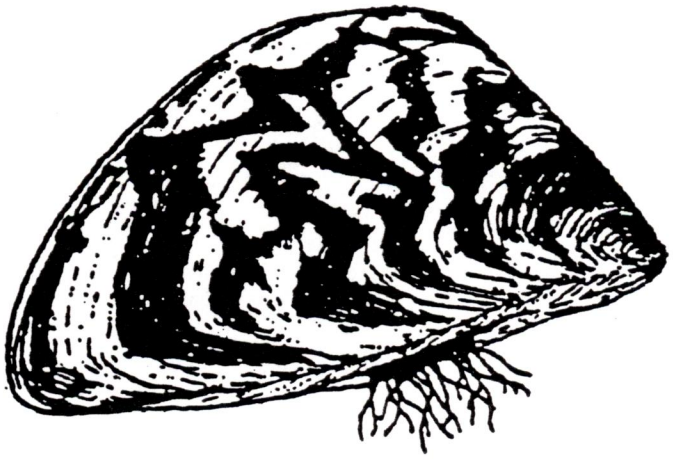
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ZEBRA MUSSEL RESPONSE PLAN

ST. PAUL DISTRICT, U.S. ARMY CORPS OF ENGINEERS



ZEBRA MUSSEL
(ENLARGED)

OCTOBER 1997

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ZEBRA MUSSEL RESPONSE PLAN
ST. PAUL DISTRICT, U.S. ARMY CORPS OF ENGINEERS

1.0 BACKGROUND AND PURPOSE

The zebra mussel (*Dreissena polymorpha*) is a small, freshwater bivalve mollusk (clam). Native to the Caspian Sea and Ural River area of Asia, the zebra mussel was introduced into North America in 1988, probably through the discharge of ballast water from a vessel entering from an overseas port. Since their initial discovery, zebra mussels have spread throughout the Great Lakes to many of the inland navigable waterways including the Upper Mississippi River (UMR). In 1991, another species of attached biofouling mollusk, for now called the quagga mussel, was identified in portions of the Great Lakes. Throughout this document, the term zebra mussel is used to describe attached biofouling mollusks as a group, including zebra mussels, quagga mussels and any other similar "look-alike" species with the same system-infesting behavioral characteristics commonly associated with zebra mussels.

The zebra mussel is a macrofouler: it quickly colonizes new areas and rapidly achieves high densities. Zebra mussels attach to a wide variety of firm surfaces using tough, proteinaceous byssal threads. Under natural conditions, they are found on rocks, logs, aquatic plants, shells of native mussels and exoskeletons of crayfish. They can also attach to plastic, concrete, wood, fiberglass, iron pipes, polyvinyl chloride (PVC) and surfaces covered with conventional paints. Zebra mussel larvae (veligers) are planktonic and can be drawn into raw water piping systems. Layers of zebra mussels can build up in critical piping systems as the animals settle and attach. Partial or total blockage of piping systems can result, causing damage to or outages of equipment and facilities. Zebra mussels may also foul areas in locks such as gage wells, bubbler systems, concrete surfaces, and untreated metal surfaces such as lock miter gates. Masses of dead zebra mussels can accumulate in gate recesses, hindering gate operation. The zebra mussel has become a multi-million-dollar pest in the Great Lakes region, affecting private and public facilities alike.

Zebra mussel populations are present at all St. Paul District locks and dams on the UMR and these infestations could have serious economic and other consequences. These conditions intensify the need for identifying control measures to counter these pest organisms. Zebra mussels reproduce prodigiously, and what are now moderate populations may within a few years become very heavy infestations. This rapid buildup has been observed repeatedly in North America. Several control techniques, including application of non-fouling coatings, physical removal, and chemical treatment, have been identified to date.

This document presents a response plan for controlling zebra mussels at St. Paul District facilities located on the UMR. Alternative response and control methodologies are presented for various District facilities and facility components.

2.0 CONTROL/PREVENTION AND DISPOSAL METHODS

A variety of control and prevention techniques are available. Table 1 provides a listing of these techniques and a discussion of how each technique would be applied. In some circumstances, for example zebra mussel infestations on lock walls, the presence of zebra mussels may have no adverse impacts on facility operation. The most financially prudent course of action under these conditions may be to take no action at all.

All control/prevention and disposal techniques would be applied in an environmentally sound manner. The following control measures would be considered for use in controlling zebra mussel infestations at District facilities.

2.1 Physical Removal - Scraping, brushing, and high pressure water spraying are very effective methods of removing zebra mussels from walls, trash racks, or other equipment. Where large quantities of zebra mussels must be removed, labor saving devices (i.e., a suction pump attached to a mechanical scraper) have been designed to dislodge and vacuum zebra mussels. Mechanical cleaning typically is environmentally compatible, provided suitable disposal sites exist. Mechanical cleaning would be employed on systems where some buildup of zebra mussels is tolerable or where it is simply not possible to economically control zebra mussels through other methods. Divers would normally be needed where dewatering of a facility is not possible.

2.2 Molluscicides/Chemicals - Chlorine, bromine, ozone, and potassium permanganate are some of the chemical biocides commonly used to disinfect water supplies and to control biological pests. Chlorine is a commonly used control agent in Europe, this country and Canada. Continuous exposure at 0.5 mg/l will kill zebra mussels in 14 to 21 days, which is preferable to application of a concentrated "slug dose" that zebra mussels can withstand for several days by closing their shells. Chlorine can be used in pipes or ducts that contain pressure sensing or other equipment.

Although biocides may not kill all organisms when applied to turbid, unfiltered water, they nonetheless kill most of the organisms present. For this reason, the presence of residual concentrations of biocides in the open aquatic environment is restricted by State and Federal regulatory authorities responsible for the protection of fish and other aquatic life. Regulatory agencies typically establish in-stream surface water criteria for the protection of fish and other aquatic life and/or apply effluent limitations to point-source discharges to surface waters.

In those cases where chlorine or other biocides are selected for control of zebra mussels, the District would limit or control discharges of chlorine or other biocides to surface waters of the United States so as not to cause any applicable in-stream water quality criteria to be violated or any effluent limitation imposed by regulatory authority to be exceeded. Chlorine or other chemicals would mainly be used in systems where manual cleaning would not be possible and/or where total control is required.

Table 1. Alternative zebra mussel control/cleanup and infestation prevention techniques.

CODE	METHOD	DESCRIPTION
A	Physical removal	Zebra mussels would be removed by scraping, brushing and/or high pressure water or steam spraying. For many systems, this is probably the most efficient method of zebra mussel removal. For example, in large culverts, along walls and gates, physical cleaning could be accomplished during periodic dewatering of the structure.
B	Molluscicides (oxidizing and nonoxidizing)	Use of primarily oxidizing biocides (chlorine), with the possibility of periodic selective use of nonoxidizing biocides. This method would require designing appropriate systems to facilitate component treatment while minimizing the risk of exposure of the biocide to the environment.
C	Thermal treatments	Hot water, steam or air injection would be used periodically to kill adult and larval zebra mussels. Water temperatures >32 degrees C are lethal, 36 degrees C produces instantaneous kill. Immersion or strip heaters could be installed to elevate water temperatures above lethal limits for zebra mussels. This method would require designing appropriate systems to facilitate component treatment while minimizing impacts on surrounding environment.
D	Dewatering and desiccation	Isolation of susceptible components from the river environment would prevent infestation/establishment of zebra mussel colonies in these systems. Components could be isolated by removal from the river. Below 30 degrees C, kill time is temperature and relative humidity dependent; rapid kill of zebra mussels when air temperature exceeds 35 degrees C.
E	Removable/replaceable components	Replacement components which can be easily removed should infestation occur would be used in favor of permanent structures. This method would primarily apply to screens.
F	Antifoulant construction materials	Construction materials toxic to zebra mussels, primarily copper, brass or galvanized materials, would be used in place of traditional materials like PVC, stainless steel, or iron. Toxic metal pipe inserts would also be considered.
G	Antifoulant coatings	Surfaces susceptible to infestation would be treated or coated with antifoulant coatings or materials resistant to zebra mussel attachment or toxic to zebra mussels. Hot metallic sprays, copper or zinc paints and coatings, or molluscicide impregnated paints would be used.
H	Non-toxic (silicone-based) foul-release coatings	Surfaces susceptible to infestation would be treated or coated with antifoulant coatings or materials resistant to zebra mussel attachment or toxic to zebra mussels. Silicone-based coatings which prevent strong byssal attachment would be used.
I	Hypoxia/anoxia	Exposure of zebra mussels to anoxic conditions would kill both adults and larvae in a relatively short timeframe.
J	Filtration/strainer systems	Submerged sand filtration beds, onshore backwash systems, or strainer systems would be used to remove adults and larvae from incoming water supplies.
K	Robotics/pigging	Robotic surface cleaners, pipe cleaners or pigging systems would be used to remove and control adult zebra mussels.
L	Electrical fields	Electric fields or electrification of metal surfaces would be used to control zebra mussels. High-voltage electric fields (600 V/CM2, 36 MW/5,000 gallons) provide strong deterrents to zebra mussel establishment.
M	Ultraviolet light	Ultraviolet light would be used to destroy zebra mussels in incoming supply water.
N	Ultrasonics and high-intensity sound	High-intensity sound would be used to deter settlement of zebra mussels on facility components.

