



INFORMATION GUIDE  
ON LAKE OUTLETS



April 22, 2021

Mark Dunaski  
Windemere Township Lakes Association/Windemere Township  
89210 East Frontage Road  
Sturgeon Lake, MN 55783  
Via email: mdunaski@msn.com

**Subject: Lake Outlet Expertise to Assist with Sturgeon Lake**

Dear Mark:

We recently discussed the situation with the high water levels on Sturgeon Lake with Caleb Anderson, Pine County Land and Resource Manager, and Caleb suggested that we reach out to you directly. We want to offer you, the Windemere Township Lakes Association, Pine County, and other project stakeholders our expertise and experience as you move ahead and explore potential solutions to the high water problems around the lake.

We've helped lake associations and improvement districts, counties, and watershed districts throughout Minnesota explore, understand, and implement outlet projects similar to the one being considered for Sturgeon Lake. This includes offering engineering, environmental, public engagement, and construction management services. We have put together a brief packet outlining the components of these projects, the services we provide, and some of the projects we've successfully helped our clients develop to solve similar challenges.

We have completed similar work on many other Minnesota lakes. We would be happy to discuss these completed and in-progress projects:

- Devils Lake and Little Devils Lake
- Swede Grove Lake
- Sand Lake
- Labelle Lake and Boyer Lake
- Lake Shamineau
- Many others

If you want to ask any questions, we'd be happy to chat and lend our insights. Please don't hesitate to reach out to either one of us by phone or email.

Sincerely,

HOUSTON ENGINEERING, INC.

A handwritten signature in blue ink, appearing to read 'Michael M. Opat', written over a horizontal line.

Michael M. Opat, MBA, PE, CFM  
Senior Project Manager  
Direct: 701.499.9473  
mopat@houstoneng.com

A handwritten signature in blue ink, appearing to read 'Moriya Ruffer', written over a horizontal line.

Moriya Ruffer, MS, CLM  
Environmental Scientist/Certified Lake Manager  
Direct: 218.396.1169  
mruffer@houstoneng.com



## TABLE OF CONTENTS

## Information Guide on Lake Outlets

	Page
A. Lake Outlet Improvements.....	1
B. Environmental and Permitting.....	3
C. Related Experience.....	4
D. About Houston Engineering, Inc.....	13



## A. LAKE OUTLET IMPROVEMENTS

Maintaining desirable water levels and healthy water quality for lakes can be complicated work, and a lake's outlet (or lack of one) plays a major factor. Many lakes have natural or constructed outlets and these features often require maintenance and improvements to keep them operating properly. In other cases, a lake may not have a natural outlet and water levels can rise in an uncontrolled fashion if water flows into the lake faster than it evaporates and/or enters the groundwater system. In those cases, a new outlet may need to be constructed to address the negative impacts that may be caused by the rising water levels.

HEI is committed to providing engineering, environmental, and planning services for our clients' water resources needs, and we have developed a robust team of lakes experts that specialize in lake outlets. Our team has provided successful, cost-effective solutions to stakeholders impacted by outlet issues on lakes throughout Minnesota and the Upper Midwest.

Some of these projects are described in more detail later in this packet, including the following:

### New Outlet Design and Construction

- Devils Lake Outlet Project (page 4)
- Swede Grove Outlet Project (page 5)
- Drawdown of Sand Lake Project (page 6)
- Lake Shamineau High Water Outlet (page 7)
- LaBelle and Boyer Lakes High Water Outlet Project (page 8)
- Nelson Lake Outlet
- Little McDonald Lake Outlet

### Existing and Natural Outlet Improvements

- Blackduck Lake Dam Modifications (page 9)
- Lake Ogechie Ecological Restoration (page 10)
- Ravine Lake Outlet Structure – CDSF Overflow Project Phase III (page 11)
- Nammacher's Lake (page 12)
- Latendresse Dam Outlet Structure Repair
- E2 Wetland Nutrient Removal Retrofit
- Bakers Lake Outlet Feasibility

Our successful approach to these projects and others focuses on several key facets, as described briefly below.

### Identify What Is Causing the Problem

The key to identifying a successful solution is properly identifying the root cause of the problem. HEI's team of experienced hydrogeologists and hydrologists assist our clients with analyzing the various groundwater, surface water, and climatic variables that often contribute high water levels on closed basin lakes.

On lakes with existing outlets, there might be problems caused by structural failures or structures with insufficient capacity. HEI's team of structural engineers and hydraulic experts know what it takes to identify these problems.

### Identify Potential Solutions

Every lake and outlet project are different, and we help clients explore the feasibility and costs of different outlet types to make the best choice for their specific situation. HEI's staff have retrofits and new outlets involving structures- large and small, open channels, buried pipes, and combinations of the two. We have also designed outlets with small and large pumping systems, some including filtration systems that addressed aquatic invasive species present in the lake. Our approach begins with a broad range of



solutions, and we work with our clients to identify the most cost-effective solution to meet their needs.

