Amendment to Technical Workplan and Budget of the 2021-2022 Fiscal Year

As approved by the Delta RMP Steering Committee on July 29, 2021

Amendment approved by the Delta RMP Board of Directors on January 24, 2022

Prepared by Melissa Turner, Delta RMP Program Manager

Amendment to the Approved 21/22 Workplan

The Detailed Workplan and Budget for the 2021-2022 Fiscal Year (21/22 Workplan) was approved on July 29, 2021. At the time of approval, the 21/22 Workplan did not contain any additional funding for the cyanotoxin study conducted by the United States Geological Survey (USGS) and Department of Water Resources (DWR); the original funding allocation for the study was approved as a part of the FY20-21 budget under the nutrient focus area which will continue through February of 2022. Additional funding must be added under the current Workplan and budget to allow for cyanotoxin monitoring to continue after February of 2022.

This document amends the approved 21/22 Workplan with the following additions:

1. Updates to the nutrients budget to include additional monitoring of cyanotoxins at Middle River station in the Delta for a full year, beginning in March 2022 through February 2023.

This amendment includes language describing the additional cyanotoxin monitoring under Monitoring Plan Implementation Expenses. Table 1 of the original Workplan lists the budgets for each monitoring sector and has been amended to include a line item for nutrients. The Scope of Work (SOW) for the additional monitoring is included as Appendix 7 of the Workplan.

Monitoring Plan Implementation Expenses

Nutrients

Ms. Turner presented options for nutrient monitoring at the October 27, 2021 Delta RMP Steering committee based on discussions within the Nutrient Technical Advisory Committee (TAC) on what monitoring proposal could be developed in the short amount of time remaining before the current funding ran out. The Steering Committee recommended to the Delta RMP Board of Directors (BOD) to allocate up to $100K for the FY21/22 nutrient monitoring and directed the Nutrient TAC to provide a proposal that would include funding to USGS for the project Cyanotoxin Monitoring in the Delta: Leveraging existing USGS and DWR field efforts to identify cyanotoxin occurrence, duration and drivers". This project is already funded by Proposition 1 for 5 of the 6 monitoring locations and therefore the Delta RMP would be providing additional funds for the 6th monitoring location which would be consistent with the monitoring that the Delta RMP contributed to from March 2021 through February 2022. The Steering Committee also directed the Nutrient TAC to evaluate the cost for adding cyanotoxin monitoring to high frequency cruises in FY22/23 and options for doing work in the Stockton area. Based on the recommendation from the Steering Committee, the Delta RMP approved the allocation of up to $100K for nutrient monitoring in FY21/22. On December 14, 2021, the Steering Committee was presented with options for funding in FY21/22 and FY22/23 based on direction from the October 27, 2021 meeting. The Steering Committee recommended for approval by the BOD funding of an additional 12 months of cyanotoxin monitoring at the Middle River Station in the Delta to allow for continued work efforts from the previous year. After the Steering Committee meeting on December 14, 2021, USGS made some minor adjustments in the budget associated with the proposal and this was presented to the BOD on December 16; the BOD approved the allocation of up to $130K for the nutrient monitoring associated with the USGS proposal.

Appendix 7 includes a description of the additional cyanotoxin monitoring design. The funding allocation for this additional year of monitoring, including in kind funding from the USGS, is $85,896; if the USGS match funding is not an option, the total cost will increase to $125,429. Data collection and reporting will be conducted by USGS ($80,332); if the USGS match funding is not an option, the USGS costs will increase to $102,849. Separate contracts with the analytical laboratories, Lumigen Laboratories ($19,380) and BSA Environmental ($4,200), will be executed by the Delta RMP for sample analysis using LCMS-MS and ELISA techniques; these costs would not change regardless of USGS match funding since these contracts are directly Delta RMP and the laboratories.

Delta RMP Technical Program FY21-22 Budget

The technical program and monitoring budgets for the Delta RMP for the fiscal year are provided in **Table 1** which has been revised to include the USGS/DWR cyanotoxin project under Nutrients.

Table 1. Delta RMP Technical Workplan budget for FY21-22 (revised based on BOD approval of the USGS/DWR nutrients proposal on December 16, 2021).

