



# Environment and Natural Resources Trust Fund (ENRTF)

## M.L. 2018 ENRTF Work Plan (Main Document)

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**Today's Date:** March 4, 2018

**Date of Next Status Update Report:** January 31, 2019

**Date of Work Plan Approval:** ....

**Project Completion Date:** January 31, 2021

**Does this submission include an amendment request?** N

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**PROJECT TITLE:** - Install and Evaluate an invasive carp deterrent for Mississippi River Locks and Dams

**Project Manager:** Peter Sorensen

**Organization:** University of Minnesota

**College/Department/Division:** College of Food, Agriculture and Natural Resource Sciences, FWCB, MAISRC

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**Location:** Statewide

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**Total Project Budget:** \$998,000

**Amount Spent:**

**Balance:** \$998,000

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**Legal Citation:** M.L. 2018, Chp. xx, Sec. xx, Subd. xx

**Appropriation Language:**

t.b.d.

## I. PROJECT STATEMENT:

Untold millions of invasive Silver and Bighead carp (together known as Bigheaded carp - a variety of Asian carps that is also known as “invasive carp” by the state of Minnesota) presently inhabit the Mississippi River below the Iowa border from where they are moving north. This project seeks to solve this problem by conducting a proof-of concept study using state-of-the-art fish deterrent technologies at the most southern lock and dam structure in Minnesota. The work promises to protect the entire state from these carp and has two components:

- 1) Activity #1 will install a new, state-of-the-art acoustic carp deterrent system in the lock at Lock and Dam #8 while guiding efforts to enhance velocity fields through its spillway gates to selectively stop carp moving through this structure. Overall efficacy of this integrated deterrent system will be evaluated by monitoring passage rates of common carp (a surrogate for bigheaded carp) and several native fishes (walleye, etc.) while adjustments are made to improve system function. Recommendations for purchase or improvement will be rendered at the end of the project.
- 2) Activity #2 will quantify predatory fish populations in the pool above Lock and Dam #8 to determine if, and how, these populations might be naturally enhanced to suppress survival of any possible young carp that might be spawned if a few adult still happen to pass through the Lock and Dam. Predator populations from several river sites, with, and without carp, will be compared. Recommendations will be made to the MN DNR and USFWS at project end.

At present, the only impediment to the upstream invasion of Bigheaded carp into the Upper Mississippi River and its tributaries including the Minnesota and St. Croix Rivers are the lock and dams maintained by the US Army Corps of Engineers (USACE). Each lock and dam contains a lock chamber to permit navigation and a series of gated spillways that regulate velocity flow-fields (depth), both of which can be modified to stop carp (and allow native fish to pass). Four years of previous LCCMR-funded laboratory research show that: 1) spillway gates, and especially those at Lock and Dam #8, can be adjusted in ways that block carp without affecting safety, scour or navigation; 2) two types of sound system can block approximately 85% - 99% of carp, one of which, the SILAS system (see below) could easily be deployed at Lock and Dam #8 where it would be much more effective than the home-built system we installed in that location in 2012. This location is also ideal (and better than Lock and Dam #5 where we initially had thought of working) because the bigheaded carp have not passed it yet (at least in biologically relevant numbers) so it is the southernmost location in Minnesota we can work, our data suggest gate operations would be very effective here, and the USACE has already granted us a license to work at this location. (In the meantime, Lock and Dam #5 is an excellent fallback.) Herein, we describe a plan to add a custom-designed “SILAS” system (“Synchronized light and sound system” designed by Fish Guidance Systems Ltd. [FGS]) to the lock gate doors at Lock and Dam #8, while continuing to coordinate changes to spillway gate operations we have suggested as part of LCCMR—funded work to reduce carp passage, and then monitoring the passage of carp and native fish to gauge efficacy and make improvements. In addition, we will evaluate the population of predatory fishes located above and below Lock and Dam #8 because studies by others suggest that predators can help control carp abundance at low densities. The SILAS system is the third generation sound system produced by FGS and produces a series of highly effective patented sweeping or chirping sounds which are controlled by computer and are combined with light system. It could, if needed, at project end be updated to a more effective but more complex and expensive Bioacoustic Fish Fence (or “BAFF” incorporates an air curtain that must be mounted on the bottom of the river and would require custom engineering and special permits while costing well over \$1,000,000 to install), or left in place or moved to a different location in the river. We chose to lease (vs purchase) the SILAS system for this study because it saves the state approximately \$50,000, offers the state flexibility to modify/upgrade/improve, and comes with a pre-paid service package that should also save additional costs. Further, we have as part of our proposed lease, an option to purchase this system at a significant discount at the end of the study.

