Zebra Mussels - Water Plant Vulnerabilities and Mitigation Techniques

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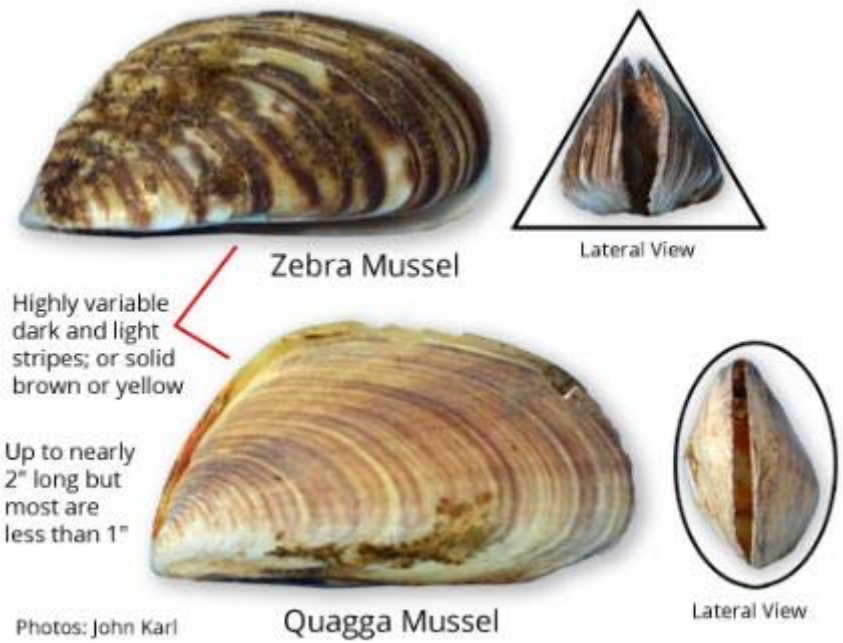
Zebra and Quagga Mussels



Zebra Mussels

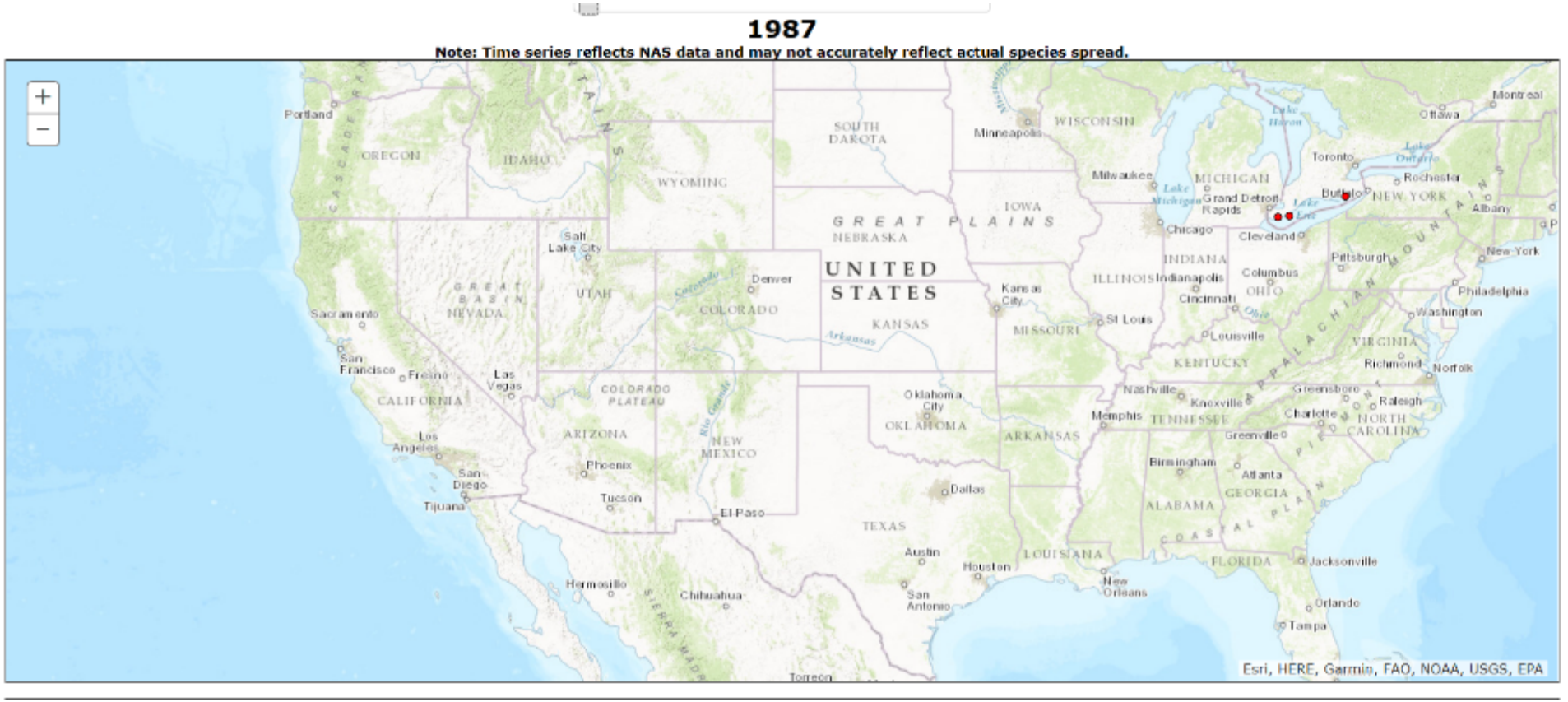
- Native to lakes of southern Russia
- First detected in US in 80s
- Stripped, triangular shell
- Arrived in Texas in 2009
- Prolific breeders
- Max size 50 mm
- Mainly found in depths 6'-45'
- Can live at any depth above thermocline

