ASSESSMENT OF SERVICE AND ECOLOGICAL FUNCTION OF CONSTRUCTED WETLANDS FOR STORMWATER MANAGEMENT IN DELAWARE COUNTY, OHIO

By

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DEDICATION AND ACKNOWLEDGEMENTS

This work is dedicated to my family who motivate me every day to achieve my goals. To Sydney Binger, Jean Binger and Katie Kniery for their continued love, support and encouragement. To my grandpa, Edward, who instilled a belief in me to chase my passions, keep exploring and live each day with a purpose.

I would like to acknowledge the entire Department of Land Resources and Environmental Sciences for their support and guidance over the past two years. I would like to acknowledge Dr. William Kleindl for his guidance, expertise and resources that were essential to the success of this project. I would also like to thank Bennett and Williams, specifically, Linda Aller and Kerry Zwierschke, for their continued support and investment in my development

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ABSTRACT

I conducted a case study in Delaware County, Ohio to assess the service and function of constructed stormwater ponds and their contribution to maintaining wetland functions and values. As a result of population expansion around the City of Columbus, natural wetland cover decreased from 2,471 to 2,250 acres from 1994 to 2019. To manage the excess surface runoff, increasing numbers of stormwater ponds are being constructed to substitute for the absence of wetlands. Stormwater pond land cover was found to have increased from 1,145 to 2,482 acres from 1994 to 2019. When considering the status and trends of the wetlands, the functions and service of constructed systems such as stormwater ponds are not considered. Using the Ohio Rapid Assessment Method (ORAM), nine detention and seven retention ponds were scored providing a numeric representative of the condition of the system's structure necessary to perform functions and were factored into the Delaware County wetland budget. The average ORAM score for the constructed stormwater ponds was 15.06 in comparison to reference wetlands which was 80. If the 221 acres of wetland lost from 1994 to 2019 had the same average ORAM score as the three-reference wetland, it would be a 17,680 loss of wetland "value and function" as defined by ORAM. If the 1,337 acres of stormwater ponds added from 1994 to 2019 had the same average ORAM score as the observed stormwater ponds, it would be a 20,135 gain of "value and function" as defined by ORAM. Overall, this would suggest that even though there has been a loss in total wetland area, wetland functions and values have been maintained by the construction of stormwater ponds. Even with the addition of 1,116 acres of aquatic ecosystem from 1994 to 2019, the representative score of wetland structure remained nearly the same. This estimate of the preservation of wetland functions and values demonstrates both the benefits but shortcomings of stormwater ponds in replacing wetland values such as diverse ecological habitats. By evaluating the differences in metric scores between the stormwater ponds and reference wetlands, I recommended design improvements for future stormwater pond construction to provide the same services, but with improved ecological benefits.

SECTION ONE

INTRODUCTION

Ohio's current total wetland acreage of approximately 483,000 acres is about 10% of its estimated pre-European expansion area and today covers about 1.8% of the state area (Fretwell, 1996). Efforts to preserve wetlands began with the implementation of the Clean Water Act (CWA) of 1972. The law's goal was to restore and maintain the chemical, physical, and biological integrity of our nation's waters by prohibiting pollution from being dumped into waterways. The law also directed the U.S. Army Corps of Engineers (ACOE) to administer a permit program to regulate development activities that could adversely affect wetlands, streams, and rivers. If the construction or development would require the dredging, filling, or other impairment of wetlands, the project's developer must obtain a Section 404 permit.

The rule was expanded in 1989, when President George H. W. Bush established the National policy of "no-net loss of wetlands", that strives to achieve a goal of no overall net loss of functions and values of wetlands. Following this directive, the ACOE and the Environmental Protection Agency (EPA) began to require developers to conduct compensatory mitigation for unavoidable impacts permitted through CWA Section 404 permit. ACOE guidelines call for a mitigation sequence approach to: (1) avoid filling wetland resources; (2) minimize adverse impacts to those wetlands that cannot reasonably be avoided; and (3) provide compensation for those unavoidable adverse impacts that remain after all minimization measures have been exercised (Salzman, 2006).

This set the groundwork to replace impacted wetlands with a replacement wetland of the same size and with similar wetland functions and values. The preferred method of compensatory

mitigation is mitigation banking. Wetland banking is a wetland area that has been restored, established, enhanced or preserved, which is then set aside to compensate for future conversions of wetlands for development activities (USEPA, 2008). Permittees can purchase credits from a mitigation bank to meet their requirements for compensatory mitigation. The value of these credits is determined by quantifying the wetland functions or acres restored or created. The bank sponsor is then responsible for the continued maintenance of the project.

Other compensatory methods are in-lieu fee mitigation and permittee-responsible mitigation. In-lieu-fee mitigation occurs when a permittee provides funds to a sponsor such as a public agency or non-profit organization. Like banking, in-lieu fee mitigation is also off-site and the responsibility of the sponsor but unlike mitigation banking, it typically occurs after the permitted impacts (USEPA, 2008). The least preferred method of mitigation is permittee-responsible mitigation. Permittee-responsible mitigation is the restoration, establishment, enhancement or preservation of wetlands undertaken by a permittee to compensate for wetland impacts resulting from a specific project. The permittee performs the mitigation after the permit is issued and is ultimately responsible for implementation and success of the mitigation. Permittee-responsible mitigation may occur at the site of the permitted impacts or at an off-site location within the same watershed (USEPA, 2008).

With the no-net loss plan in place and increases in wetland mitigation banks, George W. Bush announced in 2007 that “no-net loss” had been accomplished nationally and that we had a net-gain of total acres of wetlands (USDA, 2019). However, this ignores the biggest complication in wetland mitigation in assuring that there is no-net loss of functions and values, not just total area.

Constructed Wetlands

There are key definitions in wetland mitigation that differentiate the purpose of the wetlands. The term *wetland restoration* is generally used to refer to the return of a degraded wetland to a former condition. *Created wetlands* are wetlands established in a location where one previously did not exist, usually to replace function and area for mitigation actions. However, there are other wetlands that are constructed to perform specific services that are not part of wetland banking or contributing towards no-net loss. These *constructed wetlands* are treatment systems that use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality or manage water quantity (US EPA, 2000). Constructed wetlands have been used for water treatment for wastewater such as domestic and municipal sewage, agricultural wastewaters, mine drainage, food processing wastewaters, heavy industry wastewaters, landfill leachate, storm water and runoff waters (Vymazal et al. 2001).

Wetlands provide an assortment of ecosystem services that have considerable value to society. It is estimated that the economic value of services provided by the wetlands on a per-hectare basis are the most valuable ecosystem in the world (Batzer, 2014). The services such as nutrient cycling, improved water quality, flood regulation and erosion control provide goods to society. Other services such as recreation, aesthetic beauty, artistic inspiration, spiritual and scientific education, provide non-market benefits to society (Costanza et al. 1997).

In wetland systems, biophysical structure interacts to support ecological functions and a subset of these functions support services that provide good and benefits to maintain human well-being (Kleindl 2018). In both created and constructed wetlands, these biophysical features are usually engineered so that constructed wetlands perform a specific service or created wetlands restore functions and replace area (Moreno-Mateos, 2012). However, a constructed

wetland designed to provide a specific service may not adequately perform the wide range of wetland functions necessary to compensate for unavoidable losses under the CWA. Conversely, created wetlands may not adequately perform the specific service necessary to meet other regulatory standards (e.g. stormwater management). From constructed to natural wetlands, there is increasing biophysical structural complexity and an associated increase in the diversity of function and services that these can provide (Figure 1). At one end are constructed wetlands for single services, like sewage treatment, and highly engineered systems with limited structural diversity but extremely efficient at enhancing water quality. On the other end are created and restored wetlands that are designed with the biophysical structure necessary to perform a wide range of wetland functions that indirectly support wetland services. As we transition across the gradient from constructed to natural wetland systems, there are a suite of human-made aquatic green-infrastructure constructed to meet a regulatory standard, but also indirectly offer more structural and function diversity than highly engineered systems specifically designed to perform a single service. Stormwater management is one such system.

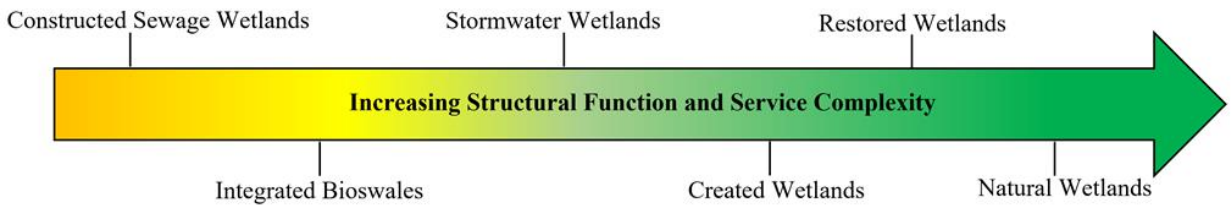

Figure 1. Structural function and service complexity of constructed and natural wetland systems.