Monitoring Sector	FY 21-22 Budget
Technical Program Management	
MLJ - Technical Program Manager	$230,470.00
ASC - Transition Budget	$64,677.23
Subtotal	**$295,147.23**
Current Use Pesticides (CUP)	
PER - Toxicity (FY22)	$127,565.48
MLJ - Data Management (FY22)	$59,692.50
USGS - Sampling/Analytical (FY22)	$169,693.00
USACE (In Kind)	*($37,333.00)*
USGS (In Kind)	*($23,543.00)*
Subtotal	**$296,074.98**
Mercury	
MLML - Sampling/Analytical	$199,080.00
Regional Board – SWAMP (In Kind)	*($205,600.00)*
Subtotal	**($6,520.00)[1]**
Constituents of Emerging Concern (CEC)	
MLJ - Sampling, Data Management, Analytical	$335,015.22
Subtotal	**$335,015.22**
Nutrients	
USGS - Cyanotoxin Analysis, Data Collection, and Reporting	$80,332.00
Lumigen Laboratories - Analytical	$19,380.00
BSA Environmental - Analytical	$4,200.00
USGS (In Kind)	*($18,016.00)*
Subtotal	**$85,896.00**
Total	**$1,012,133.43**

[1]Unused in-kind funds not subtracted from total budget.

Appendix 7. Cyanotoxin Monitoring

Cyanotoxin Monitoring in the Delta: Leveraging existing USGS and DWR field efforts to assess cyanotoxin status, trends, and drivers

Proposed by: **USGS Biogeochemistry Group, California Water Science Center**
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Problem Statement

One major impediment to improved understanding and prediction of harmful algal blooms (HABs) and the cyanotoxins they produce is the dearth of systematic collection of observational data across both space and time. HABs, which in freshwater comprise mostly cyanobacteria (cyanoHABs), are distributed worldwide and are a growing concern because they can adversely affect drinking water supplies, interfere with water transfers, harm aquatic organisms, and potentially harm humans and wildlife. Worldwide, the distribution and abundance of cyanoHABs are intensified by increased nutrient loads from agriculture and urban runoff, atmospheric deposition, global warming, and droughts. It is most often the cyanotoxins produced by these organisms that are the hazard rather than the organisms themselves – which may or may not produce toxins – so improved monitoring efforts seek to combine cyanobacterial detection with measurement of the toxins themselves.

Identifying drivers of cyanoHABs and their associated toxins requires an understanding of the conditions that foster their growth as well as hydrologic drivers that then transport them through the ecosystem. Environmental factors that have been attributed to the occurrence of cyanoHABs and the toxins they produce include nutrient concentrations, light conditions, water temperature, hydrologic conditions, water residence time, and meteorological conditions. These factors change rapidly in aquatic systems, particularly in hydrologically complex and tidal estuaries like the Delta (Kraus et al., 2017). Thus, a robust monitoring program for cyanoHABs and cyanotoxins requires investing in collection of a wide array of parameters. Unfortunately, there has been limited and sporadic cyanotoxin sampling in the Delta to date (Lehman et al. 2005, 2008, 2017; Otten et al. 2017). However, we do know from this work that cyanoHABs occur each year and negatively impact aquatic species at multiple trophic levels in the estuary (Lehman et al. 2010, 2017, 2020, 2021).

Another challenge for monitoring cyanotoxins is that the occurrence of these compounds can be episodic. Thus, discrete sampling programs that occur on a monthly or even bimonthly interval can miss key events and underestimate cyanotoxin risk, or if they capture a high-concentration event can give a false impression that cyanotoxins are a widespread health hazard. The use of SPATT (Solid Phase Adsorption Toxin Tracking) samplers helps address this issue by providing a temporally integrated signal of dissolved cyanotoxin concentrations (Kudela, 2017; Howard et al, 2017; Peacock et al., 2018, Howard et al., 2018). SPATT samplers have been used as a compliment to traditional monitoring programs and can elucidate toxin dynamics and environmental drivers. SPATT samplers have detected cyanotoxins when

