Case Studies of Zebra Mussel Control at Raw Water Intakes

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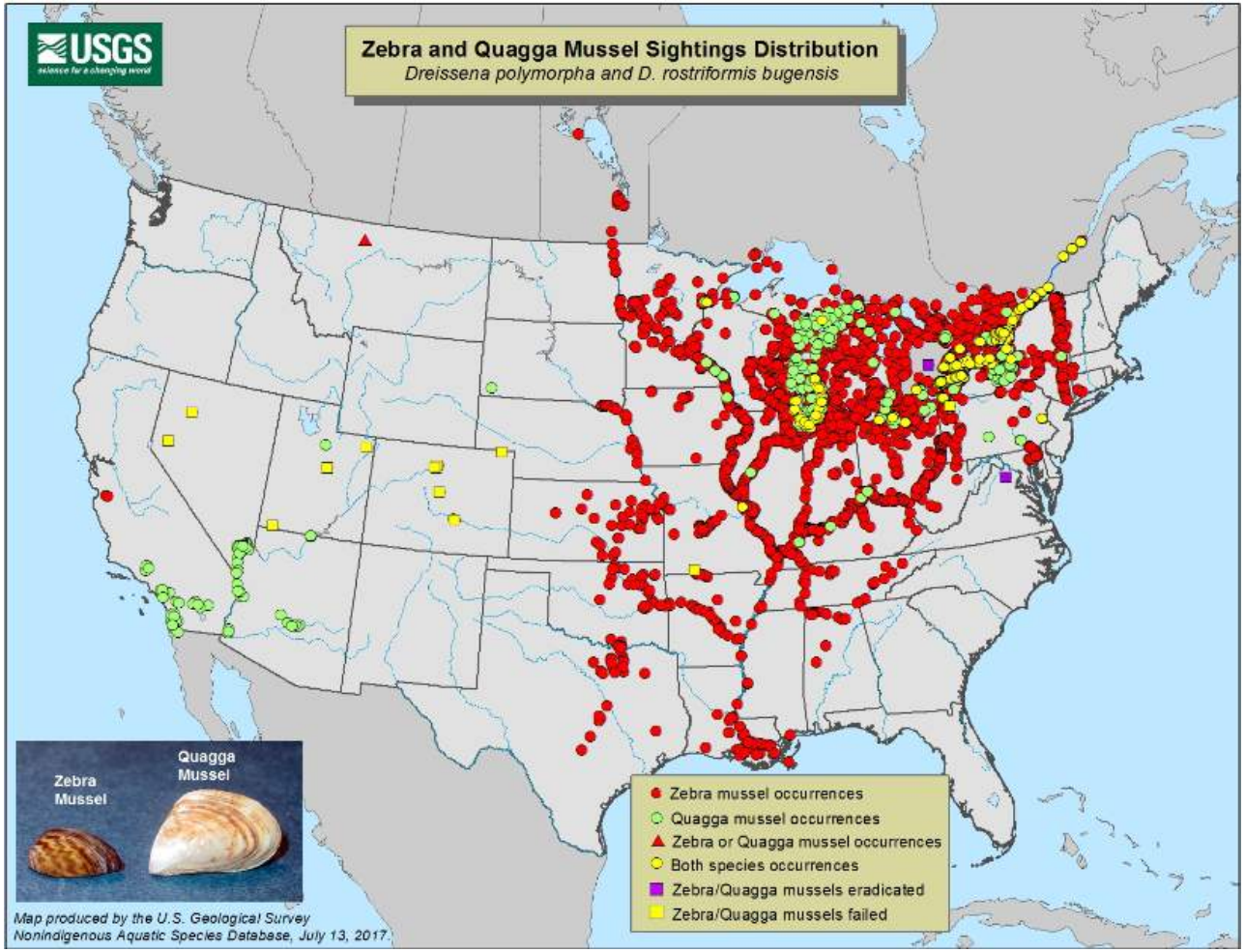
Agenda

- Zebra Mussel Background
- Problems with Zebra Mussels
- Control of Mussels at Raw Water Intakes
- Three Case Studies
  - Milford Municipal Utilities
  - City of Spirit Lake
  - DNR Fish Hatchery

Spread of Mussels in United States

Spread of Mussels in United States



Zebra Mussel Facts

- Filter feeders (1 L of water per day)
- ***One million*** eggs per spawning season per female
- 3-9 year life span (adults)
- Adults are 1-2 cm in size
- Ideal water temperature = 68-77°F
- Optimal pH
  - 8.4 for veligers (larval stage)
  - 7.4–8.0 for adults
- Low salinity tolerance
- Generally don't see below thermocline

Issues with Zebra Mussels

Control vs. Prevention

- Few natural controls (limited predators)
- Once found, likely there to stay
- Prevention techniques have limited success rates

