

Project Understanding

Appendix B

On a national level, there is significant concern regarding the potential impacts to water resources and public infrastructure systems due to projected climate change and associated extreme weather events (USDOE, 2012, NRDC 2011, USGS 2009). It is believed that the predicted changes will result in the increased occurrence of extreme weather, both precipitation and drought events. Scientists agree that warmer temperatures, altered patterns of precipitation and runoff will increasingly compromise our ability to effectively manage water supplies, as well as significant critical water, wastewater and stormwater infrastructure.

In Central Ohio, 85% of daily water usage is supplied by surface water according to the USGS (USGS, 2012). The anticipated climate shifts suggest that during the summer months a 10-15% decrease in precipitation will occur along with an increase in temperature and growing season thereby increasing the strain on the available water resources in the area, especially as some streams become dry and unusable during the summer months. However, during the winter months, an increase in precipitation of approximately 15-20% has been suggested. In addition, when precipitation does occur it will more likely occur more intensely and over a shorter period of time. The question to be answered is: will these changes occur in a manner that can be managed and used to assuage increased demands and decreased precipitation during the summer months? MORPC has begun to take steps to answer this question for the citizens in this region.

Water-related infrastructure systems are typically designed based on historical hydrologic data which is assumed to remain constant throughout the life of the infrastructure. Recent studies indicate that the assumptions about historic hydrologic patterns should no longer be relied upon for the design of water infrastructure (O'Neill, 2010), especially in light of recent extreme storm and drought events. Changes in precipitation and runoff patterns increase the uncertainty or risk related to our water supply sources, to water quality, to adequacy of our flood management structures and to the capacity of our stormwater and wastewater infrastructure systems and treatment facilities.

The impacts and disruptions to infrastructure systems from extreme weather includes not only direct costs associated with clean-up, repair and or replacement of the affected infrastructure but also the social, economic and environmental costs as supply chains are disrupted, economic activities are suspended or social well being of a community is threatened.

Extreme weather events, such as those that have occurred in the past decade, remind us of the effects as critical infrastructure systems are flooded or have become dysfunctional due to extended years of drought. Due to the interdependencies of our infrastructure systems associated with water, impacts may be to both the health of communities as well as to the local economic balance. A recent report by DOE (2012) on "Climate Change and Infrastructure, Urban Systems and Vulnerabilities" suggests that related system failures associated with extreme weather events will increase the threat to human health and local economies. However, these threats can be substantially reduced by developing and implementing appropriate adaptation strategies. One of the most common adaptive strategies is consideration of options to provide greater flexibility in system operation along with development of selective system redundancy.

MORPC has initiated a two-part study to address these issues through a modeling and planning process which includes:

- Evaluation of the potential impacts of climate change on the water resources in Central Ohio through hydrologic and hydraulic modeling of the watershed, and
- Development of adaptive management strategies to allow responsive actions to mitigate these impacts.

The study is being conducted on the Scioto River Watershed, upstream of the streamgage in Circleville Ohio. The drainage area of the watershed area is 3,217 square miles, representing nearly half of the total drainage area of the river.

For the first part of the study, the USGS has partnered with MORPC to develop a regional watershed rainfall-runoff model that incorporates a range of downscaled climate change scenarios as well as build out development scenarios. The USGS has used the HSPF model to simulate the existing streams and reservoirs and current land use development. The model has been calibrated using the USGS gages and reservoir storage and withdrawal records. In order to simulate the impact of climate change, downscaled regional climatic data was used to reflect a range of potential climate change scenarios.

This second part of the project, as presented in the RFP, consists of two phases. The first phase will include development of future water use projections for use in the USGS model, development of public education documents regarding water use within the basin and an overview of this project. This first phase will also include local stakeholder facilitation regarding the potential impact of climate change on the water resources and infrastructure in Central Ohio. The second phase of the project will allow MORPC and a regional stakeholder group to use the information from the model to evaluate potential alternatives and develop adaptive management strategies to ensure the presence of safe and reliable water resources and public utilities for the citizens in this region.