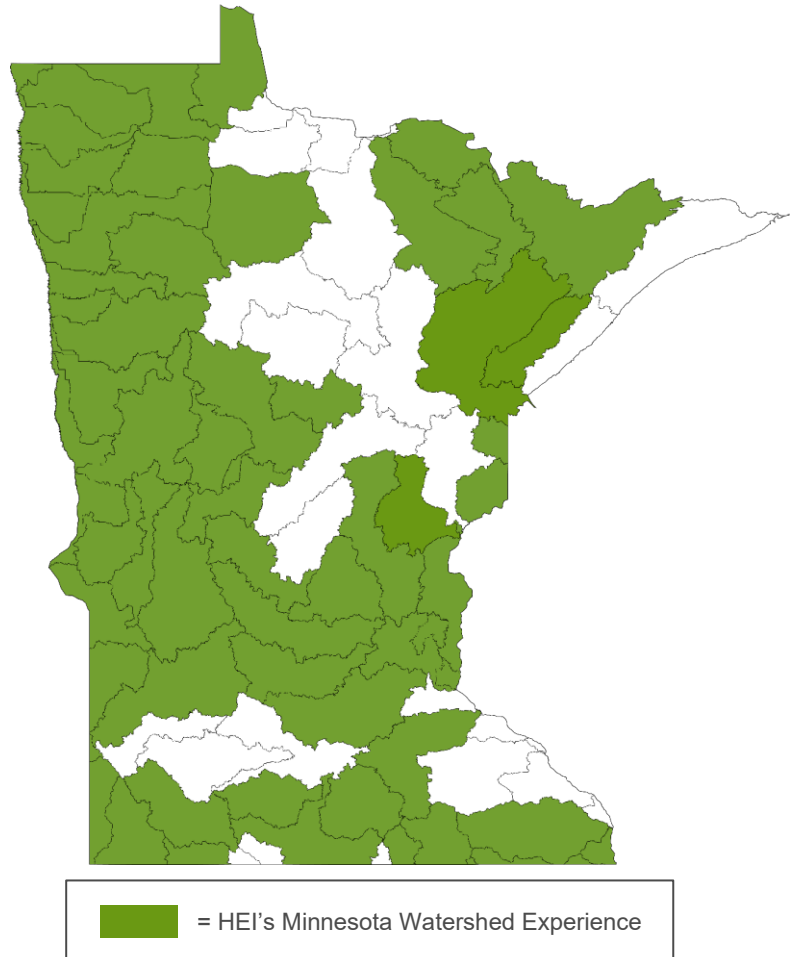
### Employ Public Drainage Facilities as Outlets

In some instances, outlet improvements require the use of an existing public drainage facility or even the creation of a new public facility. HEI has extensive experience with the management and development of public drainage facilities. Drainage authorities throughout the region rely on HEI to provide hydrologic and hydraulic modeling, design, and permitting support for drainage facilities in both rural and urban settings.

### Devise Effective Operating Plans

High water levels on lakes without natural outlets typically can't be addressed without moving water out of the lake. Doing so can cause adverse impacts downstream if the project is not designed and operated in a manner that takes these downstream impacts into consideration. These lakes, and lakes with existing outlets, often have requirements for maintaining specific water levels for water quality, aquatic habitat, recreation and property protection benefits.

HEI works with our clients to design outlet projects with this in mind, and we also work together to develop detailed operating plans to guide the operation and maintenance of outlets to limit adverse impacts while providing the desired benefits for those utilizing the lake. This is a key component in securing necessary permits and in obtaining right-of-way and regulatory approvals.



**Figure 1:** HEI has provided engineering and environmental services in watersheds throughout Minnesota, and we will put that experience to work for your project



## B. ENVIRONMENTAL AND PERMITTING

Artificial lake outlets often present challenging environmental and permitting issues. HEI's staff draw from extensive experience as both environmental consultants and regulators to help clients meet those challenges. Our extensive experience with these projects provides our clients with the expertise and connections necessary to navigate these issues.

HEI's approach to a few of these challenges is outlined below.

### Water Quality

Water quality is often a hot button topic, but it can be especially so when it comes to transferring lake water to another water body. In some cases, the lake water is of higher quality than the potential receiving water, but that doesn't make the situation easy. In other cases, the lake water presents challenges that require remediation or other considerations to facilitate the transfer of the water downstream. HEI provides numerous water quality-related services, including the following:

- Data collection
- Modeling of lakes, rivers, and stormwater systems
- National Pollutant Discharge Elimination System (NPDES) compliance
- Total Maximum Daily Load (TMDL) studies
- Sediment reduction
- Funding acquisition and compliance

### Aquatic Invasive Species

In addition to water quality, an ever-growing challenge with lakes around the region is the presence of aquatic invasive species (AIS). Preventing and slowing the spread of invasive

species is vital to maintaining the health of water bodies throughout the Upper Midwest. Our staff is experienced in the design of filtration systems that are approved by regulators as sufficient means of transferring excess water downstream without permitting AIS to move downstream with it.