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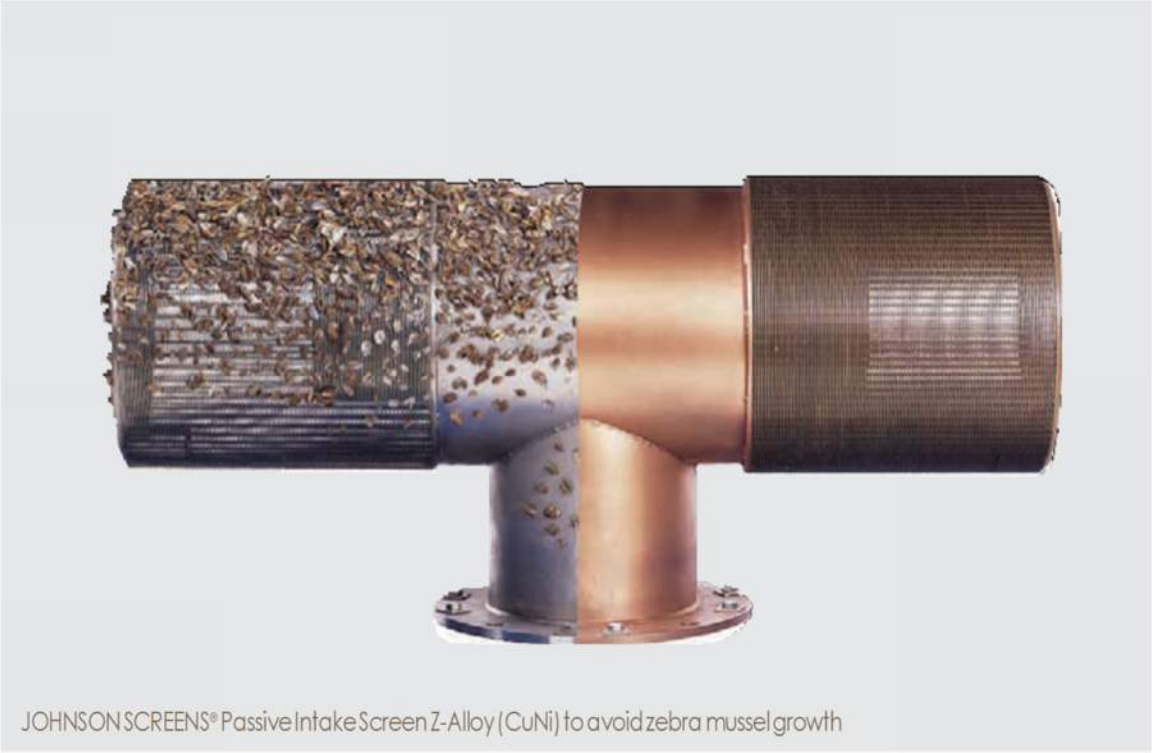
Water Systems – Raw Water Intakes

- Intake screens
  - Copper
  - Brass
  - Galvanized steel
  - Z-Alloy ™ material



JOHNSON SCREENS® Passive Intake Screen Z-Alloy (CuNi) to avoid zebra mussel growth