simultaneous “grab” samples of water have failed to detect the same cyanotoxins . SPATT captures ephemeral cyanotoxin events that may be missed by discrete water sampling, and exhibits more sensitivity compared with grab samples (Lane et al., 2010, Kudela, 2011; Howard et al., 2017; Kudela, 2017; Peacock et al., 2018). A timeseries of water (particulate fraction) and SPATT samples were collected in San Francisco Bay (SFB) from 2011 to 2016 and analyzed for both cyanotoxins and marine toxins (Peacock et al., 2018). The SPATT results indicated ubiquitous toxins throughout SFB, however, the particulate water samples only captured toxins during some timepoints and generally indicated toxins were not very prevalent. Both particulate and dissolved toxins are concentrated by shellfish (Miller et al., 2010; Gibble et al., 2016) and additional studies found multiple toxins were routinely present in mussels indicating a potential for transfer of toxins throughout the food web (Gibble et al., 2016; Peacock et al., 2018). Therefore, using SPATT samplers as a monitoring tool provided insight into the toxin detections in mussel samples, and the potential for transfer to the food web that the grab samples did not capture (Peacock et al., 2018).

Background

The Sacramento-San Joaquin Delta (Delta) serves as critical aquatic habitat and as a vital drinking water resource for almost 30 million Californians. It is also a physically, biologically, and hydrologically complex system, receiving flows from the Sacramento and San Joaquin Rivers, which drain approximately 40% of California and then move through and merge within the Delta, a maze-like network of interconnected channels and sloughs (Figure 1). Analysis of long-term observational data demonstrate that the Delta is in a state of severe ecological decline (Sommer et al. 2007; Thomson et al. 2010). In particular, the structure and function of habitats and the lower trophic levels has been transformed through invasive aquatic macrophytes, localized issues with low dissolved oxygen, excessive anthropogenic nutrients, and cyanoHABs.

Information about cyanoHABs and cyanotoxins in the Delta are available for the summer and fall months (Lehman et al. 2005, 2008, 2010, 2017; Otten et al. 2017). However, with warmer conditions due to climate change and extended droughts, blooms are starting earlier and lasting longer, suggesting that more extensive temporal sampling is needed to determine the current bloom impact (Lehman et al. 2017). The spatial extent of cyanoHABs is also changing; while these organisms have been detected in the Central and Southern Delta for many years, they have more recently been observed in the northern Delta including the Cache Slough Complex (Figure 1).

