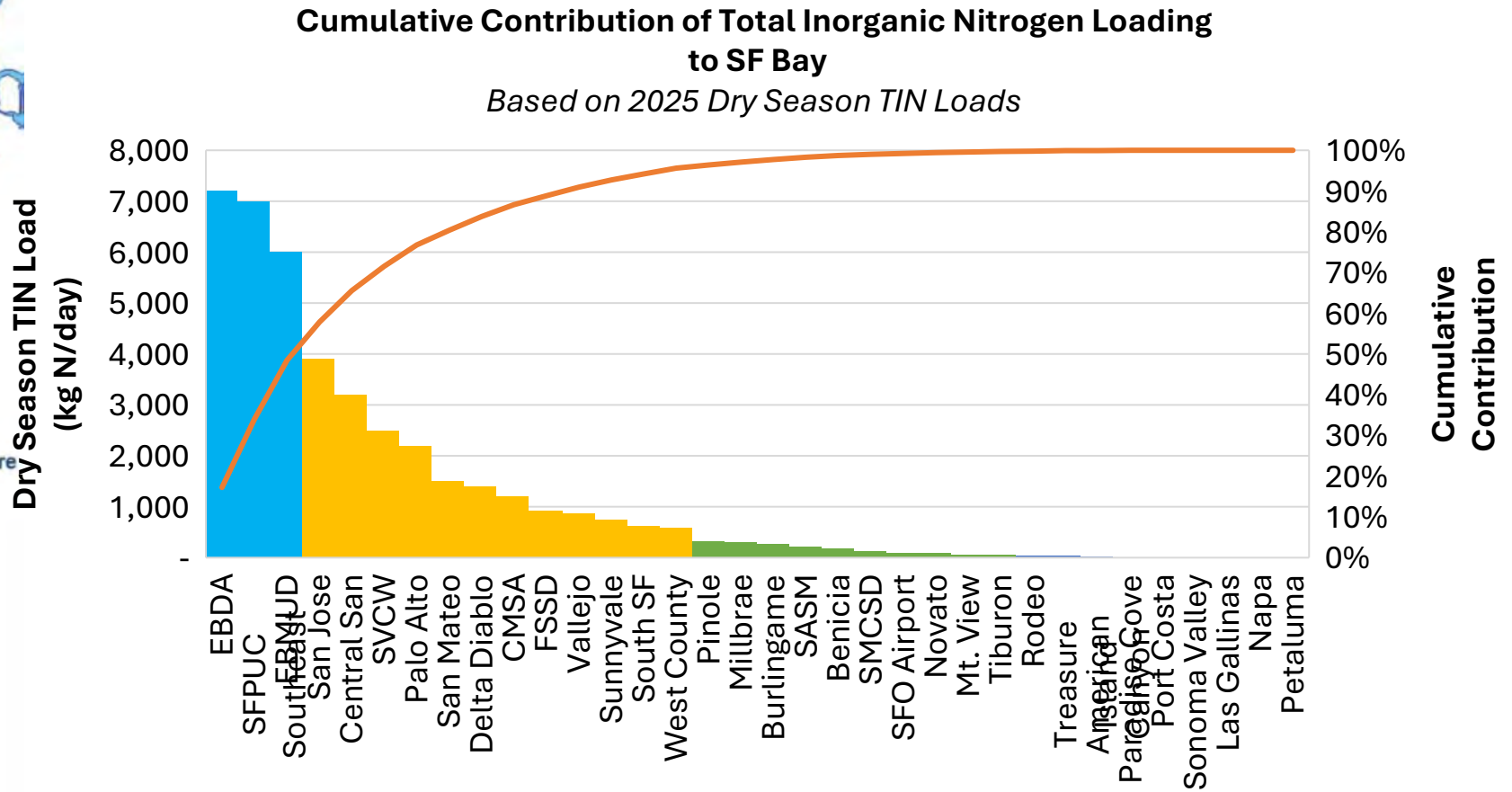
Joint fact-finding allows us to share an understanding of nutrient impacts

- How much nitrogen is being discharged?
- What are the impacts?
- What are our tools to reduce nitrogen loads and what will it cost?



40 POTWs discharge 86% of dry season nitrogen to SF Bay

Population = 7.5M



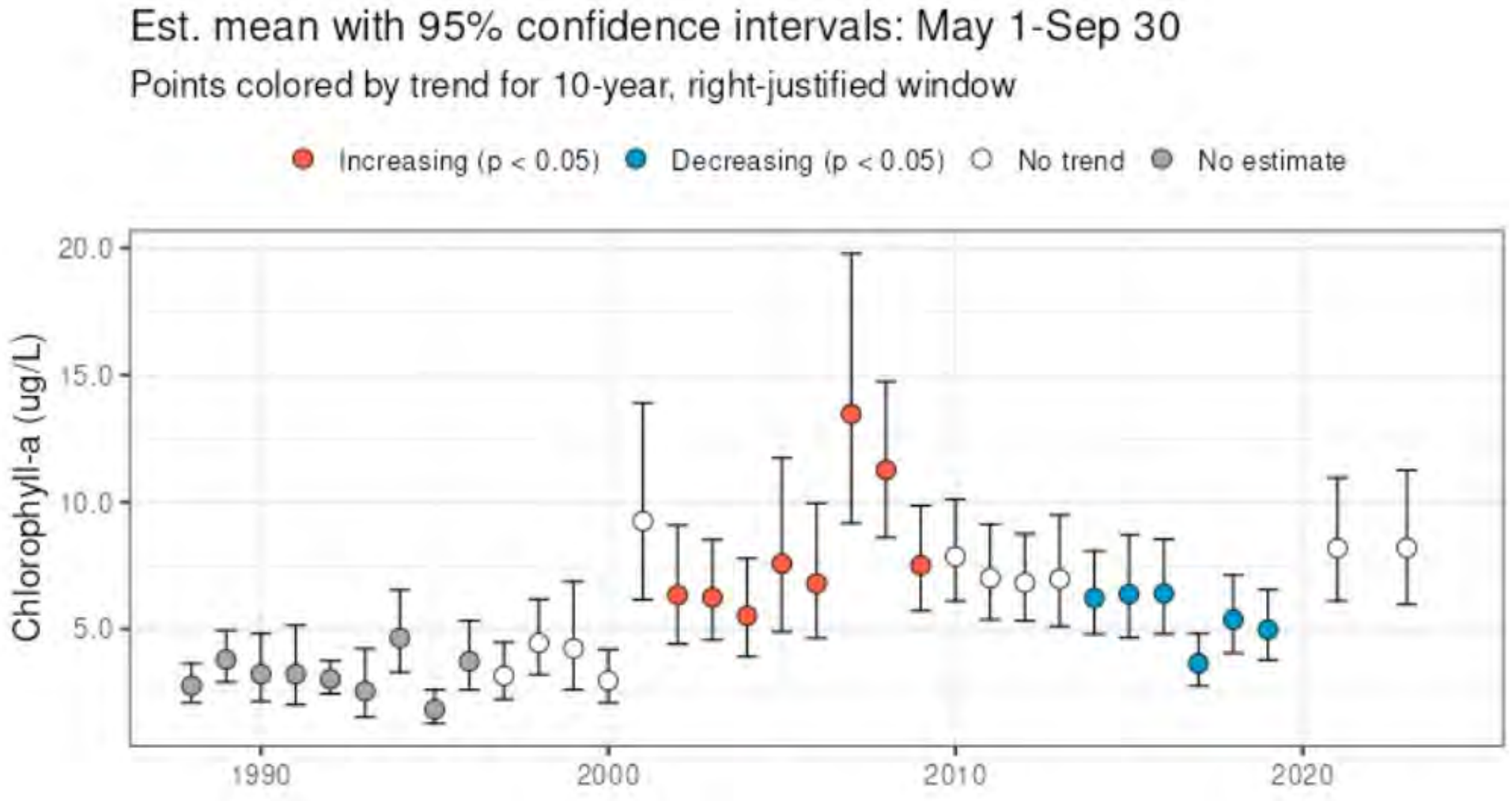
The SF Bay has historically been resilient to nutrients

1. High turbidity blocks the light phytoplankton needs to grow

2. Strong tidal mixing reduces nutrient concentrations

3. Filter-feeding clams reduces phytoplankton concentrations

Chlorophyll levels were rising in the 2010s, prompting worries we were headed to a tipping point



History of the Nutrient Watershed Permit

#1: **2014**	#2: **2019**	
• Monitoring and Reporting • Support for Science ($880K/yr) • Nutrient Reduction via Optimization and Upgrade Study	• Monitoring and Reporting • Support for Science ($2.2M/yr) • Nutrient Reduction via Recycled Water and NBS Studies	← How much nitrogen are we discharging? ← What are the impacts? ← What are our tools to reduce nitrogen loads, and what do they cost?

