

1.0 Project Proposal Summary Sheet

Project Title	Assessing the effectiveness of dredging as a BMP to improve lake water quality
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Project Period	July 1, 2017-June 30, 2019
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Project Sponsor:	
Organization	South Dakota School of Mines and Technology
Primary Contact	Lisa Kunza
Title	Assistant Professor, CABS
E-mail address	<a href="mailto:lisa.kunza@sdsmt.edu">lisa.kunza@sdsmt.edu</a>
Mailing address	501 E. St. Joseph St
City, State, Zip	Rapid City, SD 57701
Telephone	605-394-2449
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Project Funding:	
Budget Category	Amount (\$)
NPS Funds Requested	\$140,699
Match (cash/in-kind)	\$93,807
Other federal funds	\$
Total Project Cost	\$234,506

Project Type: Planning/Assessment
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Project Location	
Watershed(s):	Horsetheif Lake, Legion Lake, Center Lake
303(d) Listed Stream	<b>Yes</b> No Listed Segment + AUID# SD-CH-L-Horsetheif_01; SD-CH-L-Legion_01; SD-CH-L-Center_01
HUC (8 digit)	10120109
County(ies)	Custer, Pennington
Coordinates of project location	Center Lake-43°48'2.22"N 103°24'59.54"W Legion Lake-43°45'37.33"N 103°27'44.59"W Horsetheif Lake- 43°53'34.94"N 103°28'54.79"W

NPS Pollution Source categories to be addressed (enter percent for each applicable source)			
20	Agriculture		Silviculture
	AFOs		Hydrologic Modification
20	Urban Runoff	30	Construction
	Resource Extraction	30	Other: recreational use & nutrient loading

NPS Functional Category (enter percent for each applicable functional category)			
	BMP Implementation	5	Technical Assistance
10	Information and Education	10	Planning
	Watershed Assessment		Groundwater
75	Water Quality Monitoring		Other:

NPS Pollutants to be addressed (Check all that apply)			
X	Excess Nitrogen		Pesticides
X	Excess Phosphorus		Oil and grease
	Sedimentation	X	Temperature
	Pathogens/Bacteria	X	pH
	Metals	X	Other: chlorophyll <i>a</i>
X	Low dissolved oxygen		Other:

Summary Statements	
Project Goals	<ol style="list-style-type: none"> <li>1) Assess the effectiveness of dredging on lake water quality.</li> <li>2) Develop a standard sampling design to incorporate the new chlorophyll <i>a</i> standard to inform future BMPs.</li> <li>3) Implement the sampling design to evaluate the fluctuations in chlorophyll <i>a</i> concentrations and the implications for water quality in SD lakes.</li> </ol>
Project Description	<p>We will evaluate the effectiveness of dredging on lake water quality by examining 3 waterbodies (Horsetheif Lake, Legion Lake, and Center Lake) that are in close proximity to each other and had varying amounts of dredging implemented recently. In addition, we will sample frequently to develop a standard sampling design for lake water quality monitoring. Chlorophyll <i>a</i> has been proposed as a new standard for lake water quality. However, chlorophyll <i>a</i> concentrations fluctuate with nutrient availability and algal species composition shifts throughout the year and particularly during the summer recreational use period. Outcomes from this project will provide insight into the effectiveness of dredging as a BMP and broader insight into future implementation of BMPs incorporating chlorophyll <i>a</i>.</p>

## Proposal Narrative

### 2.0 Statement of Need

#### 2.1 Demonstrated Water Quality Need:

Across the nation billions of dollars are spent on implementation projects each year. Assessment of the success of the projects are less common. As stressors on aquatic ecosystems continue to increase, it becomes more important to assess the effectiveness of the implementation projects.