Water Systems – Raw Water Intakes

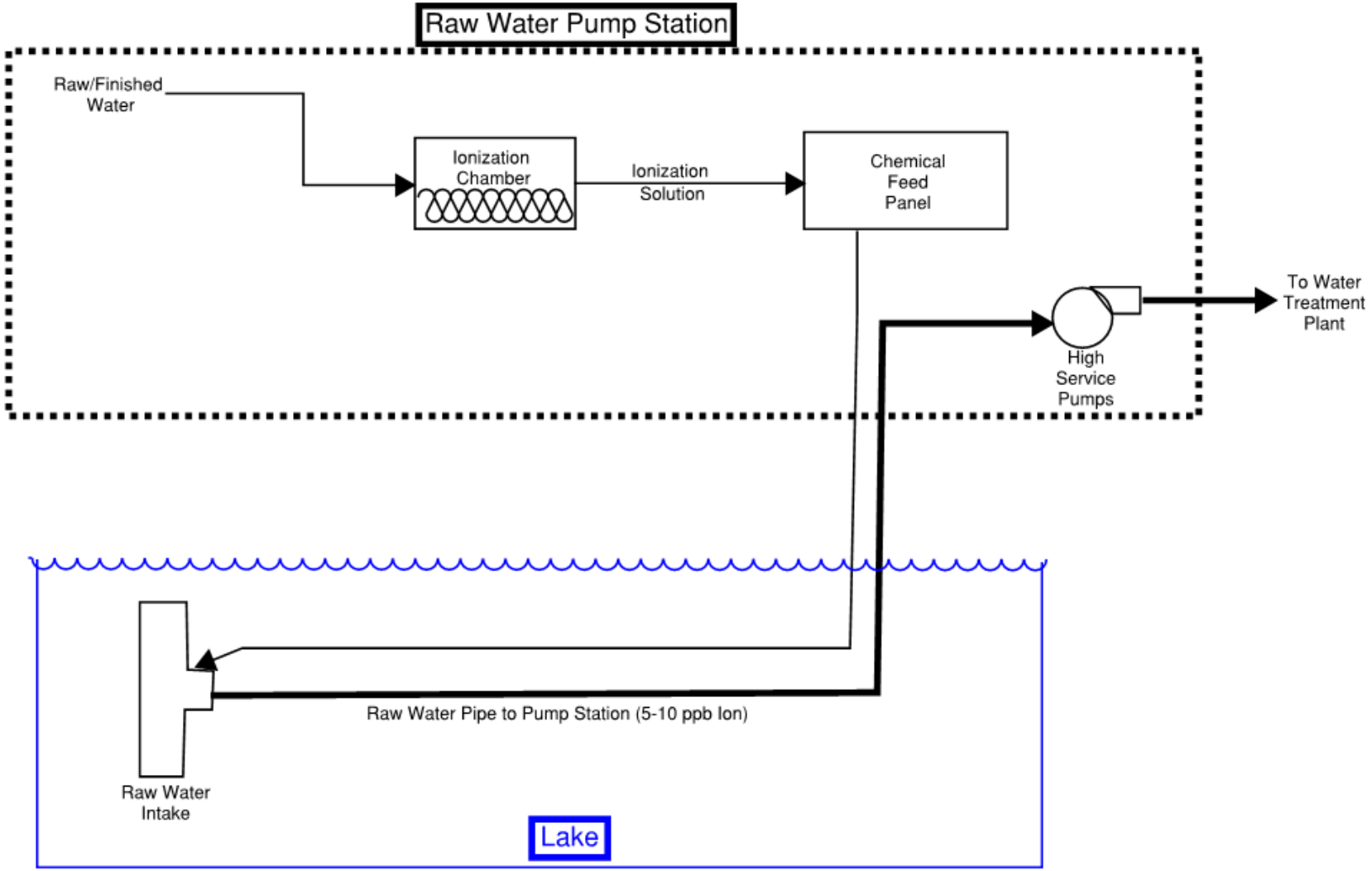
- Intake piping
  - Chemical
    - Chlorine, various forms (oxidant)
    - Permanganate (oxidant)
    - Ozone (oxidant)
    - Bromine (oxidant)
    - Hydrogen Peroxide (oxidant)
    - Free Copper Ion/Aluminum/Aluminum Hydroxide (nonoxidizing)
    - Quaternary ammonium compounds (nonoxidizing)
    - Aromatic hydrocarbons (nonoxidizing)
    - Endothall (nonoxidizing)
    - Potassium/potash/potassium chloride (nonoxidizing)
  - Physical
    - Permeable Barrier
    - Mechanical Cleaning
    - Mechanical Filtration
    - Light Sources
    - UV Radiation
- US Army Corps of Engineers Guide
  - Sprecher, S. L., and Getsinger, K. D. (2000). "Zebra mussel chemical control guide," ERDC/EL TR-00-1, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Free copper ion solution technology

- Free copper ions are a biocide that inhibits mussel and bacterial growth
- Concentrations as low as 1-2 parts per billion (ppb) is effective for zebra mussel control (U.S. Bureau of Reclamation)
- Recommend effective dosing concentrations of 5-10 ppb
- EPA: Copper action level of 1.3 mg/L, or 1,300 ppb

Free copper ion solution technology

- Generation equipment produces copper ion solution
- Equipment inputs:
  - Raw or Finished carrier water stream (10-20 gallons per minute)
  - Electrical current (5A, 120VAC)
  - Copper anodes (replaceable)
  - Control inputs
- Equipment outputs:
  - Copper ion solution in carrier water stream, 1 part per million (ppm) concentration
- Copper Ion Solution injected into bulk raw water flowstream, blending down total effective copper concentration to 5-10 ppb


Raw Water Pump Station
Raw/Finished Water
Ionization Chamber
Ionization Solution
Chemical Feed Panel
To Water Treatment Plant
High Service Pumps
Raw Water Pipe to Pump Station (5-10 ppb Ion)
Raw Water Intake
Lake