**II. OVERALL PROJECT STATUS UPDATES:**

**First Update January 31, 2019**

**Second Update June 30, 2019**

**Third Update January 31, 2020**

**Fourth Update June 30, 2020**

**Final Update January 31, 2021**

**III. PROJECT ACTIVITIES AND OUTCOMES:**

**ACTIVITY 1: Install a SILAS sound deterrent system at Lock & Dam #8 and conduct a proof-of-concept test.**

**Description:** To invade Minnesota waters, bigheaded carp must pass through Lock and Dam #8 which is located just upstream of our southern border. Laboratory tests have already identified a relatively simple yet highly effective (approximately 85-95%) and inexpensive sound-light system, known as “SILAS” manufactured by Fish Guidance Systems Ltd (FGS) which can be placed in a lock. We will work with FGS to custom –design a SILAS system for this location and install it on the lock gates at Lock and Dam #8 while continuing to work with the USACE to modify spillway gate operations to deter carp passage via that route. The SILAS system will be controlled by a computer to produce various a few types of sounds and lights in multiple ways depending on sound transmission properties in the lock and the ways that barges pass through it. Its operating protocols will offer the option of manual control and remote monitoring. Because this is the first time a SILAS system has been installed on lock gates, we allow for an initial several month period to optimize system operations, after which the system will be removed for the winter when the lock also shuts for the winter. Following winter-time the SILAS system will be modified (if appropriate) then be re-installed and its efficacy stopping carp and other native fish (walleye, bass, sturgeon, etc.) studied until lock winter shut-down when it will removed and reinstalled for a second season and study. We will work with the USACE to evaluate different operating protocols (volumes, times turned on/off, etc.) for this system. Success will evaluating by monitoring the movements and passage rates of over 500 acoustically-tagged common carp and native fishes using a custom built acoustic receiver array that will be paced across Lock and Dam #8 and allow us to determine exactly what species of fish pass and at what location (lock, tainter gate, roller gate) and why (so changes can be made). Each season of study the sound system will be turned on, and off, for approximate week-long periods of time. We aim for a 90+% block. The USFWS will work as our partner and assist by catching and tagging fish, and monitoring. The USACE has already issued a license for this work and is presently working with us to evaluate and improve spillway gate operations. At the end of this project we will, depending on the system’s performance at Lock and Dam #8, recommend options for next steps including: purchasing this system (the lease offers a deep discount) or improving it; and leaving it in place, moving it, and/or installing other similar systems elsewhere to create redundancy and greater protection.

**ENRTF BUDGET: \$889,750**

<b>Outcome</b>	<b>Completion Date</b>
1. Install SILAS Deterrent and perfect it with initial engineering pilot work	January 31, 2019
2. Test effects of SILAS on the passage rates of carp and native fish throughout 2019	January 31, 2020
3. Test effects of SILAS on the passage rates of carp and native river fish 2020, summarize findings, and make recommendations.	January 31, 2021

**First Update January 31, 2019**

**Second Update June 30, 2019**

**Third Update January 31, 2020**

**Fourth Update June 30, 2020**

**Final Update January 31, 2021**

**ACTIVITY 2: Describe the population of predatory fish in Pool 8 and determine if it could be managed to enhance carp control.**

**Description:** Recent studies in experimental ponds suggest that young bigheaded carp and their eggs are subject to predation by several species of predatory fish including bass and alligator gar (Lamer and Anderson, Western Illinois University; Duane Chapman, USGS, personal communication). While we do not expect predatory fish alone to be able to control an established population of carp in the open river, it is conceivable that predators could control a small population of young carp that might happen to pass through Lock and Dam #8 (although we aim for 90+% overall efficiency, “acts of God” [ex. floods, barge breakdowns in the lock, etc.] means that we should address the possibility that a very small number of fish could still pass. This study will evaluate this possibility of using predators for redundancy in Pool #8 by examining fisheries datasets already collected and managed by the U.S. Geological Survey (USGS) as part of its 30-year old Long Term Resource Monitoring-Environmental Management Program (LTRM). This dataset, which is publically available, includes fish survey data from Pool #8 and several pools downstream. We will evaluate these datasets and then analyze them, likely in collaboration with Brain Ickes, a statistician from the USGS who runs this program and has expressed interest in working with us.