### Permitting and Regulatory Approval

Even small projects have strict regulations to abide by. And as projects grow—and the number of funding sources grow alongside them—projects become subject to even more local, state, and federal regulations.

With more than 50 years of consulting experience in the Upper Midwest, HEI has specialized in understanding the permits and regulations our clients must abide by. HEI helps clients work with the following (and more):

- Local agencies (city, township, county, soil and water conservation districts, etc.)
- State agencies (Minnesota, North Dakota, South Dakota, and others)
- US Army Corps of Engineers
- FEMA
- Federal Highway Administration
- Railroads (including BNSF Railway and Canadian Pacific Railway)

### Public Outreach

When water is involved, projects can become controversial, and lake outlet projects are no exception. Whether it involves concerns over how a project will be paid for or how downstream properties will be impacted by a project, lake outlet projects tend to present challenges in terms of informing project stakeholders and the general public. HEI helps clients engage the public, whether that means providing support materials or leading public engagement meetings ourselves.

### DEVILS LAKE OUTLET PROJECT OTTER TAIL COUNTY, MINNESOTA



#### Background

The Devils and Little Devils lakes near Perham have no natural outlet and as a result have dealt with high water conditions for more than 20 years. The Devils and Little Devils Lake Improvement District (LID) hired Houston Engineering, Inc. (HEI) to develop a feasibility study to consider various alternatives addressing the feasibility of a lake outlet, alignment opportunities, and methods for conveying the water to a suitable outlet. HEI initiated the study process in 2015.

#### The Project

HEI investigated several outlet alternatives, presented the pros and cons of each to the LID membership, incorporated comments and concerns into the study, and recommended a preferred alternative.

Downstream property owners and HEI communicated in great detail during the planning, designs, and the right-of-way acquisition process. Emphasis was placed on this process to ensure the public did not develop opposition to the project, since the project limits extended beyond the property interests of the LID membership.

The selected project design included 3 miles of pressurized piping system, a lake outlet structure, screens and filters, a pump station, nearly 3 miles of piping and valves, and an outfall structure into the Otter Tail River.

Both surface water and groundwater flows were estimated, resulting in a design discharge of 5 cubic feet per second.

An Environmental Assessment Worksheet (EAW), several state and federal environmental permits, county planning and zoning permits, township road authority permits, a BNSF Railway permit, a Minnesota Department of Transportation District 4 permit, and other required permits were successfully acquired to facilitate the construction of a lake outlet. Concerns about the spread of zebra mussels were addressed through the incorporation of a mechanical filter in the outlet system to ensure no infestations are passed on to the Otter Tail River through this outlet.

HEI administered the bidding and construction process and completed construction in 2019. This outlet is now functional. ■

#### » Location

Otter Tail County, Minnesota

#### » Client

Devils and Little Devils Lake Improvement District

#### » Contact

Luke Lenius  
lukelenius@gmail.com

#### » Client Benefits

- Investigated several constructed lake outlet alternatives and concluded with a plan that manages lake levels and minimizes impacts to receiving waterbodies and downstream landowners.
- Provides for improved lakeshore management, including economic, recreational, and natural resource interests.
- Project implementation consistent with state rules and project development—application of Flood Damage Reduction funding from state bonding.
- Developed hydrologic and hydraulics analysis, the results of which provided the most efficient design discharge and target operating elevations.

# SWEDE GROVE LAKE OUTLET PROJECT NORTHEAST OF HAWLEY, MINNESOTA



## Background

Swede Grove Lake is a largely landlocked basin. During the recent wet cycle, Swede Grove Lake rose significantly—above its natural outlet at various times. When the lake rises sufficiently, natural channels carry the water a few miles to the Buffalo River. The Buffalo-Red River Watershed District (BRRWD) was petitioned by Clay County to develop the Swede Grove Lake Outlet Project in 2004. County Roads 37 and 24 required raising and improvements to keep them out of the rising waters of the lake. At the present time, the road ditch sits full of water soaking up the roadway.

Swede Grove Lake was previously used by the Minnesota DNR as a walleye rearing pond. With the higher water levels, rough fish have overwintered in the lake and the lake is no

longer productive as a walleye rearing pond. The lake currently has a maximum depth of about 16 feet. The lake is near its ordinary high water elevation of 1,238.5 at this time. The project was discussed with the BRRWD project team and a more comprehensive project was considered.

