National Pollutant Discharge Elimination System (NPDES) Permit Program

F A C T   S H E E T

Regarding an NPDES Permit To Discharge to Waters of the State of Ohio
for Dayton Wastewater Treatment Plant
(Revised 11/24/15)

Public Notice No.: 15-08-010
Public Notice Date: August 7, 2015
Comment Period Ends: September 7, 2015

OEPA Permit No.: 1PF00000*OD
Application No.: OH0024881

<u>Name and Address of Applicant:</u>

City of Dayton
101 West Third Street
Dayton, Ohio 45401

Name and Address of Facility Where <u>Discharge Occurs:</u>

Dayton Wastewater Treatment Plant
2800 Guthrie Road
Dayton, Ohio
Montgomery County

Receiving Water: Great Miami River

Subsequent Stream Network: Ohio River

<u>Introduction</u>

Development of a Fact Sheet for NPDES permits is mandated by Title 40 of the Code of Federal Regulations, Section 124.8 and 124.56. This document fulfills the requirements established in those regulations by providing the information necessary to inform the public of actions proposed by the Ohio Environmental Protection Agency, as well as the methods by which the public can participate in the process of finalizing those actions.

This Fact Sheet is prepared in order to document the technical basis and risk management decisions that are considered in the determination of water quality based NPDES Permit effluent limitations. The technical basis for the Fact Sheet may consist of evaluations of promulgated effluent guidelines, existing effluent quality, instream biological, chemical and physical conditions, and the relative risk of alternative effluent limitations. This Fact Sheet details the discretionary decision-making process empowered to the Director by the Clean Water Act and Ohio Water Pollution Control Law (ORC 6111). Decisions to award variances to Water Quality Standards or promulgated effluent guidelines for economic or technological reasons will also be justified in the Fact Sheet where necessary.

An antidegradation review was not required

Effluent limits based on available treatment technologies are required by Section 301(b) of the Clean Water Act. Many of these have already been established by U.S. EPA in the effluent guideline regulations (a.k.a. categorical regulations) for industry categories in 40 CFR Parts 405-499. Technology-based regulations for publicly-owned treatment works are listed in the Secondary Treatment Regulations (40 CFR Part 133). If regulations have not been established for a category of dischargers, the director may establish technology-based limits based on best professional judgment (BPJ).

Ohio EPA reviews the need for water-quality-based limits on a pollutant-by-pollutant basis. Wasteload allocations are used to develop these limits based on the pollutants that have been detected in the discharge, and the receiving water's assimilative capacity. The assimilative capacity depends on the flow in the water receiving the discharge, and the concentration of the pollutant upstream. The greater the upstream flow, and the lower the upstream concentration, the greater the assimilative capacity is. Assimilative capacity may represent dilution (as in allocations for metals), or it may also incorporate the break-down of pollutants in the receiving water (as in allocations for oxygen-demanding materials).

The need for water-quality-based limits is determined by comparing the wasteload allocation for a pollutant to a measure of the effluent quality. The measure of effluent quality is called PEQ - Projected Effluent Quality. This is a statistical measure of the average and maximum effluent values for a pollutant. As with any statistical method, the more data that exists for a given pollutant, the more likely that PEQ will match the actual observed data. If there is a small data set for a given pollutant, the highest measured value is multiplied by a statistical factor to obtain a PEQ; for example if only one sample exists, the factor is 6.2, for two samples - 3.8, for three samples - 3.0. The factors continue to decline as samples sizes increase. These factors are intended to account for effluent variability, but if the pollutant concentrations are fairly constant, these factors may make PEQ appear larger than it would be shown to be if more sample results existed.

Summary of Permit Conditions

The effluent limits and monitoring requirements proposed for the following parameters are the same as in the current permit, although some monitoring frequencies may have changed: flow, temperature, dissolved oxygen, $CBOD_5$, total suspended solids, ammonia-nitrogen, oil and grease, pH, residual chlorine, nitrate+nitrite-nitrogen, total Kjeldahl-nitrogen, cadmium, chromium, hexavalent chromium, copper, lead, nickel, zinc and bis(2-ethylhexyl)phthalate.

New water-quality–based effluent limits are proposed for free cyanide and mercury. These parameters have the reasonable potential to cause or contribute to exceedances of WQS.

The permittee is required to begin using one of the approved methods for monitoring free cyanide: ASTM D7237-10 and OIA-1677-09 - Flow injection followed by gas diffusion amperometry.

Final effluent limits are proposed for *Escherichia coli*. New water quality standards for *E. coli* became effective in March 2010.

New monitoring is proposed for dissolved orthophosphate (as P). This monitoring is required by Ohio Senate Bill 1, which was signed by the Governor on April 2, 2015. Monitoring for orthophosphate is proposed to further develop nutrient datasets for dissolved reactive phosphorus and to assist stream and watershed assessments and studies. Ohio EPA monitoring, as well as other in-stream monitoring, is taken via grab sample, orthophosphate is proposed to be collected by grab sample to maintain consistent data to support watershed and stream surveys. Monitoring will be done by grab sample, which must be filtered within 15 minutes of collection using a 0.45-micron filter. The filtered sample must be analyzed within 48 hours.

New monitoring is proposed for total filterable residue (total dissolved solids) to build a data set for evaluating this pollutant of concern.

Quarterly monitoring for acute and chronic toxicity is proposed during the first 17 months of the permit, both to provide additional data to characterize toxicity in the Dayton effluent and to fulfill minimum monitoring requirements at OAC 3745-33-07 (B)(11).

In part II of the permit, special conditions are included that address sanitary sewer overflow reporting; operator certification, minimum staffing, and operator of record; whole effluent toxicity testing; pretreatment program requirements; outfall signage; and water quality trading.

To address sanitary sewer overflows (SSOs), a compliance schedule is proposed for development of a Management, Operation and Maintenance (MOM) program.

Addressing nutrient-related impairment in the lower Great Miami River (GMR)
Ohio EPA is proposing an adaptive management approach to addressing the nutrient-related impairment in the lower GMR. Adaptive management is an iterative process that involves implementing certain controls to reduce pollutant loads, allowing time to evaluate the effectiveness of the controls and obtain additional information, and then using this new knowledge to guide the next implementation step.

Issuing new NPDES permits to the major municipal wastewater treatment plants (WWTP) is the first step in the process to eliminate impairment in the lower GMR. These permit renewals include:

For the Dayton and Montgomery County Western Regional WWTPs – A seasonal aggregate total phosphorus loading limit that applies for the period July through October. The limit was calculated using the plant's median seasonal flow for the years 2010 through 2014 and a total phosphorus concentration of 1 mg/l. The permits allow 36 months for the plants to meet the seasonal loading limit.

These two plants are the largest and most upstream discharges of the lower Great Miami River watershed and contribute to a significant increase in the total phosphorus concentrations, dissolved oxygen swings and chlorophyll-a values in the river.

For the other major WWTPs – Continued monitoring of total phosphorus in their effluent as well as upstream and downstream of their discharges. These plants also must develop a study that evaluates the technical and financial capability of their existing treatment facilities to reduce total phosphorus to 1 mg/l or lower. This study is required by Ohio Senate Bill 1, which was signed by the Governor on April 2, 2015. The study must be submitted to Ohio EPA by December 1, 2017. Ohio EPA is implementing this Ohio Senate Bill 1 requirement outside of NPDES permits. Instead, Ohio EPA will send a letter instructing all applicable facilities how to comply with the evaluation study required by Ohio Senate Bill 1.

Ohio EPA is working with Ohio Department of Natural Resources and representatives of the Joint Board of the Soil Water Conservation Districts to identify areas for concentrating efforts to reduce agricultural runoff to streams. This effort includes site selection; installing best management practices; and measuring the baseline and success of the practices.

If the river has not returned to full attainment, the next NPDES permit renewals may be informed by an Ohio EPA-approved integrated management plan prepared by the lower GMR dischargers and/or an approved TMDL prepared by Ohio EPA. If supported by these or other applicable reports, the permittees may propose using alternate reduction strategies to achieve future phosphorus reductions. The strategies could include point source-nonpoint source trading, point source-point source trading, habitat restoration offsets, physical watershed alterations and other approved nutrient management/reduction strategies.

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Procedures for Participation in the Formulation of Final Determinations

The draft action shall be issued as a final action unless the Director revises the draft after consideration of the record of a public meeting or written comments, or upon disapproval by the Administrator of the U.S. Environmental Protection Agency.

Within thirty days of the date of the Public Notice, any person may request or petition for a public meeting for presentation of evidence, statements or opinions. The purpose of the public meeting is to obtain additional evidence. Statements concerning the issues raised by the party requesting the meeting are invited. Evidence may be presented by the applicant, the state, and other parties, and following presentation of such evidence other interested persons may present testimony of facts or statements of opinion.

Requests for public meetings shall be in writing and shall state the action of the Director objected to, the questions to be considered, and the reasons the action is contested. Such requests should be addressed to:

Legal Records Section
Ohio Environmental Protection Agency
P.O. Box 1049
Columbus, Ohio 43216-1049

Interested persons are invited to submit written comments upon the discharge permit. Comments should be submitted in person or by mail no later than 30 days after the date of this Public Notice. Deliver or mail all comments to:

Ohio Environmental Protection Agency
Attention: Division of Surface Water
Permits Processing Unit
P.O. Box 1049
Columbus, Ohio 43216-1049

The OEPA permit number and Public Notice numbers should appear on each page of any submitted comments. All comments received no later than 30 days after the date of the Public Notice will be considered.

Citizens may conduct file reviews regarding specific companies or sites. Appointments are necessary to conduct file reviews, because requests to review files have increased dramatically in recent years. The first 250 pages copied are free. For requests to copy more than 250 pages, there is a five-cent charge for each page copied. Payment is required by check or money order, made payable to Treasurer State of Ohio.

For additional information about this fact sheet or the draft permit, contact Joe Reynolds (Southwest District Office), (937) 285-6097, joseph.reynolds@epa.ohio.gov , or Gary Stuhlfauth (Central Office), (614) 644-2026, gary.stuhlfauth@epa.ohio.gov .

Information Regarding Certain Water Quality Based Effluent Limits

This draft permit may contain proposed water quality based effluent limitations for parameters that **are not** priority pollutants. (See the following link for a list of the priority pollutants: http://epa.ohio.gov/portals/35/pretreatment/Pretreatment_Program_Priority_Pollutant_Detection_Limits.pdf). In accordance with Ohio Revised Code Section 6111.03(J)(3), the Director established these water quality based effluent limits after considering, to the extent consistent with the Federal Water Pollution Control Act, evidence relating to the technical feasibility and economic reasonableness of removing the polluting properties from those wastes and to evidence relating to conditions calculated to result from that action and their relation to benefits to the people of the state and to accomplishment of the purposes of this chapter. This determination was made based on data and information available at the time the permit was drafted, which included the contents of the timely submitted National Pollutant Discharge Elimination System (NDPES) permit renewal application, along with any and all pertinent information available to the Director.

This public notice allows the permittee to provide to the Director for consideration during this public comment period additional site-specific pertinent and factual information with respect to the technical feasibility and economic reasonableness for achieving compliance with the proposed final effluent limitations for these parameters. The permittee shall deliver or mail this information to:

Ohio Environmental Protection Agency
Attention: Division of Surface Water
Permits Processing Unit
P.O. Box 1049
Columbus, Ohio 43216-1049

Should the applicant need additional time to review, obtain or develop site-specific pertinent and factual information with respect to the technical feasibility and economic reasonableness of achieving compliance with these limitations, written notification for any additional time shall be sent to the above address no later than 30 days after the Public Notice Date on Page 1.

Should the applicant determine that compliance with the proposed water quality based effluent limitations for parameters other than the priority pollutants is technically and/or economically unattainable, the permittee may submit an application for a variance to the applicable water quality standard(s) used to develop the proposed effluent limitation in accordance with the terms and conditions set forth in Ohio Administrative Code (OAC) Rule 3745-33-07(D). The permittee shall submit this application to the above address no later than 30 days after the Public Notice Date.

Alternately, the applicant may propose the development of site-specific water quality standard(s) pursuant to OAC Rule 3745-1-35. The permittee shall submit written notification regarding their intent to develop site specific water quality standards for parameters that are not priority pollutants to the above address no later than 30 days after the Public Notice Date.

Location of Discharge/Receiving Water Use Classification

The Dayton wastewater treatment plant discharges to the Great Miami River (GMR) at River Mile (RM) 76.11. Figure 1 shows the approximate location of the facility.

This segment of the Great Miami River is described by Ohio EPA River Code: 14-001, U.S. EPA River Reach #: 05080002-009, County: Montgomery, Ecoregion: Eastern Corn Belt Plains. The Great Miami River is designated for the following uses under Ohio's Water Quality Standards (OAC 3745-1-21): Warmwater Habitat (WWH), Agricultural Water Supply (AWS), Industrial Water Supply (IWS), and Class A Primary Contact Recreation (PCR).

Use designations define the goals and expectations of a waterbody. These goals are set for aquatic life protection, recreation use and water supply use, and are defined in the Ohio WQS (OAC 3745-1-07). The use designations for individual waterbodies are listed in rules -08 through -32 of the Ohio WQS. Once the goals are set, numeric water quality standards are developed to protect these uses. Different uses have different water quality criteria.

Use designations for aquatic life protection include habitats for coldwater fish and macroinvertebrates, warmwater aquatic life and waters with exceptional communities of warmwater organisms. These uses all meet the goals of the federal Clean Water Act. Ohio WQS also include aquatic life use designations for waterbodies which cannot meet the Clean Water Act goals because of human-caused conditions that cannot be remedied without causing fundamental changes to land use and widespread economic impact. The dredging and clearing of some small streams to support agricultural or urban drainage is the most common of these conditions. These streams are given Modified Warmwater or Limited Resource Water designations.

Recreation uses are defined by the depth of the waterbody and the potential for wading or swimming. Uses are defined for bathing waters, swimming/canoeing (Primary Contact) and wading only (Secondary Contact - generally waters too shallow for swimming or canoeing).

Water supply uses are defined by the actual or potential use of the waterbody. Public Water Supply designations apply near existing water intakes so that waters are safe to drink with standard treatment. Most other waters are designated for agricultural and industrial water supply.

Facility Description

The Dayton wastewater plant is an advanced treatment facility with an average design flow of 72 million gallons per day (MGD). Wet stream processes include screening and grit removal, primary settling with scum removal, trickling filtration for CBOD (carbonaceous biochemical oxygen demand) removal, intermediate settling, activated sludge aeration for nitrification, final clarification, tertiary filtration, disinfection by chlorination, dechlorination, and post aeration. Solid stream processes are thickening of waste activated sludge by dissolved air floatation, sludge stabilization by anaerobic digestion, dewatering using centrifuges, and recycling of the stabilized sludge by land application at agronomic rates. Digester gas is used for firing boilers and other equipment whenever possible.

Dayton implements an Ohio EPA approved industrial pretreatment program. Thirty four (34) categorical industrial users and 11 significant noncategorical industrial users discharge to the wastewater treatment plant based on information in the 2013 annual program report. On average, the flow to the treatment plant from its industrial users is 6.290 MGD.

Dayton's collection system consists of separate sanitary sewers and serves a 160 square mile planning area. The Dayton plant serves all or part of Dayton, Clayton, Moraine, Oakwood, Trotwood, Riverside, Harrison Township, and Wright Patterson Air Force Base. Its total service population is approximately 269,850.

The City is responsible for 13 lift stations on the collection system. The Broadway and Westwood pump stations have overflow capabilities, which activate infrequently under extreme conditions. From January 2010 through December 2014, a discharge at the Broadway pump station was reported on one day (March 14, 2010) and no discharges were reported for the Westwood pump station. The City makes the proper notifications to Ohio EPA when these discharges occur.

These pump stations are located on the collection system, and Ohio EPA agreed to a request from the City to reclassify the discharges as sanitary sewer overflows (SSOs) instead of bypasses. Each station will continue to have its own reporting table in the new permit. Monitoring and reporting is required for total daily flow and duration of discharge.

Description of Existing Discharge

Table 1 presents chemical specific data compiled from annual pretreatment reports and collected by Ohio EPA.

Table 2 presents a summary of unaltered Discharge Monitoring Report (DMR) data for outfall 1PF00000001. Data are presented for the period August 2009 through February 2014. Current permit limits are provided for comparison.

Table 3 summarizes the chemical specific data for outfall 001 by presenting the average and maximum Projected Effluent Quality (PEQ) values.

Table 4 summarizes the results of acute and chronic whole effluent toxicity tests of the final effluent.

The City reports sanitary sewer overflow (SSO) occurrences under station 300 in its NPDES permit. The City reported 34 in 2011, 22 in 2012, 17 in 2013 and 13 in 2014. The City is currently working to implement a 2009 master plan that includes wet weather infrastructure. In addition, a proposed compliance schedule in the draft permit requires the City to develop and implement a CMOM program (Capacity, Management, Operation and Maintenance) to address collections system overflows.

Under the provisions of 40 CFR 122.21(j), the Director has waived the requirement for submittal of expanded effluent testing data as part of the NPDES renewal application. Ohio EPA has access to substantially identical information through the submission of annual pretreatment program reports and/or from effluent testing conducted by the Agency.

Assessment of Impact on Receiving Waters

The Great Miami River from the Mad River to Four Mile Creek has been identified as a priority impaired water on Ohio's 303(d) list. The aquatic life, recreation and human health uses are listed as impaired.

The Great Miami River was evaluated by Ohio EPA staff for aquatic life and recreational use potential during the 2009 and 2010 field seasons. This assessment included the collection of water chemistry and biological sampling at numerous sites in the mainstem Great Miami River and selected tributaries. A summary of the results from this assessment can be found in Table 5.

The complete results of the most recent water quality surveys of the Great Miami River are included in the Technical Support Documents (TSD) "*Biological and Water Quality Study of the Middle Great Miami River and Principal Tributaries, 2009", Jan. 2013; and "Biological and Water Quality Study of the Lower Great Miami River and Selected Tributaries, 2010", May 2012* (Ohio EPA), which are available through this Internet link: http://epa.ohio.gov/dsw/document_index/psdindx.aspx .

The addendum to this fact sheet provides additional information on the impacts that discharges from major municipal wastewater treatment plants are having on water quality in the lower Great Miami River.

Development of Water-Quality-Based Effluent Limits

Determining appropriate effluent concentrations is a multiple-step process in which parameters are identified as likely to be discharged by a facility, evaluated with respect to Ohio water quality criteria, and examined to determine the likelihood that the existing effluent could violate the calculated limits.

Parameter Selection Effluent data for the Dayton wastewater treatment plant were used to determine what parameters should undergo wasteload allocation. The parameters discharged are identified by the data available to Ohio EPA - Discharge Monitoring Report (DMR) data submitted by the permittee, compliance sampling data collected by Ohio EPA, and any other data submitted by the permittee, such as priority pollutant scans required by the NPDES application or by pretreatment, or other special conditions in the NPDES permit. The sources of effluent data used in this evaluation are as follows:

Self-monitoring data (DMR)	January 2008 through September 2013
Pretreatment data	2009 through 2014
OEPA compliance sampling data	2012

The effluent data were checked for outliers and the following values were removed from the evaluation to give a more reliable projection of effluent quality: one for Bis(2EHP), 185ug/l; one for copper, 794.5 ug/l; one for nickel, 1410 ug/l; and one for zinc, 763 ug/l.