Quagga Mussels

- Native to Ukraine
- First detected in US in 80s
- Dark concentric rings
- Lack color near the hinge
- Prolific breeders
- Slightly larger than zebra
- Major concern in the Great Lakes
- Not yet in Texas

http://www.seagrant.umn.edu/ais/mussel

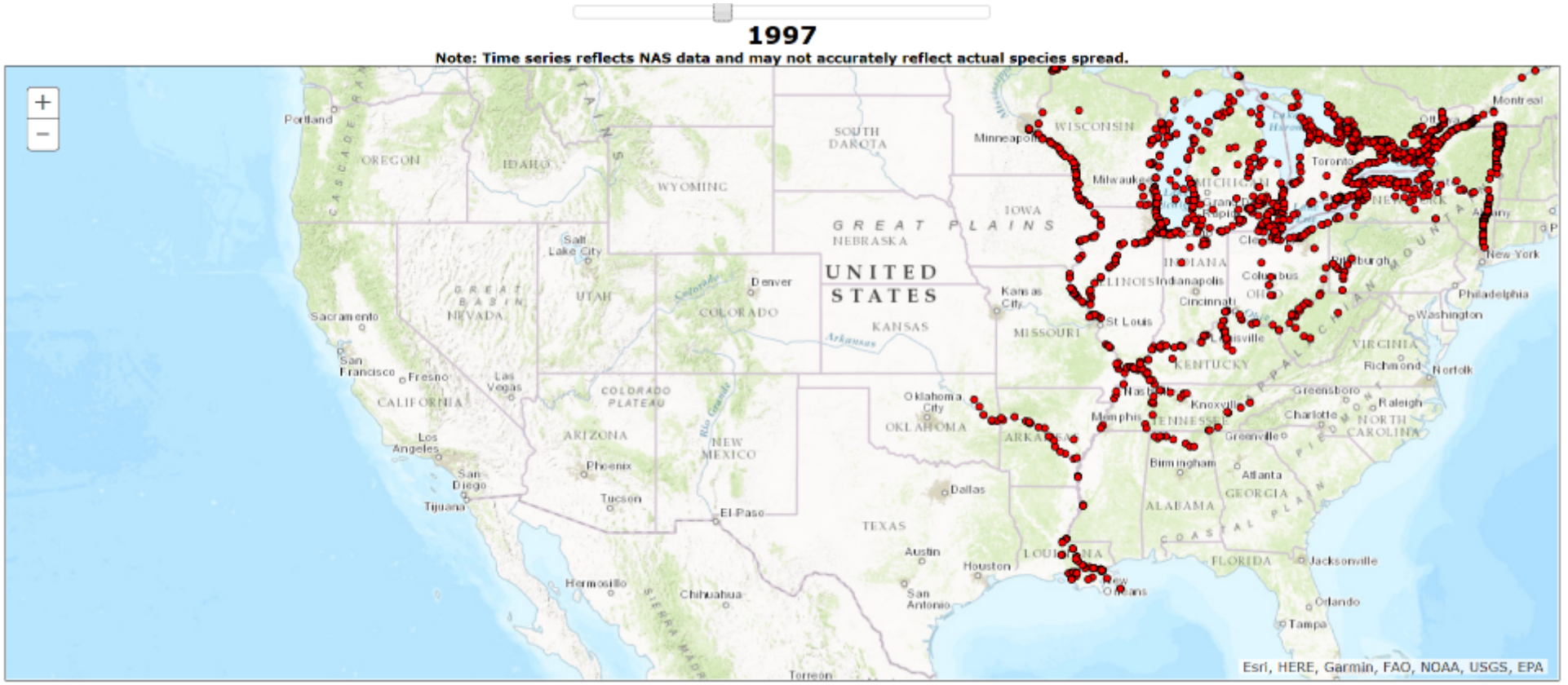