Dredging has been a common best management practice (BMP) to alleviate a variety of management concerns and has been used in many lakes in the Black Hills of South Dakota in the recent past. To examine the effectiveness of this BMP, we propose to examine 3 lakes that are in close proximity to each other. Horsetheif Lake has had extensive dredging, while Legion Lake was only partially dredged and Center Lake has not been dredged recently. All 3 of the lakes were listed for elevated pH in the 2014 South Dakota

Integrated Report for Surface Water Quality Assessment. We are proposing to examine the effectiveness of the dredging efforts on decreasing the pH of the lakes. Elevated pH can also be an indicator of increased nutrient concentrations.

Increased nutrient concentrations in lakes can also be indirectly measured via chlorophyll *a* concentrations. A new chlorophyll *a* standard may be proposed for lakes in South Dakota. Currently, the lakes in the Black Hills are sampled by DENR once in June and August or not assessed at all. Algal species composition shift through time as N:P ratios are altered through the summer season and the variability in chlorophyll *a* concentrations need to be examined along with other water quality parameters to come up with an integrated water management plan to help inform future BMP implementations.

## 2.2 Waterbody Information:

## 2.3 Project Map:

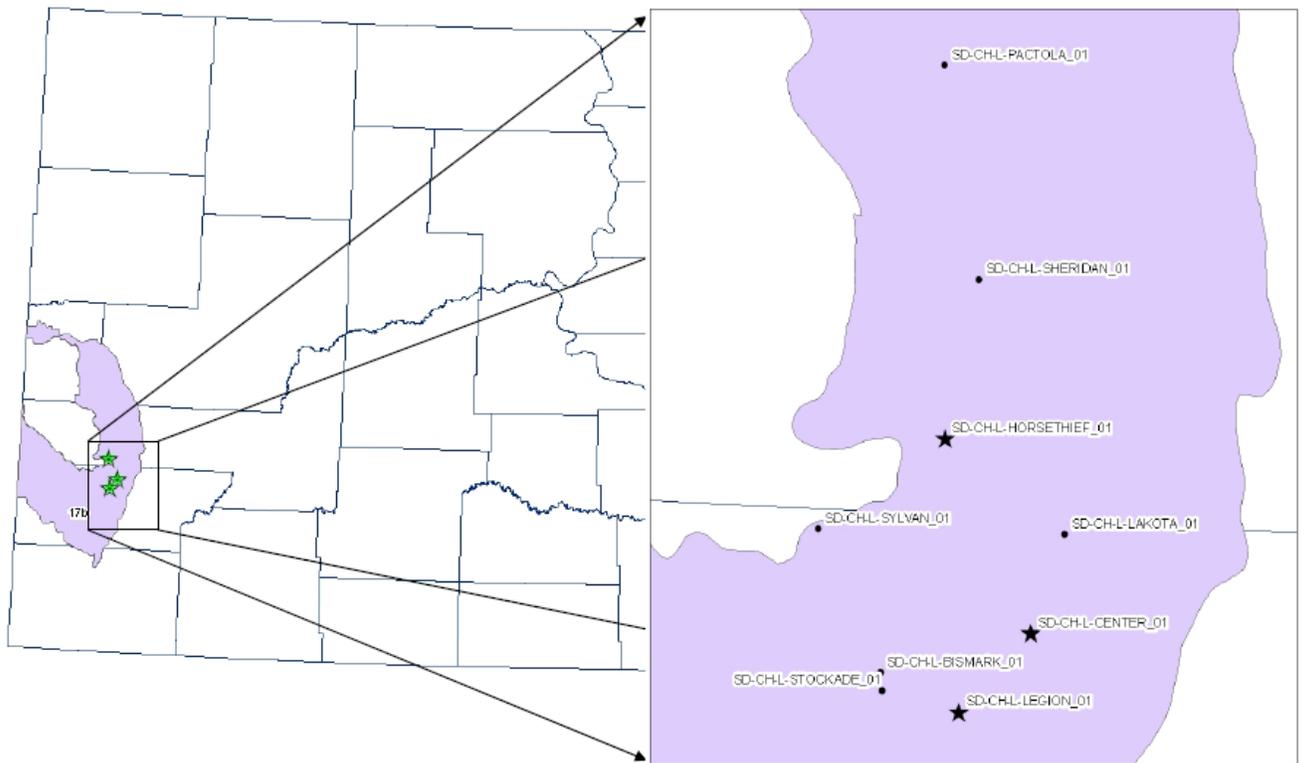


Figure 1. Locations of Horsethief Lake, Legion Lake and Center Lake are indicated with stars on the map and interspersed with the other DENR assessment locations. (Source: TMDL)

