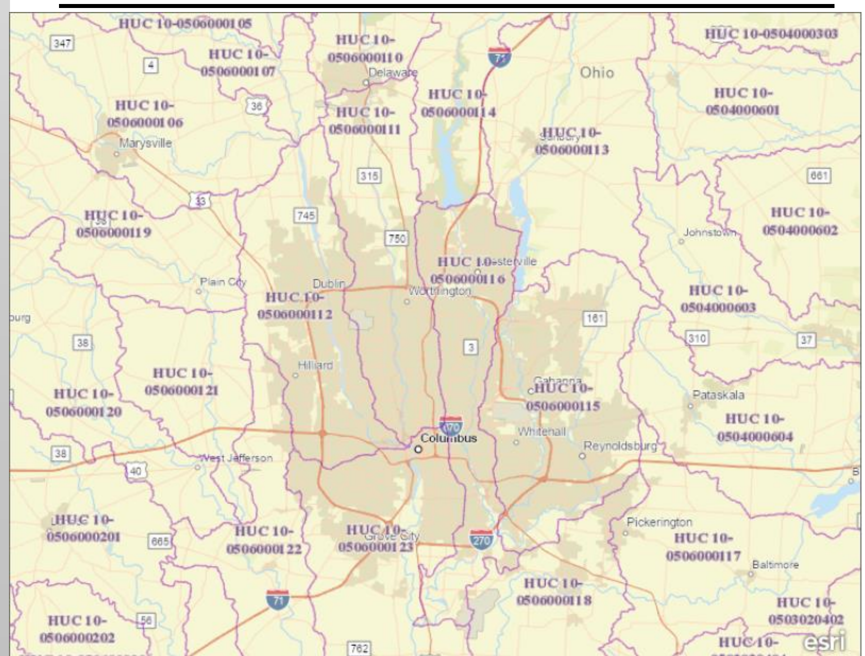
Midwest Biodiversity Institute
Center for Applied Bioassessment & Biocriteria
P.O. Box 21561
Columbus, OH 43221-0561

Watershed Monitoring and Bioassessment Plan for the Central Ohio Watersheds

Midwest Biodiversity Institute
Center for Applied Bioassessment & Biocriteria
P.O. Box 21561
Columbus, OH 43221-0561
Chris O. Yoder, Project Manager
www.midwestbiodiversityinst.org



Trent A. Dougherty, Executive Director
Dr. David J. Horn, Board President

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Central Ohio Watersheds Biological and Water Quality Assessment Plan

Guidance for Developing the Scope and Location of Annual Watershed Monitoring and Assessment by DOSD

--FINAL PLAN--

Submitted to:

City of Columbus
Department of Public Utilities
Division of Sewers and Drains
1250 Fairwood Ave.
Columbus, OH 43206
Tim Evans, Project Manager
TAEvans@columbus.gov

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Submitted by:

Midwest Biodiversity Institute
4673 Northwest Parkway
Hilliard, OH 43026
Chris O. Yoder, Project Manager
www.midwestbiodiversity.org

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

AQLU	Aquatic Life Use
AWPD	Assessment and Water Protection Division
BMP	Best Management Practice
cm	centimeter
COW	Central Ohio Watershed Council
CPUE	Catch Per Unit Effort
CSO	Combined Sewer Overflow
CWA	Clean Water Act
D.O.	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DOSD	Division of Sewers and Drains
DOW	Division of Water
DQO	Data Quality Objective
EA3	Ohio EPA Data Management System
EPA	Environmental Protection Agency
EWH	Exceptional Warmwater Habitat
FACT	Friends of Lower Alum Creek and Tributaries
FLOW	Friends of the Lower Olentangy River Watershed
GPP	Gas Powered Pulsator
HD	Hester-Dendy (artificial substrate sampler)
HUC	Hydrologic Unit Code
Hz	Hertz
ITFM	Intergovernmental Task Force on Monitoring Water Quality
IR	Integrated 305[b]/303[d] Report
Km	Kilometer
LOT	Lower Olentangy Tunnel
LRAU	Large River Assessment Unit
M&A	Monitoring and Assessment
MBI	Midwest Biodiversity Institute
MORPC	Mid-Ohio Regional Planning Commission
MS4	Municipal Separate Storm Sewer Systems
MSDGC	Metropolitan Sewer District of Greater Cincinnati
MWH	Modified Warmwater Habitat
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
QA/QC	Quality Assurance/Quality Control

QDC	Qualified Data Collector
QHEI	Qualitative Habitat Evaluation Index
OAC	Ohio Administrative Code
OARS	OSIS Augmentation Relief Sewer
ORC	Ohio Revised Code
OSIS	Olentangy Scioto Interceptor Sewer
PAH	Polycyclic Aromatic Hydrocarbon
PHWH	Primary Headwater Habitat
PSP	Project Study Plan
PWS	Public Water Supply
SDWA	Safe Drinking Water Act
SNAP	Stream Nutrient Assessment Procedure
SOW	Scope of Work
SSO	Sanitary Sewer Overflow
SWCD	Soil and Water Conservation District
TBD	To Be Determined
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
US	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VDC	Volts (Direct Current)
WIB	Water in Basement Events
WQS	Water Quality Standard
WRF	Water Research Foundation
WWH	Warmwater Habitat
WWMP	Wet Weather Management Plan
WWTP	Wastewater Treatment Plant

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Central Ohio Watersheds Biological and Water Quality Assessment Plan:

Guidance for Developing the Scope and Location of Annual Watershed Monitoring and Assessment by DOSD

INTRODUCTION

In August 2019 the Midwest Biodiversity Institute (MBI) proposed to perform tasks in support of a biological and water quality assessment of the Middle Scioto and Lower Olentangy Rivers in Franklin and Pickaway Counties Ohio beginning in 2020 and as supported by the City of Columbus Division of Sewers and Drains (DOSD). A Scope of Work (SOW) based on meeting a schedule of tasks within a project period of May 2020 through December 2021 was developed to include sampling, data management, analysis, and reporting. A comprehensive report including a retrospective analysis of more than 50 years of data was completed (MBI 2022). A follow-up survey of a similar scope to 2020 was completed in 2022-23 (MBI 2024). In March 2020, MBI was requested to expand the scope of work to include river and stream reaches in the Blueprint Columbus tributaries to the Olentangy River in the Clintonville and Beechwold neighborhoods and other tributaries within the Columbus municipal separate storm sewer system (MS4) subwatersheds.

Periodic discussions took place within DOSD and included the MS4 program beginning in June 2020 and extending into 2023 about the merits and scope of implementing a watershed based approach to assessing the quality and status of streams within DOSD sewersheds, Blueprint Columbus areas, and the MS4 areas of Central Ohio. These discussions focused on the development of a watershed monitoring program and development of assessments that would directly support DOSD programs from a receiving stream perspective. The resulting Plan mirrors similarly scoped programs that have been underway since 2010 on behalf of the Metropolitan Sewer District of Greater Cincinnati (MSDGC) and since 2006 across Northeastern Illinois and on behalf of five watershed groups (MBI 2023). Each effort has served both municipal wastewater and MS4 stormwater management goals and objectives in addition to enhanced watershed planning that is of vital interest to local stakeholders. Both of these multiyear efforts were initially supported by the development of similarly scoped Watershed Monitoring and Assessment Plans (MBI 2006; MBI 2011). One of the NE Illinois groups was the subject of a U.S. Environmental Protection Agency (EPA) case study that detailed the need for and uses of the data and information generated by comprehensive watershed assessments (U.S. EPA 2007).

More recently U.S. EPA, trade organizations such as the Water Research Foundation (WRF), and major municipal water and wastewater utilities have been collaborating on an approach termed One Water. In a recent summary of One Water, the Columbus Project Blueprint was cited as a prime example (Kent 2022):

> *"Integrated planning approaches, such as EPA's Framework for Integrated Planning for Municipal Stormwater and Wastewater, facilitate collaboration between multiple departments and agencies to implement shared solutions that meet multiple objectives. For example, Columbus Department of Public Utilities, in Ohio, is implementing Blueprint Columbus, a plan to redirect stormwater from the sanitary laterals and foundations on private property to public streets and to green infrastructure located in the right-of-way to reduce sanitary sewer overflows (SSO). This will reduce the amount of inflow and infiltration in the sewers, addressing the root cause of SSOs, without the need to build additional tunnels to handle the excess flow,* ***and improving water quality in streams.****"(emphasis added)*

It is documenting the *"improving water quality in streams"* in the vision for One Water that this Plan is intended to fulfill with biological, physical, and chemical data supporting an integrated analysis of causes and sources of impairment and threat. However, initiatives like One Water have historically been long on planning exercises and administrative measures, but weak to non-existent on demonstrating environmental results with sufficiently rigorous monitoring and assessment. With the exception of only a handful of examples across the U.S. (e.g., the Southern California Stormwater Monitoring Coalition[1]), documenting improvements in water quality is largely an assumed outcome, much the same as it has been done over 50+ years of Clean Water Act (CWA) administration by U.S. EPA and the states. Through the execution of this Monitoring and Assessment (M&A) Plan, DOSD will be a leader in completing the cycle of water quality management espoused by the U.S. EPA Environmental Indicators Initiatives of the 1990s (U.S. EPA 1995a,b), as described in the National Academy of Sciences (NAS) Committee on Science in TMDLs report (NRC 2001), and by Karr and Yoder (2004) as a follow on to the NAS effort. It will also meet a key recommendation of the National Academy of Sciences report on urban stormwater management in the United States (NRC 2009) that *". . . more comprehensive biological monitoring of waterbodies will be critical to better understanding the cumulative impacts of urbanization on stream condition."*

This Plan describes the spatial and temporal sampling design and the indicators and parameters that are to be collected at each sampling site. It also describes the type of biological sampling methods for fish and macroinvertebrate assemblages and habitat assessment that will be employed. Chemical and physical measures are included to provide supporting data and information for the biological assessment including the Ohio EPA combined nutrient assessments for the larger streams and rivers. The bacterial indicator *Escherichia coli* will be used to assess the applicable recreational uses. This Plan will be used to guide the development

[1] https://socalsmc.org/about/organizational-goals/

of detailed study plans for the annual field work and the subsequent data analysis for a multi-year series of baseline bioassessments beginning in 2024 primarily in support of the Wet Weather Management Plan (WWMP; Columbus DOSD 2015) and DOSD priorities as listed in Appendix A.

INVENTORY OF EXISTING MONITORING NETWORKS

The first task of the monitoring and assessment planning process is to compile an inventory of existing monitoring networks across Central Ohio focusing on those that produce data and information that either qualifies or has the level of rigor to qualify as Level 3 under the Ohio Credible Data Law and Regulations[2]. Besides the biological and water quality monitoring and assessments recently supported by Columbus DOSD and carried out by MBI, the Ohio EPA and the Columbus Division of Water (DOW) are the two other principal sources of this level of water quality and biological data in the Upper and Middle Scioto River basins.

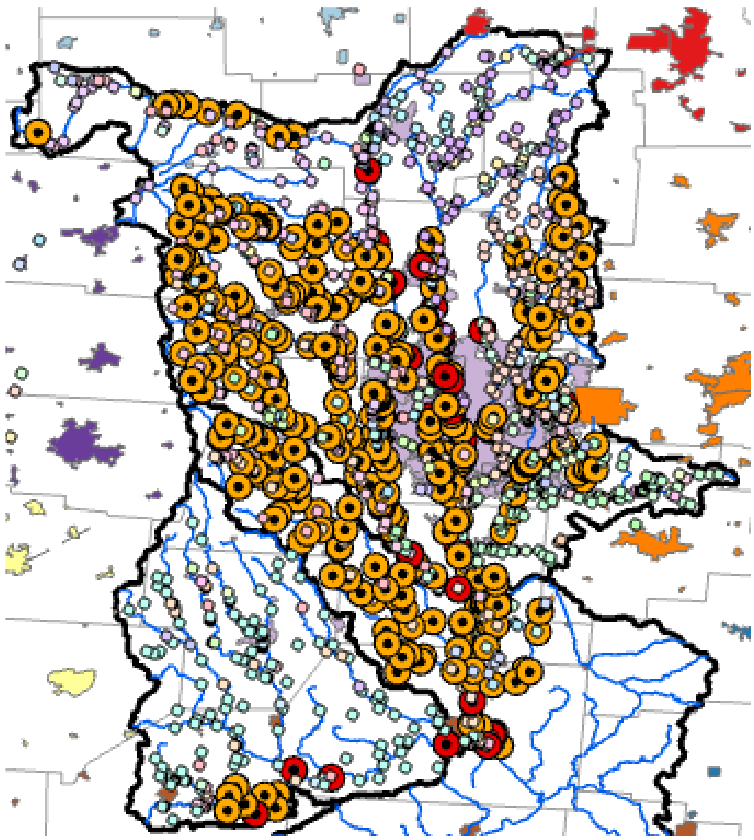

Figure 1*. Ohio EPA biological and water quality monitoring locations in the Upper and Middle Scioto River subbasins 1979-2009 (○), 2010-2019(☉), and by Ohio EPA and MBI in 2020 and 2022 (☉).*

Ohio EPA Division of Surface Water

Historically, the Ohio EPA Division of Surface Water biological and water quality monitoring program has produced the most comprehensive monitoring of Central Ohio watersheds since 1979. More than 750 sites in the Columbus MS4 area (Figure 1) have paired chemical, habitat, and biological data that has supported numerous comprehensive reports[3]. The data is stored in a relational format in the Ohio EPA EA3 data management system and is readily available. MBI compiled this data for the Upper and Middle Scioto River and western Licking River

[2] ORC 6111.5 ad OAC 3745-4.