Urbanization and increased population density alter land cover and land use, typically increasing impervious surfaces, such as asphalt, concrete, and buildings (Barbosa et al 2012). To manage the excess surface runoff, an increasing amount of stormwater ponds are being constructed to substitute for the absence of wetlands. Stormwater wetlands and ponds are naturally imitating engineered ecosystems effectively designed to provide runoff hydrology and

quality regulating services (Moore, 2011). Stormwater runoff provides ecosystem services including flood control, improve water quality and support habitat. Benefits of these of these services improve soil moisture, interflow, baseflow, groundwater recharge, and filtration of water through the environment (Prudencio, 2018). The performance of constructed wetlands and ponds, and other stormwater control measures are typically evaluated in terms of hydrology and pollutant removal (Moore, 2011). However, these urban ecosystems have the potential to provide a range of other ecosystem services.

Typically, when considering the status and trends of the wetlands, the functions and service of constructed systems such as stormwater ponds not considered. Yet, green stormwater infrastructure research has increasingly shown that the benefits of stormwater management extends beyond controlling runoff volume and timing, or water quality improvement but also provide additional functions such as groundwater replenishment, and creation of diverse ecological habitats, as well as valued ecosystem services such as aesthetics and recreation opportunities (Prudencio, 2018). This leads to a question as to how we quantify these functions and services. To assess these functions and services, I designed a case study to evaluate if constructed wetlands designed to perform a limited service, such as stormwater management, also result in an improvement of other wetland functions. If yes, how much do they add to preserving the total sum of wetlands functions and values. If no, can I make design recommendations to stormwater management systems that still provide water quality and quantity control services, as well as a suite of other functions? The goal of this work is to better construct stormwater ponds that will result in both high-quality services in improving water quality and quantity, but have improved functioning habitat (US EPA, 2000).

SECTION 2

STORMWATER PONDS

In Ohio, as areas become increasingly urbanized, there is a loss of wetland area and an increase of impervious surface area. These land cover changes lead to increased runoff that requires management under stormwater laws in Ohio (OAC-3745-39). Stormwater runoff harms Ohio's waters as increased runoff from lands modified by human development harms surface water resources in several ways, including the changing of natural hydrologic patterns and elevating pollutant concentrations and loadings. Storm water runoff may contain or mobilize high levels of contaminants, such as sediment, suspended solids, nutrients, heavy metals, pathogens, toxins, oxygen-demanding substances and floatables with concentrate in the streams and lakes (OAC-3745-39-02). From increased impervious surface area, less rainfall is intercepted and used by vegetation and infiltrates into the soils and affects groundwater aquifer water budgets. All of these hydrologic changes result in more stormwater runoff reaching rivers and streams faster than before development. The hardening of a watershed impacts streams by increasing runoff contribution causing to them becoming flashier, which means flows rise quickly and diminish quickly after each rainfall. Groundwater, normally replenished by percolating rainfall, receives lower levels of recharge in urban areas, affecting both the human and natural communities dependent on groundwater. Certain ecosystems, such as wetlands and small streams, that require groundwater recharge to sustain them are impacted hydrologically (Matthews, 2006).

As faster and higher stream flows occur on a regular basis, stream channels typically respond by adjusting their shape and size. In urban areas the balance of bank erosion and floodplain deposition becomes degraded. The stream cuts downward due to increased flow rates,

losing access to its floodplain and the associated floodplain and stream corridor functions. These deeply entrenched urban streams provide less natural stormwater storage and treatment than healthy channels and compounds impacts to downstream quality habitat features such as clean gravel substrates, deep pools and stable riffles (Matthews, 2006).

To mitigate these negative effects, the Ohio EPA (OEPA) identifies the following eight stormwater management objectives for development in Ohio: 1) preserve the natural drainage system and important water resources; 2) minimize imperviousness of the proposed development; 3) improve degraded streams; 4) plan additions to the site drainage system that are stable and sustainable; 5) manage post-construction runoff; 6) control erosion and sediment impacts during construction; 7) control high risk pollution sources; 8) assure long-term access to and maintenance of stormwater systems (Matthews, 2006). Facilities that discharge runoff with elevated constituents are approved for an NPDES permit, a license for a facility to discharge a specified amount of a pollutant into a receiving water under certain conditions. Facilities with large areas of impervious surface are managed by constructed controls, such as excavated water holding facilities for runoff capture (Rooney, 2014). These constructed controls are commonly either detention or retention ponds (Figure 2).

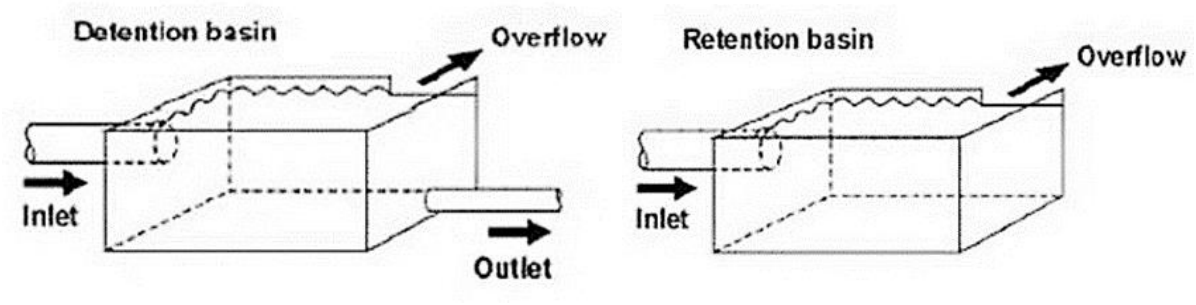

Figure 2. Conceptual input and output of flow of detention and retention basins for stormwater management.

Detention and Retention Pond Design

A detention pond has no permanent pool of water and holds water temporarily in response to precipitation or runoff, while a retention pond holds water permanently. Most stormwater management ponds are surface-water systems and are isolated from groundwater by natural or synthetic liners. In contrast, many natural wetlands may have some degree of groundwater connection. The distinction between the two types of stormwater management ponds is based on the type of hydrologic control needed to be provided. Stormwater management ponds can be designed to provide for both control of increases in stormwater volumes and peak flow rates, as well as for treatment of stormwater pollution. In many cases, depending on the design of the pond, multiple functions are provided resulting in a hybrid system. The pond design features that determine its function, and thus provide the basis for categorization include depth of permanent pool, storm event discharge volume/storage volume, storm event peak discharge rate, and detention time. (US DOT, 2020)

Pond design for detention and retention ponds begins with an excavated basin and forming of surrounding berms that can hold the capacity of a specific volume of water. The part of the basin that permanently retains water is known as the treatment pool (Pitt, 2005). The treatment pool is designed to permanently hold at least the first one inch of rainfall that falls on the area of the urban development that drains to the pond. The treatment pool must be large enough to hold water long enough to allow gravity to remove sediment and debris and allow sunlight and biochemical processes to remove other pollutants such as bacteria and nutrients (Pitt, 2005). The water capacity above the treatment pool to the top of the bank slopes is known as the temporary storage which fills and drains with each storm event. The temporary storage is usually designed to be large enough to accommodate the "25-year storm". The submerged area

near the edge of the pond where the sunlight can penetrate through the water to the bottom is the littoral zone. In many ponds, this area is a shallow shelf establishment of emergent wetland plants which provide water treatment and stabilize the base of the bank slope and also provides habitat for fish, amphibians, and invertebrates.

The most critical component of the pond is the outlet control structure that regulates the water level and maintains the pool elevation. This may be a weir, concrete riser, spillway or inverted pipe. According to design standards, the surface of the permanent pool should return to the level of the bottom of the outlet control structure within 24 hours after the storm (Pitt, 2005). The important distinction between a detention pond (Figure 3) and a retention pond (Figure 4) is the elevation of the outlet (Clemson University, 2020). The retention pond is designed to have a permanent pool of water that only discharges water as a result of stormwater input raising the water level above the height of the outlet pipe. Detention ponds purpose is to slow down water flow and hold it for a short period of time such as 24 hours. In a detention pond, the outlet pipe is set at a lower elevation in the pond to ensure that water is moving through the system.

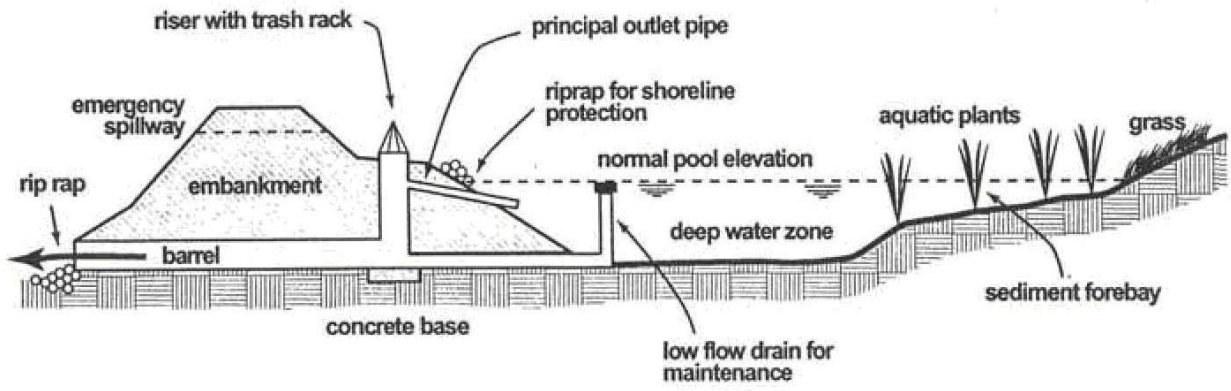

Figure 3. Conceptual design of a stormwater retention pond (Clemson University, 2020).