## 2.4 General Watershed Information:

Detailed watershed descriptions can be found in the TMDLs for all 3 lakes accessible online via the SD DENR website (<https://denr.sd.gov/dfta/wp/tmdlpage.aspx>).

## 3.0 Project Description

### 3.1 Project Outcomes:

Goals for this project:

- 1) Assess the effectiveness of dredging on lake water quality.
- 2) Develop a standard sampling design to incorporate the new chlorophyll *a* standard to inform future BMPs.
- 3) Implement the sampling design to evaluate the fluctuations in chlorophyll *a* concentrations and the implications for water quality in SD lakes.

The project will assess the effectiveness of dredging as a BMP in regard to the current listing of Horsetheif Lake, Legion Lake, and Center Lake for high pH in the 2014 South Dakota Integrated Report for Surface Water Quality Assessment. Due to the recent dredging lakes may be shifted to “non-assessed” for the 2016 report. In addition, a new water quality criterion for chlorophyll *a* may soon start to be examined. This project will also provide water resource managers information regarding the potential lag time from the dredging to improved water quality within those waterbodies.

These goals will be achieved through the following outcomes and tasks:

### 3.2 Outcomes, Targets, and Tasks:

Outcome 1: Detailed protocols and sampling design document creation.

Task # 1: Examine existing literature.	
Task Description:	Collect existing literature on success of dredging as a BMP and also for chlorophyll <i>a</i> fluctuations. Examine trends in temporal variability in water quality for lakes in South Dakota. Evaluate the suitability for sampling designs from elsewhere to be used in South Dakota.
Task Outputs:	Provide a detailed protocol and sampling design document.
Cost:	Labor costs included in overall budget

Task # 2: Examine spatial variability in water quality in lakes.		
Task Description:	Collect and process data from at least 5 different locations within each of the 3 lakes for water quality.	
Task Outputs:	Include estimates with statistical evaluation of spatial variability in the lakes in the sampling design document. Comparisons between the lakes will also be included.	
Cost:	Federal (319) Funds:	\$300
	Non-Federal Match:	\$500
	Other Federal Funds:	
	Total Task Cost:	\$800, Labor costs included in overall budget

Outcome 2: Analyze water quality in the lakes frequently.

Task # 1 : Assess the water quality in each of the 3 lakes.		
Task Description:	Using the sampling protocols, assess the water quality of the lakes at minimum biweekly throughout the summer recreational use season.	
Task Outputs:	A dataset of water quality with frequent sampling events for Horsetheif Lake, Legion Lake, and Center Lake.	
Cost:	Federal (319) Funds:	\$1,700
	Non-Federal Match:	\$6,000
	Other Federal Funds:	
	Total Task Cost:	\$7,700, Labor costs included in overall budget.

Task # 2 : Assess the effectiveness of dredging as a BMP for decreasing pH.		
Task Description:	Examine the data collected and compare results among the 3 lakes.	
Task Outputs:	Statistical analyses of the datasets created in this project as well as the trends in water quality data previously gathered by SD DENR.	
Cost:	Federal (319) Funds:	
	Non-Federal Match:	
	Other Federal Funds:	
	Total Task Cost:	Labor costs included in overall budget.