[3] https://epa.ohio.gov/divisions-and-offices/surface-water/reports-data/biological-and-water-quality-reports

subbasins as part of Task 5 of this project in a relational database that is described later. MBI has already made extensive use of the database in other projects including a 37 year retrospective of the changes in the fish assemblages related to reductions in water pollution and improvements in water quality over that time period (Yoder et al. 2019) and a 50 year retrospective of biological and water quality in the Middle Scioto River mainstem in and below Columbus (MBI 2022). Ohio EPA monitoring before that time frame consisted entirely of fixed stations sampled monthly for water chemistry and occasionally for macroinvertebrate assemblages at a small subset of the post-1979 locations dating back to the 1960s and 1970s.

After nearly 40 years of systematic intensive pollution surveys, Ohio EPA fundamentally changed their approach to monitoring streams and rivers in 2018 with the Two Pronged Approach to Monitoring and Assessment as described in the Ohio EPA 2022 Integrated Report (IR), Section D (Ohio EPA 2022). Compared to the historical program, the level of effort within individual watersheds and mainstem rivers has declined by as much as 60-75% and at a longer return interval of 12 years. The most recent Ohio EPA survey of the Middle Scioto River, Big Walnut Creek (including the Alum and Blacklick Creek watersheds), and Walnut Creek watersheds was accomplished in 2023 under the new design. The agency did not sample the Scioto River mainstem opting instead to rely on the DOSD sponsored MBI Level 3 assessments of 2020 and 2022. The reduction in spatial coverage is the most apparent in headwater streams with what formerly consisted of multiple sites in tributary subwatersheds being reduced to single “pour point”[4] sites in most cases. This leaves the smaller headwater streams that receive the most direct impacts from SSOs, stormwater, and undocumented local impacts unassessed. As a result monitoring is not done at the scale needed to determine cumulative impacts and pollution abatement effectiveness in more than “end-of-pipe” terms and the over-extrapolation of monitoring results from too widely spaced sites. The comprehensive Ohio EPA dataset available for Central Ohio during 1979-2016 is aging hence this Plan is an attempt to keep it current and relevant for better supporting present-day water quality management objectives.

Columbus Division of Water (DOW)

The Columbus Division of Water (DOW), being responsible for ensuring a safe and quality drinking water supply, has naturally focused monitoring on the principal source waters including streams and rivers that feed and four (4) major water supply reservoirs, O’Shaughnessy and Griggs Reservoirs on the Scioto River, Hoover Reservoir on Big Walnut Creek, and the Alum Creek Reservoir on Alum Creek, and an upground reservoir along the

[4] A “pour point” site is located at the mouth of a subwatershed and represents watershed quality via extrapolation.

Scioto River, all of which are situated upstream from Columbus. Each receives varying levels of nonpoint source inputs that originate primarily from the extensive agricultural row cropping practices in the upper Scioto basin watersheds and which pose issues for the treatment of raw water to Safe Drinking Water Act (SDWA) and Ohio EPA Water Quality Standards (WQS) for public water supplies. Even though the Ohio WQS consist of a "point of use" application for determining compliance, DOW has taken a watershed focused approach to their monitoring design (Figure 2).

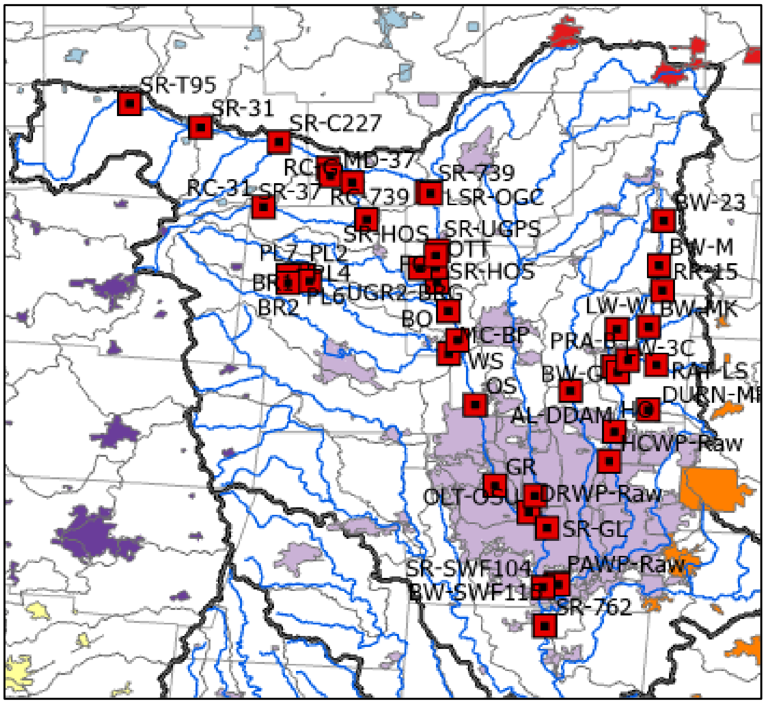

Figure 2*. Columbus DOW fixed station chemical monitoring locations in the Upper Scioto River subbasin. These are sampled by collecting grab samples on a bi-monthly basis.*

DOW Chemical Monitoring for Public Water Supplies

The DOW fixed station chemical monitoring network consists of 47 locations in the upper Scioto River, Alum Creek, and Big Walnut Creek subbasins upstream from Columbus. Grab samples are collected twice each month for an array of compounds and bacteria including nutrients and common water quality parameters at all sites, plus herbicides, metals, Total Organic Carbon (TOC)/Dissolved Organic Carbon (DOC), anions/cations, and *E. coli* bacteria at selected sites. Algae are also sampled at selected locations and the water treatment plant intakes and identified to the lowest limit of taxonomic resolution. This is likely the longest tenured of the monitoring efforts in Central Ohio dating back to the 1930s. More recently DOW contracted with the U.S. Geological Survey to establish continuous monitoring devices (Datasondes) to record temperature, conductivity, pH, dissolved oxygen (D.O.), nitrate-N, TOC/DOC, and/or chlorophyll a, and the blue green algae associated protein phycocyanin at 11 locations. One of the continuous monitoring locations is located on the Scioto River at Shadeville below Columbus and was used to supplement the long term Datasonde deployment by MBI for the 2022 DOSD survey. The DOW monitoring also supports the Sustaining Scioto Initiative coordinated by the Mid-Ohio Regional Planning Commission (MORPC) and including multiple stakeholders in the watersheds upstream from Columbus.

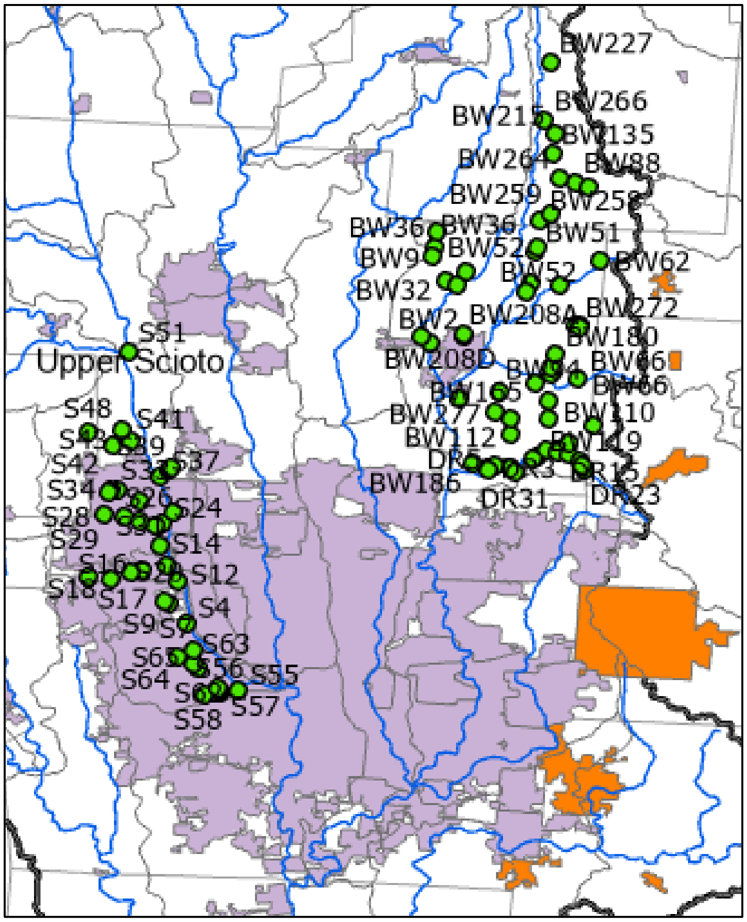

Figure 3*. Locations sampled for fish, habitat, and grab water quality by DOW-AWPD during 2014-21.*

DOW Biological and Water Quality Assessments

The Columbus DOW Assessment and Water Protection Division (AWPD) has conducted intensive biological, habitat, and water quality assessments of the wadeable and headwater tributary streams in the watersheds upstream from the major Columbus water supply reservoirs since 2014 (Figure 3). The biological data includes the fish assemblage and the Qualitative Habitat Evaluation Index (QHEI) collected and analyzed by Level 3 Qualified Data Collectors (QDCs) along with chemical data via grab samples. This program is intended to emphasize the critical relationship between biological and habitat quality and the capacity of a receiving stream to assimilate and process nutrients, sediment, and other attributes of nonpoint source runoff that can result in a cumulative impact to the water quality in the receiving streams that feed the public water supply reservoirs. Perhaps of equal importance is it provides direct observation of the mosaic of land use, habitat, and biology as it affects source water quality and positioning DOW to intercept issues before they become insurmountable problems. Unfortunately, the level of effort for this program has been reduced since 2022. While the quality of these Upper Scioto basin watersheds are not necessarily of direct importance to DOSD, there remains the risk of exporting degraded water quality and altered flows downstream into the reaches of direct interest to DOSD such as the Scioto River, Alum Creek, and Big Walnut Creek mainstems. An example that has already revealed symptoms of the congruence of flow alterations and water quality is the Scioto River mainstem between Griggs Reservoir and the Greenlawn Dam impoundment as evidenced by the 2020 (MBI 2022) and 2022 (MBI 2024) biological and water quality results. Symptoms of nutrient enrichment exacerbated by altered flows were identified, but have not resulted in use impairments as this reach was in full attainment in both 2020 and

2022. The lone exception has been the persistent non-attainment of the Modified Warmwater Habitat (MWH) use designation in the Greenlawn Dam impoundment which is a high use recreational area for kayaks and other small watercraft. The impoundment appears to export these effects downstream as evidenced by the 2020 and 2022 Scioto mainstem results, including elevated urban pollutants, nutrient responses, and subpar responses by some of the key biological metrics. Nonetheless this represents an opportunity for the better integration of interests between DOW, DOSD, and the many stakeholders involved in the Sustaining Scioto and One Water Initiatives.

Midwest Biodiversity Institute (MBI)

MBI has conducted Level 3 biological and habitat assessments on behalf of several organizations including the Franklin Co. Soil and Water Conservation District (SWCD), The Nature Conservancy Ohio Chapter, Appalachian Ohio Alliance, and the Friends of Upper Alum Creek during 2016-2022. These consisted of reach specific sampling to update the existing baseline and rectify outdated aquatic life use designations that were submitted to Ohio EPA for WQS rulemaking purposes. Other sites were sampled to fulfill MBI staff Level 3 QDC renewals. The Franklin Co. SWCD sampling was done to support specific projects for nonpoint source assessment and to support stream water quality inventories for local jurisdictions such as Whitehall and Dublin. The overall list of sites for the various Central Ohio Rivers and Streams assessments conducted by MBI is provided in Appendix B.

Future Stakeholder Engagement

The M&A Plan presents an opportunity to better engage diverse stakeholders both within and adjacent to the watersheds of immediate importance to DOSD. Besides the Sustaining Scioto and Columbus One Water initiatives, there is the Central Ohio Watersheds (COW) Council, Friends of the Lower Olentangy River Watershed (FLOW), Friends of Alum Creek and Tributaries (FACT), the Middle Scioto Watershed Group, and the Franklin Co. SWCD. Such groups and their partners usually lack sufficient expertise or capacity to effectively assess rivers and streams, hence the DOSD effort should enhance their understanding and potentially serve as a resource for awareness and actions taken by these groups to promote, protect, and improve water quality in Central Ohio. Other City of Columbus departments such as the Department of Recreation and Parks and the Franklin County Metroparks will likewise benefit from the knowledge about water quality and stream and river conditions along their properties that border the major rivers and streams. For example, this type of information has been and could be used to support land conservation grant applications in popular grant programs like the Clean Ohio Fund, the Ohio Water Resource Restoration Sponsorship Program (WRRSP), and the newer H2Ohio program. Lastly, stakeholders internal to DOSD including the Wet Weather

Management Plan (WWMP), Project Blueprint, and the MS4 will likewise benefit from the standardized watershed assessment level data and resulting analyses of that data.

DOSD PRIORITIES FOR MONITORING AND ASSESSMENT

The water quality management issues that DOSD deals with in Central Ohio are varied and complex. Besides the operation of the two largest wastewater treatment plants (WWTPs) in Central Ohio and an extensive network of sewer lines, DOSD is committed to a Wet Weather Management Program (Columbus DOSD 2015) implementation plan to incrementally reduce wet weather discharges of sewage. The principal regulatory drivers are consent orders with the Ohio EPA for Sanitary Sewer Overflows (SSOs) intended to determine feasible steps to eliminate and mitigate the impact of SSOs and water in basement events (WIBs) and providing adequate capacity to convey and treat base and peak flows to the collection system. The CSO Consent Order establishes specific milestones to address discharges from CSOs. The WWMP will (and already has) employ(ed) a mix of gray and green infrastructure to address CSO and SSO discharges by 2035 (Columbus DOSD 2015). While the potential scope of the Monitoring and Assessment Plan encompasses the Hydrological Unit Code (HUC)12 watersheds wholly or partially within the Greater Columbus MS4 area, the focus for watershed level monitoring and assessment over the next decade includes the following:

1. The Middle Scioto River and Lower Olentangy River mainstems as these two rivers receive impacts from the two major Columbus wastewater treatment plants (WWTPs) and/or overflows from combined and sanitary sewers subject to the WWMP (Columbus DOSD 2015) plus general urban runoff that is subject to MS4 stormwater permitting.
2. Assess watersheds that are directly and indirectly affected by Project Blueprint to establish a more relevant baseline and assess the effectiveness of that program and other WWMP actions in improving biological condition and water quality over the term of the consent agreement.
3. Assess river mainstem reaches and HUC12 watersheds with active CSOs, SSOs, and trunk sewer relief points.
4. Assess river mainstem reaches and HUC12 watersheds where increased development is imminent as a demonstration about how watershed based monitoring and assessment can benefit the MS4 stormwater program.
5. Adhere to major river mainstem assessment reaches and the HUC12 watershed scale for tributaries as the basis of the spatial sampling design.