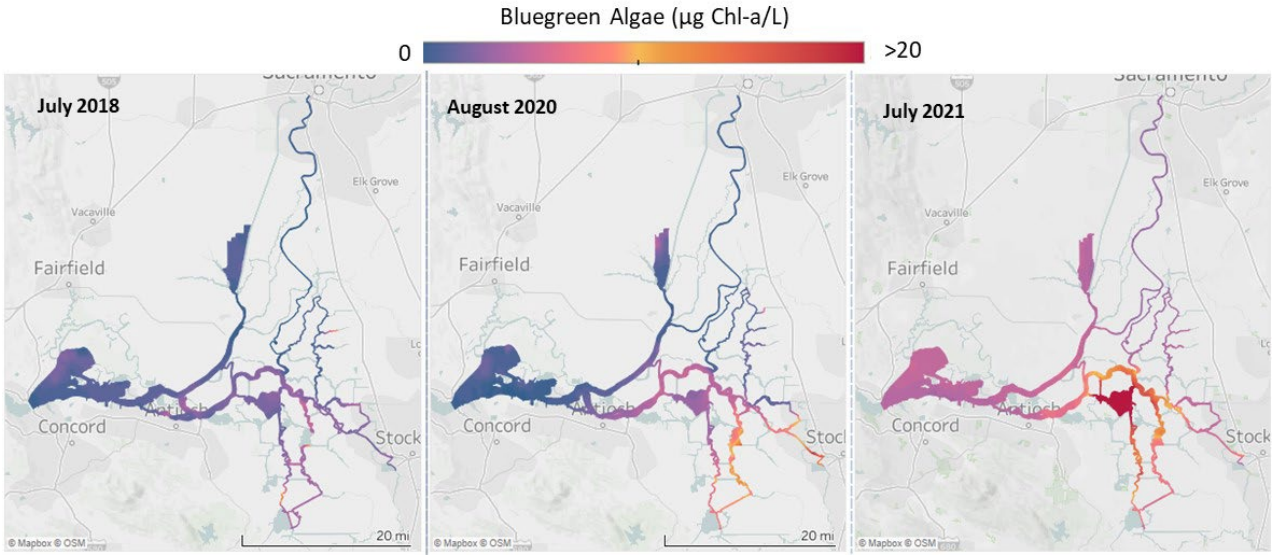

Figure 1. Data collected in July 2018, August 2020 and July 2021 during high resolution boat-based mapping surveys of the study area (Sacramento-San Joaquin Delta, California). Color gradient shows variation in the chlorophyll-a pool attributed to blue green algae (i.e.cyanobacteria) measured using a bbe Fluoroprobe (FP).

In the fall of 2019, the USGS received internal funding to collect cyanotoxins at two USGS continuous monitoring stations in the Delta (Jersey Point (JPT) and Decker (DEC), Figure 2). Then in 2020 the Delta Regional Monitoring Program (DRMP) funded the collection of samples for cyanotoxin analyses at four additional stations: two run by the USGS and two run by DWR (Figure 2). With the internal USGS and DRMP funding in 2020-2021 USGS was able to monitor cyanotoxins in 6 sites, however, both these funding sources expire in early 2022. Fortunately, in 2021 the USGS received funding from the Delta Science Program (DSP) to continue cyanotoxin collection at 5 of these sites. This funding will begin in Spring 2022, but funding was not sufficient enough to cover all previous 6 sites. Without additional funding, cyanotoxins will have to be dropped from one of the monitoring stations – Middle River (MDM).

In addition to cyanoHAB specific projects, the U.S. Geological Survey (USGS) California Water Science Center (CAWSC) and the California Department of Water Resources (CDWR) operate a network of continuous flow and water quality monitoring stations across the Delta (Figure 2). Stations are instrumented with multiparameter sondes that measure water temperature, specific conductance, turbidity, pH, dissolved oxygen (DO), fluorescence of "total" chlorophyll (fCHL), as well as a sensor that measures nitrate (Table 1). These stations are serviced approximately monthly, and at the same time interval discrete water samples are collected to validate and calibrate these instruments (e.g., chlorophyll-a, nitrate) as well as to collect samples for laboratory analyses (e.g., phosphorus, ammonium, dissolved organic nitrogen, phytoplankton identification and enumeration). Most stations report flow, water velocity, and stage, allowing for calculation of constituent fluxes.