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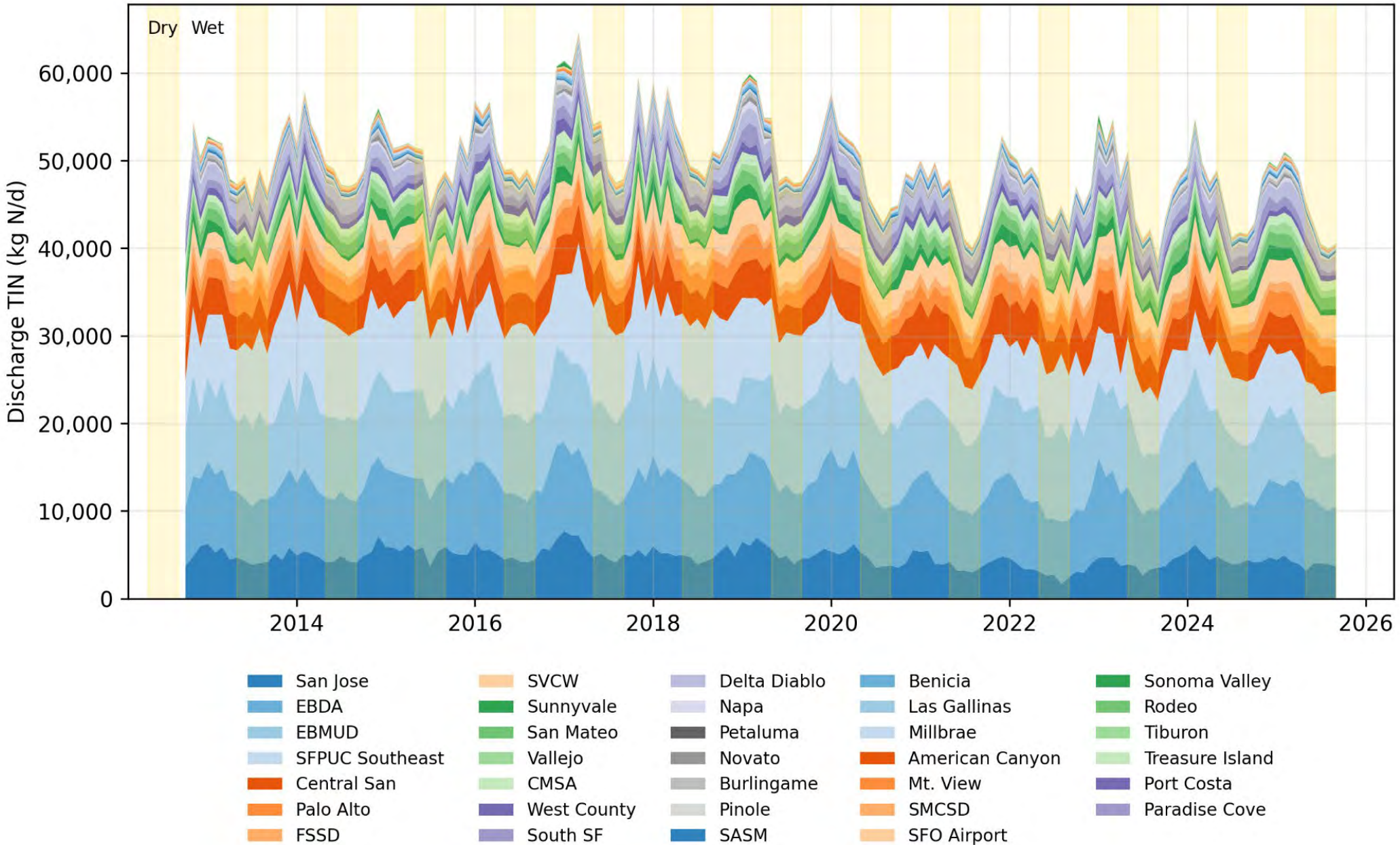
How much nitrogen are we discharging?

POTW load data are summarized in Group Annual Reports



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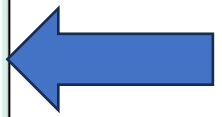
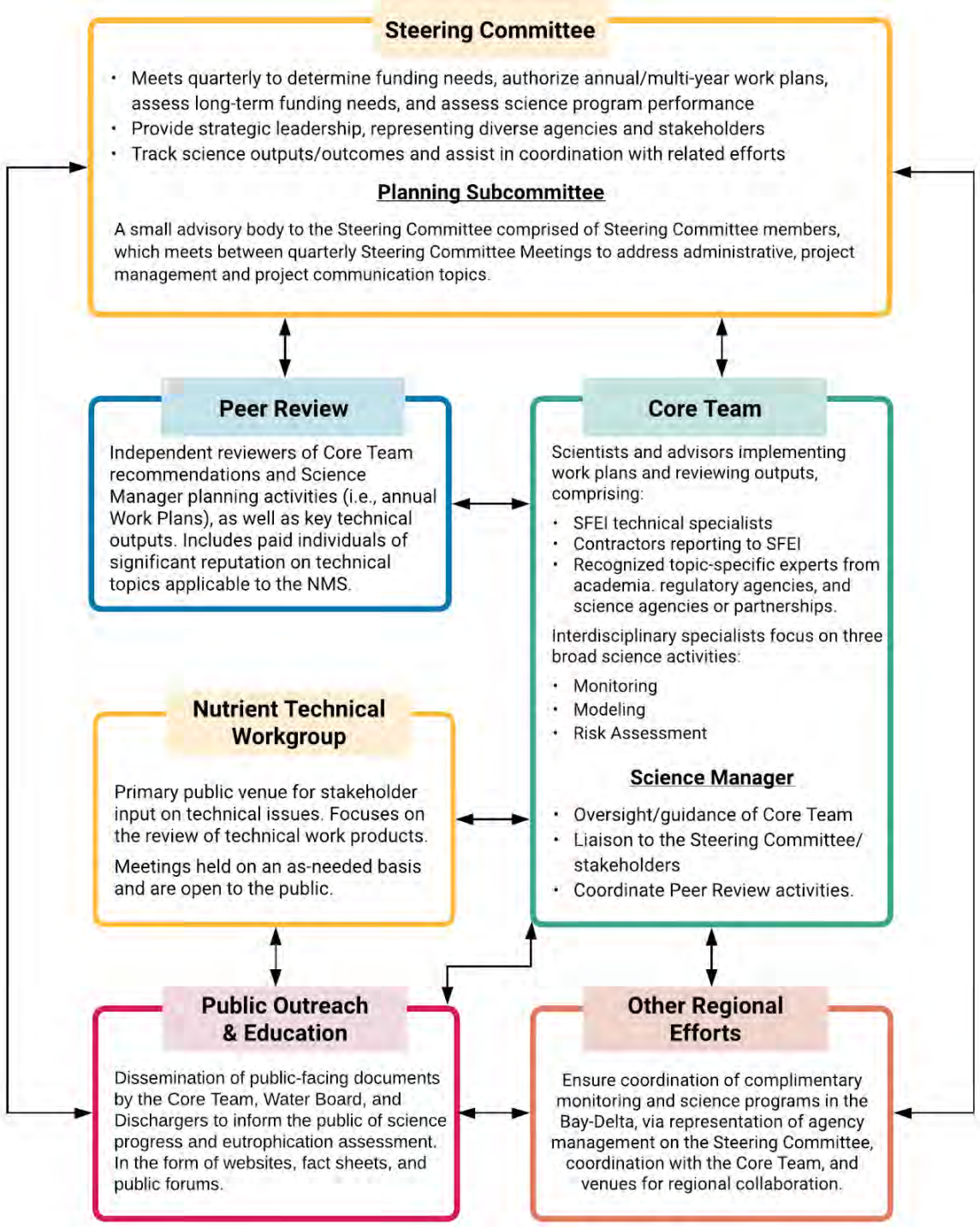


What are the impacts?