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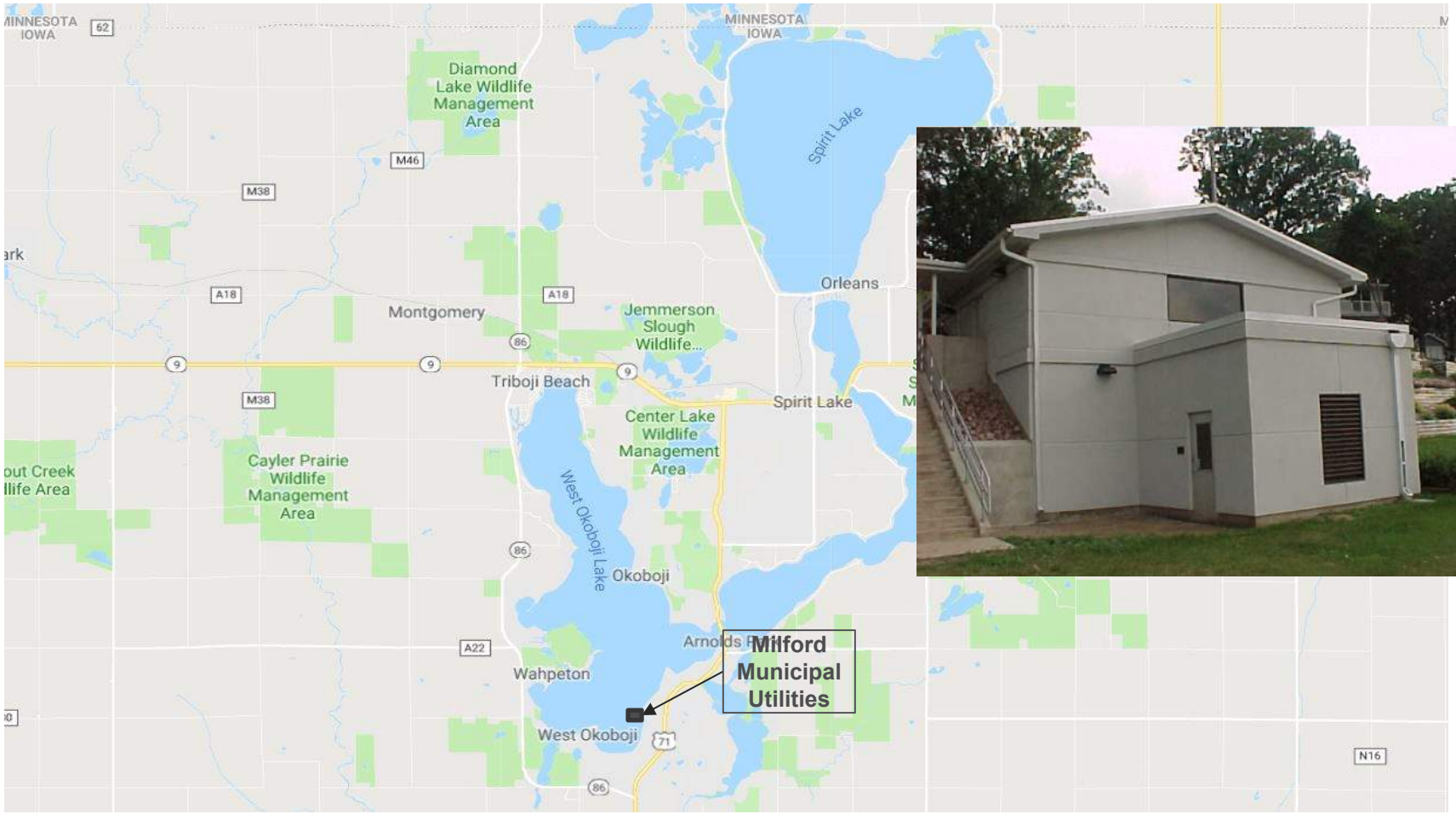
NEW ANODES

ORIGINAL ANODES (22 MONTHS)

Case Study #1 – Milford Municipal Utilities, Milford Iowa



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Project Highlights

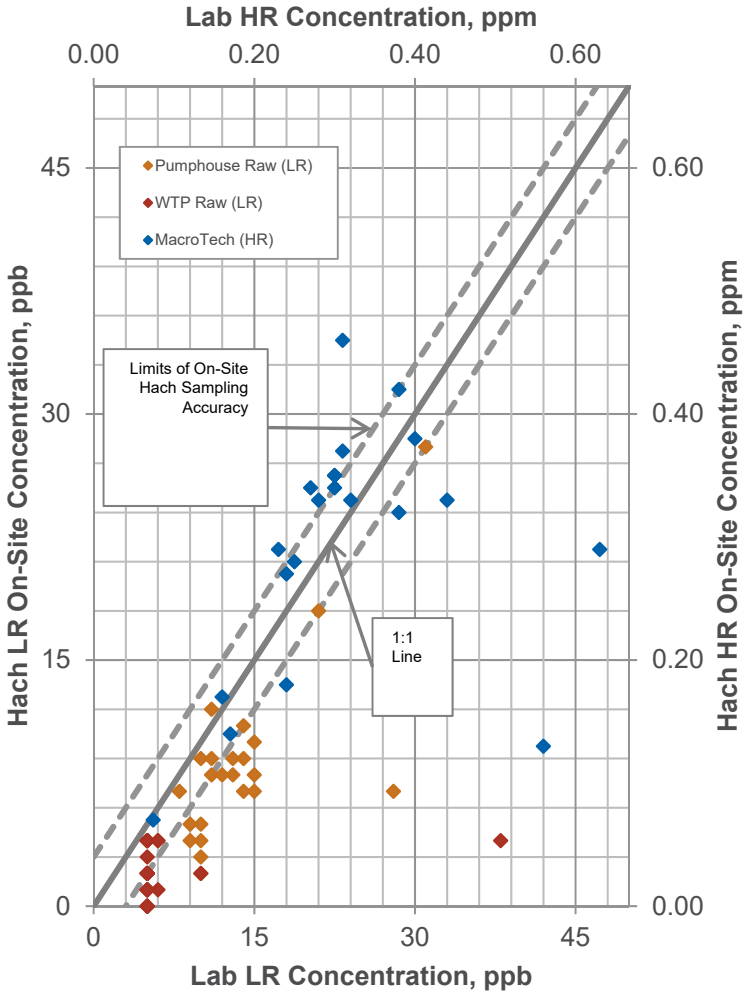
- Utilized ZM-1 equipment by MacroTech, Inc.
- Milford was the first installation in Iowa on a public water system
- Iowa DNR required 12-month pilot study
- New screen on existing intake
- New intake piping and screen installed on ice during winter
- Chemical feed system added with no building addition