This data is evaluated statistically, and Projected Effluent Quality (PEQ) values are calculated for each pollutant. Average PEQ (PEQ_{avg}) values represent the 95th percentile of monthly average data, and maximum PEQ (PEQ_{max})

values represent the 95th percentile of all data points. The average and maximum PEQ values are presented in Table 3.

The PEQ values are used according to Ohio rules to compare to applicable water quality standards (WQS) and allowable waste load allocation (WLA) values for each pollutant evaluated. Initially, PEQ values are compared to the applicable average and maximum WQS. If both PEQ values are less than 25 percent of the applicable WQS, the pollutant does not have the reasonable potential to cause or contribute to exceedances of WQS, and no waste load allocation is done for that parameter. If either PEQ_{avg} or PEQ_{max} is greater than 25 percent of the applicable WQS, a waste load allocation is conducted to determine whether the parameter exhibits reasonable potential and needs to have a limit or if monitoring is required. See Table 9 for a summary of the screening results.

Wasteload Allocation   For those parameters that require a WLA, the results is based on the uses assigned to the receiving water body in OAC 3745-1. Dischargers are allocated pollutant loadings/concentrations based on the Ohio Water Quality Standards (OAC 3745-1). Most pollutants are allocated by a mass-balance method because they do not degrade in the receiving water. Waste load allocations using this method are done using the following general equation: Discharger WLA = (downstream flow x WQS) - (upstream flow x background concentration). Discharger WLAs are divided by the discharge flow so that the allocations are expressed as concentrations.

The Dayton WWTP discharges to the Great Miami River within a large interactive segment (approx. RM 87 to 15) with multiple other dischargers. Wasteload allocations for conservative parameters in this interactive segment were calculated through use of the CONSWLA (CONservative Substance WasteLoad Allocation) model. The study area, showing relative positions of significant dischargers and tributaries, is depicted in Figure 2.

The applicable water body uses for this facility's discharge and the associated stream design flows are as follows:

Aquatic life (WWH)		
Toxics (metals, organics, etc.)	Average	Annual 7Q10
	Maximum	Annual 1Q10
Ammonia	Average	Summer/winter 30Q10
Agricultural Water Supply		Harmonic mean flow
Human Health (nondrinking)		Harmonic mean flow

Allocations are developed using a percentage of stream design flow as specified in Table 7, and allocations cannot exceed the Inside Mixing Zone Maximum criteria.

Ohio's water quality standard implementation rules [OAC 3745-2-05(A)(2)(d)(iv)] required a phase out of mixing zones for bioaccumulative chemicals of concern (BCCs) as of November 15, 2010. This rule applied statewide. Mercury is a BCC. The mixing zone phase-out means that all dischargers requiring mercury limits in their NPDES permit must meet water quality standards at the end-of-pipe, which are 12 ng/l (average) and 1700 ng/l (maximum) in the Ohio River basin.

The data used in the WLA are listed in Tables 6 and 7. The waste load allocation results to maintain all applicable criteria are presented in Table 8. The current ammonia limits were evaluated using the waste load allocation procedures and are protective of water quality standards for ammonia toxicity.

Whole Effluent Toxicity WLA   Whole effluent toxicity (WET) is the total toxic effect of an effluent on aquatic life measured directly with a toxicity test. Acute WET measures short term effects of the effluent while chronic WET measures longer term and potentially more subtle effects of the effluent.

Water quality standards for WET are expressed in Ohio's narrative "free from" WQS rule [OAC 3745-1-04(D)]. These "free froms" are translated into toxicity units (TUs) by the associated WQS Implementation Rule (OAC 3745-2-09). Waste load allocations can then be calculated using TUs as if they were water quality criteria.

The waste load allocation calculations for WET are similar to those for aquatic life criteria - using the chronic toxicity unit (TU_c) and 7Q10 flow for the average and the acute toxicity unit (TU_a) and 1Q10 flow for the maximum. These values are the levels of effluent toxicity that should not cause in stream toxicity during critical low-flow conditions. For Dayton, the waste load allocation values are 0.98 TU_a and 3.54 TU_c.

The chronic toxicity unit (TU_c) is defined as 100 divided by the IC_{25}:

$$TU_c = 100/IC_{25}$$

This equation applies outside the mixing zone for warm water, modified warm water, exceptional warm water, cold water, and seasonal salmonid use designations except when the following equation is more restrictive (*Ceriodaphnia dubia* only):

$$TU_c = 100/\text{geometric mean of NOEC and LOEC}$$

where NOEC is No Observed Effect Concentration and LOEC is Lowest Observed Effect Concentration.

The acute toxicity unit (TU_a) is defined as 100 divided by the LC_{50} for the most sensitive test species:

$$TU_a = 100/LC_{50}$$

This equation applies outside the mixing zone for warm water, modified warm water, exceptional warm water, cold water, and seasonal salmonid use designations.

When the acute waste load allocation is less than 1.0 TU_a, it may be defined as:

Dilution Ratio (downstream flow to discharger flow)	Allowable Effluent Toxicity (percent effects in 100% effluent)
up to 2 to 1	30
greater than 2 to 1 but less than 2.7 to 1	40
2.7 to 1 to 3.3 to 1	50

The acute waste load allocation for the Dayton wastewater plant is 50 percent mortality in 100 percent effluent based on the dilution ratio of 3.3 to 1.

Reasonable Potential/ Effluent Limits/Hazard Management Decisions

After appropriate effluent limits are calculated, the reasonable potential of the discharger to violate the water quality standards must be determined. Each parameter is examined and placed in a defined "group". Parameters that do not have a water quality standard or do not require a waste load allocation based on the initial screening are assigned to either group 1 or 2. For the allocated parameters, the preliminary effluent limits (PEL) based on the most restrictive average and maximum waste load allocations are selected from Table 8. The average PEL (PEL_{avg}) is compared to the average PEQ (PEQ_{avg}) from Table 3, and the PEL_{max} is compared to the PEQ_{max}. Based on the calculated percentage of the allocated value [($PEQ_{avg} \div PEL_{avg}$) X 100, or ($PEQ_{max} \div PEL_{max}$) X 100)], the parameters are assigned to group 3, 4, or 5. The groupings are listed in Table 9.

The final effluent limits are determined by evaluating the groupings in conjunction with other applicable rules and regulations. Table 10 presents the final effluent limits and monitoring requirements proposed for Dayton outfall 1PF00000001 and the basis for their recommendation.

Free Cyanide and Mercury
The Ohio EPA risk assessment (Table 10) places free cyanide and mercury in group 5. This placement as well as the supporting data indicate that the reasonable potential to exceed WQS exists and limits are necessary to protect water quality. For these parameters, the PEQ is greater than 100 percent of the wasteload allocation. The proposed limits are based on the wasteload allocation (Table 8). The final effluent limits become effective 18 months after the effective date of the permit.

Currently there are two approved methods for free cyanide listed in 40 CFR 136.3 that have quantification levels lower than any water quality-based effluent limits:

- ASTM D7237-10 and OIA-1677-09 - Flow injection followed by gas diffusion amperometry

These methods will allow Ohio EPA make more reliable water quality-related decisions regarding free cyanide. Because the quantification levels are lower than any water quality-based effluent limits, it will also be possible to directly evaluate compliance with free cyanide limits.

New NPDES permits no longer authorize the use of method 4500 CN-I from Standard Methods for free cyanide testing. The new permits require permittees to begin using one of these approved methods as soon as possible. If a permittee must use method 4500 CN-I during the transition to an approved method, they are instructed to report the results on their DMR and enter "Method 4500 CN-I" in the remarks section.

Dissolved Oxygen, $CBOD_5$, Total Suspended Solids, Ammonia-Nitrogen
The limits proposed for dissolved oxygen, $CBOD_5$ (5-day carbonaceous biochemical oxygen demand), total suspended solids and ammonia-nitrogen are a continuation of the existing permit limits. The proposed ammonia-N limits were evaluated and are adequate to maintain water quality standards for ammonia toxicity. In addition, the winter limits proposed for suspended solids and $CBOD_5$ are technology-based treatment standards included in 40 CFR Part 133, Secondary Treatment Regulation. Secondary treatment is defined by the Best Practicable Waste Treatment Technology criteria, which are required of all publicly owned treatment works discharging to effluent limited stream segments (with respect to conventional pollutants).

pH, Oil and Grease, Escherichia coli
The limits proposed for pH, oil and grease and *E. coli* are based on Ohio water quality standards (OAC 3745-1-07). Class A Primary Contact Recreation standards apply to the Great Miami River. The *E. coli* limits become effective 15 months after the effective date of the permit. The current limits for fecal coliform apply during the interim period.

Total Residual Chlorine
The limit proposed for total residual chlorine is based on waste load allocation, and consistent with OAC 3745-33-07(C), a practical quantification level is proposed.

Total Phosphorus
A final effluent limit is proposed for total phosphorus that will become effective 36 months from the effective date of the permit. The addendum to this fact sheet provides the justification for including a total phosphorus limit in the permit.

The proposed limit is expressed as a seasonal aggregate loading limit that applies for the period July through October. It was calculated using an effluent concentration of 1.0 mg/l total phosphorus and the treatment plant's median daily flow during July through October for the years 2010 through 2014. To determine compliance, the plant's median total phosphorus effluent concentration and median daily plant flow for the period July through October will be used to calculate a loading value that will be compared to the limit. The permittee will make this calculation each year and report the value on its December DMR.

A compliance schedule is proposed for the permittee to submit a proposal within 24 months of the permit effective date for meeting the limit. This proposal may include submittal of a permit to install for treatment improvements or data showing the plant can meet the limit through current operations.

The phosphorus reduction proposed in this NPDES permit renewal is the first step in a process to return the lower Great Miami River to full attainment of its aquatic life water quality standards. The next NPDES permit renewal may be informed by an Ohio EPA-approved integrated management plan prepared by the lower GMR dischargers and/or an approved TMDL prepared by Ohio EPA. If supported by these reports, the permittee may propose using alternate reduction strategies to achieve future phosphorus reductions. The strategies could include point source-nonpoint source trading, point source-point source trading, habitat restoration offsets, physical watershed alterations and other approved nutrient management/reduction strategies.

Ohio EPA anticipates that future NPDES permits will provide time for the river's chemistry and biology to respond to the proposed phosphorus reductions accompanied by ambient chemical and biological monitoring. Based on the results of future monitoring, adjustments in required phosphorus reduction actions or the timeline for these actions may be possible.

Dissolved Orthophosphate

New monitoring is proposed for dissolved orthophosphate (as P). This monitoring is required by Ohio Senate Bill 1, which was signed by the Governor on April 2, 2015. Monitoring for orthophosphate is proposed to further develop nutrient datasets for dissolved reactive phosphorus and to assist stream and watershed assessments and studies. Ohio EPA monitoring, as well as other in-stream monitoring, is taken via grab sample, orthophosphate is proposed to be collected by grab sample to maintain consistent data to support watershed and stream surveys. Monitoring will be done by grab sample, which must be filtered within 15 minutes of collection using a 0.45-micron filter. The filtered sample must be analyzed within 48 hours.

Bis(2-ethylhexyl)phthalate

Ohio EPA risk assessment (Table 9) places bis (2-ethylhexyl) phthalate (BEHP) in group 4. This placement as well as the supporting data indicates that these parameters do not have the reasonable potential to contribute to WQS exceedances, and limits are not necessary to protect water quality. Monitoring for Group 4 pollutants (where PEQ exceeds 50 percent of the WLA) is required by OAC Rule 3745-33-07(A) (2). For BEHP, a special condition is proposed in Part II of the permit that requires effluent sampling for this pollutant is conducted using manual composite samples collected in glass. This is to eliminate the potential for contamination from plastic sampling apparatus and containers.

Cadmium, Total Chromium, Dissolved Hexavalent Chromium, Copper, Lead, Nickel, Zinc and Total Filterable Residue

Ohio EPA risk assessment (Table 9) places cadmium, total chromium, dissolved hexavalent chromium, copper, lead, nickel, zinc and total filterable residue (total dissolved solids) in groups 2 and 3. This placement as well as the supporting data indicate that these parameters do not have the reasonable potential to contribute to WQS exceedances, and limits are not necessary to protect water quality. Monitoring at a frequency of once per month is proposed to document that these pollutants continue to remain at low levels.

Additional Monitoring

New monitoring is proposed for dissolved orthophosphate (as P) at upstream station 801.

Additional monitoring requirements proposed at the final effluent, influent and upstream/downstream stations are included for all facilities in Ohio and vary according to the type and size of the discharge. In addition to permit compliance, this data is used to assist in the evaluation of effluent quality and treatment plant performance and for designing plant improvements and conducting future stream studies.

No Monitoring Proposed
Ohio EPA risk assessment antimony, arsenic, barium, bromodichloromethane, chloroform, dibromochloromethane, dieldrin, molybdenum, selenium, silver and strontium in groups 2 and 3. This placement as well as the supporting data indicate that these parameters do not have the reasonable potential to contribute to WQS exceedances, and limits are not necessary to protect water quality. No additional monitoring is proposed for these parameters

Sludge
Limits and monitoring requirements proposed for the disposal of sewage sludge by the following management practices are based on OAC 3745-40: land application, removal to sanitary landfill or transfer to another facility with an NPDES permit.

Whole Effluent Toxicity Reasonable Potential
Based on best engineering judgment, quarterly chronic toxicity testing with the determination of acute endpoints is proposed for the first year of the permit. Evaluating the whole effluent toxicity data presented in Table 4 and other pertinent data under the provisions of OAC 3745-33-07(B) placed the Dayton wastewater plant in Category 4 with respect to whole effluent toxicity.

While this indicates that the plant's effluent does not currently pose a toxicity problem, a January 2012 Ohio EPA acute screening test showed toxicity to *Ceriodaphnia dubia* in a grab and composite sample. A definitive acute test of the composite sample did not show acute toxicity to *C. dubia* (see Table 4). Conducting the proposed testing during the first year of the permit will provide adequate data to determine if additional testing is warranted. The four tests will also fulfill the minimum monitoring requirements of OAC 3745-33-07(B).

<u>Other Requirements</u>

Compliance Schedules
A six month compliance schedule is proposed for the City to submit a technical justification for either revising its local industrial user limits or retaining its existing local limits. If revisions to local limits are required, the City must also submit a pretreatment program modification request.

A 24 month schedule is proposed for the City to develop and submit a Management, Operation and Maintenance (MOM) Program summary. The MOM program will address the essential elements the City must have in place for proper oversight of its collection system.

Sanitary Sewer Overflow Reporting
Provisions for reporting sanitary sewer overflows (SSOs) are also proposed in this permit. These provisions include: the reporting of the system-wide number of SSO occurrences on monthly operating reports; telephone notification of Ohio EPA and the local health department, and 5-day follow up written reports for certain high risk SSOs; and preparation of an annual report that is submitted to Ohio EPA and made available to the public. Many of these provisions were already required under the "Noncompliance Notification", "Records Retention", and "Facility Operation and Quality Control" general conditions in Part III of Ohio NPDES permits.

Operator Certification
Operator certification requirements have been included in Part II, Item A of the permit in accordance with rules adopted in December 2006. These rules require the Dayton wastewater treatment plant to have a Class IV wastewater treatment plant operator in charge of the sewage treatment plant operations discharging through outfall 001.

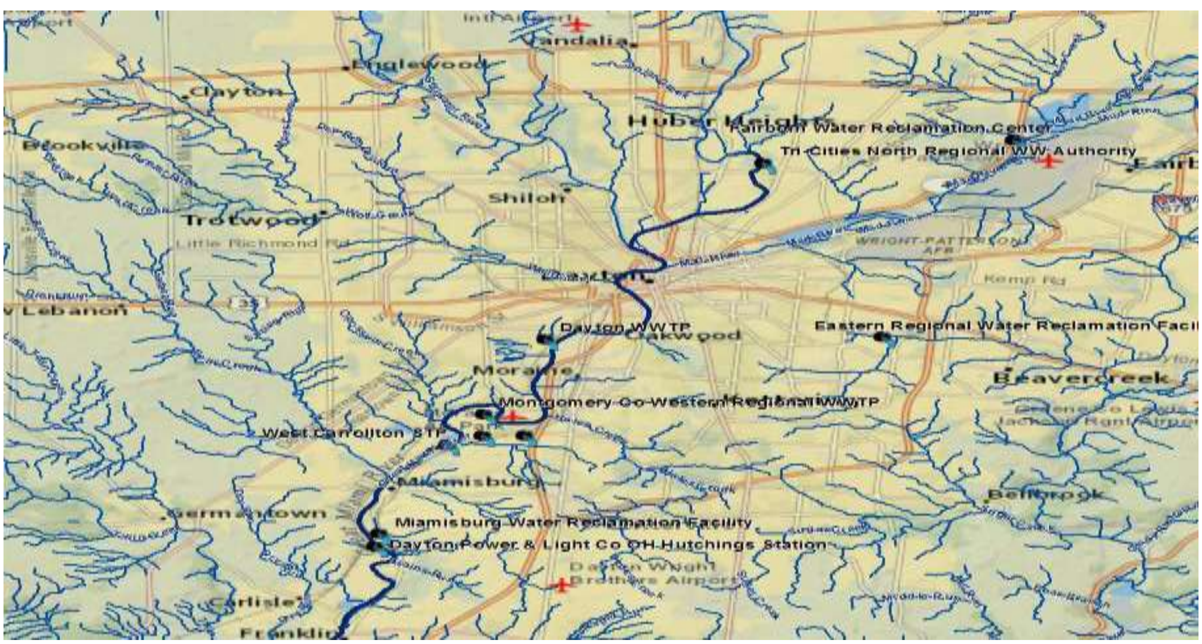
Operator of Record
In December 2006, Ohio Administrative Code rule revisions became effective which affect the requirements for certified operators for sewage collection systems and treatment works regulated under NPDES permits. Part II, Item A.2 of this NPDES permit is included to implement rule 3745-7-02 of the Ohio Administrative Code (OAC). It

requires the permittee to designate one or more operator of record to oversee the technical operation of the treatment works

Storm Water Compliance
The Parts IV, V, and VI storm water language has been updated to reflect sector specific language pertinent to municipal storm water system.

Water Quality Trading
The permittee is a voluntary participant in the Great Miami River Watershed Water Quality Credit Trading Program that is managed through The Miami Conservancy District (MCD). A special condition is included in Part II, Item Z of the permit regarding the permittee's participation in the MCD trading program and the proposed prohibition on utilizing water quality credits accrued through participation in the program to comply with the total phosphorus limit included in this NPDES permit.

Outfall Signage
Part II of the permit includes language requiring the maintenance of signs at each outfall to the Great Miami River, including information about the discharge. Signage at outfalls is required pursuant to Ohio Administrative Code 3745-33-08(A).



Figures 1 - Dayton WWTP Location.

Table 1. Effluent Characterization Using Ohio EPA Data and Pretreatment Data

Summary of analytical results for Dayton outfall 1PF00000001. OEPA = data from analyses by Ohio EPA; PT = data from pretreatment program reports; NA = not analyzed; ND = not detected (detection limit).

