Grand Lake St. Marys
Adaptive Management Plan

September 2017

Moving Forward

Prepared for:
Grand Lake St. Marys
Lake Restoration
Commission

Prepared by:
KCI Associates of Ohio
Akron OH

FINAL

GRAND LAKE ST. MARYS RESTORATION COMMISSION

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The goal of the GLSM Restoration Commission is to:

Provide a holistic blueprint for the sustainable environmental and economic renewal of Grand Lake St. Marys and its contributing watersheds through an approach that will motivate and coordinate stakeholders to increase the ecological and economic effectiveness of restoration activities. These efforts will also help lake communities realize their potential to improve and protect the natural and economic resources of the region.

Commission Members

- Board of Auglaize County Commissioners
- Board of Mercer County Commissioners
- City of Celina
- City of St. Marys
- Grand Lake St. Marys State Park
- Greater Grand Lake Visitors Center
- Lake Development Corporation
- Lake Facilities Authority
- Lake Improvement Association
- Mercer County Civic Foundation
- St. Marys Community Foundation
- Wright State University Lake Campus

PREFACE

This document is an Adaptive Management Plan (AMP) intended to supplement and update the Strategic Plan (SP) developed for Grand Lake St. Marys (GLSM) based on observed changes to the system since its inception in 2011. This document should be utilized in tandem with the original SP as an updated chapter which describes the latest objectives, strategies and actions needed to improve and protect GLSM's environmental and economic health based on the current system indicators.

- Section 1 documents the actions that were implemented under the SP and evaluates their effectiveness in achieving the stated goals and objectives.
- Section 2 makes recommendations for changes to the SP based on the "lessons learned," and revises actions that should be taken to continue the efforts underway.

An Adaptive Management Plan is a living document and should be continually analyzed and modified as data is available to determine the effectiveness of the actions being undertaken. It is not intended to replace the SP, but to critically assess the path forward based on the observed responses to the system.

EXECUTIVE SUMMARY

The Strategic Plan (SP) was formulated in 2011 to provide a framework and timeline for restoration of the Grand Lake St. Marys (GLSM) ecosystem utilizing nutrient management control and removal projects and economic management tools to implement solutions for current and future lake improvements and revitalization. The SP was integrated with ongoing efforts by the Ohio Environmental Protection Agency (OEPA), Ohio Department of Natural Resources (ODNR) and the GLSM Lake Restoration Commission (LRC) as part of a Consolidated Action Plan (CAP) which established an interrelated framework of objectives to synergistically pursue the ecologic and economic restoration of GLSM through the utilization of Adaptive Management (AM) protocols. Attributes of these protocols were captured and developed into a Conceptual Ecosystem Revitalization Model (CERM). Numerous management actions were identified for implementation through coordination with the primary stakeholders and adopted as Critical Response Actions (CRA). Completed and ongoing CRAs undertaken from 2011 through 2016 as a result of SP included:

- Developed the GLSM Consolidated Action Plan (CAP)
- Establishment of the Lake Facilities Authority (LFA)
- Established Lake Manager Position
- Established Communications Plan
- Created Fund Raising Program
- Water quality monitoring stations were active and data was assessed
- Administered chemical alum treatments
- Dredged sediment depositions
- Treatment Train establishment
- Rough fish removal
- Applied aeration and circulation technologies
- Water level management
- Implementation and new participation in multiple Best Management Practices (BMPs) and projects within the watershed.
- Establishment of Agricultural Solutions Group
- Development of the Beaver Creek and Chickasaw Creek Nine Element Watershed Plans

The cumulative effect of these efforts has yielded benefits to both the ecologic and economic conditions of the lake. The performance measures selected for the CERM sought to assess the influence of the CRAs on both the environmental quality and economic climate of the system. Monitoring of these trends moving forward will provide valuable insight into the resiliency of the system to recover from extremes in annual weather cycles and act as an indicator of temporal lag time response in the system.

A review of the implemented CRAs successes and the recognized effects of their implementation provided guidance for the development of the Adaptive Management Plan (AMP). The AMP validated the goal of SP and extended its objectives to include: Water Quality Improvement, Study/Document, Coordinate, Public Outreach, Economic Revitalization, and Infrastructure Management. In support of

these objectives, 22 CRAs were developed and/or continued as ongoing actions, 9 of which were identified as Critical Implementation Priorities (CIPs) as follows:

- Treatment Trains and littoral wetland systems
- Rough fish removal
- Re-establish public connection with the lake as a recreational destination for swimming and water contact sports
- Watershed Best Management Practices
- In-lake features development
- Management of channel water
- Natural/man-made infrastructure management
- Monitoring, documentation and modeling of scientific data
- Beneficial use of organic waste

Implementation of the CRAs with emphasis on the CIPs will occur over the next 5 years dependent upon funding. The implementation of the AMP necessitates the continued monitoring and modification of these efforts. To improve sensitivity and management decisions individual Conceptual Ecosystem Models (CEMs) will be developed and monitored for associated performance metrics for each CRA.

1. Strategic Plan 2011 Summary

Grand Lake St. Marys (GLSM) is a 20 square mile lake supported by a 92 square mile watershed (total land area) in north western Ohio. GLSM is located in Mercer (90 percent) and Auglaize (10 percent) Counties and sits on a watershed divide between the Lake Erie Basin and Ohio River Basin (GLWWA, 2009). A majority of lake outflow drains to the west to the Wabash River via Beaver Creek and then and eventually to the Ohio River. It is estimated that only about 10 percent of lake discharge flows to the east into a feeder canal to the St. Marys River and then to the Maumee River and Lake Erie (GLWWA, 2009).

GLSM has been an influence on the local and regional economy within Auglaize and Mercer Counties, and West Central Ohio since its creation. As the health of the lake and its native habitats has thrived, so has the economy. However, the health of the lake in recent years has felt the drastic cumulative effects of gradual land use changes, related to both growth and development surrounding the immediate lake area and the agricultural industry boom within the surrounding watershed.

These impacts have affected both recreational and economic activities throughout the lake communities. Although numerous plans to reduce the levels of pollution entering the lake have been developed over the years, the lake's water quality continues to suffer from nutrient inputs and other water quality degradation issues leading to dangerous levels of algae microcystin toxin. These threats could endanger public health and welfare. Algae blooms were of such a magnitude and duration during the summer of 2010, that the State of Ohio was forced to close the lake to all recreational activity.

In 2011, a Strategic Plan (SP) was formulated to provide a framework and timeline for restoration of the Grand Lake St. Marys (GLSM) ecosystem utilizing nutrient management control and removal projects and economic management tools to implement solutions for current and future lake improvements and revitalization. The SP was integrated with ongoing efforts by the Ohio Environmental Protection Agency (OEPA), Ohio Department of Natural Resources (ODNR) and the GLSM Lake Restoration Commission (LRC) as part of a Consolidated Action Plan (CAP). These plans established an interrelated framework of objectives to synergistically pursue the ecologic and economic restoration of GLSM through the utilization of Adaptive Management (AM) protocols. Attributes of these protocols were captured and developed in a Conceptual Ecosystem Revitalization Model (CERM).

The SP addressed the elements of the ecosystem restoration through implementation of Regulatory Controls, Sediment Management, Biological Treatments, Chemical Treatments, and Best Management Practices. The primary objectives of these elements are to improve water quality and increase wildlife/fisheries habitat. Numerous management actions were identified for implementation in support of these objectives through coordination with the primary stakeholders and adopted as Critical Response Actions (CRA). The CRAs included; Chemical Treatments, Dredge Accumulated Sediments, Beneficial Use of Organic Waste, Watershed Best Management Practices, Rough Fish Removal, a Lake Manager, Development of a Natural Resources Capital Improvement Program, and Participation and Prioritization in the Water Pollution Control Loan Fund.

Since the release of the SP in 2011 many of the CRAs have been or are in the process of being implemented. The following summarizes the accomplishments of SP and establishes a basis to develop the Adaptive Management Plan (AMP) to address changes that have occurred in the watershed, regulatory environment, technological advancements and experiences since the implementation of the SP and CAP.

