Current State of Harmful Algal Bloom Impacts

on

Michigan Drinking Water Supplies

September 2014

Following the occurrence of the algal toxin microcystin at levels above World Health Organization guidelines in the public water system in Toledo, Ohio, and the communities it serves in early August 2014, many other communities have expressed concern over this contaminant and whether it may impact their own public water system. In response to these concerns, the Michigan Department of Environmental Quality, Office of Drinking Water and Municipal Assistance has developed this document to provide a current state of Michigan's public drinking water supply systems and the potential for impact from harmful algal blooms.

This document provides an overview of public water supply systems in the State of Michigan including where their water comes from, narrowing the scope of this issue to water bodies where both harmful algal blooms may be present and source water intakes for drinking water treatment plants exist. The few instances that meet these conditions are described in greater detail. Within this subset of systems only those in Lake Erie are shown to be directly impacted by blue green algal blooms that have the potential to be harmful in drinking water.

Cyanobacteria and microcystin, its associated toxin as the contaminant of concern, are both described and then differentiated from true plant based algae. Goals for removal of this contaminant are then provided, which utilize water treatment processes to effectively minimize the associated risk to public health.

Based on these risks an in depth look is taken at those public water systems which must rely on Lake Erie for its drinking water. First, who they are, where they are located, and their current water needs. Next, each of these systems has developed its own multiple barrier approach that deals with algal toxin contaminants. These include the location and influences on their intake facilities, real time monitoring of source water conditions, interconnections with other water systems, and other contingencies. Monitoring and optimization of treatment processes is performed recognizing the specific vulnerabilities within each system while simultaneously balancing other regulatory treatment requirements.

Finally, the document provides information regarding emergency response preparedness for each of these systems as well as the Department's own emergency support functions.

Overview of Michigan's Public Water Supply Supervision Program

In Michigan, there are approximately 1,400 community public water systems serving over 7.6 million residents, or approximately 76% of the state's population. Of the 1,400 community public water systems, almost 1,100 rely solely upon groundwater as their source. Although the majority of community public water systems rely upon groundwater, these systems only serve 1.8 million residents, or about 20% of the state's total. The remaining 5.8 million people served by a community public water system receive their drinking water from the Great Lakes and connecting channels or from inland rivers and lakes. Approximately 60 community systems have one or more intakes in one of these surface waters with the remaining systems purchasing water from one or more of these surface water systems (see attached table).

Location of Intakes - Statewide

The Public Water Supply Supervision (PWSS) Program provides regulatory oversight for these community public water systems to assure that drinking water meets the standards established in the federal and Michigan Safe Drinking Water Acts (SDWA). This assurance is provided primarily through a technical assistance program of conducting frequent on-site visits and periodic sanitary surveys, performing plan review to assure proper design and operation, training and certifying operators and managers, establishing monitoring and reporting requirements and implementing emergency response activities. In addition, the PWSS Program promotes wellhead and source water protection activities to protect drinking water supplies from potential contamination, implements a capacity development program to assure public water systems have adequate technical, financial and managerial capabilities, and more recently, ensures adequate security measures are provided, including adequate response plans.

For surface water systems, our district engineers are expected to conduct on-site visits quarterly to review and observe the treatment plant operation, maintenance and performance and discuss any emerging issues and/or problems. By meeting so frequently with the system operators, engineers become familiar with each plant's physical facilities and their operation, learn of any current or impending operational problems, observe plant operations such as filter backwashing, and inspect equipment that may be out of service for maintenance. These visits may also focus on distribution system issues like cross connection control, operation and maintenance practices, storage tank inspections, and any problem areas as far as providing adequate flows and pressures. Perhaps the greatest benefit resulting from this routine surveillance activity is the establishment of a comfort level between the water system and ODWMA resulting in open and candid communication.

In addition to routine surveillance, each public water system undergoes a comprehensive sanitary survey every 3 years that assesses the ability of the water supply system to produce, treat, and distribute adequate quantities of water meeting the drinking water standards. For surface water systems, these surveys are an in-depth analysis of the plant's physical facilities, operational condition, capacity to reliably supply customer demands, maintenance programs, monitoring programs, staffing levels, compliance record, condition of the distribution system and storage tanks, security measures, and source water protection program.

These pro-active practices have proven successful in minimizing public health threats originating from surface water treatment systems in Michigan, and for the most part, allowed any threats that do occur to be minimized, the impacts on the customers to be mitigated and the problem to be promptly resolved.