2.3 Thermal Treatments - Zebra mussels are intolerant of elevated temperatures. Holding water at 32.5 °C (90.5 °F) for 3 hours causes 100 percent mortality; raising the temperature to 40 °C (104 °F) causes instantaneous death. Thermal treatments would be used where hot water is available such as floating plant (boats, vessels, dredges) and bubbler systems.

2.4 Dewatering and Desiccation - Zebra mussels can be killed by exposure to hot, dry air (desiccation) or by freezing. This technique is most applicable to systems which can be temporarily dewatered or system components which can be dry stored until needed.

2.5 Removable/Replaceable Components - Design and installation of facility components which can be easily removed or replaced should they become infested with zebra mussels reduces the cost and dangers associated with underwater manual cleaning of these components. Intake screens and trash racks are examples of such components which would be designed or redesigned to allow for easy "changeout" to remove zebra mussels.

2.6 Antifoulant Construction Materials - Copper, zinc, brass and galvanized steel are toxic to zebra mussels. Although more expensive than conventional construction materials, these metals/alloys offer excellent zebra mussel protection with little or no environmental impact. Use of toxic construction materials would be considered for many of the smaller piping systems and components.

2.7 Antifoulant Coatings - Toxic and nontoxic coatings are available which either prevent zebra mussel settlement or cause very weak byssal attachment (mussels can be easily removed). These products include silicon and epoxy compounds, copper-based paints and thermal metallic sprays. Some of these compounds can remain viable for 20 years or more. These materials can be used on structures that are difficult to clean or if there are anticipated difficulties with removal and disposal of large numbers of zebra mussels.

2.8 Hypoxia/Anoxia - Zebra mussels must have oxygen for metabolic processes. Oxygen deprivation is an effective control method. In systems where time and other conditions permit, it would be feasible to isolate the system and allow stagnation to occur, creating an oxygen deficient environment in which zebra mussels cannot survive. Chemical agents, such as sodium-meta-bisulfate ($Na_2S_2O_5$), could also be used to remove oxygen from an isolated system.

2.9 Other - The costs associated with zebra mussel infestations have spurred the development of several other cleaning/control methods including robotics/pigging, electrical fields, electro-coagulation, ultraviolet light and ultrasonics. Many of these techniques are currently experimental; however, if future research proves the efficacy of these techniques, they could be employed to control zebra mussels within the St. Paul District.

Large quantities of zebra mussels generated during cleaning operations would create a solid waste disposal concern. As filter feeding bivalves, zebra mussels can bioaccumulate contaminants in their tissue. Depending upon concentrations of contaminants so accumulated, a large mass of

zebra mussels could be a hazardous waste concern. Studies by some researchers have demonstrated that zebra mussels do not appear to be major bioaccumulators. To date, most disposal has been by conventional means; e.g., land filling, composting, and spreading on agricultural lands as fertilizer. Solid waste regulations determine whether animals would be allowed to remain in the water as they are generated, or if they must be taken upland for disposal. The basic rule is that animals generated during underwater removal actions can, in most circumstances, remain in the water column. Animals generated in a non-aquatic situation, for example during the cleaning of a dewatered navigation lock, should not be placed back into the aquatic environment.

The District would follow the rules outlined above: For zebra mussels removed by divers or other in-situ (i.e., underwater) treatment methods, the zebra mussel mass generated would remain in the aquatic environment. For zebra mussels removed during dewatering operations or using treatment techniques which require removal of equipment from the aquatic environment, the waste generated, consisting of dead and/or dying zebra mussels, would be disposed of at upland locations following appropriate Federal, State and local requirements.

3.0 FACILITIES COVERED BY THIS RESPONSE PLAN

Zebra mussel populations are currently known only from the Mississippi, Minnesota and St. Croix Rivers within the St. Paul District. The focus of this plan concerns control and prevention of zebra mussel infestation at the 13 locks and dams and other facilities operated by the District on the UMR. However, zebra mussels have demonstrated an amazing ability to invade previously uninfested waters. A variety of transfer vectors, including boat hulls and trailers, bait buckets, and other recreational watercraft, are believed to be a primary dispersal mechanism of zebra mussels. It appears likely that, at some point in the future, District projects outside of currently infested waters will become infested. Additionally, many of the control methods discussed in this document would likely be employed at other District facilities should the need arise. However, this plan only covers facilities located on the commercially navigable portions of the UMR including facilities on the Minnesota and St. Croix Rivers. A listing of the primary facilities covered by this plan is presented in Table 2.

The District's Fountain City Service Base is home to the hydraulic dredge *Thompson* as well as a large variety of floating plant, vessels and other dredges. Additionally, nearly all District facilities have some type of small watercraft. These vessels are all potential candidates for infestation by zebra mussels. This document discusses control and prevention strategies for District watercraft.

Project features intended to enhance/maintain natural resources are present at many locations on the UMR. Backwater aeration culverts and aeration notches in spillways are examples of project features designed to enhance natural resources. If infested by zebra mussels, these features could cease to function, with adverse impacts on natural resources.

Table 2. Listing of St. Paul District facilities covered by the zebra mussel response plan.

Facility Name	Facility Type/Purpose	River System
Upper St. Anthony Falls Lock and Dam	navigation (9-foot channel project)	Mississippi River
Lower St. Anthony Falls Lock and Dam	navigation (9-foot channel project)	Mississippi River
Lock and Dam 1	navigation (9-foot channel project)	Mississippi River
Lock and Dam 2	navigation (9-foot channel project)	Mississippi River
Lock and Dam 3	navigation (9-foot channel project)	Mississippi River
Lock and Dam 4	navigation (9-foot channel project)	Mississippi River
Lock and Dam 5	navigation (9-foot channel project)	Mississippi River
Lock and Dam 5A	navigation (9-foot channel project)	Mississippi River
Lock and Dam 6	navigation (9-foot channel project)	Mississippi River
Lock and Dam 7	navigation (9-foot channel project)	Mississippi River
Lock and Dam 8	navigation (9-foot channel project)	Mississippi River
Lock and Dam 9	navigation (9-foot channel project)	Mississippi River
Lock and Dam 10	navigation (9-foot channel project)	Mississippi River
Boatyard - Fountain City, Wisconsin	equipment maintenance and support	Mississippi River
Natural Resource Management Projects/Features	natural resource enhancement (aeration culverts, etc.)	Minnesota, St. Croix and Mississippi Rivers
High Density Recreation Areas (Blackhawk Park, Goose Island, etc.)	recreation	Mississippi River
All District vessels, dredges and floating plant	support of District operations	Minnesota, St. Croix and Mississippi Rivers

A "laundry list" of the potential facility components affected and the hypothesized effect is presented in Table 3. Included in Table 3 are proposed short- and long-term alternative control techniques for various facility components.

4.0 PROCEDURES FOR PREVENTING CONTAMINATION OF DISTRICT PROJECTS

In 1991, the District adopted a Standard Operating Procedure (SOP) for preventing contamination of other waters within the District. The SOP is provided as Appendix A. Basically, the SOP requires all District vessels, including dredges, operating in the UMR to be removed from the water, thoroughly cleaned and carefully inspected for zebra mussels before being launched in any uninfested waters. The District would continue to follow this SOP, but generally, a policy of not transferring vessels from one water body to another has been practiced.

Table 3. Proposed alternative zebra mussel control techniques for various St. Paul District facilities and facility components.