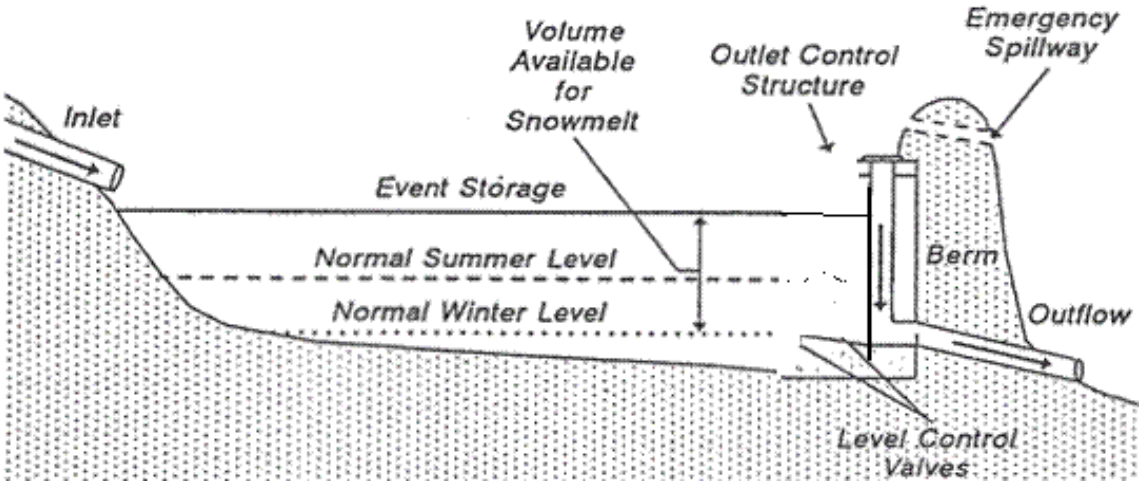

Figure 4. Conceptual design of a stormwater detention pond (MPCA, 2019).

Study Area: Delaware County

An area that has seen an increase in constructed stormwater ponds as a result of land cover changes is Delaware County, Ohio, located approximately 15-miles north of the City of Columbus. Before development in the late 18th century, it is estimated that Delaware County, Ohio had approximately 74,834 acres of wetlands. However, by 1994 wetland land cover was reduced to 2,471 acres (3.3% remaining) (ODNR, 1994). It is estimated that surface water ponds covered approximately 1,145 acres (not including lakes and rivers) in 1994. In 1994, the primary land use was agriculture or open grassland (74%) and the population was approximately 78,000 people. Over the next 25 years from 1994 to 2019, the population rose to 205,000 people (260% increase) as a result of development and expansion of the greater city of Columbus area.

Agricultural and open land was urbanized for both residential and business development. The total area of wetlands in Delaware County decreased from 2,471 acres in 1994 to 2,250 acres in 2019 (Figure 5). As part of stormwater management due to the increase in impervious surfaces the total area of surface water ponds increased from 1,145 acres in 1994 to 2,482 acres in 2019

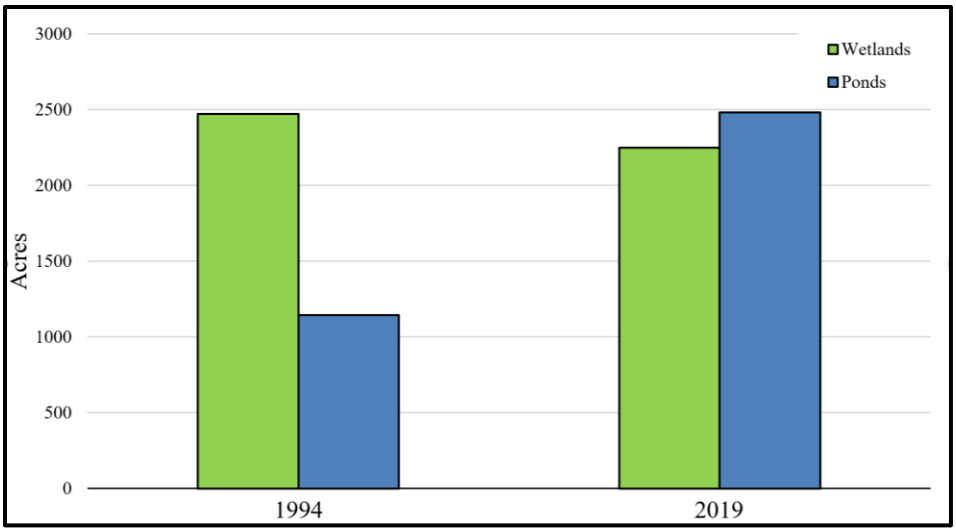

Figure 5. Changes in wetland and pond total area from 1994 to 2019 in Delaware County.

due to the increase of detention and retention facilities (Figure 5). Figure 6 and Figure 7 show the aerial distribution of change in wetland and pond cover from 1994 to 2019 (ODNR,1994; USFWS, 2020).

The case study I designed was to evaluate if constructed stormwater wetlands designed to perform a single service, also result in an improvement of other wetland functions. I conducted the assessment of the services of constructed stormwater retention and detention systems was conducted on 16 sites in Delaware County using the Ohio Rapid Assessment Method (ORAM). Nine of the sites are constructed detention ponds and seven are retention ponds. Ponds were assessed in a variety of environmental settings such as in residential neighborhoods, urban development, open fields, industrial complexes and along roadsides. Assessments were also conducted on three references wetlands to compare to the constructed stormwater ponds. The purpose of this assessment was to determine how much added functions and values from stormwater ponds contribute to preserving the total sum of wetlands functions and values in Delaware County and identify criteria that can be made to design stormwater management systems that provide a single high-quality service as well as a suite of other functions.

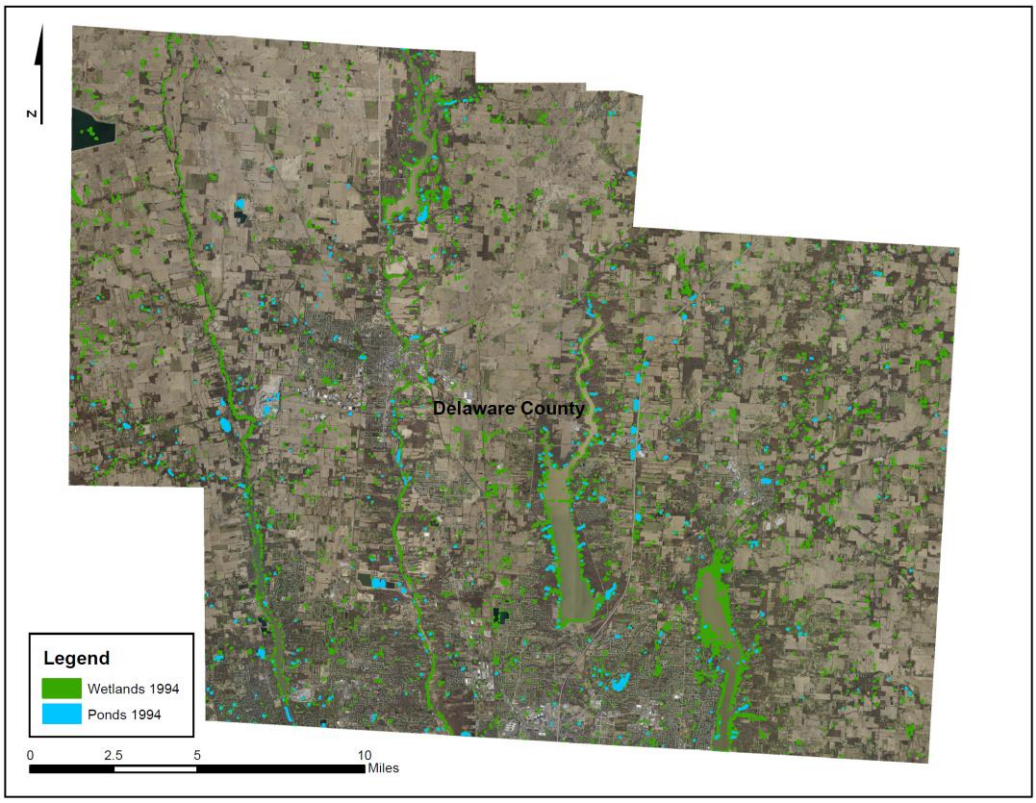

Figure 6. Wetlands and ponds in Delaware County in 1994 (ODNR,1994; USFWS, 2020).

