Managing Environmental Contamination of Wetland Habitats in the Bay-Delta: Balancing Regional Exports with Wildlife Health (BREWing Health)

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Introduction

The San Francisco Bay-Delta has a legacy of mercury contamination from historic mining and this source of inorganic mercury into the Bay-Delta watershed will persist for thousands of years (Singer et al. 2013). Inorganic mercury is then methylated by microbial activity into methylmercury within Bay-Delta wetlands and waterways, and this is the form of mercury that biomagnifies through aquatic food chains and poses a significant health risk to fish, wildlife, and humans. Aquatic environments within the Bay-Delta have conditions which are conducive to methylmercury production (Marvin-DiPasquale et al. 2003), and methylmercury pollution in the Bay-Delta is widespread and is having toxic effects on animals (Ackerman et al. 2014*a*). State regulators have mandated large reductions in methylmercury produced within Bay-Delta wetlands and waterways (Wood et al. 2010), and specific wetland management practices are urgently needed to reduce methylmercury production and bioaccumulation.

Problem

Wetland environments provide numerous ecological benefits (Mitsch 2005). However, wetlands often have increased methylmercury production compared to other aquatic habitats, because biogeochemical conditions common within wetlands facilitate methylation of inorganic

mercury to its more toxic form (Krabbenhoft et al. 1995, Marvin-DiPasquale et al. 2003, Hall et al. 2008). Consequently, wetlands contribute substantially to mercury bioavailability within downstream environments (St. Louis et al. 1994, Hurley et al. 1995) as well as to *in situ* bioaccumulation locally (Snodgrass et al. 2000, Ackerman and Eagles-Smith 2010a,b).

The California Central Valley Regional Water Quality Control Board has identified wetlands as a predominant source of methylmercury to Total Maximum Daily Loads (TMDL) in the Sacramento–San Joaquin River Delta (Wood et al. 2010). Among the Delta's sub-watersheds, the Cosumnes watershed is particularly problematic and may be required to reduce methylmercury loadings by 64% in order to meet TMDL goals (Wood et al. 2010).

Currently, the TMDL process regulates only the pollution that is discharged into Delta Channels, but does not consider pollution within source areas. Because wetlands are known to be sites of elevated methylmercury production, wetlands are considered sources by the regulatory process. Wetland managers, and land managers in general, will therefore have to comply with a regulatory policy that evaluates only the net discharge from wetland outlets. This policy framework may be harmful to many species of fish and wildlife because management actions that seek to reduce loads from wetlands into downstream habitats (the waterways of the Delta) may be elevating pollution within the wetlands themselves. For example, a simple way to reduce loads from wetlands is to restrict water flow out from wetlands. This management strategy to reduce export of methylmercury could be applied to rice fields or reverse-cycle seasonal wetlands which are irrigated during the summer growing season and have high rates of evaporation. Yet, this strategy of limiting flow through and evaporating water from wetlands would likely have a negative effect on local fish and wildlife which rely on wetlands for foraging habitat. Seasonal wetlands and flooded rice fields in particular are known to have among the highest concentrations of methylmercury in biota relative to other water bodies within the Bay-Delta (Ackerman and Eagles-Smith 2010a, Windham-Myers et al. 2010). Therefore, fish and wildlife are already at considerable risk to mercury contamination in wetlands, and management actions that seek to reduce export to the Delta could exacerbate this contamination problem.

Relevance and Benefits

We propose a comprehensive land management approach that considers both methylmercury exports to the Delta and bioaccumulation within Delta wetlands themselves.

This approach considers the health of the complete Delta ecosystem, including the Delta itself as well as within the wetlands adjacent to the water conveyances within the Delta landscape. Considering the larger Delta ecosystem is a necessity because the wetland habitats that are considered to be methylmercury sources are much more productive biologically then the more open water channels of the Delta. Most wildlife, including migratory birds, are located within these adjacent wetlands. Importantly, the Bay-Delta watershed contains numerous State and Federal Wildlife Refuges (such as the Cosumnes River Preserve, Yolo Bypass Wildlife Area, and Grizzly Island Wildlife Area) which manage thousands of acres with the mandate of promoting wildlife value. In particular, the Central Valley of California is a major wintering area for migratory birds, with nearly 5 million waterfowl wintering in the Bay-Delta watershed, accounting for 68% of the waterfowl in the Pacific Flyway (Ackerman et al. 2014*c*). Thus, most of the land managers within the Bay-Delta ecosystem are more concerned with managing their wetlands to promote wildlife value and less concerned about the export of any pollutants travelling downstream. Therefore, our proposed approach attempts to benefit wildlife management as well as pollutant regulatory policies.