Project/Component	Potential Problem(s)	Proposed Control Method(s)	
Lock Structures		*Short-term*	*Long-term*
Lock walls	Heavy encrustations can be expected; infestations of zebra mussels up to 10 cm (4 inches) have been observed at the Black Rock Lock on the Niagara River. Structural damage is expected to be limited to abrasion during cleaning operations. Long-term effects such as increased deterioration rates of concrete due to chemical reactions (ammonia production by zebra mussel mass) are possible. Cleaning and disposal of large quantities of dead zebra mussels pose a considerable problem.	A,D	H,K
Level gages	Encrustations could obscure level markings, making visual observation difficult.	A,D,E	F,H
Thermometers	Encrustations could reduce reliability of readings.	A	A
Miter gates	Miter gates have many locations suitable for accumulation of zebra mussels. Potential problems include increased corrosion of metal surfaces, paint deterioration and unbalanced or excessive loadings. Accretion of mussels could interfere with complete closure of gates, causing leakage and vibration. Clearance for fully opened gates could be reduced by accumulations of mussels in recesses.	A,D	G,H,K
Bubbler systems	All locks have bubbler systems on the miter gates that are operated throughout the winter to deice the gates. Encrustation of mussels could interfere with operation of these systems.	A,C,D	F
Bulkhead slots	Accumulations along the slots or sealing surfaces could cause closure problems.	A,D	G,H,K
Grating and screening	Accretion of mussels could foul or block intake ports, resulting in unbalanced flows, excessive loadings on bars, and slower operation. Increased corrosion of metal under encrustations is also of concern.	A,D,E	G,H,K
Lock culverts	Reduction of flow area and increased hydraulic roughness could cause unequal filling and emptying of lock chamber, increased turbulence in lock, and increased filling and emptying times. Disposal of large volumes of decaying zebra mussels is also of concern.	A,D	G,H,K
Fire protection systems	For fire suppression systems pumping water directly from the river, zebra mussels could foul intakes and be drawn into smaller diameter hoses and lines during use.	D, I, or alternative supply source	D or alternative supply source
Intake trash screens	See discussion under grating and screening above.	A,D,E	E,G,H
Air vents/internal piping	Plugging of smaller diameter piping could cause problems with internal drainage and lock operations.	B,C	B,C
Gaging systems with small-diameter piping and openings	Occlusion of the pipe leading from well to river and the weight of mussels on the float could lead to erroneous or no readings resulting in incorrect conclusions regarding project conditions.	B,C	B,C,F,K,L,M,N
Valves	Accretion of mussels could interfere with complete closure of valves. This could cause leakage and, under certain conditions, cavitation. Added loads for the operating machinery and paint deterioration could occur.	A,D	G,H,K
Auxiliary locks	Low water flow when unused may allow rapid accumulation of zebra mussels. See lock walls above.	A,D	G,H,K
Trash booms	Accumulation of mussels on booms and anchor cables could result in sinking of the booms.	A,D,E	G,H
Ladders	No large buildup of mussels expected between lower and upper pools: however, attached mussels could cut exposed sink.	A,D	G
Navigation aids (buoys, mooring cells)	Accumulation of mussels on buoys, mooring cells, and anchoring cables could sink navigation aids because of increased weight and drag forces.	A,D,E	G,H
Cathodic protection	Accumulation of mussels on these devices could impair their ability to prevent corrosion.	A,D,E	
Boats	Many locks and dams maintain boats at water-based facilities. Boat intakes, motors, and hulls could become infested with mussels, causing breakdowns, expensive repairs, and frequent removal of mussels.	A,C,D	G,H

Table 3. Proposed alternative zebra mussel control techniques for various St. Paul District facilities and facility components.

Project/Component	Potential Problem(s)	Proposed Control Method(s)	
Navigation Dams		*Short-term*	*Long-term*
Roller gates	Increased gate weight could stress operating machinery. Corrosion of metallic surfaces and paint deterioration are also potential problems.	A,D	G,H
Rubber side seals on roller gates	Abrasive nature of zebra mussel shells could cause accelerated deterioration of seals causing leakage and improper sealing.	A,D,C,E	F,G,H
Gate interiors	Increased metal corrosion and paint deterioration are of concern.	A,D	G,H
Roller gate tracks, chains, cables	Accumulation of zebra mussels could prevent movement of roller gates. Metal and paint deterioration.	A,D	G
Pier nose	Increased rate of concrete wear and deterioration.	A,D,C	G,H
Vessels and Dredges			
Hulls	Accumulation of zebra mussels would increase drag on vessels, increasing fuel consumption. Increased rates of metal and paint deterioration are also of concern.	A,C,D	G,H
Keel coolers	Encrustations could reduce or render inoperable the engine cooling system.	A,C,D	G,H
Piping systems	Critical piping systems for engine cooling, fire protection, air conditioning, refrigeration and bearing cooling could become plugged with zebra mussels and rendered inoperable.	B,C,D,E	F,G,H
Sea chests	Clogging of protective gratings could reduce water flow of water to sea chest, directly affecting engine cooling piping systems.	A,C,D	E,G,H
Natural Resource Management Reservoirs/Projects			
Beaches	Dead mussels could foul beaches, causing public health concerns associated with decomposing zebra mussels and sharp shell edges. Presence and odor of large numbers of dead mussels would limit desirability of beaches.	A	A
Launching ramps	Accumulation of mussels could cause health problems as stated above under beaches.	A	A
Floating facilities (courtesy floats, fishing piers, docks, buoys, etc.)	Accumulation of mussels would add weight, possibly causing structures to sink. Increased maintenance associated with removing large numbers of mussels and repainting structures. Sinking of navigational buoys could result in public safety impacts.	A,D,E	G,H
Boats	Many locks and dams maintain boats at water-based facilities. Boat intakes, motors, and hulls could become infested with mussels, causing breakdowns, expensive repairs and frequent removal of mussels.	A,C,D	G,H
Backwater aeration features (culverts, spillways, etc.)	Many of the dikes and associated spillways have structural features designed to provide flowing aerated water to backwaters. Infestation of these structures by zebra mussels could result in reduced delivery of aerated water to backwaters with associated adverse impacts on aquatic species.	A,C,D	F, G, H
Dam and associated structures (lift gates, stoplogs, etc.)	Operating machinery could be stressed by increased loadings on vertical lift gates. On a smaller scale, many of the same components listed under navigation dams and locks could be affected at reservoirs.	A,D,E	F,G,H

Appendix A

Standard Operating Procedures (SOP) for controlling the spread of zebra mussels.

CENCS-DE 29 July 1992

MEMORANDUM FOR: All St. Paul District Employees

SUBJECT: Standard Operating Procedures for Controlling the Spread of Zebra Mussels

1. The presence of zebra mussels in the Upper Mississippi River system has been confirmed. In addition to disrupting the ecosystem, zebra mussels can cost municipalities, industry, shippers, and recreational users of the waterbodies they invade millions of dollars for cleanup and control. Although a number of State and Federal agencies are working cooperatively on methods to control zebra mussels, there are no environmentally acceptable methods for their elimination available at the present time. Like Eurasian watermilfoil, another exotic species, the zebra mussel is likely to hitchhike on commercial and recreational boats. In addition, the microscopic zebra mussel larvae, called veligers, can unknowingly be introduced to uninfested waters in bilges, engine cooling systems, or anyplace with trapped water. Adult zebra mussels can live out of water for several days in moist shaded areas. Kept wet, but not submerged in water, for example in bilges or inside trailer frames, adult zebra mussels may survive out of water for well over a week. Although nothing can be done at the present time to rid the Upper Mississippi River system of zebra mussels, special precautions should be taken to prevent, or at least slow, their spread into other aquatic systems.

We must do what we can to assure that we are not inadvertently transporting zebra mussels to our western reservoir projects, headwaters projects, and other bodies of water throughout the District. Therefore, the St. Paul District is implementing a Standard Operating Procedure for decontaminating boats or equipment used on the Upper Mississippi River, the navigable portions of the St. Croix River and Minnesota Rivers, and any other waterbody infested by zebra mussels before that boat or piece of equipment is transported to any other waterbody or aquatic system.

2. Areas susceptible to colonization by zebra mussels include, but are not limited to:

Trailer frames
Boat hulls
Boat motors and drive components
Transducers
Anchors along with ropes and chains
Bilges
Live wells
Any other boat parts and/or accessories that get wet
Any equipment that gets wet (i.e. diving, boring, sampling, and surveying equipment)

3. The St. Paul District has implemented a zebra mussel monitoring program for each lock and dam within the District. The monitoring plan is designed to be compatible with those of other natural resource agencies on the Upper Mississippi River. It is designed to provide data on population densities, rates of reproduction, colonization, and spread, and the effectiveness of any control strategies implemented. To assist in our monitoring effort, any employees encountering what they believe to be zebra mussels should collect a sample, preserving it in a 70-percent alcohol solution (rubbing alcohol), note the location and the approximate number of individuals present, and promptly forward the sample and data to Tim Peterson, Environmental Resources Branch, Planning Division, (612) 220-0274.

/S/

Richard W. Craig
Colonel, Corps of Engineers
District Engineer

Appendix B

Comment letters received on preliminary plan.

STATE OF WISCONSIN
REPLY MESSAGE
DOA-5185(R09/91)

INSTRUCTIONS TO SENDER:
REMOVE YELLOW COPY FOR YOUR FILE.
SEND REMAINDER OF FORM INTACT TO PERSON ADDRESSED.