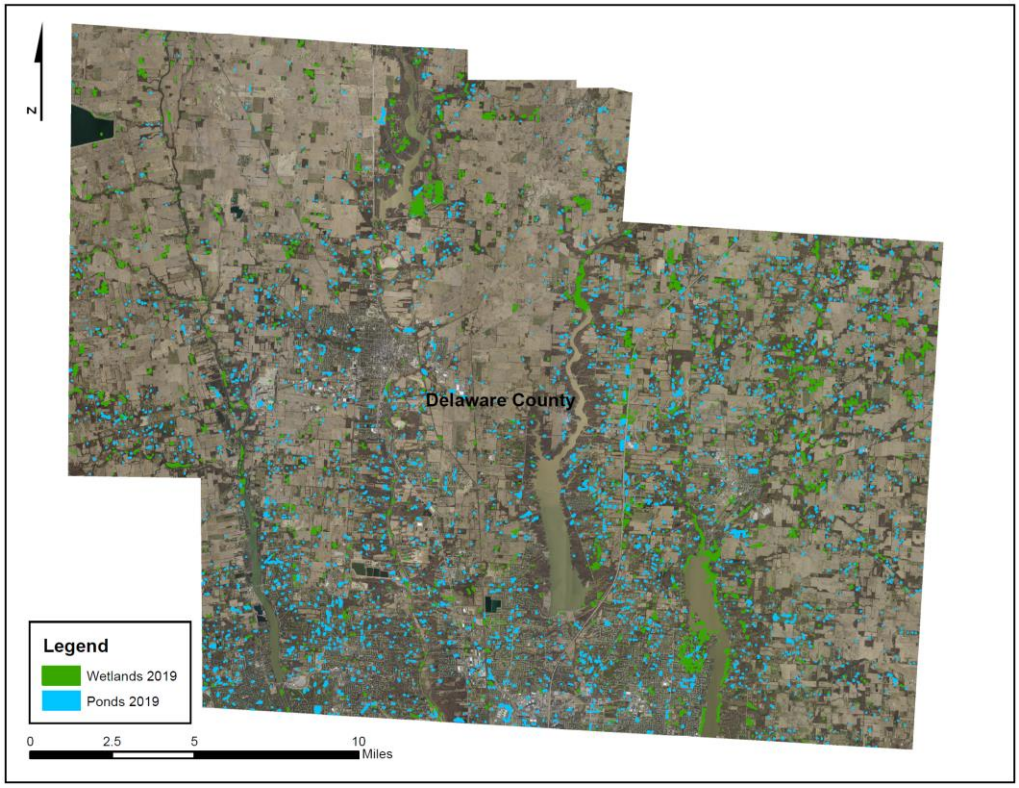

Figure 7. Wetlands and ponds in Delaware County in 2019(ODNR,1994; USFWS, 2020).

SECTION 3

METHODS

Assessment Method

The quality of the constructed detention and retention ponds were scored and categorized by ORAM version 5.0 developed by the Ohio EPA and compared to reference wetlands in Delaware County. ORAM provides a rapid method for determining the appropriate category and score of a particular wetland under the Wetland Antidegradation Rule OAC-3745-1-54 (OAC, 2018). ORAM involves two methods of scoring wetlands by a narrative and quantitative rating. The narrative rating consists of a series of eleven questions designed to determine whether a wetland is a Category 1 or Category 3 wetland. The quantitative rating scores six metrics of the wetland to assign a score between 0 and 100. The ORAM scores can also be used determine wetland categories that relate to their function and subsequent values (Figure 8).

category	ORAM v. 5.0 score
1	0 - 29.9
1 or 2 gray zone	30 - 34.9
modified 2	35 - 44.9
2	45 - 59.9
2 or 3	60 - 64.9
3	65 - 100

Figure 8. Scoring break points for wetland categories based on ORAM scores. (Mack, 2001)

The purpose of categorizing wetlands is for mitigation of wetlands under the Wetland Antidegradation rule. The observed wetland category and type, impacts the minimum mitigation area ratio and replacement category (Table 1). For example, if one acre of category 3 wetland was impacted, it would need to be replaced with three acres of category 3 wetlands.

Table 1. Compensatory mitigation ratios.

Category of wetland impacted	Wetland type	Minimum mitigation ratio	Wetland replacement category
Category 1	Non-Forested	1.5: 1	Category 2 or 3
	Forested	1.5: 1	
Category 2	Non-Forested	2.0: 1	Category 2 or 3
	Forested	2.5: 1	
Category 3	Non-Forested	2.5: 1	Category 3
	Forested	3.0: 1	

Category 1 wetlands are defined as wetlands which support minimal wildlife habitat, and minimal hydrological and recreational functions (OAC, 2018). Category 1 wetlands are often hydrologically isolated, and have some or all of the following characteristics: low species diversity, no significant habitat or wildlife use, limited potential to achieve beneficial wetland functions, and/or a predominance of non-native species (OAC, 2018). Category 2 wetlands are defined as wetlands that support moderate habitat, or hydrological or recreational functions (OAC, 2018). Wetlands assigned to category 2 may include, but are not limited to: wetlands dominated by native species but generally without the presence of, or habitat for, rare, threatened or endangered species; and wetlands which are degraded but have a reasonable potential for reestablishing lost wetland functions (OAC, 2018). Category 3 wetlands are defined as supporting superior habitat, or superior hydrological or recreational functions (OAC, 2018). Category 3 wetlands include wetlands which contain or provide habitat for threatened or endangered species, are high quality mature forested wetlands, vernal pools, bogs, fens, or which are scarce regionally and/or statewide (OAC, 2018).

Narrative Rating

The narrative rating consists of a series of eleven questions designed to determine whether a wetland is a Category 1 or Category 3 for wetland protection purposes. The narrative questions are answered by a review of available resources and the results of the visit to the

wetland site. Table 2 summarizes the narrative questions and resulting categorization based on the site observations.

Table 2. Summary of narrative rating questions.

Narrative Rating Question	Result if YES
Question 1. Is site a critical habitat?	Wetland is category 3
Question 2. Does site have threatened or endangered species?	Wetland is category 3
Question 3. Is site high quality natural wetland	Wetland is category 3
Question 4. Is site significant bird habitat	Wetland is category 3
Question 5. Category 1 assessment	Wetland is category 1
Question 6. Is site a bog?	Wetland is category 3
Question 7. Is site a fen?	Wetland is category 3
Question 8. Is site an old growth forest or mature forested wetland?	Wetland may be category 3, but should be scored to determine category
Question 9. Is site a Lake Erie wetland?	Wetland may be category 3, but should be scored to determine category
Question 10. Is site a Lake Plains Sand Prairie?	Wetland is category 3
Question 11. Is site a relict wet prairie?	Wetland may be category 3, but should be scored to determine category

The only question that relates to the evaluation of constructed stormwater ponds is question five, determining if a wetland is category 1. A wetland can be determined to be a category 1 wetland if it is less than 1 acre in size and hydrologically isolated and either comprised of vegetation that is dominated (greater than eighty percent areal cover) by invasive species of vegetation or an acidic pond created or excavated on mined lands that has little or no vegetation. The narrative score sheet instructions and questions can be seen in Appendix A. The results of the narrative questions are then applied to metric five of the quantitative portion of the assessment.

Quantitative Rating

The quantitative rating consists of six metrics (score ranging from 0-100) to determine the wetland quality based on wetland size, upland buffers and surrounding land use, hydrology, habitat, special wetland communities and vegetation, interspersion, and microtopography. The

initial step in completing ORAM is to delineate the scoring boundaries of the wetland being rated. The delineation of the wetland for scoring allows the first metric of wetland size to be scored. The wetland area metric can range from 0 points (less than 0.1 acres) to 6 points (greater than 50 acres). The questions, list of scoring ranges, and related points assigned for all six metrics of the quantitative rating can be seen in Appendix B.

The second metric is assessing the upland buffers and surrounding land use around the wetland. Wetlands are sensitive to human disturbances and impact both directly and indirectly. Disturbances such as nutrient enrichment, eutrophication from stormwater inputs, urban and agricultural runoff can degrade the wetland quality (Mack, 2001). These effects are quantified in metric two as the buffer between the wetland and human activity, and the type of human activity are scored. Constructed stormwater ponds are typically constructed adjacent to impervious human land uses and be connected to stormwater culverts and receive urban runoff. Therefore, the metric two score for these wetlands will typically total lower.

Metric three is assessing the wetland hydrology and connectivity. Hydrology is considered the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes (Mitsch and Gosselink, 1996). Hydrology metric scores represent the greatest total points possible (30) of any of the six metrics. Metric three evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human disturbances. Wetlands have potential water contribution from multiple sources, such as groundwater, precipitation and surface water (Mack, 2001). But constructed stormwater ponds are commonly isolated systems, mostly receiving water from stormwater inputs and runoff from precipitation. Also, they are less likely to be connected to surrounding

surface water systems such as 100-year floodplains, riparian or upland corridors and upland complexes. The construction and modifications to the hydrological regime from stormwater inputs results in a degraded score.