Objectives and Scope

Our objectives are to reduce methylmercury export from wetlands, as well as simultaneously reducing local bioaccumulation within wetlands by modifying the physical structure of wetlands to enhance the naturally occurring biogeochemical and hydrologic processes that might reduce methylmercury in surface waters.

In collaboration with the Cosumnes River Preserve and U.S. Bureau of Land Management, we constructed 4 deep-water treatment cells at the downstream-end of wetlands where mercury-contaminated water is held for naturally-occurring methylmercury removal processes to occur, such as particulate settling and photodemethylation, before the water is exported to the Bay-Delta. These 4 treatment wetlands will be compared to 4 control wetlands.

These wetlands were constructed in the fall 2014, and we tested their ability to remove mercury from surface waters and fish in the springs of 2015 and 2016. The project we are proposing for USGS PES funds builds off an existing project funded by the State Water Board ($750k) and Ecosystem Restoration Program ($450k) during 2014-2016. We are specifically

seeking funds to continue studying these constructed wetlands in 2017 (year 3) when no other funding is available.

This third year is critically important to the project's success because methylmercury concentrations often spike in the year immediately following large-scale soil disturbance and wetland construction activities, and 2 years of study will likely not be enough to assess the effectiveness of the implemented wetland management strategy. For example, a recent tidal marsh restoration project for the South Bay Salt Pond Restoration Project in San Francisco Bay resulted in a huge short-term spike in methylmercury concentrations in bird eggs and fish, elevating concentrations far above toxic benchmarks, but mercury contamination levels fell back to ambient conditions by year 3 of the project (Ackerman et al. 2013, 2014*b*). Because considerable dirt-moving activities were associated with the construction of these treatment wetlands, a similar short-term spike in mercury contamination is expected, and we need to get to year 3 in order to truly test the effectiveness of our treatment wetlands. Additionally, this project is cost effective because it leverages over $1.2 million in funds and wetland construction activities have already been completed.

In year 3 of the project, our specific objectives are to determine if:

1) fish mercury concentrations in treated wetlands are lower than in control wetlands 3 years after wetland construction.
2) water mercury concentrations and export from treated wetlands are lower than in control wetlands 3 years after wetland construction.

Approach

The Delta Methylmercury TMDL Non-Point Sources Workgroup has identified and evaluated a series of management practices that might reduce methylmercury export from natural and agricultural wetlands. Among the approaches evaluated, treatments ponds, such as permanent wetlands, are thought to be among the most feasible and likely to reduce methylmercury loading into the Delta. This approach would require treatment ponds to be built near agricultural and natural wetland complexes and their water to be directly routed to these treatment ponds. There, polluted water from these wetlands would be held in deep treatment ponds where particulate settling and photodemethylation could reduce methylmercury concentrations in exported water. Recent studies suggest that permanent wetlands, which are an

example of the types of treatment ponds that could be built, may be net sinks for methylmercury (Ackerman and Eagles-Smith 2010a, Windham-Myers et al. 2010, Windham-Myers and Ackerman 2012). Net removal and degradation of methylmercury in permanent wetlands appears to be a characteristic of deeper, open-water wetlands on mineral soils with low water flow, low turbulence, and little vegetation cover. There are several reasons why these characteristics allow for biogeochemical and hydrologic processes that might reduce methylmercury in surface waters (Windham-Myers and Ackerman 2012), but the important point is that treatment ponds appear to be a viable management practice to reduce methylmercury loads when given the opportunity.