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PARAMETER	OEPA 05/15/12	OEPA 01/13/12	PT 06/06/13	PT 05/08/12	PT 05/19/11	PT 05/06/10	PT 07/09/09
Antimony	NA	NA	ND(2.0)	ND(100)	ND(1.0)	ND(1)	0.344
Arsenic	3.0	ND(2.0)	ND(2.0)	ND(100)	ND(20)	ND(10.0)	ND(2)
Barium	46	59	NA	NA	NA	NA	NA
Chromium	ND(2.0)	7.4	ND(2.0)	ND(40)	ND(10.0)	ND(5.0)	ND(1.0)
Copper	4.7	3.2	4.06	ND(20)	ND(5.0)	ND(10.0)	ND(5.2)
Dissolved solids, T (mg/l)	968	900	NA	NA	NA	NA	NA
Nickel	6.8	6.7	5.82	ND(10)	6.76	8.54	ND(6.5)
Strontium	555	516	NA	NA	NA	NA	NA
Zinc	ND(10)	35	ND(25.0)	60.2	37.3	55.1	24.9
Nitrate+nitrite (mg/l)	16.7	15.4	NA	NA	NA	NA	NA
Phosphorus, T (mg/l)	2.03	2.05	NA	NA	NA	NA	NA
Bromodichloromethane	3.87	ND(0.50)	ND(5)	5.21	2.70	6.41	4.92
Chloroform	9.22	ND(0.50)	6.47	11.5	5.92	12.1	10.9
Dibromochloromethane	0.82	ND(0.50)	1.56	1.20	ND(1)	1.56	ND(1)

Table 2. Effluent Characterization Using Self-Monitoring Data

Summary of current permit limits and unaltered discharge monitoring report data for Dayton outfall 1PF00000001 (January 2008 – September 2013). All values are based on annual records unless otherwise indicated. a = weekly average.

Parameter	Season	Units	Current Permit Limits		# Obs.	Percentiles		Data Range
			30 day	Daily		50th	95th	
Water Temperature	Annual	C	Monitor		2100	19.5	27.3	8.5-31
Dissolved Oxygen	Summer	mg/l		5.0 min	1071	7.8	8.95	5-11
Dissolved Oxygen	Winter	mg/l		5.0 min	1027	9	10	1-11
Residue, Total Dissolved	Annual	mg/l	--	--	19	950	1100	755-1110
Total Suspended Solids	Annual	mg/l	12/30[#]	18/45[#a]	1444	0	5	0-140
Oil and Grease, Hexane	Annual	mg/l		10	100	0	0	0-5.76
Oil and Grease, Freon	Annual	mg/l	--	--	82	0	0	0-5.48
Nitrogen, Ammonia (NH3)	Summer	mg/l	1.0	1.5[a]	744	0.035	0.112	0-3.45
Nitrogen, Ammonia (NH3)	Winter	mg/l	5.0	7.5[a]	698	0.03	0.483	0-6.12
Nitrogen Kjeldahl, Total	Annual	mg/l	Monitor		70	1.14	2.52	0-4.96
Nitrite Plus Nitrate, Total	Annual	mg/l	Monitor		1238	17.7	26.6	0-32.2
Phosphorus, Total (P)	Annual	mg/l	Monitor		583	1.9	3.1	0-4.2
Cyanide, Free	Annual	mg/l	Monitor		183	0	0.0521	0-0.116
Nickel, Total Recoverable	Annual	ug/l	Monitor		1003	0	29	0-1410
Strontium, Total Recoverable	Annual	ug/l	Monitor		19	449	534	374-547
Zinc, Total Recoverable	Annual	ug/l	Monitor		1003	18	41	0-763
Cadmium, Total Recoverable	Annual	ug/l	Monitor		1002	0	0.314	0-4.36
Lead, Total Recoverable	Annual	ug/l	Monitor		1004	0	1.15	0-5.83
Chromium, Total Recoverable	Annual	ug/l	Monitor		991	0	20	0-105
Copper, Total Recoverable	Annual	ug/l	Monitor		1001	0	19	0-795
Chromium, Dissolved Hexavalent	Annual	ug/l	Monitor		70	0	0	0-0
Fecal Coliform	Annual	#/100 ml	1000	2000[a]	587	8	78.5	0-630
Bis(2-ethylhexyl) Phthalate	Annual	ug/l	Monitor		17	0	46.1	0-185
Flow Rate	Summer	MGD	Monitor		1073	38.9	60.3	20.5-148
Flow Rate	Winter	MGD	Monitor		1027	44.3	85.1	10.4-163
Flow Rate	Annual	MGD	Monitor		2100	41.6	75.9	10.4-163
Chlorine, Total Residual	Annual	mg/l		0.037	751	0	0	0-0.058
Mercury, Total (Low Level)	Annual	ng/l	Monitor		69	4.2	12.2	0-28.3
pH, Maximum	Annual	S.U.		9.0	2100	7.6	8.1	6.9-8.8
pH, Minimum	Annual	S.U.		6.5	2100	7.4	8	6.5-8.7
CBOD 5 day	Summer	mg/l	8.0	12[a]	584	0	3.84	0-7.64
CBOD 5 day	Winter	mg/l	25	40[a]	546	0	3.79	0-20.2

= summer/winter limits

Table 3. Projected Effluent Quality Values

Parameter	*Units*	# of *Samples*	# > *MDL*	Average *PEQ*	Maximum *PEQ*
<u>*Self-Monitoring (DMR) Data*</u>					
Total Dissolved Solids (TDS) [A]	*mg/l*	*21*	*21*	*1058.*	*1203.*
Ammonia-S	*mg/l*	*510*	*321*	*0.078*	*0.176*
Ammonia-W	*mg/l*	*346*	*222*	*0.145*	*0.319*
NO_3+NO_2 [A]	mg/l	1240	1234	14.09	19.30
Phosphorus [A]	mg/l	585	581	1.84	2.52
Cyanide, free	µg/l	126	28	67.74	92.80
Nickel - TR [A]	µg/l	1009	198	14.51	30.42
Strontium [A]	µg/l	21	21	522.4	584.0
Zinc [A]	µg/l	1009	894	26.05	46.52
Cadmium	µg/l	1002	257	0.207	0.359
Lead	µg/l	1004	113	2.554	3.498
Chromium - TR [A]	µg/l	998	55	45.99	63.0
Copper - TR [A]	µg/l	1007	81	16.14	18.55
$Chromium^{+6}$, diss.	µg/l	70	0	--	--
Bis(2-ethylhexyl)phthalate [C]	µg/l	16	2	12.48	17.1
Dieldrin [C]	µg/l	6	0	--	--
Chlorine, tot. res.	µg/l	751	2	25.40	34.80
Mercury	ng/l	69	65	15.69	24.19
<u>Combined Other Data</u> [B]					
Antimony	µg/l	5	1	1.557	2.133
Arsenic	µg/l	7	1	5.694	7.80
Barium	µg/l	2	2	163.7	224.2
Bromodichloromethane [C]	µg/l	7	5	9.359	12.82
Chloroform [C]	µg/l	7	6	17.67	24.20
Dibromochloromethane [C]	µg/l	7	4	2.278	3.12

[A] DMR data combined with Ohio EPA data
[B] Combined other data sources include Pretreatment Program data and Ohio EPA data
[C] Carcinogen

Table 4. Summary of toxicity test results on the Dayton wastewater treatment plant effluent.

Test Date(a)	*Ceriodaphnia dubia 48 hours*	*Fathead Minnows 96*	*Ceriodaphnia dubia 7 days*	*Fathead Minnows 7 days*
	TUa[b]	TUa[b]	TUc[b]	TUc[b]
08/11/09(E)	BD	BD	BD	BD
12/15/09(E)	BD	BD	1.1	BD
03/02/10(E)	BD	BD	BD	BD
06/15/10(E)	BD	BD	1.35	BD
08/17/10(E)	BD	BD	BD	3.65[@]
1/10, 11/12(O)*		BD		
1/10/12(O)* Day 1 Grab sample	100% mortality at 24 hrs.**			
1/11/12(O)* 24 hr. composite sample[#]	50% mortality at 24 hrs.; 55% at 48 hrs.			
5/15, 16/12(O)*	BD	BD		
12/03/13(E)	BD	BD	BD	BD

[a] O = EPA test; E = entity test
[b] TUa = acute toxicity units, TUc = chronic toxicity units
BD = below detection
* = 48 hour screening test
** = 95% mortality in 1:1 manual mixing zone sample at 24 hrs.; 100% mortality at 48 hrs
# = definitive acute test of composite sample showed 10% mortality in 100% effluent at 24 and 48 hrs
[@] = reviewed against guidance, this result is invalid

Figure 2. Great Miami River Study Area (not to scale).

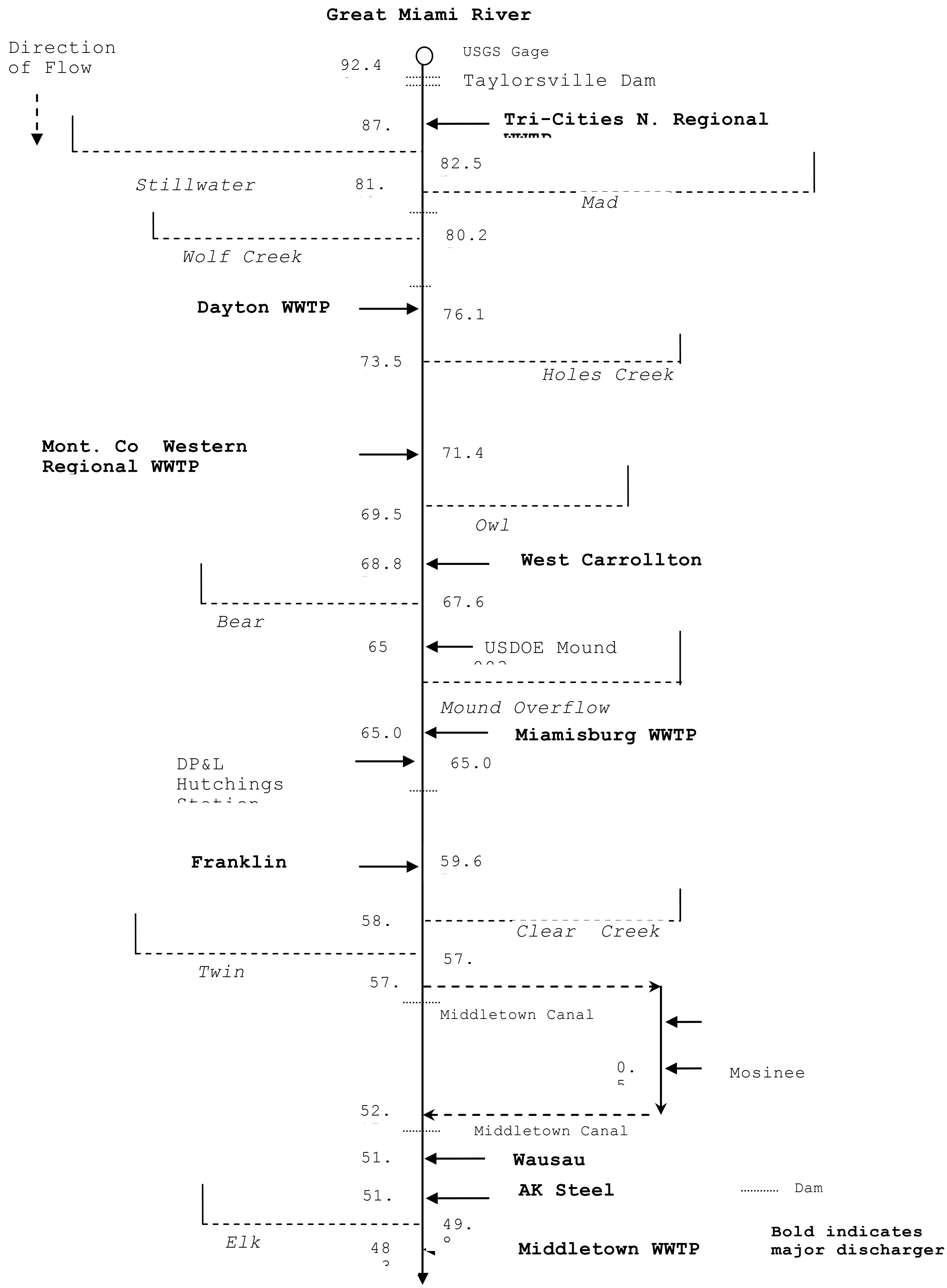

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Figure 2. Great Miami River Study Area - Continued.

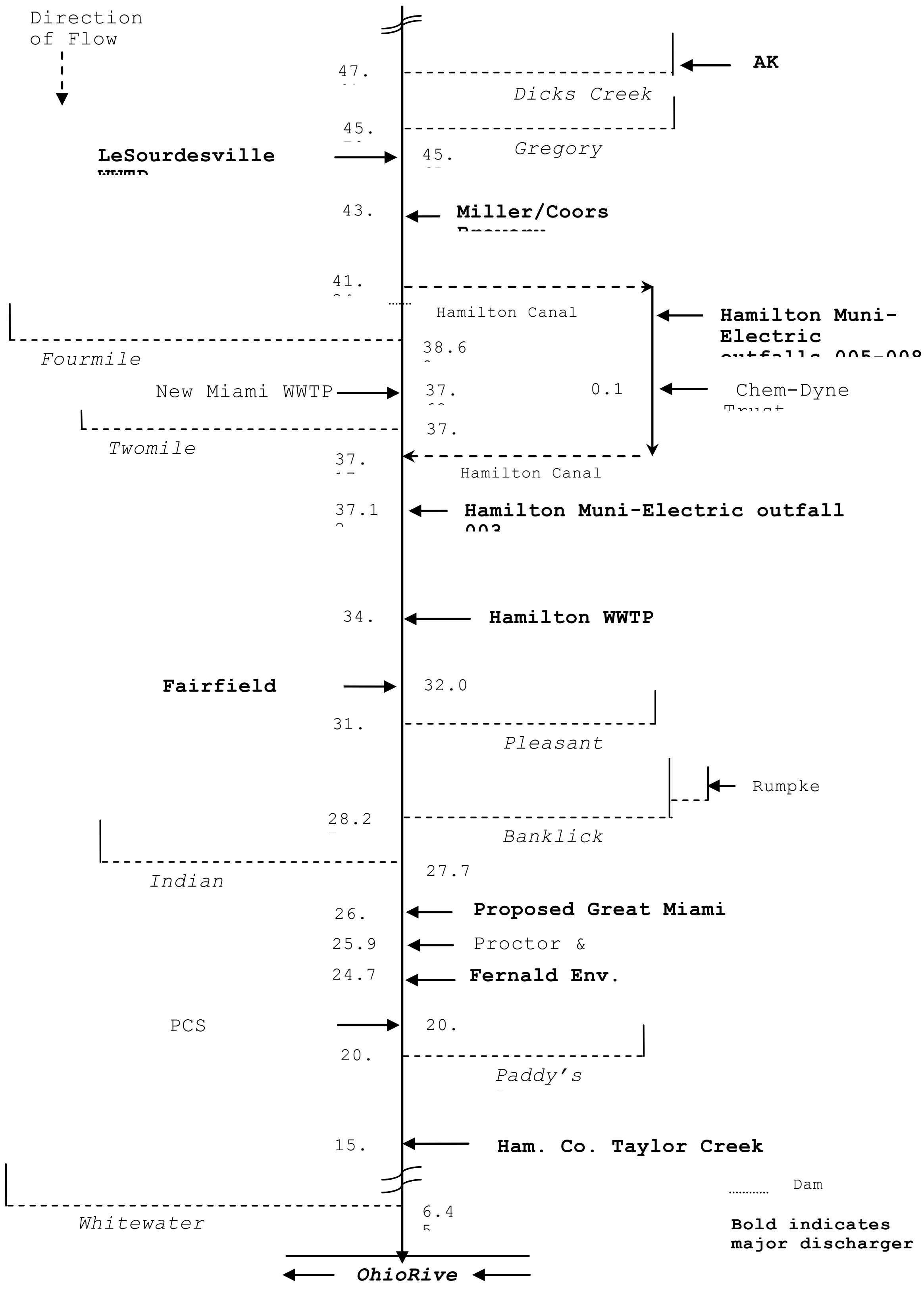


Table 5. A Summary of the Great Miami River Mainstem Use Designation Status and Causes/Sources of Impairment, 2009-10 Surveys.

Location	RM	AL Use Desig.	Attain. Status	Causes of Impairment	Sources of Impairment
Upst. Tri-Cities N. WWTP	87.7	EWH	FULL		
Dst. Tri-Cities N. WWTP	85.8	EWH	PARTIAL	Ammonia (modest toxicity)	Major WWTP (Tri-Cities N. WWTP)
Upst. Mad River to Dst. Bear Creek	82.1 to 66.9	WWH	FULL		
Dst. DP&L Hutchings discharge	64.1	WWH	PARTIAL	Temperature	Industrial Thermal Discharges (DP&L)
Further Dst. DP&L to Dst. Franklin WWTP	62.6 to 58.2	WWH	FULL		
Middletown area	52.6	WWH	PARTIAL	Nutrients	Livestock (grazing or feeding operations), Crop production (crop land or dry land), Municipal point sources
Dst. Wausau Papers to Just Upst. Hamilton WWTP	51.6 to 34.2	WWH	FULL		
Dst. Hamilton WWTP	33.6	WWH	PARTIAL	Temperature	Industrial thermal discharges (Hamilton Muni-Electric Plant)
Upst. Fairfield WWTP to Upst. Banklick Creek	32.7 to 28.7	WWH	PARTIAL	Nutrients, Biochemical Oxygen Demand	Livestock (grazing or feeding operations), Crop production (crop land or dry land), Municipal point sources
Dst. Indian Creek to Upst. Taylor Creek WWTP	26.1 to 15.5	WWH	FULL		
Dst. Taylor Creek WWTP	14.8	WWH	PARTIAL	Nutrients, Biochemical Oxygen Demand	Livestock (grazing or feeding operations), Crop production (crop land or dry land), Municipal point sources
Upst. Whitewater River	8.2	WWH	FULL		

Table 6. Water Quality Criteria in the Great Miami River Study Area

Parameter	Units	Outside Mixing Zone Criteria: Average: Human Health	Outside Mixing Zone Criteria: Average: Agri-culture	Outside Mixing Zone Criteria: Average: Aquatic Life	Outside Mixing Zone Criteria: Maximum Aquatic Life	Inside Mixing Zone Maximum
Antimony	µg/l	4300.	--	190.	900.	1800.
Arsenic	µg/l	--	100.	150.	340.	680.
Barium	µg/l	--	--	220.	2000.	4000.
Benzene [C]	µg/l	710.	--	160.	700.	1400.
3,4-Benzofluoranthene [D]	µg/l	0.49	--	--	--	--
Benzo(a)pyrene [C]	µg/l	0.49	--	--	--	--
Beryllium [A]	µg/l	280.	100.	65.	560.	1100.
Bis(2-ethylhexyl)phthalate [C]	µg/l	59.	--	8.4	1100.	2100.
Boron	µg/l	--	--	3900.	33000.	65000.
Bromodichloromethane [C]	µg/l	460.	--	--	--	--
Cadmium [A]	µg/l	--	50.	5.9	16.	32.
Chlorine, tot. res.	µg/l	--	--	11.	19.	38.
Chlorobenzene	µg/l	21000.	--	47.	420.	850.
Chloroform [C]	µg/l	4700.	--	140.	1300.	2600.
Chromium^{+6}, diss.	µg/l	--	--	11.	16.	31.
Chromium -TR [A]	µg/l	--	100.	210.	4500.	8900.
Copper [A]	µg/l	1300.	500.	24.	40.	80.
Cyanide, free	µg/l	220000.	--	12.	46.	92.
Dibromochloromethane [C]	µg/l	340.	--	--	--	--
Dibenzo(a,h)anthracene [C]	µg/l	0.49	--	--	--	--
1,2-Dichloroethane [C]	µg/l	990.	--	2000.	9600.	19000.
1,1-Dichloroethylene [C]	µg/l	32.	--	210.	1900.	3800.
2,4-Dimethylphenol	µg/l	2300.	--	15.	140.	280.
Ethylbenzene	µg/l	29000.	--	61.	550.	1100.
Fluoride	µg/l	--	2000.	--	--	--
Heptachlor Epoxide [C]	µg/l	0.0011	--	--	--	--
Hexachlorobenzene [B C]	µg/l	0.0077	--	--	--	--
Ideno(1,2,3-c,d)pyrene [C]	µg/l	0.49	--	--	--	--
Iron	µg/l	--	5000.	--	--	--
Lead [A]	µg/l	--	100.	26.	500.	1000.
Mercury [B]	ng/l	12.	10000.	910.	1700.	3400.
Molybdenum	µg/l	--	--	20000.	190000.	370000.
Naphthalene	µg/l	--	--	21.	170.	340.
Nickel [A]	µg/l	4600.	200.	130.	1200.	2400.
Nitrate+Nitrite	mg/l	--	100.	--	--	--
Phenol	µg/l	4600000.	--	400.	4700.	9400.
Selenium	µg/l	11000.	50.	5.0	--	--
Silver [A]	µg/l	--	--	1.3	11.	22.