Metric four is assessing the habitat alterations and development of the wetland. This metric, which scores range from 3 to 20 points, evaluates the soil, type or class and intactness or lack of disturbance of the wetland. This provides an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically or hydrogeomorphically similar wetlands. The ACOE uses the hydrogeomorphic (HGM) classification for wetlands, which identifies five major types of wetlands of riverine, slope, depressional, flat and fringe (Brinson, 1993). The U.S. Fish and Wildlife Service uses the Cowardin classification system that classifies wetlands by landscape position, vegetation cover and hydrologic regime (Cowardin, 1979). Cowardin classification identifies five main types of wetlands of marine, estuarine, riverine, lacustrine and palustrine wetlands. Descriptions of the HGM and Cowardin classifications are summarized in Appendix C.

For evaluating substrate or soil disturbance, habitat development and habitat alteration the scoring is based on how good a representation of its type or class is. Constructed stormwater wetlands in most cases will classify as depressional wetlands in the HGM classification method, and as Palustrine wetlands in Cowardin's classification. All available information such as field visits, aerial photos, maps, etc. were used to identify possible ongoing or past habitat alterations to each site.

Metric five assigns or deducts up to 10 additional points to the types of wetlands and circumstances addressed in the narrative rating questions. For example, if the wetland is a critical habitat, features threatened or endangered species, are significant bird concentration areas or are

considered high quality wetlands then it is assigned 10 points. If wetlands are less than 1 acre in size and hydrologically isolated and either comprised of vegetation that is dominated (greater than eighty percent areal cover) by invasive vegetation or an acidic pond created or excavated on mined lands that has little or no vegetation then 10 points are deducted.

Metric six assesses the plant communities, interspersion and microtopography observed in the wetland. Six vegetation communities are identified to be scored: aquatic bed, emergent, shrub, forested, mudflats, and open water (with mudflats and open water being notable for assessing a lack of vegetation). In ORAM, for a vegetation community to be considered "present" in the wetland, the community must cover a minimum contiguous area of 0.1 hectares (0.2471 acres), unless the wetland itself is less than 0.1 hectares in size. This can be a common issue in assessing small constructed stormwater ponds. The pond is also observed for the presence of invasive species. This question incorporates narrative descriptions found in OAC Rule 3745-1-54 for Category 1 wetlands and requires points to be deducted for the presence of the listed invasive plant species or to add a point if these species are absent from the wetland. This metric also includes evaluating the degree of horizontal interspersion, which is also a measure of biodiversity (Mack, 2001).

Data Collection

To efficiently collect and translate the ORAM survey data, I used the ESRI geographical information systems (GIS) apps Survey123 and Collector. Survey123 allows for the custom design of smart forms which can be published to ArcGIS online for field data collection. Collector allows for collection of location-based data, such as the location and boundary of a wetland, that can be associated to Survey123. I programed the quantitative portion of the survey for ORAM in an Excel form and included features such as auto generating fields, calculations,

photo attachments and pre-populated fields from data in the Collector app to expedite the data collection process. Data collected in the field was then immediately available for analysis. Reports and excel books can be programmed to be autogenerated to avoid data entry as shown in auto generating report in Appendix D.

SECTION 4

RESULTS

Site Findings

From March 6, 2020 to March 22, 2020, ORAM was conducted on 16 constructed stormwater detention and retention ponds and three reference wetlands in Delaware County. A summary of the results can be seen in Table 3 and the complete ORAM report for each site can be seen in Appendix D. All 16 of the constructed stormwater ponds were classified using HGM classification as depressional wetlands that were excavated by human activities. Sites ranged from 0.06 acres to 5.6 acres. ORAM scores for the constructed stormwater ponds ranged

Table 3. Summary of 16 constructed stormwater ponds and 3 reference wetlands ORAM surveys.

Constructed Stormwater Ponds								
Site ID	**Metric 1**	**Metric 2**	**Metric 3**	**Metric 4**	**Metric 5**	**Metric 6**	**Final Score**	**Pond Type**
POND-127	2	4	10	4	0	5	25	Retention
POND-439	2	5	7	4	0	3	21	Detention
POND-796	2	1	9	3	0	2	17	Retention
POND-1686	2	4	9	3	0	3	21	Retention
POND-1697	2	4	9	3	0	3	21	Retention
POND-1997	3	2	8	3	0	3	19	Retention
POND-2015	2	2	10	4	0	2	20	Retention
POND-3089	0	4	8	4	-10	0	6	Detention
POND-3090	1	2	10	4	0	1	18	Detention
POND-3091	3	5	9	3	0	3	23	Retention
POND-3092	2	4	8	7	-10	0	11	Detention
POND-3093	0	1	7	3	-10	0	1	Detention
POND-3094	1	7	6	4	-10	0	8	Detention
POND-3095	1	7	6	4	-10	0	8	Detention
POND-3096	1	10	7	6	-10	0	14	Detention
POND-3097	1	5	8	4	-10	0	8	Detention
Reference Wetlands								
RW-1	2	14	24	17	5	18	80	Wetland
RW-2	3	14	26	18	5	17	83	Wetland
RW-3	2	14	24	18	5	14	77	Wetland

from 1 to 25. The average ORAM score for the constructed stormwater ponds was 15.06. Reference wetland RW-1 was classified as a riverine wetland, while RW-2 and RW-3 were classified as depressional wetlands. Sites ranged from 0.35 to 4.35 acres in size. ORAM scores for the three reference wetlands ranged from 77 to 83. The average ORAM score for the reference wetlands was 80. A summary of the scores between all constructed stormwater ponds, detention ponds, retention ponds and reference wetlands can be seen in Table 4.

Table 4. Summary of ranges and scores of all stormwater ponds, detention ponds, retention ponds and reference wetlands.

Constructed Stormwater Ponds							
	Metric 1	**Metric 2**	**Metric 3**	**Metric 4**	**Metric 5**	**Metric 6**	**Total**
Max	3	10	10	7	0	5	25
Min	0	1	6	3	-10	0	1
Range	3	9	4	4	10	5	24
Average	1.56	4.18	8.18	3.93	-4.37	1.56	15.06
Detention Ponds							
Max	2	10	10	7	0	3	21
Min	0	1	6	3	-10	0	1
Range	2	9	4	4	10	3	20
Average	1	5	7.40	4.40	-7.77	0.44	10.50
Retention Ponds							
Max	3	5	10	4	0	5	25
Min	2	1	8	3	0	2	17
Range	1	4	2	1	0	3	8
Average	2.29	3.14	9.14	3.29	0	3	20.86
Reference Wetlands							
Max	3	14	26	18	5	18	83
Min	2	14	24	17	5	14	77
Range	1	0	2	1	0	4	6
Average	2.33	14	24.6	17.66	5	16.33	80

Figure 9 shows the comparison of total ORAM scores between each individual constructed stormwater pond and reference wetland. Figure 10 shows the average score of each individual metric of the constructed stormwater ponds versus the reference wetlands, as well as the maximum possible ORAM score. Figure 11 shows each stormwater detention and retention pond total ORAM score in relation to pond area.