USGS Nonindigenous Aquatic Species Map



1987 Zebra Mussels Reported Locations

https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=5

USGS Nonindigenous Aquatic Species Map



1997 Zebra Mussels Reported Locations

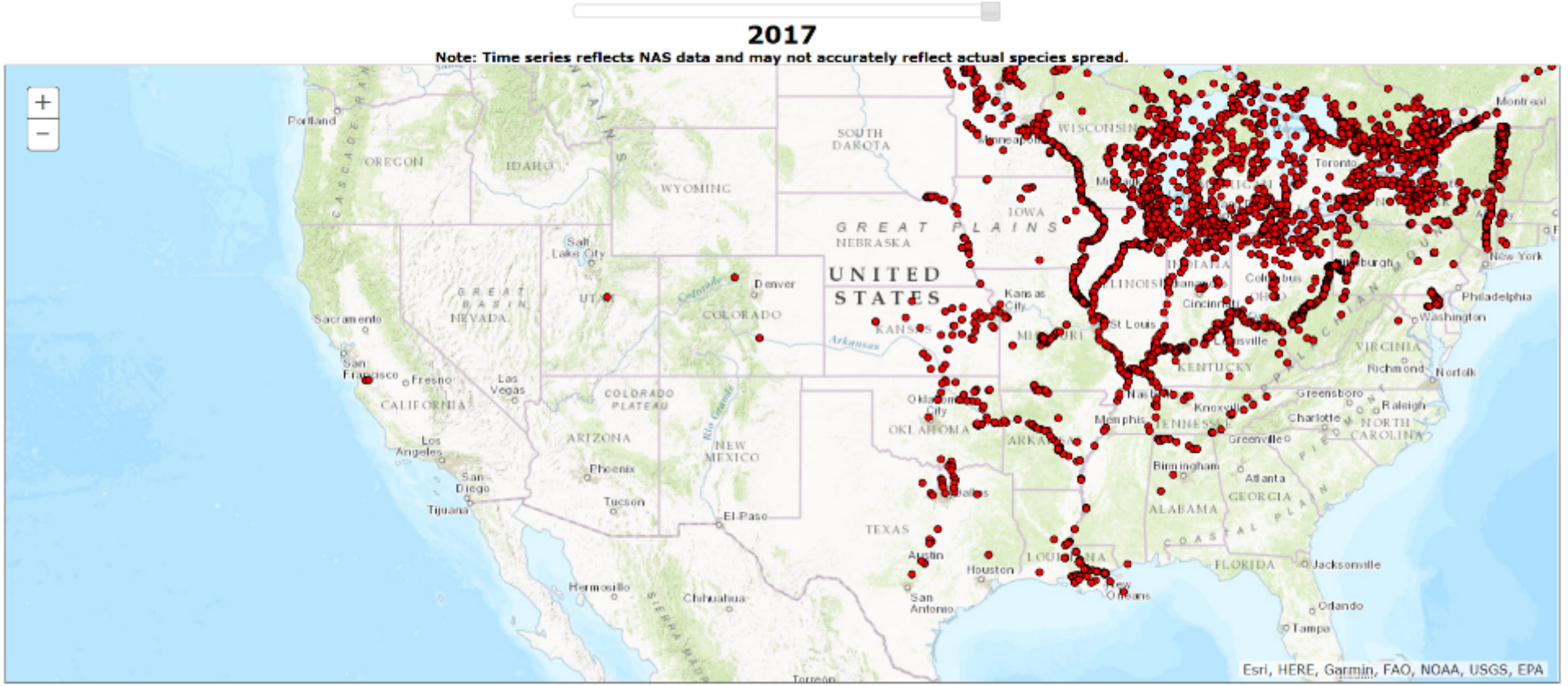
https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=5