## The Project

The comprehensive project proposed by the project team included the following features:

- Outlet with a drawdown capability to elevation 1,231.
- Outlet would be designed to prevent migration of fish from the Buffalo River.
- Upland buffer establishment
- Ditch plugs to restore wetland in the contributing drainage area.

The BRRWD considered both channel and piped outlet alternatives. Several alternatives were considered, with an estimated cost of \$350,000. The project has not gone beyond the preliminary design effort. A partial temporary drawdown was completed by the County. Future highwater conditions may result in project construction, but for now, the project is not actively being pursued. ■

## » Location

Northeast of Hawley, Minnesota

## » Client

Buffalo-Red River Watershed District

## » Contact

Gerald Van Amburg, PhD  
Manager  
218.789.3100

## » Client Benefits

- Provide management of lake levels for wildlife habitat and fisheries.
- Provide additional flood storage.
- Protect roadway/improved public safety.



## DRAWDOWN OF SAND LAKE NEAR US HIGHWAY 59 OTTER TAIL COUNTY, MINNESOTA



### Background

A 1-mile segment of US 59 north of Pelican Rapids, with a projected Annual Average Daily Traffic (AADT) of 3,500, was threatened to be submerged by Sand Lake water—and ultimately closed to traffic—within a year. The high water condition had also made traveling this segment of highway very dangerous. Minnesota Department of Transportation (MnDOT) requested a solution and completed construction within a year of contacting Houston Engineering, Inc. (HEI). The process of finding a solution included considering several formal alternatives, conducting public meetings, coordinating permits, and designing plans. The lake was drawn down with no traffic detour once pumping operations were initiated.

### The Project

A permanent pump station and force main were designed and constructed

to draw down a landlocked lake to its ordinary high water (OHW) elevation and discharge flows into a river. The drawdown was proposed due to flooding conditions along the lake shoreline and imminent submergence of US 59 north of Pelican Rapids, MN. A single 60-hp turbine pump, wet well, 8,000 linear feet of 14-inch PVC force main, fish screen structure, flow meter manhole, air relief valve manholes, outlet structure, and other necessary features were designed and constructed to provide for a 5 cfs steady discharge from the lake. Hydraulic modeling of the outlet channel was conducted to determine downstream impacts.

HEI performed hydrologic modeling of the drainage basin to the lake, including a cursory analysis of groundwater contribution. Drawdown duration was estimated based on the hydrologic analysis work, and the pumping operations were developed

based on the estimated drawdown duration. An operating and maintenance plan for pumping operations was developed to address downstream high water concerns that developed as a result of the project. The project is completed and pumping operations are progressing as anticipated. Submergence and resulting closure of US 59 was prevented because of the successful acceleration of the project schedule and the operation of the pumping facility.

HEI faced difficult design issues including:

- Public opposition
- Accelerated project schedule
- High-risk losses if project did not succeed
- Construction details and work below water surface
- Design within existing right-of-way
- The need to coordinate operations to work best with MnDOT Maintenance
- The need for a project design to significantly minimize environmental impacts ■

### » Location

Otter Tail County, Minnesota

### » Client

Minnesota Department of Transportation

### » Contact

Bridget Miller, PE  
Project Manager  
218.846.3619

### » Client Benefits

- Fast-track schedule.
- Avoided highway closure.
- Infrastructure in place for future operations.
- Provided with the most cost-effective solution to the problem.
- Provides safe and efficient operation of high-priority highway segment.

## LAKE SHAMINEAU HIGH WATER OUTLET MORRISON COUNTY, MINNESOTA



### Background

Lake Shamineau is a 1,600-acre lake located in central Minnesota. The lake is landlocked with no natural outlet. In recent history, the lake's water levels have been rising due to consistently wetter-than-normal conditions and a lack of an outlet, causing shoreline erosion, loss of wildlife habitat, and more than \$2.2 million in estimated losses to lake owner properties.

In 2015, the Lake Shamineau Lake Improvement District (LID) was established by the Morrison County Board of Commissioners to manage high water levels. The LID contracted Houston Engineering, Inc. (HEI) to conduct a feasibility report and research potential solutions to their high-water problem in 2018.

In 2020, the LID retained HEI once more to move ahead with design and construction of a new outlet.

### The Project

The main objective of the project is to create a new artificial outlet to Lake Shamineau to help manage water levels.

HEI has assisted the LID with preliminary engineering tasks, including topographic surveys, geotechnical and hydrogeological reviews, and an outreach campaign directed at landowners and other stakeholders. HEI used this information to complete hydrologic and hydraulic analyses and a preliminary design that was then presented to the client.

The proposed project will include a pump station with a DNR-approved aquatic invasive species filtration

system that will move water out of the lake at a maximum rate of 10 cfs.