[A] Aquatic Life Criteria is hardness-based.
[B] Bioaccumulative Chemical of Concern
[C] Carcinogen
[D] Use Criteria for Benzo(b)fluoranthene

Table 6. Water Quality Criteria in the Study Area - Continued.

Parameter	Units	Outside Mixing Zone Criteria				Inside Mixing Zone Maximum
		Average			Maximum	
		Human Health	Agri-culture	Aquatic Life	Aquatic Life	
Strontium	µg/l	--	--	21000.	40000.	81000.
Tetrachloroethylene [C]	µg/l	89.	--	53.	430.	850.
Thallium	µg/l	6.3	--	17.	79.	160.
Toluene	µg/l	200000.	--	62.	560.	1100.
Total Dissolved Solids (TDS)	mg/l	--	--	1500.	--	--
1,2,4-Trimethylbenzene	µg/l	--	--	15.	140.	280.
Xylenes	µg/l	--	--	27.	240.	480.
Zinc [A]	µg/l	69000.	25000.	310.	310.	610.

[A] Aquatic Life Criteria is hardness-based.
[C] Carcinogen

Table 7. Instream Conditions and Discharger Flow

Parameter	Units		Value	Basis
Upstream Flows				
GMR at Taylorsville				
7Q10	cfs	annual	58.4	USGS gage #03263000, 1970-2012 data
1Q10	cfs	annual	42.0	USGS gage #03263000, 1970-2012 data
30Q10	cfs	summer	73.0	USGS gage #03263000, 1970-2012 data
	cfs	winter	180.3	USGS gage #03263000, 1970-2012 data
Harmonic Mean Flow	cfs	annual	299.9	USGS gage #03263000, 1970-2012 data
Mixing Assumption	%	average	100	Stream-to-discharge ratio
(GMR & Tribs.)	%	maximum	100	Stream-to-discharge ratio
Stillwater River at Mouth				
7Q10	cfs	annual	24.2	USGS gage #03266000, 1970-2012 data
1Q10	cfs	annual	20.4	USGS gage #03266000, 1970-2012 data
30Q10	cfs	summer	29.8	USGS gage #03266000, 1970-2012 data
	cfs	winter	79.4	USGS gage #03266000, 1970-2012 data
Harmonic Mean Flow	cfs	annual	143.3	USGS gage #03266000, 1970-2012 data
Mad River at Mouth				
7Q10	cfs	annual	177.8	USGS gage #03270000, 1970-2012 data
1Q10	cfs	annual	166.9	USGS gage #03270000, 1970-2012 data
30Q10	cfs	summer	210.0	USGS gage #03270000, 1970-2012 data
	cfs	winter	264.7	USGS gage #03270000, 1970-2012 data
Harmonic Mean Flow	cfs	annual	482.7	USGS gage #03270000, 1970-2012 data

Table 7. Instream Conditions and Discharger Flow - Continued.

Parameter	Units		Value	Basis
Wolf Creek at Mouth				
7Q10	cfs	annual	5.13	USGS gage #03271000, 1986-2012 data
1Q10	cfs	annual	4.18	USGS gage #03271000, 1986-2012 data
30Q10	cfs	summer	5.77	USGS gage #03271000, 1986-2012 data
	cfs	winter	14.1	USGS gage #03271000, 1986-2012 data
Harmonic Mean Flow	cfs	annual	23.3	USGS gage #03271000, 1986-2012 data
Twin Creek at Mouth				
7Q10	cfs	annual	5.04	USGS gage #03272000, 1970-2012 data
1Q10	cfs	annual	4.50	USGS gage #03272000, 1970-2012 data
30Q10	cfs	summer	7.26	USGS gage #03272000, 1970-2012 data
	cfs	winter	32.4	USGS gage #03272000, 1970-2012 data
Harmonic Mean Flow	cfs	annual	44.9	USGS gage #03272000, 1970-2012 data
Four Mile Creek at Mouth				
7Q10	cfs	annual	6.67	USGS gage #03272700, 1970-2012 data
1Q10	cfs	annual	5.84	USGS gage #03272700, 1970-2012 data
30Q10	cfs	summer	8.90	USGS gage #03272700, 1970-2012 data
	cfs	winter	24.6	USGS gage #03272700, 1970-2012 data
Harmonic Mean Flow	cfs	annual	50.2	USGS gage #03272700, 1970-2012 data
Holes Creek at Mouth				
7Q10	cfs	annual	1.16	USGS gage #03271300, 2002-2012 data
1Q10	cfs	annual	1.13	USGS gage #03271300, 2002-2012 data
30Q10	cfs	summer	3.54	USGS gage #03271300, 2002-2012 data
	cfs	winter	11.9	USGS gage #03271300, 2002-2012 data
Harmonic Mean Flow	cfs	annual	9.07	USGS gage #03272000, 2002-2012 data
Indian Creek at Mouth				
7Q10	cfs	annual	0.2	USGS gage #03274200, 1961-69 data
1Q10	cfs	annual	0.2	USGS gage #03274200, 1961-69 data
30Q10	cfs	summer	0.3	USGS gage #03274200, 1961-69 data
	cfs	winter	0.8	USGS gage #03274200, 1961-69 data
Harmonic Mean Flow	cfs	annual	1.17	USGS gage #03272800, 1960-72 data
Clear Creek at Mouth				
7Q10	cfs	annual	0.4	USGS gage #03271700, 1959-69 data
1Q10	cfs	annual	0.4	USGS gage #03271700, 1959-69 data
30Q10	cfs	summer	0.6	USGS gage #03271700, 1959-69 data
	cfs	winter	2.5	USGS gage #03271700, 1959-69 data
Harmonic Mean Flow	cfs	annual	3.0	USGS gage #03272000, 1970-2012 data
Elk Creek at Mouth				
7Q10	cfs	annual	0.4	USGS gage #03272200, 1960-67 data
1Q10	cfs	annual	0.4	USGS gage #03272200, 1960-67 data
30Q10	cfs	summer	0.6	USGS gage #03272200, 1960-67 data
	cfs	winter	2.1	USGS gage #03272200, 1960-67 data
Harmonic Mean Flow	cfs	annual	3.0	USGS gage #03272000, 1970-2012 data

Table 7. Instream Conditions and Discharger Flow - Continued.

Parameter	Units		Value	Basis
Bear Creek at Mouth				
7Q10	cfs	annual	0.85	USGS gage #03272000, 1970-2012 data
1Q10	cfs	annual	0.76	USGS gage #03272000, 1970-2012 data
30Q10	cfs	summer	1.23	USGS gage #03272000, 1970-2012 data
	cfs	winter	5.48	USGS gage #03272000, 1970-2012 data
Harmonic Mean Flow	cfs	annual	7.59	USGS gage #03272000, 1970-2012 data
Gregory Creek at Mouth				
7Q10	cfs	annual	0.26	USGS gage #03272200, 1960-67 data
1Q10	cfs	annual	0.26	USGS gage #03272200, 1960-67 data
30Q10	cfs	summer	0.39	USGS gage #03272200, 1960-67 data
	cfs	winter	1.35	USGS gage #03272200, 1960-67 data
Harmonic Mean Flow	cfs	annual	1.93	USGS gage #03272000, 1970-2012 data
Pleasant Run at Mouth				
7Q10	cfs	annual	0.04	USGS gage #03274200, 1961-69 data
1Q10	cfs	annual	0.04	USGS gage #03274200, 1961-69 data
30Q10	cfs	summer	0.06	USGS gage #03274200, 1961-69 data
	cfs	winter	0.16	USGS gage #03274200, 1961-69 data
Harmonic Mean Flow	cfs	annual	0.23	USGS gage #03272800, 1960-72 data
Banklick Creek at Mouth				
7Q10	cfs	annual	0.01	USGS gage #03274200, 1961-69 data
1Q10	cfs	annual	0.01	USGS gage #03274200, 1961-69 data
30Q10	cfs	summer	0.02	USGS gage #03274200, 1961-69 data
	cfs	winter	0.05	USGS gage #03274200, 1961-69 data
Harmonic Mean Flow	cfs	annual	0.07	USGS gage #03272800, 1960-72 data
Twomile Creek at Mouth				
7Q10	cfs	annual	0.02	USGS gage #03274200, 1961-69 data
1Q10	cfs	annual	0.02	USGS gage #03274200, 1961-69 data
30Q10	cfs	summer	0.02	USGS gage #03274200, 1961-69 data
	cfs	winter	0.06	USGS gage #03274200, 1961-69 data
Harmonic Mean Flow	cfs	annual	0.10	USGS gage #03272800, 1960-72 data
Paddy’s Run at Mouth				
7Q10	cfs	annual	0.03	USGS gage #03274200, 1961-69 data
1Q10	cfs	annual	0.03	USGS gage #03274200, 1961-69 data
30Q10	cfs	summer	0.05	USGS gage #03274200, 1961-69 data
	cfs	winter	0.13	USGS gage #03274200, 1961-69 data
Harmonic Mean Flow	cfs	annual	0.19	USGS gage #03272800, 1960-72 data
Dayton WWTP design flow				
	cfs (mgd) avg.		111.4 (72.0)	DSW
Instream Hardness	mg/l	annual	303.	STORET/DMRs; 753 values, 2008-2013

Table 7. Instream Conditions and Discharger Flow - Continued.

Parameter	Units		Value	Basis
Background Water Quality for the Great Miami River				
Antimony	µg/l	annual	0.	No representative data available.
Arsenic	µg/l	annual	1.0	STORET; 18 values,10 <MDL, 2009-10
Barium	µg/l	annual	92.	STORET; 18 values, 0 <MDL, 2009-10
Benzene	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Benzo(a)pyrene	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
3,4-Benzofluoranth.	µg/l	annual	0.	No representative data available.
Beryllium	µg/l	annual	0.	No representative data available.
Bis 2EHP	µg/l	annual	0.66	STORET; 5 values, 3 <MDL, 2009
Boron	µg/l	annual	0.	No representative data available.
Cadmium	µg/l	annual	0.	STORET; 18 values,18 <MDL, 2009-10
Chlorine, total res	µg/l	annual	0.	No representative data available.
Chlorobenzene	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Chloroform	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Chromium^{+6}, diss	µg/l	annual	0.	No representative data available.
Chromium, total	µg/l	annual	1.0	STORET; 18 values,17<MDL, 2009-10
Copper	µg/l	annual	2.1	STORET; 18 values, 5<MDL, 2009-10
Cyanide, free	µg/l	annual	0.	No representative data available.
Dibenzo(a,h)anthrac.	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
1,2-Dichloroethane	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
1,1-Dichloroethylene	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
2,4-Dimethylphenol	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Ethylbenzene	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Fluoride	µg/l	annual	0.	No representative data available.
Heptachlor epoxide	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Hexachlorobenzene	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Indeno(1,2,3,-cd)pyr.	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Iron	µg/l	annual	468.	STORET; 18 values, 0<MDL, 2009-10
Lead	µg/l	annual	1.0	STORET; 18 values, 17<MDL, 2009-10
Mercury	ng/l	annual	0.	No representative data available.
Molybdenum	µg/l	annual	0.	No representative data available.
Napthalene	µg/l	annual	0.	STORET; 6 values, 6 <MDL, 2009
Nickel	µg/l	annual	2.95	STORET; 18 values, 0<MDL, 2009-10
Nitrate+Nitrite	mg/l	annual	1.26	STORET; 26 values, 2<MDL, 2009-10
Phenols	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Selenium	µg/l	annual	0.	STORET; 18 values,18 <MDL, 2009-10
Silver	µg/l	annual	0.	No representative data available.
TDS	mg/l	annual	412.	STORET; 26 values, 0<MDL, 2009-10
Tetrachloroethylene	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Thallium	µg/l	annual	0.	No representative data available.
Toluene	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
1,2,4-Trimethylbenz.	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Xylenes	µg/l	annual	0.	STORET; 3 values, 3 <MDL, 2009
Zinc	µg/l	annual	5.0	STORET; 18 values, 13<MDL, 2009-10

Table 8. Summary of Effluent Limits to Maintain Applicable Water Quality Criteria

Parameter	Units	Average: Human Health	Average: Agri Supply	Average: Aquatic Life	Maximum Aquatic Life	Inside Mixing Zone Maximum
Arsenic [B]	µg/l	--	399.	276.	596.	680.
Barium	µg/l	--	--	330.	3614.	4000.
Bis(2-ethylhexyl)phthalate	µg/l	322.	--	21.	2625. [A]	2100.
Cadmium [B]	µg/l	--	198. [A]	11.	28.	32.
Chlorine, tot. res.	µg/l	--	--	21.	35.	38.
Chromium, total	µg/l	--	397.	387.	7907.	8900.
Chromium^{+6}, diss. [B]	µg/l	--	--	23.	32. [A]	31.
Copper	µg/l	3941. [A]	1514. [A]	37.	60.	80.
Cyanide, free	µg/l	1.435e6 [A]	--	30.	108. [A]	92.
Lead [B]	µg/l	--	377.	45.	829.	1000.
Mercury [C]	ng/l	12.	10000. [A]	910.	1700.	3400.
Molybdenum [B]	µg/l	--	--	42720.	385300. [A]	370000.
Nickel [B]	µg/l	18190. [A]	781.	236.	2092.	2400.
Selenium [B]	µg/l	46960.	213.	7.6	--	--
Silver [B]	µg/l	--	--	2.3	18.	22.
TDS	mg/l	--	--	2360.	--	--
Zinc [B]	µg/l	25750. [A]	93340. [A]	533.	507.	610.

[A] Allocation must not exceed the Inside Mixing Zone Maximum.

[B] This parameter would not require a WLA based on reasonable potential procedures, but allocation requested for use in pretreatment program.

[C] Bioaccumulative Chemical of Concern (BCC); no mixing zone allowed after 11/15/2010, WQS must be met at end-of-pipe, unless requirements for an exception are met as listed in 3745-2-08(L).

Table 9. Parameter Assessment

Group 1: Due to a lack of numeric criteria, the following parameters were not evaluated at this time.

No Parameters

Group 2: PEQ < 25% of WQS or all data below minimum detection limit; WLA not required. No limit recommended, monitoring optional.

Ammonia-S&W	Antimony	Arsenic
Bromodichloromethane	Cadmium	Chloroform
$Chromium^{+6}$, diss.	Dibromochloromethane	Dieldrin
Lead	Molybdenum	Nickel
Nitrate+Nitrite	Selenium	Silver
Strontium	Zinc	

Group 3: PEQ_{max} < 50% of maximum PEL and PEQ_{avg} < 50% of average PEL. No limit recommended, monitoring optional.

Barium	Chromium, tot.	Copper
TDS		

Group 4: $PEQ_{max} \geq$ 50% but <100% of the maximum PEL or $PEQ_{avg} \geq$ 50% but < 100% of the average PEL. Monitoring is appropriate.

Bis(2-ethylhexyl)phthalate

Group 5: Maximum PEQ $\geq$ 100% of the maximum PEL or average PEQ $\geq$ 100% of the average PEL, or either the average or maximum PEQ is between 75 and 100% of the PEL and certain conditions that increase the risk to the environment are present. Limit recommended.

Limits to Protect Numeric Water Quality Criteria

Parameter	Units	Applicable Period	Recommended Effluent Limits Average	Maximum
Chlorine, tot. res.	µg/ l	summer only	21.	35.
Cyanide, free	µg/ l	annual	30.	92.
Mercury	ng/l	annual	12.	1700.

Table 10. Final Effluent Limits and Monitoring Requirements

		Effluent Limitations				
		Concentration		Loading (kg/day)[a]		
Parameter	Units	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Basis[b]
Flow	MGD	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M
Temperature	^oC	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M
Dissolved Oxygen	mg/l	5.0 minimum		--	--	EP
$CBOD_5$	mg/l					
Summer		8.0	12[c]	2184	3275[c]	EP
Winter		25	40[c]	6824	10918[c]	EP, BPT
Suspended Solids	mg/l					
Summer		12	18[c]	3275	4913[c]	EP
Winter		30	45[c]	8188	12283[c]	EP, BPT
Ammonia-N	mg/l					
Summer		1.0	1.5[c]	273	409[c]	EP
Winter		5.0	7.5[c]	1364	2046[c]	EP
Oil and Grease	mg/l	--	10	--	--	WQS, EP
pH	S.U.	- - - - - - - - - - - 6.5 to 9.0 - - - - - - - - - - -				WQS, EP
E Coli						
Summer Only	#/100ml	126	284[c]	--	--	WQS
Chlorine Residual						
Summer Only	mg/l	--	0.035	--	--	WLA, EP
Phosphorus, Total	mg/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP, SB1
Phosphorus, Total	kg	--	--	--	136.95*	BTJ
Orthophosphate, Dissolved (as P)	mg/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				SB1
Nitrate(N) + Nitrite(N)	mg/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M. EP
Total Kjeldahl-N	mg/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP
Cyanide, Free	ug/l	30	92	8.18	25.1	WLA
Cadmium, T. R.	ug/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP
Chromium, T. R.	ug/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP
Hex. Chromium (Dissolved)	ug/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP
Copper, T. R.	ug/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP
Lead, T. R.	ug/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP
Mercury, T.	ng/l	12	1700	0.00328	0.464	WLA
Nickel, T. R.	ug/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP
Zinc, T. R.	ug/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP
Bis(2-ethylhexyl) phthalate	ug/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				RP, EP
Total Filterable Residue	mg/l	- - - - - - - - - - - - Monitor - - - - - - - - - - - - -				M, EP
Whole Effluent Toxicity Acute, Chronic	TUa, TUc	- - - - - - - - - - - - - Monitor - - - - - - - - - - - -				WET

Table 10. Final Effluent Limits and Monitoring Requirements - Continued

[a] Effluent loadings based on average design discharge flow of 72 MGD.