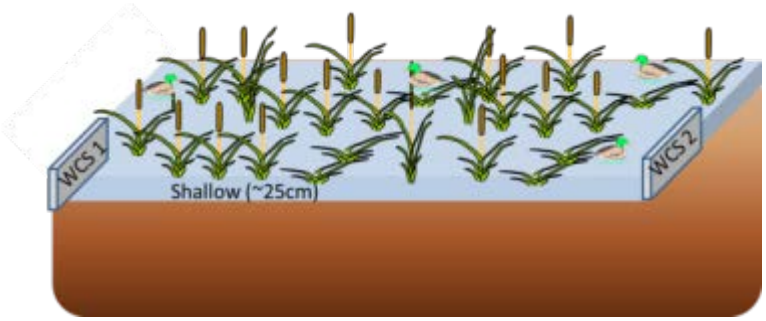
Although treatment ponds are intriguing, their scalability across the Delta landscape would be difficult. It would be necessary to build treatment ponds adjacent to each wetland complex and then route wetland water directly to the treatment pond. However, it can be costly to construct treatment ponds, and often water from wetlands cannot be routed directly to a treatment pond. Because of the costs and logistical hurdles, this approach may not be scalable to the landscape level across the Bay-Delta watershed. In addition, whereas treatment ponds may reduce methylmercury loads into the Delta, they do little to clean the water within the wetlands themselves. Yet, these agricultural and natural wetlands are often managed for the express purpose of fish and wildlife, and receive heavy use by wildlife during both summer and winter. Thus, local wildlife may still be exposed to high levels of methylmercury within wetlands, even as exported methylmercury loads might be reduced.

Therefore, we proposed a modification of the treatment pond idea, to meet the dual goals of reducing methylmercury export as well as reducing methylmercury concentrations within wetlands themselves and the subsequent bioaccumulation of methylmercury in fish and wildlife. We proposed to modify existing wetlands such that each individual wetland contains its own "treatment pond." Each wetland would be modified to contain the same characteristics that successfully reduced methylmercury export and bioaccumulation in permanent wetlands. In short, each wetland was modified to create the biogeochemical and hydrologic processes that might reduce methylmercury in surface waters.

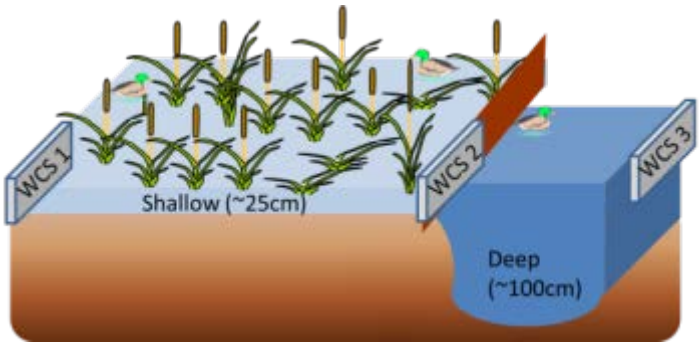
Wetlands were modified by adding an internal "check" levee near the outlet that effectively divided the wetland into two parts – an upstream wetland that is managed traditionally and a downstream 5-10-acre "treatment pond" that is managed to have deep, slow

moving water, and devoid of vegetation (**Figure 1**). **Figures 2 and 3** provide a map of the study area and aerial pictures of 2 of the 8 wetlands used in the study.

Figures 1A and 1B. *Graphical depiction of control (A) and treatment (B) wetlands to reduce methylmercury contamination of fish and wildlife within the wetlands as well as in down-stream Delta habitats. Water control structures (WCS) have been installed for monitoring hydrologic and mercury loads.*



A. *Control Wetland (standard seasonal wetland)*



B. *Treatment Wetland (standard seasonal wetland with deep-water "mercury-cleaning" cell)*

The treatment pond was built within the wetland by moving dirt from the treatment pond area and using it to build a check levee that divided the wetland into two parts. This has the dual