TO: Tim Yager
St. Paul District COE

FROM: Ron Martin
WDNR

SUBJECT-MESSAGE

Hi Tim,

I reviewed the ZM Response Plan & EA that you recently sent. Thanks for the opportunity to comment on the proposed plan. It looks like you did an excellent job in putting it together. I don't have any specific comments. Enclosed is a copy of the Dept's ZM Boater's Guide, our internal ZM guidance to Dept staff & the exotic species advisory sign - It looks like its pretty close to your standard operating procedures - Take care -

REPLY

SIGNED Ron Martin DATE 8/12/97

SIGNED _____ DATE _____

State Historical Society of Wisconsin
816 State Street ♦ Madison, Wisconsin 53706-1488 ♦ 608/264-6400 ♦ Fax: 264-6504

Division of Historic Preservation
608/264-6500

August 15, 1997

Mr. Robert J. Whiting
Chief, Environmental Resources Section
St. Paul District, Corps of Engineers
190 Fifth Street East
St. Paul, MN 55101-1638

IN REPLY PLEASE REFER TO SHSW: #97-0851/VA
RE: Zebra Mussell Response Plan

Dear Mr. Whiting:

The Division has reviewed the your Determination of No Adverse Effect for the above-referenced project as required for compliance with Section 106 of the National Historic Preservation Act and 36 CFR Part 800: Protection of Historic Properties, the regulations of the Advisory Council on Historic Preservation governing the section 106 review process and have the following comments to make.

We concur with your determination that this project will have **no adverse effect** on those qualities that make the Mississippi Locks and Dams eligible for listing on the National Register of Historic Places.

This completes our review of this project, with this letter constituting our final comments. Should project plans be modified, please submit any changes for review. If you have any questions regarding this matter please call me at (608) 264-6506.

Sincerely,
Richard A Bernstein
Richard A. Bernstein
Historian, Compliance Section

c: John Anfinson, COE-St. Paul

United States Department of the Interior

NATIONAL PARK SERVICE

ST. CROIX NATIONAL SCENIC RIVERWAY
401 HAMILTON STREET, P.O. BOX 708
ST. CROIX FALLS, WISCONSIN 54024-0708

IN REPLY REFER TO:

August 18, 1997

N50(SACN)

Mr. Robert J. Whiting, Chief, Environmental Resources Section
Management and Evaluation Branch
Engineering and Planning Division
Department of the Army
St. Paul District, Army Corps of Engineers
190 Fifth Street East
St. Paul, MN 55101-1638

Dear Mr. Whiting:

Thank you for the opportunity to comment on the Preliminary Zebra Mussel Response Plan for the St. Paul District, and the Preliminary Environmental Assessment which addresses the impacts of the proposed plan.

As you know, the St. Croix National Scenic Riverway is a partner agency in the Interagency St. Croix Zebra Mussel Task Force, which was formed in 1992 to prevent the spread of zebra mussels into the St. Croix. The Task Force has implemented a plan to achieve this goal. To date, we do not have evidence of a reproducing (self-sustaining) population of zebra mussels in the St. Croix.

We encourage the use of all preventative actions that can be implemented by your agency to ensure that vessels and/or equipment entering the St. Croix from the Mississippi have undergone zebra mussel decontamination procedures, as identified in Appendix A of the Draft Plan.

Sincerely,

Anthony L. Andersen
Superintendent

Minnesota Department of Natural Resources

500 Lafayette Road
St. Paul, Minnesota 55155-40__

August 26, 1997

Robert J. Whiting, Chief
Environmental Resources Section
Management and Evaluation Branch
St. Paul District, Corps of Engineers
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Re: Zebra Mussel Response Plan and Environmental Assessment

Dear Mr. Whiting:

The Minnesota Department of Natural Resources has reviewed the above-referenced documents and has no concerns or comments to offer at this time. However, if the Corps should decide to use other methods for zebra mussel control than those outlined in the plan (such as chemical treatments, for example), we request that you contact us in sufficient time to review the proposal.

Thank you for the opportunity to review the plan and assessment. If we can be of further assistance to you, please call Ken Wald of my staff at 296-4790.

Sincerely,

Thomas W. Balcom

Thomas W. Balcom, Supervisor
Natural Resources Environmental Review Section
Office of Planning

c: Con Christianson, Larry Nelson, Pete Otterson, Kathleen Wallace, Steve Johnson, Mike Davis

980016-1

United States Department of the Interior

NATIONAL PARK SERVICE
Mississippi National River and Recreation Area
175 Fifth Street East, Suite 418, Box 41
St. Paul, Minnesota 55101-2901

IN REPLY REFER TO:

L8050(MISS)-2

August 26, 1997

Tim Yager
St. Paul District; Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, MN 55101-1638

Dear Mr. Yager:

The National Park Service (NPS) has reviewed the Preliminary Zebra Mussel Response Plan for the St. Paul District and the Preliminary Environmental Assessment addressing the impacts of the proposed plan. A portion of the area discussed is within the boundary of the Mississippi National River and Recreation area (MNRRA), a unit of the national park system. NPS review of this project is required by 16 U.S.C. § 460zz-3(b).

We are pleased that the Corps, in addition to clean-up actions, is placing emphasis on zebra mussel prevention techniques. These techniques, combined with procedures for preventing contamination of other waters within the District, are key to preventing the spread of these exotics to uninfested waters. While the Mississippi River is contaminated at present, the majority of the St. Croix is free of zebra mussel contamination and measures such as the Standard Operating Procedure described in Appendix A of the Response Plan will be instrumental in maintaining that status.

Thank you for the opportunity to review and comment on these documents. If you have questions on this letter or the MNRRA, please contact Nancy Duncan at 290-4160, extension 237.

Sincerely,

Ron Erickson, acting for

JoAnn Kyral
Superintendent

MINNESOTA HISTORICAL SOCIETY

September 2, 1997

Mr. Robert J. Whiting
U.S. Army Corps of Engineers
Environmental Resources Section
190 5th Street East
St. Paul, MN 55101-1638

RE: Zebra Mussel Response Plan for the Upper Mississippi River
SHPO Number: 97-3568

Dear Mr. Whiting:

Thank you for the opportunity to review and comment on the above project. It has been reviewed pursuant to the responsibilities given the State Historic Preservation Officer by the National Historic Preservation Act of 1966 and the Procedures of the Advisory Council on Historic Preservation (36CFR800).

We have reviewed the proposed project, and we concur that the work will have **no effect** on those locks and dams which meet National Register criteria.

Please contact Dennis Gimmestad at 612-296-5462 if you have any questions regarding our review.

Sincerely,

Britta L. Bloomberg
Deputy State Historic Preservation Officer

345 KELLOGG BOULEVARD WEST / SAINT PAUL, MINNESOTA 55102-1906 / TELEPHONE: 612-296-6126

State Historical Society of Iowa

The Historical Division of the Department of Cultural Affairs

September 4, 1997

In reply refer to RC#: 970800084

Robert J. Whiting, Chief, Environmental Resources Section
Management and Evaluation Branch
Engineering and Planning Division
St. Paul District, Corps of Engineers
190 Fifth Street East
St. Paul, Minnesota 55101-1638

RE: COE - ZEBRA MUSSEL RESPONSE PLAN FOR THE UPPER MISSISSIPPI RIVER - CONCURRENCE WITH RECOMMENDATIONS

Dear Mr. Whiting:

Thank you for the copy of the preliminary draft of the report concerning the above referenced project. We offer the following comments and recommendations.

We have had an opportunity to review the information and agree with the findings and recommendations. Accordingly, we concur that the methods to be used will not adversely affect the lock and dam structures which have been determined eligible for listing in the National Register of Historic Places.

If you have any questions or if we may be of further assistance, please contact me at (515) 281-3306.

Sincerely,

Lowell Soike

Lowell J. Soike, Ph.D.
Historian, Bureau of Historic Preservation

☐ 402 Iowa Avenue
Iowa City, Iowa 52240-1806
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☑ 600 E. Locust
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DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF NP

October 3, 1997

Management and Evaluation Branch
Engineering and Planning Division

SUBJECT: Zebra Mussel Response Plan and Environmental Assessment

Dear Interested Parties:

Two documents are enclosed for your review and comment: a zebra mussel response plan for the St. Paul District, Corps of Engineers and an environmental assessment addressing the impacts of the proposed plan.

The zebra mussel response plan has been developed to guide zebra mussel control/prevention efforts at locks and dams on the Upper Mississippi River within the St. Paul District. We are asking you to review the proposed plan and the accompanying environmental assessment and provide comments. It is our conclusion that the plan would have minimal impacts on the human environment.

We would like to receive your comments by November 3, 1997. If this review time is inadequate, please advise Tim Yager, the point of contact. Tim can be reached at (612) 290-5277 or at Timothy.K.Yager@MVP01.usace.army.mil. Thank you.