[b] Definitions: BTJ = Best Technical Judgment; BPT = Best Practicable Waste Treatment Technology, 40 CFR Part 133, Secondary Treatment Regulation; EP = Existing Permit; M = BEJ of Permit Guidance 1: Monitoring Frequency Requirements for Sanitary Discharges; RP = Reasonable Potential for requiring water quality-based effluent limits and monitoring requirements in NPDES permits [OAC 3745-33-07(A)]; SB1 = Implementation of Senate Bill 1 [ORC 61111.03]; WET = Reasonable potential for requiring water quality-based effluent limits and monitoring requirements for whole effluent toxicity in NPDES permits [OAC 3745-33-07(B)]; WQS = Ohio Water Quality Standards (OAC 3745-1-07).

[c] Weekly average limit.

* Seasonal aggregate loading limit for the period July through October

Addendum

Division of Surface Water
June 2015

Lower Great Miami River

Total phosphorus effluent limits for major wastewater treatment plants

Factsheet Addendum

The lower Great Miami River (GMR) was assessed for its aquatic life beneficial use in 2010 as reported in Ohio EPA's 2012 Integrated Water Quality Monitoring and Assessment Report. This study area starts at the confluence with the Mad River at river mile (RM) 81.48 and ends at the Ohio River (RM 0). Two GMR large river assessment units (05080002 90 01 and 05080002 90 02) are included in this assessment. Assessment sites within both assessment units were found to be impaired due to nutrient enrichment (RMs 52.64, 32.7, 31.4, 28.7, and 14.8). These assessment sites indicate that 14.4 river miles are directly impaired, however data show that excessive nutrient enrichment occurs throughout most of the lower GMR. The over-enriched condition begins downstream of the Dayton wastewater treatment plant (WWTP) (RM 76.11) and continues downstream to just upstream of the confluence with the Whitewater River (RM 6.45). In addition to the biological data collected in 2010, chemical and algal data were collected from 2010 through 2012 to fully document this condition: hence, this factsheet addendum outlines the scope of nutrient enrichment in light of all available data. It also documents why Ohio EPA is seeking modest point source effluent phosphorus reductions to address the enrichment. Why point to nonpoint source trading is not an acceptable means of addressing the enrichment is also explained below.

Linkage of nutrients to aquatic life use impairment

Nutrients rarely approach concentrations in the ambient environment that are toxic to aquatic life and, in small amounts, are essential to the functioning of healthy aquatic ecosystems. However, excess nutrients can manifest as multiple problems that affect the beneficial use of a stream, including causes of impairment presented in the section 303(d) list such as:

- Nutrient enrichment (biological indicators)
- Nutrient eutrophication
- Excess primary production
- Dissolved oxygen

These causes are identified by various water quality and biological indicators within the system; however, they are intrinsically linked to the root cause of excess nutrients. In general, the linkage between the causes of impairment due to nutrients can be described as follows: nutrients in excess of the needs of a balanced ecosystem increase algal and aquatic plant life production (Sharpley et al. 1994) and stimulate microbial decomposition of organic matter (Rosemond et al. 2015). This excess primary production and respiration causes negative effects, including large diel fluctuations of dissolved oxygen (DO). Large diel fluctuations of DO are caused by excessive photosynthesis (O_2 production) during daylight hours and ongoing respiration (O_2 consumption) during dark periods. These DO swings stress fish and macroinvertebrates and often result in DO concentrations that fall below DO water quality criterion.

It is important to note that large diel fluctuations in dissolved oxygen that do not cause DO criterion exceedances are stressful to biological life. Comprehensive water quality studies in the Midwest have shown that high diel fluctuations strongly correlate to declines in biological community performance (Miltner 2010; Heiskary and Markus 2003). Additionally, it is possible to see eutrophic conditions in systems where dead organic matter accumulates and decomposes resulting in a seasonal hypoxic (or anoxic) condition (Dodds 2006).

This process of eutrophication, as explained above, shifts species composition away from functional assemblages consisting of intolerant species, benthic insectivores and top carnivores typical of high quality streams. These taxa are replaced by less functionally and biologically diverse assemblages of tolerant species, niche generalists, omnivores and detritivores typical of degraded streams (Ohio EPA 1999). Such a shift in community structure lowers the diversity of the system, thus lowering the Index of Biological Integrity and Invertebrate Community Index scores. This precludes a stream from achieving its desired state of a beneficial aquatic life use.

Seasonality is an important consideration when examining eutrophication. Warm waters are required to produce enough phytoplanktonic organisms that cause shifts in DO as explained above. Light availability is also important. When streams are turbid due to storm events light penetration is not adequate to allow enough production of algae to cause eutrophic conditions. Many studies have documented streams experience eutrophication in late spring and early summer before leaf canopy shades a stream. However, later, when the canopy completely shades waters, algal production cannot proliferate enough to be deleterious to the stream (Dodds 2006). The lower GMR is too wide to be sufficiently shaded to limit photosynthetic primary production. As a result, summertime, low streamflow periods are when eutrophication negatively impacts aquatic life in the lower GMR.

Total phosphorus

Phosphorus is selected as the nutrient of concern to reduce eutrophic impacts because nitrogen is typically present in *ad libitum* concentrations in large rivers in Ohio. Miltner (2010) found that only 12 of 109 Ohio streams analyzed are not limited by phosphorus based on molar ratios. Data from the GMR indicates that it is a phosphorus limited system. Miltner also suggests that the functional difficulty in limiting nitrogen makes forcing phosphorus limitation a desirable option even in streams that are nitrogen limited. In effect, limiting the loading of phosphorus to streams reduces the impacts described above that are caused by excessive algal growth, thus addressing a stream's nutrient enrichment. Statewide total phosphorus (TP) targets for various size drainage area streams have been developed by Ohio EPA (1999) in order to address excess nutrients impacting aquatic life.

The mainstem GMR downstream of the Dayton WWTP exhibits excessive nutrient concentrations and shows signs of over enrichment. The blue dots on Figure 1 shows 7,221 TP concentration sample results monitored at the GMR in Miamisburg (RM 66.65) by Heidelberg University's National Center for Water Quality Research from 1996 to 2012. These data are presented as a concentration duration curve. This means that they are sorted based on streamflow; with high flows on the left and low flows on the right. The thick red line on this plot shows a locally weighted scatterplot smoothing or LOESS (also known as LOWESS) of the concentration data. LOESS is a method used for regressing non-parametric data and is recommended by USGS for data of this sort (Helsel and Hirsch 2002). A LOESS line is included to best understand the concentration trend through flow regimens. The black horizontal line at 0.3 mg/l concentration is the Ohio EPA TMDL TP target for large rivers (from Ohio EPA 1999). The bold, black vertical lines are present to divide up flow regimens and are only present as a reference.

Note on Figure 1 that the TP concentrations are elevated in the high flows on the left side of the plot. This is observed typically throughout Ohio's large rivers (Baker et al*.* 2006). This indicates the predominantly agricultural land use drained upper GMR exports a great deal of phosphorus-laden sediment during times of high flow. The middle of the plot shows TP concentrations in general below the 0.3 mg/l target. However, unlike most large rivers in Ohio, the TP concentration in the lower GMR again exceeds the target as flows recede (moving to the right) from the median flow. This is explained by the discharge from the multiple large publicly owned WWTPs with little or no TP controls, and is a strong indication of an effluent dominated system.

Through the Ambient Surface Water Monitoring Program, Ohio EPA regularly monitors the nutrient concentration of the lower GMR at a site very close to the one monitored by Heidelberg University and discussed here. While not nearly as many data points have been captured by Ohio EPA, the same trend of increasing TP concentrations during the lower stream flows has been observed.

Note that a Mann-Kendall trend test was carried out by Ohio EPA on the Heidelberg data presented in Figure 1 and determined that no long-term temporal change in concentration occurred over the years 1996-2012.

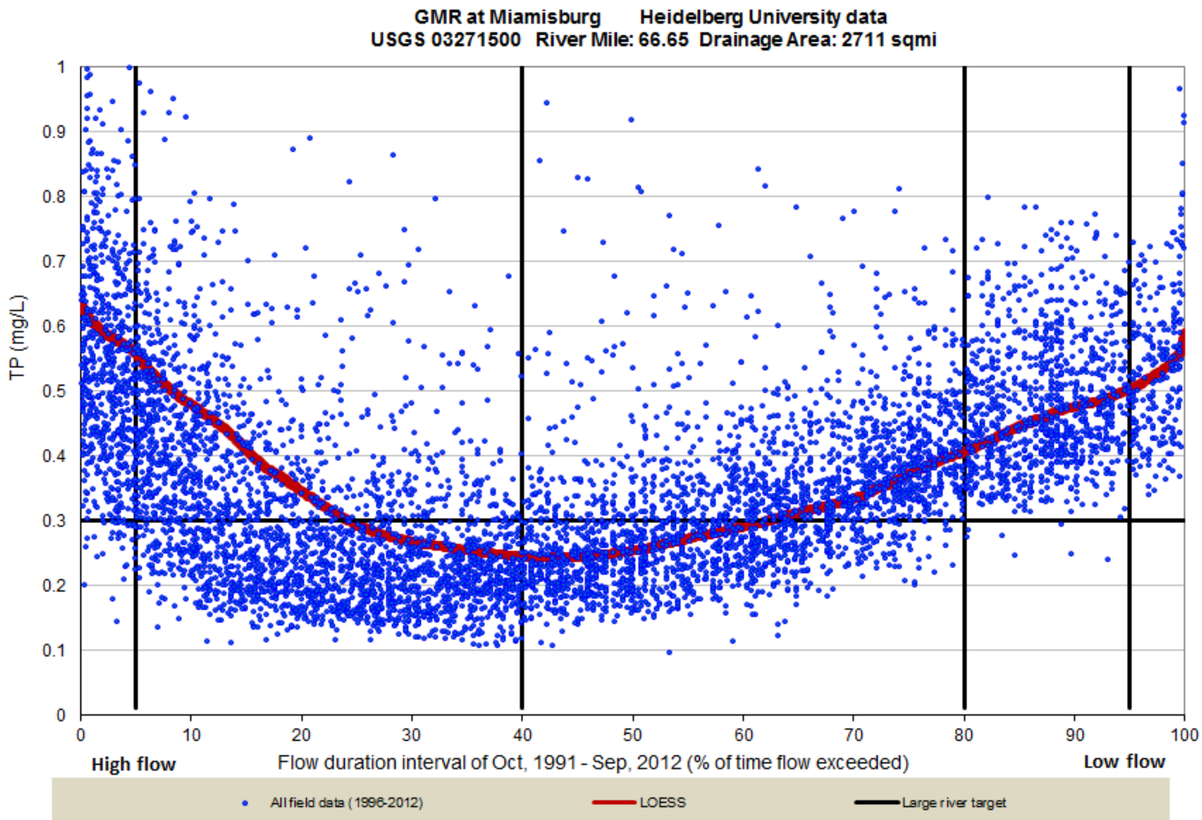


Figure 1 Concentration duration curve of total phosphorus concentrations at the Great Miami River at Miamisburg plotted along the flow duration interval, data from the Heidelberg University National Center for Water Quality Research.

Figure 2 shows a similar plot to Figure 1 except instead of TP this plot represents dissolved reactive phosphorus (DRP) concentrations. This parameter is a fraction of TP that is most readily utilized by algal primary production, the process that drives eutrophic nutrient enrichment. Ohio EPA does not currently have a target for this parameter. Note that the DRP concentration is not elevated during times of high streamflow (the left half of the plot). This is because the TP that is present during high flows is predominantly attached to sediment particles and therefore not dissolved in solution. However similar to TP in Figure 1, the DRP concentrations increase as flow recedes from the median flow, and continue to increase as flows recede to the lowest flow (the right half of the plot). The TP present in properly functioning WWTP effluent is predominantly in the DRP form. Therefore Figure 2 offers more evidence that WWTP discharges are a very significant source of the elevated TP concentrations in the lower flows of the lower GMR.

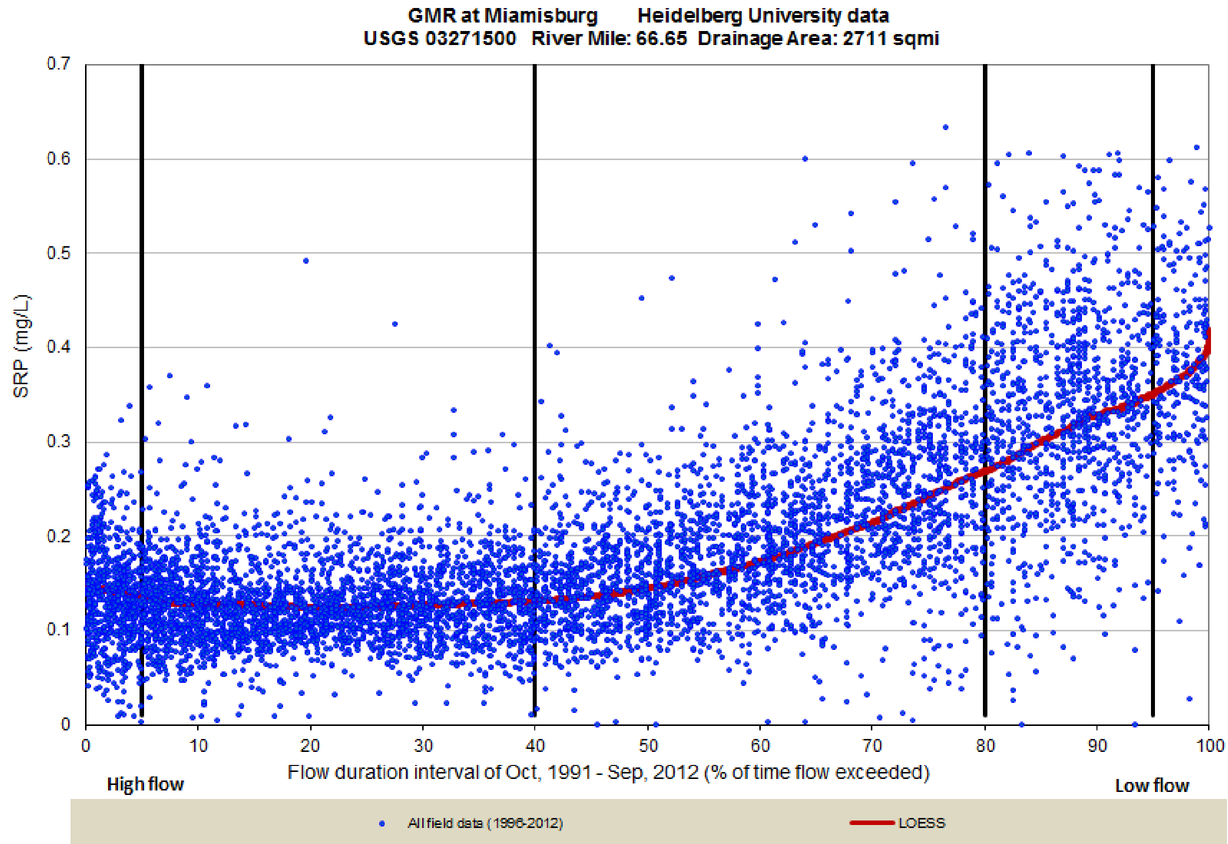
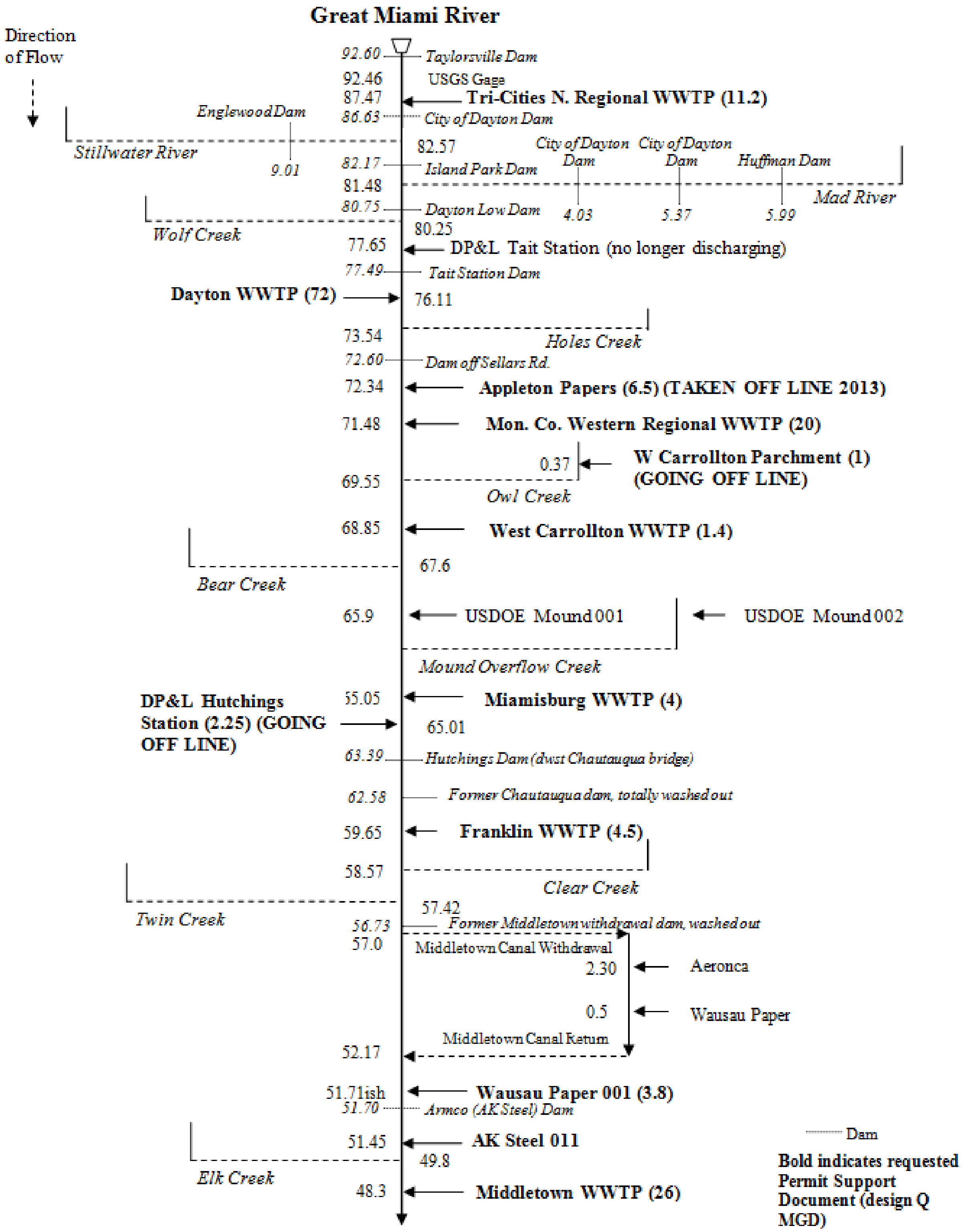


Figure 2 Concentration duration curve of soluble reactive phosphorus concentrations at the Great Miami River at Miamisburg plotted along the flow duration interval, data from the Heidelberg University National Center for Water Quality Research.