**ENRTF BUDGET:** \$98,250

<b>Outcome</b>	<b>Completion Date</b>
1. Evaluate LTRM dataset	January 31, 2019
2. Analyze data from Pool 8	January 31, 2020
3. Analyze data from a pool which has carp and if possible, one other that does not, summarize make recommendations.	January 31, 2021

**First Update January 31, 2019**

**Second Update June 30, 2019**

**Third Update January 31, 2020**

**Fourth Update June 30, 2020**

**Final Update January 31, 2021**

**IV. DISSEMINATION:**

**Description:** Findings will disseminated via peer-reviewed publications, presentations to both scientific and lay audiences, and the website of FWCB and the Minnesota Aquatic Species Research Center.

**First Update January 31, 2019**

**Second Update June 30, 2019**

**Third Update January 31, 2020**

**Fourth Update June 30, 2020**

**Final Update January 31, 2021**

**V. PROJECT BUDGET SUMMARY:**

**A. Preliminary ENRTF Budget Overview:** See attached budget spreadsheet

**Explanation of Capital Expenditures Greater Than \$5,000:** n.a.

**Explanation of Use of Classified Staff:** n.a.

**Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:**

Enter Total Estimated Personnel Hours: 10,000	Divide by 2,080 = TOTAL FTE: 4.5
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**Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:**

Enter Total Estimated Personnel Hours: 400	Divide by 2,080 = TOTAL FTE: 0.20
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**B. Other Funds:**

SOURCE OF AND USE OF OTHER FUNDS	Amount Proposed	Amount Spent	Status and Timeframe
<b>Other Non-State \$ To Be Applied To Project During Project Period:</b>			
	\$	\$	
<b>Other State \$ To Be Applied To Project During Project Period:</b>			
	\$	\$	
<b>Past and Current ENRTF Appropriation:</b>			
ENRTF M.L. 2009 Chp.143, Sec. 2, Subd. 6d.	\$300,000	\$300,000	Fish bubble barriers, successfully completed

ENRTF M.L. 2012, Chp. 264, Art.4, Sec. 3	2,000,000	\$1,930,000	MAISRC incl Carp repellents and eDNA, all completed except for one modeling study
ENRTF M.L. 2013, Chp. 52, Sec. 2, Subd. 06a	8,700,000	8,350,000	MAISRC incl carp attractants and sound. Successfully completed except for ongoing work with sound
ENRTF M.L. 2014, Chp. 226, Sec. 2, Subd. 04a	854,000	854,000	Carp deterrents, successfully completed
<b>Other Funding History:</b>			
Minnesota DNR	\$880,000	\$720,000	Successfully confirming numeric models of fish passage, Last year of this project

**VI. PROJECT PARTNERS:**

**A. Partners receiving ENRTF funding**

Name	Title	Affiliation	Role

**B. Partners NOT receiving ENRTF funding**

Name	Title	Affiliation	Role
U.S. Fish and Wildlife Service	Biologist	LaCross Lab	Assist with fish tagging at Lock and Dam #8

**VII. LONG-TERM- IMPLEMENTATION AND FUNDING:**

**VIII. REPORTING REQUIREMENTS:**

- The project is for 3 years, will begin on July 1, 2018, and end on January 31, 2021.
- Periodic project status update reports will be submitted January 31 of each year.
- A final report and associated products will be submitted between June 30 and August 15, 2021.

**IX. SEE ADDITIONAL WORK PLAN COMPONENTS:**

- A. Budget Spreadsheet
- B. Visual Component or Map
- C. Parcel List Spreadsheet
- D. Acquisition, Easements, and Restoration Requirements
- E. Research Addendum