SURFACE WATER SOURCES IN MICHIGAN

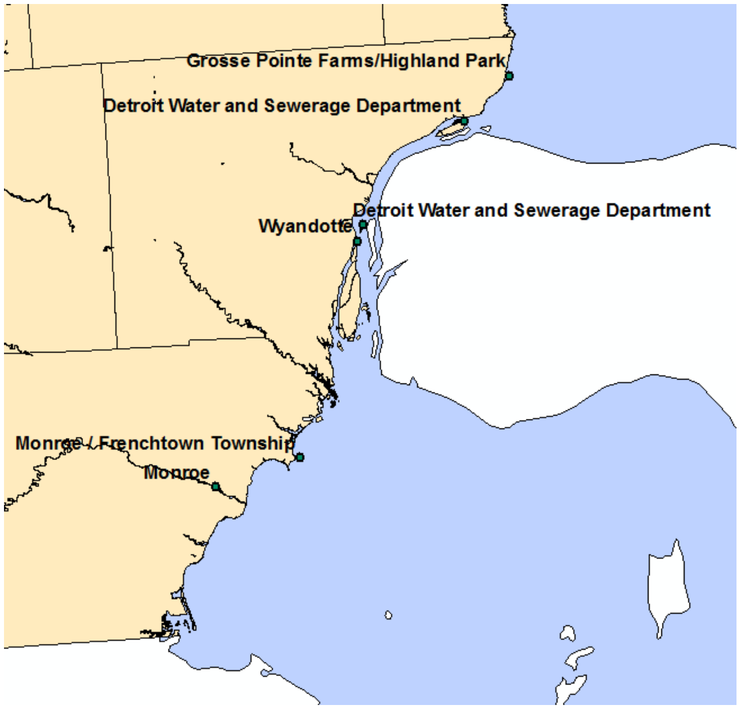
Another benefit Michigan has from the standpoint of surface water sources is widespread access to the high quality water provided by the Great Lakes and connecting channels. With only a few exceptions, the Great Lakes and connecting channels are not subject to the same problems that inland lakes and rivers present from a vulnerability and variability standpoint. With intakes in the Great Lakes thousands of feet off shore, or in some cases, buried beneath highly permeable lake bottom, Michigan communities are much less susceptible to the impacts of runoff, seasonal fluctuations, and other sources of contamination such as pipelines, chemical storage tanks and NPDES discharges compared to shallow water intakes, such as those utilized by water systems in southern Lake Erie. Intakes in the connecting channels of the Detroit, St. Clair and St. Mary's Rivers, while more susceptible than intakes in the Great Lakes, have the benefit of huge flows passing through these channels, diluting the influences of any adverse impact (including algal blooms that prefer stagnant water) when compared to typical inland river systems prevalent in other states. Most of these systems also have some real time monitoring of their source water and when necessary, have the ability to stop drawing in water and rely upon system storage while contaminant plumes of unknown origin pass by their intakes.

Location of South Lake Huron and St. Clair River Intakes

Michigan currently has only 6 inland river and lake intake systems. They are Ann Arbor, Adrian, Alma, Blissfield, Deerfield, Flint, and Manistique. Adrian and Alma have been installing additional groundwater sources to reduce their reliance on the river source. Flint will be connecting to a Lake Huron source sometime in 2016 and Ann Arbor has several well fields to supplement their source and employs the most sophisticated treatment regime in Michigan to deal with the water quality problems they periodically experience from the Huron River. Blissfield and Deerfield do not have a groundwater option, as they are located in the groundwater poor region of Southeast Michigan. They have constructed treatment plants that incorporate advanced treatment methods to deal with the problems presented by having to rely upon the Raisin River. Manistique has an intake in the Indian River and recently completed construction of new treatment processes to assure continued compliance with drinking water standards.

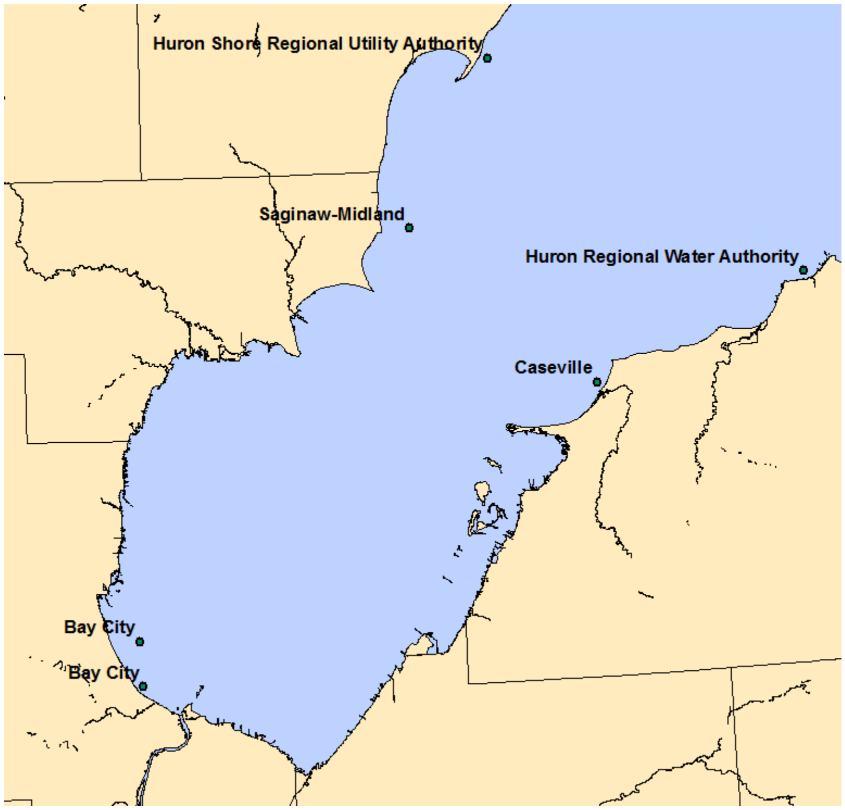
The few exceptions in the Great Lakes where Michigan water systems have experienced problems that other Great Lakes intakes don't face are those with intakes in Lake Erie, Lake St. Clair, and in lower

Saginaw Bay. There is only one intake in Lake Erie and it serves two systems each with their own treatment plant, the city of Monroe and Frenchtown Township.