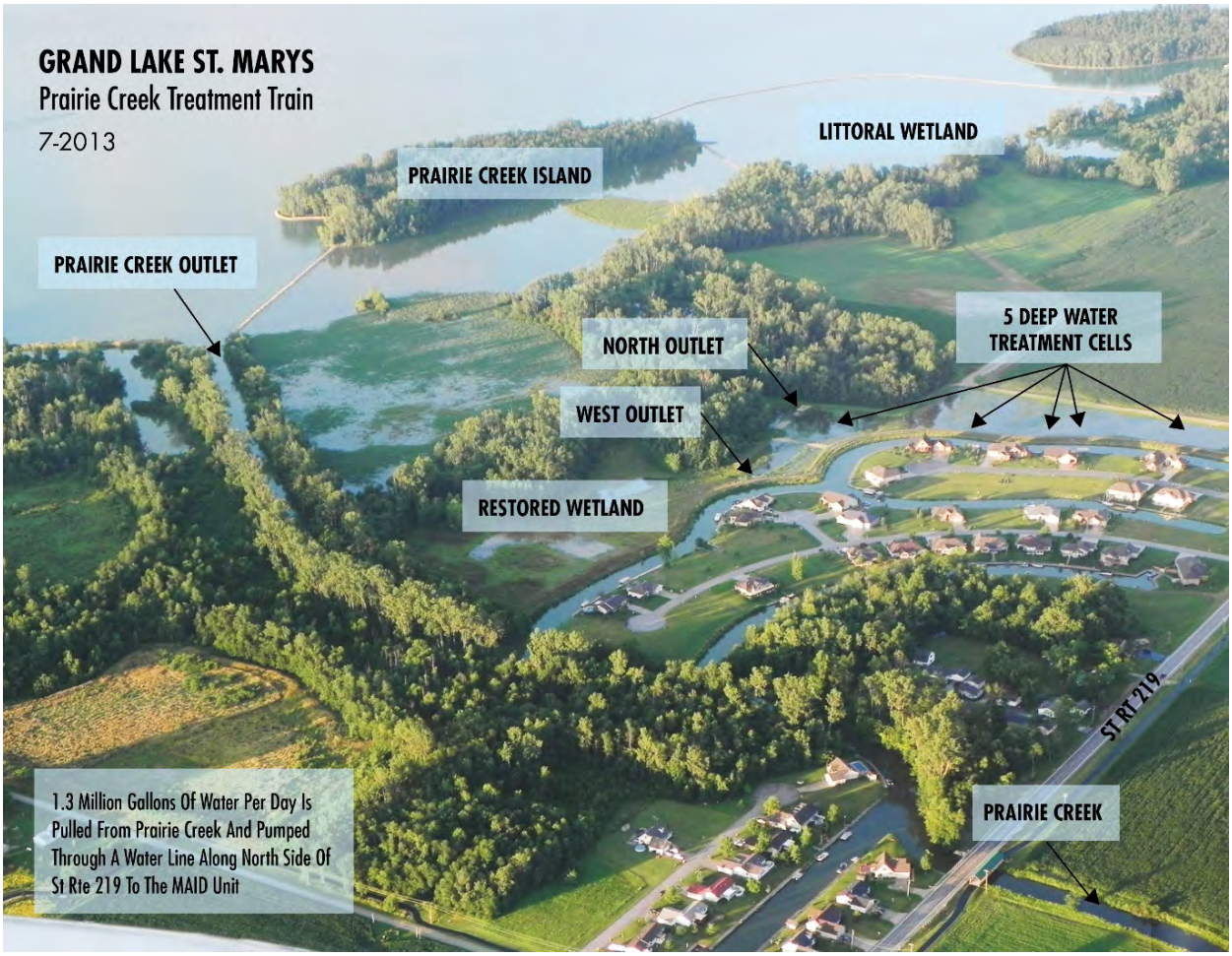
1.1. CRITICAL RESPONSE ACTIONS

There were 25 CRAs proposed in support of the goals and objectives established in the original 2011 SP. These CRAs were then further prioritized based on the immediate needs at that time, to establish 8 Critical Implementation Priorities (CIPs). From 2011 through 2016, 4 of the CRAs were completed, 9 are ongoing, 2 were considered not currently technologically viable, and 10 were Not Pursued (NP). Of the 8 CIPs, 6 were either completed or ongoing and 2 were determined to be Not Technologically Viable (NTV). The following is a summary of these original CRAs and their status.

- GLSM CONSOLIDATED ACTION PLAN (CAP): The LRC developed the CAP in January 2011 in an effort to coordinate the economic, water quality and public health/welfare actions and provide a unified agency and organizational approach to the environmental and economic revitalization of the GLSM region.
- LAKE FACILITIES AUTHORITY (LFA): In 2013 the LFA for Grand Lake St. Marys (GLSM) was legislatively established to provide a funding source and managing authority for improvements through establishment of local taxes, etc.
- LAKE MANAGER POSITION: In 2012 a Lake Manager position was established and filled reporting directly to the Grand Lake St. Marys Restoration Commission to oversee, manage and coordinate progress of the Strategic Plan implementation. This position remains in place currently.
- COMMUNICATIONS PLAN: A communications plan was developed by the Convention and Visitors Bureau in conjunction with the lake manager and associated partner organizations. From 2012 to 2016, extensive efforts were made to disseminate information regarding actions being undertaken by the Lake Restoration Committee, and to help promote tourism on the lake. This included regular newspaper articles, mass media coverage, presentations to local groups and organizations, participation in stakeholder groups and presentations at conferences.
- FUND RAISING PROGRAM: A fund raising program was initiated and pursued by the lake manager. From 2012 to 2016 these efforts yielded $915,000 in private donations.
- WATER QUALITY MONITORING STATIONS: Ongoing testing of water quality in the contributing drainages to GLSM and in the lake itself has been and continues to be conducted by several organizations. Heidelberg University's National Center for Water Quality Research, operates 3 continuous monitoring stations in three tributaries, OEPA samples at 25 locations in the lake and watershed, and Celina Water Treatment Plant monitors lake water at the plant intake daily (with microcystin sampling occurring weekly). USDA-ARS Ohio has installed three different edge of field monitoring sites within the Grand Lake St. Marys watershed collecting baseline data in support of assessing BMP effectiveness.
- CHEMICAL ALUM TREATMENTS: Chemical Alum treatments were administered via contract by the State of Ohio through ODNR for experimental test coves and the larger lake area in 2010, 2011 and 2012. Smaller more localized alum applications were also used and found to be effective in the Prairie Creek Treatment Train System.
- DREDGE SEDIMENT DEPOSITIONS: Through ODNR, dredging occurred in 2011, removing 272,000 cubic yards, in 2012, removing 289,861 cubic yards, and in 2013, 302,226 cubic yards were dredged. In 2014, 232,000 cubic yards of dredging material were collected and relocated and in

2015, 364,590 cubic yards and in 2016, 405,523 cubic yards of deposition were dredged and removed. The largest challenge with this effort is disposal of spoils.

- TREATMENT TRAIN ESTABLISHMENT: Three Treatment Trains (TT) Systems have been established and are operational on Prairie, Coldwater and Beaver Creeks within the watershed. Prairie Creek is an engineered system that includes a Mobile Alum Injection Device as well as extensive constructed and restored wetlands. Coldwater Creek is also an engineered system, similar to Prairie Creek TT, but is larger. Both of these projects are operational and have successful preliminary results. Monitored removal efficiencies on Prairie Creek TT were 31% and 71% for nitrogen (NO2-N, NO3-N, NH3-N) and phosphorus (P04) respectively (more detail in Section 1.3). Scheduled to be completed in the fall of 2017, Beaver Creek is a Biofilter Complex treating water in three vegetated cells. Big Chickasaw Creek TT is in design and scheduled for implementation in 2018. Beaver Creek/Prairie Creek TTs was funded by the 319 Program. Coldwater Creek/Big-Little Chickasaw Creek TTs are funded through state appropriations.



- ROUGH FISH REMOVAL: Since 2011, several tons of rough fish have been removed by ODNR and through rough fish derbies. To help further offset rough fish issues, ODNR has recently authorized permits to a commercial fisherman to assist with rough fish removal and Wright State University is working to identify and monitor the honing locations to best net the fish.
- AERATION AND CIRCULATION: In early 2011 the LRC contracted with Battelle to conduct an artificial circulation / aeration testing study to evaluate effectiveness of this treatment. Linear Aeration system implements were privately funded by landowners and private organizations and included 2.2 miles of bubble tubing, 116 units and 9 surface water feature units within the channels of GLSM. The results and benefits from these implements indicated potential localized DO level and Redox Potential Discontinuity improvements within a protected area, however lakewide application results of further application are currently inconclusive based on applications in large lake systems within other states. Visual improvement has been observed in the locality of the installed systems.
- IMPLEMENTATION AND NEW PARTICIPATION IN MULTIPLE BEST MANAGEMENT PRACTICES (BMPS) PLANS AND PROJECTS: Through both the Watershed Action Plan and the Strategic Plan, many BMPs have been implemented and many more are underway. Applications include cover crops, tillage transects, development and implementation of numerous Nutrient Management Plans (some associated with the new Distressed Watershed designation of GLSM), milkhouse waste containment, the implementation of filter strips and innovative manure containment, treatment and application technologies, septic system corrections and improvements, and a fertilizer and chemical lawn application soil testing program implemented.
- AG SOLUTIONS: In March 2016, the Mercer County Commissioners funded a full-time Ag Solutions Coordinator that is housed in the Community & Economic Development office. Ag Solutions researches alternative methods of manure management, nutrient concentration, solid-liquid separation and researching edge-of-field practices that can improve water quality. Much of this edge of field research is being completed in conjunction with Wright State University-Lake Campus and The Ohio State University.
- BEAVER CREEK AND CHICKASAW CREEK NINE ELEMENT WATERSHED PLANS: Ag Solutions, along with Mercer SWCD, spear headed the development of these plans which are critical and required in applying for 319 funding for future water quality improvements. Both plans were submitted to US EPA in April 2017 and the Beaver Creek Plan was approved on June 7, 2017, and the Chickasaw Creek Plan was approved on June 29, 2017.

1.2. REGULATORY ENVIRONMENT

In addition to the CRAs undertaken by the Lake Facilities Authority, Ohio Department of Environmental Protection, Ohio Department of Agriculture, Grand Lake/Wabash Watershed Alliance (which was dissolved in 2016, although efforts are continued by a Mercer County Soil and Water Conservation District watershed technician with assistance from Ag Solutions), Soil and Water Conservation, and Ag Solutions, the state of Ohio developed numerous pieces of legislation to protect the waters of the state from nutrient pollution. Though these regulatory standards do not solely apply to GLSM, they support the goals and objectives of SP.

- OHIO SENATE BILL 150 (AUGUST 2014): requires that all fertilizer applicators be certified and educated on the handling and application of fertilizer starting September 31, 2017. The legislation also authorizes a person who owns / operates agricultural land to develop a voluntary nutrient management plan or request that one be developed for him or her.

- DISTRESSED WATERSHED DESIGNATION: On January 18, 2011, GLSM was officially designated as a "Distressed Watershed" (Ohio Administrative Code 901:13-1-11). As a result of this designation, effective January 18, 2011, farm owners / operators, animal manure applicators or anyone responsible for applying manure in GLSM are required to follow the USDA NRCS Field Office Technical Guide (NRCS Standard 590) when land applying manure. Effective January 19, 2013 the same parties are required to follow strict guideline requirements regarding timing of manure application and must keep accurate records of applications. The new rules also require that by December 15, 2012, all livestock operations and manure applicators handling greater than 350 tons and/or 100,000 gallons of manure per year conform to a nutrient management plan that addresses the methods, amount, form, placement, cropping system and timing of all nutrient applications. The Division of Soil and Water Conservation is the current Ohio Department of Agriculture Division responsible for enforcing these rules.