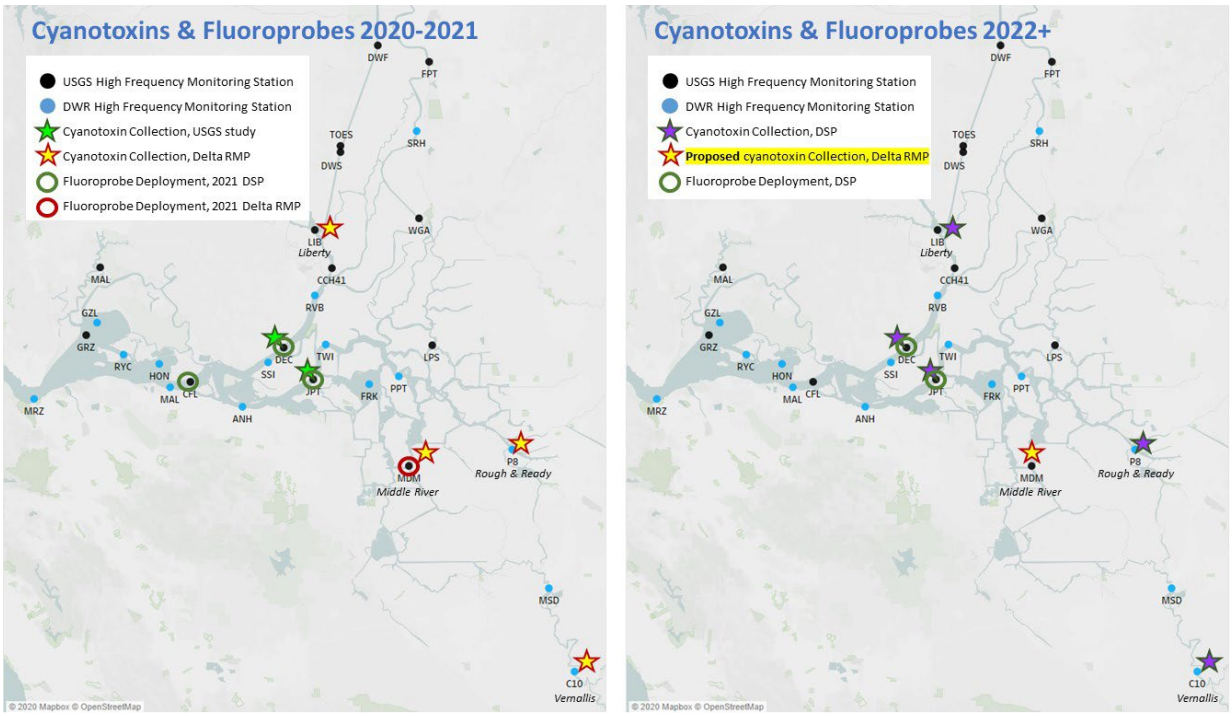

Figure 2. Map of the Delta showing locations of USGS (black circles) and DWR (blue circles) continuous monitoring stations. LEFT panel shows cyanotoxin and fluoroprobe monitoring in 2020-2021 funded by Delta RMP, Delta Science Program (DSP), and internal USGS funds. Funding for all these projects ends in early 2022. RIGHT panel shows cyanotoxin and fluoroprobe monitoring funded by DSP beginning in 2022. The yellow star in the right panel shows the MDM location for cyanotoxin monitoring proposed in this study.

Table 1. Configuration of USGS and DWR continuous monitoring stations.

Type	Description
ADCP, Pressure Sensors	Flow, Discharge, Gauge Height
Infrastructure	Data Collection Platform (Enclosure, Datalogger, wire and cable, telemetry, solar panels, regulators and batteries)
YSI EXO	Temp/Cond sensor
	pH sensor
	D.O. sensor
	Turbidity sensor
	fDOM sensor*
	Total algae sensor (Total chlorophyll (fCHL) and Phycocyanin (PC)
	Central Wiper
	signal output adaptors
SUNA Nitrate Analyzer*	SUNA Nitrate Analyzer*
bbe Fluoroprobe**	chlorophyll attributed to four phytoplankton classes (cyanobacteria, diatoms, green algae, chlorophytes)

*USGS stations only; **planned for MDM, JPT, DEC, CFL stations

Study Objectives

To provide a more comprehensive picture of the seasonal variation of HABs and their associated toxins in the Delta, this study would:

> Collect a full year of measurements of cyanotoxins (March 2022-Februrary 2023) at one station (Middle River, MDM) in the Delta that already have existing, robust monitoring programs, to supplement DSP funding and maintain a network of 6 cyanotoxin monitoring stations in the Delta.

Relevance to RMP Management Questions

The data gathered will provide important information to help stakeholders engaged in the Delta Nutrient Research Plan to determine whether nutrient concentrations and future management of nutrient concentrations could affect the initiation, duration, and source of cyanobacterial species and toxins in the Delta. Simultaneous collection of nutrients, phytoplankton and cyanotoxin data along with other water quality parameters (temperature, specific conductance, DO, pH) also will allow researchers to investigate how the suite of conditions along with nutrient concentrations contribute to HABs. The objectives of the project and how the information will be used relative to the RMP's high-level management questions are summarized in Table 2.

Table 2. Study objectives and questions relevant to RMP management questions.