In order to provide MORPC with the best technical guidance relative to sustainable, long range water resource planning, BC plans to engage a Technical Leadership Advisory Panel, including our experts in water and wastewater master planning and climate change. This panel will meet via virtual meeting technology, bringing the most current knowledge on these subjects directly into the MORPC conference room to facilitate understanding and collaboration. We propose to hold one briefing meeting with our technical experts at the first stakeholder committee meeting during the first phase of the project. We will hold a second and possibly a third meeting as the project moves into the second phase of risk assessment and the development of adaptive management strategies. This team will share their knowledge from integrated water resource planning efforts and climate change projects from across the US, providing technical

expertise and added insights into approaches that work.

This project will include a comprehensive evaluation of the total water resources within the region, current and future uses and establish an integrated adaptive management plan for effective management of the water supply and critical water/wastewater infrastructure of Central Ohio.

BC will utilize the results of the USGS modeling to frame an understanding of the associated risks and vulnerabilities to our water related infrastructure. With this understanding, we will work with local stakeholders to develop adaptive management strategies for maintaining the function of critical infrastructure during a range of extreme weather events associated with climate change.

Scope of Work

Phase I

Task 1.0 – Stakeholder Advisory Committee

Critical to the success of this project is the development and engagement of an active and balanced Stakeholder Advisory Committee. The stakeholder committee meetings will be led by task leader, Lisa Jeffrey, in partnership with MORPC. Kristen Atha and Mo Wright will assist Lisa with stakeholder meeting facilitation. We understand that a Steering Committee was established during the USGS modeling task of the overall project by MORPC to review the USGS modeling, maintain understanding of the scenarios being evaluated and of the results and limitations of the different model evaluations. The voting members of this Steering Committee have been comprised primarily of representatives of those organizations who are contributing financially to the project.

BC will work with the MORPC staff to recommend additional members for this expanded adaptive management Stakeholder Advisory Committee. Stakeholders may include:

- Water providers
- Water users
- Industrial Community
- Agricultural Community
- Soil & Water Conservation Districts
- OEPA
- ODNR
- Environmental Advocacy groups
- Farm Bureau
- Local government officials
- Representatives from the development community

It is recommended that this committee meet on a bi-monthly basis during the first funded phase of the project (through Task 4.0, end of 2013). During the work on subsequent tasks, monthly meetings are recommended to facilitate consensus and input relative to risk assessment and adaptive management strategies. A draft schedule reflecting the stakeholder meetings and overall project deliverables is attached to this Scope of Work. A list of meeting dates, topics and responsibilities will be developed and provided to each committee member following the notice to proceed.

The Stakeholder Advisory Committee will review the output of the modeling project, discuss uses and needs for water resources within the watershed and then evaluate risks and system vulnerabilities related to the modeling scenario results. The committee will review and discuss the multiple uses and demands for water resources, as well as water quality constraints to use.

The BC task leader, Lisa Jeffrey will facilitate each meeting and lead the committee through the modeling approach helping to educate them regarding potential risks and system vulnerabilities associated with extreme weather events. Through an iterative process, the Stakeholder Advisory Committee will define current policies for reacting to storm/drought related conditions, define vulnerabilities and develop management strategies to mitigate this risk or vulnerability. BC will provide the unbiased leadership team required to develop the committee, lead the planning forum as well as to produce the necessary long-range planning guidance documents.

Task 2.0 – Data Compilation

This task will focus on compilation of available data on water resources in Central Ohio. The USGS modeling team compiled substantial information on the existing water uses, reservoir operations and withdrawals as part of their model development. For cost savings purposes, the BC team will utilize this compiled information as a basis for development of a water use inventory. Additional information and reports from Ohio EPA and the Soil and Water Conservation Districts will be reviewed and compiled on water supply systems including storage reservoirs, yield, permitted withdrawal rates, current and future water needs of municipal as well as industrial, and agricultural sectors. Information on the wastewater and stormwater infrastructure will be obtained from 208 Facility Reports, and utility

master planning documents.

Task 3.0 – Water Use Projections

One of the primary goals of this task is to define the future water use within the Scioto River watershed. This task will include the development of future demand projections for the watershed, based on recent population growth projections conducted by MORPC for 2040 and for the projected future build-out condition. Potential increases in commercial, industrial and agricultural water use will also be projected for this time period using available information on anticipated commercial industrial growth for the region.