Task # 3: Examine the fluctuations in chlorophyll <i>a</i> concentrations through time.		
Task Description:	Sample chlorophyll <i>a</i> concentrations frequently to examine the fluctuation through time.	
Task Outputs:	Concentrations of chlorophyll <i>a</i> will be assessed at least biweekly in each lake throughout the summer recreational use season.	
Cost:	Federal (319) Funds:	\$2,000
	Non-Federal Match:	\$500
	Other Federal Funds:	
	Total Task Cost:	\$2,500, Labor costs included in overall budget.

Task # 4: Evaluate the linkages between chlorophyll a, pH, nutrient loading, temperature, and dissolved oxygen in the lakes.		
Task Description:	Statistical analysis of the dataset to examine the relationships among water quality parameters.	
Task Outputs:	A detailed assessment using standard statistical procedures will be completed and included in report.	
Cost:	Federal (319) Funds:	\$
	Non-Federal Match:	\$
	Other Federal Funds:	
	Total Task Cost:	Labor costs included in overall budget

Outcome 3: Inform and present findings at scientific meetings as well as public forums.

Task # 1: Inform public of findings		
Task Description:	Inform scientists, management agency personnel and general public of the findings through scientific and public meetings.	
Task Outputs:	Presentations at scientific and public meetings.	
Cost:	Federal (319) Funds:	\$1500
	Non-Federal Match:	\$
	Other Federal Funds:	
	Total Task Cost:	Labor costs are included in the overall budget

Task # 2 : Report findings to funding agency		
Task Description:	Create annual and final report of findings	
Task Outputs:	Annual and final reports to DENR/EPA	
Cost:	Total Task Cost: Labor costs are included in the overall budget	

### 3.3 Milestone Table

Date: July 2017- June 2019	Year 1												Year 2																	
Task	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J						
Outcome 1: Detailed protocols and sampling design document creation	[Shaded]																													
Task 1: Examine existing literature	[Shaded]																													
Task 2: Examine spatial variability in water quality in lakes	[Shaded]	[Shaded]	[Shaded]	[Shaded]																										
Outcome 2: Analyze water quality in the lakes frequently										[Shaded]																				
Task 1: Assess the water quality in each of the 3 lakes.										[Shaded]																				
Task 2: Assess the effectiveness of dredging as a BMP for decreasing pH										[Shaded]																				
Task 3: Examine the fluctuations in chlorophyll a concentrations through time										[Shaded]																				
Task 4: Evaluate the linkages between chlorophyll a, pH, nutrient loading, temperature, and dissolved oxygen in the lakes																					[Shaded]	[Shaded]	[Shaded]	[Shaded]	[Shaded]					
Outcome 3: Inform and present findings at scientific meetings as well as public forums	[Shaded]																													
Task 1: Inform public of findings										[Shaded]																	[Shaded]	[Shaded]	[Shaded]	
Task 2: Report findings to funding agency						[Shaded]						[Shaded]								[Shaded]						[Shaded]	[Shaded]	[Shaded]		

### 3.4 Project Management and Tracking

The project personnel have expertise with water quality including standard limnological analyses of water quality parameters. Progress will be tracked by semi-annual and annual reports that will be submitted to DENR in December and July of each project year. In addition, the project personnel will meet annually with the DENR to discuss project progress.

### 3.5 Permits

No permits for water sampling are required, as all sites have public access.

## **4.0 Coordination Plan**

### 4.1 Cooperating Organizations

The SD Mines personnel on this project have expertise with water quality and limnology. The research team will have access to the Shimadzu Environmental Research Laboratory at SD Mines. SD Mines will also provide facilities and equipment to process the water quality samples.

### 4.2 Local Support for the Project

Many entities and groups support the efforts of dredging lakes in the Black Hills.

### 4.3 Duplicate Effort

Currently SD DENR sample the lakes at most twice annually, but not always after implementation of dredging. This project will coordinate with SD DENR to supplement their efforts. In addition, our efforts would likely be helpful for understanding trophic dynamics that influence the fisheries in these lakes and we will coordinate with SD Game, Fish & Parks as well.