Figure 3 is a schematic of the lower GMR's point sources and tributaries; low head dams are also indicated on this schematic. Major WWTPs are denoted by bold face text in this figure. The GMR is unique in Ohio regarding the large amount of wastewater it receives.

Figure 4 shows a typical TP survey Ohio EPA carried out on the lower GMR on August 23-25, 2010. TP concentrations from upstream to downstream (left to right) are shown as blue diamonds. Labels along the top of the plot indicate the discharge locations of the major WWTPs. Labels along the bottom show several tributaries. Notice that downstream of the Dayton WWTP the river experiences a large jump in TP concentration, causing it to exceed the 0.3 mg/l target. Moving downstream the TP concentration decreases slightly due to attenuation, with periodic increases caused by additional WWTP discharges.



continued on next page

Figure 3 Schmatic of the lower Great Miami River with point sources, dams and tributaries noted (upper half). Major plants are noted in bold, and their average design flow in million gallons per day are noted in parentheses.

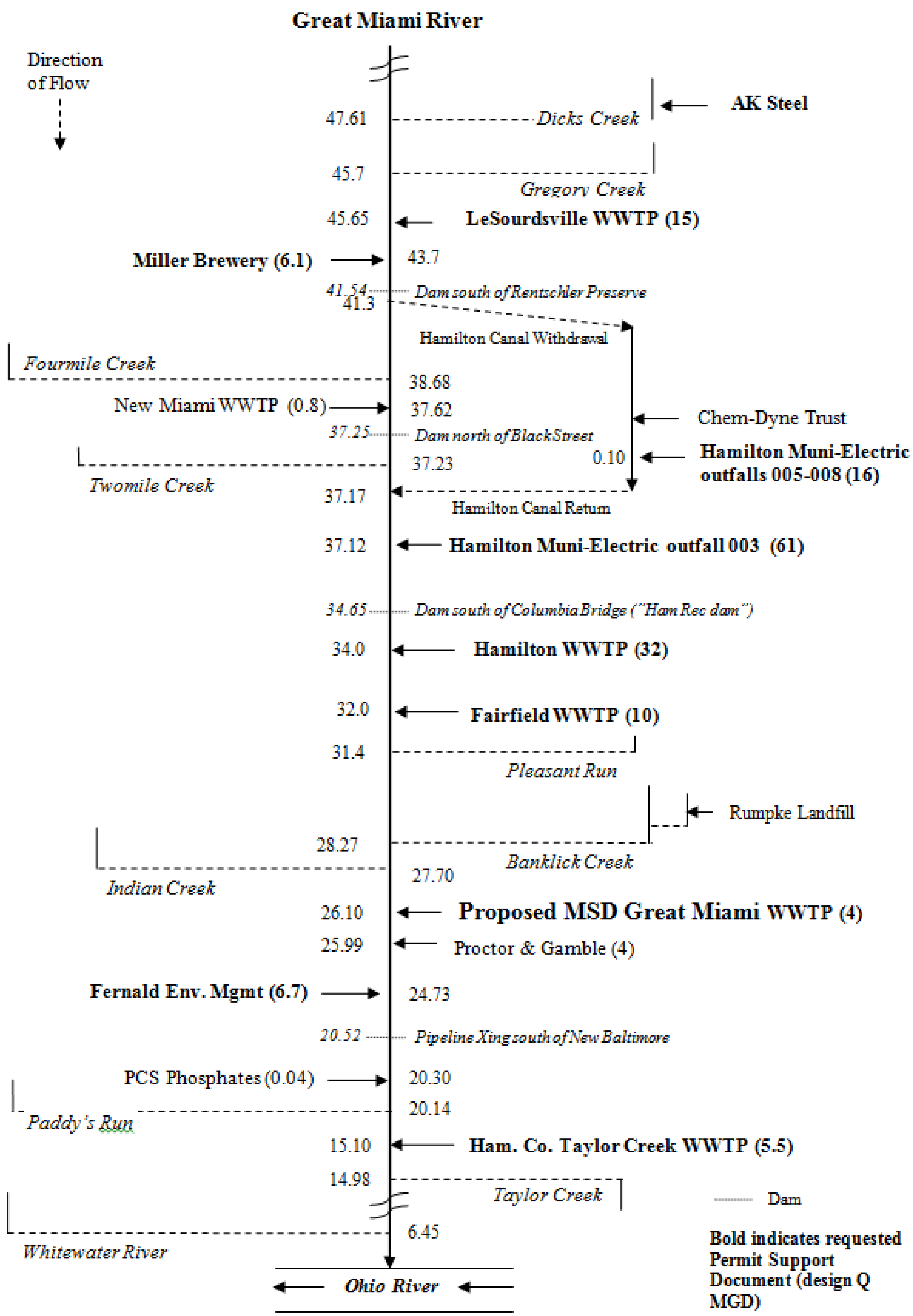
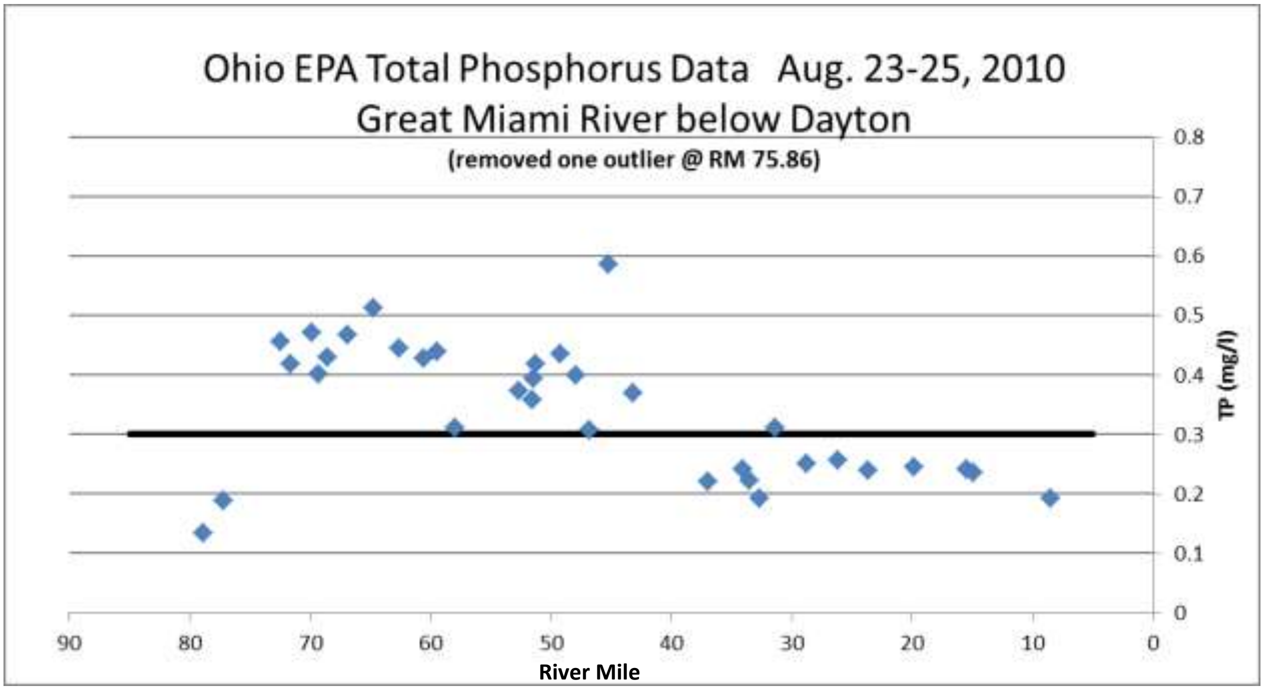


Figure 3 (continued) Schmatic of the lower Great Miami River with point sources, dams and tributaries noted (lower half). Major plants are noted in bold, and their average design flow in million gallons per day are noted in parentheses.



RM	Point source		RM	Point source
76.11	Dayton WWTP		45.65	LeSourdsville WWTP
72.34	Appleton Papers*		43.70	Miller Brewery WWTP
71.48	Mon. Co. W. Reg.		37.12	Ham. Muni-Electric 003
68.85	W.Car. WWTP		34.00	Hamilton WWTP
65.05	M.burg WWTP		32.00	Fairfield WWTP
59.65	Franklin WWTP		27.10	New MSD plant
51.71	Wausau Paper 001		24.73	Fernald WWTP
51.45	AK Steel 011		20.30	PCS Phosphates
48.30	M.town WWTP		15.10	Ham Co Taylor Ck WWTP

RM	Tributary
82.57	Stillwater R
81.48	Mad River
80.25	Wolf Creek
69.55	Owl Creek
47.61	Dicks Creek
41.30	Ham. canal withdrawal
37.17	Ham. canal return

* Appleton Papers has ceased direct discharge to the Great Miami River since these data were collected.

Figure 4 Total phosphorus concentrations during August 23-25, 2010 from upstream to downstream in the lower Great Miami River and tables explaining the labels on the plot.

Figure 5 shows a summary of the TP concentrations in four surveys conducted by Ohio EPA in 2010, and includes the data in Figure 4. All of these surveys occurred during relatively steady state, low streamflows. Additionally, all of these surveys show the same trend of elevated TP concentrations downstream of the Dayton WWTP.

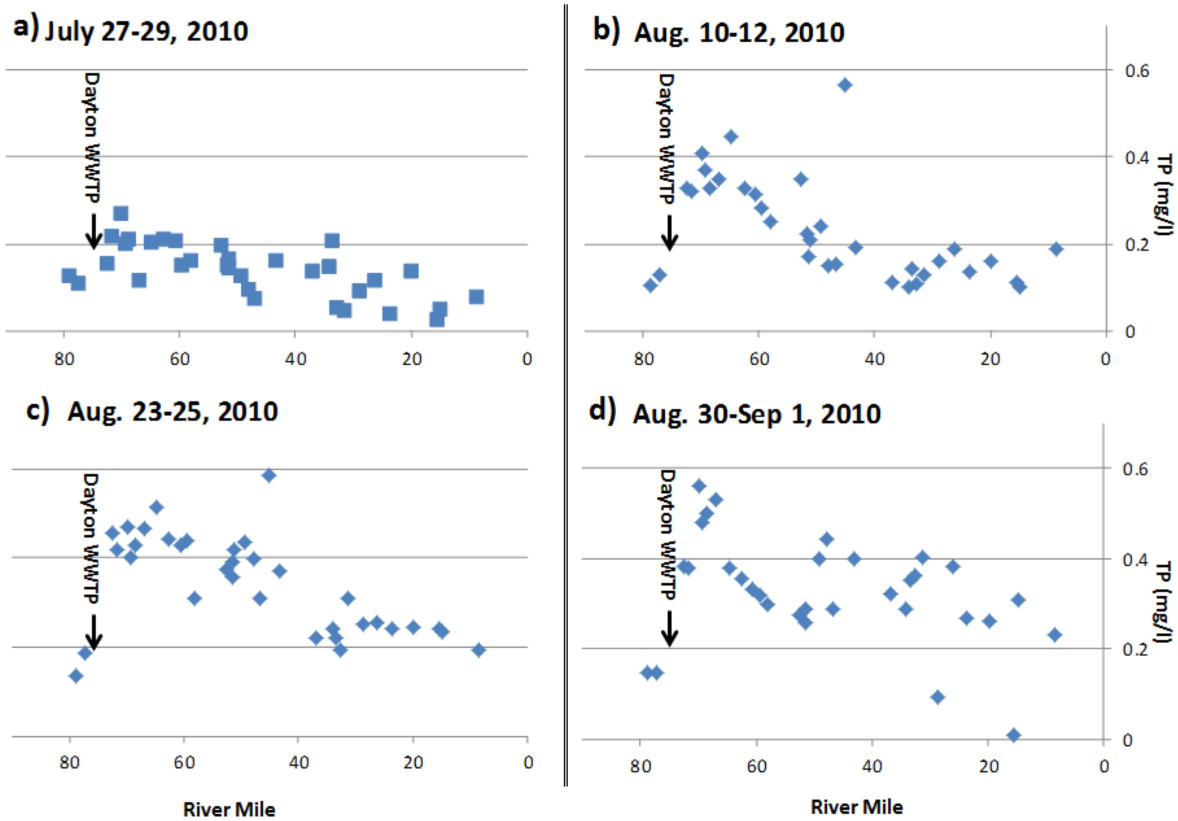


Figure 5 Total phosphorus concentration from four 2010 surveys from upstream to downstream

Chlorophyll *a*

Sestonic (or suspended) chlorophyll *a* (henceforth referred to as "chlorophyll") is a parameter monitored in large rivers (>200 mi^2 drainage area) as an indicator of the concentration of phytoplanktonic organisms (Royer et al. 2008). (Note that periphyton or benthic algae chlorophyll *a* is the parameter that Ohio EPA is currently using to develop nutrient water quality standards for smaller streams; draining areas up to 1,000 square miles.) Figure 6 shows the chlorophyll concentrations as blue diamonds along the lower GMR during a similar time period as the TP data presented in Figure 4. The labels used in Figure 6 are also the same as in Figure 4. The shading in Figure 6 indicate a potential for enrichment with concentrations 40-100 ug/l and over enriched conditions at concentrations >100 ug/l. These thresholds are based on Miltner 2010 and Dodds 2006. Note the sample upstream of Dayton WWTP (the first sample on the left) is on the bottom of the potential for enrichment zone. However the chlorophyll concentrations increase markedly downstream of the Dayton WWTP, and by river mile (RM) 65 this parameter indicates that the river is over enriched throughout the remainder of the lower GMR.

The Heidelberg University data presented in Figures 1 and 2 were collected at RM 66.65. Note on Figure 4 that the TP is elevated above the target concentration at this point during the Ohio EPA August, 2010 data collection. At this river mile the chlorophyll data on Figure 6 indicate only a potential for enrichment however very close downstream the chlorophyll data crosses the threshold to become over enriched. This observation is viewed as the river's response to the nutrient loading from the Dayton WWTP, and to a lesser degree continued loading from other WWTPs, in growing more algal material. This phenomenon is a well-documented interaction between phosphorus loads and residence time (Jarvie 2013, Bowes et al. 2012).

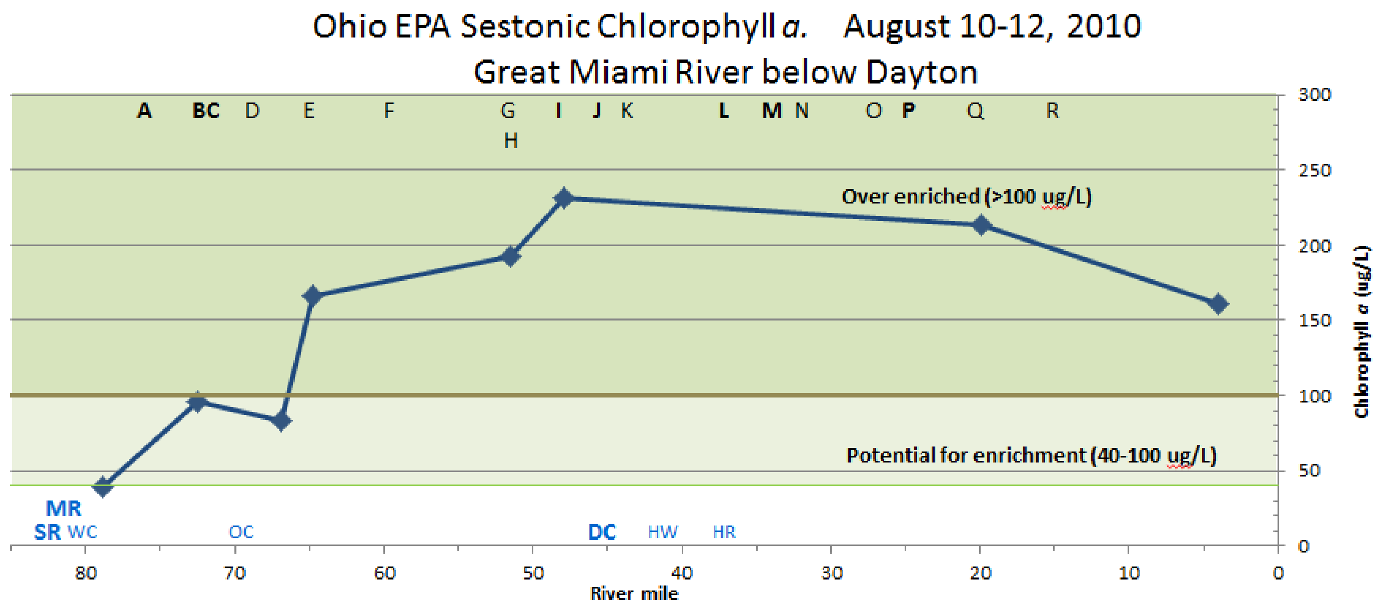


Figure 6 Sestonic chlorophyll *a* concentrations during August 10-12, 2010 from upstream to downstream in the lower Great Miami River. The tables in Figure 4 above explain the labels on the plot.

Several additional chlorophyll sampling events by the Ohio EPA agreed with these findings (84 samples collected during 8 different surveys in 3 years of study, 80% of those samples >40 ug/l and 40% > 100 ug/l). One sample collected in July 2011 near Middletown resulted in 280 ug/l chlorophyll, the highest value found in a lotic system the Ohio EPA's laboratory has ever observed. That high value is included in Figure 7 which shows two additional surveys chlorophyll data. Figure 8 presents a summary of the results of all chlorophyll data collected in the lower GMR 2010-2012.

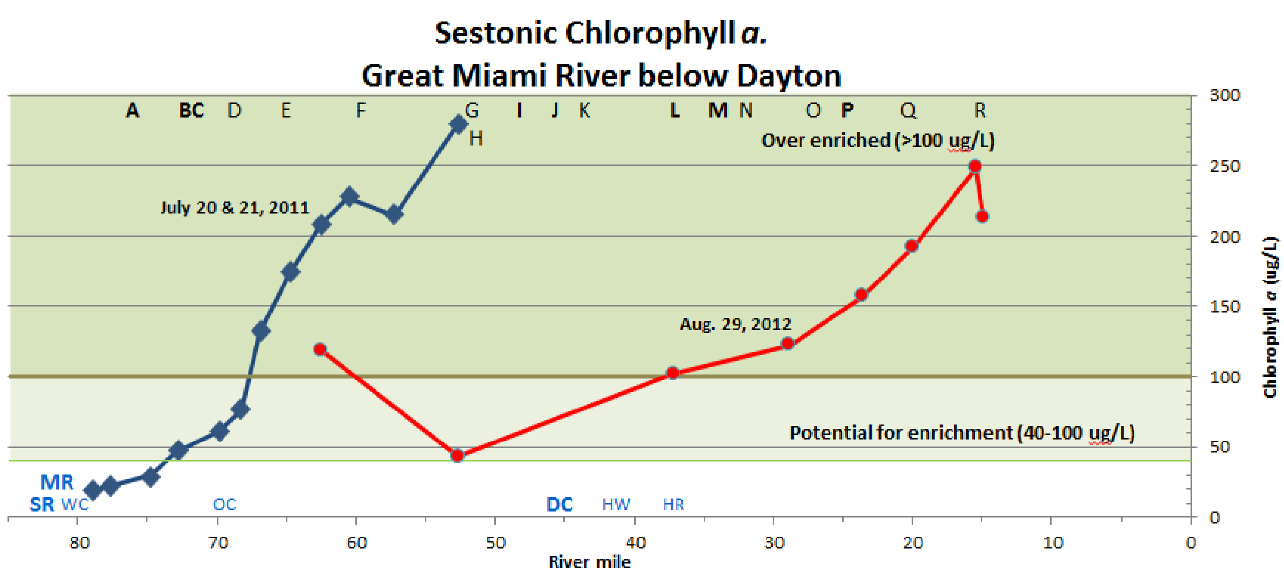


Figure 7 Sestonic chlorophyll *a* concentrations during two surveys, July 20-21, 2011 from Dayton to Middletown (in blue) and August 29, 2012 from Franklin to Miamitown (in red). The tables in Figure 4 above explain the labels on the plot.