Location of South Lake St. Clair, Detroit River and Lake Erie Intakes

We only have two intakes in lower Saginaw Bay, Bay City and Caseville. Caseville's intake is buried beneath the lake bottom and not as susceptible to the periodic water quality issues that develop in that bay. Bay City constructed a treatment plant in the 1960s that was specifically designed to deal with the taste and odor problems created in the lower Saginaw Bay. It included special monitoring equipment and additional treatment (ozonation) to address these problems. Furthermore, Bay City will be connecting to a new water treatment plant that is currently being constructed by Bay County to serve Bay City and all of their customers. This facility will be receiving their source water from the Saginaw-Midland Water Authority whose intake is located north of the Saginaw Bay and outside the zone that has traditionally experienced algal blooms and/or taste and odor problems found in the lower bay. The Bay County system is schedule to be on line in 2016.



Location of Saginaw Bay Intakes

We have 3 intakes in Lake St. Clair serving the communities of Mount Clemens, New Baltimore and Ira Township. Given the shallow depth of this lake, these systems are more susceptible to organic loading and the resulting problems. When constructed, these plants were provided with additional treatment processes to deal with taste and odor that result from algal blooms among other sources. However, the lack of any problems arising in the past decade or more has in some cases resulted in this equipment no longer being operational should the source water quality deteriorate and require additional treatment.

Location of North Lake St. Clair / Anchor Bay Intakes

It is no surprise that the water systems in Michigan that installed additional treatment for taste and odor control and to treat additional organic loading they periodically experienced were Ann Arbor, Monroe, Bay City and Mount Clemens, given the increased vulnerability of their sources. Several of these communities were pioneers in the use of ozone for destruction of organic material and taste and odor compounds. As drinking water standards have developed further and in some cases, been lowered, ozone has become more prevalent industry-wide, but these communities have been employing it for years. They are also aware of their susceptibility and have the ability to adjust their treatment to address problems like increased organic loading and algal blooms. However, there are some systems that no longer can easily adjust treatment (such as feeding powdered activated carbon) since the equipment has not been used in years.

CYANOBACTERIA AND MICROCYSTIN RISK IN MICHIGAN

Based on the considerations described above, the public water supply locations with the -most-potential to experience harmful algal blooms containing Cyanobacteria and its associated toxin, microcystin, are those systems which rely on source water from Lake Erie.

Blue-green algae (also known as cyanobacteria) are microscopic organisms found naturally in surface water and typically grow lakes, ponds, and slow-moving streams. True algae and blue-green algae both utilize some form of chlorophyll to perform photosynthesis and produce oxygen. True algae are essentially plants. However, blue-green algae are actually bacteria that exhibit a blue or green color, similar to true algae, but contain cellular structures typical of bacterial cells. True algae and blue-green algae are very different organisms and therefore should not be treated the same.

Environmental conditions that can promote the growth of blue-green algae include ample sunlight, warm weather, low turbulence, and high nutrient levels, particularly phosphorous. Once established, blue-green algae possess several traits that contribute to their success in aquatic environments such as the ability to regulate their buoyancy. Buoyancy regulation allows cyanobacteria to obtain ideal amounts of nutrients and sunlight, and is the reason why colonies are often observed at the water surface and as scum layers. They also possess the unique ability to utilize atmospheric nitrogen as a nutrient source when at the water surface, thus giving them a competitive advantage over other algae. Blue-green algal blooms can arise quickly and are highly visible, often appearing as a blue-green paint sheen or scum at the water surface. These blooms can be aesthetically displeasing and wind-driven accumulations on shorelines can cause significant odors as the algae decay.

There are no known harmful toxins released by dying true algae. Blue-green algae, however, can contain harmful toxins within the cell wall which may be released as part of their natural life cycle during cell growth or death. Some species of blue-green algae can produce toxins, including neurotoxins (nervous systems), hepatotoxins (liver) and dermatotoxins (skin irritant), cytotoxins, and compounds that affect the gastrointestinal tract. Ingestion of these toxins can have both acute and chronic effects and can result in illness and, in rare instances, even death of humans and animals.

In general, the most effective way to remove algal toxins is while they are still encased within the intact algal cells. Once toxins are released from the cells they are much more difficult to remove, so the most efficient and cost effective method for toxin removal includes optimization of current treatment processes for cell removal.

The goal of water treatment for potable use should be undisruptive transport, removal, and disposal of healthy, intact blue-green algal cells. Each treatment process should be evaluated for cell removal performance and optimized to mitigate the risk of cell breakthrough and/or release of dissolved toxins (microcystin).

As a result of the acute risks associated with microcystin and other toxins present in Cyanobacteria the following sections review the impacts to public water systems in Michigan that utilize water from Lake Erie, their existing conditions, and resiliency to respond to the occurrence of harmful algal blooms containing Cyanobacteria and microcystin.