It is anticipated that data from additional agencies such as the Ohio Farm Bureau and the Soil and Water Conservation Districts will be included in the projection. The water use projections will be presented and discussed at the USGS modeling team meeting as it is being developed.

A technical memorandum on the future water use projections for model use in the USGS modeling will be prepared for review by MORPC and the Committee. The summary will be included as a section of the Adaptive Management Plan Report for Central Ohio.

Task 4.0 – Scioto River Watershed Water Budget

This task will include development of a public document presenting an inventory of all current water uses within the Scioto River watershed. The inventory will include water supply, wastewater, industrial, farming, and environmental needs. Again, a great deal of this information has been obtained by USGS as part of their model development. BC will use their compiled data and then augment that, as needed using updated 208 planning reports, existing water and wastewater master planning documents.

The water budgets will be important to help MORPC evaluate various adaptive management scenarios and understand at least at a basic level how the dynamic climate will likely impact their water resources through time.

Water budgets can be simple or complex depending on the intended use. The water balances for this project will be more complex due to the fact that true adaptive management scenarios at a local level will likely be evaluated using these budgets. The BC team has extensive background in completing watershed based water budgets that are used to evaluate water uses throughout the watershed. This knowledge will be brought to this project to construct a watershed based water balance that accounts for inflows, outflows, seepage, evaporation and other losses from the head of the watershed to the end of the study. This will allow the team to evaluate the effectiveness of different adaptive measures discussed in Task 6.

Information developed from the water use and inventory task will be used as a basis for development of the Scioto River watershed budget. Future use projections and seasonal use factors will be developed based on the buildout projection used by USGS in their modeling project.

The budget will be calculated based on the available surface water and the current and projected water use given current water use practices. Potential increases to water use given the projected changes to climate will be evaluated. The available water on a seasonal basis during average and drought conditions will be compared to existing water use to determine the generalized water budget for the basin.

A public education document describing the overall project, the water budget for the watershed and the modeling approach which is the basis for the study will be prepared for review by MORPC and the Committee. This document will be used as a basis for a first round of public outreach meetings as presented in Task 5.0. The document will be included as a Section of the Adaptive Management Plan Report for Central Ohio.

Task 5.0 – Public Outreach

An important aspect of the adaptive management plan is public education. Due to the political issues related to the climate change topic, many utilities are framing public education campaigns as adaptive management plans for extreme weather events including drought conditions, dropping the reference to “Climate Change”.

It will be critical that the plan be presented to the public and local businesses to gain support and understanding. These groups need to understand that MORPC is taking a proactive role by conducting this study to ensure that the region has sustainable and secure water resources for growth and economic development into the future. The outreach program should include an overview of adaptive management strategies and the potential vulnerabilities related to extreme storm events and droughts.

The public and local businesses are aware of how extreme weather events, such as those that have occurred in the past decade, affect critical infrastructure systems through flooding or extreme drought. They have likely seen stories on national television reflecting how these types of events have had a direct impact on the local environment and infrastructure.

Kristen Atha and Mo Wright will work with MORPC to develop a public education and outreach program, at the level needed to reach the community. The goal of this program will be to ensure that the public understands that MORPC is taking a proactive role in planning for sustainable utilities and the successful preservation of their community and its resources.

Phase II

Task 6.0 – Risk Assessment

Prior to the conduct of the Risk Assessment planning task, BC will engage our Technical Leadership Advisory Panel in a virtual meeting with the Stakeholder Committee at MORPC to discuss risks to water-related infrastructure systems due to climate change and the strategies that are being utilized by water management agencies across the United States. This facilitated meeting will start with a discussion of the typical risks, vulnerabilities to water related infrastructure systems and approaches to mitigate risk. Our team of experts will guide a portion of this meeting, bringing national level expertise in long range planning of water, wastewater and stormwater utilities given the uncertainties of climate change.

Following that meeting, we will send out a questionnaire to our stakeholder committee and set up a follow-up committee meeting to develop the range of impacts and scenarios that they feel should be considered in the adaptive management strategies for the Central Ohio region. The goal of this meeting will be to develop understanding of system vulnerabilities and build consensus among the stakeholder committee regarding the risks that apply in this region.