**Attachment A:**  
**Environment and Natural Resources Trust Fund**  
**M.L. 2018 Budget Spreadsheet**



**Project Title:** An effective and practical invasive carp deterrent

**Legal Citation:**

**Project Manager:** Peter Sorensen

**Organization:** University of Minnesota

**College/Department/Division:** CFANS, Fisheries, Wildlife & Conservation Biology

**M.L. 2018 ENRTF Appropriation:**

**Project Length and Completion Date:** 3.0 years, June 2022

**Date of Report:**

<b>ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET</b>	<b>Budget</b>	<b>Amount Spent</b>	<b>Balance</b>
<b>BUDGET ITEM</b>			
<b>Personnel (Wages and Benefits) - Overall</b>	<b>\$366,943</b>		<b>\$366,943</b>
<i>Professor/PI, Sorensen , 4 weeks/yr x 2.5; \$3100/wk (74% salary, 26% benefits), 0.20FTEs (Total estimated amount \$41,920)</i>			
<i>Postdoc or Biological technician, TBD, fulltime x 2.5 ; \$48,000 (79% salary, 21%benefits), 2.5 FTEs (Total estimated amount \$152,400)</i>			
<i>Technician, TBD, partime \$10,000 (.2FTE)</i>			
<i>Graduate student, TB; 50% time x 2.25yr; \$48,000 (49% salary, 51%benefits), 1.13 FTE(Total estimated amount \$108,000)</i>			
<i>Undergraduate fish student#1, 400h@\$15 (100% salary), 0.14FTE (Total estimated amount \$6,000)</i>			
<i>Engineer/PI, Marr, 48hrs@\$52.7; (74% salary, 26% benefits), 0.04FT (Total estimated amount \$3,379)</i>			
<i>Technician, Christopher, 600h@\$32.8; (74% salary, 26%benefit)0.22 FTE (Total estimated amount \$26,289)</i>			
<i>Undergraduate Eng student#2, Gabrielsen, 316h @\$21, (79% salary, 21% benefits), 0.1 FTE (Total estimated amount \$8,433)</i>			
<i>Assoc Engineer, Milliren, 156h@\$25.4 (79% salary, 21% benefits), 0.1 FTE (Total estimated amount \$5,040)</i>			
<i>Coord Enginner, Ericksen, 144h@\$29.9 (79% salary, 21% benefits), 0.1 FTE (Total estimated amount \$5,482)</i>			
<b>Professional/Technical/Service Contracts</b>	<b>\$414,000</b>		<b>\$414,000</b>
<i>Dive team (\$5000/day *6) to install, remove FGS deterrent / year</i>	\$30,000		\$30,000
<i>Internet contractor - to be selected competitively</i>	\$7,000		\$7,000
<i>Electrical contractor- to be selected competitively</i>	\$7,000		\$7,000
<i>Lease (with buy option),Fish Guidance System</i>	\$370,000		\$370,000
<b>Equipment/Tools/Supplies</b>	<b>\$163,636</b>		<b>\$163,636</b>
<i>Misc engineering supplies for deterrent assembly and mounting</i>	\$6,000		\$6,000

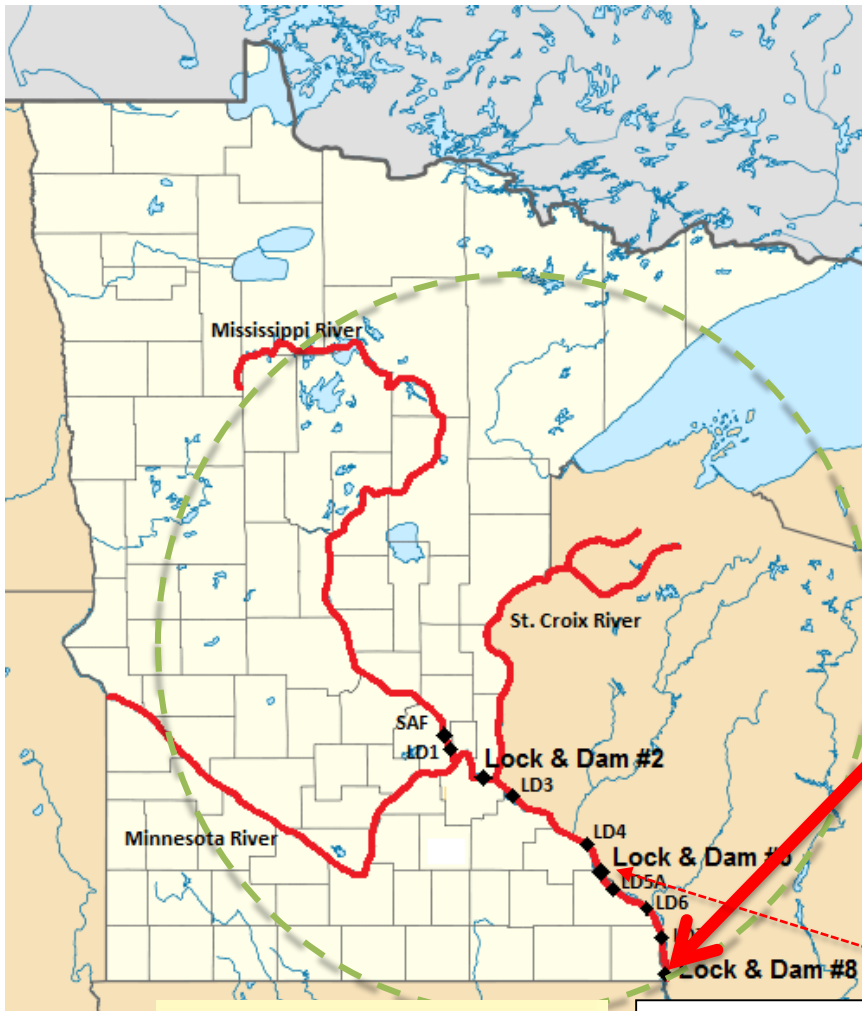
700 accoustic fish tags@\$200 (Total estimated amount \$140,000)	\$140,000		\$140,000
ATS batteries for receivers for fish tags 50+ @\$248	\$14,000		\$14,000
Misc biology field supplies (gas, nets, boots, electrodes, etc) (Total	\$3,636		\$3,636
<b>Travel expenses in Minnesota</b>	<b>\$38,421</b>		<b>\$38,421</b>
Engineer travel, hotel and meals to L&D #8 (Total estimated amount \$3421)	\$3,421		\$3,421
Sorensen lab travel to LD8 (400miles*50 trips/ full year =40,000 miles; lease +gas=10K/y) , 25 hotel overnight with meals/y (\$4000/y)	\$35,000		\$35,000
<b>Other - overall</b>	<b>\$15,000</b>		<b>\$15,000</b>
Fish management workshops, travel outstate Total estimated amount \$1,000)	\$1,000		\$1,000
Shipping FGS equipment (Total estimated amount \$5,000)	\$5,000		\$5,000
Shipping FGS gear to LD8 from SAFL (Total estimated amount \$1,500)	\$1,500		\$1,500
Internet and electrical service (Total estimated amount \$2,500) for equipment installed at the lock and dam	\$2,500		\$2,500
Field equipment repairs (Total estimated amount \$5,000)	\$5,000		\$5,000
<b>COLUMN TOTAL</b>	<b>\$998,000</b>		<b>\$998,000</b>