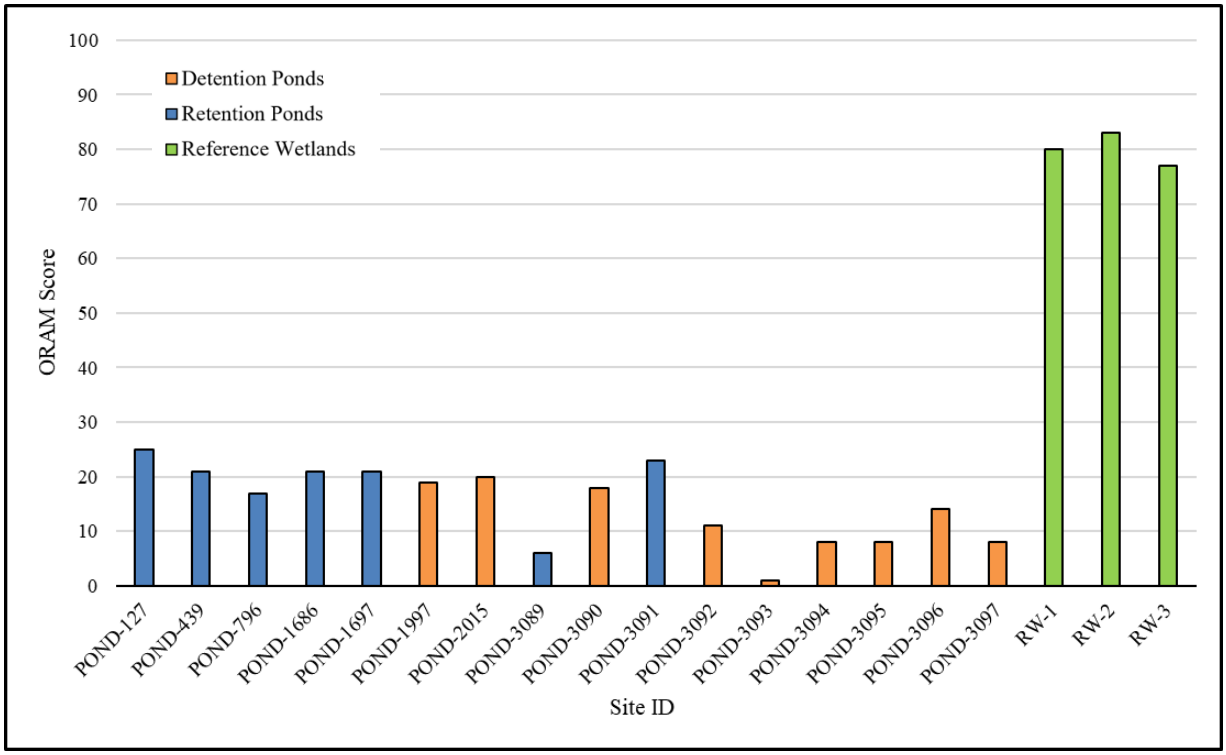

Figure 9. ORAM scores for the 16 constructed stormwater ponds and 3 reference wetlands.

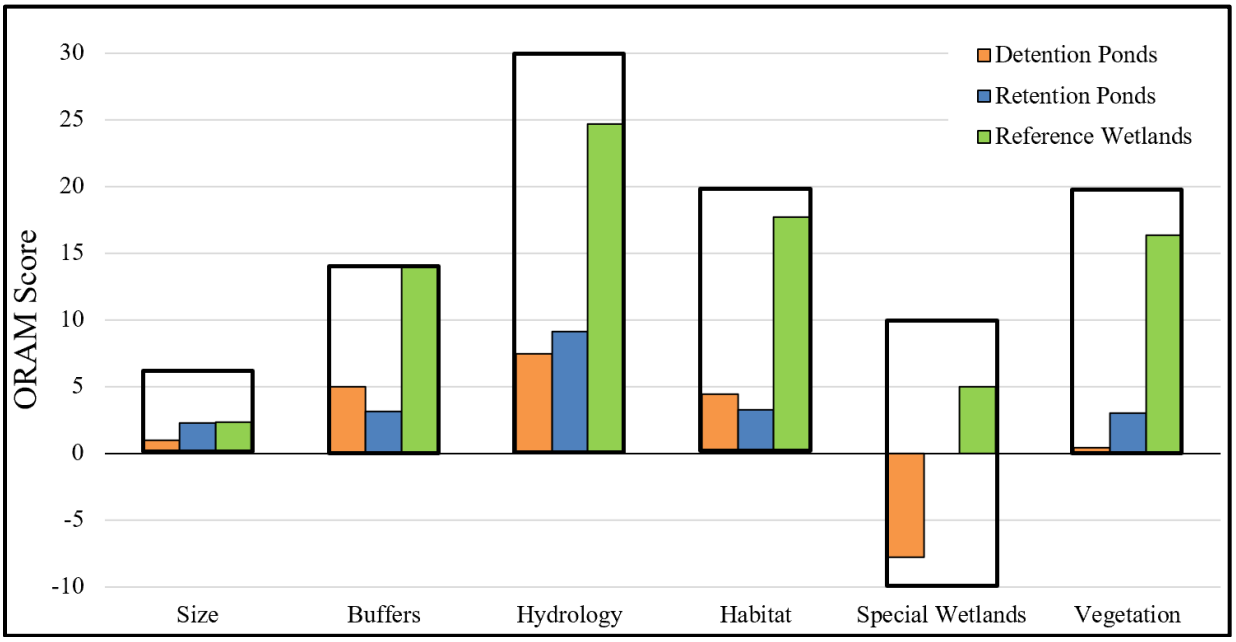

Figure 10. Comparison of average metric scores between constructed stormwater ponds (detention and retention) and reference wetlands.

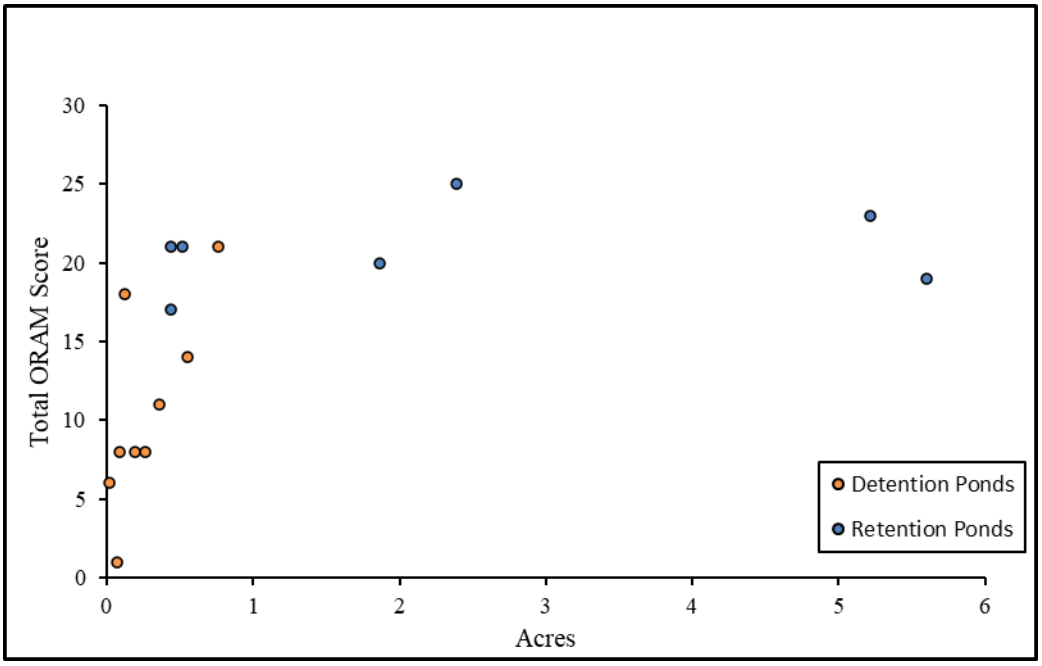

Figure 11. Total ORAM score of constructed stormwater ponds versus area.

SECTION 5

DISCUSSION

The Ohio Rapid Assessment Method allowed for quantitative scoring of wetlands providing a numeric representation of the condition of the system's structure necessary to perform functions. The assessment attempts to determine the ecological quality and the level of function of a particular wetland by relating to the wetland category and the quality of the values these wetlands provide. All three reference wetlands scored very high (over 65) with scores of 77, 80, and 83, indicating they are high quality wetlands. This is not unexpected; as they are complex systems that have a high level of diversity, high proportion of native species and unaltered hydrogeomorphic settings, resulting in high functional values. Further, all 16 of the constructed stormwater ponds assessed had an ORAM score less than 30, indicating low quality wetlands. This is also not unexpected; as they are simplified systems that have disturbed settings from construction, isolated hydrology and continued disturbances. However, it was unexpected that the average ORAM score of stormwater retention ponds would be approximately double that of stormwater detention ponds. Detention ponds score ranged from 1 to 21, while retention ponds scores ranged from 17 to 25.

While constructed stormwater ponds had low scores, they still provided service and ecosystem benefits. The stormflow and pollution attenuation functions of the ponds result in benefits including reduced downstream hydrologic and pollutant loadings, thereby mitigating some of the negative impacts of impervious surfaces. Both stormwater retention and detention ponds significantly reduce peak runoff rates and reduce erosion and sediment rates in receiving streams (Line et al., 2008). Retention ponds generally do not remove nitrogen as effectively due to less vegetation but may provide comparable solids and phosphorus removal benefits (Comings

et al., 2000). The continuous presence of water and environmental conditions at the ponds promote the growth of aquatic plant communities, along with other terrestrial plants. They also provide habitat and food for a range of animals such as fish, amphibians, birds, macroinvertebrates, and small mammals. At the sites I observed waterfowl such as mallards, Canadian geese, and blue herons. Amphibians such as bullfrogs and unidentified tadpoles were also observed. Mammals such as muskrats, rabbits, and squirrels were observed in and around the buffer of the ponds. Research has also shown that stormwater ponds have aesthetic values and increase property values. A survey in Columbia, Maryland, found that 75% of homeowners felt that permanent bodies of water such as stormwater ponds added to real estate values. Seventy-three percent were willing to pay more for property located in a neighborhood with stormwater control basins designed to enhance fish or wildlife uses (Adams et al., 1984).