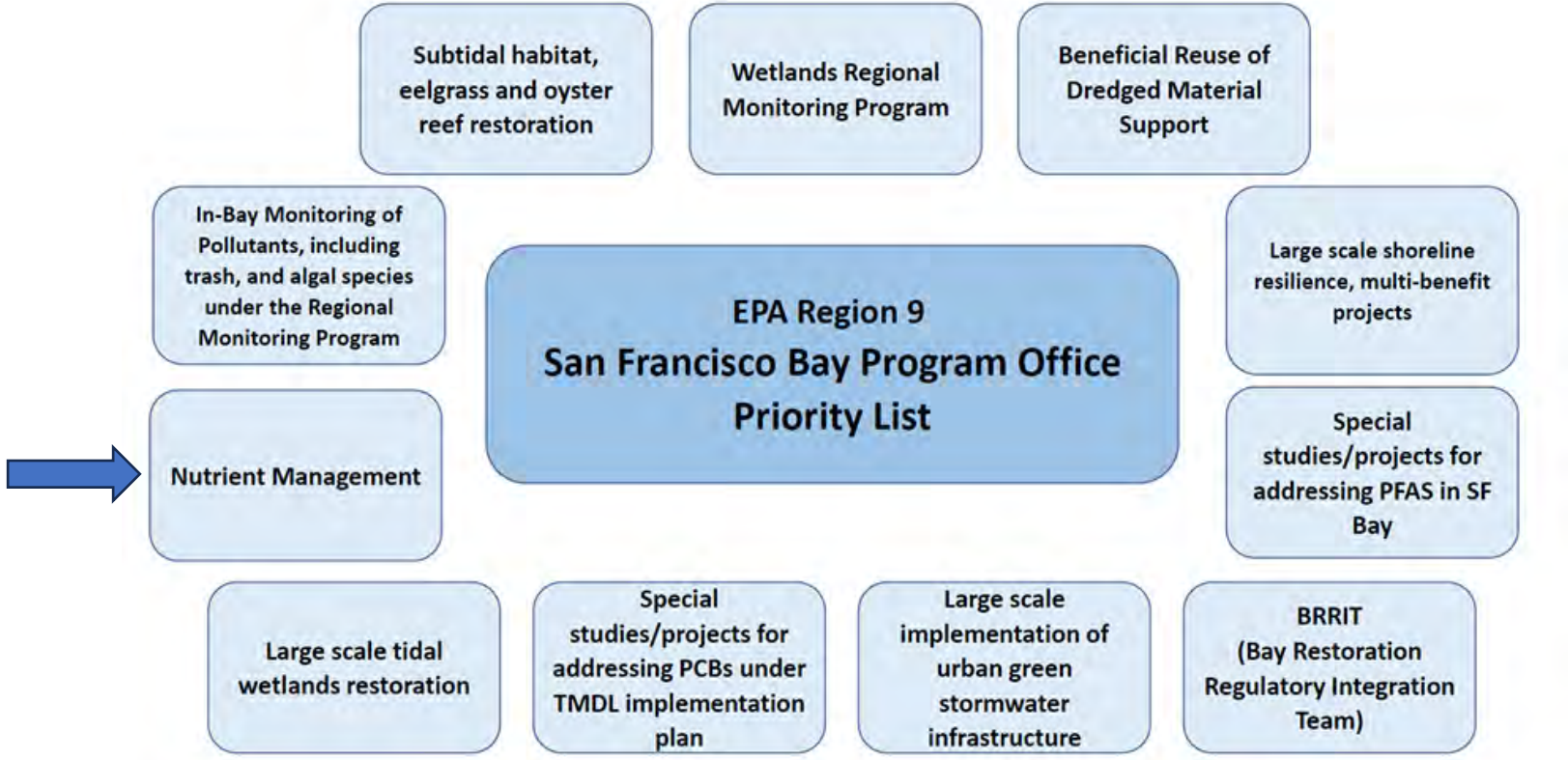
Nutrient Management Strategy defines science priorities



- Steering committee:
- R2
- R5
- BACWA
- Baykeeper
- EPA
- NOAA
- CalDFW
- US FWS
- OPC
- Water Contractors
- & Others

Who pays for the science?

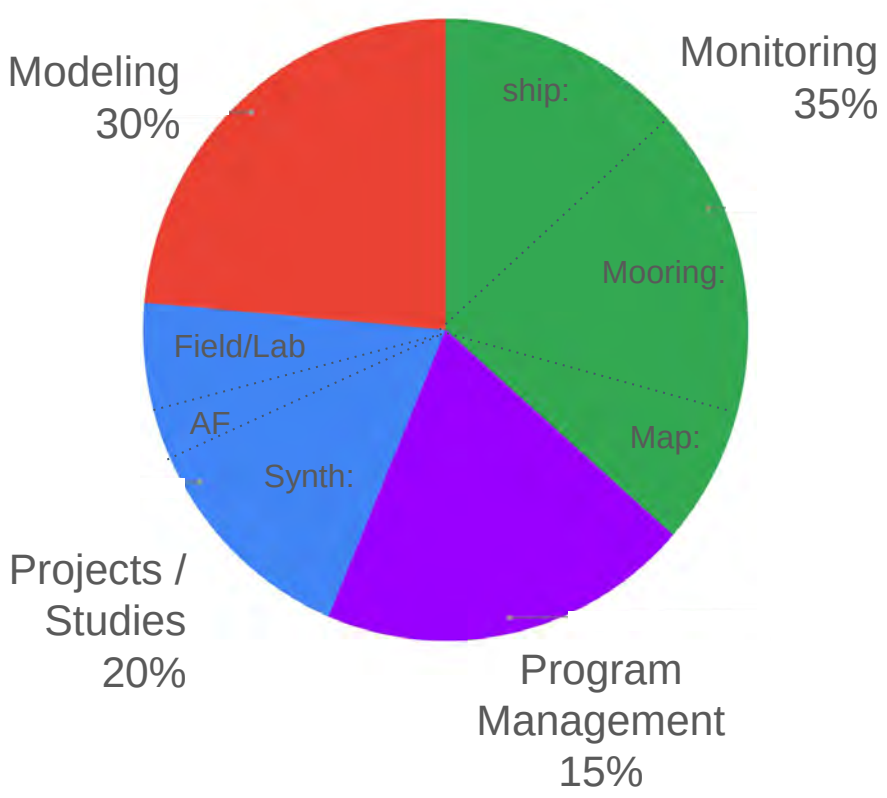
- Historically most funding from POTWs - $21M+ since 2012
- Regional monitoring program provides ~$500K/yr
- Recent funding from USEPA - ~$4.5M since 2024
  - Hope for sustainable long-term funding from new USEPA SFBay Program office



NMS approves a 5-yr science program and annual science plan

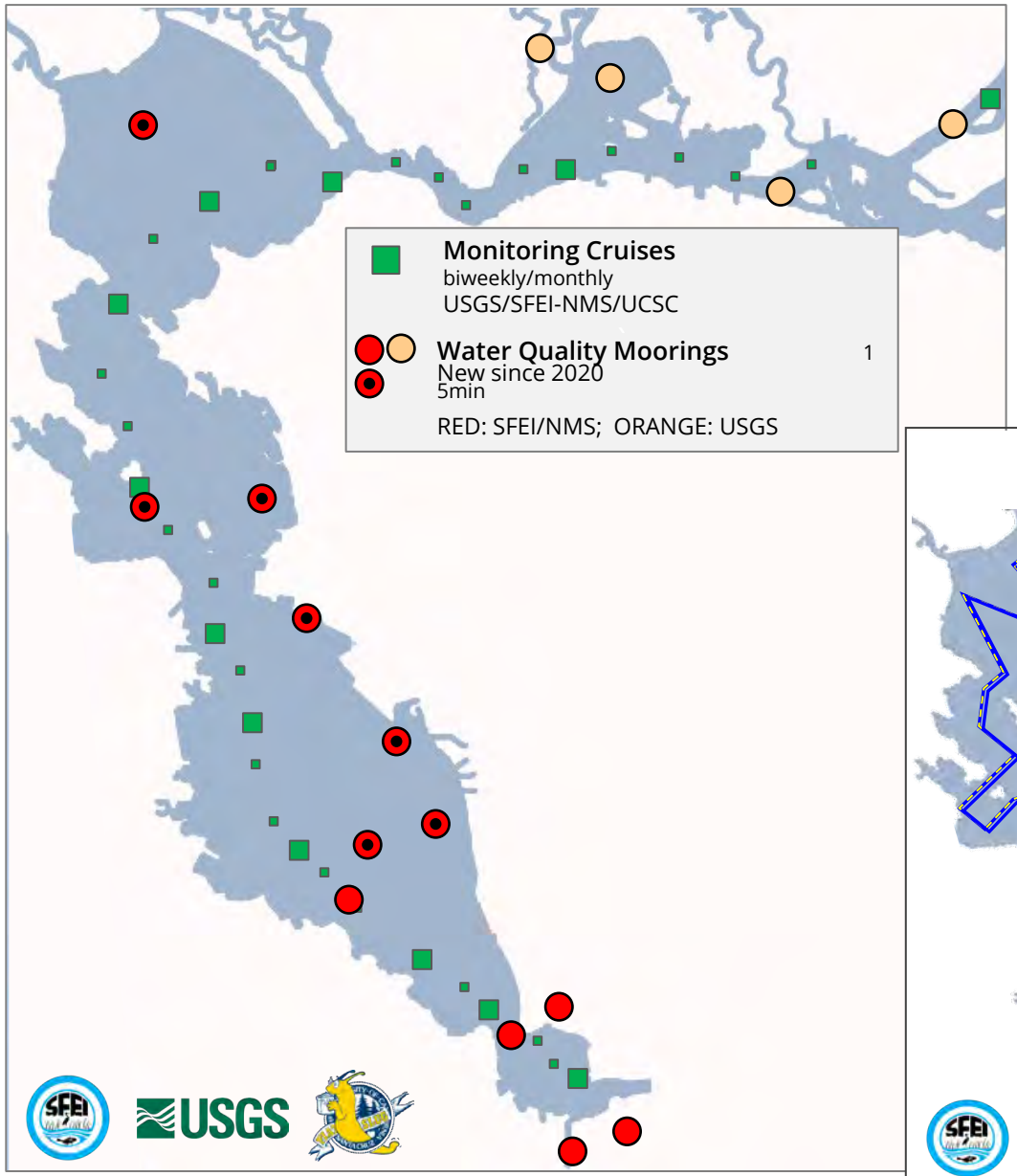
<u>Management Questions (paraphrased)</u>

1. Are the permit limits protective of beneficial uses?
2. What is the risk of future HAB events?
3. What is the current status and trends of indicators in the Bay?
4. What are actions we can take in addition to nutrient reductions to protect the Bay?