Michigan public water systems utilizing water from Lake Erie

Water System/Municipality	Population	Million Gallons per Day
Monroe South County (via City of Toledo WTP)	33,816 (Total)	10 MGD Capacity 3 MG Avg. Day Demand
Bedford Township		
Erie Township		
Luna Pier		
LaSalle Township		
City of MonroeWTP	48,726 (Total)	18 MGD Capacity 7.7 MG Avg. Day Demand
Retail (regulated through City of Monroe)		
City of Monroe	20,738	
Monroe Township	14,599	
Raisinville Township	5,833	
Village of Maybee	566	
London Township	207	
Exeter Township	1,115	
Ida Township	420	
LaSalle Township	79	
Frenchtown Township	70	
Wholesale (regulated as separate water systems)		
Village of Dundee	3,972	
City of Petersburg	1,136	
Frenchtown Township WTP	16,481 (Total)	8 MGD Capacity 3.2 MG Avg. Day Demand
Frenchtown Township		
Total Service Population and Demand Demand	99,023	14 MG Avg. Day

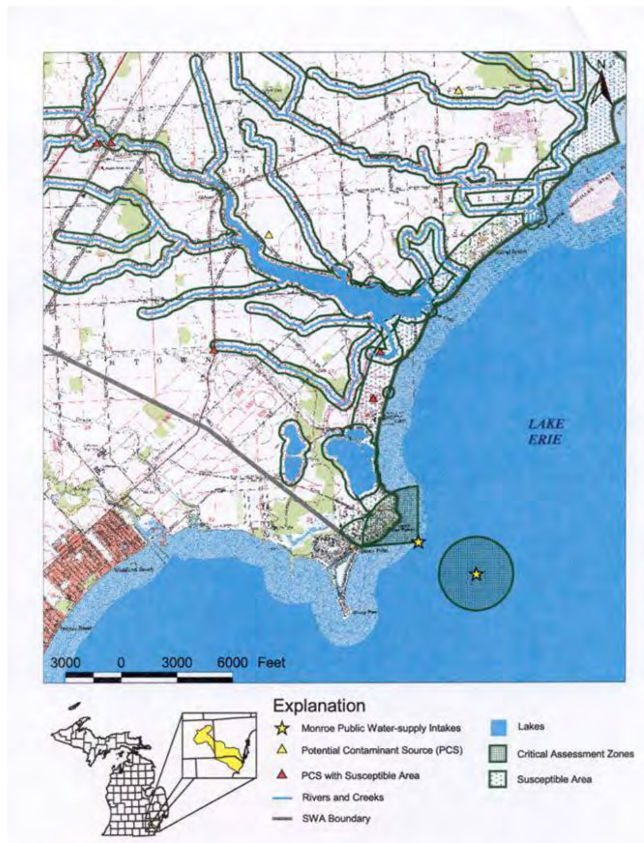
Resiliency Considerations for Public Water Supplies using water from Lake Erie

Intake Facilities

Monroe WTP and Frenchtown Township WTP share 2 intakes in Lake Erie. In addition to the intakes in Lake Erie, the Monroe WTP has maintained its original intake in the River Raisin for use in emergencies.

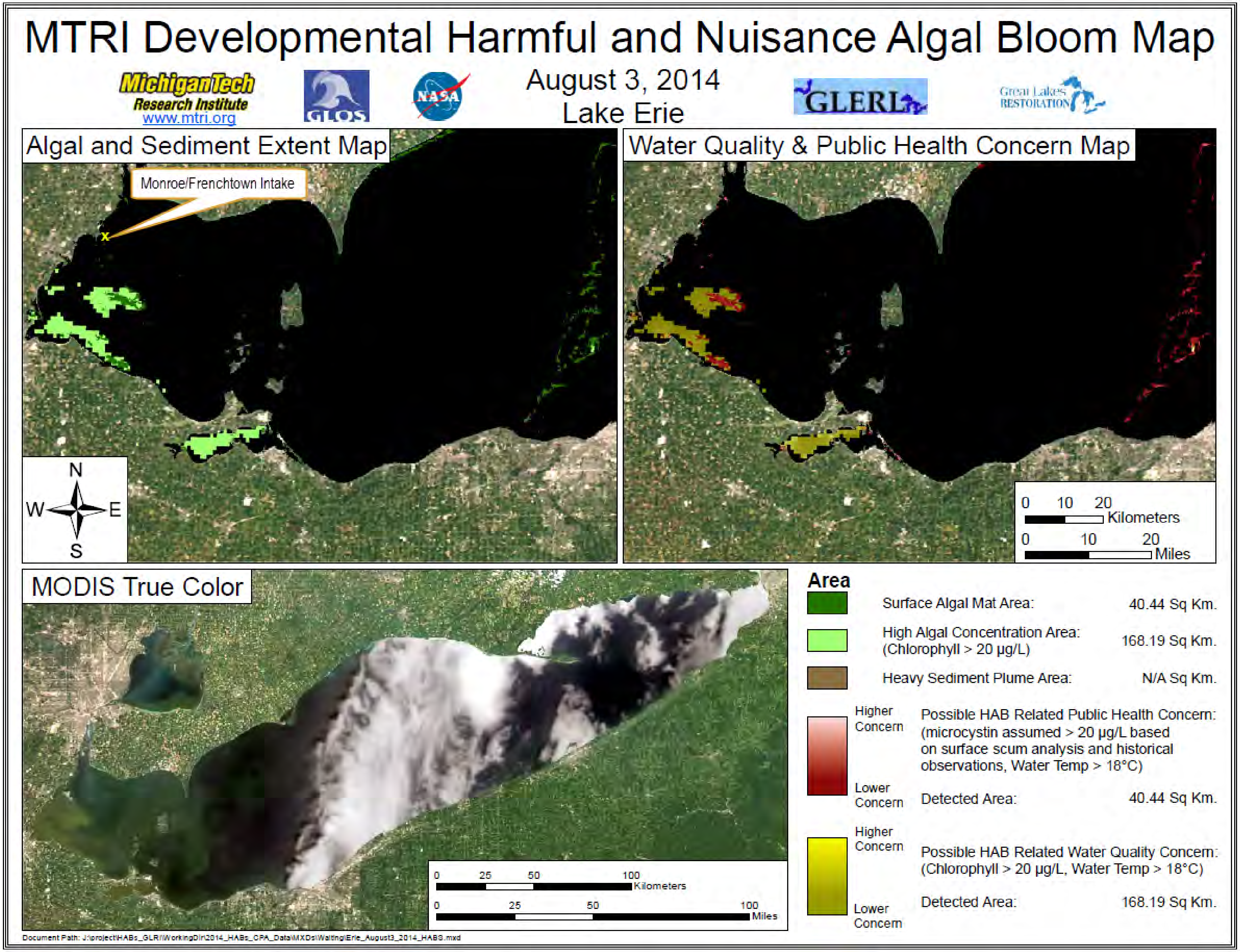
The Lake Erie intakes for Monroe WTP and Frenchtown Township WTP, located north of Stony Point, are more directly influenced by currents which flow down from the north out of the Detroit River and thus protected from algal blooms which occur in the southern portion of Lake Erie. This influence can be seen in the map provided on the following page which shows algal bloom locations on August 3, 2014, at which time the City of Toledo, Ohio, experienced high levels of microcystin in both its raw and treated water, requiring the issuance of a do not drink advisory.