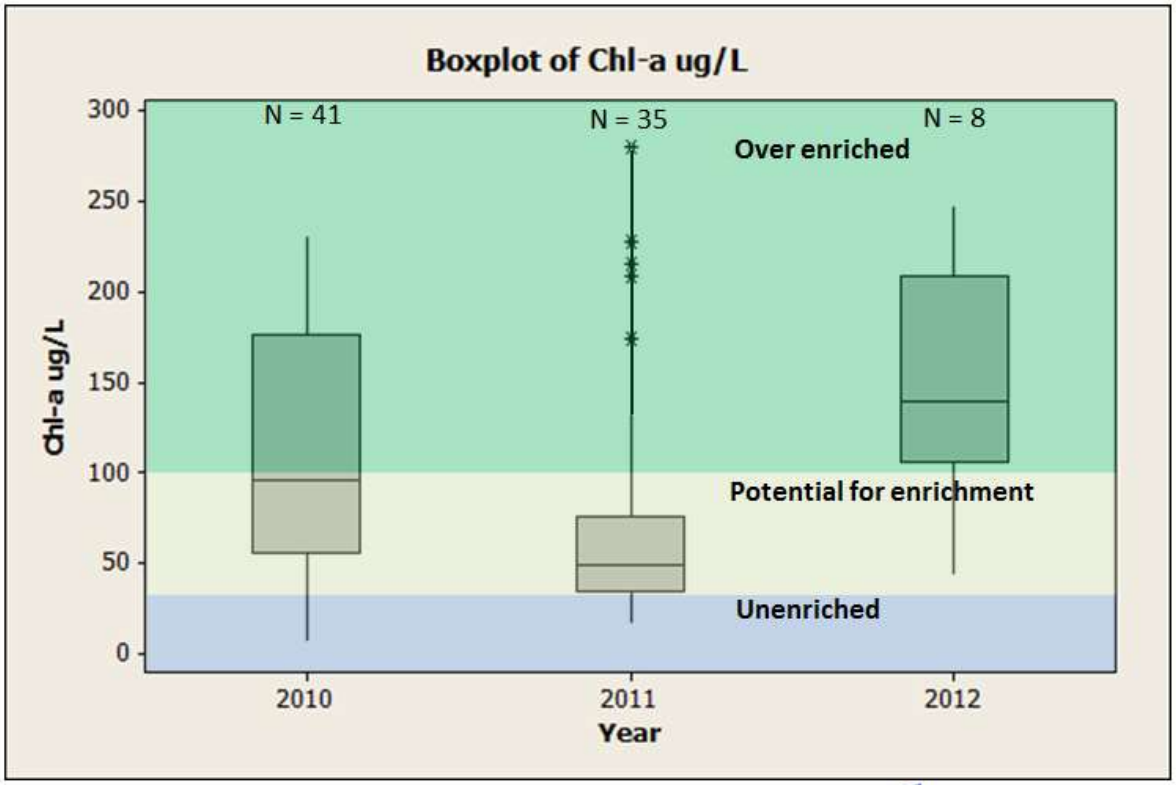


Figure 8 Sestonic chlorophyll *a* concentrations results of all lower GMR Ohio EPA collected data in 2010, 2011 and 2012.

Low head dams and dam pools upstream of these structures are present throughout much of the lower GMR, and the presence of these dams is very likely a contributor to the excessive enrichment. However, chlorophyll data indicate little to no enrichment upstream of Dayton WWTP, as noted in both Figures 6 and 7. This is a stream reach with several dam pools similar to downstream enriched reaches. This provides evidence that the enrichment is primarily fueled by the large nutrient loadings from the Dayton WWTP and downstream.

Dissolved oxygen

Dissolved oxygen (DO) concentrations observed during surveys also confirm enrichment starting around RM 65 and continuing downstream. Figure 9 shows the diel 24-hour range of concentrations at nineteen sampling locations from July 6-7, 2010. These data are presented in the form of boxplots where the horizontal line in the middle of each box sampling site is the median concentration observed. The top and bottom of each box is the 75th and 25th percentiles respectively. Finally the tip of the tails above and below each box shows the maximum and minimum of each sampling site respectively. As noted above, enrichment processes cause DO to swing high during sunlight hours due to photosynthesis and low during the night due to continued respiration. A maximum to minimum range of greater than 9 mg/l is considered by Ohio EPA to be a sign of excessive nutrient enrichment in wadeable streams and small rivers. To put this range into context, Gammons et al. (2011) reported a 24 hour DO range of 9 m/l from Silver Bow Creek, and noted that that range was among the largest reported in the literature. Also, a range of 5 mg/l is considered a sign of over-enrichment in large, eutrophic Minnesota rivers due to a strong negative correlation between increasing 24-h DO swings and decreasing biological condition (Heiskary et al. 2010). The boxes for sites where this was observed are filled in green on Figure 9. Note that the location of the low head dams throughout the lower GMR in addition to the major point sources and tributaries are labeled on this figure. Similar to the inference drawn from the sestonic chlorophyll shown in Figures 6 and 7, DO data do not indicate excessive enrichment in the areas through the City of Dayton, where several dam pools are present. However about ten river miles downstream of the Dayton WWTP DO diel ranges do show signs of enrichment, and this enrichment continues downstream.

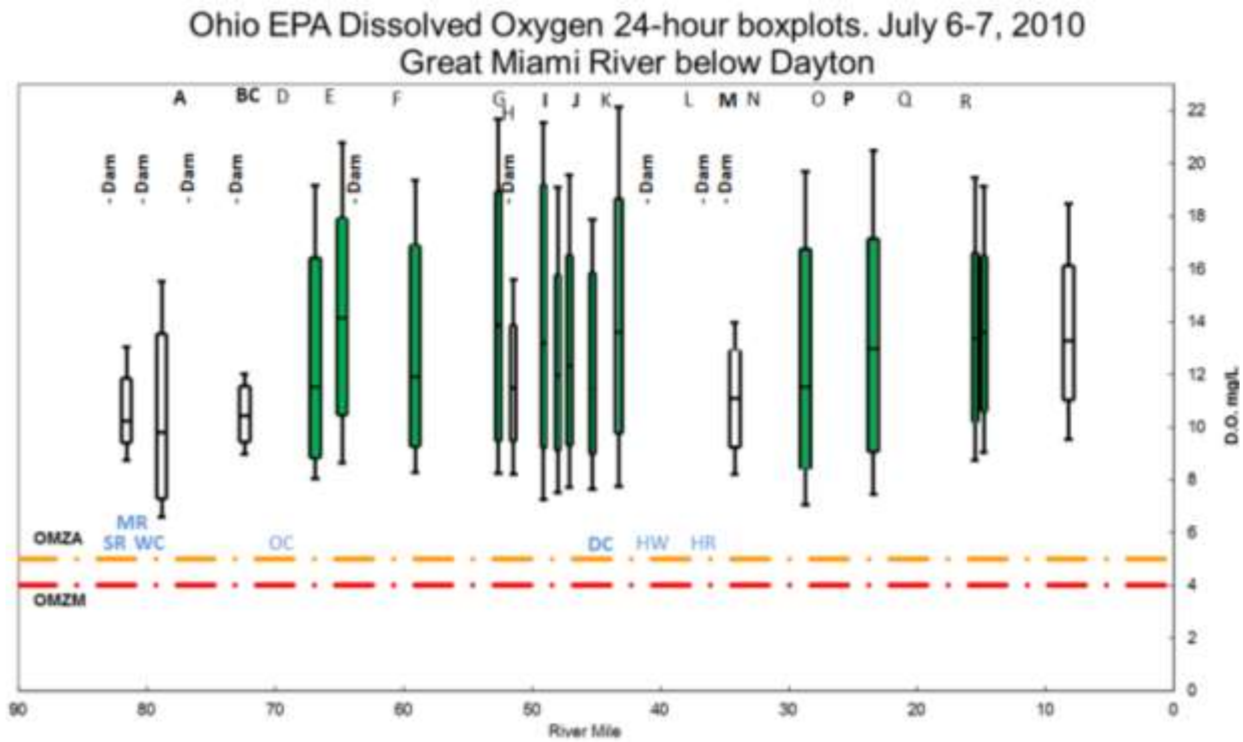


Figure 9 24-hour dissolved oxygen boxplots during July 6-7, 2010 from upstream to downstream in the lower Great Miami River. Sites filled in with green exceed 9 mg/l dissolved oxygen in the 24-hour period. The tables in Figure 4 above explain the labels on the plot.

Ohio EPA has documented enrichment in the GMR in three consecutive years. Figure 10 shows another 2010 DO survey on the lower GMR. In the free flowing river reach downstream of the Fairfield WWTP (labeled "N") diel ranges greater than 9 mg/l again are observed. Figure 11 shows a 2011 DO survey that focused only on the upper half of the lower GMR (from Dayton to Middletwon). Note on this plot that diel ranges greater than 9 mg/l are observed just downstream of Dayton WWTP and continue downstream at all observed points but two. On Figure 11 it is easy to note that enrichment persists in free flowing waters well downstream of the Hutchings Dam at RM 64.4. Figure 12 shows a 2012 survey DO survey that examined the river from Hamilton and downstream. Here again excessive enrichment was observed in a dam pool and at multiple free-flowing sites.

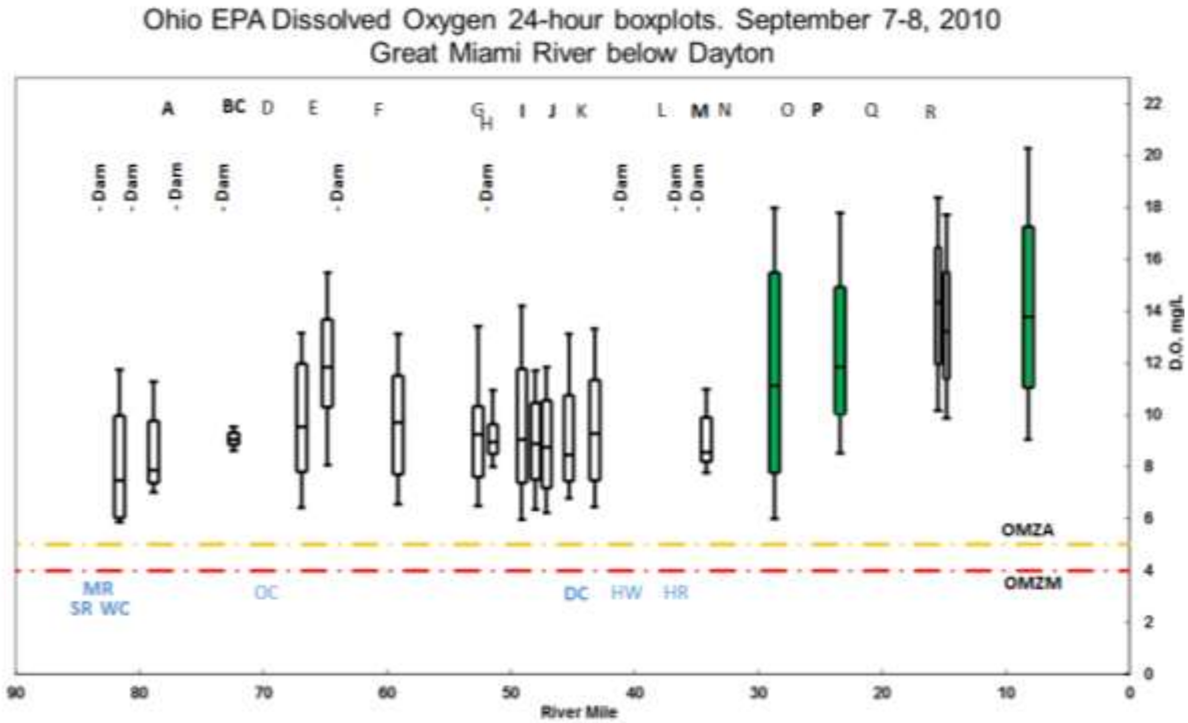


Figure 10 24-hour dissolved oxygen boxplots during September 7-8, 2010 from upstream to downstream in the lower Great Miami River. Sites filled in with green exceed 9 mg/l dissolved oxygen in the 24-hour period. The tables in Figure 4 above explain the labels on the plot.

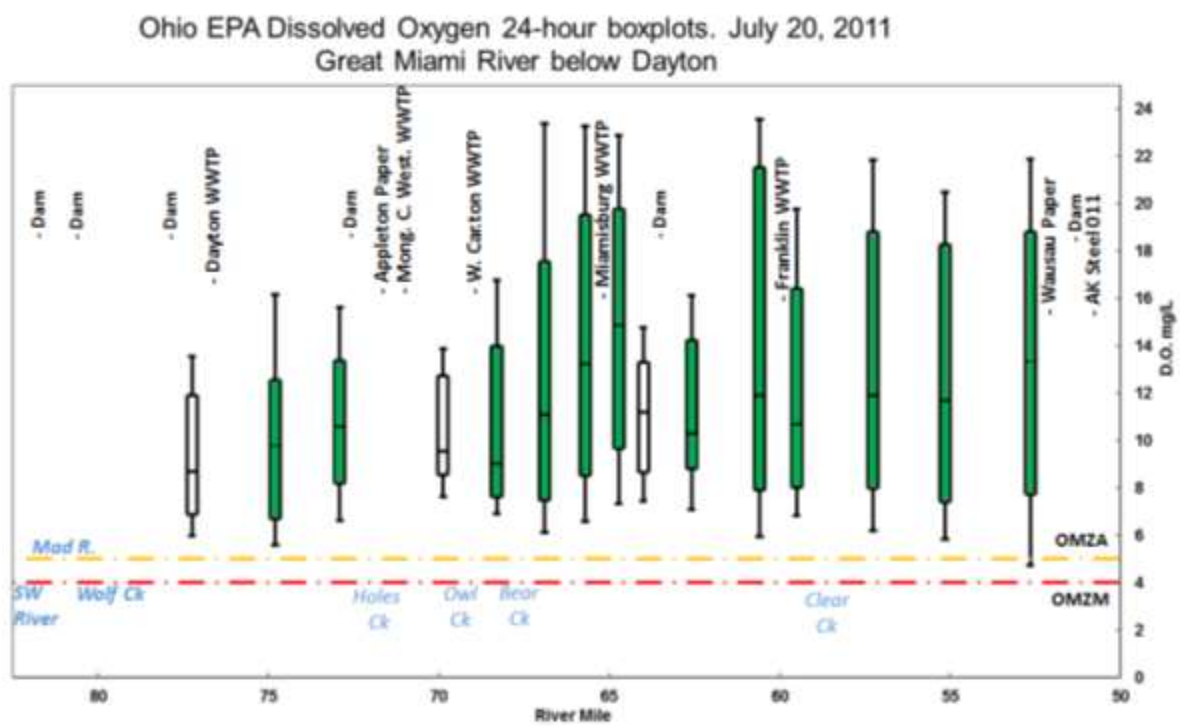


Figure 11 24-hour dissolved oxygen boxplots during July 20, 2011 from upstream to downstream in the upper half of the lower Great Miami River. Sites filled in with green exceed 9 mg/l dissolved oxygen in the 24-hour period. Note the change in scale on the DO axis compared to the previous DO plots; required due to super-saturated dissolved oxygen findings.

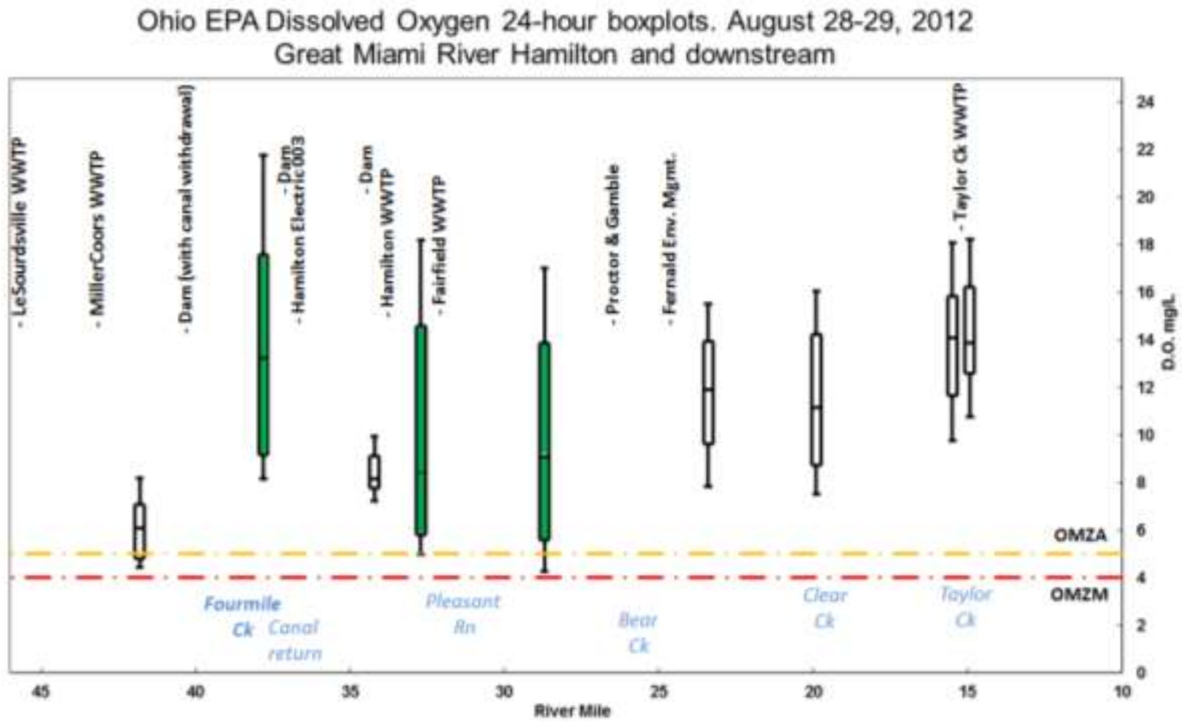


Figure 12 24-hour dissolved oxygen boxplots during August 28-29, 2012 from upstream to downstream in the lower third of the lower Great Miami River. Sites filled in with green exceed 9 mg/l dissolved oxygen in the 24-hour period.

Accounting and interactions of phosphorus

The phosphorus component that is most relevant to eutrophication in streams is soluble reactive phosphorus (SRP) (Baker 2011). Total phosphorus is used instead of SRP to develop TMDLs and permit limits because TP is the most commonly monitored species of phosphorus in waters, and it includes the reactive component. Figure 13 shows the ratio of soluble reactive phosphorus to total phosphorus using the same data from Heidelberg University's monitoring station in Miamisburg that is shown above in Figures 1 and 2. This plot clearly indicates that phosphorus in the dissolved form is the predominate species present in the river in lower streamflow conditions, the right side of the plot. Considering the large phosphorus loads from Dayton WWTP and several other major WWTPs, this clearly indicates that the high concentration of phosphorus in the lower GMR at lower flows is nearly entirely from WWTP effluent.