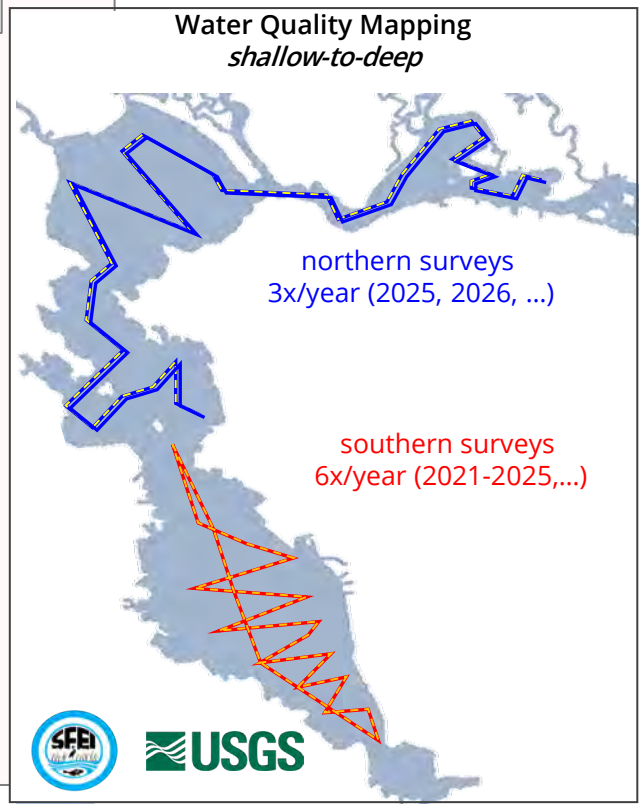


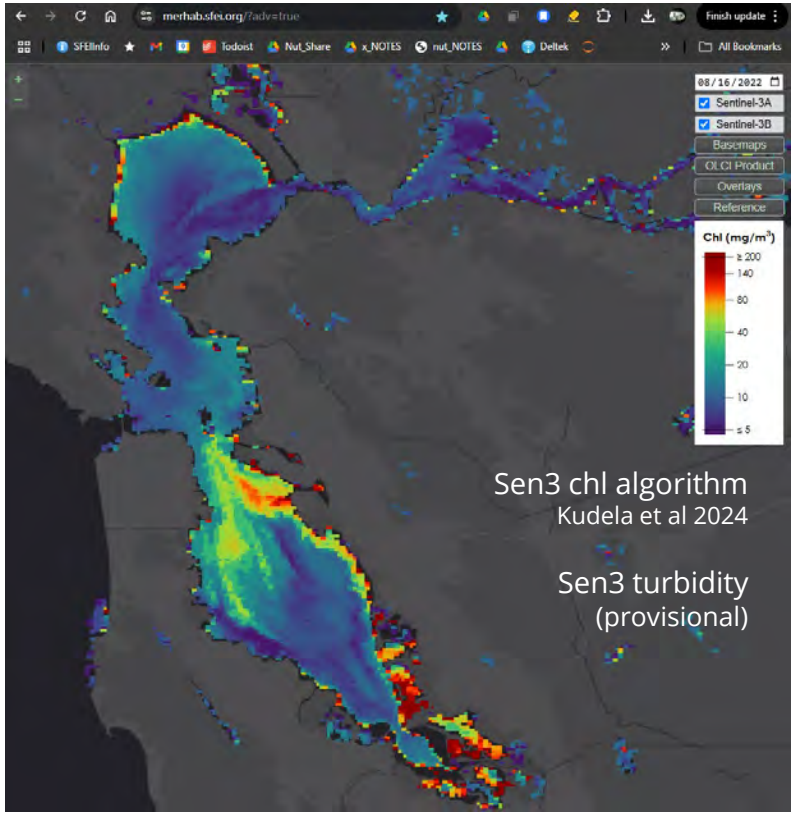
FY26-FY29: $4,500,000/yr

The NMS has a multi-pronged monitoring approach



- Ship-based monitoring
- Continuous Water Quality moorings
- High-Res Water Qual 'mapping'
- Remote-sensed chlorophyll, turbidity

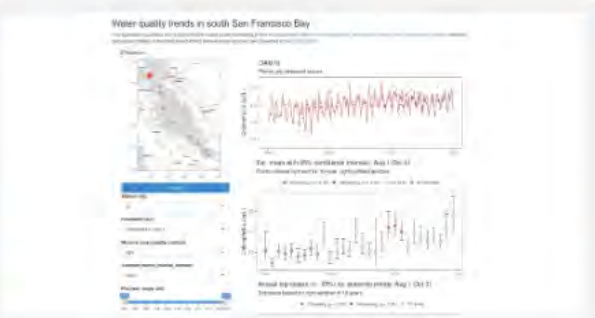




Nutrient Management Strategy: Shiny Visualizations

Nutrient Load Browser

This app allows users to browse time series of past POTW loads, either by individual POTW, or grouped by subembayment.



Water Quality Trends

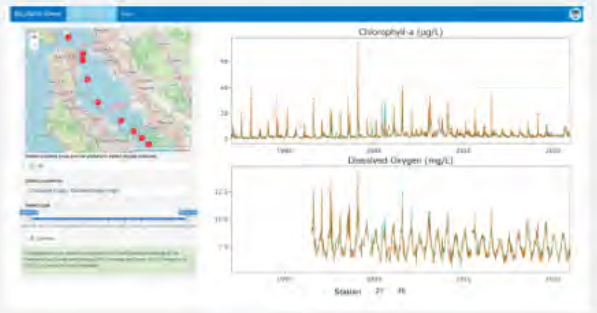
This app, associated with Beck et al (2022) allows for multi-year trends in long-term time series data to be calculated for different Bay stations and parameters including gross primary production, chlorophyll-a, dissolved oxygen and others.

IFCB Viewer

The Imaging Flow CytoBot is used to monitor the density and biovolume of phytoplankton through automated flow cytometry, and can automatically identify some taxa. This app allows users to browse time series of IFCB data from 2018-2023 from a series of stations across SF Bay.

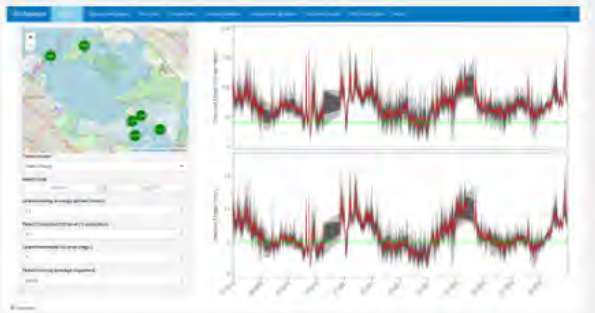
Molecular Data Viewer

NMS has collected a time series of 18S metabarcoding data quantifying the relative abundance of different phytoplankton taxa through time at a series of SF Bay stations. This app allows users to browse through those time series, in a similar interface to the IFCB Viewer app, and change between percent abundance and direct molecular counts.



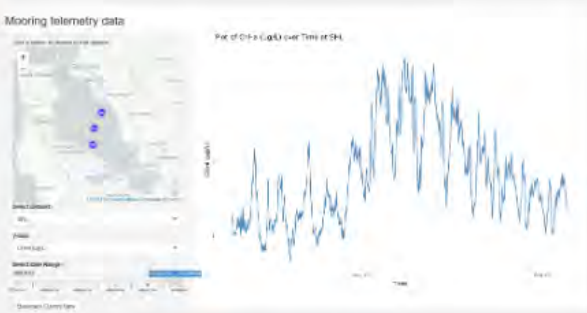
Bay Station Viewer

The Peterson cruises are a long-term time series of water quality data collected from a series of stations across San Francisco Bay. In this app, users can browse through time series of eight different parameters across Central and South Bay stations in the dataset.