USGS Nonindigenous Aquatic Species Map

2007 Zebra Mussels Reported Locations

https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=5

USGS Nonindigenous Aquatic Species Map



2017 Zebra Mussels Reported Locations

https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=5

USGS Nonindigenous Aquatic Species Map

2017 Quagga Mussels Reported Locations

https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=5

Environmental Requirements

Water Quality Parameter	Survival Range	Preferred Range	Lake Austin / Lake Travis (2007-2017)
Temperature	32° - 90° F	68° - 79° F	48° - 88° F
Calcium	≥ 8 mg/L	≥ 30 mg/L	22 – 80 mg/L
Alkalinity	≥ 30 mg/L	100 - 280 mg/L	116 – 225 mg/L
Hardness	≥ 30 mg/L	100 - 280 mg/L	128 – 268 mg/L
pH	7.0 – 9.0	8.2 – 8.8	7.5 – 8.8
Dissolved Oxygen	≥ 3 mg/L	≥ 8 mg/L	4.8 – 12.8 mg/L

Life Cycle of Zebra Mussels

- Zebra mussels live 3 to 9 years
- Females usually reproduce in their second year
- Males reproductively mature in the first year
- Each female produces 1,000,000 eggs/year
- The survival rate is approximately 1%
- In 2 days, fertilized eggs develops into free floating larvae called veligers
- Veligers can be transported downstream by current, upstream by fish, or to a different body of water by boats
- Veligers settle within 2-3 weeks and attach to any hard surface
- There is no known method to eradicate zebra mussels in large lakes

http://www.piscatorialpursuits.com/forum/ubbthreads.php/topics/836901/all/Mandatory_boat_inspection_fees.html

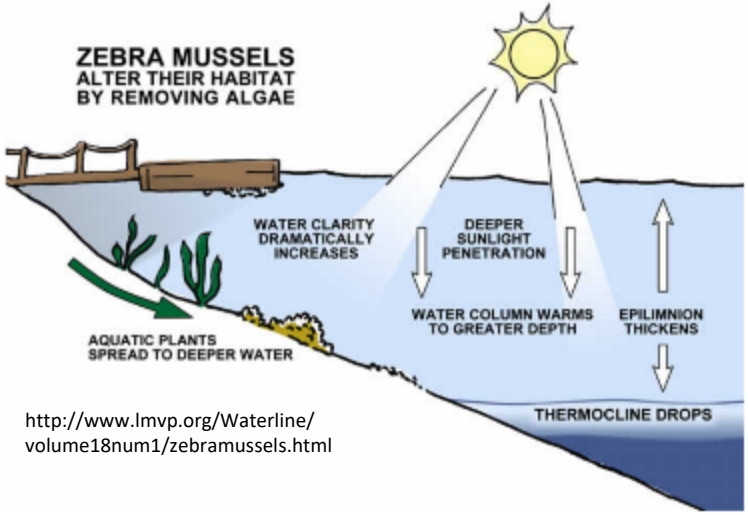
http://www.sleloinvasives.org/about-invasives/general-invasive-species-list/zebra-mussel-quagga-mussel/