For the scope and level of effort to be expended each year, DOSD established general guidelines for annual costs, laboratory capacity, and the framework of the monitoring in terms of a rotating cycle of watershed assessments. Hence the scope and schedule of monitoring and

***Table 1**. Priority mainstem and HUC12 watersheds of interest to Columbus DOSD in terms of projects and issues that are most relevant to the management of the sewer system and the Wet Weather Management Plan (WWWP; Columbus DOSD 2015) with DOSD project years, M&A goals, baseline M&A years, DOSD Phase I, Ohio EPA M&A years, aquatic life use attainment status, and current 303[d] listing status.*

DOSD Priority Mainstem or Watershed	Primary Issue(s) of Interest to DOSD	Secondary/Overlapping Issues of Interest to City/Local Stakeholders	DOSD Project Year(s)	M&A Goal(s)	Most Recent Baseline M&A Year	DOSD Phase I M&A Year	Ohio EPA M&A Year	AQLU Status	303[d] Status
Scioto River Mainstem - Griggs to Southerly	Jackson Pike, OARS Phase I, WWH Status	Flow modifications, Griggs impacts, PWS, Scioto Mile, High recreation usage	Ongoing	Long term trends/ effectiveness, emerging threats	2020/2022	2028	2012/2023	Full WWH; Green-lawn impoundment MWH impairment	Status in 2022 IR outdated by 2020-22 data
Scioto River Mainstem - Big Walnut to Circleville	Southerly, Intel Startup, EWH status	Flow modifications, Griggs impacts, High recreation usage	Ongoing	Long term trends/ effectiveness, emerging threats	2020/2022	2027	2012/2023	Full EWH	Status in 2022 IR outdated by 2020-22 data
Rush Run Olentangy River - Hyatts Rd. to Rush Run HUC 050600011103	Upper SSO Area	Flow modifications, High recreation usage, dams, FLOW	2016-2040	Long term trends/ effectiveness, emerging threats	2020/2022	2029	1999/2003 /2024	Partial EWH, full WWH	Status in 2022 IR outdated by 2020-22 data
Outlet of the Olentangy River - HUC 050600011103 Rush Run to mouth - (Adena Brook, Turkey Run, + other tributaries)	CSO/SSO, LOT (OARS Phase II), Project Blueprint (Clintonville/ Beechwold/Riverlea)	Flow modifications, High recreation usage, dams, FLOW	2016-2025	Long term trends/ effectiveness, emerging threats	2020/2022 (Adena Brook)	2029	1999/2003 /2024	Partial, full WWH/MWH, remaining impoundments	Status in 2022 IR outdated by 2020-22 data
Robert Milliken Ditch- HUC 050600011205 (Dry Run, Trabue Run)	Blueprint Columbus (Hilltop)	MS4 Stormwater	2021-2028	Update Baseline	2010	2024	2010/2023	WWH non-attainment	Non-support; AQLU, Recreation
Scioto Big Run - HUC 0506000123 (Marsh Run)	Blueprint Columbus (Hilltop); Big Run Interceptor	MS4 Stormwater	2021-2028	Update Baseline	2010	2026	2005/2023	WWH partial attainment	Non-support; AQLU, Recreation
Kian Run - Scioto River - HUC 050600012302	Blueprint Columbus (Near South)	MS4 Stormwater; Legacy pollution	2019-2025	Update Baseline	2010	2028	2010/2023	WWH non-attainment	Non-support; AQLU, Recreation

***Table 1**. continued.*

DOSD Priority Mainstem or Watershed	Primary Issue(s) of Interest to DOSD	Secondary/Overlapping Issues of Interest to City/Local Stakeholders	DOSD Project Year	M&A Goal(s)	Most Recent Baseline M&A Year	DOSD Phase I M&A Year	Ohio EPA M&A Year	AQLU Status	303[d] Status
Grant Run - Scioto River HUC 050600012303 (Republican Run)	Grove City Contract Area	MS4 Stormwater	TBD	Establish Baseline	2010	2026	2010/2023	WWH full/partial/ non-attainment	Non-support; AQLU, Recreation
Bliss Run – Alum Creek HUC 050600011602 (Alum Creek mainstem to Three Rivers Park)	Blueprint Columbus, SSO/DSR, Alum Creek Standby Storm Tanks, Alum Cr.k Trunk Sewer	MS4 Stormwater, Recreation Uses, FOAC	2021-2030	Update Baseline	2000	2025	2000/2023	WWH partial attainment	Non-support; AQLU, Recreation
Gahanna - Big Walnut Creek mainstem - Hoover Reservoir to Gahanna - HUC 050600011502	Big Walnut Trunk Sewer, Gahanna Contract Area	MS4 Stormwater, Recreation Usage	TBD	Update Baseline, Update Trends	2000/2016	2030	2000/2023	WWH/EWH Status	Non-support; AQLU, Recreation
Mason Run – Big Walnut Creek mainstem to Three Rivers Park - HUC 050600011505	SSO, Blueprint, Columbus Big Walnut Trunk Sewer, Rickenbacker, Rapid Development	MS4 Stormwater, Recreation Usage	2024-2031	Update Baseline	2000	2030	2000/2023	WWH non-attainment	Non-support; AQLU, Recreation
Lockbourne - Alum Creek HUC 050600011603 - Lower Big Walnut Creek mainstem	Big Walnut Trunk Sewer, Rickenbacker, Rapid Development	MS4 Stormwater, Recreation Usage	TBD	Update Baseline	2000	2030	2000/2023	EWH Designated	AQLU Full Support (needs updating)
Town of Brice - Blacklick Creek - HUC 050600011504	Blacklick Main Trunk Sewer, MS4, Rapid Development	MS4 Stormwater, Recreation Usage	TBD	Update Baseline, Update Trends	2000	2031	2000/2023	WWH full/non-attainment	Non-support; AQLU, Recreation
Headwaters Blacklick Creek - HUC 050600011503	Blacklick Main Trunk Sewer, MS4, Rapid Development	MS4 Stormwater, Recreation Usage	TBD	Update Baseline, Update Trends	2000	2031	2000/2023	WWH full/non-attainment	Non-support; AQLU, Recreation

assessment for each year was developed within these constraints (Table 1). The information for supporting the selection and scheduling of HUC12 watersheds was obtained from the WWMP (Columbus DOSD 2015) and subsequent updates in 2021 (Columbus DOSD 2021) and 2022 (Columbus DOSD 2022) and the SSO and WIB report (Columbus DOSD 2023). The experience gained with the 2020 (MBI 2022) and 2022 (MBI 2023) Scioto River and Olentangy River and tributaries biological and water quality assessments also factored into this process.

The sampling design employs a combination of a geometric (stratified-random) selection of sites and targeted-intensive pollution surveys. These are employed to fulfill multiple management purposes and goals of importance to Columbus DOSD by focusing on the status of existing and recommended aquatic life and recreational uses and their relationship to chemical, physical, and biological stressors. This conforms to the principles of adequate monitoring (ITFM 1995; Yoder 1998) that includes the anticipation that the resulting biological and water quality assessments will be used to support effectiveness assessments of pollution controls, best management practices, and the iterative development of cost-effective watershed management responses to existing and emerging issues that span individual programs, agencies, and stakeholder groups. It also ensures that stressors outside of the immediate control of DOSD are accounted for as background or competing influences on present and future conditions within Central Ohio watersheds.

Biological and Water Quality Surveys

A biological and water quality survey, or "bioassessment", is an interdisciplinary monitoring effort coordinated on a river reach-specific or small watershed scale (e.g., HUC12). Biological, chemical, and physical monitoring and assessment techniques are employed in biosurveys to meet three major objectives:

1) Determine if use designations and/or goals set for or assigned to a given water body in the WQS are appropriate and attainable; and,

2) Determine the extent to which verified or recommended use designations assigned in the WQS are either attained or not attained;

3) Determine if any changes in key ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices for nonpoint sources.

The data gathered in a bioassessment is processed, evaluated, and synthesized in an assessment report. For the DOSD program this will be at a level of effort that encompasses mainstem river reaches and all or parts of HUC12 watersheds on an annual basis. Each assessment will address recommendations for revisions to WQS, provide feedback to DOSD about the effectiveness of pollution abatement efforts, future monitoring needs, problem discovery, or other actions which may be needed to resolve impairments or threats to designated uses. While the principal focus of a bioassessment is on the status of aquatic life uses, the status of recreation uses will be evaluated in tandem. Other designated uses such as water supply and human health concerns, when present, can be addressed via the addition of chemical and/or pathogenic indicators specific to those uses. It should be noted here that the Columbus Division of Water (DOW) monitoring program for the Columbus source water supplies is an opportunity to integrate the two monitoring programs when they overlap.

A positive consequence of this type of sustained, routine, and standardized effort is a database and informational resource that supports ongoing water quality management efforts of interest to DOSD and local stakeholders in the aggregate. The critical concept is that by doing the level of monitoring and assessment that is required by a rotating basin approach, the informational infrastructure needed to support the entirety of water quality management is in place when the need for such support is realized. This demonstrates how this type of sustained approach is inherently anticipatory. Anticipatory monitoring and assessment is essential to maintaining and improving the integration of water quality management programs.

Watershed Monitoring Design

A key first step in conducting watershed bioassessment is the selection of spatial and temporal monitoring designs. It is widely recognized that fixed station designs that were once the mainstay of state and local monitoring programs are simply insufficient to meet the previously stated objectives. However, this is not to conclude that fixed stations do not have an appropriate role in a monitoring program. A good example of this currently is the Columbus DOW chemical monitoring network. However, this monitoring alone is insufficient to support management decision-making and effectiveness assessments at the local watershed scale. A combination of two designs that have been successfully implemented in Central Ohio and elsewhere is termed the combined Geometric Site Selection and Intensive Pollution Survey framework. It is best employed for mainstem river reaches and within tributary watersheds that correspond to the 12 digit HUC scale (i.e., HUC12) in order to support important local water quality management objectives. It meets the requirement that the spatial scale of monitoring be representative of and relevant to the scale at which management is being applied. An example of the differences that sampling at a refined scale of spatial resolution with a pollution focused design compared to general condition surveys that are employed on a broader spatial scale are summarized in Table 2.

***Table 2**. Key characteristics of condition-focused and intensive pollution survey monitoring designs in terms of spatial organization, sampling site density, outcomes, CWA program support, stressor identification, and the capacity for detecting and dealing with cumulative effects (from MBI 2022).*

Key Characteristics	Condition Monitoring	Pollution Monitoring
Spatial Organization	• Probabilistic • Synoptic (non-random) • "Pour point" (HUC8-12)	• Sites, Reaches, Sub-watersheds (HUC12) • Along longitudinal pollution gradients
Sample Site Density	• >25 $mi.^2$ per site[1] • 10-25 miles per site[1] • 1.5 avg. sites per HUC12[1] • 4.6 avg. sites per HUC10[1]	• 1.5-3.0 $mi.^2$ per site[2] • 1-5 miles per site[2] • 10.4 avg. sites per HUC12[2] • 59.3 avg. sites per HUC10[2]
Outcome(s)	• Delineate status over wide area (regional, statewide) • First order stressor identification	• Delineate status at the site, reach, and watershed (HUC12) scales. • Delineate pollution gradients. • Quantify severity and extent of reach scale impacts. • Detailed stressor identification. • Use attainability analysis.
CWA Program Support	• 305[b]/303[d] reporting & listing. • Indirect support for implementation (TMDL, NPDES, etc.)	• 305[b]/303[d] reporting & listing. • Direct support for implementation (TMDL, NPDES, WQS, 404/401, stormwater, planning, BMPs).
Stressor Identification	• First order determination of stressor relationships (limited by scale).	• Detailed delineation of stressor relationships across watershed strata. • Regional development of stressor thresholds.
Cumulative Effects	• Too few sites at HUC12 scale to distinguish site- and HUC-specific (cumulative) effects of stressors. • Insufficient sites to reveal detailed pollution gradients and profiles.	• Multiple sites at HUC12 sufficient to distinguish site- and HUC-specific (cumulative) effects of stressors. • Sufficient sites to reveal longitudinal pollution gradients and profiles. • Ability to set cost-effective priorities for BMP implementation.

Sampling sites within a subwatershed unit are allocated in a semi-random, but spatially comprehensive manner using a geometric progression of drainage areas starting with the area at the mouth of the watershed unit and working “upstream” through the member tributaries to the headwaters. This allocation of sites is supplemented by the targeted selection of additional sampling sites that are needed to provide more complete pollution profiles in support of the mosaic of local water quality management issues that can include point source discharges, habitat, flow modifications, and diffuse impacts (e.g., stormwater runoff) within a watershed. It fosters data analysis that takes into consideration overlying natural and human caused influences within the streams of a watershed. Hence it captures multiple management issues including the proportionate assessment of streams and rivers within a watershed. It includes applying tiered designated uses for aquatic life, the development of watershed strategies that include the inter-relationships of both pollutant and non-pollutant stressors, and the development of a comprehensive and spatially representative database through time. Other benefits of this design include the application of cost-effective sampling methods, the development of a database that is representative of the full gradient of quality from excellent through very poor conditions, and an enhanced ability to include previously unassessed and undesignated streams. The design has been particularly useful for watersheds that are targeted for TMDL development in that unassessed waters and incomplete or outdated assessments can be addressed prior to TMDL development. The same would apply to other water quality management tasks such as the DOSD WWMP where designated uses and attainment status are important policy driving factors.