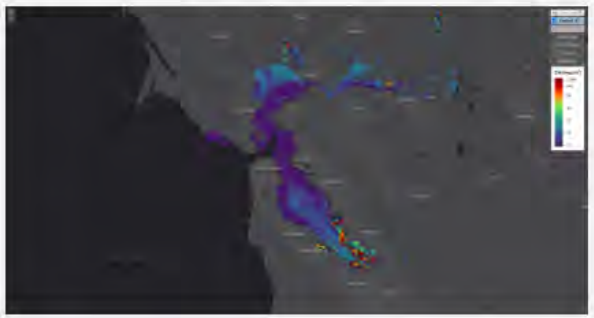
LSB Assessment Framework

Variability of dissolved oxygen across the Lower South Bay of SF Bay was investigated as part of an Assessment Framework effort. In this app, users can view dissolved oxygen time series for a selection of stations in different settings of LSB, and view calculations related to the distributions of DO above or below user-set thresholds.



Telemetry Viewer

The latest data can be viewed from NMS moored sondes at San Leandro Marina (SLM), Shoal (SHL) and San Mateo Bridge (SMB) stations, including continuous chl-a, dissolved oxygen, pH, nitrate and other parameters.



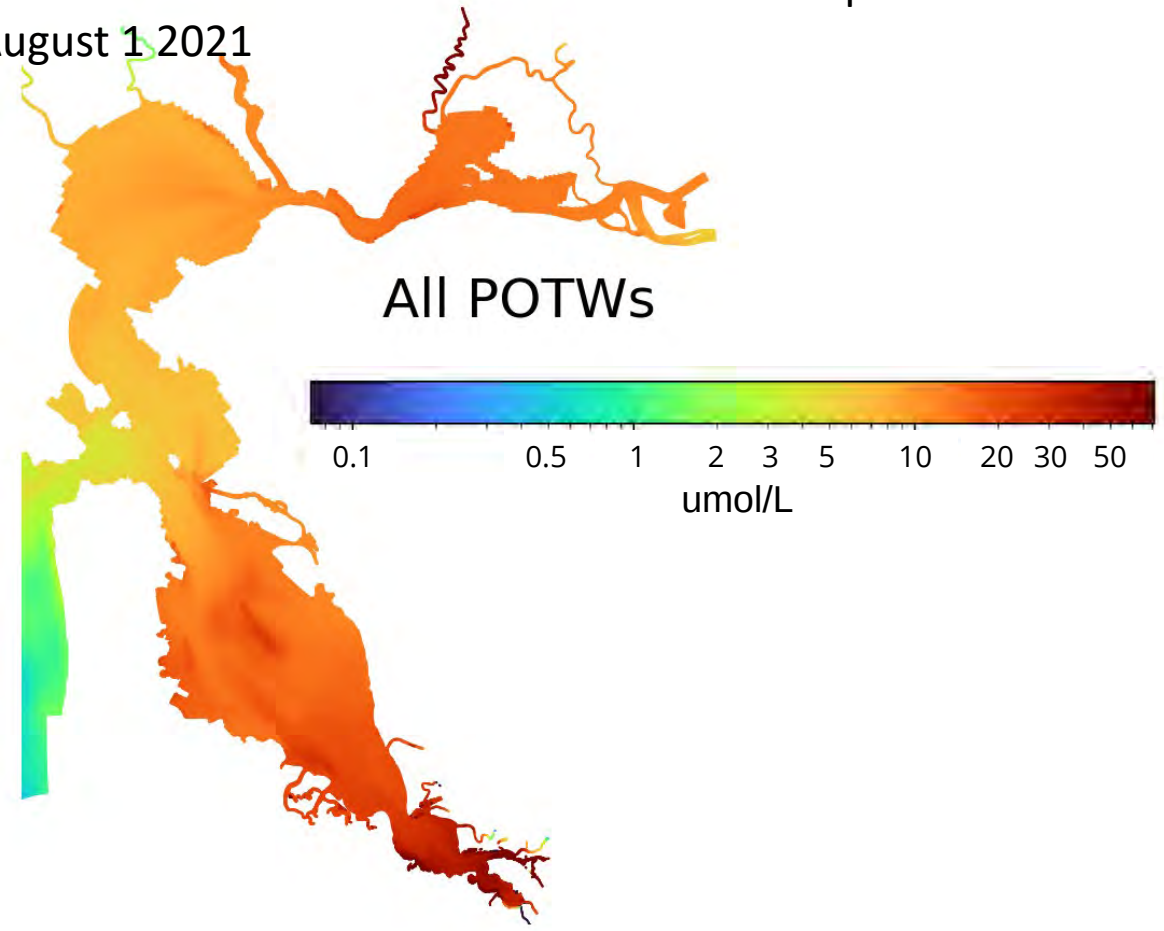
Remote Sensing Viewer

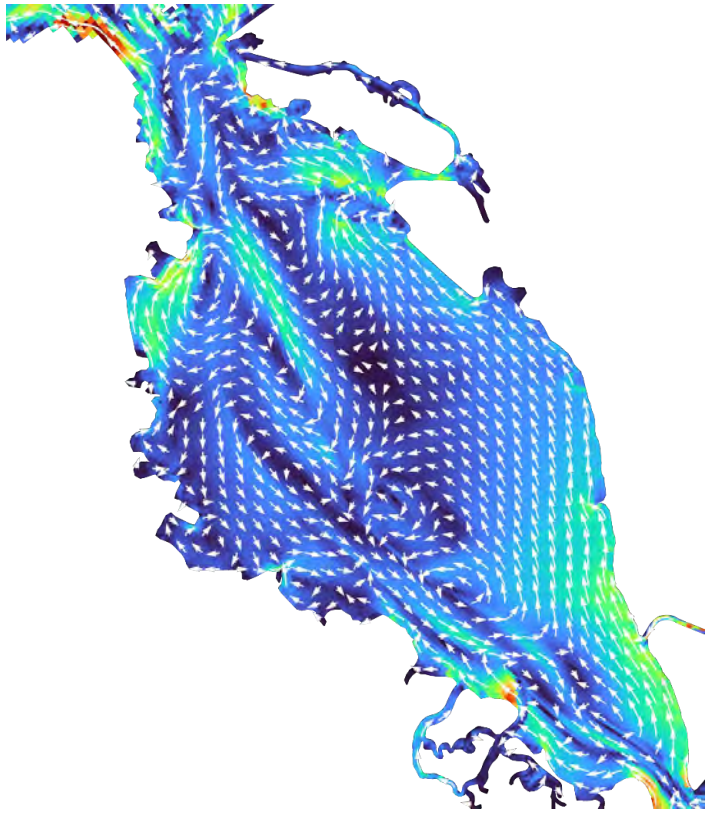
Remote sensed chl-a data from the Sentinel-3 satellites can be viewed, using an algorithm developed for SF Bay as described in Kudela et al. (2024)

https://nutrient-data.sfei.org/

Like the Bight, SF Bay has a paired hydrodynamic/biogeochemical model

Predicted DIN concentrations based on transport:
August 1 2021





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What are our tools to reduce nitrogen, and what do they cost?

Site Visits

Objectives:

- Review data with lab staff
- Review permit requirements
- Develop treatment concepts to satisfy the permit requirements
- Walk the plant to confirm viability of developed concepts
- Produce a site visit report that confirms the concepts developed during the site visit

Treatment Levels

Level	Study	Ammonia	TN	TP
Level 1 *	Optimization	--	--	--
Level 2 *	Upgrades	2 mg N/L	15 mg N/L	1.0 mg P/L
Level 3 *	Upgrades	2 mg N/L	6 mg N/L	0.3 mg P/L

* Seasonal impacts considered for all three treatment levels:
  - Dry Season = May 1 to September 30
  - Wet Season = October 1 to April 30