- OHIO'S NUTRIENT REDUCTION STRATEGY: This strategy is an outgrowth of Ohio's participation on the Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force as well as requests from U.S. EPA Region 5 to produce a state strategy as called for in the 2008 Gulf Hypoxia Action Plan. Ohio's Nutrient Reduction Strategy was originally submitted to Region 5 in July 2013. The strategy and each update provide focus to reduce specific impacts of nonpoint source pollution. The next update of the Ohio Nutrient Reduction Strategy will be revised to include an assessment on the status of public drinking water supply beneficial use impairments due to nitrates and algae. Currently, only nitrate impairments are considered. Ohio expects to complete these steps and update the Nutrient Reduction Strategy by June 30, 2017.

- NUTRIENT WATER QUALITY CRITERIA: In November 2013, OEPA, Division of Surface Water formed a Technical Advisory Group (TAG) to assist in drafting nutrient standards with the Division of Surface Water personnel. Thus far the result is a process called the Stream Nutrient Assessment Procedure or SNAP, based on an OEPA prototype. The SNAP and other recommendations from the TAG were delivered to Ohio EPA in mid-2015. Currently the Division of Surface Water is in the process of draft rulemaking which will encompass many of the TAG recommendations. A few key notes about SNAP from the draft rules:

    - Based on this protocol, when SNAP shows nutrients are causing biocriteria impairment, the Director will evaluate whether nonpoint source reductions in nutrient loading will result in improvement of the aquatic biology. If reductions would make a material improvement then adaptive management to achieve nutrient loading reductions shall proceed via a watershed action plan developed to serve as the adaptive management plan (WAPAMP).

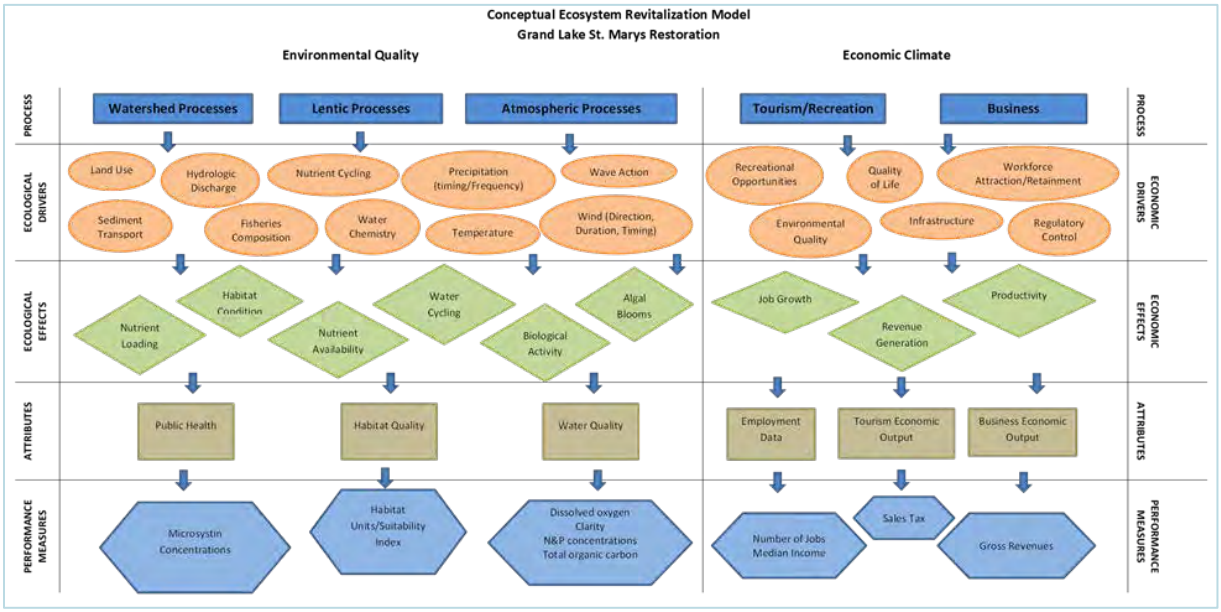
    - A WAP-AMP is to be developed by a local watershed stakeholder group within three years and submitted to the Director and Ohio DNR for endorsement. The WAP-AMP must be in accordance with Ohio's Guide to Developing Local Watershed Action Plans in Ohio (June 1997), including the Appendix 8 Update (February 7, 2003), and the most recent U.S. EPA section 319 planning guidance (federal fiscal year 2006), and modified to incorporate an adaptive management post implementation monitoring program and iterative revisions and implementation.

- Nutrient Mass Balance Study for Ohio's Major Rivers: Ohio HB 64 bill, effective June 30, 2015, required the development of the Nutrient Mass Balance Study for Ohio's Major Rivers by spring 2016 on mass loading of nutrients delivered. The biennial report would be used to determine the most environmentally beneficial and cost effective mechanisms to reduce nutrient loading to watersheds in the state. Initial focus of the report is on Lake Erie and the Ohio River watersheds from Ohio's point and nonpoint sources, however, the Wabash River Watershed (which includes GLSM) is listed as a "Priority 2" target for the expansion of the nutrient balance study. OEPA is listed as the lead for the expansion based on funding. According to Melinda Harris, OEPA does not have a timeline for the list of "priorities" and are not likely to get to Wabash in the next report. However, the presence of Heidelberg's monitoring on the outlet of GLSM in Beaver Creek and several lake tributaries means that is likely to be included in the not too distant future.

- Ohio NPS Management Plan: The Clean Water Act, Section 319(h), requires the development of the Ohio Nonpoint Source Management Plan. Ohio's original plan was approved by US EPA Region 5 in 2006 and it has been updated several times as recently as 2014. The most recent updated plan is designed to help focus nonpoint source management activities being implemented by Ohio EPA's Nonpoint Source Management Program during the period FY2014 through FY2018. Management Practices listed in the updates are now eligible for federal Section 319 grant funding and grants awarded from other sources.

1.3. PERFORMANCE MONITORING

The ecological condition of GLSM was described in the context of a Conceptual Ecosystem Model (CEM) (Fischnenich, 2008). The CEM is a simplified relational diagram model that communicates the processes, functions, and relationships at work in an ecosystem. In addition to communication of how a system works, the CEM can be used to make qualitative predictions of system response and can therefore aid managers in identification of stressor response relationships and in description of where management strategies can be implemented to illicit the desired outcome. The CEM is not a final or comprehensive depiction, as there can be many unknown, less understood, or less relevant components that are not described. The model developed for Grand Lake St. Marys adds the ecological services and economic component, as such this model is further described as a Conceptual Ecosystem "Revitalization" Model or CERM.



Attributes and Performance Measures - Attributes are indicators of the condition. While a wide distribution of attributes may be available, the most effective approach is a simplified list that best represents the particular system of interest, and in the case of a restoration effort, the strategies to be implemented. Performance measures are the specific items that will be measured over space and time to detect system response. The attributes and performance measures follow logically from the goals and objectives. Data generated from the performance measures is the key component for informing decision making in the Adaptive Management Process.

The performance measures selected for the GLSM CERM sought to assess the influence of the CRAs on both the Environmental Quality and Economic Climate of the system. Eleven performance measures were established as follows:

ENVIRONMENTAL QUALITY

- Microcystin Concentrations – the concentration of microcystin the in water in ug/L as an indicator of blue green algal production
- Habitat Suitability Index – Metric of habitat quality (metric not developed).
- DO – Dissolved oxygen concentrations as an indicator of biological integrity
- Clarity – Depth of light penetration into the water as measured by a Secchi disk as an indicator of algal growth and density
- Nitrogen – concentration of Kjeldahl nitrogen measured in mg/L as an indicator of the key nutrient in the system that drives algal growth
- Phosphorous – concentration of dissolved phosphorus measured in mg/L as an indicator of key nutrient in the system that drives algal growth
- Total Organic Carbon – concentration of organic carbon as an indicator of algal volume in the water

ECONOMIC CLIMATE

- Number of Jobs – total number of jobs in the region as an indicator of growth
- Median Income – as an indicator of job value and growth
- Sales Tax – as an indicator of economic activity in the region
- Gross Revenues – as an indicator of total economic value

Performance monitoring of SP as defined by the CERM, was limited by available funding to specific CRAs, academic research and economic activity data. However, this information provides important insights regarding the effectiveness of the SP implementation related to improvements in the Environmental Quality/Conditions and the Economic Climate within the lake.