Sincerely,

Robert J. Whiting

Enclosures

Robert J. Whiting
Chief, Environmental Resources Section
Management and Evaluation Branch

Printed on Recycled Paper

ENVIRONMENTAL ASSESSMENT

ZEBRA MUSSEL RESPONSE PLAN
ST. PAUL DISTRICT, U.S. ARMY CORPS OF ENGINEERS

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ENVIRONMENTAL ASSESSMENT

ZEBRA MUSSEL RESPONSE PLAN
ST. PAUL DISTRICT, U.S. ARMY CORPS OF ENGINEERS

1.0 INTRODUCTION

The St. Paul District, Corps of Engineers (District), has prepared this assessment of the environmental effects of zebra mussel control, prevention and disposal methods proposed in the zebra mussel response plan for District facilities located on the Upper Mississippi River (UMR) including the navigable portions of the Minnesota and St. Croix Rivers. The purpose of this environmental assessment (EA) is to document the environmental consequences of employing control measures to reduce or eliminate zebra mussel and other attached biofouling mollusk infestations at facilities operated by the District. This assessment was completed to satisfy the requirements of the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality regulations (40 CFR 1500-1508), and Corps of Engineers (COE) regulations (ER 200-2-2).

2.0 AUTHORITY AND NEED FOR ACTION

The zebra mussel (*Dreissena polymorpha*) is a small, freshwater bivalve mollusk (clam). Native to the Caspian Sea and Ural River area of Asia, the zebra mussel was introduced into North America in 1988, probably through the discharge of ballast water from a vessel entering from an overseas port. Since their initial discovery, zebra mussels have spread throughout the Great Lakes to many of the inland navigable waterways including the UMR. In 1991, another species of attached biofouling mollusk, for now called the quagga mussel, was identified in portions of the Great Lakes. Throughout this document, the term zebra mussel is used to describe attached biofouling mollusks as a group, including zebra mussels, quagga mussels and any other similar "look-alike" species with the same system-infesting behavioral characteristics commonly associated with zebra mussels.

The zebra mussel is a macrofouler: it quickly colonizes new areas and rapidly achieves high densities. Zebra mussels attach to a wide variety of firm surfaces using tough, proteinaceous byssal threads. Under natural conditions, they are found on rocks, logs, aquatic plants, shells of native mussels and exoskeletons of crayfish. They can also attach to plastic, concrete, wood, fiberglass, iron pipes, polyvinyl chloride (PVC) and surfaces covered with conventional paints. Zebra mussel larvae (veligers) are planktonic and can be drawn into raw water piping systems. Layers of zebra mussels can build up in critical piping systems as the animals settle and attach. Partial or total blockage of piping systems can result, causing damage to or outages of equipment and facilities. Zebra mussels may also foul areas in locks such as gage wells, bubbler systems, concrete surfaces, and untreated metal surfaces such as lock miter gates. Masses of dead zebra mussels can accumulate in gate recesses, hindering gate operation. The zebra mussel has become a multi-million-dollar pest in the Great Lakes region, affecting private and public facilities alike.

Zebra mussel populations are present at all St. Paul District locks and dams on the UMR, and these infestations could have serious economic and other consequences. These conditions intensify the need for identifying control measures to counter these pest organisms. Zebra mussels reproduce prodigiously, and what are now moderate populations may within a few years become very heavy infestations. This rapid buildup has been observed repeatedly in North America. Several control techniques, including application of non-fouling coatings, physical removal, and chemical treatment, have been identified to date.

Passage of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Public Law 101-646) directed the Secretary of the Army to foster a program of research and technology development for the environmentally sound control of zebra mussels at public facilities. Public facilities are broadly defined and include locks, dams, reservoirs, water-pumping stations, water intakes, power generating stations, drainage structures and others. The U.S. Army Corps of Engineers' Waterways Experiment Station (WES) is designated to implement a program to develop environmentally sound control strategies for zebra mussels.

The District is responsible for maintaining a navigable channel on the UMR including the navigable portions of the St. Croix and Minnesota Rivers. Maintenance of the 9-foot channel project is achieved through operation of the 13 locks and dams between the head of navigation in Minneapolis, MN and Guttenberg, IA to maintain adequate water depth, supplemented by dredging. Authority for continued operation and maintenance of the Mississippi River Nine-Foot Channel Project is provided in the River and Harbor Acts of 1930 and 1932. Serious zebra mussel infestations could hinder the efficient operation of any of the locks and dams on the UMR.

The District operates/maintains a number of recreational and natural resource management projects/features on the UMR. Infestation of these projects/features by zebra mussels could have adverse impacts on recreational opportunities and natural resources. Additionally, the District maintains a large "fleet" of boats and floating plant equipment which is susceptible to zebra mussel infestations.

In this EA, the term "facilities" is used to describe a wide variety of structures, vessels and other installations operated by the District which come into contact with surface water. Major facilities include dams, navigation locks, floating equipment, remote sensing water level and water quality monitoring stations, etc. The use of zebra mussel control measures may be required at these "facilities" to prevent or correct potential malfunctions associated with zebra mussel infestation. Different techniques are likely to be available and/or cost effective at each of the many types of facilities. Anticipated control methods are identified in Section 4.0 *DESCRIPTION OF PROPOSED ACTION.*

3.0 ALTERNATIVES CONSIDERED

Two alternatives are evaluated in this EA. The first alternative, the proposed action, would employ a variety of control, prevention or cleanup/disposal techniques to District facilities impaired or at risk of being impaired by zebra mussel infestations. No single control technique will work in all applications; therefore, a number of different methods are required. Each of these techniques must be as environmentally benign as possible, yet provide adequate levels of control and protection to ensure operational integrity of facilities.

The second alternative is the "no action" alternative. This alternative is evaluated to provide some perspective on the potential adverse impacts on District facilities of choosing not to implement zebra mussel control/prevention techniques.

3.1 Implement Control Measures

Under this alternative, a range of potential zebra mussel control techniques would be employed on a facility or facility component specific basis to control, prevent and/or clean up and dispose of zebra mussels. Appropriate control measures would be chosen from a "menu" of options ranging from chemical treatments to physical barriers (see Section 4.0 *DESCRIPTION OF PROPOSED ACTION*). The selection of a treatment method for each specific use would include an evaluation of potential environmental impacts, the level of control required and the effectiveness of each method in that application.

Zebra mussel control would be limited to use in or on types of facilities as defined in Section 2.0 *AUTHORITY AND NEED FOR ACTION;* no attempt would be made to control zebra mussels away from these facilities (i.e., in the open environment). Some types of control measures are expected to be necessary at some District facilities operating in the UMR for the remainder of their productive lives.

3.2 No Action

Under this alternative, no measures would be implemented to control zebra mussels at District facilities. This scenario would be expected to lead to periodic impairment of vital systems at navigation locks and dams. Closure or impairment of navigation locks would have profound effects on the regional economy as well as impacts on the recreating public. Based upon the experiences of other water users in the northern United States and Canada, the time frame in which mussel populations can increase from relatively low numbers to nuisance levels is short (1 to 3 years).

The serviceability of other Federal facilities could be threatened by taking no action. River gaging equipment could be rendered unreliable or inoperable if zebra mussel control measures were not implemented. Vessels and dredges operating within the District could be significantly impaired by zebra mussel infestations on hulls, keel coolers, piping systems and sea chests. Heavy infestations

of zebra mussels could accumulate on public boat launching ramps and swimming beaches at District operated natural resource management reservoirs/projects. Additionally, dam operations at these facilities could be impaired.

4.0 DESCRIPTION OF PROPOSED ACTION

A variety of control and prevention techniques are available and discussed below. In some circumstances, for example zebra mussel infestations on lock walls, the presence of zebra mussels may have no adverse impacts on facility operation. The most financially prudent course of action under these conditions may be to take no action at all. Additionally, zebra mussel populations may not reach nuisance levels near all facilities because natural water quality conditions may not be optimal (may be limiting or self-inhibiting). Other facilities may have constant, large infestations because they exist where habitat and water quality conditions are highly conducive to zebra mussel propagation and growth.

All control/prevention and disposal techniques would be applied in an environmentally sound manner. The following control measures would be considered for use in controlling zebra mussel infestations at District facilities.

4.1 Proposed Control Measures

Physical Removal - Scraping, brushing, and high pressure water spraying are very effective methods of removing zebra mussels from walls, trash racks, or other equipment. Where large quantities of zebra mussels must be removed, labor saving devices (i.e., a suction pump attached to a mechanical scraper) have been designed to dislodge and vacuum zebra mussels. Mechanical cleaning typically is environmentally compatible, provided suitable disposal sites exist. Mechanical cleaning would be employed on systems where some buildup of zebra mussels is tolerable or where it is simply not possible to economically control zebra mussels through other methods. Divers would normally be needed where dewatering of a facility is not possible.