goal of making the treatment pond deeper and removing vegetation to provide more characteristics that promote methylmercury removal processes. The check levee provides management control over the hydrologic flow into the treatment pond. The treatment pond size at 1m depth was constructed so it would contain the same volume of water (10-20 acre feet) as in the upstream portion of the wetland at 25cm depth (**Table 1**). Surface waters experience methylmercury enrichment as they pass through the shallow upstream portion of the wetland, but methylmercury degradation as they move through the treatment pond area. Because processes of methylmercury removal (photodemethylation and particle settling) are concentration dependent, the greatest decreases in methylmercury concentrations will likely be achieved within the first few days of water residence. Thus, the treatment pond and associated management practices could provide increased potential for photodemethylation and particulate settling that could lead to reduced methylmercury export from wetlands. While the surface water will generally follow a path and thus have limited mixing, average water methylmercury concentrations within wetlands would be reduced and a lower methylmercury concentration refuge would be established. Methylmercury bioaccumulation within treated wetlands, therefore, may also be reduced.

This management practice could be widely applied across the Bay-Delta with only slight modifications to current land management practices to seasonal and permanent wetlands, as well as agricultural wetlands, such as rice fields.

Table 1. *Wetland construction and management activities to achieve the desired water depth and volume of water treated. Italics indicate the deep portion of the treated wetland.*

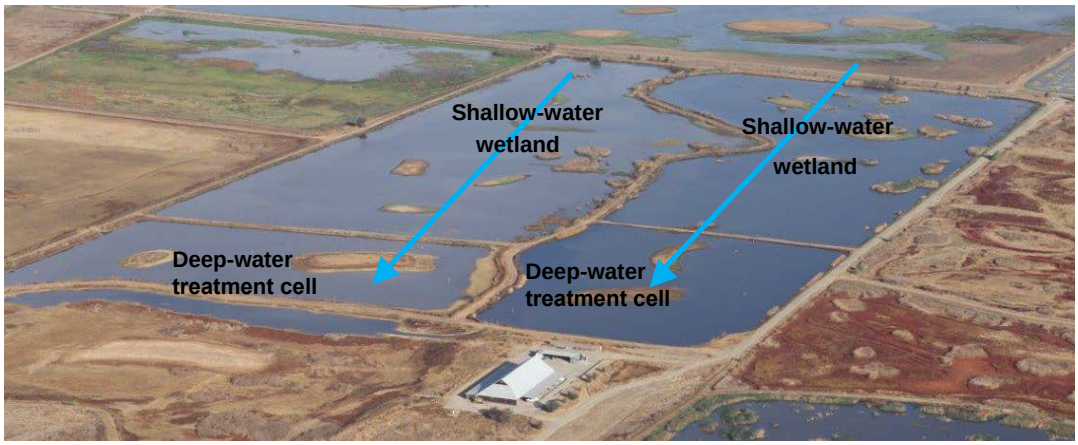
Wetland Type	#	Cell	Acreage Scraped	Acreage Mowed	Acreage Disked	Dominant Vegetation	Average Depth (cm) (AVG ± SD)	Average Volume (acre feet)
Treatment	*1*	*Deep 01*	*4.5*	*x*	*x*	*Swamp timothy*	*73±7.3*	*10.6*
Treatment	1	Shallow 01	x	13.6	11.7	Barren	33±18	27.1
Treatment	*7*	*Deep07*	*7.0*	*x*	*X*	*Primrose*	*82±6*	*12.0*
Treatment	7	Shallow 07	x	7.1	5.9	Barren	22±8	12.4
Treatment	*17*	*Deep 17*	*8.2*	*x*	*x*	*Swamp timothy*	*80±10*	*14.8*
Treatment	17	Shallow 17	x	9.5	10.2	Barren	38±3	15.0
Treatment	*18*	*Deep18*	*5.8*	*x*	*x*	*Swamp timothy*	*91±21*	*17.1*
Treatment	18	Shallow 18	x	9.7	8.2	Barren	33±15	29.1
Control	2	Control	x	8.3	7.0	Rush	37±30	15.3

		02						
Control	6	Control 06	x	10.6	9.7	Swamp timothy	19±5	20.3
Control	9	Control 09	x	13.5	6.1	Swamp timothy	28±21	19.6
Control	13	Control 13	x	17.1	7.7	Swamp timothy	12±3	24.8