Core Management Question	Study Objectives/Questions
Status & Trends Is there a problem or are there signs of a problem? a. Is water quality currently, or trending towards, adversely affecting beneficial uses of the Delta? b. Which constituents may be impairing beneficial uses in subregions of the Delta? c. Are trends similar or different across different subregions of the Delta?	**How do harmful algal blooms and cyanotoxin concentrations vary spatially and temporally year-round?** **How are ambient concentrations and trends in HABs and cyanotoxins affected by variability in water quality conditions, particularly nutrients?** Collect cyanotoxin data and associated phytoplankton and water quality variables year-round from MDM to complement sampling occurring at other Delta monitoring stations. Year-round data collection will enable a more comprehensive assessment of the variation of HABs and cyanotoxins and how they are impacted by water quality conditions, flow (i.e., drought) including nutrient concentration.
Sources, Pathways, Loadings, and Processes Which sources and processes are most important to understand and quantify? a. Which sources, pathways, loadings, and processes (e.g., transformations, bioaccumulation) contribute most to identified problems? b. What is the magnitude of each source and/or pathway (e.g., municipal wastewater, atmospheric deposition)? c. What are the magnitudes of internal sources and/or pathways (e.g. benthic flux) and sinks in the Delta?	**Which areas of the Delta are cyanotoxins produced and how are they transported?** **Which sources and levels of nutrients are more closely linked to HAB and toxin formation?** Provide online access to data and spatial and temporal trend plots of nutrient concentrations, associated water quality conditions, phytoplankton abundance and cyanotoxins for managers and scientists.

Core Management Question	Study Objectives/Questions
Forecasting scenarios a. How do ambient water quality conditions respond to different management scenarios b. What constituent loads can the Delta assimilate without impairment of beneficial uses? c. What is the likelihood that the Delta will be water quality-impaired in the future?	**Are cyanotoxin concentrations linked with nutrient concentrations, forms and ratios?** **How will changes to nutrient inputs to the Delta (e.g., WWTP upgrades) affect the development of HABs and cyanotoxins?** Improving understanding of linkages between environmental drivers (nutrients, flow, temperature) on HAB formation, initiation, and duration will assist modeling and targeted data analyses.
Effectiveness Tracking a. Are water quality conditions improving as a result of management actions such that beneficial uses will be met? b. Are loadings changing as a result of management actions?	Data collected by this study can be used to help determine whether cyanotoxins are at concentrations of concern in the Delta and will help managers develop future monitoring programs.

Study Approach

Cyanotoxin monitoring at Middle River (MDM) for 12 months

We will continue to measure cyanotoxins at the Middle River site (MDM). Cyanotoxins will be measured with discrete water samples and solid phase adsorption toxin tracking (SPATT) samplers. The MDM station is currently equipped with a YSI EXO (water temperature, specific conductance, turbidity, pH, dissolved oxygen, chlorophyll-a/BGA), a SUNA nitrate analyzer, and a bbe Fluoroprobe (Table 1).

Previous studies suggest that cyanotoxin concentrations in the Delta are higher in the summer and fall and lower in the winter and spring, thus we will collect samples approximately every 4 weeks (monthly) in the winter and spring, and approximately every 2 weeks in the summer and fall, for a total of 18 sample dates at MDM. Monthly (12 per year) water samples are collected at these stations under existing USGS and DWR programs, so additional samples for nutrients, phytoplankton enumeration, and picoplankton counts only are needed under this study for the 6 additional sampling dates (Table 3).

SPATT samples: The use of SPATT samplers (Figure 3) has recently been refined as a monitoring tool to compliment traditional discrete sampling programs by providing a time-integrated indicator of dissolved toxin presence (Lane et al., 2010; Kudela, 2011; Howard et al., 2017; Kudela, 2017, Peacock et al., 2018; Roue and others, 2018). SPATT samplers will be constructed in the USGS laboratory following methods described in Howard and others (2018). SPATTs will be deployed adjacent to sonde measurements. Each SPATT will be deployed for approximately two weeks; when one sampler is removed from the station a new one will immediately be deployed in its place. SPATT bags will be placed in ziplock bags, placed immediately on dry ice in the field, kept frozen (-80° C), and then sent to the laboratory (Lumigen Instrument Center, http://chem.wayne.edu/lumigen/director.html) for extraction and analysis. All (100%) SPATTs will undergo analysis via the method of liquid chromatography with tandem mass spectrometry (LCMS-MS) for the detection of cyanotoxins listed in Table 2. Upon review of LCMS-MS data – a subset of samples (~20%) will be selected for analysis via the method of enzyme-linked immunosorbent assay (ELISA) by BSA Environmental Services (https://www.bsaenv.com/), which is limited to the detection of four cyanotoxins (Table 3). Cyanotoxin methods of analysis differ by state and federal entities – analyses of SPATTs from this study using both analytical methods allow for data and method comparability across different HABs-funded studies.