Molluscicides/Chemicals - Chlorine, bromine, ozone, and potassium permanganate are some of the chemical biocides commonly used to disinfect water supplies and to control biological pests. Chlorine is a commonly used control agent in Europe, this country and Canada. Continuous exposure at 0.5 mg/l will kill zebra mussels in 14 to 21 days, which is preferable to application of a concentrated "slug dose" that zebra mussels can withstand for several days by closing their shells. Chlorine can be used in pipes or ducts that contain pressure sensing or other equipment.

Although biocides may not kill all organisms when applied to turbid, unfiltered water, they nonetheless kill most of the organisms present. For this reason, the presence of residual concentrations of biocides in the open aquatic environment is restricted by State and Federal regulatory authorities responsible for the protection of fish and other aquatic life. Regulatory

agencies typically establish in-stream surface water criteria for the protection of fish and other aquatic life and/or apply effluent limitations to point-source discharges to surface waters.

In those cases where chlorine or other biocides are selected for control of zebra mussels, the District would limit or control discharges of chlorine or other biocides to surface waters of the United States so as not to cause any applicable in-stream water quality criteria to be violated or any effluent limitation imposed by regulatory authority to be exceeded. Chlorine or other chemicals would mainly be used in systems where manual cleaning would not be possible and/or where total control is required.

Thermal Treatments - Zebra mussels are intolerant of elevated temperatures. Holding water at 32.5 °C (90.5 °F) for 3 hours causes 100 percent mortality; raising the temperature to 40 °C (104 °F) causes instantaneous death. Thermal treatments would be used where hot water is available such as floating plant (boats, vessels, dredges) and bubbler systems.

Dewatering and Desiccation - Zebra mussels can be killed by exposure to hot, dry air (desiccation) or by freezing. This technique is most applicable to systems which can be temporarily dewatered or system components which can be dry stored until needed.

Removable/Replaceable Components - Design and installation of facility components which can be easily removed or replaced should they become infested with zebra mussels reduces the cost and dangers associated with underwater manual cleaning of these components. Intake screens and trash racks are examples of such components which would be designed or redesigned to allow for easy "changeout" to remove zebra mussels.

Antifoulant Construction Materials - Copper, zinc, brass and galvanized steel are toxic to zebra mussels. Although more expensive than conventional construction materials, these metals/alloys offer excellent zebra mussel protection with little or no environmental impact. Use of toxic construction materials would be considered for many of the smaller piping systems and components.

Antifoulant Coatings - Toxic and nontoxic coatings are available which either prevent zebra mussel settlement or cause very weak byssal attachment (mussels can be easily removed). These products include silicon and epoxy compounds, copper-based paints and thermal metallic sprays. Some of these compounds can remain viable for 20 years or more. These materials can be used on structures that are difficult to clean or if there are anticipated difficulties with removal and disposal of large numbers of zebra mussels.

Hypoxia/Anoxia - Zebra mussels must have oxygen for metabolic processes. Oxygen deprivation is an effective control method. In systems where time and other conditions permit, it would be feasible to isolate the system and allow stagnation to occur, creating an oxygen deficient environment in which zebra mussels cannot survive. Chemical agents, such as sodium-meta-bisulfate ($Na_2S_2O_5$), could also be used to remove oxygen from an isolated system.

Other - The costs associated with zebra mussel infestations have spurred the development of several other cleaning/control methods including robotics/pigging, electrical fields, electro-coagulation, ultraviolet light and ultrasonics. Many of these techniques are currently experimental, however, if future research proves the efficacy of these techniques, they could be employed to control zebra mussels within the St. Paul District.

4.2 Disposal Methods

Large quantities of zebra mussels generated during cleaning operations would create a solid waste disposal concern. As filter feeding bivalves, zebra mussels can bioaccumulate contaminants in their tissue. Depending upon concentrations of contaminants so accumulated, a large mass of zebra mussels could be a hazardous waste concern. Studies by some researchers have demonstrated that zebra mussels do not appear to be major bioaccumulators. To date, most disposal has been by conventional means; e.g., land filling, composting, and spreading on agricultural lands as fertilizer. Solid waste regulations determine whether animals would be allowed to remain in the water as they are generated, or if they must be taken upland for disposal. The basic rule is that animals generated during underwater removal actions can, in most circumstances, remain in the water column. Animals generated in a non-aquatic situation, for example during the cleaning of a dewatered navigation lock, should not be placed back into the aquatic environment.

The District would follow the rules outlined above: For zebra mussels removed by divers or other in-situ (i.e., underwater) treatment methods, the zebra mussel mass generated would remain in the aquatic environment. For zebra mussels removed during dewatering operations or using treatment techniques which require removal of equipment from the aquatic environment, the waste generated, consisting of dead and/or dying zebra mussels, would be disposed of at upland locations following appropriate Federal, State and local requirements.

4.3 Procedures for Preventing Contamination of District Projects

In 1991, the District adopted a Standard Operating Procedure (SOP) for preventing contamination of other waters within the District. Basically, the SOP requires all District vessels, including dredges, operating in the UMR to be removed from the water, thoroughly cleaned and carefully inspected for zebra mussels before being launched in any uninfested waters. The District would continue to follow this SOP, but generally, a policy of not transferring vessels from one water body to another has been practiced.

5.0 AFFECTED ENVIRONMENT AND ASSESSMENT OF EFFECTS

An environmental analysis has been conducted for the proposed action, and a discussion of the impacts follows. As specified by Section 122 of the 1970 Rivers and Harbors Act, the categories of impacts listed in Table 1 were reviewed and considered in arriving at the final determinations.

Table 1. Environmental assessment matrix (Section 122 of the River and Harbor and Flood Control Act of 1970 [P.L. 91-611]), Zebra mussel response plan.

	MAGNITUDE OF PROBABLE EFFECTS						
	BENEFICIAL EFFECT			NO APPRECIABLE	ADVERSE EFFECT		
PARAMETER	SIGNIFICANT	SUBSTANTIAL	MINOR	EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT
A. SOCIAL EFFECTS							
1. Noise Levels				X			
2. Aesthetic Values			X				
3. Recreational Opportunities			X				
4. Transportation		X					
5. Public Health and Safety			X				
6. Community Cohesion (Sense of Unity)				X			
7. Community Growth & Development				X			
8. Business and Home Relocations				X			
9. Existing/Potential Land Use				X			
10. Controversy				X			
B. ECONOMIC EFFECTS							
1. Property Values				X			
2. Tax Revenues				X			
3. Public Facilities and Services			X				
4. Regional Growth				X			
5. Employment				X			
6. Business Activity				X			
7. Farmland/Food Supply			X				
8. Commercial Navigation		X					
9. Floodplain Effects				X			
10. Energy Needs and Resources				X			
C. NATURAL RESOURCE EFFECTS							
1. Air Quality				X			
2. Terrestrial Habitat				X			
3. Wetlands				X			
4. Aquatic Habitat					X		
5. Habitat Diversity and Interspersion				X			
6. Biological Productivity				X			
7. Surface Water Quality					X		
8. Water Supply				X			
9. Groundwater				X			
10. Soils				X			
11. Threatened or Endangered Species				X			
D. CULTURAL RESOURCE EFFECTS							
1. Historic Architectural Values				X			
2. Pre-Historic and Historic Archeological Values				X			

5.1 Socioeconomic Resources

5.1.1 Safety - Public safety is an important consideration at all District facilities. Safety is enhanced through maintenance of facilities which are clean and hazard free. Visitation is very high at public use areas such as boat launch ramps and beaches, which are susceptible to zebra mussel fouling. The recreating public expects a reasonable degree of safety precautions to be provided for their welfare.

5.1.1.1 Implement Control Measures - Public safety would be maintained, but not totally guaranteed, by implementation of zebra mussel control measures. A regular maintenance program to remove mussels from lock chambers and areas used by recreational boaters during locking procedures would ensure public safety. Fouling of recreation areas could still occur, but removal of most shell material would reduce the risk of personal injury to the public.

5.1.1.2 No Action - Public safety could be compromised by taking no action to control zebra mussels. Heavy fouling of lock chamber walls could create hazards to recreational boaters "locking through" lock and dam chambers. The fouling of beaches and boat ramps by zebra mussel shells, which are often sharp, could result in personal injuries such as cuts.

5.1.2 Economics - District operated and maintained facilities produce a wide range of economic benefits vital to the economy of the region. Benefits accrue from maintenance of commercial and recreational navigation, reduced property damage through flood control, and maintenance of high quality recreational facilities used by a growing recreating public. Uncontrolled populations of zebra mussels at facilities could reduce the level of benefits realized. Failure to control nuisance zebra mussel populations at District operated facilities would have adverse consequences ranging from slightly negative to profound in magnitude.