Analysis of Monitoring and Assessment Methods Options

The selection of the appropriate biological, physical, and chemical assessment methods is primarily driven by defining appropriate data quality objectives (DQOs), which are determined by the cumulative array of management goals and objectives, and standards set Ohio EPA. For the DOSD priority river reaches and watersheds these are defined by the applicable protocols published by the Ohio EPA (1987; 1989a,b; 2006; 2015a; 2019a,b,c). This conforms to the Ohio WQS and the attendant methods for determining use attainability and use attainment used by Ohio EPA and required by the Ohio Credible Data Law (ORC 6111.5) and Regulations (OAC 3745-4) for Level 3 data. The rationale for DOSD having Level 3 data is to have the capacity to affect use designations and impairment determinations.

CENTRAL OHIO WATERSHED MONITORING AND ASSESSMENT PLAN

The guiding concepts of the Central Ohio Watershed M&A Plan includes the following:

1. The CWA is the guiding theme including WQS (uses and criteria), National Pollution

Discharge Elimination System (NPDES) permitting (major and minor point sources), stormwater (MS4 and other), TMDLs, grants, and planning.
2. Ohio Credible Data Law and Regulations – Level 3 specifications for all data collection and analysis regardless of the source.
3. An emphasis on aquatic life uses because of its breadth of influence on CWA programs and its application to all water bodies – biocriteria based assessment of attainment status with chemical/physical, habitat, and GIS data sufficient to support assignments of proximate causes to be addressed via ongoing or new management, restoration, or pollution prevention practices.
4. Recreational use assessment via *E. coli* via chemical sample collection and lab analyses.
5. Drinking water and human and wildlife health uses can be included as necessary.
6. The historical database will be used to assess for trends whenever available (~750 sites available for MS4 watersheds since 1979).
7. Collaborate with other programs (e.g., Franklin Co. SWCD, Columbus DOW), emerging watershed management initiatives (e.g., MORPC, One Water), and other stakeholders with overlapping interests in stream and watershed quality (e.g., FLOW).

By following these concepts DOSD intends to use the results and analysis of the biological and water quality monitoring and assessment program to specifically support and accomplish the following:

1. Evaluate the appropriateness of existing aquatic life and recreational uses designations and make recommendations for any changes to those designations;
2. Determine the status of Central Ohio rivers and streams in quantitative terms, i.e., not only if the waterbody is impaired, but the spatial extent and severity of the impairment or the extent to which a river, stream, or watershed meets its designated uses;
3. Determine the proximate stressors that result in observed impairments or those that threaten existing full attainment for the purpose of targeting current or new management actions to those stressors; and,
4. Develop a comprehensive database of existing and paired biological, habitat, and chemical data to serve as a resource for supporting trend and effectiveness assessments and develop relevant effect thresholds to support water quality management.

To meet these objectives DOSD will develop data generated by methods and implementation consistent with the Ohio Credible Data Law (ORC 6111.5) and Regulations (OAC 3745-4).

Credible Data Requirements

In order to accomplish two of the key planned uses of the data and subsequent analyses, the data and information will be generated in conformance with the provisions of the Ohio Credible Data Law (ORC 6111.5). Under the regulations that govern the Credible Data program at Ohio EPA, data and analyses will be performed under the direction of Level 3 Qualified Data Collectors (OAC 3745-4). DOSD wishes to use the data to evaluate the attainability of aquatic life and recreational uses and determine the status of Central Ohio rivers and streams. As such, the sampling and analysis will conform to the Ohio Credible Data Law and Regulations.

Indicators and Parameters

The allocation of indicators and parameters is done following the principles of the adequate monitoring framework (Yoder 1998). The biological, chemical, and physical indicators are grouped by category in keeping with the concept of core and supplemental parameters. Fish and macroinvertebrate assemblages are the principal biological indicator assemblages that meet the goal of having a minimum of two assemblages (U.S. EPA 2013) with the potential to add a third assemblage such as freshwater mussels as appropriate. These are accompanied by a qualitative habitat assessment (QHEI; Rankin 1989, 1995; Ohio EPA 2006) and field measured chemical/physical parameters at all sites. Demand and nutrient parameters are collected at all sites, but the frequency of collection may be varied based on the inherent risk of variation due to stream or river size and local area complexity. *E. coli* serves as both an indicator of recreational use and at high levels, the presence of human sewage. Sediment chemical analysis for heavy metals, organics common to urban areas (e.g., polycyclic aromatic hydrocarbon or "PAH" compounds), and an organic scan are recommended for mainstem sites, larger tributaries, the pour points of HUC12 watersheds, and upstream and downstream from significant discharges and other potential sources. Consideration for adding emerging pollutants and those identified by USGS in their recent study of urban watersheds (Bradley et al. 2023) can be done on a pilot basis. As such the recommended indicator, parameter, and frequency coverage is risk based, i.e., higher analytical costs are incurred only when there is a reasonable expectation of meaningful detections. Available laboratory capacity is critical limiting factor.

Biological Methods

Biological sampling for fish and macroinvertebrate assemblage data will follow established protocols of the Ohio EPA (1989a; 2015a). An important assumption of this Plan is that an economy of effort will be achieved for biological assessment and water sampling in the smaller drainage area sites due to their smaller size. Experience shows that at least six (6) or more of these sites can be sampled each field day with the appropriate methods and with a water sampling frequency of 2-4 times per season. The Project Study Plans (PSPs) will describe the appropriate sampling protocols or the two best candidates, i.e., non-wadeable vs. wadeable, generator-powered vs. back-pack electrofishing methods, qualitative vs. semi-quantitative macroinvertebrate methods, etc. The specifications for the different equipment and methods are described in Tables 3 and 4. The specific decisions about methods and the level of effort are determined when the annual Level 3 PSP is produced ahead of each field season.

Determination of Sampleability

In the smallest headwater streams, particularly the higher geometric level sites, the issue of "sampleability" will need to be addressed. Some of these streams will likely have intermittent or ephemeral flows during the summer-fall index period. The guidelines to be followed for determining if a biological or chemical sample should be collected is simply based on the presence of sufficient water from which a sample can be collected. Sites with intermittent flows will be sampled provided the pools are at least 20 cm in depth. The established protocols should be followed for determining a sampling reach regardless of intermittency. For example, the fish sampling protocol calls for site reach lengths of 150-200 meters. If flow at the site is intermittent, the dry areas between the disjunct pools are included in the contiguous reach even though the dry areas would not be directly sampled. The same philosophy applies to the qualitative macroinvertebrate protocols as well.

Fish Methods

Fish sampling methods will follow the specifications in Table 3 and defer to the most effective method given site characteristics such as drainage area, channel width, and maximum pool depth. For example, a generator-pulsator method is preferred in nearly every situation over a battery back-pack unit. Deference is given to the most powerful method in making these choices. Specifications restricting the use of back-pack units to situations where they will offer adequate effectiveness are specified by Ohio EPA (1989a). For example, a small wadeable stream sampling site that is more than two times the depth or five times the width of the net ring (anode) is sampled with a generator powered long line method as opposed to using a back pack electrofishing unit. It may be easier to sample with the less powerful method, but ease of access is not a primary criterion. Access with this type of equipment should not be an issue in the study area. The determination of which fish sampling method and gear to use is ultimately a field decision made by an experienced Level 3 crew leader. The choice between wadeable and non-wadeable gear will necessarily be made in the field, but here also deference is given to the more powerful boat-or raft-mounted methods. Sites with extended pools greater than 1 meter average depth will likely require a boat or raft platform. Where this type of approach has been employed, there is an area of overlap between boatable and wadeable methods where either can produce acceptable results. Navigability and accessibility issues may be a secondary determinant in this decision. Most fish are processed in the field therefore the crew leader will need to be a skilled taxonomist with experience with the fish fauna of the Central Ohio region, all of which comes with a Level 3 certification. The Level 3 PSP outlines specific procedures for

***Table 3**. Specifications for boatable, wadeable, and headwater fish sampling methods.*

Parameter/Attribute	Inland River Boatable[1]	Inland Stream - Wadeable[2]	Inland Stream - Headwaters[3]
Waterbody Size in Drainage Area (mi.^{2})	>200-500	<300-500	<20
Channel Dimensions[4]	>1-3 meters depth; 10-100 meters width	0.5-1.0 meters depth; >2-20 meters width	>0.2-0.5 meters depth; <1-2 meters width
Sampling Platform	14-16' john boat/raft	Tow barge or bank set long line	Bank set long line or backpack unit[5]
Field Crew Size	Crew Leader[6] plus two technicians	Crew Leader[6] plus two technicians	Crew Leader[6] plus two technicians
Electrofishing Unit	Smith-Root 5.0 GPP (or equivalent)	Smith-Root 2.5 GPP (or equivalent)	T&J 1736 DCV (or equivalent); ABP-3
Power Source	5000 Watt Alternator	2500 Watt Alternator	1750 Watt Alternator; 12 V Battery
Power Output	500-1000 VDC	500-1000 VDC	150-300 VDC
Unit Settings	Low or High Range (500-1000VDC) 120 Hz	Low or High Range (500-1000VDC) 120 Hz	Low or High Range (150-300 VDC) 120 Hz
Anodes (+ charge)	Retractable boom w/4-5 straight droppers	Net ring	Net ring
Cathodes (- charge)	Bow droppers	Single trailing cable	Single trailing cable; wire "rat tail"
Sampling Direction	Downstream	Upstream	Upstream
Sampling Distance	0.5 Km	0.15-0.20 Km	0.15 Km
CPUE[7] Basis	per Km	per 300 meters	per 300 meters
Time Electrofished[8]	2400-3600 seconds	1800-3600 seconds	1500-1800 seconds
Seasonal Index Period	June 16-October 15	June 16-October 15	June 16-October 15
Time of Day	Daytime	Daytime	Daytime

Footnotes: 1 - Requires a boat or raft platform to effectively sample fish; 2 - Sampled effectively by wading; 3 - drainage area <20 mi.^{2}; 4 - Depth along shoreline, avaerage width; 5 - Restriction on the use of bacjpack units apply per Ohio EPA (2015); 6 - Level 3 QDC crew leader; 7 - Catch per unit of effort measured by site distance; 8 - lower time is the required minimum, maximum can exceed upper time if necessary to sample effectively.

the retention of voucher specimens. In addition to the baseline relative abundance data (counts, biomass, and identifications) and the identification and enumeration of external anomalies will be done per Ohio EPA (1989a; 1996; 2015a).

Macroinvertebrate Methods

Macroinvertebrate sampling methods will follow Ohio EPA (1989a; 2015a) and will be based on a preference for the modified Hester-Dendy (HD) artificial substrate method as the preferred approach at sites with drainage area of $\geq$10 mi.^{2} (Table 4). A qualitative dip net/hand pick method that includes a determination of relative abundance will be employed in lieu of HDs in the wadeable streams <10 mi.^{2}. As stated in the fish methods section, we expect that some of the smallest sites will not be amenable to evaluation with the Ohio fish and macroinvertebrate assemblage protocols due to small size, a temporal fish assemblage, and a lack of sufficient water quantity and/or depth. The Ohio Primary Headwater Habitat (PHWH) methodology (Ohio EPA 2020) will be employed in tandem with the two assemblage approach at sites <2.5 mi^2. This approach allows the applicability of the PHWH classification system to be entirely data driven as opposed to a simple reliance on *a priori* rules-of-thumb such as drainage area.

Macroinvertebrate laboratory procedures will follow Ohio EPA (1989a, 2015a) methods. For artificial substrates the laboratory processing includes the production of a sample by the disassembly, cleaning, and sieving of the artificial substrate and subsampling procedures as described by Ohio EPA (1989a; 2015a). The qualitative dip net/hand pick samples do not require an initial laboratory reduction. Taxonomic resolution is done to the lowest practicable resolution for the common macroinvertebrate assemblage groups such as mayflies, stoneflies, caddisflies, midges, and crustaceans and in keeping with the practices of Ohio EPA (2015a). A reference collection is maintained by MBI as required by the Credible Data Program and the Level 3 PSPs. All work will be done by QDC Level 3 certified macroinvertebrate taxonomists.

Habitat Assessment

The QHEI (Rankin 1989, 1995; Ohio EPA 2006) will be employed as it has been proven to be adequate for the stated purposes of this study. The protocol is accomplished as part of the fish assemblage method in order to produce the data quantity required by the study design. This will be performed by a Level 3 QDC fish crew leader.