The filtered water will be conveyed through more than 7,500 feet of buried pipe before flowing through a series of natural and manmade channels on its way to Todd County Ditch 41 and eventually into the Long Prairie River.

HEI is currently assisting the LID with the process of petitioning the local ditch authority for the use of Todd County Ditch 41 as an outlet. Upon approval of the ditch petition, the LID will move forward with final design, permitting, right of way acquisition, and then construction. ■

### » Location

Morrison County, Minnesota

### » Client

Lake Shamineau Lake Improvement District

### » Contact

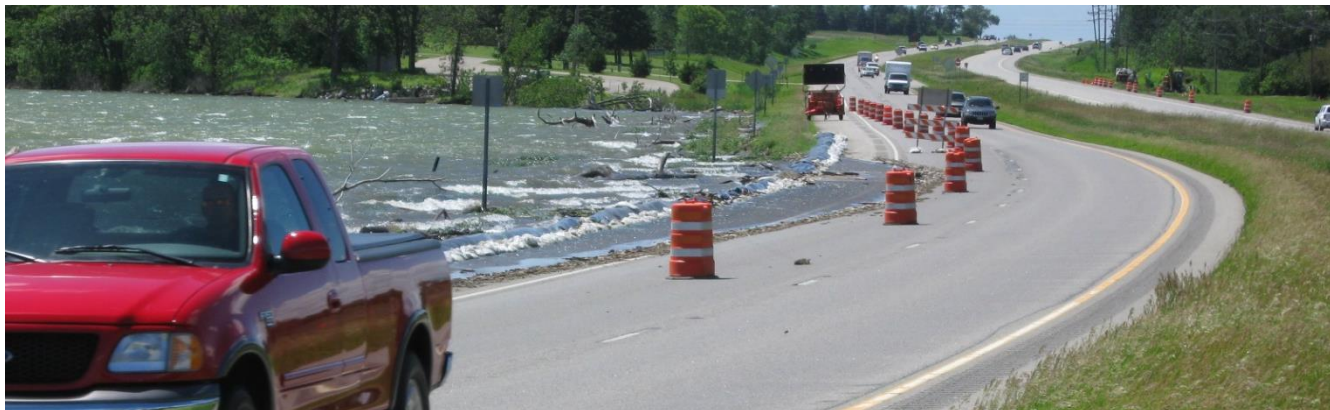
Rick Rosar  
President  
612-709-6402

### » Client Benefits

- Reduction in flood related damages to homes, structures, and other property.
- Improved water quality and public water access.
- Ability to meet DNR requirements for preventing the transfer of AIS to downstream water bodies.
- Flexibility to control lake levels and operate the system year-round if downstream conditions allow.

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# LABELLE AND BOYER LAKES HIGH WATER OUTLET PROJECT LAKE PARK, MINNESOTA



## Background

A wet hydrologic cycle that began in 1993 slowly led to higher and higher water levels on four landlocked lakes: East and West LaBelle, Boyer, and Felker. The project area is near Lake Park, MN, in the glacial moraine area of the Buffalo-Red River Watershed District. Barricades were installed along US 10 because of water on the highway. The high water on the landlocked lakes created access problems for landowners, as well as significant shoreline erosion, especially during high wind conditions. Several township and county roads were inundated or impacted by the high water affecting the road bed. In the spring of 2010, high south winds stranded floating logs on the shoulder of US 10. The Minnesota Department of Transportation was considering an expensive road raise similar to one

completed in 2005 to address their concerns but agreed to wait for the installation of this project first.

## The Project

Several tasks were included in order to complete the project and to evaluate the feasibility of various alternatives, size, and design project features; complete conceptual, preliminary, and construction plans; and develop opinions of probable cost (OPC). Both traditional ground survey and LiDAR survey techniques were used to obtain the needed topographic data. Evaluated alternatives included both potential outlet routes and potential methods of releasing water.

The team also evaluated pumping, channel improvements, siphoning, and gravity piped outlets. Local, state, and federal permitting requirements were addressed. Environmental review

included consideration for exotic species, water quality concerns, wetland impacts, and fish migration. Project design and operation features were built to address concerns for both downstream and upstream impacts.

The contract was awarded to HEI to complete construction administration during the 2010 construction season. The OPC for the project was \$300,000. The project was constructed between May and July 2010 and has been discharging water from both East LaBelle and Boyer lakes since then.

Water levels have retreated significantly, even during times of relatively wet weather in the project area (30+ inches). ■

## » Location

Lake Park, Minnesota

## » Client

Buffalo-Red River Watershed District

## » Contact

Gerald Van Amburg, PhD  
Manager  
218.789.3100

## » Client Benefits

- Provided flood protection to several lake homes and property accesses.
- Provided protection to US 10, county roads, and township roads.
- Completed engineering reports, environmental review, permit applications, plans, specifications, and bid documents on a fast track so that a construction contract was awarded less than two years following the commencement of the study.