5.1.2.1 Implement Control Measures - Enacting zebra mussel control measures would ensure the continued normal output of services and economic benefits from facilities that could be affected by zebra mussel fouling. Implementation of the zebra mussel control program would increase maintenance cost of District projects. The most significant increase in maintenance costs would probably occur on the 9-foot channel project on the UMR. However, the cost of controlling zebra mussels compared to the potential costs to the navigation industry of repeated lock closures is likely small.

5.1.2.2 No Action - The principal economic risk incurred by the District in adopting a no action policy regarding zebra mussels would involve the potential shutdown of a lock or locks because of zebra mussel fouling problems. Delays to commercial traffic as a result of a lock shutdown could have substantial economic impacts. A conservative estimated cost for lockage delays for a commercial tow is approximately $300/tow/hour.

Zebra mussel fouling resulting in increased lock outages would also inflict a hardship on recreational boat traffic. Maintenance costs for some lock structures would increase, and the life-span of certain components might be greatly reduced.

5.1.3 Aesthetics - The aesthetic qualities of facilities covered by this document vary greatly. These range from large lock and dam complexes to more natural settings at most recreation areas where aesthetic qualities are one of the major attractions. Zebra mussel fouling of some facilities would degrade the aesthetic characteristics of some locations while having no appreciable effect on others.

5.1.3.1 Implement Control Measures - Control measures at most facilities would emphasize maintaining serviceability first, with appearance or aesthetics as a secondary concern. For example, on lock walls, accumulations of zebra mussels could be scraped off and the wall resurfaced with non-fouling materials, thus restoring the appearance of that component. However, this measure would probably be implemented only if zebra mussel accumulations were causing damage to the lock wall. Appearance would not be an overriding reason for implementing a control measure. On the other hand, if zebra mussel fouling occurred at a recreational beach or boat ramp at a District operated recreational area, cleaning of the fouling would likely be completed for both safety and appearance reasons. Control measures used at recreation sites would attempt to restore the aesthetic qualities of areas degraded by zebra mussels.

5.1.3.2 No Action - The aesthetic qualities of most facilities would not be significantly degraded by zebra mussels if no control measures were implemented. At most facilities, accumulations of zebra mussels would occur on surfaces entirely submerged. These accumulations would only be revealed during dewatering of facilities. However, at District operated recreational areas, aesthetic qualities would be lessened by fouling of shorelines, beaches and boat ramps. Zebra mussel masses would undergo natural decay processes, with foul odors adversely affecting aesthetics. At certain times, the aesthetic qualities of some recreational facilities could be significantly degraded.

5.2 Recreational Resources - District operated facilities provide a wide range of recreational opportunities and benefits. A considerable recreation related industry has developed in association with District projects. Zebra mussel populations could foul recreational beach areas, shorelines and boat ramps or other accesses. Zebra mussel impacts on navigation locks could result in adverse impacts on recreational boaters and safety (see Section 5.1.1 *Safety)*.

5.2.1 Implement Control Measures - Implementing control measures at recreation facilities would generally involve removing zebra mussels from areas of high public use or areas where contact with the animals would degrade the recreational experience. Swimming beaches and boat ramps would be the primary sites where zebra mussel removal would be likely to occur. At recreational beaches, zebra mussels would most likely be swept inshore by wave action or high river flows. It is likely that many zebra mussels accumulating on beach areas would be

dead/decaying, resulting in odor and shell fragment problems. Concentrations of zebra mussels would be removed and disposed of in an approved manner. Zebra mussels interfering with boat ramps would be removed.

5.2.2 No Action - In the event of significant zebra mussel fouling, public use of beaches and boat ramps would be impaired. The odor of decaying zebra mussel flesh is obnoxious. Sharp shell fragments are a serious hazard to beach users. Many recreationists would probably avoid beaches fouled by zebra mussels.

Fouling of boat ramps would probably not render these facilities unusable; however, some inconvenience to the public would result from the nuisance of stepping on dead and live zebra mussel shells and from the odor. Large populations of zebra mussels could sink, weight down or destabilize courtesy docks, and sink beach area marker floats.

5.3 Cultural Resources - Zebra mussels have the potential to significantly infest District facilities located within riverine and reservoir environments. Many of these facilities, but particularly those associated with the early development of flood control and navigation, meet the minimum requirements for National Register eligibility, have been determined eligible, or are listed on the National Register of Historic Places.

5.3.1 Implement Control Measures - Implementation of zebra mussel control measures would ensure the continued operation and service of infested facilities. Such measures would have little or no effect on those characteristics of the facilities which would qualify them for listing on the National Register of Historic Places.

5.3.2 No Action - If no action is taken to control zebra mussel infestations at District facilities, the serviceability and operation of those facilities could be threatened. Given the historic context of many of these facilities (i.e., their historic association with the development of flood control and navigation along affected waterways), their serviceability and continuing operation are part of their historic significance. No action may, in some cases, result in adverse effects on potentially significant historic properties.

5.4 Water Resources

5.4.1 Water Quality - The quality of surface waters at District projects is variable, but generally suitable for most recognized uses including propagation of fish and wildlife, domestic water supply, industrial water supply, livestock watering, agricultural uses and water contact recreation. Water quality at most District projects has been described in other documents. Site specific descriptions of water quality are available through these sources.

As mentioned, water quality is highly variable from one location to another; depending primarily on watershed characteristics. Facilities covered by this document are located on the UMR including the navigable portions of the Minnesota and St. Croix Rivers (Table 2).

Table 2. Listing of St. Paul District facilities covered by the zebra mussel response plan.

Facility Name	Facility Type/Purpose	River System
Upper St. Anthony Falls Lock and Dam	navigation (9-foot channel project)	Mississippi River
Lower St. Anthony Falls Lock and Dam	navigation (9-foot channel project)	Mississippi River
Lock and Dam 1	navigation (9-foot channel project)	Mississippi River
Lock and Dam 2	navigation (9-foot channel project)	Mississippi River
Lock and Dam 3	navigation (9-foot channel project)	Mississippi River
Lock and Dam 4	navigation (9-foot channel project)	Mississippi River
Lock and Dam 5	navigation (9-foot channel project)	Mississippi River
Lock and Dam 5A	navigation (9-foot channel project)	Mississippi River
Lock and Dam 6	navigation (9-foot channel project)	Mississippi River
Lock and Dam 7	navigation (9-foot channel project)	Mississippi River
Lock and Dam 8	navigation (9-foot channel project)	Mississippi River
Lock and Dam 9	navigation (9-foot channel project)	Mississippi River
Lock and Dam 10	navigation (9-foot channel project)	Mississippi River
Boatyard - Fountain City, Wisconsin	equipment maintenance and support	Mississippi River
Natural Resource Management Projects/Features	natural resource enhancement (aeration culverts, etc.)	Minnesota, St. Croix and Mississippi Rivers
High Density Recreation Areas (Blackhawk Park, Goose Island, etc.)	recreation	Mississippi River
All District vessels, dredges and floating plant	support of District operations	Minnesota, St. Croix and Mississippi Rivers

Typically, the main channel impoundments on the UMR are relatively shallow, run-of-river water bodies that exhibit characteristics of both lentic and lotic waters. The upper portions of the navigation pools are primarily riverine in nature with a trend toward more lake-like conditions nearer the navigation locks and dams and in backwaters. The substantial flows characteristic of the main channel aid in maintaining dissolved oxygen concentrations. Temperature stratification does occur, generally in deeper, more lake-like portions of the navigation pools and in backwaters, but is less persistent and easily destabilized by the introduction of flow. Water quality is generally good on the UMR within the context of industrial development, operation of dams, watershed development, point and non-point sources of pollutants and many other factors.

5.4.1.1 Implement Control Measures - Most zebra mussel control measures would have relatively minor or no impact on water quality. Procedures to control zebra mussels such as deoxygenation, thermal shock, desiccation and coatings would produce very localized degradations of water quality which would be quickly diluted by the volume of the receiving waters and minimized immediately downstream of the project. Use of mechanical cleaning techniques could affect water quality on a localized and temporary basis, if large quantities of detached zebra mussels were released into the aquatic environment.

Biocide residuals released into the environment would be diluted by untreated river flows many times the volume of the water treated with biocides. Additionally, organic material loads which are generally high in most streams, would rapidly oxidize biocide residuals. The use of biocides would have minimal impacts on water quality. Regardless, minimization of biocide use is a goal of the District, and in most cases, other equally effective alternative treatment methods are available.