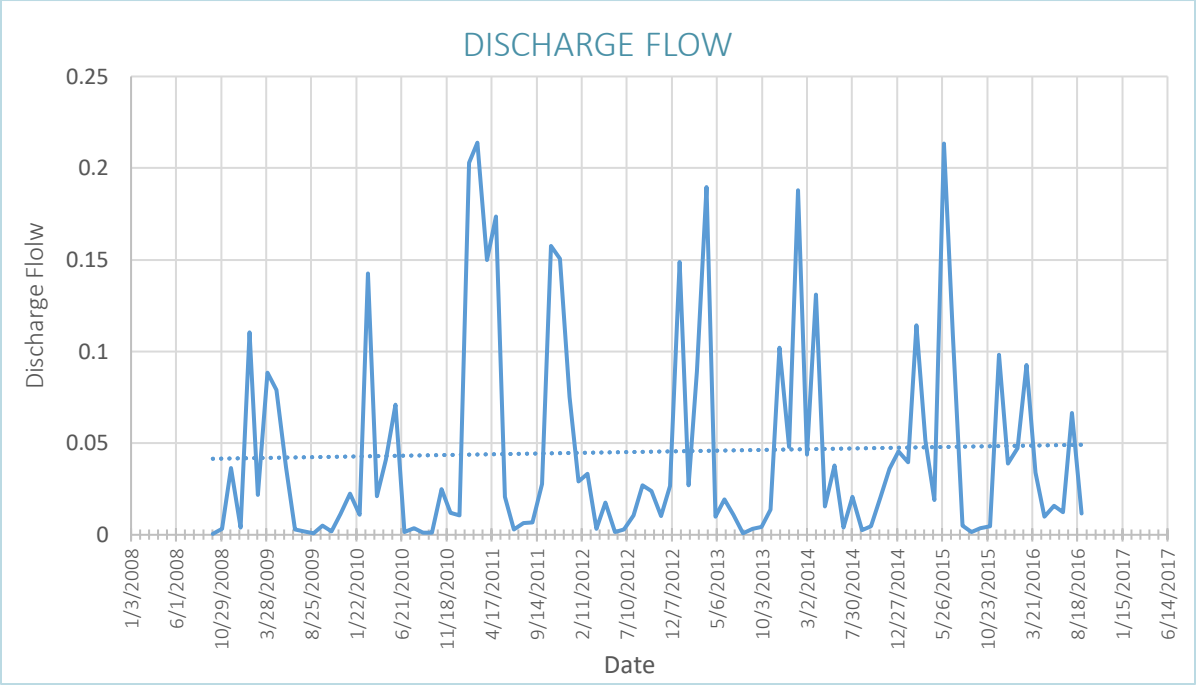
ENVIRONMENTAL QUALITY - Specific monitoring of watershed data and implemented BMP's show improving trends.

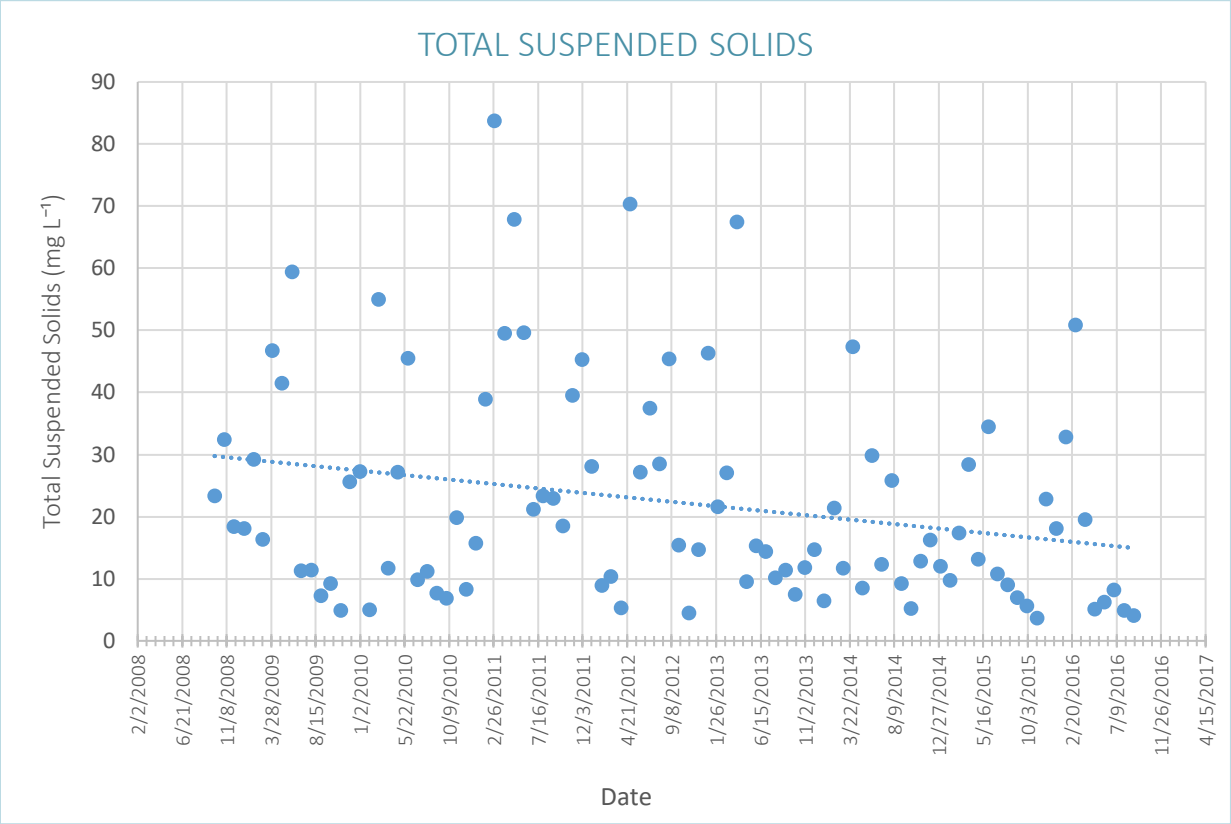
- Watershed Water Quality - Following the Distressed Watershed designation in 2011, a series of watershed regulations and management items were phased in to advance the process of mitigating nutrient runoff to reduce external loading. As part of these regulations a manure application ban specific to frozen ground was implemented. Beginning in 2013 this manure application ban was expanded from pertaining to frozen ground to also include a blanket no application rule regardless of field conditions extending from December 15 to March 1. Frozen ground was specifically focused on as this is a particularly susceptible time for runoff to occur as ground permeability and

vegetative uptake/adsorption rates are decreased. Analysis was conducted to quantify nutrient and sediment concentrations and loading before and after the ban. Long term water quality monitoring data spanning 2008 to 2016 from Chickasaw Creek (National Center for Water Quality Research) was used to describe general temporal trends in total suspended solids (TSS), particulate phosphorus (PP), soluble reactive phosphorus (SRP), nitrate (NO3−), and total Kjeldahl nitrogen (TKN) in relation to the manure application ban. The analytical approach employed controls for flow dependent measurements and compared nutrient runoff concentrations and rates at low, medium, and high flows (equal percentiles) before and after the initial phase of regulations beginning in 2011. In summary, when comparing the winter period (Dec. 15 – Mar. 1) before and after the ban, nutrient loadings were strongly decreased across nutrients and flows. TSS changes ranged from no change at low flows to 36% to 29% decreases at medium and high flows. PP changes ranged from 55% to 57% to 46% reductions at low, medium, and high flows. SRP changes ranged from 48% to 28% to 18% reductions at low, medium, and high flows. NO3- changes ranged from 1% to 16% to 19% reductions at low, medium, and high flows. TKN changes ranged from 39% to 42% to 36% reductions at low, medium, and high flows. These changes indicate that the highest reductions occurred during the periods of highest flows, indicating significant reductions in external loading. Interestingly, many of these decreases in nutrients also continued into the spring, summer, and fall months. However, numbers were far more variable outside of the ban period (Mar. 2 – Dec. 14) and are the subject of continued study as additional nutrient mitigation and reduction techniques and approaches are employed. This study documents an important trend during a particularly problematic time period and monitoring efforts are ongoing.

Jacquemin SJ, Johnson LT, Dirksen TA, McGlinch G. 2017. Changes in water quality of Grand Lake St. Marys watershed following a manure application ban. *Manuscript Submitted for Publication*.

In support of the this assessment, water quality monitoring data for Chickasaw Creek from Heidelberg University's National Center for Water Quality Research (below) shows the improving trends in Nitrogen and Phosphorous described by Jacquemin et al.




TOTAL SUSPENDED SOLIDS
Total Suspended Solids (mg L⁻¹)
90
80
70
60
50
40
30
20
10
0
2/2/2008
6/21/2008
11/8/2008
3/28/2009
8/15/2009
1/2/2010
5/22/2010
10/9/2010
2/26/2011
7/16/2011
12/3/2011
4/21/2012
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1/26/2013
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7/9/2016
11/26/2016
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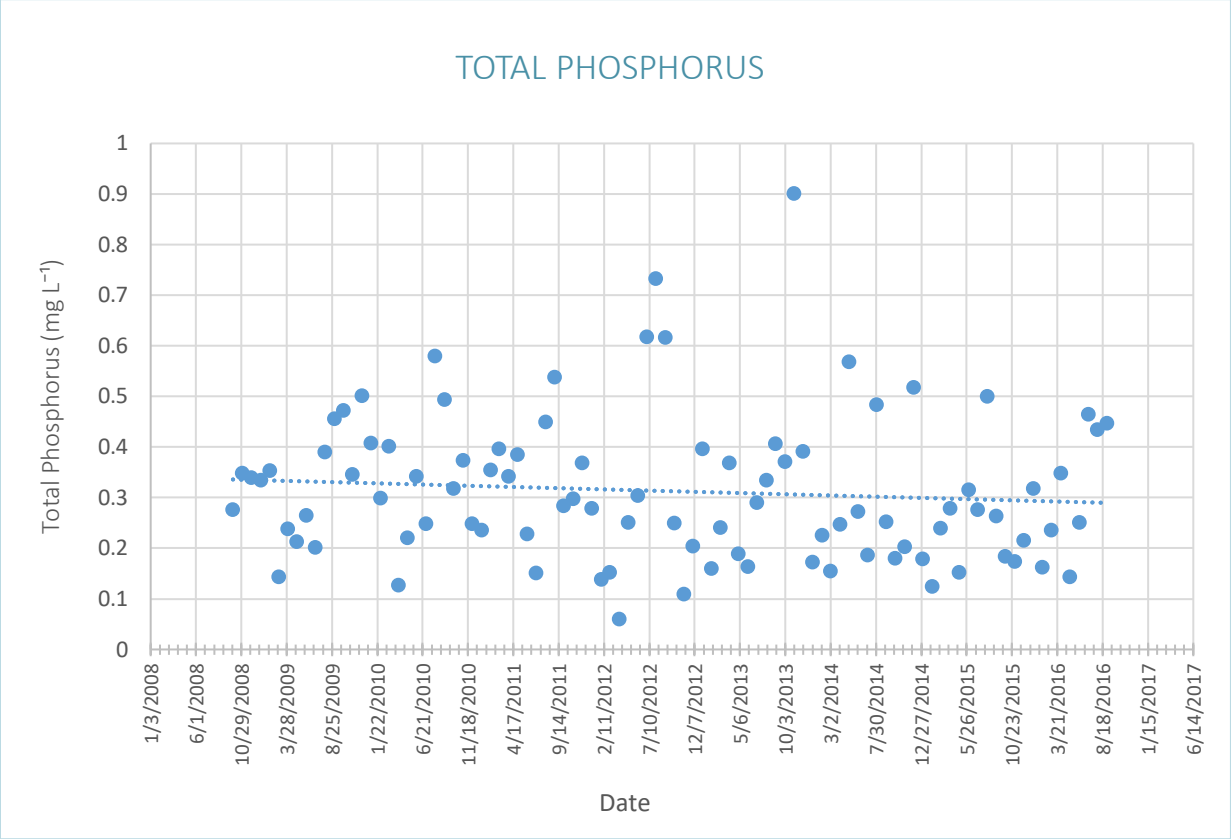
Date