# BLACKDUCK LAKE DAM MODIFICATIONS BELTRAMI COUNTY, MINNESOTA



## Background

Blackduck Lake Dam serves as the outlet and lake level control structure establishing manageable lake levels on Blackduck Lake, which is the headwater of the Blackduck River ultimately flowing to Red Lake.

The dam, which was constructed in 1938, consists of a fixed sheet pile weir wall with a concrete apron incorporated into a concrete bridge with concrete abutments. The weir establishes the statute run-out elevation of the lake. An existing stop-log section of the structure has been damaged by ice impacts and is no longer functional. During dry periods, the surface elevation of Blackduck Lake has dropped to 5 or 6 inches below the top of the control structure due to leakage between the damaged stop-log section.

The structure also acts as a fish barrier. Migratory fish (e.g., walleye and lake whitefish) are often observed below the dam in large numbers as the structure halts them from migrating from Lower Red Lake to spawn in Blackduck Lake.

## The Project

This project intends to replace the damaged lake level control structure with a sheet pile weir with a fixed crest elevation. The structure will be located on the upstream side of the bridge and will provide a two-tier fixed crest elevation to manage lake levels and restore the statute run-out elevation of the lake.

A rock-arch rapids fish passage structure will be constructed on the downstream side of the control structure and bridge. The rock-arch rapids structure is a natural channel

design concept that has been successfully and extensively applied throughout Minnesota over the past several decades. The rock-arch rapids design will allow fish passage capabilities within the channel and over the weir.

As part of this project, Houston Engineering, Inc. (HEI) completed HEC-RAS and HydroCAD models to predict lake levels pre- and post- project. HEI also completed detail design of the structures, permit applications and support documentation, property owner coordination, surveying, construction plans, specifications and bid documents, bidding process, staking, and construction administration/ observation. ■

## » Location

Beltrami County, Minnesota

## » Client

Red Lake Watershed District

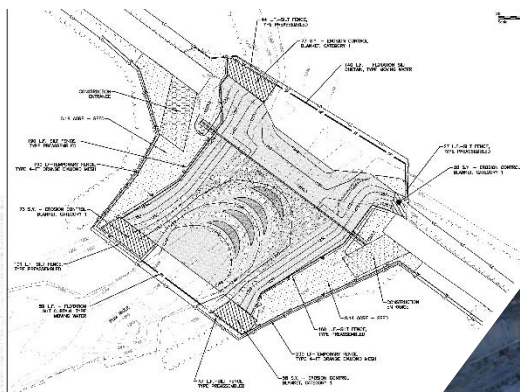
## » Contact

Myron Jesme  
Watershed Administrator  
218.681.5800

## » Client Benefits

- A new rock-arch rapids structure will re-establish fish passage needs for migratory aquatic species.
- A new sheet pile weir lake outlet control structure will restore the lake to its statute run-out elevation.
- The design will allow continued use of the bridge with negligible impacts to private property interests.

# ECOLOGICAL RESTORATION OF LAKE OGECHIE THROUGH DAM MODIFICATIONS MILLE LACS DAM AND BUCKMORE DAM, EAST-CENTRAL MINNESOTA



## Background

Lake Ogechie is a shallow lake with an “enlargement” of the Rum River. The lake is in east-central Minnesota immediately downstream from Lake Mille Lacs and is an important cultural resource for the Ojibwe people. Lake Ogechie once supported dense and vigorous stands of wild rice, serving both as a source of sustenance and a gathering place.

Over time, several factors may have contributed to the ecological decline of Lake Ogechie. During the mid- to late-1800s, logging dams on the Rum River were common. The first known dam, constructed near the current outlet of Lake Ogechie in 1933, resulted in a permanent change in water levels. The dam was reconstructed in 1951 and controls water levels for Lake Mille Lacs and Lake Ogechie.

The lake’s aging dam proved to be the culprit of the missing wild rice.

## The Project

Houston Engineering, Inc. (HEI) completed several tasks to understand the hydrology and hydraulics of Lake Ogechie, including the historical water levels and factors that influence wild rice. The project’s goal is to stimulate natural ecological processes to restore the wild rice’s health and vigor.

With the feasibility phase, our team guided the effort through stages of permitting and environmental review. HEI worked closely with the Mille Lacs Band of the Ojibwe to design and construct a new Mille Lacs Lake Dam and modifications to Buckmore Dam. It was extremely important to not change Mille Lacs Lake’s elevation, so its dam was designed to hold the water at its current elevation. Phase I consisted of installing a two-stage, 170-foot sheet pile structure at the outlet to Lake Mille Lacs and rock arch rapids to allow for fish passage. Phase II consisted of modifying the existing Buckmore Dam by lowering its crest by 3 feet to lower

the water elevation slightly so wild rice can grow. Construction was completed in 2015, and spawning suckers and other wildlife were already visible in the clear, shallow water upon inspection that same year.