Impacts of Zebra Mussels Infestation

Effects on the Ecosystem

Zebra mussels consume phytoplankton, zooplankton, and other suspended material which results in increased clarity of water.

- Increased habitat for aquatic plants
- Lowering of the thermocline
- Increasing the volume of habitable water for mussels to invade
- Zebra mussels decrease the indigenous fish population
    i. Zooplankton is the primary food source for fish larvae
    ii. Reduction of suitable spawning areas
    iii. Reduction of soft substrates can compromise foraging
- Removal of the food source also reduces the population of indigenous mussels



http://www.lmvp.org/Waterline/volume18num1/zebramussels.html

http://www.michigan.gov/invasives/0,5664,7-324-68002_73844-368738--,00.html

Impacts of Zebra Mussels Infestation

Effects on Lake Recreation

- Dead mussels litter shorelines and emit a foul odor
- Shells are sharp and pose a hazard to swimmers
- Growth of mussel will have an impact on all lake structures
- Could damage boats

http://crowwing11.org/?page_id=240

https://www.deeptrekker.com/worker-zebra-mussel-invasion-remediation/?locale=en

Impacts of Zebra Mussels Infestation

Effects on Water Treatment Plants

- Restrict intake structures and pipelines
  i. Reduce plant capacity
  ii. Increase energy consumption
- Taste and odor issues
  i. Directly by decaying dead mussels
  ii. Indirectly by increasing the population of blue-green plankton
- Damage pumps and valves

https://flatheadlakers.org/programsissues/thwarting-aquatic-invaders/zebra-mussels-other-invaders/

Mitigation Techniques

Preventative Methods

- Repellent Materials
- Coatings
- Filters and Screens

Control Methods

- Chemical treatment
- Biological Treatment
- UV light
- Low Frequency Magnetism and Pulse Acoustics