Study Findings for Nitrogen Load Reduction

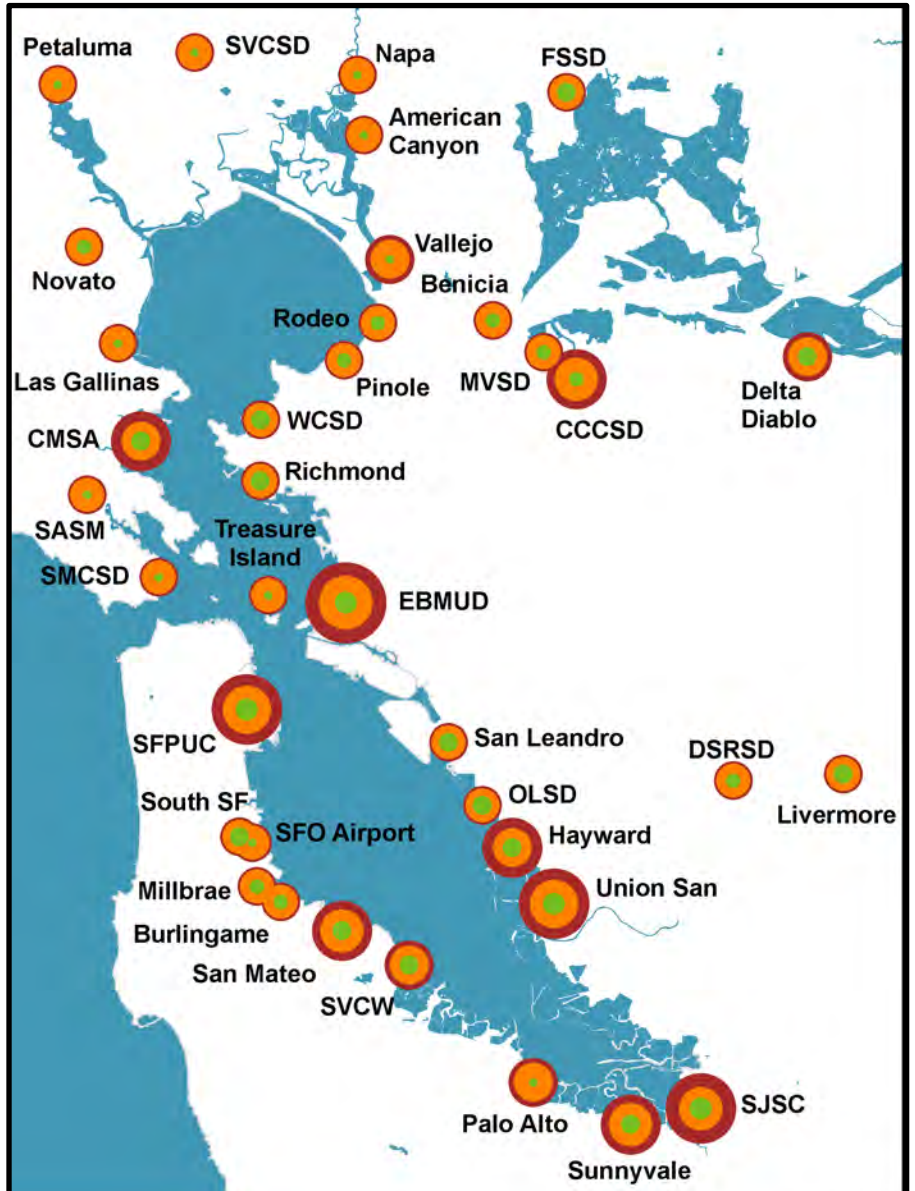
Total Nitrogen Load Reduction	Total Nitrogen Concentration	Estimated Total Capital Cost ($2018)
0%	32 mg/l	$0
10-20%	26 mg/l	$119 - $391M
60%	<15 mg/l	$7 Billion
80%	<6 mg/l	$8.5 Billion

Legend (Circle Size Increases with Cost)

Cost for 10-20% Nutrient Reduction

Cost for 60% Nutrient Reduction

Cost for 80% Nutrient Reduction



San Francisco Chronicle

Poop and pee cause algae blooms in S.F. Bay. Water agencies will spend $11 billion to fix the problem

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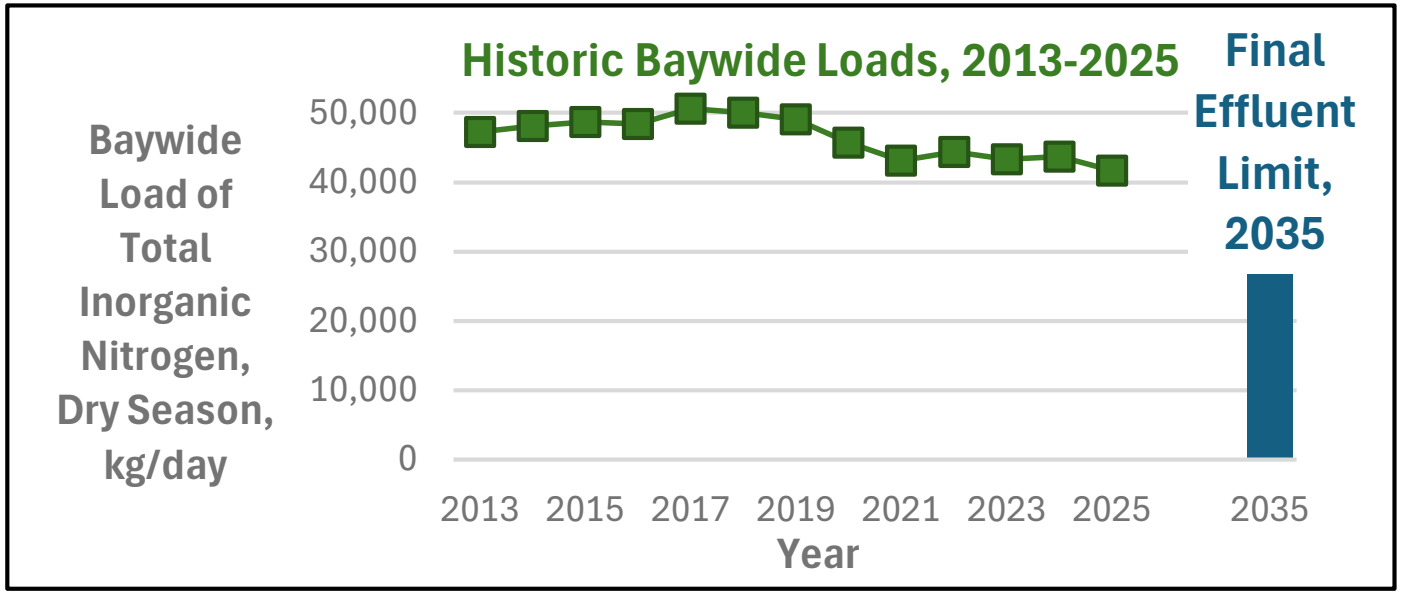
#3: **2024**

- Monitoring and Reporting
- Support for Science
- **Load Limitations**
- Compliance Milestone Reporting
- Regional Planning

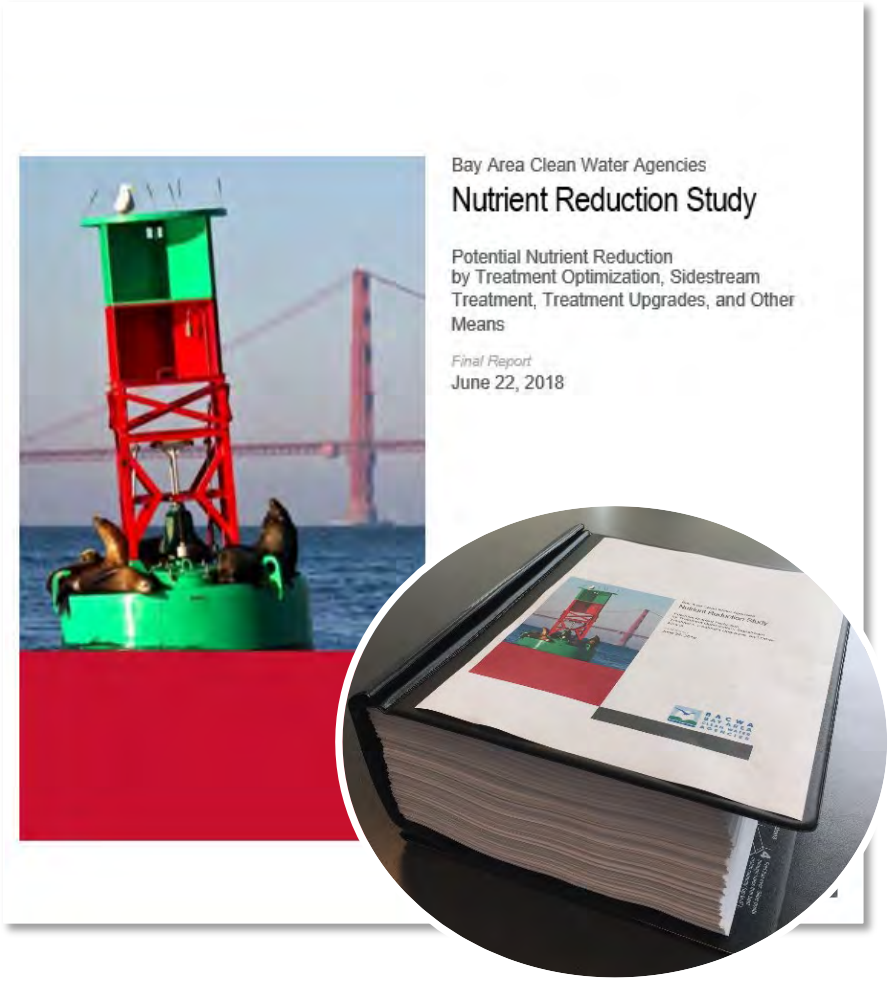
Third Watershed Permit adopted July 10, 2024