HEI completed the following tasks:

- Researched and identified ecological design criteria for wild rice
- Completed a historical analysis of water levels and flow rates
- Completed hydrologic and hydraulic analysis of various design alternatives
- Prepared an engineering analysis to determine the feasibility of various dam modifications or other options
- Developed construction plans and specifications for the new Mille Lacs Dam and Buckmore Dam modifications
- Performed construction administration services for both dams. ■

## » Location

East-Central Minnesota

## » Client

Mille Lacs Band of the Ojibwe

## » Contact

Perry Bunting  
Environmental Programs Manager  
320.532.7446

## » Client Benefits

- The project resulted in the restoration of native stands of wild rice, which are of cultural importance to the Ojibwe people at Lake Ogechie.
- Design and construction of a new Mille Lacs Lake Dam that maintained existing water elevation of Mille Lacs Lake and provided rock arches for fish passage.
- Design and modifications to Buckmore Dam to restore water levels in Lake Ogechie to support natural ecological processes.

# RAVINE LAKE OUTLET STRUCTURE – CDSF OVERFLOW PROJECT PHASE III COTTAGE GROVE, MINNESOTA



## Background

In 2015, the South Washington Watershed District (SWWD) hired Houston Engineering, Inc. (HEI) to complete a feasibility study to determine the flood potential at Ravine Lake from the Central Draw Storage Facility (CDSF) Overflow Project. The CDSF provides flood protection to the cities of Woodbury and Cottage Grove. In its existing condition, Ravine Lake outlets through a small culvert and occasionally floods the park entrance roadway. Flow from the overflow project could potentially cause higher lake elevations, increasing roadway flooding and creating a need for a stabilized lake outlet structure. HEI completed modeling for Ravine Lake and the preliminary design of a stable outlet structure. **This project is Phase III of the larger CDSF Overflow Project.**

## The Project

The feasibility study found that the existing Ravine Lake outlet structure was undersized for even the minimum design criteria (2-year storm event). This caused a large increase in the lake's water elevation during storm events, resulting in frequent flooding of the park entrance road and other areas along the shoreline.

HEI was tasked with preparing preliminary designs of a new outlet structure to replace the old one. The main goal of this outlet structure is to match the natural hydrologic processes during various storm events, with consideration of future hydrologic conditions. This will ultimately minimize the potential impacts on the surrounding area, including the raised water level of Ravine Lake during storm events, downstream flooding, and passing the

CDSF overflow baseflow discharge of 145 cfs.

For Phase III, HEI's tasks included:

- Modeling analysis of Ravine Lake
- Hydraulic calculations and preliminary design of the outlet structure
- Coordination of analysis and design with SWWD and Washington County ■



## » Location

Cottage Grove, Minnesota

## » Client

South Washington Watershed District

## » Contact

Matt Moore  
Administrator  
651.714.3729

## » Client Benefits

- Feasibility study identified potential impacts to Ravine Lake and park infrastructure and presented alternative solutions to these impacts.
- Preliminary concept design of the outlet structure and roadway modifications.
- Permitting assistance and coordination with regulatory officials.
- Results of the feasibility study were used to work through project alternatives during the final design process.

## NAMMACHER'S LAKE OUTLET REPAIR PINE COUNTY, MINNESOTA



### Background

The Mille Lacs Band of the Ojibwe (MLBO) hired Houston Engineering, Inc. (HEI) to replace a principal spillway on Nammacher's Lake, which was in poor condition and created a dam breach hazard. A new structure was installed with the ability to adjust the water level of the lake.

### The Project

To begin this project, the HEI team completed a site survey of the principal and emergency spillways, top of the embankment profile, and embankment cross sections as well as collected additional spot elevation data to verify LiDAR data. Our team then used the LiDAR data to delineate the drainage areas to Nammacher's Lake.

Once all the necessary survey and LiDAR data was collected, our team designed a new outlet structure,

prepared the preliminary plans, and completed the final bid package to distribute to contractors.

HEI then assisted the MLBO with a permit application to the Environmental Protection Agency.

Once the preferred contractor was selected, HEI and the MLBO moved into the construction phase of the project. HEI provided construction engineering and administrative assistance, which included:

- review and approval of shop drawings;
- construction observation;
- review and recommendations of pay request approval; and
- final project closeout and as-builts.