TOTAL PHOSPHORUS
Total Phosphorus (mg L⁻¹)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/3/2008
6/1/2008
10/29/2008
3/28/2009
8/25/2009
1/22/2010
6/21/2010
11/18/2010
4/17/2011
9/14/2011
2/11/2012
7/10/2012
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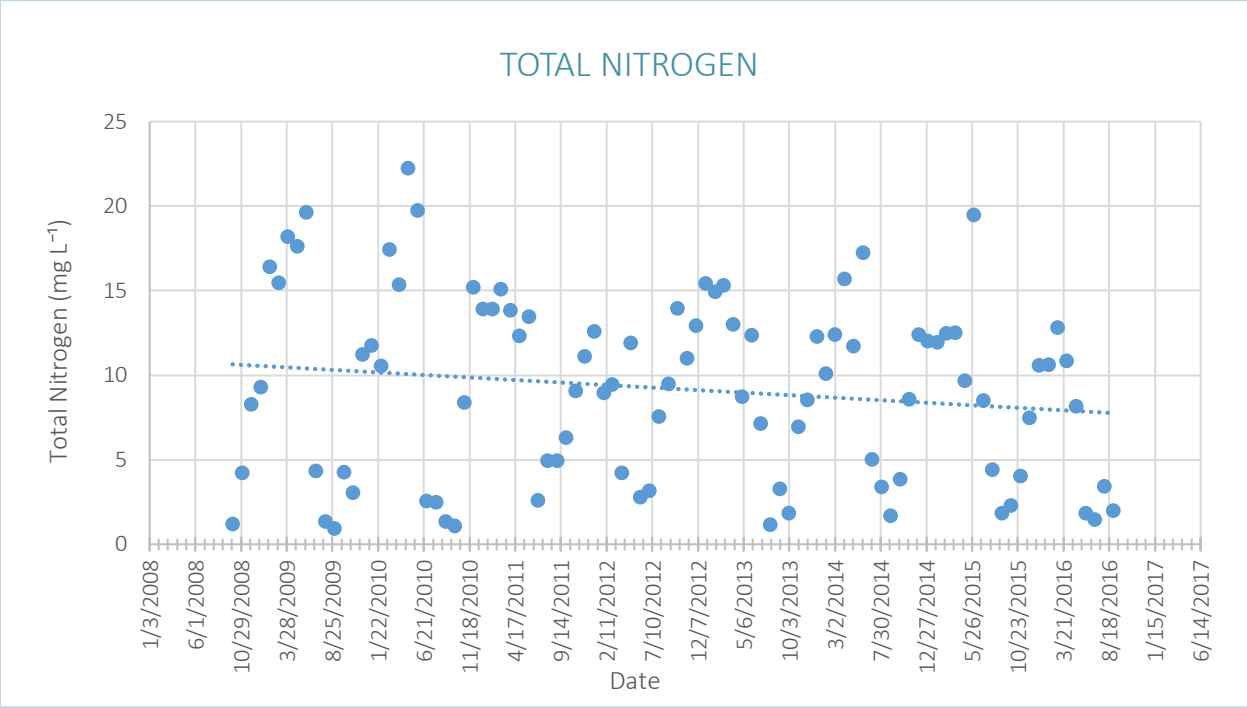
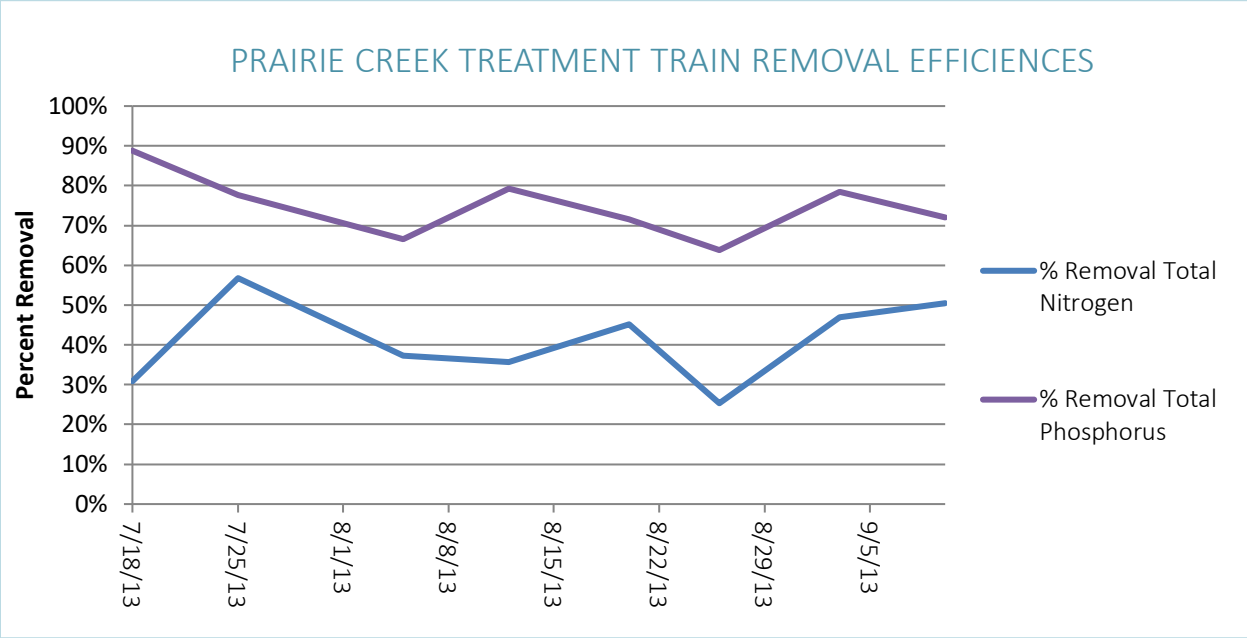


- Prairie Creek Treatment Train (PCTT) - The PCTT consists of a series of four in-line components, including a wetland treatment system that are synchronized to provide significant water quality improvements with this system. The innovative application of these components stems from the integration of engineered, biotechnical, and natural systems as an "engineered ecosystem" to address degradation of a natural system as part of an overall Adaptive Management Framework.

  The system functions by conveying raw water via an intake, lift station and force main at a maximum rate of 1.3 million gallons per day to the wetland treatment system. The intake is located at the intersection of the free flow of Prairie Creek and the backwater of GLSM. The treatment system originates with a Mobile Alum Injection Device, which regulates the flow of water through the system and allows for the injection of alum to remove particulate and dissolved constituents in advance of the treatment wetland to maximize the efficiency.

  The system was commissioned and placed into operation in June of 2013. Water quality monitoring of the system documented an average removal efficiency of 31% and 71% for nitrogen (NO2-N, NO3-N, NH3-N) and phosphorus (P04) respectively, (Mercer SWCD – Abbey Hayward, Brookside Laboratories) resulting in water quality improvements, a shift in the trophic state of the embayment and resurgence of natural vegetation. The system has been responsible for the re-establishment of 55 acres of littoral wetlands, which have provided integral contributions to these improvements in water quality.

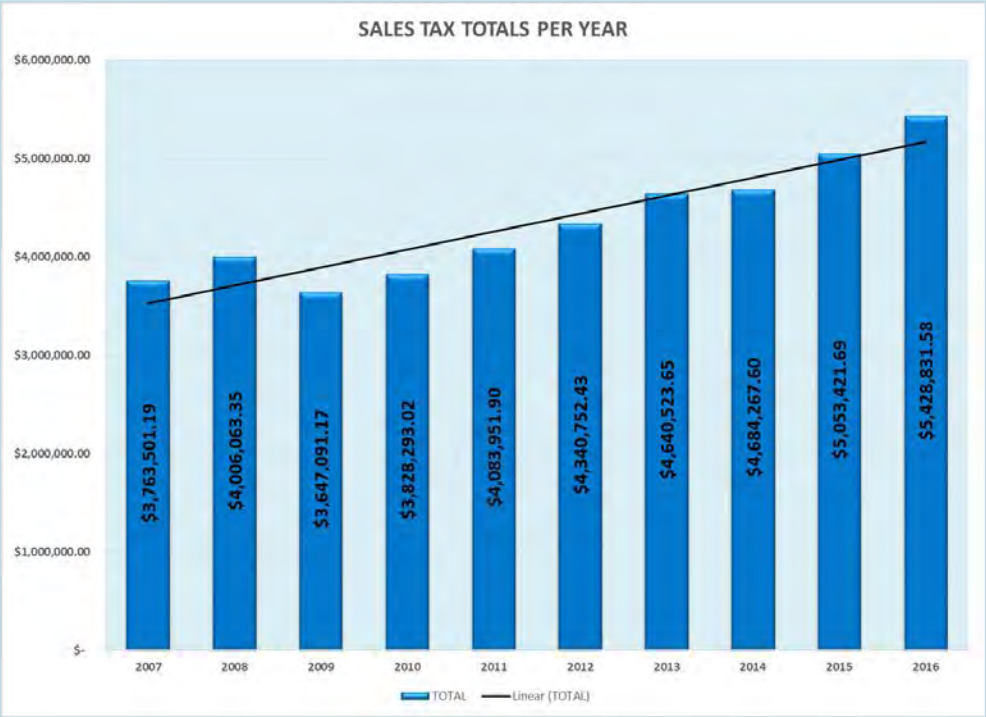
  Pfeiffer JJ, Overcash CL, 2014 Surface Water Quality and Ecosystem Restoration. Water Environment Federation; WEFTEC Conference Proceedings.