Water Quality Assessment

Water quality samples will be collected as grabs during normal summer-fall flow conditions. Because chemical/physical data is being used in a supporting role and as an exposure indicator, the statistical rigor needed to validate water quality criteria exceedances is reduced. The frequency and parameter requirements have been scaled to the risk or likelihood of detecting a

Table 4. *Specifications for boatable, wadeable, and headwater macroinvertebrate sampling methods.*

Parameter/Attribute	Inland River Boatable[1]	Inland Stream - Wadeable[2]	Inland Stream - Headwaters[3]
Waterbody Size in Drainage Area (mi.^{2})	>200-500	<10-500	<10
Protocol	Quantitative Method	Quantitative Method	Qualitative Method
Primary Collection Device	Artificial Substrates	Artificial Substrates	Dip Net/Hand Pick
Secondary Collection Device	Dip Net/Hand Pick	Dip Net/Hand Pick	PHWH <2.5 mi.^{2}
Effort	6 week deployment	6 week deployment	$\geq$30 minutes until no new taxa observed
Seasonal Index Period	June 16-October 15	June 16-October 15	June 16-October 15
CPUE[4] Basis	Number organisms/ft.^{2}	Number organisms/ft.^{2}	General estimates of abundance
Subsampling	Proportioned by Sample Splitting	Proportioned by Sample Splitting	Time based (min. = 30 minutes)
Taxonomic Resolution	Lowest Practicable (Genus/species)	Lowest Practicable (Genus/species)	Lowest Practicable (Genus/species)
Field Crew	Crew Leader plus one technician	Crew Leader plus one technician	Crew Leader plus one technician

Footnotes: 1 - Requires a boat or raft platform to effectively sample fish; 2 - Sampled effectively by wading; 3 - drainage area <10 mi.^{2}; 4 - Catch per unit of effort measured by artificial substrate surface area.

particular substance or parameter. Other parameters not included in the core conventional, demand, ionic strength, or nutrient parameter groups can be added as necessary.

Datasondes will be deployed in selected mainstem and tributary segments with suspected or known D.O. and nutrient enrichment issues. This consists of multiple Datasondes deployed over 3-4 day periods at the biological sites in a longitudinal “pollution survey” design to develop and understand the D.O. profile. The deployments will also be done during the lowest flow and highest temperature weeks of the summer study period which generally occurs between early-

July and early September. The segments and number of sites will be determined during the annual study planning.

Reference Sites

Least impacted reference sites should be located both within and outside of the DOSD MS4 area for biological, habitat, and chemical/physical data. The first choice will be to rely on existing Ohio EPA reference sites within the Upper and Central Scioto River basin with respect to keeping similarities in ecoregions and subregions as a guiding principle.

A Rotating Basin Approach

This Plan establishes a systematic process by which subwatersheds with priority DOSD projects and operations will be assessed and which is amenable to a rotating approach through time. Within this approach there is flexibility in terms of which parts of each subwatershed are the subject of what types of sampling, i.e., problem areas or “hot spots” identified by updated baseline assessments can be followed up with specific types and designs of biological, chemical, and physical monitoring and assessment or other types of follow-up investigations. New subwatersheds that are not included in the initial design can be added at any time and others in the current Plan can be deferred to a later year.

HUC12 watersheds and the Ohio EPA Large River Assessment Units (LRAU) will be used as the initial organization of the stream subwatersheds and river mainstem reaches as the basis for a rotating approach to monitoring and assessment. It is important to understand that HUC12 “watersheds” are not true watersheds in terms of forming boundaries of the drainages of individual rivers and streams within a catchment area. Accounting for individual streams and their tributaries is an important part of the annual Project Study Plan process hence the initial allocation of sites was done on that basis. It also raises an important difference between how Ohio EPA reports status in their biennial Integrated Report and how accounting for impairment and attainment of aquatic life and recreational uses will be done at the site, reach, and HUC12 scales by this Plan.

Fourteen (14) priority monitoring units are included among the DOSD priority mainstems and HUC12 watersheds in terms of priority DOSD management and abatement actions that are anticipated over the next 10-25 years in accordance with information gleaned from the WWMP (Columbus DOSD 2015). Sampling sites were allocated using a combined geometric design and pollution survey approach previously described and portrayed in Figure 4 with and without the coinciding Ohio EPA historical and MBI 2016-2022 sites. The individual accounting of geometric sites, historical sample sites, and the 2023 Ohio EPA sites appears in Appendix B. In this process the geometric sites are matched to historical sites when they are in close enough proximity,

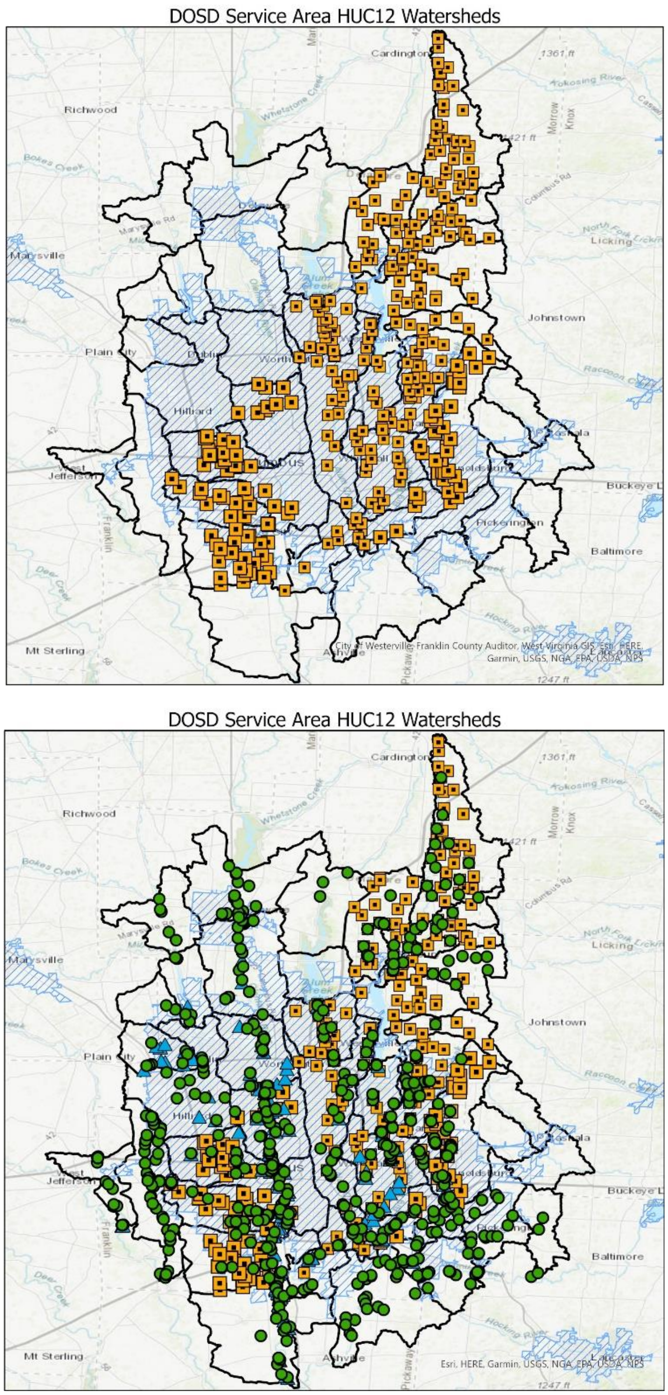

***Figure 4**. Geometric site locations within priority DOSD HUC12 watersheds (upper) compared to locations sampled by Ohio EPA prior to 1999-2012 and MBI in 2016-22.*

otherwise the geometric site will be a new sampling location intended to fill gaps left by prior surveys. Mainstem rivers have varying levels of historical coverage so these sites will be selected to match the most comprehensive of the historical surveys some of which date back to The 1970s, 1980s, 1990s, and 2000s. The Scioto and Olentangy River mainstem sites have already been established by the 2020 and 2022 MBI/DOSD surveys.

The result is an allocation of sites by each HUC12 that forms the basis for a rotation of watersheds and mainstems between 2024 and 2031 for Phase I, and 2032 and 2039 for Phase II which will follow up on WWWP implementation after the Phase I baseline is updated (Table 5). A phase III should be added for 2040-2047 given the population growth that is anticipated through this time period. Phase I will accomplish the updating of baseline biological, habitat, and chemical data by filling gaps left by previous surveys by Ohio EPA and recognizing that the 2023 and 2024 Ohio EPA surveys scheduled for the Central Ohio area will leave many of these gaps unfilled. The Phase I monitoring will also resolve any undesignated or improperly designated streams, updating the current attainment status, revealing previously unknown pollution sources, and filling gaps left by historical surveys for the HUC12 watersheds. Phase II will be a follow-up to management actions taken via the WWMP via Project Blueprint, CSO and SSO abatement, and general management and maintenance of the sewer system. This will

***Table 5**. Annual monitoring rotation for priority mainstem and HUC12 watersheds of interest to Columbus DOSD relevant to the management of the sewer system and the Wet Weather Implementation Plan (WWIP; Columbus DOSD 2015) with the most recent M&A year, Phase I and II follow-up M&A for 2024-20321 and 2033-2041, and the number of sites with fish, macroinvertebrate, and chemical/physical parameter groups.*

DOSD Priority Mainstem or Watershed	Survey Years			Estimated Sites	Fish Assemblage			Macroinvertebrates		Chemical Parameter Groups					
	Most Recent Survey	Phase I	Phase II		Boat/Raft	Wading	Head-water	HD	Qualita-tive	Conven-tional/ Demand	Nutrient Related	Ionic Strength	Metals/ Toxics	Sediment	Data-sonde
Robert Milliken Ditch- HUC 050600011205 (Dry Run, Trabue Run)	2012/2023	2024	2033	25	0	5	20	0	20	80	80	80	80	8	6
Kian Run - Scioto River - HUC 050600012302	2012/2023	2024	2033	3	0	0	3	0	3	12	12	12	12	3	1
Scioto Big Run - HUC 0506000123 (Marsh Run)	2012/2023	2025	2034	25	0	0	25	0	25	100	100	100	100	12	6
Outlet of the Olentangy River - HUC 050600011103 Rush Run to mouth - (Adena Brook, Turkey Run, + other tributaries)	2022	2026	2037	18	7	0	16	7	16	106	106	106	106	9	0
Rush Run Olentangy River - Hyatts Rd. to Rush Run HUC 050600011103	2022	2026	2037	6	4	0	2	4	2	32	32	32	32	8	3
Scioto River Mainstem - Big Walnut Creek to Circleville LRAU	2022	2027	2036	17	17	0	0	17	0	102	102	102	102	17	15
Scioto River Mainstem - Griggs to Big Walnut Creek LRAU	2022	2028	2035	17	17	0	0	17	0	102	102	102	102	17	15
Grant Run - Scioto River HUC 050600012303 (Republican Run)	2012/2023	2029	2038	10	0	0	10	0	10	40	40	40	40	6	4
Bliss Run – Alum Creek HUC 050600011602 (Alum Creek mainstem Three Rivers Park)	2000/2023	2029	2038	20	4	10	6	14	6	108	108	108	108	14	10
Gahanna - Big Walnut Creek mainstem - Hoover Reservoir to Gahanna - HUC 050600011502	2000/2023	2030	2039	10	0	6	4	6	4	52	52	52	52	12	8
Mason Run – Big Walnut Creek mainstem to Three Rivers Park - HUC 050600011505	2000/2023	2030	2039	14	0	8	6	6	2	72	72	72	72	12	10
Lockbourne - Alum Creek HUC 050600011603 - Lower Big Walnut Creek mainstem	2000/2023	2031	2040	8	3	3	2	6	2	44	44	44	44	8	6
Town of Brice - Blacklick Creek -HUC 050600011504	2000/2023	2031	2040	15	0	10	5	10	5	80	80	80	80	16	10
Headwaters Blacklick Creek - HUC 050600011503	2000/2023	2032	2041	20	0	12	8	12	8	104	104	104	104	16	12
Totals				**208**	**52**	**54**	**107**	**99**	**103**	**1034**	**1034**	**1034**	**1034**	**158**	**106**

also provide additional support for the MS4 program and local stakeholders that would otherwise not have been available. As resources permit it is recommended to conduct a limited number of chemical analyses for newly emerging pollutants (Bradley et al. 2023) that pose a potential threat to the current high quality of many Central Ohio rivers and streams and potentially limit the abatement actions planned to correct SSOs and CSOs. Urban areas are prime sources of such pollutants most of which are not monitored routinely or at all.

The Scioto River mainstem will be re-assessed over two consecutive years, 2026/2027 and 2035/2036 in follow-up to the anticipated start-up of receiving new wastewater flows from Intel and related developments that are anticipated to take place before and during the Phase I timeframe (Table 5). It will duplicate the scope of the 2020 and 2022 surveys (MBI 2022, 2024) in the aggregate, support needs related to anticipated developments related to potential new nutrient and other water quality criteria that might affect either one of the major wastewater treatment plants and characterize and evaluate any changes in attainment status from new or emerging threats. The Olentangy River mainstem and tributaries are scheduled for 2028 and will follow the scope of the 2020 and 2022 surveys and timed for the completion of Project Blueprint phases and CSO/SSO abatement in general. The remaining watersheds and mainstems are likewise scheduled to coincide with Project Blueprint in those watersheds first to establish a baseline coverage within each watershed and with Phase II as a follow-up to that implementation. Other issues of importance to DOSD include Alum Creek which has a mix of Project Blueprint, SSO abatement, and a CSO in the form of the standby storm tanks in the lower mainstem. Big Walnut Creek and Blacklick Creek are included as later project areas that have a dated, but nearly complete baseline dating back to 2000. These mainstems and watersheds have major trunk sewers and sewersheds, and are major contract areas for DOSD. Each will be subjected to the rapid development that is imminent in these eastern Franklin Co. and Western Licking Co. watersheds.