Wetland Budget

With constructed stormwater ponds assessed using ORAM, estimates can be generally made of added functions and values that stormwater ponds contribute to preserving the total sum of wetlands functions and values in Delaware County. As previously mentioned, it is estimated that Delaware County, Ohio had approximately 74,834 acres of wetlands before the 18th century. By 1994, wetland land cover was reduced to 2,471 acres (ODNR, 1994). In 1994, it is estimated that land cover included approximately 1,145 acres of surface water ponds (not including lakes and rivers). From 1994 to 2019, the total area of wetlands in Delaware County decreased from 2,471 acres in 1994 to 2,250 acres. But as part of stormwater management due to the increase in impervious surfaces the total area of surface water ponds increased from 1,145 acres in 1994 to 2,482 acres in 2019 due to the increase of detention and retention facilities. This summary of land use change can be seen in Table 5. If the 221 acres of wetland lost from 1994 to 2019 had

the same average ORAM score as the three-reference wetland, it would be a 17,680 loss of wetland "value and function" as defined by ORAM. If the 1,337 acres of ponds added from 1994 to 2019 had the same average ORAM score as the observed stormwater ponds, it would be a 20,135 gain of "value and function" as define by ORAM. Overall, this would suggest that even though there has been a loss in total wetland area, wetland functions and values have been maintained by the construction of stormwater ponds.

Table 5. Delaware County wetland values budget from 1994 to 2019

	1994 Area (Acres)	1994 Total ORAM Value	2019 Area (Acres)	2019 Total ORAM Value	Area % Change	ORAM % Change
Wetlands	2,471	197,680	2,250	180,000	-8.94	-8.94
Ponds	1,145	17,244	2,482	37,379	+116.77	+116.77
Total	3,616	214,924	4,732	217,379	+30.86	+1.14

While the creation of stormwater ponds was able to balance the amount of wetland loss, it took an overwhelming addition of total area. Even with the addition of 1,116 acres of aquatic ecosystem from 1994 to 2019, the representative score of wetland structure remained nearly the same. This estimate of the preservation of wetland functions and values demonstrates both the benefits and shortcomings of stormwater ponds in replacing wetland values such as diverse ecological habitats. By evaluating the differences in metric scores between the stormwater ponds and reference wetlands, design improvements can be made to provide the same services, but with improved ecological benefits.

Constructed Stormwater Ponds vs. Reference Wetlands

Differences between the reference wetlands and constructed stormwater ponds can identify changes to the design of constructed stormwater ponds that would result in improved functioning habitat. There were large differences between the scores of constructed stormwater ponds and reference wetlands in buffers, hydrology, habitat and vegetation community. For buffer, constructed stormwater ponds are typically constructed adjacent to impervious human

land uses and connected to stormwater culverts that receive urban runoff. Most had narrow buffers of less than 82 feet from human land uses such as residential neighborhoods, urban development, industrial complexes and roadsides. In contrast, all three reference wetlands were surrounded by mature forest or natural habitat and had wide buffers of greater than 164 feet on all sides.

I observed constructed stormwater ponds to have modified and isolated hydraulic regimes. Sources of water in all the stormwater ponds was received water from stormwater inputs and runoff from precipitation. All stormwater ponds were regularly or permanently inundated with water. Most retention ponds had max water depths categorized as greater than 27.6 inches, while detention ponds had ranges from less than 15.7 inches to greater than 27.6 inches. Reference wetland RW-2 and RW-3 are better hydrologic comparisons to the stormwater ponds because they are also HGM classified depressional wetlands. Although they scored similarly in sources of water, water depth, connectivity and inundation, both reference wetlands had no observed modifications to the hydrologic regime. This category accounted for the greatest distribution of points in the hydrology metric.

Due to the construction of the stormwater ponds, most were found to have highly disturbed substate composed of fill with little to no soil profile development or had presence of a bed liner. The stormwater ponds were found to be poor representations of depressional wetlands such as the reference wetlands RW-2 and RW-3. Stormwater ponds also featured disturbances such as mowing, vegetation removal or treatment and nutrient enrichment from fertilizer runoff.

The difference in scores were apparent in special wetlands and vegetation communities between retention and detention ponds, as well as all constructed stormwater ponds and reference wetlands. Metric five is based on the special wetlands narrative rating and metric six assessed the

plant communities, interspersion and microtopography observed in each wetland. The average score of metric five for detention ponds was -7.77, while it as an average of 0.0 for retention ponds and 5.0 for reference wetlands. The average score for metric six was 0.44 for the detention ponds, 3.0 for retention ponds and 16.33 for the reference wetlands. Seven of the nine constructed detention stormwater ponds were considered Category 1 wetlands from the narrative rating because they were hydrologically isolated and comprised of vegetation that is dominated (greater than eighty percent areal cover) by invasive species of vegetation. While zero of the seven retention ponds were categorized as category 1 in the narrative rating. In total, 10 of the 16 constructed stormwater ponds had a presence of invasive cattail (*Typha angustifolia*). In addition to cattails, two of the 16 constructed stormwater ponds also had a significant presence of invasive reed canary grass (*Phalaris arundinacea*). The presence of invasive species results in the deduction of points in metric six.

Based on appearance, detention ponds visually looked more similar in comparison to the reference wetlands, although they did not score as well. A study in Alberta, Canada observed a trend of higher mean biotic integrity and biodiversity in what they called stormwater retention wetlands, than in stormwater ponds (Rooney, 2014). This study observed that stormwater wetlands were a marginal improvement over stormwater ponds but are inadequate in the short term to compensate for the loss of natural wetlands, in terms of biodiversity and ecological integrity value. When placed relative to naturally occurring wetlands, the difference becomes insignificant. Additional research comparing the primary and secondary productivity of natural wetlands and stormwater management facilities supports the conclusion that these two types of systems are functionally different on a fundamental level (Woodcock et al., 2010).

Design Improvements

Although not feasible to have constructed stormwater ponds provide the same wetland functions and values that may be replicated in mitigation, it is possible to improve the design by using the observations from ORAM. The purpose of design improvements would be to increase the complexity of ecological habitats, while maintaining the quality of services of flood control, water quality improvement and aesthetic values. In retention ponds, it was observed in Figure 11 that ponds less than an acre and greater than five acres, had similar total ORAM scores. Whereas detention ponds showed a positive correlation between area and resulting ORAM score. To construct ponds with higher functions and values and improve scores, it would be recommended that larger, less fragmented ponds be constructed as opposed to many small systems.

While the general setting of constructed stormwater systems will remain consistent, the distance and immediate adjacent buffer could be improved to lessen the impact from human development. For improved scoring, buffers around the wetland should average at least 82 feet (medium buffer). Also, it is recommended that a natural buffer be allowed to form 10 feet around the pond that is unaffected by mowing and treatment. In residential areas that see stormwater ponds as aesthetic features, this may not be seen as practical as unmaintained vegetation may be presented as neglect to the property and negatively affect property value.

A negative feature in many of the observed constructed stormwater ponds was the presence of invasive species such as cattails and reed canary grass. Invasive cattails are invasive are typically found in damp soil or shallow water where sufficient nutrients are available. They are commonly found along expressways, in artificial ditches and shallow ponds and at the edges of calm waters. These taxa also invade fens, wet meadows, wet prairies, and beach swales (OIPC, 2010). Narrow-leaved cattails establish dense stands and may be allelopathic, producing

chemicals which discourage growth of other plants. Cattails reproduce both by rhizomes and dispersal of large amounts of seeds. The flower head of the parent plant can produce 250,000 seeds, which are wind-dispersed and remain viable in the seed bank for up to 100 years (OIPC, 2010).

In many cases it is likely that cattails were intentionally planted to provide benefits of bank stability and water quality improvement even though they are considered invasive in Ohio. Selecting plants for stormwater management is not a simple process because stormwater systems are often affected by a number of environmental conditions that are not conducive to plant growth and survival. These environmental conditions include prolonged flooding, fluctuating water levels, sedimentation and pollutants (Shaw and Schmidt, 2003). To complicate matters, invasive species such as cattails are sometimes better adapted to these conditions and ongoing plant management may be important for the projects intended service success.

Different plants species vary greatly in their ability to assimilate toxins and pollutants into their stems and roots. With application in phytoremediation and wastewater cleansing, an increasing number of species are being investigated to determine their ability to assimilate pollutants and toxins. A study investigated the ability of five wetland species to take up zinc, lead and total petroleum hydrocarbons (TPH) into plant tissue (Seattle Metro, 1993). The species chosen for the study were common cattail (*Typha latifolia*), water flag (*Iris pseudacorus*), burreed (*Sparganium* spp.), blunt-spikerush (*Eleocharis ovata*) and hardstem bulrush (*Scirpus acutus*). Cattail was the most efficient at taking up pollutants, but concentrations of lead, zinc and TPH were highest in burred tissue. Cattail was more vigorous and therefore had a higher pollutant uptake per area of cover. (Shaw and Schmidt, 2003)

Ohio roadways and parking lots are salted heavily during winter months. During melting and rainfall events, salt can be washed into a stormwater system. Both purple loosestrife and cattails dominate many urban wetland and stormwater systems and their ability to germinate under high-salt conditions may contribute to their dominance (Shaw and Schmidt, 2003). Flooding can also influence plant competition by physically or physiologically damaging plants and by changing the physical and chemical environment of soils (Pollock et al. 1998). Some invasive species seem to thrive under conditions of flooding and fluctuating water levels. Studies have found that invasive species such as reed canary grass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*) can come to dominate wetlands that receive urban stormwater (Cooke et al. 1989). Variable water level and salt tolerance gives an advantage to some invasive species, and the combination of these factors may explain why so many urban wetlands and stormwater systems are dominated by invasive plants.