The two Lake Erie intakes are also in separate locations one closer to shore and one further out, and have critical assessment zones that do not intersect as shown in the figure on the right. The critical assessment zone defines the area that most significantly influences the quality of raw water being drawn by the intake.



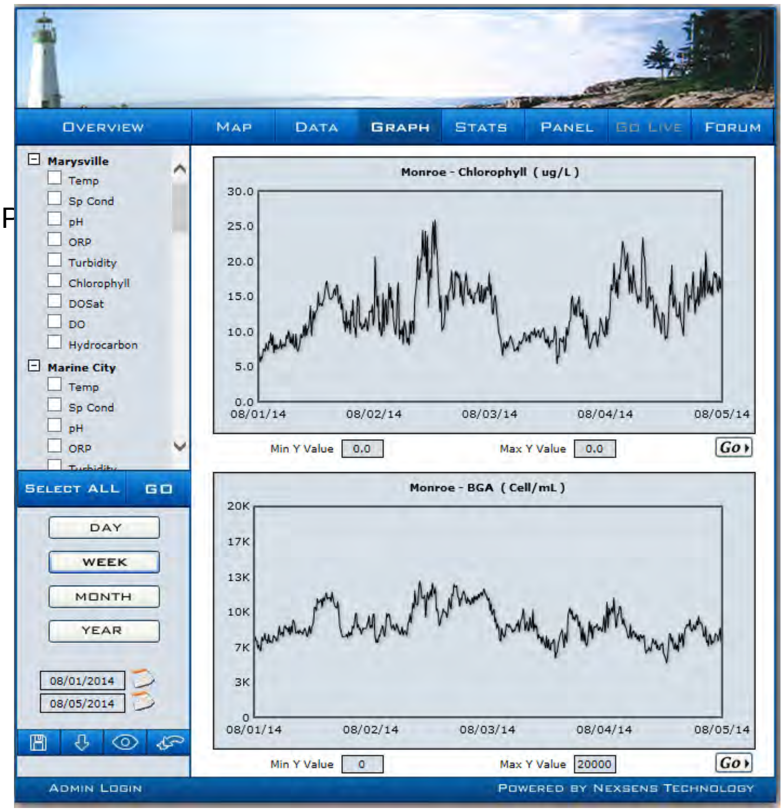
A source water assessment completed for these intake facilities (appended) establishes the critical assessment zone and identifies potential contaminant sources with the intent to ultimately prioritize protection activities for these sources of public drinking water.

The separation of these intakes and their zones of influence provide additional flexibility in operation at the Monroe and Frenchtown Township water treatment plants depending on the conditions at each location.


MTRI Developmental Harmful and Nuisance Algal Bloom Map
MichiganTech Research Institute
www.mtri.org
August 3, 2014
Lake Erie
GLERL
Great Lakes RESTORATION
Algal and Sediment Extent Map
Monroe/Frenchtown Intake
N
W
E
S
Water Quality & Public Health Concern Map
0 10 20 Kilometers
0 10 20 Miles
MODIS True Color
0 25 50 100 Kilometers
0 25 50 100 Miles
Area
Surface Algal Mat Area: 40.44 Sq Km.
High Algal Concentration Area: (Chlorophyll > 20 µg/L) 168.19 Sq Km.
Heavy Sediment Plume Area: N/A Sq Km.
Higher Concern
Lower Concern
Possible HAB Related Public Health Concern: (microcystin assumed > 20 µg/L based on surface scum analysis and historical observations, Water Temp > 18°C)
Detected Area: 40.44 Sq Km.
Higher Concern
Lower Concern
Possible HAB Related Water Quality Concern: (Chlorophyll > 20 µg/L, Water Temp > 18°C)
Detected Area: 168.19 Sq Km.
Document Path: J:\project\HABs_GLRI\WorkingDir\2014_HABs_CPA_Data\MXDs\Waiting\Erie_August3_2014_HABS.mxd

Real-Time Monitoring of Raw Water Quality
Intakes for the City of Monroe and Frenchtown Township have had real time monitoring equipment installed since March of 2012 and can monitor for the following parameters:

- Temperature
- Specific Conductivity
- pH
- Oxidation Reduction Potential (ORP
- Turbidity
- Chlorophyll
- Blue-Green Algae
- Dissolved Oxygen
- Total Organic Carbon
- Hydrocarbon



Chlorophyll and in particular, blue-green algae are used as the primary indicators to provide early warnings of harmful algal blooms in the source water.