- Requires **40% aggregate dry season** load reduction
- Apportioned based on current performance – load limits calculated by multiplying effluent flow by **20.5 mg/L** TIN



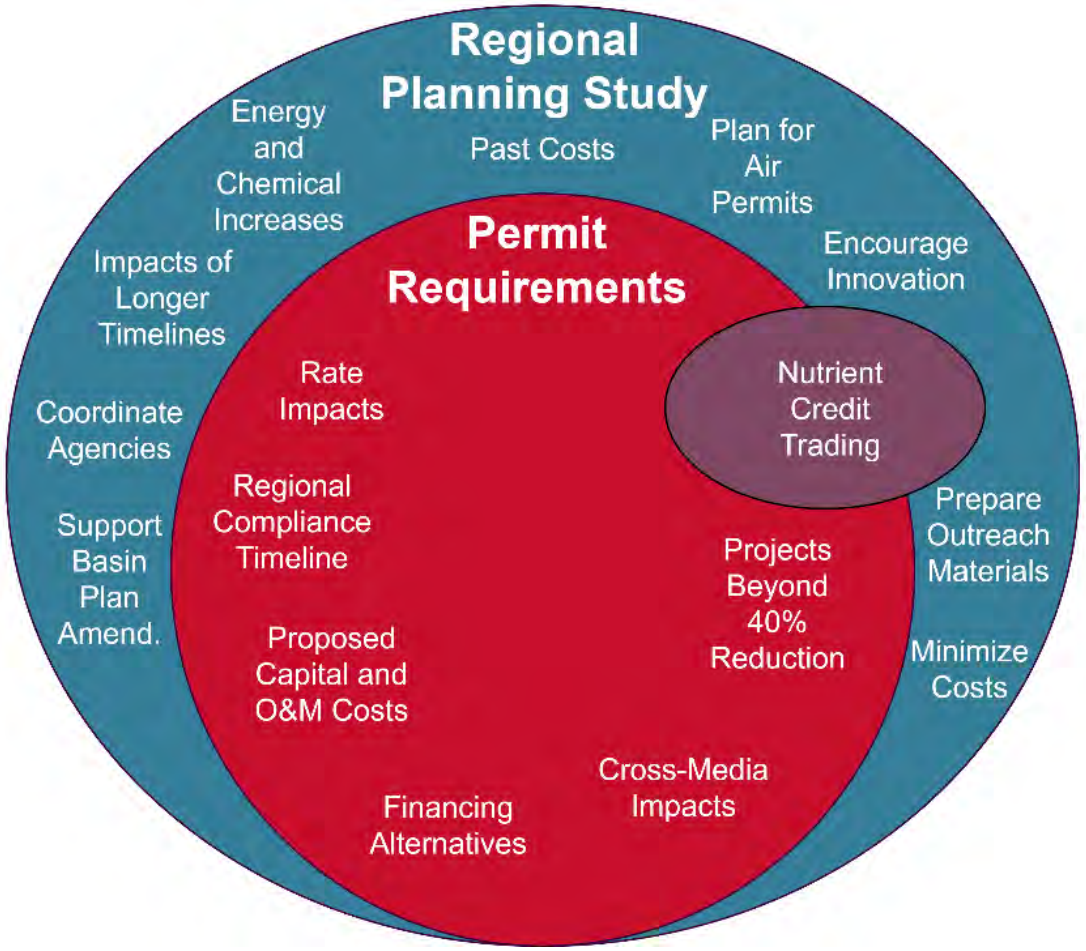
- **10-year** compliance schedule
- Recognition that early actors, projects with multiple benefits and others will need more time

Cost estimates for regional nutrient reduction from 1st Watershed Permit

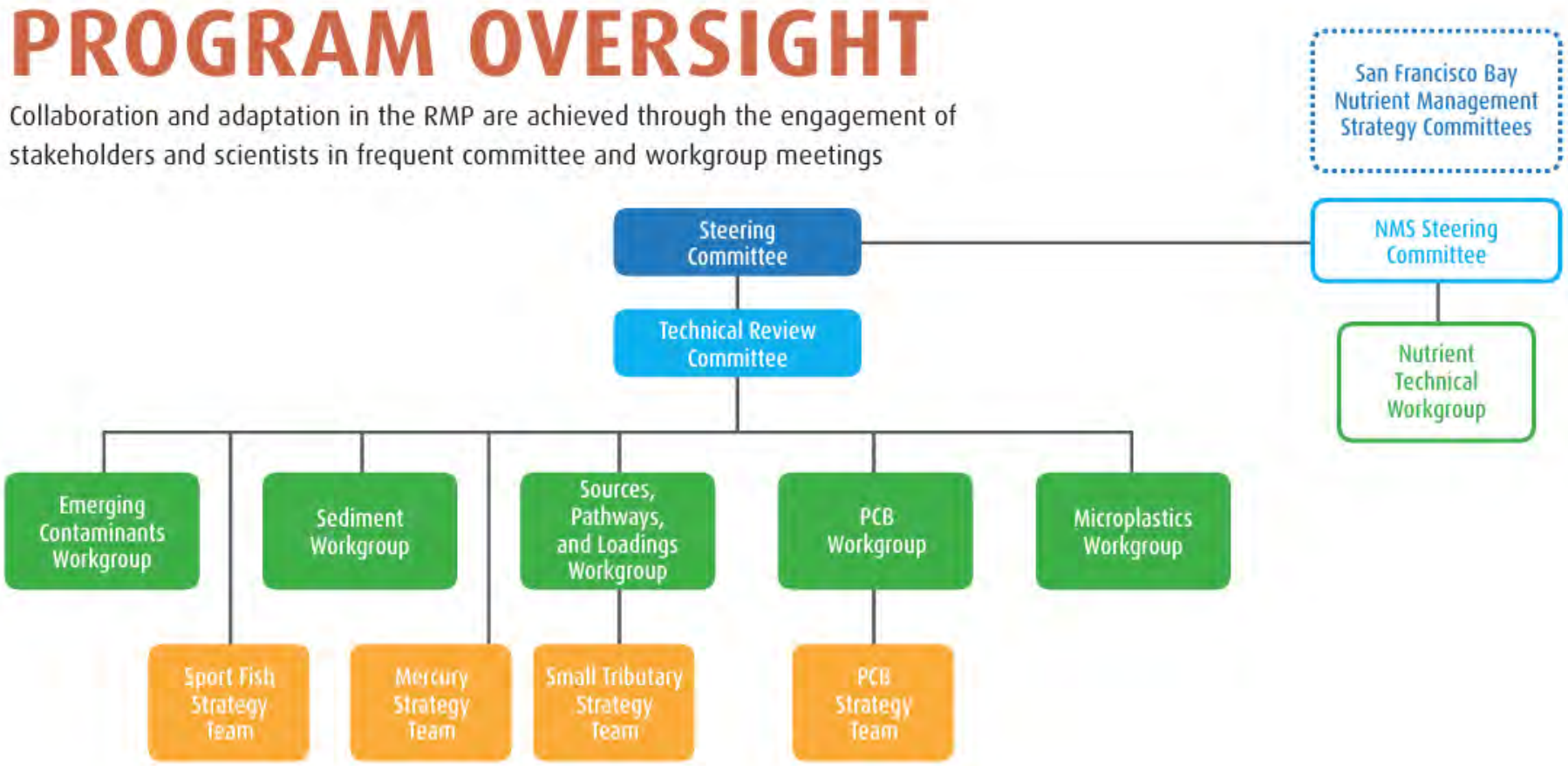


Strategy	Total N Load Reduction to the Bay	Total Present Value for Total N Load Reduction to the Bay ($ Mil in 2023)
Optimization	**7%**	**$200 M**
Sidestream Treatment	**19%**	**$870 M**
Upgrade Level 2 (15 mg N/L)	**57%**	**$10.8 B**
Upgrade Level 3 (6 mg N/L)	**82%**	**$13.0 B**