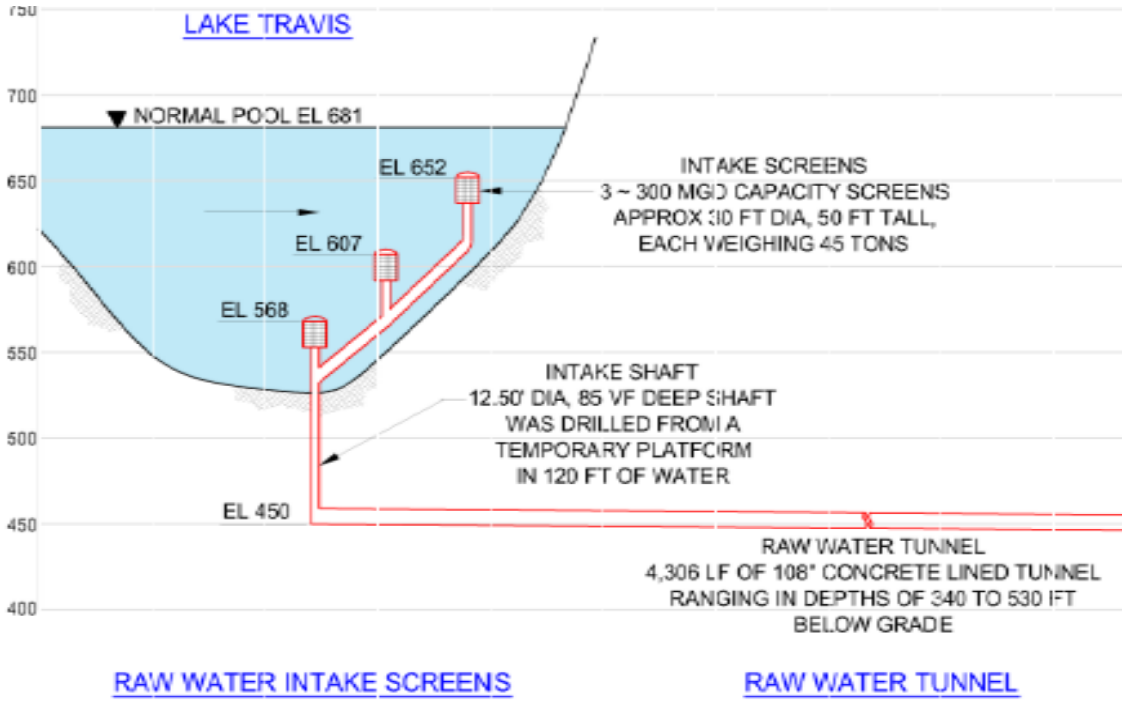
Reactive Methods

- Physical Removal
- Pressure Washing
- Dewatering
- Oxygen Deprivation

Current Condition of Treatment Facilities

Water Treatment Plant 4

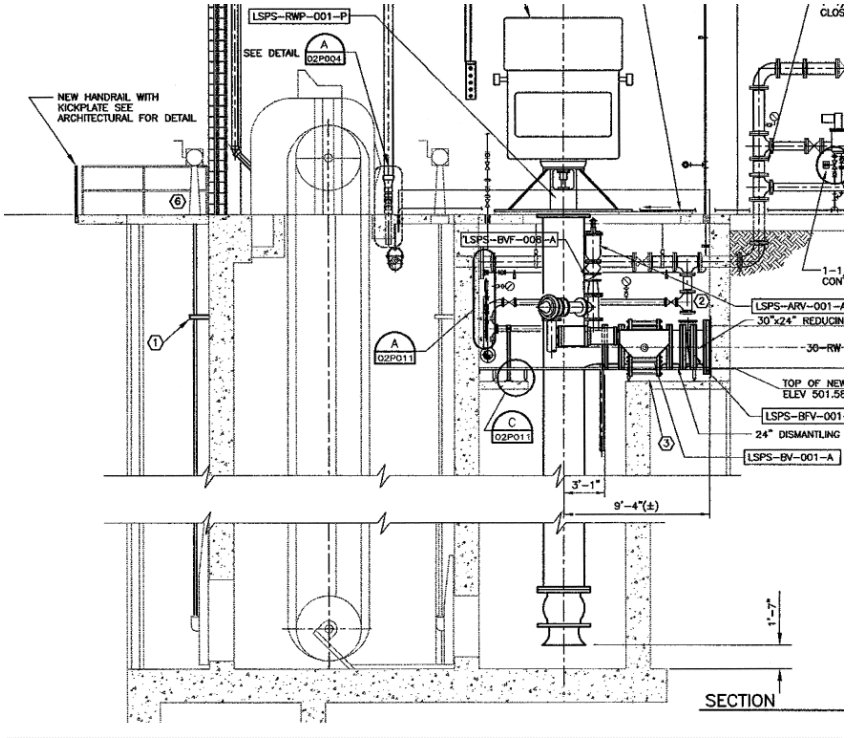
- Current diving contract to inspect the intake structure annually
- Chemical feed system to feed a liquid chemical in the tunnel
- Need to research alternatives to prevent colonization in the intake pipe and on the screen structures.



Current Condition of Treatment Facilities

Ullrich and Davis Water Treatment Plants

- Currently using the traveling screens to monitor for Zebra mussels
- Expanded the scope of the WTP4's intake inspection contract to include inspection of Davis and Ullrich intakes
- Need to research alternatives to prevent colonization on the intake structure and raw water pipes.



Future Plans

- New diving inspection contract to inspect all intake structures quarterly
  - Should appear before the Commission in March
- Hiring a consultant to research mitigation techniques and design modifications necessary to maintain the continuity of operation
- Investigating the effects of sodium permanganate on our process

Questions?

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