Discrete water samples: In addition to collecting SPATTs, we will collect discrete whole water samples concurrent with the removal/placement of SPATTs (approx.18 times per year), which is concurrent with sample collection for analytes listed in Table 3. Whole water samples will be placed immediately on dry ice in the field, kept frozen (-80° C), and then sent to the laboratory (Lumigen Instrument Center) for analysis. All (100%) whole water samples will undergo analysis via LCMS-MS and – upon review of LCMS-MS data – a subset of samples (~20%) will be selected for analysis via ELISA (BSA Environmental Services). Again, analysis of discrete water samples from this study using both analytical methods allows for data and method comparability across different HABs-funded studies.

Figure 3. Photo showing the planned system for deploying SPATT at fixed locations.

The goal of implementing SPATT into this proposed study is as a monitoring tool to provide a robust, comprehensive approach to determining toxin patterns and dynamics within the Delta that traditional water grab samples alone can miss. We are very much aware of all the confounding factors that make SPATT cyanotoxin collection challenging to interpret compared to whole water samples, particularly because relating cyanotoxin data obtained from SPATT samplers to a health advisory threshold is not straightforward. The study objective is not to relate SPATT results to human health regulations, but rather to use SPATT as a separate, complementary sampling tool with water grabs to elucidate the prevalence of toxins and to capture ephemeral events that water grab samples can miss. That is why we are collecting SPATT only in conjunction with the more traditional whole water method, which is more easily applicable to health advisories.

Table 3. List of parameters determined approximately monthly at the proposed monitoring station at Middle River (MDM). Funding from this proposal will cover cyanotoxin analysis for 18 sampling dates (18 dates, plus replicates and blanks), and analyses of other parameters not covered by other efforts.

Parameter	Approx. # Samples ($ this study)	*Approx. # Samples ($ other)*	Information Provided
Nitrate (NO3-N) (µM) **Nitrite (NO2-N)** (µM)	8	*14*	nitrogen as nitrate available for biological uptake; laboratory measurement to verify and calibrate in-situ data, increases due to nitrification or new inputs, decreases due to uptake and denitrification
Ammonium (µM)	8	*14*	nitrogen as ammonium available for biological uptake; tracer of wastewater source; shown to impact phytoplankton abundance, species composition, and primary production; increases due to mineralization or inputs decreases due to nitrification and uptake
Total Dissolved Nitrogen (TDN) (µM)	8	*14*	total nitrogen in the dissolved phase used to track the total N budget
Dissolved Organic Nitrogen (DON) (µM)	8	*14*	includes only the dissolved organic nitrogen fraction, used to track the total N budget; tracer of water source: Calculated as TDN-NO3-NO2-NH4
soluble reactive phosphate (SRP, PO4) (µM)	8	*14*	required nutrient for phytoplankton; has been shown to be inhibitory at high concentrations; tracer of water source
Chlorophyll-*a* & Phaeophytin (mg L^{-1})	0 (*no mid-month chla collection because have continuous chla data from sonde*)	*14*	laboratory measurements to verify and calibrate in-situ fCHLA data; phaeophytin to chlorophyll-a ratio provides information about algal growth versus senescence; tracer of water source
Phytoplankton Enumeration (cells L-1 and cm^3 L-1 by species)	8	*14*	microscope analysis for phytoplankton species identification, counts and biovolume; provides information about phytoplankton abundance and species composition; identifies whether the phytoplankton pool is made up of beneficial or harmful species; indicator of nutritional quality of the phytoplankton pool
Picocyanobaceria (cells L^{-1} and cm^3 L^{-1})	8	*14*	epifluorescence analysis that identifies picocyanobacteria (< 2 microns); identifies fraction of the phytoplankton pool that is made up of small cyanobacteria that are believed to be less favorable to the health of the food web
Cyanotoxins Whole Water (µg L^{-1}) SPATTs (ng g^{-1} day^{-1})	 20 20	--	**LCMS-MS** analysis for the detection of Anabaenopeptins, Anatoxin-a, BMAA, Cylindrospermopsin, Microcystins, Nodularins, and Saxitoxins
Cyanotoxins Whole Water (µg L^{-1}) SPATTs (ng g^{-1} day^{-1})	 5 5	--	**ELISA** analysis for the detection of microcystins, anatoxins, cylindrospermopsins, and saxitoxins