Monitoring for Microcystin

The City of Monroe WTP voluntarily follows the protocols established by Ohio EPA regarding monitoring for microcystin in-both their raw water and treated water from the plant tap. Samples collected at the Monroe WTP are currently sent to the Water Treatment Plant Laboratory at the City of Oregon, Ohio for analysis. . There currently is no federal or state regulatory standard for microcystin. Ohio EPA recommends a Do Not Drink – Drinking Water Threshold at 1 ppb microcystin and a Do Not Use – Drinking Water Threshold at 20 ppb microcystin, in part based on World Health Organization recommendations.

Test kits are available for both semi-quantitative and quantitative analysis of microcystin, saxitoxin, and cylindrospermopsin. All kits are based on the Enzyme-Linked ImmunoSorbent Assay (ELISA) testing method.

Besides the City of Oregon, a number of certified labs are available in both Michigan and Ohio (see attached lists) that can provide this analysis.

Procedures for repeat sampling followed by Monroe WTP are in accordance with the following Ohio EPA guidance.

If cyanotoxins are reported in the finished water above Ohio EPA reporting limits, a repeat sample should be collected and analyzed within 24 hours. Ongoing sampling will be dependent on the results of the repeat sample, as follows:

- If cyanotoxins are not detected above the reporting limit in finished water, at least one additional sample should be collected and analyzed no more than 7 days from the date of the prior sample.
- If cyanotoxins are detected at concentrations below Ohio EPA thresholds but above the reporting limit, daily sampling -with analysis at least three times per week- should continue until toxins are no longer detected in the finished water in two consecutive samples.
- If cyanotoxins are detected at concentrations above Ohio EPA thresholds, daily sampling and daily analysis should continue until toxins are no longer detected in the finished water in two consecutive samples.

Once cyanotoxins are no longer detected in the finished water in two consecutive samples, weekly sampling should continue until concentrations in the raw water are less than 50% of the threshold. If microcystin concentrations in the raw water exceed 5 ug/L, sampling frequency should increase to three times per week.

Treatment Considerations

Frenchtown Township WTP

The Frenchtown Township WTP is actually 2 separate 4 million gallon per day treatment plants that utilize different treatment processes. This provides an advantage if one plant or one type of treatment becomes impacted.

The original conventional treatment plant uses ozonation followed by coagulation, flocculation, sedimentation, and high rate filtration. Water is disinfected with chlorine prior to the filters and can be boosted prior to pumping into the distribution system. Backwash water from the filters is recycled and comingled with raw water.

Adjustments to the ozonation process, adjustments to the coagulant (alum) dosage including the use of an additional polymer, adjustments to the chlorine disinfectant dosage, lowering of the filtration rate, lowering filter run time (i.e. increasing backwash frequency and duration), and discontinuing the use of recycle water can all be used at this plant to address cyanobacteria and microcystin, both loading and treatment.

The newer plant uses membrane microfiltration units. Water is strained prior to the membranes. Water is disinfected following the filter units and can be boosted prior to pumping into the distribution system. Recycle and decant water from the membrane treatment is recycled to the conventional treatment plant and comingled with raw water.

Lowering of the filter flux rate, lowering filter run time (i.e. increasing backwash and cleaning frequency and duration), and adjustments to the chlorine disinfectant dosage can be used at this plant to address cyanobacteria and microcystin, both loading and treatment.

Chlorine is also seasonally added at the intake facility to control zebra mussels prior to either of the Frenchtown Township WTP's. While the timing for zebra mussel control generally differs from that of peak algal blooms, if zebra mussels and harmful algal blooms were of concern simultaneously this could be problematic, particularly for the membrane plant. Use of chlorine on the raw water with cyanobacteria present will cause the release of microcystin, while the membranes used in the treatment process are susceptible to damage from zebra mussel fragments. This damage is likely to increase the amount of microcystin if present, to pass through the membrane filters.

Concerns with the treatment processes at Frenchtown Township are that microfiltration membranes are not considered effective at removal of microcystin. This could be problematic if microcystin that remains present after filtration cannot be neutralized with chlorine disinfectant. If cyanobacteria is allowed to accumulate on the membranes and is not removed or effectively cleaned, this could lead to a higher release of microcystin at the filters. The conventional high rate filters are also not effective at microcystin removal and while the coagulation, flocculation, sedimentation process and the filters are effective at cyanobacteria removal, if cyanobacteria is not removed from the treatment stream in a timely manner and allowed to accumulate, release of microcystin within the treatment plant can occur. The use of chlorine disinfectant on water that is applied to the filters could also cause any cyanobacteria accumulated on the filter to release microcystin. Finally the recycle stream consists of water from filter backwash or cleaning along with settled sludge. Cyanobacteria contained in the settled and filter sludges will release microcystin, nearly 100% after two days of sludge retention. This microcystin is then likely to be returned to the treatment process in the recycle water. While carbon can be effective at microcystin removal neither of the Frechtown Township treatment streams is currently capable of feeding a form of carbon.

City of Monroe WTP

The City of Monroe WTP is a conventional treatment plant that utilizes ozonation followed by coagulation, flocculation, sedimentation, and high rate filtration. Water is disinfected with chlorine prior to the filters and can be boosted prior to pumping into the distribution system. Backwash water from the filters is recycled and comingled with raw water.