### 4.4 Assumption of responsibilities of other entities

All of the work will be completed by SD Mines faculty, staff & students.

## **5.0 Evaluation and Monitoring Plan**

### 5.1 Monitoring Strategy

Monitoring the lakes for water quality will occur biweekly from April of year 1 to March of year 2, but may be decreased to monthly in the lower recreational use times. Sampling will not occur during ice covered months.

### 5.2 Sampling and Analysis Plan

Development of the protocols and sampling design will occur beginning Year 1 July-March. This procedure will be followed for the remainder of the project.

### 5.3 Quality Assurance Project Plan

A quality assurance program plan will be developed prior to project implementation if project is selected for funding.

#### 5.4 Data Collection, Management and Analysis

The data will be collected, managed, and analyzed by SD Mines personnel. The data will be located on the SD mines server & backed up on external hard drives regularly. All data will be reported to SD DENR.

#### 5.5 Models

No models are necessary for the desired outcomes of this project

#### 5.6 Operation and Maintenance

No BMPs will be implemented in relation to this project; therefore, no operation and maintenance plan will be required. The proposed project will be used to inform future BMPs.

### **6.0 Information and Education**

#### 6.1 Information and Education Activities

The project personnel will disseminate information through state and national conferences and publications. Posters and/or presentations will be given at state and national conferences. Finally, publications will be created from this project.

## 7.0 Budget and Budget Justification

**Project:** Assessing the effectiveness of dredging as a BMP to improve lake water quality

**Date:** July 2017-June 2019

Item	Year 1	Year 2	Total	319	SDSMT
Senior project personnel, incl benefits	\$ 27,247	\$ 28,065	\$ 55,312	\$ 10,260	\$ 45,052
Graduate student assistantship	\$ 36,697	\$ 37,733	\$ 74,430	\$ 70,118	\$ 4,312
Undergraduate student assistant	\$ 5,774	\$ 5,947	\$ 11,721	\$ 11,721	\$ -
Travel	\$ 1,005	\$ 1,005	\$ 2,010	\$ 2,010	\$ -
Publication		\$ 1,000	\$ 1,000	\$ 1,000	\$ -
Tuition Remission	\$ 9,063	\$ 9,335	\$ 18,398	\$ 18,398	\$ -
Task Costs					
Outcome 1: Detailed protocols and sampling design document creation					
Task 1: Examine existing literature					
Task 2: Examine spatial variability in water quality in lakes	\$ 800		\$ 800	\$ 300	\$ 500
Outcome 2: Analyze water quality in the lakes frequently					
Task 1: Assess the water quality in each of the 3 lakes.	\$ 6,000	\$ 1,700	\$ 7,700	\$ 1,700	\$ 6,000
Task 2: Assess the effectiveness of dredging as a BMP for decreasing pH					
Task 3: Examine the fluctuations in chlorophyll a concentrations through time	\$ 1,200	\$ 1,300	\$ 2,500	\$ 2,000	\$ 500
Task 4: Evaluate the linkages between chlorophyll a, pH, nutrient loading, temperature, and dissolved oxygen in the lakes					
Outcome 3: Inform and present findings at scientific meetings as well as public forums					
Task 1: Inform public of findings					
Task 2: Report findings to funding agency					
SDSMT approved indirect 39%, Indirect recovered 23.4%	\$ 18,866	\$ 19,787	\$ 38,653	\$ 23,192	\$ 15,461
<b>Total</b>	<b>\$ 106,652</b>	<b>\$ 105,872</b>	<b>\$ 212,524</b>	<b>\$ 140,699</b>	<b>\$ 93,807</b>

## **Budget Justification**

*A. Senior Personnel:* (\$8,520) Funds are requested to support Dr. Lisa Kunza, PI of the SD Mines project, is an Assistant Professor in Department of Chemistry and Applied Bio Sciences. Dr. Kunza is committed for 2 summer weeks each year of the project.