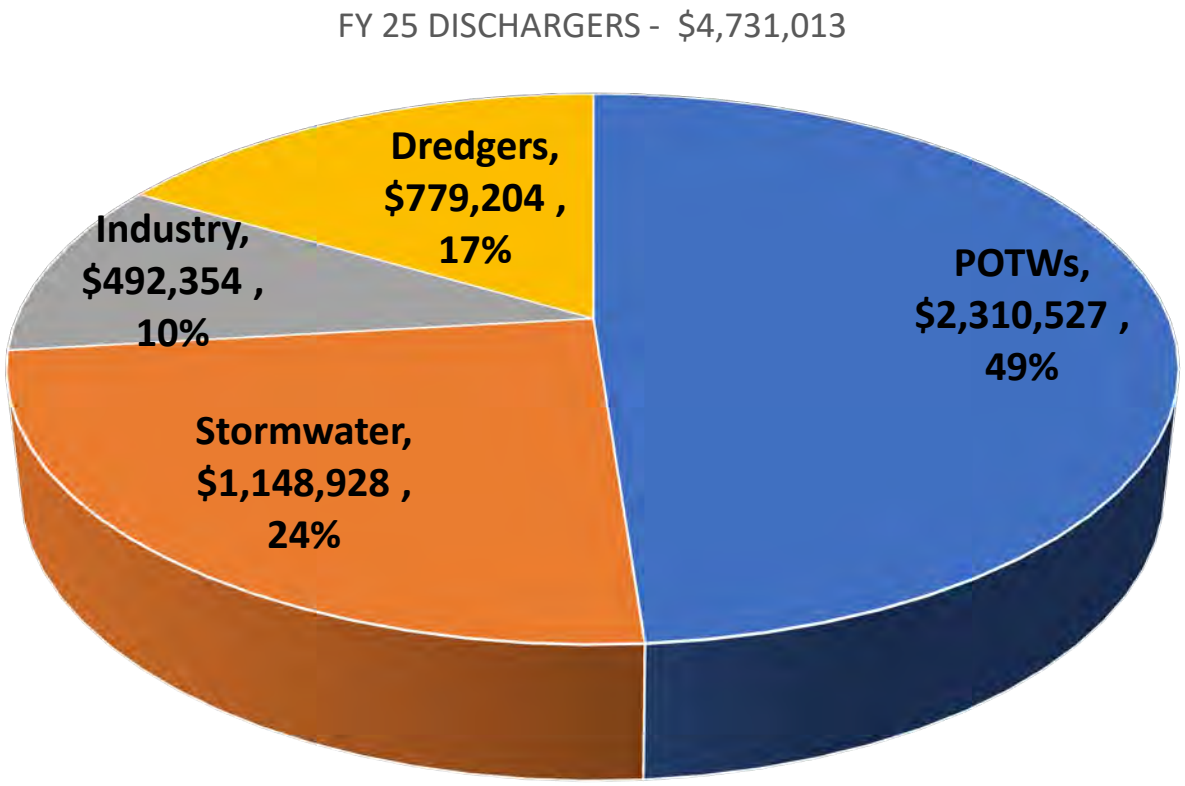
Regional Planning Study will tell the story of nutrient reduction planning to inform permit negotiations and fundraising



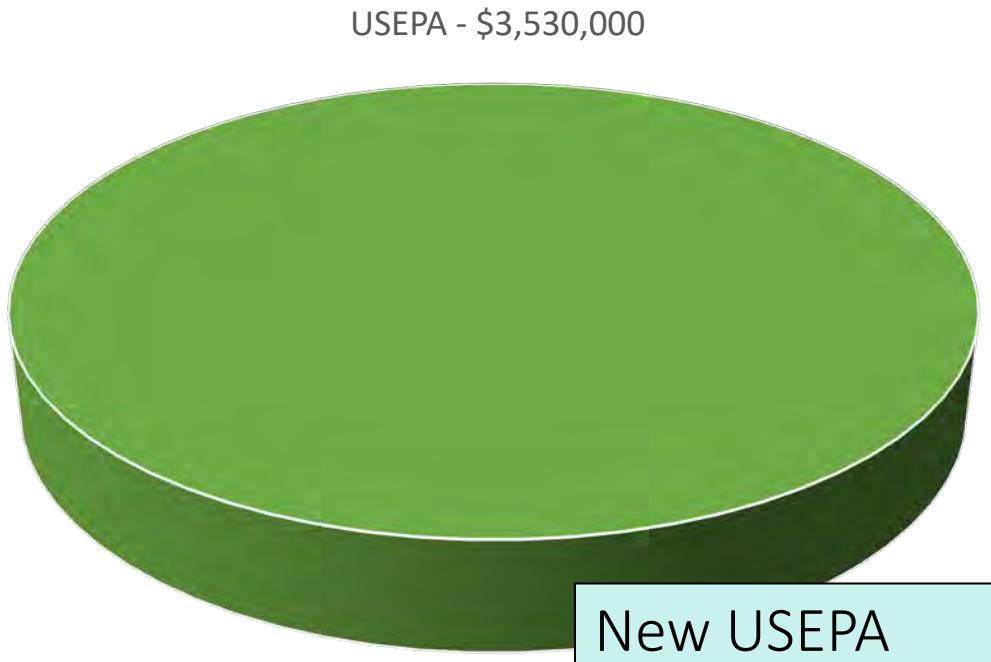
Coda: The San Francisco Bay Regional Monitoring Program (RMP) is an entity that has led collaborative science since the 1990s



Dischargers have historically provided most RMP funding



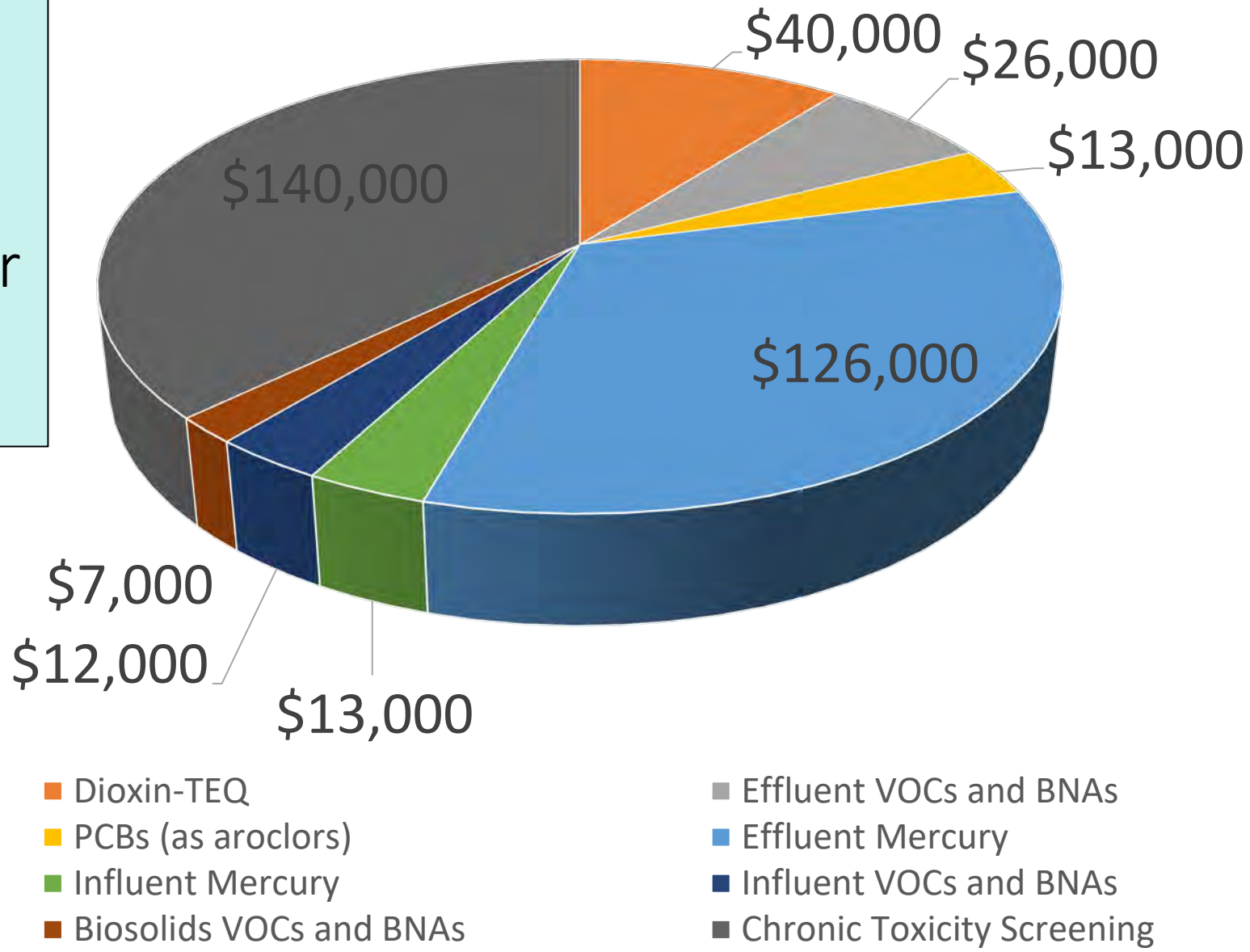
Funding in lieu of individual monitoring in permits



New USEPA Program office has provided significant matching funding since 2024

Avoided annual costs from reduced monitoring/reporting

In 2021, BACWA and R2 reached agreement to trade reduced monitoring for $ 320K/yr in CEC studies funding



BACWA
BAY AREA
CLEAN WATER
AGENCIES

More info:

https://bacwa.org/nutrients-2/

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