Execution of the Watershed Assessment Plan

The sequence of events within a given year from the initial screening of issues to detailed study planning through the production of a final assessment report is summarized in Table 6. This includes major milestones and activities including understanding the pollution issues in specific subwatershed areas for monitoring, planning the monitoring activities, developing a Level 3 Project Study Plan, conducting the monitoring, data custody, data management, QA/QC, transformation of data into information, assessment and interpretation of the results, and the making of conclusions and recommendations via formal reports. The major milestones are arranged sequentially and by major task. The process operates in a continuous cycle such that work will take place in as many as 2 or 3 different years of monitoring at any given time, i.e., while year 1 reports are being completed, year 2 mobilization is underway, and year 3 planning

***Table 6**. Important timelines and milestones in the planning and execution of annual monitoring and assessment for the Columbus DOSD watershed assessment program.*

Milestone	Project Months	Activity Description
March - May	1-3	Annual DOSD project planning; development of Level 3 Project Study Plan
May -June	3-4	Field crew mobilization; lab coordination
June - October	4-8	Field sampling; lab samples and analysis
October - November	8-9	Field crew demobilization; iniate data custody & management
November - March	9-14	Biological laboratory analysis; data entry & screening
January - April	11-15	Data analysis
April-June	15-17	Data synthesis and report production

is underway, etc. The process is coordinated by the same personnel who develop the detailed plan of study and who also manage and oversee the reporting and analysis of the results. A written study plan, which delineates the study area boundaries, the scope and objectives, specific sampling locations, indicators, parameters, frequencies, and index sampling periods, is prepared for each subwatershed year and fulfills the requirements of a Level 3 PSP for approval by Ohio EPA. Individual teams involved in the sampling are each responsible for assuring data quality, integrity, and adherence to chain-of-custody procedures under the oversight of a project manager. Data collected via this process is validated in accordance with the approved Level 3 PSP and by Level 3 QDCs.

Ohio EPA initiated monitoring under their recently adopted Two-Pronged Approach within the Columbus DOSD service and MS4 areas in 2023 and as planned for 2024. However, this new approach has a lower spatial coverage by as much as 60-75% which is a significant change in the coverage that had been provided by the watershed focused program that had existed for 40 years prior to 2018 when the Two-Pronged approach was introduced. While the historical database remains useful for conducting planning and supporting regionalized analyses of watershed characteristics and trends, the new approach will not be of a sufficient spatial density to support the types of watershed based data analysis that are needed to develop more effective and informative assessment, planning, and forecasting tools to support DOSD going forward. Hence the approach to monitoring in the DOSD service and MS4 areas detailed in this Plan is needed to maintain spatial coverage, but will take advantage of the comparatively limited monitoring that Ohio EPA will provide on a 12 year interval as much as is possible. This detailed monitoring and assessment Plan can also serve as a guide for cooperation and coordination with Ohio EPA, local government agencies, and both regional and local stakeholders with interests in watershed quality across the Central Ohio region.

DEVELOPMENT OF A REGIONAL DATABASE FOR THE UPPER AND MIDDLE SCIOTO RIVER BASIN

Effective management of water quality and biological condition in the streams and rivers of Central Ohio requires a readily available and organized baseline of biological, habitat, and chemical/physical data that can be readily merged with land use and GIS based outputs and tools such as the U.S. EPA StreamCat framework (Figure 5; Hill et al. 2016). A major task of the Central Ohio Watersheds Biological and Water Quality Assessment Plan Development is the organization of a database of existing biological, habitat, and chemical/ physical data that meets Level 3 credible data specifications and is readily available. The major sources of data that were accessed are from Ohio EPA, MBI, and Columbus DOW for fish, macroinvertebrates, and water chemistry. Freshwater mussel data is scattered across multiple sources including The Ohio State University, Otterbein, Ohio DNR, and Ohio DOT and are monitored independent of the other data hence pairing it may present some challenges. A principal requirement for being included in this database is Level 3 biological data for fish and/or macroinvertebrates,

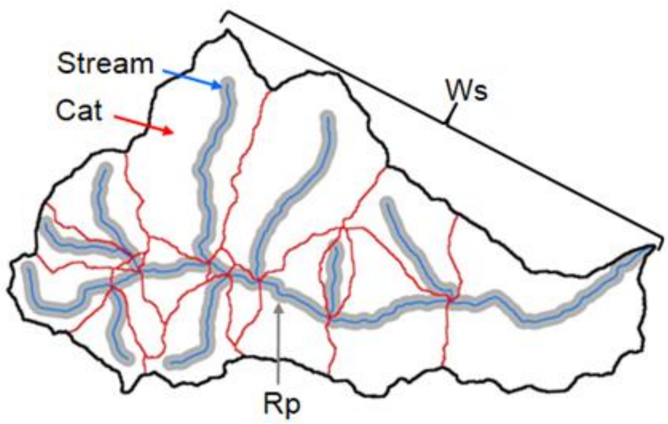

***Figure 5**. The geospatial framework used by the U.S. EPA StreamCat dataset (after Hill et al. 2016). Abbreviations follow: COMID - Stream segment unique identifier [for each reach; Catchment (Cat) is the portion of the landscape that drains directly to an NHD stream segment, excluding any upstream contributions; Watershed (Ws) is a set of hydrologically-connected catchments, including all upstream catchments that flow to any focal catchment; Riparian Buffer (Rp) is spatial buffers of 100-m that were added to the NHDPlusV2 stream network and to NLCD water pixels in contact with NHDPlusV2 stream lines. The buffers are used to spatially constrain calculations of some landscape metrics to within 100 meters of the NHDPlusPlusV2 stream lines and on-network NLCD water pixels.*

habitat data in the form of the QHEI, and paired chemical water quality data both water column and sediment chemistry. Data were initially retrieved from the Upper and Middle Scioto River subbasins, but given the anticipated development along the eastern border of these subbasins, data from the western subwatersheds of the Licking River basin were included. More than 40 years of systematic watershed level biological and water quality assessments, mostly by Ohio EPA, has produced a robust and systematic database with broad spatial coverage of all mainstem rivers and streams including headwaters (Figure 6). Table 7 lists the number of sites and samples for each of which there are between 2,500-5,000 samples. The sediment chemistry

Table 7*. The number of historical sites with qualifying data in the Upper and Middle Scioto River subbasins that are included in the Central Scioto River database managed by MBI.*

Fish/Habitat			Macroinvertebrates			Water Chemistry			Sediment Chemistry		
Head-water	Wade-able	Boat-able	Head-water	Wade-able	Boat-able	Head-water	Wade-able	Boat-able	Head-water	Wade-able	Boat-able
1555	1797	1831	1116	1015	433	820	1161	806	9	6	64
Total Samples: 5,183			Total Samples: 2,564			Total Samples: 2,787			Total Samples: 79		

database is limited by comparison to only 79 sites located mostly in major rivers and streams. The comprehensive Upper and Middle Scioto subbasins database is stored in relational PC data tables in MBI ECOS, which is exportable to multiple formats (e.g., Excel, Access). MBI ECOS is being migrated to a SQL cloud-based system over the next several years. Many of the tables follow the structure and concepts found in the Ohio EPA EA3 data system and the U.S. EPA Water Quality Exchange (WQX) data formats. The structure and links between the data are portrayed in Figure 7. Included are the key data fields and a summary of the types of fields that each data table contains (there are numerous fields in each table). It provides the structure to relate the data within their most appropriate roles as stressor, exposure, and response indicators. Data is readily exported to statistical tools (e.g., R Statistics, R Code Team 2021) and data visualization tools such as Power BI, Power Report Builder, and Arc Story Map. This is a key first step in the eventual derivation of response thresholds for an array of chemical, physical, and land use variables that will improve watershed management by offering both observed and predicted effects and outcomes. It offers a more comprehensive way to both plan and assess the impacts of watershed development and pollutional impacts in general.

PROPOSED MONITORING AND ASSESSMENT SCOPE AND BUDGETS

Cost estimates were developed for a typical year of watershed monitoring and assessment based on the level of effort needed to collect samples for fish/habitat, macroinvertebrates, and grab water samples at 25-30 sites and ~100 water samples per year in Table 8. Sediment chemistry and Datasondes will be done at fewer sites in watersheds that are dominated by

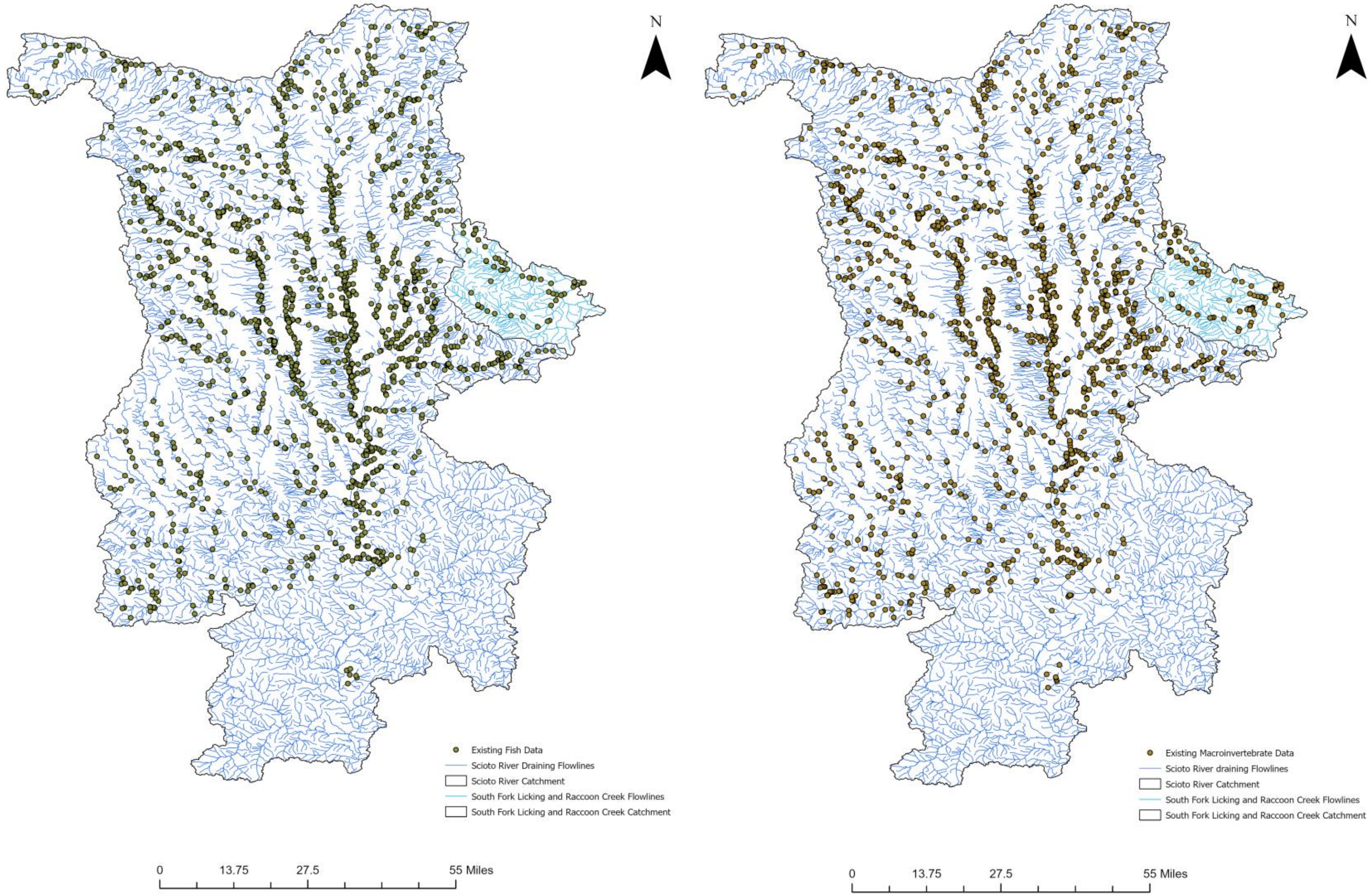

***Figure 6**. Locations of fish (left) and macroinvertebrates (right) that are included in the Central Ohio watersheds database*

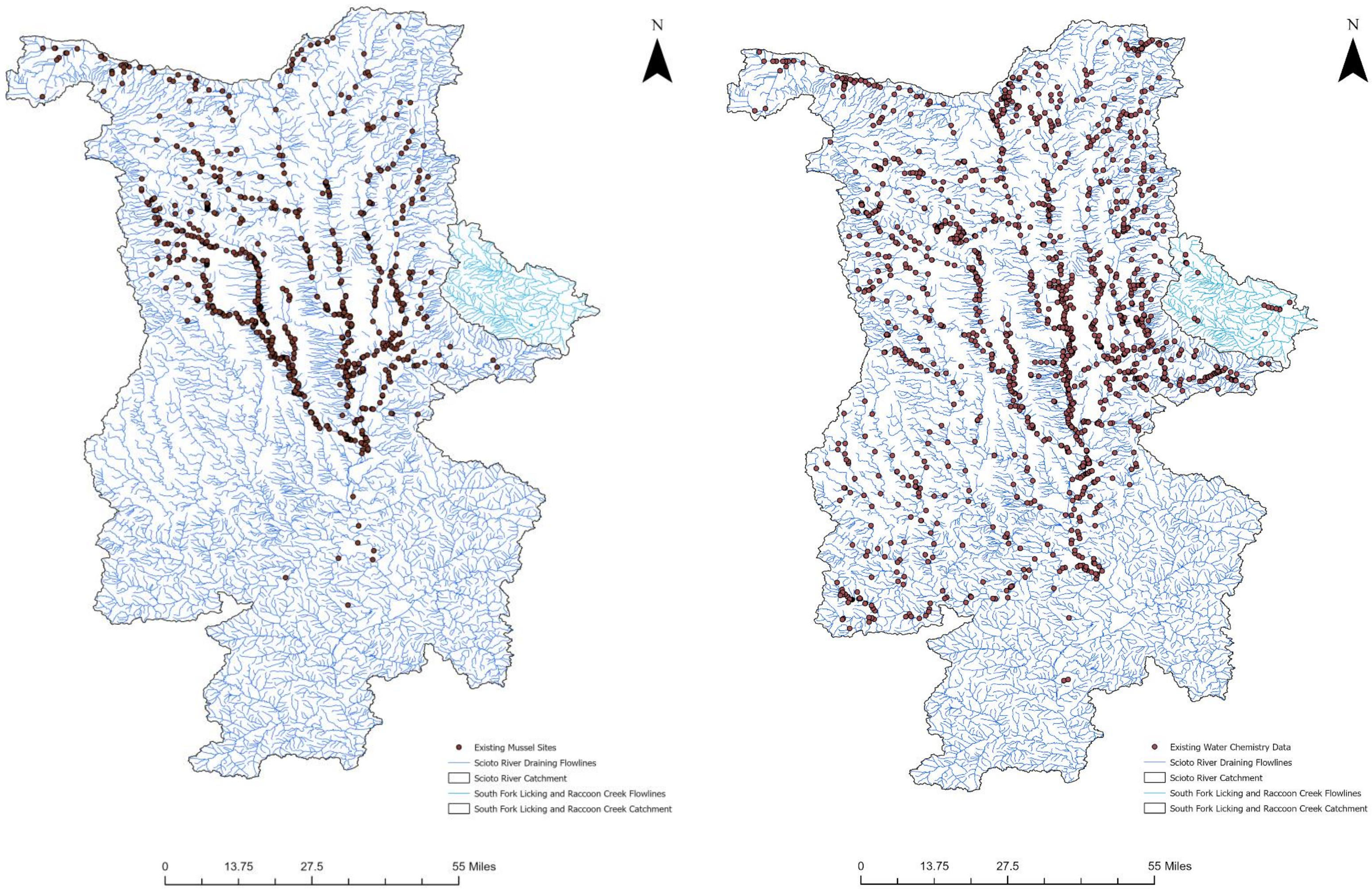

***Figure 7**. Locations of freshwater mussels (left) and water chemistry (right) data that are included in the Central Ohio watersheds database.*