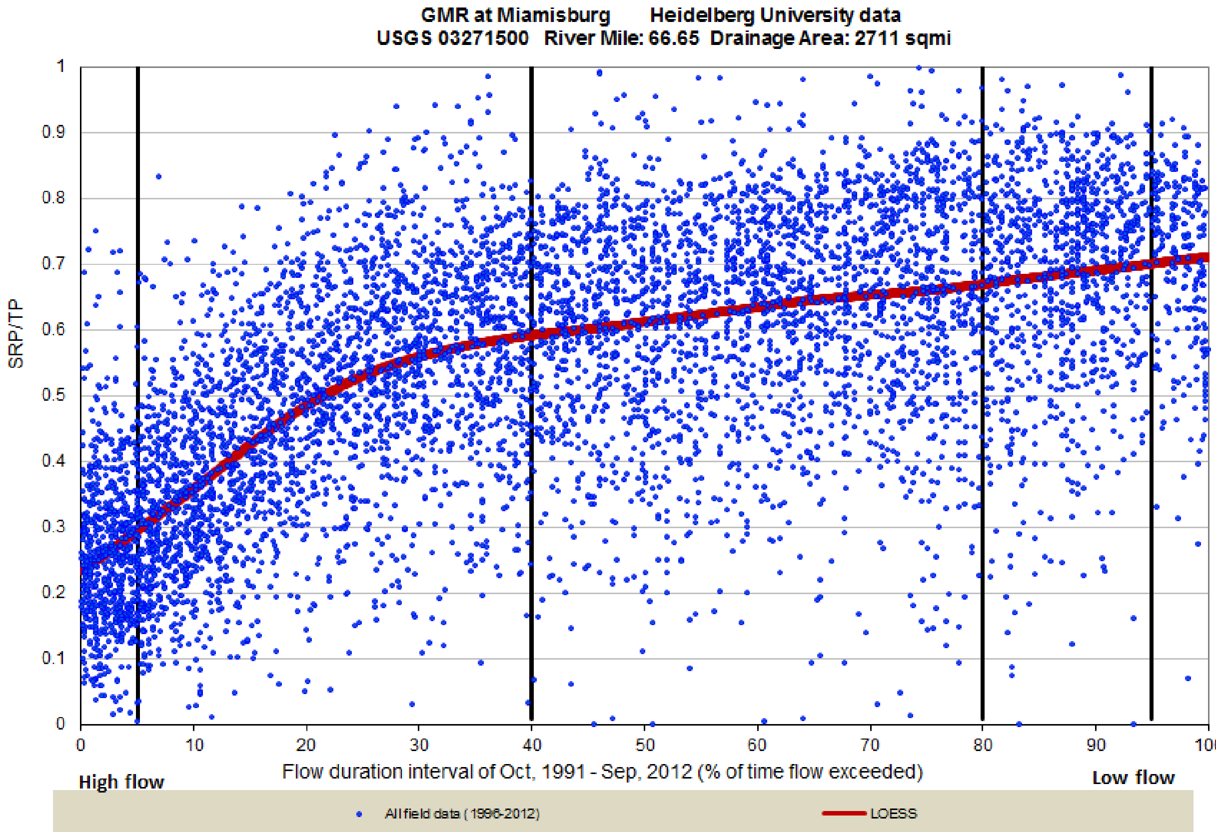


Figure 13 The ratio of soluble reactive phosphorus to total phosphorus concentrations at the Great Miami River at Miamisburg plotted along the flow duration interval, data from the Heidelberg University National Center for Water Quality Research.

Accounting of all lower GMR contributing sources of flows and TP concentrations can be carried out to further show that the lower GMR's TP load is dominated by the WWTPs that directly discharge to the river. This accounting has been calculated using two different background flow conditions for this document.

1) The first condition is that of a "typical" existing summer time day. Gaged and observed streamflow from a low flow period in August 2011 are used for the upstream and tributary flows for this condition. Discharger reported flows from the same time period are used for the point source flows. TP concentrations used are those that were sampled by Ohio EPA during this same time period for all sources.
2) The second background condition examines the TP load contributions based on average daily reported wastewater discharger flows from July through October for a five year period (2010-2014) and tributary and upstream streamflows set at the summertime seven-consecutive day, 10-year recurrence interval (7Q10) flow statistic. This flow statistic is the critical low flow value that is used when calculating conservative (e.g., metals) wasteload allocations for NPDES permitted dischargers. The TP concentrations used to calculate the loads for this second background condition are the same as the first condition.

For these calculations stream flow from to the DPL Hutching's Station, Miamisburg Canal and Hamilton Canal (including the Hamilton Power Station) are not accounted for. This is because the flow from these sources are diverted and then returned to the river.

Figure 14 shows the results of these two loading conditions as the two pie charts on the left half of the figure. These pie charts show that the lower GMR direct point sources are responsible for 68.6% of the TP load contributing to this section of the river on a typical summer day, and 85.3% of the load during the lower background flow 7Q10 condition. The two pie charts on the right half of Figure 14 show the show the relative contributions of streamflow from the flow data used to determine the TP loadings. These pie charts show that the direct lower GMR point sources make up 25.3% of the typical summer day's flow and 45.1% during the 7Q10 flow condition.

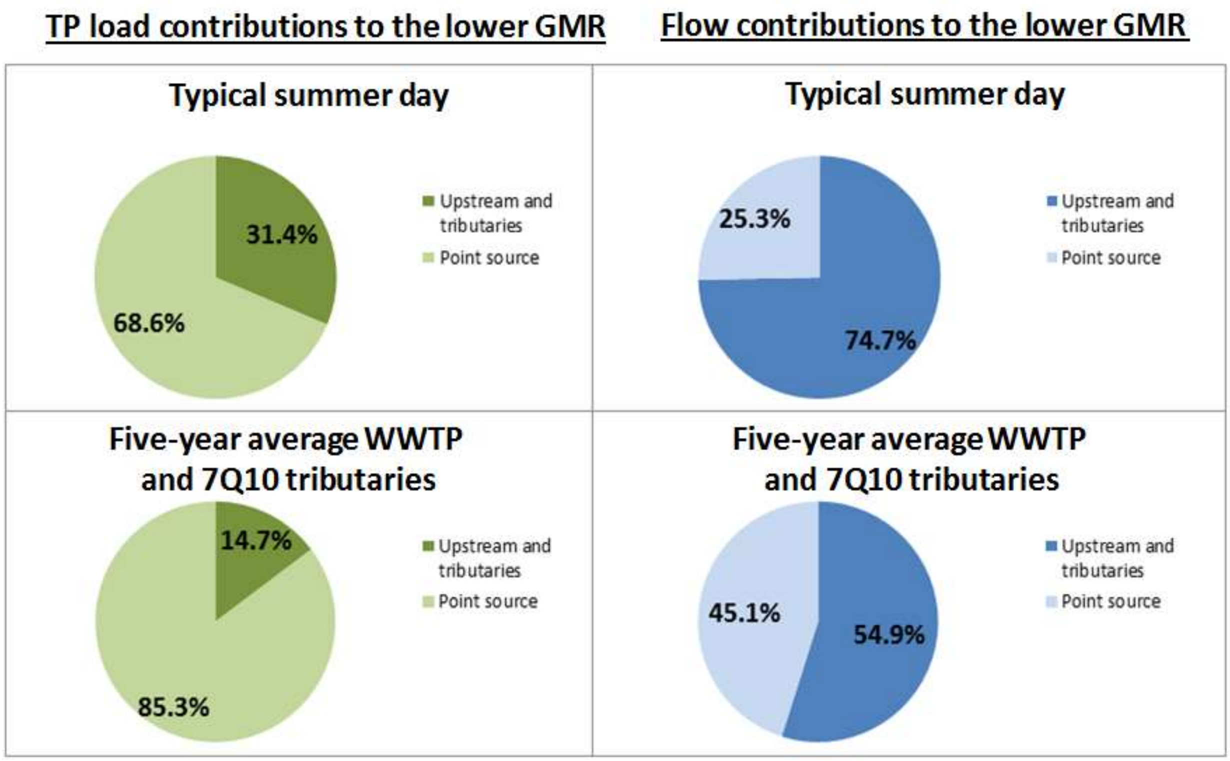


Figure 14 Relative total phosphorus load (left charts) and flow (right charts) contributions to the lower GMR from upstream/tributaries and direct lower GMR point sources. Flow conditions are set at a typical low flow, summer day using August 2011 (upper charts), and with point sources set at their 5-year average discharge flow and upstream/tributary flows set at the 7Q10 flow statistic (lower charts).

In a presentation and corresponding paper Baker et al. 2006 specifically notes the lower GMR within a discussion of point source to nonpoint source phosphorus trading in Ohio. In the paper Dr. Baker and colleagues delineate that the effluent borne phosphorus should be considered to have the greatest impact on excessive biological deleterious enrichment. This is because it is during the summertime low flow condition that excessive primary production occurs. Furthermore during low flow conditions other water sources are reduced and therefore offer much less dilution to the WWTP effluent. The ample dissolved nutrients delivered to the GMR from the WWTPs vastly overcome any other mechanisms of nutrient uptake by algae; as discussed below.

Baker et al 2006 also notes that accounting for phosphorus loading into the GMR during low flows the river delivers less phosphorus than it receives from WWTP contributions. Three mechanisms explain this phosphorus attenuation. First, direct algal uptake of phosphorus occurs. Next phosphorus is converted into biomass (*i.e.* fish and other aquatic life) as consumption occurs up the food web. Settling of algae and other aquatic life occurs and can incorporate phosphorus into bed sediments. This documented attenuation is an indication that the river system will respond to phosphorus reduction management.

In addition to the phosphorus being settled to the streambed from algae/biomass, phosphorus rich sediment runoff from the upstream contributing watersheds to the lower GMR delivers great loads of TP downstream throughout the year. Recall that the left side of Figure 1 shows large concentrations of TP during high flows at the Heidelberg sampling station. Furthermore, Figure 13 shows TP that consists of less than 50% soluble reactive phosphorus in 18% of the highest flows (note the change in slope of the red LOESS line around the 18 exceedance percentile flow on the X-axis). While much of the TP is exported out of the watershed during times of high flows, some does settle onto the river substrate, especially so in dam pools. The fate of phosphorus settled within river substrates is next examined.

Internal loading

It has been well documented that in stream systems substrate sediment may provide an "internal" phosphorus load that contributes to low flow summertime algal growth. This is dependent on the mass and aerial extent of fine sediment in the stream, sediment temperature and chemistry, overlying water column concentration and the equilibrium phosphorus concentration (EPC_0) of the substrate sediments (Taylor and Kinishi 1971; Kunishi et al*.* 1972; Meyer 1979a; Meyer 1979b). This process involves phosphorus that is locked in stream sediments desorbing to become bioavailable within the stream. The inverse can occur in which water column phosphorus can be sorbed into the stream substrate sediment. In general, for a given stream, if the overlying water column phosphorus concentration is less than the substrate's EPC_0, desorption of substrate phosphorus to the water column will occur. The reverse will happen when the overlying water column concentration is greater than the substrate substrate's EPC_0.

Ohio EPA 2015 has developed an evaluation of stream phosphorus critical conditions documenting these processes in detail as they relate to Ohio's streams. In this paper Ohio EPA used nutrient accounting to document streams where phosphorus internal loading via desorption occurs and where phosphorus sorption to the substrate occurs following the EPC_0 concept in tributaries to the GMR.

A Sharpley et al*.* 2007 study examined the nature of streambed sediments in relation to the EPC_0 concept. This research and the Ohio EPA 2015 paper found that substrates consisting of silts containing a great deal of clay are most favorable for holding more phosphorus; i.e., have relatively higher EPC_0. This is because clay has properties that are favorable to holding more phosphorus. The lower GMR's bed sediments are quite different in nature from the sediments examined in these studies. Most importantly, fine material for phosphorus to bind to in the lower GMR is scarce. Figure 15 shows the results from the Ohio EPA's habitat assessments, or QHEI surveys, of the lower GMR. The top pie chart shows that only one assessment site out of 34 had about half of its bottom sediment as silt. The vast majority of the assessment sites have gravel and cobbles as their bed material. The lower pie chart shows that very little riffle/run embeddedness (or fine sediments within those gravel and cobbles) exist. The QHEI assessments also noted 22 sites with no bank erosion at all, and 12 with "none/moderate" bank erosion. No sites were determined to have heavy bank erosion. All of these indicators point to the fact that the lower GMR's streambed capacity for phosphorus sorption and desorption of dissolved phosphorus is relatively small.

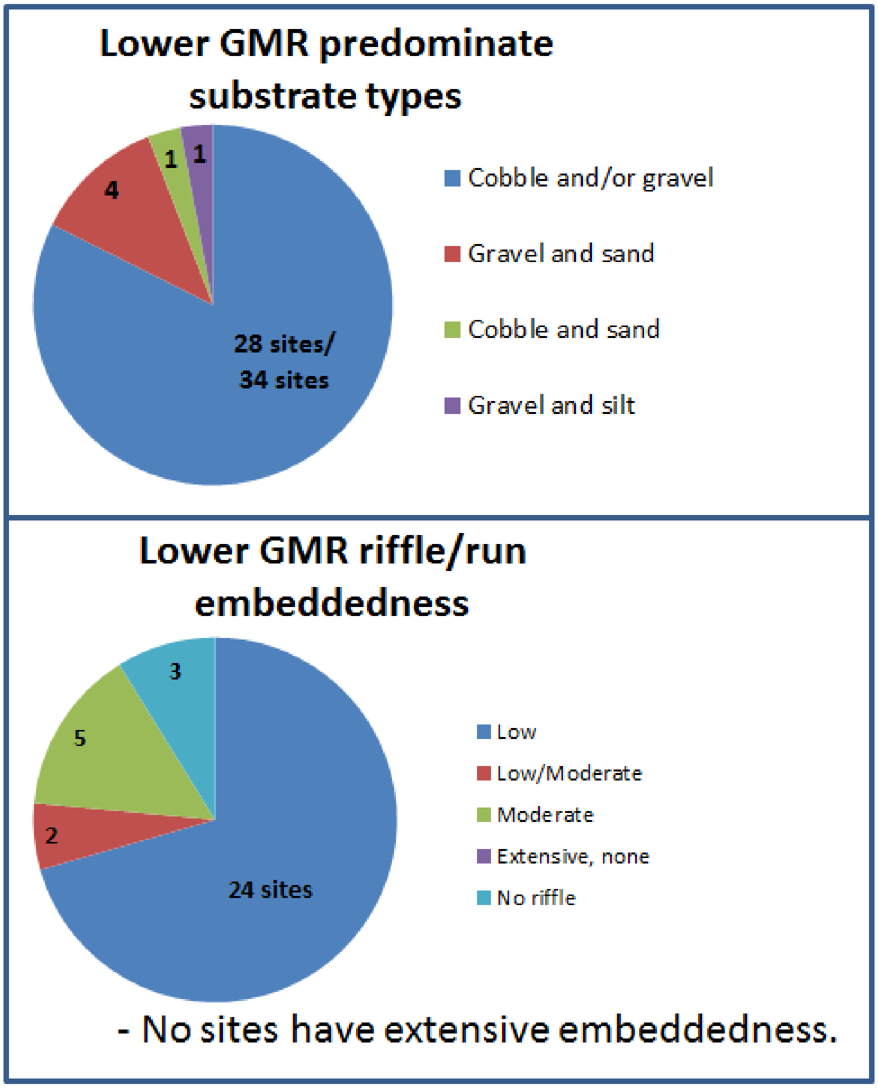


Figure 15 QHEI habitat assessment results for substrate types and stream bed embeddedness for the lower GMR.

The above examination of streambed material notwithstanding, some areas with fine stream substrate are present in the lower GMR; dam pools being the most likely location of these. Following the EPC_0 concept, the lower GMR's steady supply of SRP from wastewater point sources prevents substrate sediment from desorbing phosphorus. Jarvie *et* al. 2005 examined river systems similar to the lower GMR, and found this to be true. That research shows that in rivers with no phosphorus controls on major municipal waste treatment, sewage effluent borne phosphorus is the predominate driver of nutrient enrichment. As indicated by Baker et al. 2006 specifically in regards to the GMR, a Chomat and Westphal 2013 study show that streambed sediment is a phosphorus sink in low flow situations when the SRP concentration of the water is elevated; which is all summer for the lower GMR. As a result, internal phosphorus loading is not a significant source of eutrophication-causing phosphorus in the lower GMR.

Specific studies of the lower GMR substrate phosphorus and specifically its EPC_0 have not been carried out. Understanding the dynamics of this issue is very complex and rapidly changes over temporal and spatial scales (Chomat and Westphal 2013; James and Larson 2008; Jarvie et al 2012). For instance research on the Illinois River in Arkansas and Oklahoma found that much of the TP during high flows were originally sourced from point source effluent that had become remobilized (Jarvie et al 2012). Further, a study of the Assabet River in Massachusetts found that dredging dam pool sediments with the idea of removing sunk nonpoint source TP would not address that river's enrichment due to the continual discharge of TP rich effluent (Chomat and Westphal 2013).

It is clear however that the amount of uncontrolled WWTP sourced TP being delivered to the lower GMR must first be addressed before internal loadings are considered. The lead engineer studying pollutant nonpoint source to point source trading coefficients for the Ohio River basin for the Electric Power Research Institute has stated that effluent TP must be reduced before streambed sediment phosphorus reductions will make any difference on the lower GMR's enrichment (Keller, email communication, February 20, 2014). Given this, reducing nonpoint sources of phosphorus loads without reductions in effluent loadings will not ameliorate all of the nutrient enrichment impacts to the lower GMR. Once effluent phosphorus loading is reduced, other measures to reduce nutrient loadings further can be considered if they are necessary to return the river to full attaining its aquatic life use criteria.

Finally, it should be noted that these measures of point source TP load reduction are protective for the lower GMR's aquatic life use. These reductions do not address the total exported load of nutrients to the Ohio River and subsequently to the Gulf of Mexico via the Mississippi River. It is clear that efforts developed to protect the Gulf of Mexico from nutrient enrichment must consider all sources of phosphorus load delivered by the GMR. Baker et al*.* 2006 and others have documented that in this case the nonpoint source load of nutrients is by far the most important component as it is the majority of exported load.

Ohio EPA recognizes that the relationship between nutrients in the lower Great Miami River and aquatic life indices is not entirely linear or predictable. Therefore, the agency proposes using an adaptive management approach to eliminating the impairment in the lower Great Miami River. The first step is to reduce the phosphorus inputs from the two largest and most upstream discharges (Dayton and Montgomery County Western Regional) that appear to cause a significant increase in the total phosphorus concentrations, dissolved oxygen swings and chlorophyll-a values in the river – as shown in figures 5, 6, 7 and 11 above. After those two inputs are reduced, and the river has time to respond, Ohio EPA will reassess the impaired sites, and determine if further improvement measures are needed. Other mitigation such as dam removal in the river during this time period is also recommended to help reduce the need for including limits in additional permits and/or reducing limits below 1.0 mg/l. Future permit decisions will consider the results of the activities and reassessment.

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