Pilot Study - MMU

- Full-scale pilot from March 2014 through February 2015
- Monitored copper at 7 locations in water system:
  - Raw at Lake
  - Raw Downstream of ZM injection
  - Raw at WTP
  - ZM copper solution line
  - Sedimentation tank sludge
  - Filter backwash waste
  - WTP finished water into distribution system
- Testing on-Site by MMU with lab split samples

Pilot Study - MMU

- Overall, pilot study was successful:
  - Equipment performed as intended
  - Lab split samples showed general agreement with on-site results
  - Distribution system samples indicated no statistical difference in pre- and post-pilot study samples
  - Iowa DNR approved pilot study results and permanent installation of equipment



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Summary of Improvements

- MMU has existing 10-inch screened intake pipe and Pumphouse building on West Okoboji Lake
- Project included:
  - New 16-inch intake pipe
  - New copper Z-alloy™ screens on existing and new intake pipes
  - Chemical feed lines to inject copper ion solution at end of intake pipes
  - Hydroburst system to clean intake screens

Construction Photos - MMU

Installing the new 16-inch pipe from shore

Assembling new 16-inch intake screen

Construction Photos - MMU

Laying out intake piping on frozen lake

Lowering intake pipe through ice

Construction Photos - MMU

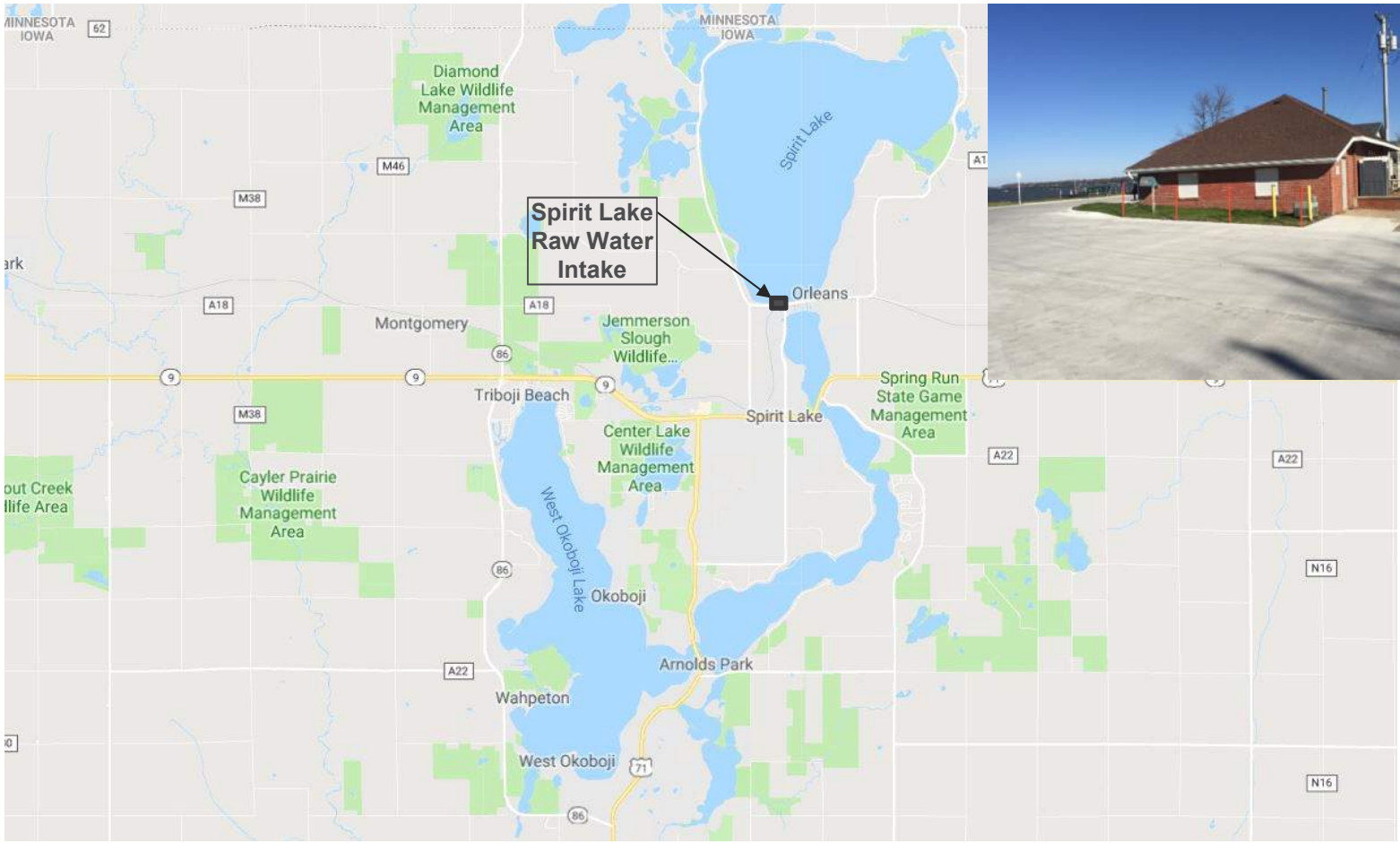
Hydroburst tank inside Pumphouse Building