ECONOMIC CLIMATE - Metrics of the economic climate in the region from 2008 to present indicate improved conditions. These successes are an outward representation of the effects of investments made into the restoration of GLSM and the proof of concept of how coordinated support between federal, state and local agencies in conjunction with local stakeholders yields jobs and economic growth.

LOCAL ECONOMY

- Sales Tax Revenue has been steadily climbing year after year with 2016 being a record year for Mercer County Sales Tax Revenue.



BUSINESS DEVELOPMENT

- Mercer County was named a top 15 Micropolitan County for 2015 and a top 10 Micropolitan County for 2016 in the US
- Approximately $132,000,000 invested in new businesses primarily focused on the manufacturing, industrial, and food processing industries
- Approximately 2,700 new jobs created as a result of the development projects
- Mercer County has consistently had the lowest unemployment rate in the State of Ohio since 2011

Approximately
2700
New Jobs

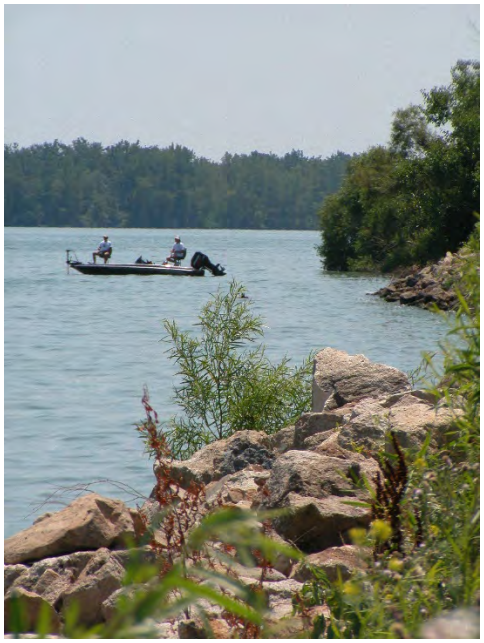
Approximately
$132 M
Invested in new businesses

TOURISM/RECREATION

- Tourism related income increased by 75%
- Local jobs supported by tourism dollars has increased by over 1,500

Tourism Income
75%
Increase

Local Jobs
1500
Increase



2. Strategic Plan Updates

The Strategic Plan was developed as a coordinated response to environmental deterioration of GLSM and the economic stresses placed on the region as a result of those changes in the lake ecosystem. The objectives of the plan are still valid as adopted in the SP. Updates to SP have been made based on a review of plan achievements, failures, system response, regulatory change, and economic climate, the nexus of which is this Adaptive Management Plan (AMP 2017). These updates will foster the continued implementation of SP.

2.1. OBJECTIVES

Six objectives were established in support of achieving the goals of the SP. Review of these objectives verified their continued validity for the AMP. However as the plan has matured, additional objectives are warranted based on the knowledge derived from the review of the CERM. As such, Infrastructure Management has been added as an objective and Design/Implementation was renamed as Water Quality Improvement. The revised list of objectives is as follows:

- WATER QUALITY IMPROVEMENT – Carry forward the identification and implementation of coordinated actions that will lead to the improvement of water quality restoration of the lake ecosystem.
- STUDY/DOCUMENT– Promote the application of science and economic re-development analyses to understand the stressors impacting the environmental and economic systems in and around the lake. These effects will be documented to promote the most appropriate technologies and cost effective solutions with the most far reaching benefits.
- COORDINATE – Provide a basis of interaction to coordinate and integrate the efforts experiences and resources of state, federal, private and business interests to achieve consensus on issues and solutions to realize a synergistic effect.
- PUBLIC OUTREACH – Establish open lines of communication to inform, educate and understand the needs and objectives of those who live within the ecological context of the system and holistically carry the message on to the overall populace.
- ECONOMIC REVITALIZATION - Seek funding to implement projects through grants, sustainable business opportunities, contributions, state/federal initiatives, and re-inoculate the economic drivers of the region. Funding mechanisms within the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers (USACE), Ohio Department of Environmental Protection as well as through other nonprofit resources will be pursued as part of these coordinated efforts to effectively provide the greatest environmental and economic benefits for the lake.
- INFRASTRUCTURE MANAGEMENT – Manage the natural and man-made infrastructure to maximize its effectiveness on the lake ecosystem.

2.2. CRITICAL RESPONSE ACTIONS (CRAs)

Associated with each objective are specific action items to initiate and maintain progress toward achieving the strategic goal. These actions provide the fundamental substructure necessary for the implementation of specific project opportunities designed to improve the physical condition of the lake and the surrounding economy. These CRAs are presented below by objective.

COORDINATION

Numerous groups/organizations including Ohio Department of Environmental Protection, Ohio Department of Natural Resources, Ohio Department of Agriculture, Natural Resources Conservation Service, Grand Lake/Wabash Watershed Alliance (dissolved in 2016), Mercer and Auglaize Soil and Water Conservation Districts, Ag Solutions, Lake Improvement Association, etc. have been developing plans and implementing projects through a variety of funding sources in an effort to stem the degradation of Grand Lake St. Marys. These efforts have focused primarily on the objectives delegated to the specific organization. Redundancy and a lack of integrated planning of projects influence the efficiency, scale of funding and support that could be achieved through a consolidated effort. Interlinking of the objectives to present a comprehensive front is necessary to synergize the overall work and allow for effective support at the federal, state and local government level.

Action Items

1. Promote the development of sustainable business practices and provide economic incentives to promote growth in the region's most directly impacted by the lakes condition. Such as TIF and Enterprise Zones.

2. Promote revisions to local land use practices to reduce activities that promote nutrient loading into the lake or its tributaries in concert with state actions.

PUBLIC OUTREACH

The regional scale of effect, which involves both the degradation of the lake as a resource and as a local and regional economic driver, influences and expands the realm of the stakeholders beyond that normally associated with a single degraded resource. As such, the integration of stakeholder comments and concerns is critical to the process of developing actions, strategies and solutions as a means to manage and distribute information about the activities and progress of the plan and the commission. An information management system will be established to provide an interface for stakeholders to maintain a continuous portal for education and feedback.

Action Items

1. Establish and maintain a comprehensive communications plan to integrate stakeholders ideas and provide continuous flow of information.

2. Develop educational programs to promote grass roots understanding of lake degradation issues for elementary, secondary and public audiences.

3. Establish and implement a comprehensive fundraising plan to support the objectives of the Strategic Plan.

4. Develop a plan and provide recommended actions to integrate the historic Miami & Erie Canal system and associated districts with the GLSM system.

5. Re-establish the public connection with the lake as a recreational destination for swimming and water contact sports through improvement of facilities and available opportunities.

STUDY/DOCUMENT

The availability of information and data to establish baseline conditions for measuring successes and providing supporting evidence for potential funding opportunities is currently a limiting factor. In addition the "value" of the lake to the region, though recognized, has not been fully accredited in the

restoration process. Critical data which provides the basis for determining the effect of various management techniques to support restoration opportunities is missing. Economic and scientific data should be collected to act as a metric for measuring success of the work being conducted and will provide critical baseline information to formulate and act on technological solutions. In order for this data to be effective, it needs to be collected consistently over long periods of time to establish trend data and relate cause and effect. A Conceptual Ecosystem Revitalization Model (CERM) was developed to aid in this effort and covers both environmental and economic metrics for the GLSM system as a whole. Individual Conceptual Ecological Models (CEM) should be established for each Critical Response Action (CRA) that share environmental metrics to allow their individual contribution to be assessed.

Action Items

1. Refine, initiate and monitor environmental and economic data designated by the CERM.
2. Establish and monitor an interlinked series of CEMs for CRAs implemented by the AMP
3. Evaluate new technologies and solutions to determine potential effectiveness for utilization as CRA's.

ECONOMIC REVITALIZATION

The creation of economic opportunities that establish sustainable actions which have the ability to fuel the local economy while resolving the causes and sources of the lake degradation are a key component to restoring the economic viability of the region. The creation of a "restorative economy" through the development and application of market-based solutions and innovative funding mechanisms, will be critical and necessary. The diversity of multiple funding sources and partnerships, each targeting aspects of the problem from different angles and approaches, will over the long haul fuel comprehensive and sustainable financial and ecologic solutions for the lake region.

To support the development of infrastructure needed to promote a "restorative economy", legislation, laws and policies that will help manage risk, and encourage/support the private sector will be established. This framework will create markets for building the critical mass necessary to attract sufficient financial and technical influxes which will influence landscape level improvements. Four different strategies will be utilized to initiate, establish and sustain the economic initiative focused on restorative processes.