Map of Study Area

Figure 2. *Four wetlands with deep-water treatment cells and an internal "check" levee were constructed (bordered by blue lines) and compared to 4 control wetlands (bordered by green lines) at the Cosumnes River Preserve demonstration area. The four control wetlands received traditional wetland management and will be monitored similarly to the treatment wetlands.*

Figure 3. *Example of two of the treatment wetlands (wetland 17 and 18 labeled in Figure 2), with deep-water treatment cells at the downstream end, at Cosumnes River Preserve. The blue lines show the direction of water flow.*



Methods

Fish Bioaccumulation

Mercury concentrations in fish and water samples will be measured in the eight project wetlands during the third year after the treatment wetlands were construction, with a project design focused on quantifying methylmercury export and bioaccumulation rates, and how these rates respond to the management practice being tested.

To assess the influence of open-water cells on mercury bioaccumulation, we will use caged western mosquitofish (*Gambusia affinis*) as biosentinels for time-integrated changes in methylmercury concentrations, following the methods of Ackerman and Eagles-Smith (2010) and Eagles-Smith et al. (2014). During spring 2017, 20-30 mosquitofish will be deployed in ~450 liter mesh cages within each of the eight project wetlands. Treatment wetlands will have fish deployed at four sites within each of the 4 wetlands: 1) shallow wetland inlet, 2) shallow wetland outlet just upstream of the inlet to each open-water cell, 3) deep-water cell inlet, and 4) deep-water cell outlet prior to the final discharge of water to the Cosumnes River and downstream Delta (**Figure 2**). Each of the 4 control wetlands will also have four sites for deployment of caged fish. In total, we will deploy 30 mosquitofish in each of 32 cages, totaling 960 fish. Each fish cage will be in place for 30 days and then 20 mosquitofish from each cage will be randomly collected for total mercury determination. Additionally, 30 reference mosquitofish collected at the time of deployment will be tested as reference fish to establish baseline mercury concentrations before fish have been deployed. Mosquitofish originate from our long-term partnership with the Sacramento-Yolo Vector Control, and have near zero mercury concentrations (Ackerman and Eagles-Smith 2010).

Water Mercury and Export

To assess the influence of open-water cells on methyl mercury export, surface water samples of total mercury and methyl mercury and estimates of hydrologic flow will be coupled for load calculations at 6 of the 8 wetlands (3 of the 4 replicate fields for control and treatment,

to reduce costs). Flow will be calculated from water height over a weir, monitored at hourly intervals using in situ pressure transducers and calibrated by manual measurements at least weekly (conducted by the USBLM field staff). Water samples will be collected approximately every 8 weeks throughout the 35-week flooded period (roughly September through May) to characterize seasonal changes in water quality (conducted by the USGS CAWSC field staff). The samples will be filtered at the USGS CAWSC laboratory and analyzed for both the particulate (>0.3) and dissolved (<0.3 µm) fractions of total mercury and methyl mercury at the Menlo Park Mercury Lab (USGS WR-BRR, NRP). Sample splits will be collected for chloride and sulfate analysis (USGS NRP) to augment quality assurance of the hydrologic calculations. Basic water quality parameters (i.e., conductivity, pH, DO, temperature, turbidity) will be collected by USGS CAWSC field staff using an in situ multi-parameter sonde (YSI EXO2, Yellow Springs, Ohio) at each water control structure during the water collection. Dissolved organic matter quantity and quality (e.g., to separate algal vs. terrestrial sources) will be analyzed at the USGS CAWSC organic matter research lab if additional funding is received from other solicited sources. Laboratory derived concentrations will be integrated with calculated flow to determine loading from each wetland cell and treatment. Chloride loading will be used as a conservative tracer to verify water flow path allocation to determine mercury loads. A method blank will be collected for each sampling event and field sampling precision will be assessed by collecting replicate samples at 10% of the locations during each event.

Mercury Determination, Quality Assurance, and Quality Control

Fish Bioaccumulation

Mosquitofish methylmercury concentrations are highly correlated with total mercury concentrations, and 94% of the total mercury in mosquitofish is comprised of methylmercury (Ackerman and Eagles-Smith 2010). We therefore will use total mercury concentrations as an index of methylmercury concentrations.