**PROJECT TITLE:** An effective and practical invasive carp deterrent

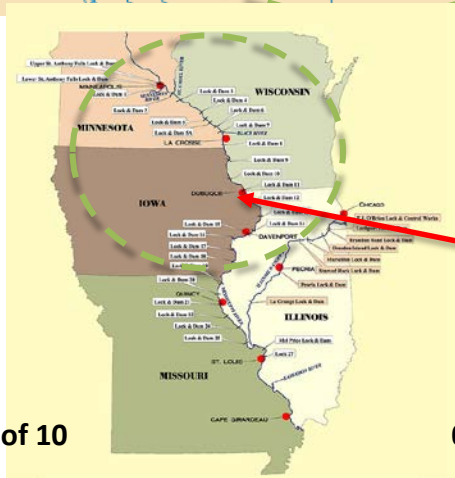
**Lock and Dam #8**

The location of Lock and Dam #8, our primary study site located downstream of Lake Pepin and near the Minnesota border, is shown. If a highly effective carp deterrent system were to be implemented here as proposed, almost all of Minnesota including the St. Croix, Minnesota and Upper Mississippi rivers would all be protected (dashed ring). The efficacy of this system could conceivably be enhanced by managing predators in Pool #8 (also proposed), resulting in a possible combined overall blockage rate of about 90+%. Of course, additional systems could be eventually added both up- (Lock and Dam #5) and down-stream (Lock and Dam #14 and/or #19) to synergize activity and protection. At the conclusion of this project, the system at Lock and Dam #8 could thus either be left in place (after being purchased at a discount), upgraded (if needed), or even (with our USFWS partnership), moved downstream, protecting even more of the river and state (see below).



**Lock and Dam #8**

Lock and Dam #5 (a possible future location- see below)



Lock and Dam #14 (IA): Our long-term goal (and that of our partner the USFWS) is to use information and experience gleaned from this project to justify matching funds from other states and the federal government to eventually place an optimized FGS sound deterrent system either at this location (current extent of active carp breeding and also the last location before MN where locks and dams can be altered) or #Lock and Dam 19. This action would protect the entire Upper Mississippi River from carp. The proposed project will enable this possibility. It is possible the FGS system we lease and test herein could be purchased and used in this manner (or left in place). Another system could also be added at Lock & Dam #5 to double efficacy in Minnesota.