Action Items

1. Evaluate highest priority projects and prepare prospectuses as to the economic development value that will be realized from implementation. Convert data into a business plan based on the best financial avenues to provide funding for implementation.
2. Seek legal/legislative approval and assistance to establish economic implementation strategies within the Grand Lake St. Marys special use districts.
3. Develop supporting economic studies and valuations to substantiate business prospectuses for development which will promote economic implementation strategies.
4. Establish a Natural Resources Capital Improvement Program and supporting economic justification for the creation of Natural Resource Tax Increment Financing.
5. Initiate and foster the development of at least one sustainable business enterprise within the watershed that aids in treating critical stressors in the ecosystem.

WATER QUALITY IMPROVEMENT

The planning and implementation of projects specifically designated to reduce in-lake and watershed nutrient loading as the primary drivers to restore the lake.

Action Items

1. Continued development of Treatment Trains and littoral wetland systems.
2. Development of in-lake features as protection for littoral wetlands and against shoreline erosion.
3. Implementation of plan to facilitate the removal of rough fish through interface with private enterprises.
4. Foster increased placement of Watershed Best Management Practices including, but not limited to: tile drain controls, cover crops, watercourse buffers.
5. Develop a regional organic waste management program to collect, treat and dispose of animal waste and high phosphorus dredged material.
6. Promote management of channel water.
7. Maintain current nutrient management plans on all livestock farms in the watershed that meet the Distressed Watershed Rules requirements.

INFRASTRUCTURE MANAGEMENT

Manage the natural and man-made infrastructure to maximize its effectiveness on the lake ecosystem. During the first 6 years of the SP, significant work has been completed in developing infrastructure to address the primary stressors affecting the lake. Continued and coordinated effort is required to operate this infrastructure to its maximum benefit.

Action Items

1. Develop a man-made infrastructure management plan to operate and maintain developed infrastructure i.e. Treatment Trains, watershed BMP's, Wastewater Treatment Plant

Develop a natural infrastructure management plan through i.e. water levels, littoral wetlands, etc. to maximize effectiveness.

2.3. CRITICAL IMPLEMENTATION PRIORITIES

Within the identified CRAs a specific subset is identified as critical to the current and future success of the AMP. Therefore these items have been further vetted and refined for priority consideration and immediate action.

1. Treatment Trains and Littoral Wetland Systems

Purpose: Treatment Trains have been demonstrated to provide significant benefits in achieving nutrient reduction goals. The operation of Prairie Creek Treatment Train to remove Nitrogen and Phosphorus from the lake and stream inputs in support of re-establishing functional littoral wetlands systems has been proven. Prairie Creek Treatment Train showed a 31% and 71% removal efficiency for Nitrogen and Phosphorus respectively. In addition, spatial coverage of vegetative biomass in the

supported littoral wetland area increased by approximately 80% in three years of operation.

Action: Establishment of Treatment Trains and littoral wetland systems on each drainage stream contributing to the lake.

2. Rough Fish Removal

Purpose: The carp population in Grand Lake St. Marys impacts ecosystem processes and creates self-perpetuating and expanding issues with eutrophication. GLSM has a population of carp estimated between 250 and 500 lbs/acre which contributes 1,000 to 2,000 lbs of phosphorus to the lake's internal loading annually. Significant progress has been made toward the eradication program by allowing commercial removal of the population. In 2015 ODNR granted permission to commercially harvest carp from the lake. In addition the LFA contracted to radio tag and track the carp to identify winter concentration areas.

Action: Netting of the carp has been restricted by underwater obstructions in the winter concentration areas. Removal of underwater obstructions in defined areas is warranted to facilitate the continued implementation of this program. Reestablish commercial fishing permit and continue carp removals on a regular basis as concentration areas are cleared of obstructions.

3. Re-establish the public connection with the lake as a recreational destination for swimming and water contact sports

Purpose: Grand Lake as a destination for water contact recreation has been impacted by water quality concerns. As a result, a change in frequency of use of the lake for contact recreation has been recognized. This trend can create long term impacts that may have significant effects on tourism revenue. Re-establishment of community/cultural connections focused on utilization of the lake can be initiated through improvement of lake facilities designated for water contact and localized improvement of water quality.

Action: Establish a designated beach area for swimming and base of operations for water contact sports, through creation of enhanced facilities; shoreline beach augmentation, recreational equipment, localized augmented water quality improvements, and improved access.

4. Watershed Best Management Practices

Purpose: Watershed inputs to the lake influence the water quality of the system. Significant progress has been made to decrease nutrient loading from the contributing watersheds.

Action: Implement recommendations of 9 Element Plans for Beaver and Chickasaw Creek and develop additional 9 Element Plans for all contributing watersheds draining to GLSM. Continue to research new and upcoming edge of field Best Management Practices, and maintain current Nutrient Management Plans on all livestock farms within the watershed that meet the Distressed Watershed Rules criteria.

5. In-Lake Features Development

Purpose: The shape, orientation and depth of GLSM creates long fetch lengths that can lead to increased erosion on its periphery. Specifically shorelines and littoral wetland systems are susceptible to damage from wind driven waves. Development of in-lake features which limit fetch length and deflect wave energy can have a significant improvement on near shore erosion and water quality.

Action: Strategically develop in lake features i.e. islands and near shore bars to protect littoral wetlands and shoreline features. Restore/reshape shoreline areas to provide resistance to wave erosion.

6. Management of Channel Water

Purpose: Numerous channels that serve residential communities are found on GLSM. Channel waters are not exposed to the same environmental conditions (wind, waves, mixing) as the main body of the lake. As such water quality can deteriorate more rapidly in these areas impacting public health and community opinion of overall status of lake health. Management of water quality in channels provides a recognized outlet for community interface with lake management and can resolve perceived threats to public health.

Action: Expand opportunities for channel water management by providing landowner education, assistance and pre-approved management options for implementation.

7. Natural/Man-Made Infrastructure Management

Purpose: Since the development of SP, significant amounts of infrastructure have been developed to address and/or support the reduction of nutrients in the system. This infrastructure requires coordinated operation and maintenance to provide maximum benefit to the system.

Action: Develop an operational plan and budget to assure the maximum benefit potential of the existing and proposed infrastructure projects can be realized.

8. Monitoring, documentation and modeling of scientific data

Purpose: Effective decision making for implementation of the AMP relies on developing and analyzing data for both the individual CRAs as well as the response of the system as a whole.

Action: Establish a defined monitoring program to collect long term data and engage academia to provide insight and understanding of the data. Establish a predictive response model for the system to aid in decision making.

9. Beneficial Use of Organic Waste

Purpose: Provide alternative use for organic waste and high phosphorus dredge material in the watershed which will limit inputs into the system as a non-point source

discharge, in addition to establishment of a revenue producing business in the locality.

Action: Create economic incentive package to attract private development and investment. Continue to demonstrate different technologies through pilot projects focused on both agricultural wastes and dredge material.

2.4. PERFORMANCE MONITORING

The CERM, as currently established, focuses on the Environmental Quality and Economic Climate of the system as a whole. The performance measures though useful in assessing the response of the system to CRAs, lacks sensitivity due to a large variance in scale between the individual CRAs and the system. As such, the true performance, effect and response on the system is difficult to assess. To address this deficiency, a Conceptual Ecosystem Model (CEM) for each CRA will be developed, and monitoring of the associated performance measures will be conducted in concert with the monitoring of the CERM performance measures. CRA specific CEM's should seek to include performance measures utilized in the CERM as described below and support assessment of the key drivers and effects.

ENVIRONMENTAL QUALITY

- Microcystin Concentrations – the concentration of microcystin the in water in ug/L as an indicator of blue green algal production
- Habitat Suitability Index – Metric of habitat quality (metric not developed).
- DO – Dissolved oxygen concentrations as an indicator of biological integrity
- Clarity – Depth of light penetration into the water as measured by a Secchi disk as an indicator of algal growth and density
- Nitrogen – concentration of Nitrates and Kjeldahl nitrogen measured in mg/L as an indicator of key nutrient in the system that drives algal growth
- Phosphorous – concentration of dissolved/particulate phosphorus measured in mg/L as an indicator of key nutrient in the system that drives algal growth
- Total Organic Carbon – concentration of organic carbon as an indicator of algal volume in the water

ECONOMIC CLIMATE

- Number of Jobs – total number of jobs in the region as an indicator of growth
- Median Income – as an indicator of job value and growth
- Sales Tax – as an indicator of economic activity in the region
- Gross Revenues – as an indicator of total economic value

Appendix A – Actions Implemented Chronology

Accomplishments and Partnerships

Since development of the GLSM Consolidated Action Plan and the Strategic Plan, the Commission has fostered and participated in partnerships with governmental, nonprofit, private and research entities to compile and calibrate information, continue ongoing work and compose the best and most sustainable solutions for the lake. These entities offer the most current research and/or experience in water quality and economics directly related to the issues of Grand Lake St. Marys:

Environmental Consulting Businesses

KCI Technologies, Inc.
Mad Scientists, LLC
Access Engineering Solutions
Tetra Tech Inc.

Government Agencies (Local, State, and Federal)

Auglaize Soil and Water Conservation District (Auglaize SWCD)
Clean Ohio Green Space Program
Grand Lake Wabash Watershed Alliance (dissolved in 2016)
Mercer Soil and Water Conservation District (Mercer SWCD)
Mercer County Ag Solutions
Natural Resources Conservation Service (NRCS)
ODNR – Division of Soil and Water Resources (DSWR)
Ohio Department of Agriculture (ODA)
Ohio Department of Health (ODH)
Ohio Department of Natural Resources (ODNR)
Ohio Environmental Protection Agency (OEPA)
U.S. Department of Agriculture (USDA)
U.S. Army Corps of Engineers (USACE)
U.S. Environmental Protection Agency (USEPA)

Research/Educational Institutions

Ball State University
Battelle Memorial Institute
Bowling Green State University
Findlay University
Heidelberg University
Ohio Northern University
Ohio State University
University of Dayton Research Institute
University of North Carolina – Institute of Marine and Environmental Sciences
Western Ohio Educational Foundation
Wright State University Lake Campus

These partnerships are intended to provide the best information and technological advancements to support physical, biological and environmental integrity of lake and surrounding watersheds. The intent of the Commission is to evaluate and build from these resources to deliver the most effective long term

economic solutions. The Commission supports this integrated approach as a unified platform for the future economic sustainability and health of Grand Lake St. Marys and her communities.