The dam and outlet structure construction was completed in August 2015. ■



### » Location

Pine County, Minnesota

### » Client

Mille Lacs Band of the Ojibwe

### » Contact

Perry Bunting  
Environmental Programs Manager  
320.532.7446

### » Client Benefits

- Design and construction observation services for a new outlet structure.
- Permitting assistance with the EPA.
- Construction administration and communication.

(006038\_0012) 4-16-21

## D. ABOUT HOUSTON ENGINEERING, INC.

### Established

1968

### Size

225+ employees

### Entity Structure

S-Corporation - 100% owned  
by employee shareholders

### Locations

Fargo (Corporate)  
Bismarck  
Dickinson  
Grand Forks  
Maple Grove  
Minot  
Sioux Falls  
Thief River Falls

### About Us

At Houston Engineering, Inc. (HEI), we have a proud history and a bright future. We pride ourselves on adapting to an ever-changing industry and welcome the challenges that make every project unique. Our clients count on us to provide comprehensive, workable solutions that produce results now and continue to provide value well into the future. Because at HEI, we are building for a better tomorrow.



### Water Resources

- Aquatic Ecosystems
- Dam and Drainage Outlets
- Drainage Systems
- Drought Management
- Flood Control
- Flood Insurance Studies and Floodplain Management
- Groundwater
- Stormwater Management
- Water Quality
- Water Supply

### Municipal

- Contaminant Characterization
- Detention Pond Design
- Facility Planning
- NPDES and SWPPP Permitting
- Sanitary Sewer Collection Systems
- Storm and Sanitary Lift Stations
- Storm Sewer Master Planning and Design
- Subdivision Layout and Platting
- Urban Street Design
- Waste Stabilization Ponds
- Water and Waste Water Treatment
- Water Storage and Distribution
- Well Development

### Surveying

- As-Built and ALTA/ACSM Land Title Surveys
- Boundary Surveys
- Bridge Surveys
- CFedS Surveys
- Construction Staking
- Elevation Certificates
- FEMA Letter of Map Change Applications
- Highway, Powerline, and Pipeline Alignment Surveys
- Hydrographic Surveys
- Right-of-Way and Easement Surveys
- Subdivision Plats
- Topographic Surveys

### Environmental

- Agribusiness
- Environmental Engineering
- Fish Passage
- Hydrogeology
- Impact Analysis
- Mitigation
- Natural Resource Inventories
- Permitting
- Regulatory and Permitting
- State and Federal Environmental Review
- Water Quality Analysis
- Wetland and Stream Restorations
- Wetland Assessment

### Transportation

- Bike and Pedestrian Trails
- Bridge Inspection and Load Rating
- Bridge and Structural Design
- Construction Management
- Corridor Analysis
- Environmental Review/Impact Analysis
- Planning
- Railroads
- Street, Highway, and Roadway Design
- Traffic Engineering
- Vehicle Routing Analysis

### GIS/Web Apps

- Data Development
- GIS Analysis
- GPS Data Collection
- Map Production
- Planning and Implementation
- Programming
- Spatial Database Design
- Web Applications

### Land/Site Development

- Civil Engineering and Design
- Construction Management
- Feasibility Studies and Reports
- Industrial Parks
- Land and Subdivision Planning
- Parking Lots
- Parks and Trails
- Plats
- Private Streets
- Site Development
- Stormwater Facilities
- Water and Sewer Improvements

### Planning/Landscape Architecture

- Community Planning
- Grant Writing
- Land Use Planning
- Master Planning
- Site Design
- Sustainable Design
- Urban Design and Streetscapes

### Waste Management

- Environmental Review, Permitting, and Siting
- Facility Procurement and Implementation
- Feasibility and Economic Analysis
- Landfill Design/Composting Facility Design
- Ownership and Management Options Analysis
- Processing and Treatment Facility Design
- Recycling/Materials Recovery Facility Design
- Regional Program Planning and Evaluation

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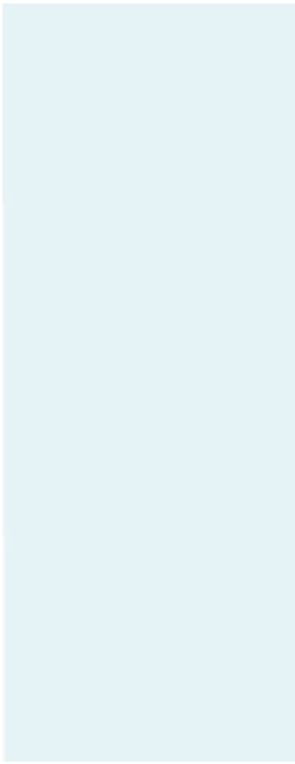
**North Dakota**

Fargo (corporate)  
Bismarck  
Dickinson  
Grand Forks  
Minot



**Minnesota**

Maple Grove  
Thief River Falls



**South Dakota**

Sioux Falls