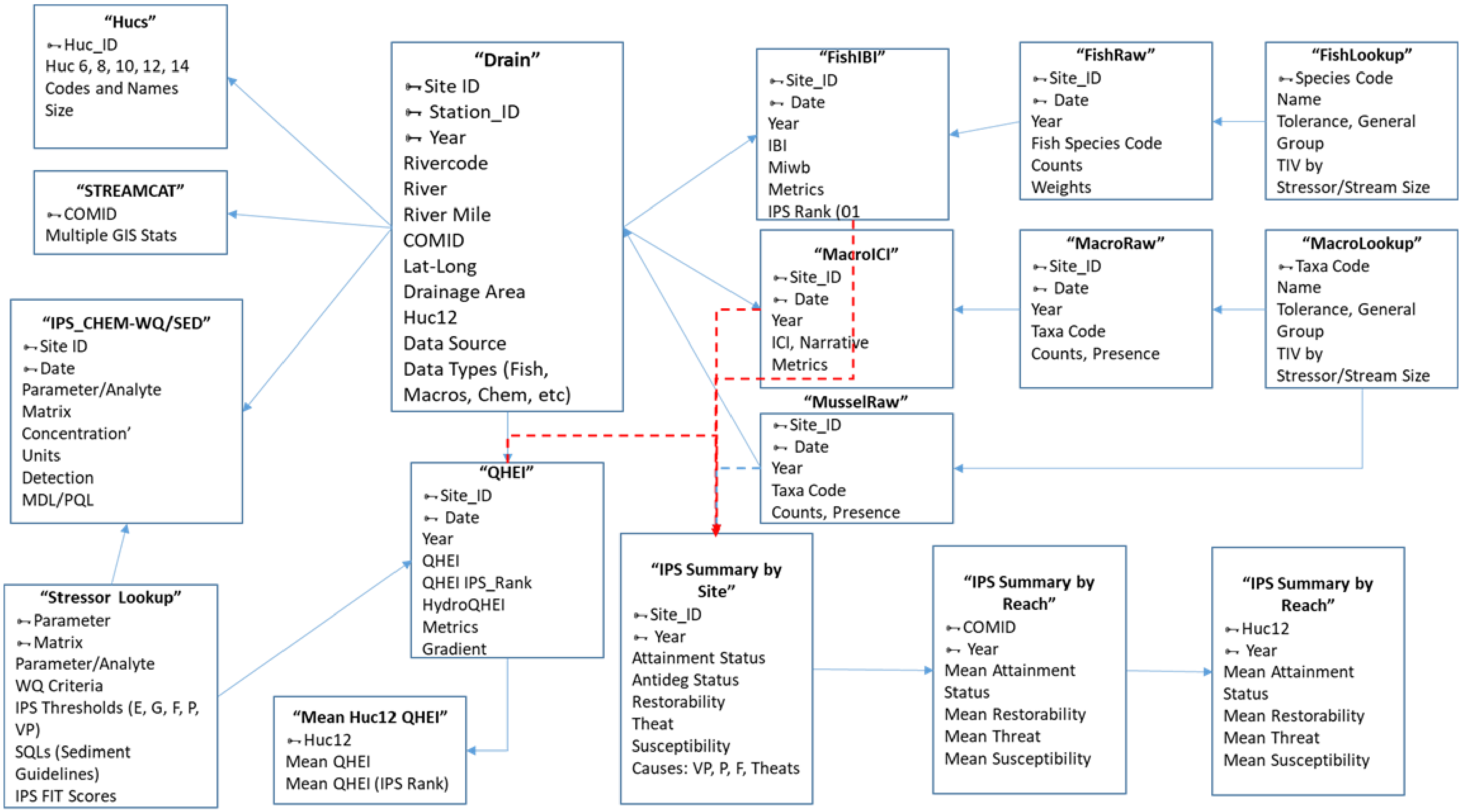

***Figure 8**. Summary schematic of the data structure underlying the Central Ohio database of existing biological, habitat, and chemical/physical data supported by MBI.*

headwater and smaller wadeable streams. For grab water sample collection, headwater sites will be sampled two (2) to four (4) times and larger wadeable and mainstem sites four (4) to six (6) times within the summer-early fall index period for the usual array of conventional, demand, nutrient related, ionic strength, and metals parameters and *E. coli* with the option to add a yet to be determined number of emerging pollutants at representative sites. The total number of water samples and analytes by parameter group ranges annually from 92-108 for each of the aforementioned parameter groups. For survey years with nutrient issues, sestonic and benthic chlorophyll a is included and to be analyzed by a contract laboratory. Annual costs are fixed so

Table 8*. Estimated annual level of effort and annual budgets for eight (8) years of monitoring following a rotation of HUC12 and mainstem survey areas to establish updated baselines and initial follow-up monitoring in DOSD priority areas 2024-2032.*

	Survey Years			**Estimated LOE_Budget**	
DOSD Priority Mainstem or Watershed	**Most Recent**	**Phase I**	**Phase II**	**Phase I Sites**	**Phase I Annual Budget**
Robert Milliken Ditch- HUC 050600011205 (Dry Run, Trabue Run)	2012/2023	2024	2033	25	$70,000
Kian Run - Scioto River - HUC 050600012302	2012/2023	2024	2033	3	
Scioto Big Run - HUC 0506000123 (Marsh Run)	2012/2023	2025	2034	25	$80,000
Outlet of the Olentangy River - HUC 050600011103 Rush Run to mouth - (Adena Brook, Turkey Run, + other tributaries)	2022	2026	2037	18	$82,500
Rush Run Olentangy River - Hyatts Rd. to Rush Run HUC 050600011103				6	
Scioto River Mainstem - Griggs to Big Walnut Cr. LRAU	2022	2027	2035	16	$85,000.00
Scioto River Mainstem - Big Walnut Cr. to Circleville LRAU	2022	2028	2036	16	$87,500.00
Grant Run - Scioto River HUC 050600012303 (Republican Run)	2012/2023	2029	2038	25	$90,000
Bliss Run – Alum Creek HUC 050600011602 (Alum Creek mainstem Three Rivers Park)	2000/2023	2030	2039	20	$93,000
Gahanna - Big Walnut Creek mainstem - Hoover Reservoir to Gahanna - HUC 050600011502	2000/2023			6	
Mason Run – Big Walnut Creek mainstem to Three Rivers Park - HUC 050600011505	2000/2023	2031	2040	14	$95,500
Lockbourne - Alum Creek HUC 050600011603 - Lower Big Walnut Creek mainstem	2000/2023			8	
Town of Brice - Blacklick Creek -HUC 050600011504	2000/2023	2032	2041	12	$98,000
Headwaters Blacklick Creek - HUC 050600011503	2000/2023			20	
Total Phase I				**214**	**$781,500**

variations between small streams and larger river sites requiring boat/raft sampling for fish, artificial substrates in lieu of qualitative only samples for macroinvertebrates, more or less frequently collected water samples, and the number of sediment chemistry and Datasonde sites will be tailored to the annual budgets. The estimated annual costs for each survey year appears in Table 8 with a simple annual escalation of 3% added to each year from 2026 through 2032. The cost estimate does not include the long term deployment of Datasondes as was done in 2022, but it does include short term deployments and the chemical parameters necessary to accomplish the Ohio EPA Stream Nutrient Assessment Procedure (SNAP; Ohio EPA 2015b) and the Large Rivers Nutrient Assessment (Miltner 2018) the same as was accomplished in 2020 (MBI 2022) and 2022 (MBI 2024). The estimates do not include the addition of a mussel survey for the larger mainstems as was recommended by the 2022 Scioto_Olentangy assessment (MBI 2024). The long term Datasondes and/or mussels could be added as deemed necessary to the 2027/2028 Scioto and 2027 Olentangy surveys.

An accounting for how the proposed 2024-2032 monitoring effort compares in terms of sites and steam sizes to past Ohio EPA surveys under the former intensive survey design and the new Two-Pronged approach appears in Table 9. The progression of drainage area ranges are the geometric divisions or “panels” up to a drainage area range of 50-100 square miles. Mainstem sites are listed separately based the number of sites that were sampled the late 1990s and early 2000s on the major mainstem rivers and streams including the Olentangy River, Alum Creek, Big Walnut Creek, and Blacklick Creek. The Scioto River mainstem sites were not included as the geometric design does not influence the selection of mainstem river sites. The decline in spatial coverage between the geometric and Two Pronged approaches is apparent while the differences between the 1990s/2000s era Ohio EPA surveys are mixed due to the low level of effort applied in certain HUC12 tributaries. The DOSD design will assure that pollution impacts of interest are adequately covered and without the need to over extrapolate the results from single sites to entire watersheds or mainstem reaches.

***Table 9**. Comparison of sampling sites for the 12 DOSD priority HUC12 watersheds derived from a geometric selection and actual sites sampled by Ohio EPA under the intensive pollution survey design in the late 1990s and early 2000s and under the Two-Pronged Approach in 2023. The 2022 MBI survey in the Rush Run and Outlet of the Olentangy R. HUCs are also included.*

Subwatershed (HUC12 Number)	Year	Total Sites	Sites <2 sq. mi.	Sites >2-4 sq. mi.	Sites >4-8 sq. mi.	Sites >8-20 sq. mi.	Sites >20-50 sq. mi.	Sites >50-100 sq. mi.	Mainstem Sites[a]
Rush Run-Olentangy River (050600011102)	Geometric	19	11	6	2	0	0	0	NA
	MBI 2022	4	3	1	0	0	0	0	4
	OEPA 1999	4	2	2	0	0	0	0	3
	OEPA 2024	To be determined							
Outlet of the Olentangy River (050600011103)	Geometric	7	4	3	0	0	0	0	NA
	MBI 2022	9	4	5	0	0	0	0	7
	OEPA 2003	5	1	4	0	0	0	0	6
	OEPA 2024	To be determined							
Robert Millikin Ditch (050600011205)	Geometric	18	8	9	1	0	0	0	NA
	OEPA 2010	3	0	0	3	0	0	0	4
	OEPA 2023	2	0	0	2	0	0	0	0
Scioto Big Run (05060001230	Geometric	19	8	8	1	1	1	0	NA
	OEPA 2007	8	1	3	1	3	0	0	3
	OEPA 2023	5	0	0	0	2	0	0	0
Kian Run - Scioto R. (050600012302)	Geometric	4	1	3	0	0	0	0	NA
	OEPA 2010	1	0	0	0	1	0	0	6
	OEPA 2023	1	0	0	0	1	0	0	0
Grant Run - Scioto R. (050600012303	Geometric	28	12	12	3	3	4	0	NA
	OEPA 2010	4	0	0	4	0	0	0	6
	OEPA 2023	4	0	0	3	1	0	0	0
Bliss Run – AlumCreek (050600011602)	Geometric	21	11	9	1	0	0	0	NA
	OEPA 2000	7	4	3	0	0	0	0	6
	OEPA 2023	2	0	1	1	0	0	0	0
Mason Run – Big Walnut Creek (050600011505)	Geometric	15	9	5	1	0	0	0	NA
	OEPA 2000	3	0	1	0	2	0	0	2
	OEPA 2023	1	0	0	0	1	0	0	3
Gahana - Big Walnut Creek (050600011502)	Geometric	5	5	0	0	0	0	0	NA
	OEPA 2000	2	2	0	0	0	0	0	4
	OEPA 2023	0	0	0	0	0	0	0	3
Lockbourne Big Walnut Creek - (050600011603)	Geometric	6	4	2	0	0	0	0	NA
	OEPA 2000	1	0	1	0	0	0	0	4
	OEPA 2023	0	0	0	0	0	0	0	2
Headwaters of Blacklick Creek (050600011503)	Geometric	34	16	13	1	1	1	0	NA
	OEPA 2000	21	7	6	1	4	3	0	9
	OEPA 2023	6	2	0	1	1	3	0	4
Town of Brice – Blacklick Creek (050600011504)	Geometric	8	3	3	1	0	0	1	NA
	OEPA 2000	6	0	2	0	0	1	3	5
	OEPA 2023	3	0	0	0	0	0	3	3

Footnotes: a - not included in total site count; NA - not applicable to mainstem site selection.