Accomplishments through December 2010

- Engaged Educational Teams to promote conservation and nutrient management practices in the watershed with over $1.5 million in incentive funds for operators of producers.
- Initiated pilot testing and partnership with EPA, ODNR and established partnerships / research support from Ohio Northern, Bowling Green and Heidelberg Universities.
- Established legislative representation through a lobbyist and formation of a legislative committee to promote statewide awareness of restoration progress and to recruit funding for continued research and lake improvements.
- Initiated a water quality monitoring program in partnership with Wright State University, MAD Scientist Inc. and the Battelle Institute to develop baseline data and monitor progress toward lake restoration.
- Contracted work with watershed / lake experts, KCI and Battelle Institute, to develop a scientifically based lake restoration plan and specific strategic action items.
- Lake Improvement Association monthly meetings have been educating the public on GLSM issues and actions to improve it.
- Continue to hold public meetings and provide media access through radio, website and newspaper vehicles. Most recent public meeting held October 2010.
- Established website for the Strategic Plan, and provided opportunity for public comment.
- Initiated investigation to develop options for financial assistance to mitigate business and industry losses.
- Initial fundraising of over $915,000 supported by Mercer County Civic Foundation and St. Marys Community Foundation.
- Applied for and received EPA SWIF Grant of $60,000 for Airy Gator to add constant aeration to sediment layers of the lake. Airy Gartors in Park Grand and Southmore shores have been installed.
- Applied for and received an EPA 319 Grant Award of $485,000 for In-Stream Treatment Train and Floating Wetlands in the Prairie Creek Watershed.
- Installed three Streamside Collection Units in Big Chickasaw, Beaver Creek and Barnes Creek
- Installed water quality monitoring station on Big Chickasaw Creek
- Coordinated with State of Ohio to conduct test dosing of alum in preparation for full scale application in 2011.
- Coordinated with State Ohio to conduct Silica/Micro Nutrients algal flipping test

Accomplishments and Progress 2011-August 2017

- **Developed the GLSM Consolidated Action Plan (CAP)**: The LRC developed CAP in January 2011 in an effort to coordinate the economic, water quality and public health/welfare actions and provide a unified agency and organizational approach to the environmental and economic revitalization of the GLSM region.

- **Establishment of the Lake Facilities Authority (LFA):** In 2013 the LFA for Grand Lake St. Marys was legislatively established to provide a funding source and managing authority for improvements through establishment of local taxes, etc. Through this authority a full time lake manager was hired to oversee, manage and coordinate progress of the Strategic Plan implementation. This position remained in place until 2016.

- **Chemical Alum Treatments:** Chemical Alum treatments were administered via contract by the State of Ohio through ODNR for experimental test coves and the larger lake area in 2010, 2011 and 2012. Smaller more localized alum applications were also issued and found to be effective through Treatment Train Systems implemented and applied within Prairie Creek.

- **Dredge Sediment Depositions**: Through ODNR, dredging occurred in 2011, removing 272,000 cubic yards, in 2012, removing 289.861 cubic yards, and in 2013, 302,226 cubic yards were dredged. In 2014, 232,000 cubic yards of dredging material were collected and relocated and in 2015, 364,590 cubic yards and in 2016, 405,523 cubic yards of deposition were dredged and removed. The largest challenge with this effort is disposal of spoils.

- **Beneficial Use of Organic Waste**: A proposal for a Methane Digester was considered as an alternative use for manure products in the watershed, however action on this item was restricted by local interest and by technology and should be re-evaluated in future planning priorities as a revenue producing business in the locality. Several technologies are still being investigated.

- **Treatment Train Establishment:** Three Treatment Trains (TT) Systems have been established and are operational on Prairie, Coldwater and Beaver Creeks within the watershed. Prairie Creek is an engineered system that includes a Mobile Alum Injection Device as well as extensive constructed and restored wetlands, Coldwater Creek is also an engineered system, similar to Prairie Creek TT but larger. Both of these projects are operational and have successful preliminary results. Scheduled to be completed in the fall of 2017, Beaver Creek is a Biofilter Complex using level spreaders and riffle grade controls to help with sediment attenuation. Beaver Creek/Prairie Creek TTs were funded by the 319 Program. Coldwater Creek/Big Chickasaw Creek TT are funded through state appropriations.

- **Rough Fish Removal:** ODNR has recently issued permits to a commercial fisherman to assist with rough fish removal and Wright State University is working to identify and monitor the honing locations to best net the fish. Since 2011, several tons of rough fish have been removed by ODNR and through rough fish derbies.

- **Algal flipping:** In 2010, Ohio Department of Agriculture funded a small algal flipping pilot to attempt to turn harmful cyanobacteria into a nonthreatening species. The harmless algae was then

to be harvested for use in biofuels and other products, however no conclusive evidence supports the continuation of these strategies for the improvement of the lake.

- **Aeration and Circulation:** In early 2011 the LRC contracted with Battelle to conduct an artificial circulation / aeration testing study to evaluate effectiveness of this treatment. The results and benefits from these implements indicated potential localized DO level and Redox Potential Discontinuity improvements within a protected area, however lakewide application results of further application are currently inconclusive based on applications in large lake systems within other states. Linear Aeration has been installed in many channels and these implements have improved water quality.

Implementation and New Participation in Multiple Best Management Practices (BMPs) Plans and Projects: Through both the Watershed Action Plan and the Strategic Plan, many BMPs have been implemented and many more are underway. More than ten million dollars was provided by NRCS to livestock and farming operations in the Grand Lake Watershed during this timeframe. Applications have included cover crops, tillage transects, development and implementation of numerous Nutrient Management Plans (some associated with the new Distressed Watershed designation of GLSM), milkhouse waste containment, the implementation of filter strips and innovative manure containment, treatment and application technologies, septic system corrections and improvements, and a fertilizer and chemical lawn application soil testing program have been implemented. Refer to: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/oh/programs/?cid=nrcs144p2_029521 for details on these projects. In addition, all farms generating more than 350 tons or 100,000 gallons of manure per year now have a current Nutrient Management Plan. There have been multiple manure storages, feedlot covers and other on-farm improvements made since 2009.

- **Establishment of Ag Solutions:** In March 2016, the Mercer County Commissioners funded a full-time Ag Solutions Coordinator that is housed in the Community & Economic Development office. Ag Solutions researches alternative methods of manure management, nutrient concentration, solid-liquid separation and researching edge-of-field practices that can improve water quality. Much of this research is being completed in conjunction with Wright State University-Lake Campus and The Ohio State University.

- **Development of the Beaver Creek and Chickasaw Creek Nine Element Watershed Plans:** Ag Solutions, along with Mercer SWCD, spear headed the development of these plans which are critical and required in applying for 319 funding for future water quality improvements. The Beaver Creek and Chickasaw Creek Plans were submitted to US EPA in April 2017 and the Beaver Creek Plan was approved on June 7, 2017 and Chickasaw Creek Plan was approved on June 29, 2017.

Appendix B – Five Year Schedule

		2017				2018				2019				2020				2021				2022				2023			
Action	Objective	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	Coordination																												
1	Establish Special Use Districts																												
2	Revise Land Use/Zoning Regulations																												
	Public Outreach																												
1	Establish and maintain a comprehensive Communications Plan																												
2	Develop and Integrate Educational Programs																												
3	Establish and Implement Fund Raising Program																												
4	Integrate Miami & Erie Canal system into system																												
5	Re-establishe public connection to lake for water contact sports																												
	Study Document																												
1	Define, initiate, monitor scienctific data and model																												
2	Establish CEM's for each CRA and monitor																												
3	Evaluate new technologies and solutions to lake issues																												
	Economic Revitalization																												
1	Prepare business plan/prospectuses																												
2	Legal/legislative approvals																												
3	Conduct Economic Studies for Prospectus Valuations																												
4	Develop Natural Resources Capital Improvement Program																												
5	Institute Sustainable Business Enterprise																												
	Water Quality Improvement																												
1	Treatment Train/Littoral Wetland Establishment																												
2	In-lake Feature Development																												
3	Rough Fish Removal																												
4	Watershed Best Management Practices																												
5	Benificial use of Organic Waste																												
6	Management of Channel Water																												
	Infrastucture Management																												
1	Man Made Infrastructure Management Plan																												
2	Natural Infrastructure Management Plan																												
	Yearly Total																												
	Contingency (10%)																												
	Total Yearly Funding Target																												

GRAND LAKE ST. MARYS RESTORATION COMMISSION

Contact Info:

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St. Marys, Ohio 45885

The goal of the GLSM Restoration Commission is to:

Provide a holistic blueprint for the sustainable environmental and economic renewal of Grand Lake St. Marys and its contributing watersheds through an approach that will motivate and coordinate stakeholders to increase the ecological and economic effectiveness of restoration activities. These efforts will also help lake communities realize their potential to improve and protect the natural and economic resources of the region.

Commission Members

Board of Auglaize County Commissioners
Board of Mercer County Commissioners
City of Celina
City of St. Marys
Grand Lake St. Marys State Park
Greater Grand Lake Visitors Center
Lake Development Corporation
Lake Facilities Authority
Lake Improvement Association
Mercer County Civic Foundation
St. Marys Community Foundation
Wright State University Lake Campus

Prepared By:

KCI