Adjustments to the ozonation process, adjustments to the coagulant (alum) dosage including the use of an additional polymer, adjustments to the chlorine disinfectant dosage, lowering of the filtration rate, lowering filter run time (i.e. increasing backwash frequency and duration), and discontinuing the use of recycle water can all be used at this plant to address cyanobacteria and microcystin, both loading and treatment.

Chlorine is also seasonally added at the intake facility to control zebra mussels prior to the Monroe WTP. While the timing for zebra mussel control generally differs from that of peak algal blooms, if zebra mussels and harmful algal blooms were of concern simultaneously this could be problematic. Use of chlorine on the raw water with cyanobacteria present will cause the release of microcystin.

Concerns with the treatment processes at the City of Monroe are that the conventional high rate filters are not effective at microcystin removal and while the coagulation, flocculation, sedimentation process and the filters are effective at cyanobacteria removal, if cyanobacteria is not removed from the treatment stream in a timely manner and allowed to accumulate, release of microcystin within the treatment plant can occur. The use of chlorine disinfectant on water that is applied to the filters could also cause any cyanobacteria accumulated on the filter to release microcystin. Finally the recycle stream consists of water from filter backwash. Cyanobacteria contained in the filter sludges will release microcystin, nearly 100% after two days of sludge retention. This microcystin is then likely to be returned to the treatment process in the recycle water. While carbon can be effective at microcystin removal the Monroe WTP is not currently capable of feeding a form of carbon.

Alternative Sources and Interconnections

While much of Michigan consists of glacial till that supports large quantities of high quality groundwater that can be utilized for public water supply, Monroe County does not, and instead lies within a karst formation.

Karsts in Monroe County have little to no surficial sediments and no confining layer at or near the earth's surface. This formation does not provide adequate filtration of recharge water prior to entering drinking water supplies, and is therefore considered under the direct influence of surface water, which then requires levels of treatment consistent with surface water sources. The presence of this Karst formation can be seen in the attached map from the USGS of karst areas in Michigan. In addition, a separate map of Monroe County from the Monroe County Environmental Health Division shows the vulnerability of groundwater to contamination.

In addition to poor quality water, water yield from the karst formation in Monroe County is insufficient to support most small community water system needs, let alone the water demands of larger systems such as Monroe, Frenchtown Township, and Monroe South County, or even the wholesale customers of Dundee and Petersburg. Thus use of ground water is not a viable alternative for source water in this area.

Additional information on water use issues related to karst formations, both quality and quantity are described in the DEQ Technical Bulletin *Water Wells in Shallow Carbonate Bedrock*. This document is linked below and a copy is appended.
http://michigan.gov/documents/deq/deq-wd-gws-wcu-waterwellshallowcarbonatebedrock_270784_7.pdf

The water distribution systems for the communities served by Monroe South County, City of Monroe WTP, and the Frenchtown Township can be broken down into the following districts, which maintain normal pressures at varied elevations:

Monroe South County	
Temperance and Lambertville High Pressure District	Overflow Elevation: 812 feet
Luna Pier and Stein Road Low Pressure District	Overflow Elevation: 723 feet
City of Monroe	
South Custer Booster Station High Pressure District	Overflow Elevation: 772 feet
Roessler Road Low Pressure District	Overflow Elevation: 745 feet
Frenchtown Township	
High Pressure District	Overflow Elevation: 741 feet
Low Pressure District	Overflow Elevation: 717 feet

Both of the City of Monroe WTP wholesale customers, the Village of Dundee and the Village of Petersburg are separately fed from the City of Monroe. Each then in turn pumps water from a transmission line to maintain pressure in their distribution system. There is no alternative water source or interconnection available for these two communities. They must receive water from the City of Monroe distribution system.

The Monroe South County system is fed by the City of Toledo into 2 separate ground storage tank locations with overflow elevations of 593 feet (Dixie) and 620 feet (Lewis), respectively. Water from these tanks is then pumped into the Monroe South County distribution system. Water must be pumped to the high pressure district and bled into the lower pressure district through a pressure regulator station.

There are 3 interconnections between the City of Monroe distribution system and the Frenchtown Township distribution system. There are also 2 interconnections between the City of Monroe distribution system and the Monroe South County distribution system. However, due to differing pressure elevations listed above only the following scenarios could provide alternative finished water between the distribution systems.

City of Monroe

- Receive water from Frenchtown Township
- Receive water from Monroe South County (via City of Toledo WTP)
- Either of these would allow water service to continue to be provided to the wholesale customers of Petersburg and Dundee.

Frenchtown Township

- Receive water from City of Monroe
- Receive water from City of Monroe (via Monroe South County)

The Monroe South County water system has no ability to receive water from the interconnection with the City of Monroe due to the higher elevations in the Monroe South County system and the inability to feed water into the ground storage tanks without depressurizing the Monroe South County water system. In order to accomplish this, a separate transmission line would need to be constructed from the City of Monroe distribution system to either one or both of the Monroe South County ground storage tanks.

Under emergency conditions, such as a do not drink or do not use water advisory, limited volumes of hauled bulk or bottled water can be accessed and provided to customers. This is further discussed in the following section on regulatory requirements for emergency response planning and water shortage response planning.

Emergency Response Planning

As required under Part 23 of the Administrative Rules, Supplying Water to the Public, of 1976 Public Act 399, the Michigan Safe Drinking Water Act, community water systems must develop a water system emergency response plan which in part, incorporates the following components:

- Emergency Contacts
- Operational Procedures
- Alternative Water Sources
- Backup Power Sources
- Identification of Critical Customers
- Public Notification Procedures

All 3 of the community water systems that utilize Lake Erie water, City of Monroe, Frenchtown Township, and Monroe South County, along with the 2 wholesale customer community water systems of Petersburg and Dundee, have each completed an emergency response plan containing this information.