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Appendix A: Central Ohio Watersheds Columbus DOSD Focused Framework Discussion Outcomes

Conceptual

1. CWA is the guiding theme including WQS (uses and criteria), NPDES permitting (major and minor point sources), TMDLs, stormwater (MS4 and other), grants, and planning.

2. Ohio Credible Data Law and Regulations – Level 3 specifications for all data collection and analysis.

3. Emphasis on aquatic life use due to its breadth of influence on CWA programs and its application to all water bodies – biocriteria based assessment of status with chemical/physical and habitat data sufficient to support assignment of predominant causes to be addressed via management and/or restoration practices.

4. Recreational use assessment via *E. coli* in chemical sample collection and lab analyses.

5. Drinking water and human and wildlife health uses can be addressed by adding chemical lab analytes and tissue analysis.

6. Historical data will be assessed for trends whenever available (~720 sites since 1979).

7. Collaborate with existing monitoring programs (e.g., Franklin Co. SWCD, Columbus AWPD), emerging watershed management initiatives (e.g., MORPC), and other stakeholders with overlapping interests in stream and watershed quality.

DOSD and MS4 Project Site-Reach Approach

1. Scioto River mainstem – extend the 37 year (1979-2015) Scioto River mainstem bioassessment into 2020-21 (completed) and 2022-23 (underway) with periodic surveys to track trends and support DOSDS NPDES permitting and related needs.

2. Assess rivers and streams directly and indirectly impacted by Project Blueprint to track any changes resulting from that program and other Wet Weather Management Program (WWMP) actions.

3. Current and future MS4 wet weather monitoring locations as a demonstration about how watershed based monitoring and assessment can benefit that program.

4. Use major river mainstems and a HUC12 watershed scale as the basis of the spatial sampling design.

Proposed MS4 Watershed Approach

1. Greater Central Ohio 12-digit HUCs; essentially the Upper and Central Scioto River Basin and adjacent watersheds that flow into the MS4 area.

2. Execute a rotating basin approach ideally over a 10 year cycle sampling ~1000 sites or 100 sites/year.

3. Development of a regional IPS model will be the ultimate outcome and tool to support NPDES and MS4 permitting and watershed management including the interests of other governmental agencies (Franklin Co. SWCD) and nongovernmental organizations (e.g., COWC, FLOW, MORPC, etc.).

Regional Watershed Approach

1. Provides a consistently developed and managed database and supporting model and tool development that will benefit different organizations each of which have their own goals and objectives and expectations.

2. M&A would be across all Central Ohio subbasins and utilizing the historical database from Ohio EPA both within and adjacent to the Columbus DOSD service and MS4 areas (~750 sites), which appears to be sufficient for the initial exploratory analyses required for IPS development.

3. Provides an ideal and data driven framework of coordination between different entities and stakeholders that have the attainment of CWA goals and the Ohio WQS as either an explicit or indirect requirement.

4. Development of a Central Ohio IPS framework and model that provides a standardized "toolset" based on a robust monitoring and assessment framework to the benefit of all organizations and stakeholders resulting in a greater assurance that planning and abatement efforts will conform to the Ohio WQS.

***Appendix Table B-1**. Central Ohio Rivers and Streams sampled by MBI in support of multiple stakeholders during 2016-2022 and as Level 3 data.*

Site ID	Basin	Stream	River/Stream Name	Latitude	Longitude	RM	Year	Location Description	Drainage Area	Fish[1]	Macroinverts.[1]	Habitat[1]
Big Walnut Creek Mainstem												
BW10	02	100	Big Walnut Creek	39.995830	-82.860000	26.7	2016	Ust Confluence with UT at RM 26.5	240	D	HD	QHEI
BW09	02	100	Big Walnut Creek	39.994110	-82.857070	26.3	2016	Dst Confluence with UT at RM 26.5	241	D	HD	QHEI
BW08	02	100	Big Walnut Creek	39.985940	-82.866090	25.57	2016	Dst Rail Road Tracks	242	D	HD	QHEI
BW07	02	100	Big Walnut Creek	39.953940	-82.853020	22.7	2017	Dst E Main St	247	D	HD	QHEI
BW06	02	100	Big Walnut Creek	39.849674	-82.971449	9.6	2021	Dst Lockbourne Rd.; Hamilton Twp. Park	540	A	HD	QHEI
Big Walnut Creek Tributaries												
MR08	02	122	Mason Run	39.97361	-82.89055	5.2	2016	Dst E Broad St	2.19	E	QL/PH	QHEI/HHEI
MR06	02	122	Mason Run	39.96615	-82.89702	4.3	2016	Dst Confluence with Turkey Run	6.54	E	QL	QHEI
MR05	02	122	Mason Run	39.95722	-82.89833	3.8	2016	Dst Elm St	7.21	E	QL	QHEI
MR04	02	122	Mason Run	39.91541	-82.89023	0.5	2016	Dst Refugee Rd	12.1	E	QL	QHEI
TR07	02	119	Turkey Run	39.98673	-82.90565	1.7	2016	Dst N James Rd	3.4	E	QL	QHEI
WCP01	02	919	Unnamed Trib to Big Walnut Creek at RM 25.0	39.98048	-82.86596	0.01	2016	At Whitehall Community Park	0.41	E/F	QL/PH	QHEI/HHEI
SHR01	02	920	Unnamed Trib to Big Walnut Creek at RM 21.3	39.93728	-82.87136	0.5	2016	Dst S Hamilton Rd, Adj to I-70	1.55	E/F	QL/PH	QHEI/HHEI
WG01	02	921	Unnamed Trib to Big Walnut Creek at RM 19.65	39.919810	-82.874710	0.3	2016	Dst I-270, Adj Walnut Glen Apartments	2.45	E/F	QL/PH	QHEI/HHEI
Scioto River												
SC20	02	001	Scioto River	39.607450	-82.958700	100.0	2019	Circleville Riffle - U.S. Rt. 22	3197	A	HD	QHEI
Olentangy River												
OLN15	02	001	Olentnagy River	40.244135	-83.058620	20.0	2019	Along Chapman Rd. at Havener Property	450	D	QL	QHEI
Upper Alum Creek Watershed												
AC01	02	110	Alum Creek	40.357610	-82.919730	43.0	2020	Ust Myers Rd	35.8	D	HD	QHEI
AC04	02	110	Alum Creek	40.375130	-82.882963	46.0	2020	Immediately Ust. SoMoCo WWTP	26.6	D,E	HD	QHEI
AC03	02	110	Alum Creek	40.373439	-82.884420	45.7	2020	Immediately Dst. SoMoCo WWTP	27.8	D,E	HD	QHEI
AC02	02	110	Alum Creek	40.369332	-82.899528	44.7	2020	Cemetary off of Worthington-New Haven Rd.	29.4	D,E	HD	QHEI
WAC01	02	118	West Branch Alum Creek	40.363140	-82.923420	0.6	2019	Ust N Old State Rd	29.0	D	HD	QHEI
ACT01	02	113	Unnamed Tributary to Alum Creek @RM 43.16	40.363140	-82.923420	0.15	2019	Ust N Old State Rd	29.0	F	QL	QHEI/HHEI
Kinnikinnick Creek 2022												
KC01	02		Kinnikinnick Creek	39.432796	-82.962360	1.40	2021	Ross Co. property NNW of St. Rt. 159/180	35.0	D/E	QL	QHEI
Upper Big Darby Creek												
PFUT01	02	370	Unnamed Trib to Big Darby Creek at RM 77.32	40.253399	-83.547871	0.4	2019	Ust Inskeep Cratty Rd. - Schwab Property	3.10	E/F	QL	QHEI

[1] - Sample types: A - boat; D - roller beast; E - longline; F - back pack; QL - Qualitative macroinvertebrate; PH - Primary Headwater; QHEI - Qualitative Habitat Evaluation Index; HHEI - Headwater Habitat Evaluation Index.

***Appendix Table B-2**. continued.*

Site ID	Basin	Stream	River/Stream Name	Latitude	Longitude	RM	Year	Location Description	Drainage Area	Fish[1]	Macroinverts.[1]	Habitat[1]
						Big Walnut Creek						
BW05.3	02	100	Big Walnut Creek	39.910883	-82.879683	18.5	2018	Ust. Hamilton Road	256	D	HD	QHEI
BW05.2	02	100	Big Walnut Creek	39.900100	-82.882670	17.3	2018	Dst. Winchester Pike	269	D	HD	QHEI
BW05.1	02	100	Big Walnut Creek	39.897865	-82.897542	16.7	2018	Dst. US 33 (power line access)	272	D	HD	QHEI
BW05	02	100	Big Walnut Creek	39.888304	-82.904524	15.9	2018	Ust. Williams Rd. (via trail @Hiland Bluff Rd)	272	D	HD	QHEI
BW06	02	100	Big Walnut Creek	39.849750	-82.971817	9.6	2017	Lockbourne Rd. @Hamilton Twp. Park	540	P	HD	QHEI
						Scioto River						
SC20	02	001	Scioto River	39.607450	-82.958700	100	2018	Circleville Riffle - U.S. Rt. 22	3197	A	HD	QHEI
						Indian Run Watershed						
IR01	02	238	Indian Run	40.102255	-83.119279	0.4	2018	Indian Run Falls Park	6.4	D/E	QL	QHEI
IR02	02	098	N. Fk. Indian Run	40.117800	-83.131900	1.8	2018	Coffman Rd.	10.2	D/E	QL	QHEI
IR03	02	098	N. Fk. Indian Run	40.122114	-83.135210	2.2	2018	N. Fork Indian Run Park	9.8	D/E	QL	QHEI
IR04	02	098	N. Fk. Indian Run	40.127221	-83.167049	4.7	2018	Wareham Drive	6.1	E	QL	QHEI
IR05	02	098	N. Fk. Indian Run	40.132600	-83.179100	5.2	2018	Hyland-Croy Rd.	5.3	E/F	QL	QHEI
IR06	02	917	U.T. to N. Fk. Indian Run	40.131598	-83.161320	0.1	2018	Shannon Glenn Park	1.4	F	QL/PH	QHEI/HHEI
IR07	02	099	S. Fk. Indian Run	40.105800	-83.138500	1.3	2018	Post Rd.	5.2	E	QL	QHEI
IR08	02	099	S. Fk. Indian Run	40.108840	-83.161089	2.6	2018	Avery-Muirfield Dr. - Trabue Nature Preserve	4.1	E	QL	QHEI
IR09	02	099	S. Fk. Indian Run	40.098061	-83.188540	4.2	2018	Cosgray Rd. - Cosgray Park	0.4	E/F	QL/PH	QHEI/HHEI
IR10	02	918	Gordon Tri-County Ditch	40.110910	-83.167633	0.1	2018	Trabue Nature Preserve	2.0	F	QL/PH	QHEI/HHEI

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***Appendix Table B-2**. continued.*

Site ID	Basin	Stream	River/Stream Name	Latitude	Longitude	RM	Year	Location Description	Drainage Area	Fish	Macroinvert	Habitat
Darby Headwaters Reserve Sites												
LD1	02	210	L. Darby Cr.	40.282376	-83.594079	2.4	2016	St. Rt. 287 - historical Ohio EPA site	3.12	LL	QL	QHEI
LD2	02	210	L. Darby Cr.	40.285904	-83.603787	3.0	2016	Logan Co. Rt. 29	2.54	LL/BP	QL	QHEI
DH3	02	xxx	U.T. to Big Darby	40.302646	-83.570865	~0.1	2016	U.T. to Big Darby - Tributary 3	0.54	BP	QL	QHEI/HHEI
DH3E	02	xxx	U.T. to Big Darby	40.303267	-83.572844	~0.1	2016	U.T. to Big Darby - Tributary 3 East	0.12	BP	QL	QHEI/HHEI
DH3W	02	xxx	U.T. to Big Darby	40.304481	-83.571909	~0.1	2016	U.T. to Big Darby - Tributary 3 West	0.33	BP	QL	QHEI/HHEI
DH4c	02	xxx	U.T. to Big Darby	40.300527	-83.572221	~0.1	2016	U.T. to Big Darby - Tributary 4C	0.07	BP	QL	QHEI/HHEI
DH5a	02	xxx	U.T. to Big Darby	40.299651	-83.57231	~0.1	2016	U.T. to Big Darby - Tributary 5a	0.10	BP	QL	QHEI/HHEI
DH6b	02	xxx	U.T. to Big Darby	40.298823	-83.571653	~0.1	2016	U.T. to Big Darby - Tributary 6b	0.14	BP	QL	QHEI/HHEI
DH7	02	xxx	U.T. to Big Darby	40.298758	-83.571195	~0.1	2016	U.T. to Big Darby - Tributary 7	0.14	BP	QL	QHEI/HHEI
WU1	02	200	Big Darby Cr.	40.320100	-83.583800	82.7	2016	Big Darby Creek - Wu Property Co. Rt. 152	1.61	BP	QL	QHEI/HHEI
BD1	02	200	Big Darby Cr.	40.302830	-83.569031	81.1	2016	Big Darby Creek - beaver dam upper impoundmer	3.23	LL	HD	QHEI
BD2	02	200	Big Darby Cr.	40.299333	-83.570000	80.9	2016	Big Darby Creek - dst. beaver dam	3.4	LL	HD	QHEI
NP1	02	xxx	U.T. to Big Darby	40.263400	-83.535100	0.7	2016	U.T. to Big Darby - Nye Property Twp. Rt. 167	0.37	BP	QL	QHEI/HHEI
Agnes Andrea Reserve Sites												
AA1	02	xxx	U.T. to Little Darby	39.951976	-83.302252	~0.1	2016	U.T. to Little Darby - Tributary E dst. retetion pon	0.32	BP	QL	QHEI/HHEI
AA2	02	xxx	U.T. to Little Darby	39.948200	-83.297700	~0.1	2016	U.T. to Little Darby - Tributary W	3.56	BP	QL	QHEI/HHEI

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