5.4.1.2 No Action - Implementation of the no action alternative would result in no impacts on water quality. Ongoing maintenance activities at District facilities would continue with no change in existing water quality conditions. However, if zebra mussel populations increased to extreme densities, those populations would likely affect various water quality characteristics as a result of their prolific water filtering capabilities. District natural resource management features, such as aeration culverts and spillways, could become clogged with zebra mussels and cease to function if no control actions were taken. This could result in degraded water quality in backwater areas supplied with oxygenated water by these features.

5.4.2 Water Supplies

The UMR is a dependable and relatively clean source of water. Many municipal, industrial and agricultural water users obtain water from the UMR within the St. Paul District.

5.4.2.1 Implement Control Measures - Implementation of zebra mussel control measures would be unlikely to affect area water supplies. Chemical control measures would release small quantities of residual chlorine or other biocides into the aquatic environment; however, dilution and oxidization by receiving waters would quickly minimize concentrations of these chemicals.

Zebra mussels removed by large-scale underwater mechanical cleaning operations could temporarily degrade water quality as the dead zebra mussels decompose. However, effects from this process would be very localized and unlikely to affect water supplies. Water intakes in the immediate vicinity of large-scale underwater cleaning operations would be identified and disposal of animals in their vicinity avoided.

5.4.2.2 No Action - Implementation of the no action alternative would result in no impacts on water quality or water supplies. Ongoing maintenance activities at District facilities would continue with no change in existing water quality conditions. Zebra mussel populations are expected to affect various water supplies in the same manner and degree to which District facilities will be affected. However, those effects would not occur as a result of decisions concerning zebra mussel control at District facilities.

5.5 Natural Resources

5.5.1 Fish and Wildlife

An abundant and diverse assemblage of fish and wildlife species occurs in the operational area covered by this document. Habitat quality controls the abundance and variety of organisms present at any given location. Free flowing or controlled-flow stream reaches support diverse aquatic communities, including many fish and invertebrate species adapted to lentic conditions. Impounded segments of streams support somewhat different aquatic communities adapted to lotic conditions. Aquatic assemblages of streams and reservoirs have been extensively studied and described in numerous general and specific sources.

5.5.1.1 Implement Control Measures - Implementation of chemical control measures could result in adverse impacts to the aquatic environment and fish and wildlife beyond the immediate confines of the pipe, tank or other closed "system" targeted for treatment. Chemicals used to control zebra mussels would also likely be toxic to other non-target fish and wildlife species. Because of the potential for impacts to non-target species, toxic concentrations of control chemicals would not be allowed to be discharged into the general environment. Any discharges of residual control chemicals would be subject to wastewater discharge permits issued by State or Federal regulatory authorities. Chemical or physical detoxification of treated waters would be achieved prior to discharge. Additionally, treated waters would be mixed with large quantities of raw water upon release from facilities, further diluting toxic chemicals. No adverse impacts within mixing zones would be expected.

Regardless, some minute quantities of control chemicals would be released into the aquatic environment. However, concentrations of toxic chemicals would be diluted to the extent that no impairment of important resources such as fisheries, including spawning habitat, larval young-of-the-year fishes or forage organisms would occur. Other aquatic resources such as aquatic invertebrates, including freshwater mollusks, would also suffer no impairment from chemicals used to control zebra mussels in District facilities.

Control measures involving physical removal or temporary extreme habitat changes in contained areas (thermal shock, oxygen depletion, etc.) would similarly not affect the aquatic environment outside of a very confined mixing zone within the facility or immediately adjacent to the facility. The water masses in which control activities would occur would be mixed with much larger discharges from routine activities at facilities (lockages, dam discharges, etc.). Habitat quality would not be adversely affected within these mixing zones or beyond.

5.5.1.2 No Action - Under the no action alternative, there would be no significant impacts on fish and wildlife resources. Operations at facilities would continue to exert essentially the same influence on aquatic biota as presently occurs. However, it is likely that zebra mussel populations will result in modification of the aquatic environment. In some cases, freshwater mollusks for example, the modifications to the aquatic environment caused by zebra mussels may result in significant adverse impacts.

5.5.2 Threatened and Endangered Species

Two species of freshwater mussels, the Higgins' eye pearly mussel (*Lampsilis higginsi*) and the winged mapleleaf mussel (*Quadrula fragosa*), are known from waters in the project area. A large number of State-listed fish and mussel species are also known from the project area.

5.5.2.1 Implement Control Measures - As with other species of fish and wildlife, the impacts of implementing zebra mussel control measures would likely have no effects on threatened and endangered species. Detoxification of chemicals used in zebra mussel control measures and mixing of treated effluents with large volumes of untreated river water ensure protection of aquatic resources including threatened and endangered mussel species.

5.5.2.2 No Action - As with other fish and wildlife species, implementation of no action would result in no impacts on threatened and endangered species above and beyond those already occurring under current project operations. However, it is very likely zebra mussels will affect threatened and endangered mussel species through direct competition for food resources and colonization of mussel shells. The impacts to threatened and endangered species could be profound, perhaps leading to extinction. These impacts would occur irrespective of control actions taken at Federal facilities.

6.0 MITIGATION MEASURES

Zebra mussels are an unwelcome but probably permanent resident of the UMR. They are likely to invade other water bodies, including those with District operated facilities, at some point in the future. Their unique biofouling characteristics and history in North America make them a threat to District facilities which provide economic benefits to the region. The District will employ controls to manage the negative impacts of zebra mussels on District facilities, while at the same time taking precautions to protect the aquatic environment and non-target organisms. The District is committed to executing an environmentally benign zebra mussel control program.

The District has an ongoing dialogue with State and Federal agencies charged with protecting natural resources. In cases where chlorine or other biocides are selected as the preferred control method, the District will limit or control discharges of chlorine or other biocides to surface waters of the United States so as not to violate an applicable water quality criteria or exceed any effluent limitation imposed by regulatory authority. Because biocides in general carry the highest risk to non-target organisms, the District will minimize the use of biocides to systems that cannot otherwise be effectively treated.

The District will continue to investigate existing and new, effective and environmentally sound control technologies. The U.S. Army Corps of Engineers, Waterways Experiment Station (WES) is specifically charged by the 1990 Non-Indigenous Aquatic Nuisance Prevention and Control Act to design and implement a program of research and technology development that identifies environmentally sound methods and strategies to control zebra mussel infestations at public facilities. Research by WES is proceeding in four major task areas:

(1) Coordination and technology transfer
(2) Environmental testing
(3) Development and evaluation of control methods
(4) Development and testing of control strategies

Technology transfer is being accomplished through the release of a series of publication entitled "Zebra Mussel Research Technical Notes." These publications are available through WES at:

Dr. Edwin Theriot
Chief, Aquatic Ecology Branch
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

The District will continue to investigate alternative structural and plant designs, within limits of engineering capability and fiscal responsibility, to employ lower risk control methods such as connection to potable water systems and isolation of facility components from raw water.

In locations where significant aquatic resources exist, such as threatened or endangered species, and where the use of chlorine or other non-selective biocides is determined necessary to control zebra mussels, the District will conduct more rigorous environmental review to assess possible impacts of control methods on these resources. In some, but likely not all cases, this could involve further field investigations and preparation of additional documentation (possibly site specific EAs and/or Biological Assessments). Any site specific document generated would arise under the pre-existing umbrella of coverage for zebra mussel control detailed in this EA. State and Federal regulatory agencies will be provided the opportunity to comment on any site specific assessments prior to control measures being implemented.

7.0 COORDINATION

7.1 Public Involvement Program

A public notice summarizing the zebra mussel response plan and indicating the availability of the plan for public review has been sent to interested river users.

7.2 Required Coordination

A preliminary copy of the zebra mussel response plan was coordinated with the Wisconsin Department of Natural Resources, the Minnesota Department of Natural Resources, the Iowa Department of Natural Resources, the Minnesota Pollution Control Agency, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the National Park Service and the Iowa, Minnesota and Wisconsin State Historic Preservation Offices. Comment letters were provided by most of these agencies (see appendix B of the zebra mussel response plan).

This assessment will be sent to the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service for review. It will also be made available to the agencies listed above and the public for review and comment.

8.0 APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

This assessment was prepared and the proposed zebra mussel response plan was designed to comply with all applicable environmental laws and regulations, including the following:

1) National Environmental Policy Act of 1969.
2) Executive Order 11514, Protection and Enhancement of Environmental Quality (as amended in Executive Order 11991).
3) Executive Order 11593, Protection and Enhancement of the Cultural Environment.
4) Executive Order 11990, Protection of Wetlands.
5) Clean Air Act of 1977.
6) Clean Water Act of 1977.
7) Endangered Species Act of 1973.
8) Fish and Wildlife Coordination Act.
9) National Historic Preservation Act.
10) 40 CFR 1500-1508, Council on Environmental Quality, Regulations for Implementing Procedural Provisions of the National Environmental Policy Act of 1969.