Hydroburst backwash of intake screen

Milford Municipal Utilities – Raw Water Improvements Summary of Construction Costs

Mobilization/General Requirements	$	160,280.10
Microtunnel 16" Steel Water Main	$	275,000.00
Air and Chemical Feed Systems	$	148,000.00
Site Piping	$	87,000.00
Submerged Piping Installation	$	375,000.00
New Intake Screen	$	80,000.00
Modifications to Exisiting Intake Screen	$	100,000.00
12" Building Connection	$	50,000.00
Electrical	$	25,000.00
TOTAL	**$**	**1,300,280.10**

Case Study #2 – Raw Water Improvements, Spirit Lake, Iowa



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Project Highlights

- Utilized Fortress MC equipment by ONG, Inc.
- Iowa DNR required 12-month pilot study
- New screen on existing intake
- New intake piping and screen using barges on open water
- Chemical feed system added with no building addition

Summary of Improvements

- Spirit Lake had 10-inch and 18-inch screened intake pipe and Pumphouse building on Big Spirit Lake
- Project included:
  - New 18-inch intake pipe
  - New copper Z-alloy™ screens on existing and new intake pipes
  - Chemical feed lines to inject copper ion solution at end of intake pipes
  - Hydroburst system to clean intake screens

Construction Photos – Spirit Lake

Dewatering at shore

Initial setup for installation of intake line

Construction Photos – Spirit Lake

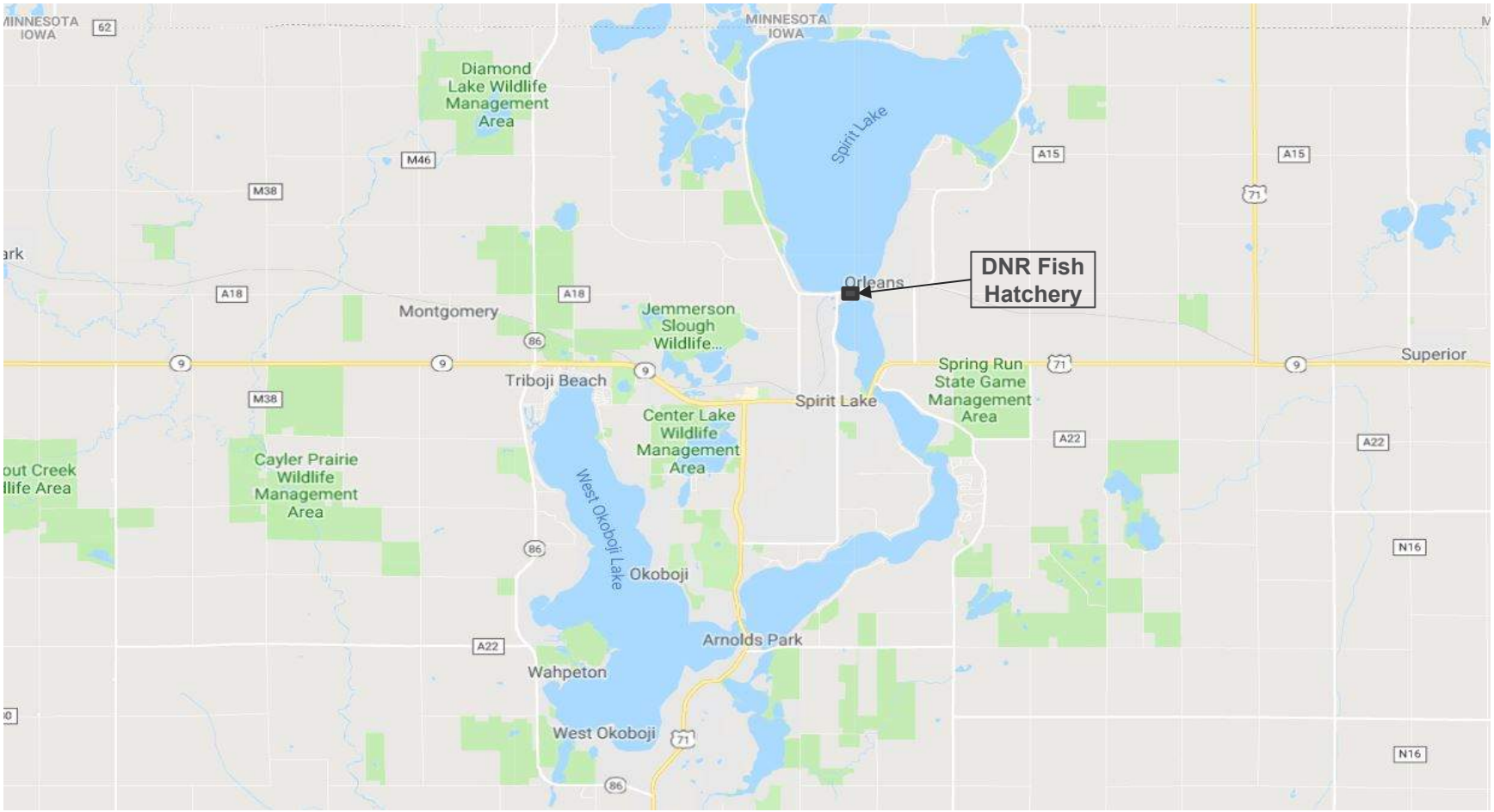
Installation of intake line

Installation of intake screen

Construction Photos – Spirit Lake

Panoramic of inside pump station

Case Study #3 – Spirit Lake Fish Hatchery, Iowa DNR



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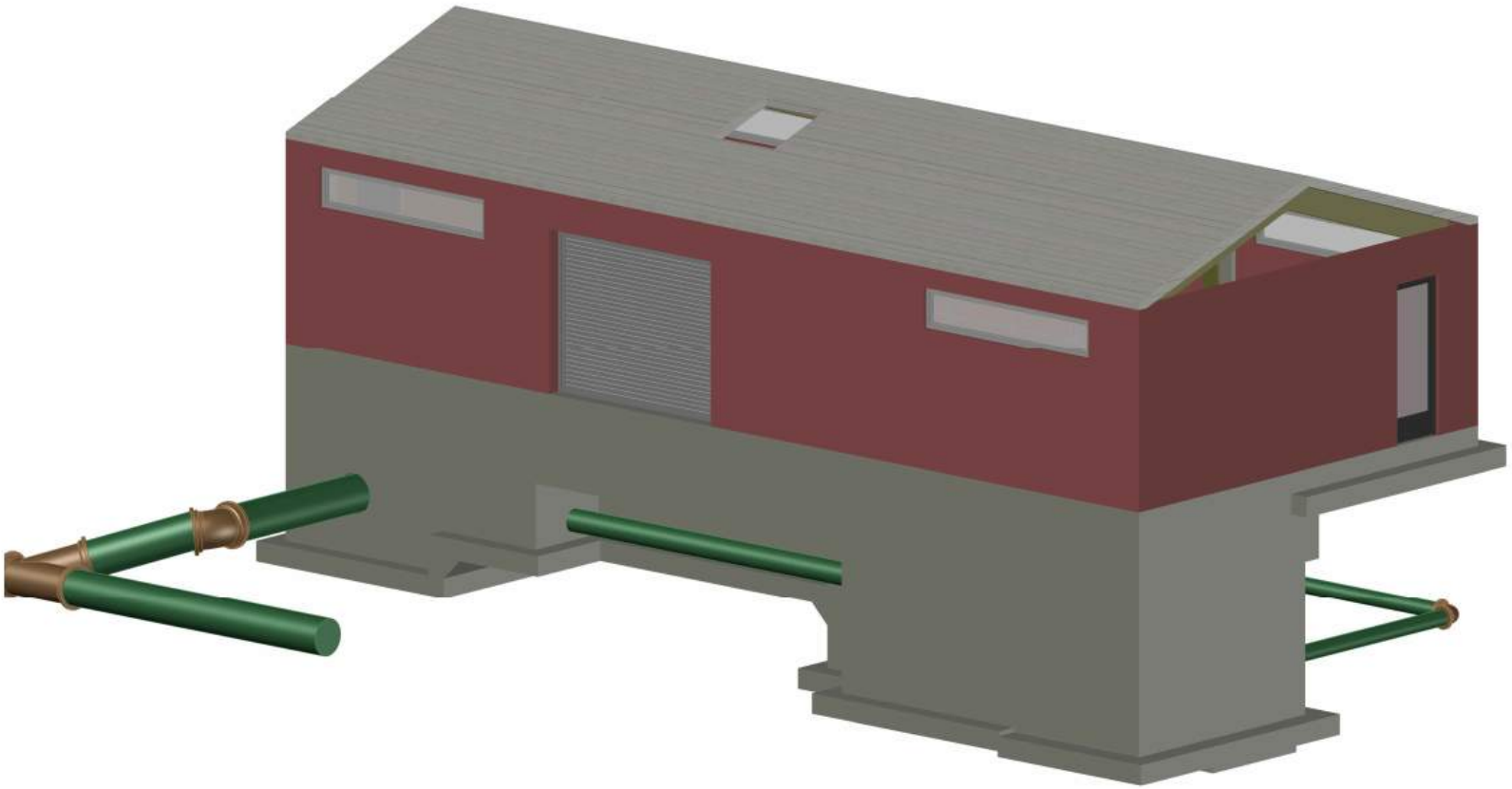
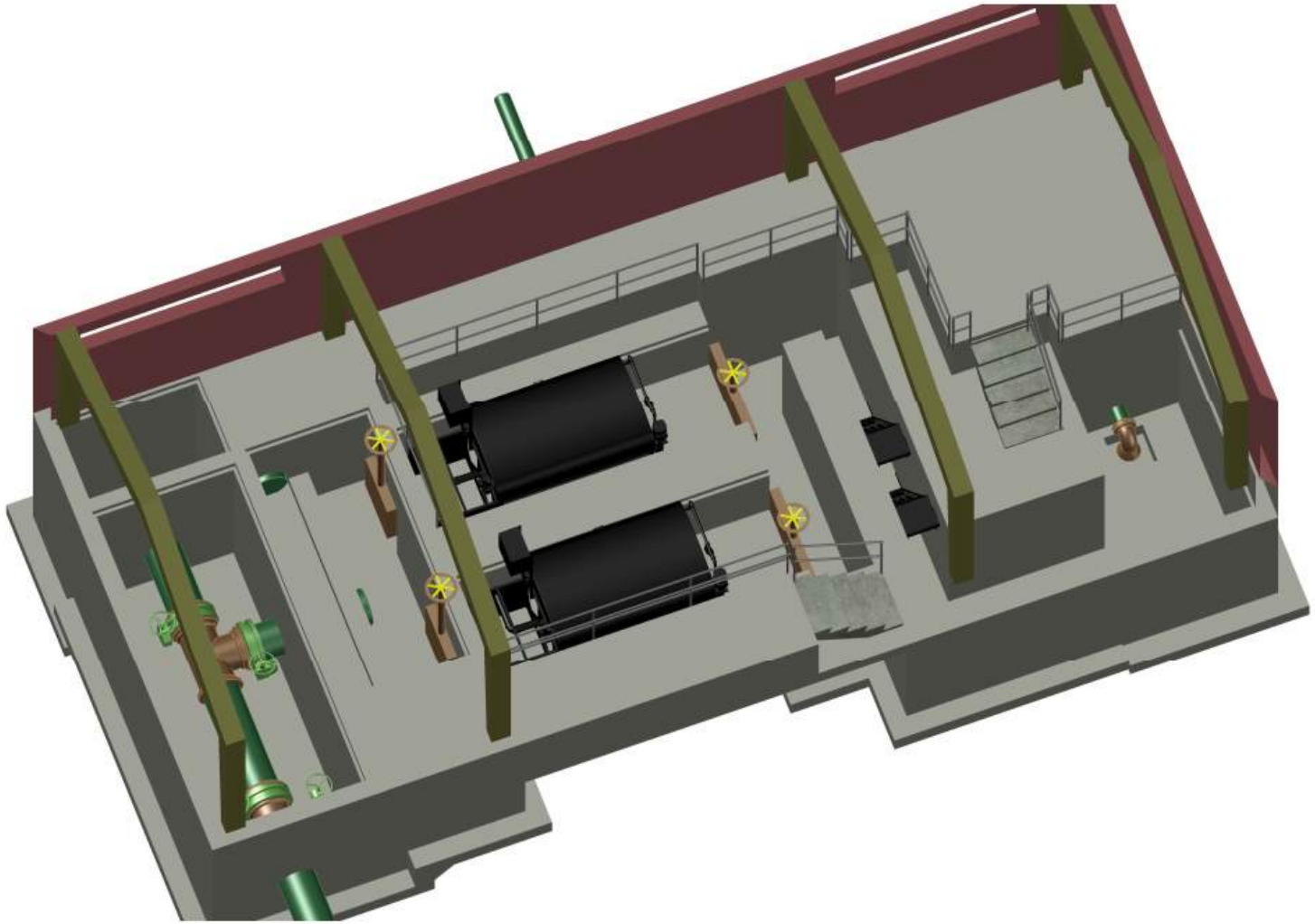
Case Study #3 – Spirit Lake Fish Hatchery, Iowa DNR

- Use of oxidizing chemicals not allowed due to toxicity to fish hatchlings
- Will use drum screens as physical barrier
- Hatchery staff will transport hatchlings to many other lakes in Iowa
- New screen on existing intake
- New building addition
- Degassing of nitrogen
- Liquid oxygen feed equip.
- UV Disinfection

Summary of Improvements



Summary of Improvements



DNR Fish Hatchery – Raw Water Improvements Engineer's Opinion of Probable Costs

Mobilization/General Requirements	$	140,000.00
Sitework	$	63,000.00
2 - 25 um Drum Filter	$	100,000.00
UV System	$	56,000.00
Slide Gates	$	36,000.00
Weir Gates	$	44,000.00
High Capacity Intake Screen	$	85,000.00
Process Pipe and Valves	$	150,000.00
Aerator/Degassification	$	140,000.00
Liquid Oxygen Feed System	$	40,000.00
Filter Building	$	650,000.00
Contingency - 10%	$	150,000.00
Preliminary Opinion of Construction Costs	**$**	**1,654,000.00**

Questions from the Audience?

Contact Information

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