Project Timeline

- **Project Start-End Dates**
  - March 1, 2022 through December 31, 2023
- **State FY21-22 (March 2022 – June 2022)**
  - Collect and analyze samples March 2022 – June 2022 (4 months of data)
  - Updates to RMP and data sharing upon request
- **State FY22-23 (July 2022 – June 2023)**
  - Collect and analyze samples July 2022 – February 2023 (8 months of data)
  - Updates to RMP, data sharing upon request, initial data analysis
- **FY23-24 (July 2023 – June 2024)**
  - Public release of final data
  - Final report to RMP due December 2023

Table 4. Timeline for data collection, analysis and reporting

TIMELINE

Federal FY	FY2022												FY2023												2024												2025					
State FY	2021-22												2022-2023												2023-2024												2024-2025					
Calendar Year:	2022												2023												2024																	
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D						
Data collection																																										
Data analysis																																										
Draft Report																																										
Final Report																																										

Deliverables

- Cyanotoxin and other data will be made available within 6 months following receipt of data from laboratory via the USGS database systems (NWIS and/or ScienceBase), or upon request. These data will also be made available using online visualization tools (e.g., https://tableau.usgs.gov/views/Bay_Delta_Portal/Portal?:embed=yes)
- Results will be reported to the Delta RMP, local conferences (e.g. Bay Delta, IEP), and upon request.
- A report that describes the approach and methods, summarizes any issues or lessons learned that occurred during data collection, provides tabular and/or graphical summaries of the spatial and temporal patterns in the data, evaluates the data quality, and relates study findings to the Delta RMP management questions will be provided at the end of the agreement. The report will also include comparison between the whole water and SPATT data and between the LCMS-MS and ELISA data.
- We anticipate data from this study along with other relevant data collected by the USGS and DWR through other funded cyanoHAB projects will be incorporated into a journal article, IEP Newsletter article, and/or USGS report.

Budget

This budget will cover USGS staff time and associated costs (e.g., boats, vehicles, fuel, supplies, instrument costs, travel, chlorophyll and nutrient analyses, phytoplankton enumeration, data analysis, presentations, data release, and report writing). This budget assumes the Delta RMP will contract directly with BSA Environmental and/or Lumigen Laboratories to cover analytical costs for cyanotoxins.

The total amount requested from the Delta RMP under this agreement is **$103,912**

USGS will contribute $18,106 in cooperative match dollars to this study.

In Kind Contributions: Well over $400,000 in equipment and annual cost sharing will be provided by the USGS to support monthly field visits (staff time, boats, vehicles, fuel, sampling equipment), analytical costs associated with samples listed in Table 2 that are collected monthly at MDM and collection of in situ continuous monitoring data at MDM.

Budget Breakdown

	DRMP Contribution	USGS Match
Cyanotoxin Analysis, Direct*	$23,580	$0
USGS data collection	$60,230	$12,991
USGS reporting	$20,102	$5,026
TOTAL, by entity	**$103,912**	**$18,016**
Project total		$121,928

*Cyanotoxin analytical costs will be paid directly to Lumigen Laboratories and/or BSA Environmental. If these samples are routed through the USGS the cost will increase to $33,720.

Analytical Costs associated with cyanotoxin analysis*

ANALYTICAL COSTS	Lab Cost per sample (2022)	Samples per year/ site	TOTAL Costs	Lumigen Lab	BSA Env. Lab
Whole Water - LCMS-MS	$400	18	$7,200	$7,200	$0
SPATT samplers - LCMS-MS	$475	18	$8,550	$8,550	$0
Whole Wate - ELISA	$400	4	$1,600	$0	$1,600
SPATT samplers - ELISA	$575	4	$2,300	$400	$1,900
TOTAL/yr, without QAQC			$19,650	$16,150	$3,500
TOTAL/yr, ~20% QA/QC			**$23,580**	$19,380	$4,200

**As noted above, this assumes a contract can be signed directly with Lumigen Labs and/or BSA Environmental. If these analyses are instead routed through a USGS agreement, the cost will increase to $33,720.*

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