After mosquitofish retrieval, we will determine total mercury concentrations in mosquitofish samples on a whole-body basis. Total mercury concentrations will be determined at the U.S. Geological Survey, Dixon Field Station Environmental Mercury Lab on a Nippon MA-3000 Direct Mercury Analyzer (Nippon Instruments, College Station, Texas) following Environmental Protection Agency Method 7473 (U.S. Environmental Protection Agency 2000),

using an integrated sequence of drying, thermal decomposition, catalytic conversion, and then amalgamation, followed by atomic absorption spectroscopy. Prior to total mercury analysis, each fish will be washed in deionized water while manually scrubbing the fish's surface to remove any surface debris, dried at 50°C for approximately 48 hrs, and then homogenized to a fine powder with a porcelain mortar and pestle.

Quality assurance measures will include analyses of certified reference materials (either dogfish muscle tissue [DORM], dogfish liver [DOLT], or lobster hepatopancreas [TORT] certified by the National Research Council of Canada, Ottawa, Canada, or fish homogenate [IAEA] certified by the International Atomic Energy Agency), two system and method blanks, three continuing calibration verifications, and two duplicates per batch.

Water Mercury and Export

The water samples will be analyzed for mercury species, total suspended sediment (TSS) concentration, and anions (chloride and sulfate) at the mercury research laboratory in Menlo Park (USGS NRP). For particulate species analysis, pre-weighed filters (<0.3 μm, GFF, MFS Advantec) loaded with suspended sediment during filtration will be freeze-dried, placed in a desiccator, and reweighed. The original weight of the filter subtracted from the final weight and divided by the volume of water filtered to obtain a volumetric measurement of TSS concentration, in milligrams per liter (mg/L). After TSS values are calculated, the samples will be analyzed for their respective mercury species and normalized to the volume of water filtered. One filter from each site will be analyzed for total mercury using the method described by Olund et al. (2004). The gravimetric concentration of total mercury (THg) in particulates is reported as pTHg-g in nanograms per gram, dry weight (ng/g dw). Taking into account the volume of water filtered, the particulate THg concentration (pTHg) is also reported in volumetric units as nanograms per liter (ng/L). A second filter will be analyzed for methyl mercury (MeHg) using the method described by Niessen et al. (1999) and reported as pMeHg-g (gravimetric, in ng/g) and pMeHg (volumetric, in ng/L). Samples for THg in the filtrate were analyzed according to U.S. Environmental Protection Agency Method 1631 Revision E (U.S. Environmental Protection Agency 2002), with quantification using cold-vapor atomic-fluorescence spectrometry (CVAFS) on a Model 2600 Automated Total Mercury Analyzer (Tekran, Inc., Canada) and reported as fTHg (in ng/L). Filtrate MeHg will be analyzed by distillation followed by ethylation (DeWild et

al. 2002), which converts MeHg to methylethlylmercury (U.S. Environmental Protection Agency 2001), with subsequent quantification by using CVAFS detection on a MERX automated MeHg analyzer (Brooks Rand Laboratories, Seattle, Wash.) and reported as fMeHg (in ng/L). Chloride and sulfate concentrations will be measured using an ion chromatograph (Dionex Corp., Sunnyvale, CA).

Products

We will produce a peer-reviewed publication, a final report which includes all years of the project, and several presentations to local outlets to transfer the information to Bay-Delta land managers (such as the Delta Tributaries Mercury Council and Bay-Delta Science Conference).

Timeline

The wetlands have already been constructed and are being constantly managed by Cosumnes River Preserve staff. Field work for the science assessment will be conducted in spring and summer of 2017. Lab work will consist of fish and water processing and mercury determination and will be conducted in fall and winter of 2017/2018. Data analysis and report preparation will be conducted in 2018, with a final report due December 2018.

Personnel

Below are the Principal Investigators of the project and additional Biologists and Biological Technicians will be needed at each of the above field stations to complete the project as noted in the budget.