Once the team has come to a consensus of the risks and vulnerabilities that should be evaluated, the risk evaluation will be undertaken.

First the evaluation will include looking at the water budget and USGS modeling to identify infrastructure that likely will be negatively impacted for each of the six scenarios. The infrastructure will be categorized into at least three categories:

- **Extremely Vulnerable (Red):** Based on the age, location, or condition, this infrastructure will need to be evaluated for improvements to be able to withstand anticipated conditions.
- **Vulnerable (Yellow):** Based on the age, location, or condition, this infrastructure needs additional evaluation to determine if improvements are necessary or not.
- **Not Vulnerable (Green):** Based on the age, location, or condition, this infrastructure is likely to withstand the anticipated conditions until it reaches the end of its design life.

While the infrastructure evaluation is being completed, a risk evaluation of the water sources will be completed based on the results of the modeling and water budget. During this evaluation, the water resources and sources will be evaluated to determine the impact of changes to water quality or other parameters not associated with quantity of water. The final output of the risk evaluation of the water resources will be a list of resources that are categorized into at least three categories:

- **Extremely Vulnerable (Red):** Based on the size, location, or water quality, this water source will need to be evaluated for improvements or replacement to be able to withstand anticipated conditions.
- **Vulnerable (Yellow):** Based on the size, location, or water quality, this infrastructure needs additional evaluation to determine if improvements or replacement are necessary or not.
- **Not Vulnerable (Green):** Based on the size, location, or water quality, this infrastructure is likely to withstand the anticipated conditions until it reaches the end of its design life.

Once the overall risk assessment has been completed, a technical memorandum on the Risk Assessment will be prepared for review by MORPC and the Committee. The summary will be included as a section of the Adaptive Management Plan Report for Central Ohio.

Task 7.0 – Adaptive Management Strategies

Adaptive management offers a framework where a wide range of decision criteria may be considered. This flexible management planning approach will consider alternatives for management of water resources in order to improve downstream water quality, preserve aquatic habitat, flood protection and water supply planning.

A series of adaptation management strategies will be developed based on integrated water management for effective water resource management. These adaptive strategies will be developed through input from the risk assessment meetings and from further evaluation of the potential impacts and risks related to climate change.

There are several water management options that may be considered to facilitate adaptation to climate change, including operational changes, demand management and infrastructure modifications. Integrated watershed management provides an important governing framework for anticipating and achieving successful adaptation measures across the range of water use systems. Operational plans will be developed to build in flexibility to adapt to potential climate change conditions, including consideration of emergency operations during drought or extreme floods. Strategies will include water supply and demand management and decisions to limit susceptibility of critical infrastructure to droughts and floods.

One of the management strategies to be evaluated during this task is the strategy to do nothing and see what happens. Many utilities currently operate under limited budgets and have used this strategy to manage the expectations of their clients and avoid raising rates. In order, to determine whether this strategy is viable an estimate of the improvements suggested by the models and water budgets will be compared to the normal replacement/improvement costs. In addition, it may be prudent for a utility that desires to evaluate this option as a management strategy to determine if there are trigger or threshold values that they should set to initiate reconsideration of

this strategy.

Task 8.0 Adaptive Management Plan

The final outcome of this project will be the development of a Final Report on the regional water resource inventory, water budgets for the Scioto Watershed, guide for future development and a preliminary adaptive management strategy including strategic action items for each of the water use categories (i.e. water supply, wastewater, agricultural, flood control, ecosystem). This report will summarize information developed during each sub-task, focusing the plan on action items that can be carried forward to maintain the economic and social well-being of the region.