Critical customers identified by these water systems include the following:

- Hospitals and Medical Offices
- Nursing Homes and Senior Care Facilities
- Schools and Colleges
- Daycares and Pre-schools
- Cabelas (Dundee)
- Chrysler Engine Plant (Dundee)

- Detroit Edison (Monroe)
- MacSteel Monroe
- Pioneer Metal Finishing (Monroe)

Outside these community water systems, the following community water supplies are available to supply hauled bulk water:

- Village of Blissfield
- Village of Deerfield
- City of Adrian

In addition to these emergency response activities, either local municipal, or county state of emergency declaration and incident command procedures may be activated.

Immediate notification to staff in the DEQ public water supply program is required under such emergency conditions. In addition the MDEQ and community water supply are in contact with both the Local Health Department (Food Service) and MDARD Food and Dairy Division (Food Processing and Food Service) regarding appropriate use restrictions.

Additional support functions provided by the DEQ under such emergencies are provided in the following section. MDEQ's Support functions for incidents related to drinking water under the Michigan Emergency Management Plan (Pub 101, 4/2014) are listed below:

EMERGENCY SUPPORT FUNCTIONS: HEALTH AND ENVIRONMENTAL PROTECTION
Contamination of Drinking Water Supplies - Public drinking water supplies may be impacted by both natural and technological disasters. As appropriate, the MDEQ will provide advice on actions needed to protect drinking water supplies and assess the need for emergency provision of alternate drinking water supplies.

EMERGENCY SUPPORT FUNCTIONS: RESOURCE SUPPORT
Coordinate the procurement of additional drinking water supplies, as required. Because Michigan's local communities obtain their drinking water supplies from many different sources, it is doubtful that there will be a drinking water shortage that cannot be adequately addressed with in-state water resources. The exception might be a prolonged, severe drought in Michigan and the upper Midwest that significantly taxes the surface and subsurface water sources here and in surrounding states. If additional drinking water supplies are required due to a statewide or regional (Midwest) water shortage, the MDEQ will (in conjunction with the MSP/EMHSD and MDTMB) consider all appropriate procurement avenues, including federal assistance under the NRF, assistance from other states under the EMAC, and direct procurement through the private sector (i.e., bottled water companies, beer or soft drink bottlers, water-related trade associations). The procurement strategy employed will be determined in large part by the nature, scope, magnitude and expected duration of the shortage. (Refer to the Natural Disaster Procedures /Drought and MEMP Recovery Support Plan.)

EMERGENCY SUPPORT FUNCTIONS: PUBLIC WORKS AND ENGINEERING
Coordinate the assessment, repair and restoration of damaged dams, water supply systems, and wastewater collection and treatment facilities. If any of these facilities and/or systems is damaged or negatively impacted in an emergency or disaster, inspectors from the MDEQ will be dispatched to the scene (through the MDEQ EMC) to help local (and federal, if involved) officials in assessing the physical damage, operational impacts, and potential public health and safety consequences. This assessment information, as well as any emergency recommendations made by the MDEQ or other involved inspectors, will be submitted to the MSP/EMHSD through the MDEQ EMC. The MSP/EMHSD will coordinate with the MDEQ and other involved local, state, and federal

departments / agencies in developing and implementing appropriate response and recovery actions to address the specific issues related to the damaged facility and/or system. If a Presidential major disaster declaration is granted under the federal Stafford Act, the MDEQ EMC will work with the MSP/EMHSD to determine if federal disaster relief funding for the repair and restoration of the facility and/or system under the PAGP or other available programs might be applicable.

Resource Shortage Decision Matrix for Basic Life Support Commodities

(Suggestions not all-inclusive or listed in any particular priority order. Table continued on next page.)

Response Measure: / Resource:	Resource Augmentation	Alternative Resources	Voluntary Conservation Measures	Mandatory Conservation Measures
DRINKING WATER	ꜝ MDMVA (water tankers) ꜝ Non-Affected Water Distribution Systems ꜝ Private Voluntary Agencies (e.g., ARC) ꜝ Michigan Bottled Water Companies / Association ꜝ Michigan Soft Drink Bottling Companies / Association ꜝ Michigan Milk Producers / Association ꜝ Major Michigan Retailers ꜝ EMAC request ꜝ National Bottled Water Companies / Association ꜝ National Soft Drink Bottling Companies / Association ꜝ National Milk Producers / Association ꜝ Major National Retailers ꜝ FEMA (NRF mission assignment)	ꜝ Portable Water Tankers ꜝ Bottled Water ꜝ Boil Water Advisories (where water is available but possibly contaminated) ꜝ Tapping into Non-Affected Water Distribution Systems ꜝ Temporary Water Distribution System ꜝ Water Substitutes (e.g., fruit juices, milk, other non-alcoholic beverages)	ꜝ Government Recommended Liquid Intake Guidelines (tailored for situation) ꜝ Government Recommended Water Use Guidelines (for all end users – residential, commercial, industrial, institutional, agricultural)	ꜝ Water Rationing (e.g., direct distribution by government, water rationing coupons) ꜝ Water Use Regulations (for all end users) ꜝ Legal Sanctions (for over-use / non-appropriate use / “hoarding” of water supply)