- Dr. Josh Ackerman, USGS WERC; *Mercury Bioaccumulation in Fish*
- Jacob Fleck, USGS CWSC; *Hydrologist*
- Dr. Collin Eagles-Smith, USGS FRESC; *Mercury Bioaccumulation in Fish*
- Dr. Mark-Marvin DiPasquale, USGS NRP, Menlo Park; *Biogeochemistry*
- Dr. Lisa Windham-Myers, USGS NRP, Menlo Park; *Plant Ecologist*
- Harry McQuillen, USBLM, *Manager of Cosumnes River Preserve*

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Budget

We are requesting funds for 1 field year (2017) to extend the currently funded 2-year project. However, we have split our request into 2 fiscal years, because this project requires considerable laboratory work, data analysis, and writing that will mostly be done in year 2 (2018). The initial construction cost of wetlands and 2-years of study from 2015-2016 were funded by State Water Board ($750k) and Ecosystem Restoration Program ($450k). These funds will have been spent by 2017.

We are requesting funds ($363k total) to extend our study for a third year in 2017. For 2017, we will have substantial in-kind support from USBLM and Cosumnes River Preserve for wetland management, coordination, and collaboration, and we are requesting an additional $37k to help defray their management costs. We are requesting an additional $326k for science to assess wetland management success using fish as biosentinels of mercury contamination within the wetlands and sampling of mercury in water to calculate loads.

If an additional $65,000 in funds are available, we could add additional water mercury sampling to bring the experimental treatment back to the original 4 full replicates (this was reduced from 4 to 3 replicates in this current proposal to save on costs) and we would increase the water sampling frequency from 4 to 6 times per year (in the first 2-years of study we sampled 8 times per year; cutting the water sampling from 8 to 4 samples was another cut we made to reduce costs in this current proposal). This increase would bring the total project fund request to $428k.

		FY2017		FY2018		Total
GRAND TOTAL	**$**	**187,946**	**$**	**175,150**	***$***	***363,096***
USGS WERC (fish field sampling and lab mercury)		FY2017		FY2018		Total
1. Operating Expenses	$	1,250	$	-		
2. Supplies and Equipment	$	1,000	$	-		
3. Salaries	$	42,173	$	36,112		
4. Laboratory Sample Processing and Mercury Determination (50% of fish)	$	-	$	25,125		
Sub-Total	**$**	**44,423**	**$**	**61,237**		
Overhead at 25.341%	$	11,257	$	15,518		
WERC Total	**$**	**55,680**	**$**	**76,755**	***$***	***132,435***
USGS FRESC (fish field sampling and lab mercury)		FY2017		FY2018		Total
1. Operating Expenses	$	3,120	$	1,250		
2. Supplies and Equipment	$	1,000	$	-		
3. Salaries	$	29,183	$	14,323		
4. Laboratory Sample Processing and Mercury Determination (50% of fish)	$	-	$	25,125		
Sub-Total	**$**	**33,303**	**$**	**40,698**		
Overhead at 21%	$	6,994	$	8,547		
FRESC Total	**$**	**40,296**	**$**	**49,245**	***$***	***89,541***
USGS CAWSC (water field sampling)		FY2017		FY2018		Total
1. Operating Expenses	$	1,000	$	-		
2. Supplies and Equipment	$	3,800	$	-		
3. Salaries	$	17,200	$	18,000		
Sub-Total	**$**	**22,000**	**$**	**18,000**		
Overhead at 51.343%	$	11,295	$	9,242		
CAWSC Total	**$**	**33,295**	**$**	**27,242**	***$***	***60,537***
USGS NRP Menlo (water lab mercury)		FY2017		FY2018		Total
1. Laboratory Sample Processing and Mercury Determination (100% of water)	$	18,645	$	18,645		
Sub-Total	**$**	**18,645**	**$**	**18,645**		
Overhead at 17.5%	$	3,263	$	3,263		
NRP Total	**$**	**21,908**	**$**	**21,908**	***$***	***43,816***
USBLM (Cosumnes River Preserve land managment)		FY2017		FY2018		Total
1. Salaries and Equipment Maintenance for Water and Land Management	$	34,685	$	-		
Sub-Total	**$**	**34,685**	**$**	**-**		
USGS Passthrough Overhead at 6%	$	2,081	$	-		
BLM Total	**$**	**36,766**	**$**	**-**	***$***	***36,766***