Preparing Central Ohio for the Hydrological Consequences of Climate Change

Project Schedule

ID	Task Name	Duration	Start	Finish	2014												2015											
					March	April	May	June	July	August	Septem	October	Novemb	Decemb	January	Februar	March	April	May	June	July	August	Septem	October	Novemb	Decemb	January	Februar
0	Project Negotiation	519 days?	Fri 3/15/13	Tue 3/31/15																								
1	Proposal Evaluation Phase	20 days	Fri 3/15/13	Thu 4/11/13																								
2	Project Kickoff & Stakeholder Advisory Committee Development	441 days	Mon 5/13/13	Sun 2/8/15																								
3	Project Award (NTP)	0 days	Mon 5/13/13	Mon 5/13/13																								
4	KO Meeting	1 day	Thu 5/23/13	Thu 5/23/13																								
5	KO Meeting Minutes	5 days	Fri 5/24/13	Fri 5/31/13																								
6	Recommend and Invite Stakeholders	25 days	Fri 5/24/13	Fri 6/28/13																								
7	Prepare and Submit Meeting Schedule and Plan for Discussions	15 days	Mon 7/1/13	Mon 7/22/13																								
8	Stakeholder Meetings	420 days	Wed 6/12/13	Sun 2/8/15																								
25	Technical Advisory Team Kickoff Meeting	0 days	Wed 6/12/13	Wed 6/12/13																								
26	Data Compilation	60 days	Fri 5/24/13	Mon 8/19/13																								
27	Water Use Projections	90 days	Mon 8/5/13	Wed 12/11/13																								
28	Develop future demand projections for Scioto River Watershed.	60 days	Mon 8/5/13	Mon 10/28/13																								
29	Submit Draft Technical Memorandum on Water Use Projections for review.	30 days	Tue 10/29/13	Wed 12/11/13																								
30	Submit Final Technical Memorandum on Water Use Projections	0 days	Wed 12/11/13	Wed 12/11/13																								
31	Scioto River Watershed Water Budget	100 days	Thu 12/12/13	Fri 5/2/14																								
32	Develop Scioto River Watershed Budget based on current water use practices.	70 days	Thu 12/12/13	Fri 3/21/14																								
33	Submit Draft Technical Memorandum on Scioto River Watershed Water Budget for review.	30 days	Mon 3/24/14	Fri 5/2/14																								
34	Submit Final Technical Memorandum on Scioto River Watershed Water Budget	0 days	Fri 5/2/14	Fri 5/2/14																								
35	Develop Public Outreach and Education Plan	110 days?	Fri 5/24/13	Tue 10/29/13																								
36	Public Outreach Activities	30 days	Mon 5/5/14	Mon 6/16/14																								
37	Risk Assessment Analysis	70 days	Fri 5/2/14	Tue 8/12/14																								
38	Technical Advisory Leadership Workshop on Risk & Adaptive Management Strategies	0 days	Fri 5/2/14	Fri 5/2/14																								
39	Develop Summary of Risks associated with Critical Infrastructure	40 days	Mon 5/5/14	Mon 6/30/14																								
40	Submit Draft Technical Memorandum on Risk Assessment for review	30 days	Tue 7/1/14	Tue 8/12/14																								
41	Submit Final Technical Memorandum on Risk Assessment	0 days	Tue 8/12/14	Tue 8/12/14																								
42	Public Outreach Activities	30 days	Wed 8/13/14	Wed 9/24/14																								
43	Development of Adaptive Management Strategies	60 days	Wed 8/13/14	Wed 11/5/14																								
44	Develop Series of Adaptive Management Scenarios for each Critical Risk	60 days	Wed 8/13/14	Wed 11/5/14																								
45	Develop Management Planning Guidance for response to potential risks per infrastructure category	60 days	Wed 8/13/14	Wed 11/5/14																								
46	Public Outreach Activities	30 days	Thu 11/6/14	Fri 12/19/14																								
47	Develop Adaptive Management Plan	100 days	Thu 11/6/14	Tue 3/31/15																								
48	Develop Draft Plan	40 days	Thu 11/6/14	Tue 1/6/15																								
49	Submit Draft Adaptive Management Plan	0 days	Tue 1/6/15	Tue 1/6/15																								
50	MORPC Review	30 days	Wed 1/7/15	Tue 2/17/15																								
51	Revise Draft Plan based on comments	30 days	Wed 2/18/15	Tue 3/31/15																								
52	Submit Final Adaptive Management Plan	0 days	Tue 3/31/15	Tue 3/31/15																								