*B. Other Personnel:* (\$65,045) Funds are requested support one graduate student at 50% effort for years 1& 2 during the academic months and full-time during the summer months of the project. Funds of \$10,873 are also requested to support one undergraduate student for the duration of the project.

The salaries that will be charged for this work will be those regularly approved for the individuals involved by the governing body of the South Dakota School of Mines and Technology (SD Mines); namely the Regents of Education of the State of South Dakota. The rates for FY 2017 (July 1, 2016through June 30, 2017) are based on current contractual agreements for FY 2017 and assume an increase of 3% per fiscal year thereafter. Rates for students are approved for the period of mid May 2016, through mid May 2017, and assume an increase of 3% per year thereafter. If increases exceed that amount, effort stated will need to correspond with salary.

Eligible personnel earn vacation at the rate of 10 hours per month if they have 15 years or less of service and 13.33 hours per month if their period of service exceeds 15 years. This vacation is handled in the budget by including the appropriate accrual adjustment in the salary rate. This procedure is utilized for all sponsored research to ensure that each project pays only its pro rata share of the vacation authorized.

*C. Fringe benefits:* (\$7,661) Fringe benefits have been budgeted at 20.42% of salaries and wages for faculty and staff personnel and 7.8% for students. The benefits consist of contributions to social security, the unemployment insurance program, the workmen's compensation program, the flexible benefit fee program, a group insurance program and matching contributions to the state employee retirement program. Only the actual costs of the fringe benefit programs are charged to the project.

*D. Equipment:* No major equipment (with dollar amount exceeding \$5,000) is requested. All necessary equipment is available at South Dakota School of Mines and Technology.

*E. Travel:* (\$2,010) Domestic travel funds will be used by the PI and/or the graduate student for site and conference visits. Travel costs are based on current estimates and will be conducted in accordance with the State of South Dakota Travel Regulations.

*F. Participant support costs:* None requested.

### *G. Other Direct Costs:*

1. Materials and Supplies: Funds of \$4,000 are allocated for research materials and supplies such as canoe, sondes, bottles, and chemicals. The expense items specifically benefit this project, are reasonable and necessary for the performance of this work, and can be readily allocable to this project.

2. Publications: Funding of \$1000 are allocated for other costs associated with publication of results in conference proceedings and in journals. Expenditures reflected in these categories are based on best estimates now available.

6. Other: none

b. Tuition remission: Funds are allocated \$18,398 for tuition remission of sponsored graduate student, based on the current rate of \$438.55 per credit hour, with an increase of 3% per year thereafter. Expenditures reflected in these categories are based on best estimates now available. In no case will the project be charged for more than actual costs incurred.

I. *Indirect costs(F&A)*: The latest indirect cost rate approved by the cognizant government audit agency for the SD Mines is 39.0% of the modified total direct costs. This rate has been applied in the budget calculations. The cognizant government audit agency for the institution is:

Director, Division of Cost Allocation  
DCA Western Field Office  
Department of Health and Human Services  
90 7<sup>th</sup> Street, Suite 4-600  
San Francisco, CA 94103-6705  
HHS Representative: Jeanette Lu  
Telephone Number (415) 437-7820

*Cost share*: Dr. Kunza commits her 9-month salary at 24% effort towards this project each year of this project as cost share. Additional, one graduate student commits \$2,000 each year on the project. The cost sharing also include fringe benefits for Dr. Kunza and the student plus the indirect cost and unrecovered indirect cost. The total \$93,807 of cost share equates to 40% of the total project cost of \$234,506.

## **8.0 References**

SD DENR. 2010. Total Maximum daily load evaluation of pH for reservoirs in the black hills plateau ecoregion of Custer and Pennington Counties, South Dakota.

Pirner, S.M. and SD DENR. 2014. South Dakota Integrated report for surface water quality assessment.