From an ecological perspective, a design change to improve the ORAM score of the stormwater ponds would be to establish native species and limit species such as cattails at each site. Plant species such as sweet flag (*Acorus americanus)*, swamp milkweed (*Asclepias incarnata)*, muskingum sedge (*Carex muskingumensis*, bristly sedge (*Carfex comosa*) and fox sedge (*Carex vulpinoidea)* are common native Ohio wetland plants that have similar structure to cattails and reed canary grass and are well adapted to inundation. But with the primary purpose of the ponds to be for the service of water quality, it is often not practical to spend additional money on establishing native species or more costly maintenance against invasive establishment. Removing cattails and not replacing the lost vegetation cover would be detrimental to the system. Although cattails are considered invasive, they do provide ecological benefits. Cattails provide nesting habitat for blackbirds and some duck species, as well as brood rearing cover.

They also provide habitat for insects that fish eat and protection for small fish. If choosing between a habitat that has no vegetation versus having the presence of cattails, the values cattails provide are still beneficial to the ecosystem. This is a limitation of ORAM, which deducts ecological value due to the presence of invasive species, which it considers to be replacing the presence of native species. It does not consider that the conditions of the stormwater ponds may be intolerable to native species or that the alternative would be having no vegetation. It would be more ecologically beneficial to ensure that constructed stormwater ponds have a wide littoral zone to allow for the establishment of emergent vegetation, regardless of whether the species is considered invasive or native.

Overall, as expected, the assessment quantitative scoring of wetlands identified the limitations of constructed stormwater ponds in comparison to reference wetlands. Due to the circumstances of the construction of the stormwater ponds, there are inevitable disturbances and alterations to the hydrology, substrate and habitat. However, creating larger ponds with wider riparian buffers and limiting disturbances such as mowing, water treatment and debris removal will improve the pond ecological values. Establishing undisturbed vegetation communities around and within the ponds will allow for improved habitat structure. Expanding the width of the littoral zone, the shallow shelf, will provide greater habitat for vegetation and animals such as fish, amphibians, and invertebrates. With these enhanced design changes and improvements, stormwater ponds may provide greater ecological benefits and better mitigate the ecological loss as a result of changing land cover in Delaware County.

SECTION 6

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Appendix A

Ohio Rapid Assessment Method Narrative Rating Score Sheet

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	NO Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	NO Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	NO Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	NO Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	NO Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	NO Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	NO Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	NO Go to Question 8b

8b	**Mature forested wetlands**. Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	NO Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands**. Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	NO Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	NO Go to Question 11
11	**Relict Wet Prairies**. Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	NO Complete Quantitative Rating

Appendix B

Ohio Rapid Assessment Method Quantitative Rating Score Sheet

Site:	Rater(s):	Date:

Metric 1. Wetland Area (size).

max 6 pts. subtotal

Select one size class and assign score.

- ☐ >50 acres (>20.2ha) (6 pts)
- ☐ 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- ☐ 10 to <25 acres (4 to <10.1ha) (4 pts)
- ☐ 3 to <10 acres (1.2 to <4ha) (3 pts)
- ☐ 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- ☐ 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- ☐ <0.1 acres (0.04ha) (0 pts)

Metric 2. Upland buffers and surrounding land use.

max 14 pts. subtotal

2a. Calculate average buffer width. Select only one and assign score. Do not double check.

- ☐ WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- ☐ MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- ☐ NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- ☐ VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.

- ☐ VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- ☐ LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- ☐ MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- ☐ HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

Metric 3. Hydrology.

max 30 pts. subtotal

3a. Sources of Water. Score all that apply.

- ☐ High pH groundwater (5)
- ☐ Other groundwater (3)
- ☐ Precipitation (1)
- ☐ Seasonal/Intermittent surface water (3)
- ☐ Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.

- ☐ 100 year floodplain (1)
- ☐ Between stream/lake and other human use (1)
- ☐ Part of wetland/upland (e.g. forest), complex (1)
- ☐ Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.

- ☐ >0.7 (27.6in) (3)
- ☐ 0.4 to 0.7m (15.7 to 27.6in) (2)
- ☐ <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.

- ☐ Semi- to permanently inundated/saturated (4)
- ☐ Regularly inundated/saturated (3)
- ☐ Seasonally inundated (2)
- ☐ Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.

- ☐ None or none apparent (12)
- ☐ Recovered (7)
- ☐ Recovering (3)
- ☐ Recent or no recovery (1)

Check all disturbances observed

- ☐ ditch
- ☐ tile
- ☐ dike
- ☐ weir
- ☐ stormwater input
- ☐ point source (nonstormwater)
- ☐ filling/grading
- ☐ road bed/RR track
- ☐ dredging
- ☐ other_____

Metric 4. Habitat Alteration and Development.

max 20 pts. subtotal

4a. Substrate disturbance. Score one or double check and average.

- ☐ None or none apparent (4)
- ☐ Recovered (3)
- ☐ Recovering (2)
- ☐ Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.

- ☐ Excellent (7)
- ☐ Very good (6)
- ☐ Good (5)
- ☐ Moderately good (4)
- ☐ Fair (3)
- ☐ Poor to fair (2)
- ☐ Poor (1)

4c. Habitat alteration. Score one or double check and average.

- ☐ None or none apparent (9)
- ☐ Recovered (6)
- ☐ Recovering (3)
- ☐ Recent or no recovery (1)

Check all disturbances observed

- ☐ mowing
- ☐ grazing
- ☐ clearcutting
- ☐ selective cutting
- ☐ woody debris removal
- ☐ toxic pollutants
- ☐ shrub/sapling removal
- ☐ herbaceous/aquatic bed removal
- ☐ sedimentation
- ☐ dredging
- ☐ farming
- ☐ nutrient enrichment

subtotal this page

last revised 1 February 2001 jjm

Site:	Rater(s):	Date:

subtotal first page

Metric 5. Special Wetlands.

max 10 pts. subtotal

Check all that apply and score as indicated.

- [ ] Bog (10)
- [ ] Fen (10)
- [ ] Old growth forest (10)
- [ ] Mature forested wetland (5)
- [ ] Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- [ ] Lake Erie coastal/tributary wetland-restricted hydrology (5)
- [ ] Lake Plain Sand Prairies (Oak Openings) (10)
- [ ] Relict Wet Prairies (10)
- [ ] Known occurrence state/federal threatened or endangered species (10)
- [ ] Significant migratory songbird/water fowl habitat or usage (10)
- [ ] Category 1 Wetland. See Question 1 Qualitative Rating (-10)

Metric 6. Plant communities, interspersion, microtopography.

max 20 pts. subtotal

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- [ ] Aquatic bed
- [ ] Emergent
- [ ] Shrub
- [ ] Forest
- [ ] Mudflats
- [ ] Open water
- [ ] Other_____

6b. horizontal (plan view) Interspersion.
Select only one.

- [ ] High (5)
- [ ] Moderately high(4)
- [ ] Moderate (3)
- [ ] Moderately low (2)
- [ ] Low (1)
- [ ] None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- [ ] Extensive >75% cover (-5)
- [ ] Moderate 25-75% cover (-3)
- [ ] Sparse 5-25% cover (-1)
- [ ] Nearly absent <5% cover (0)
- [ ] Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- [ ] Vegetated hummucks/tussucks
- [ ] Coarse woody debris >15cm (6in)
- [ ] Standing dead >25cm (10in) dbh
- [ ] Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

End of Quantitative Rating. Complete Categorization Worksheets.

Appendix C

HGM and Cowardin Wetland Classification

HGM Classification	Wetland Classification Description
Riverine	Riverine wetlands occur in flood plains and riparian corridors in association with stream channels. Dominant water sources are often overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands.
Depressional	Depressional wetlands occur in topographic depressions. Dominant water sources are precipitation, ground water discharge, and both interflow and overland flow from adjacent uplands.
Slope	Slope wetlands normally are found where there is a discharge of ground water to the land surface. They normally occur on sloping land; elevation gradients may range from steep hillsides to slight slopes.
Flats	Mineral flats are most common on interfluves, extensive relic lake bottoms, or large historic flood plain terraces where the main source of water is precipitation. They receive no ground water discharge, which distinguishes them from depressional and slope wetlands. Organic flats, or extensive peatlands, differ from mineral soil flats, in part because their elevation and topography are controlled by vertical accretion of organic matter.
Fringe	Estuarine fringe wetlands occur along coasts and estuaries and are under the influence of sea level. Lacustrine fringe wetlands are adjacent to lakes where the water elevation of the lake maintains the water table in the wetland.

Cowardin Classification	Wetland Classification Description
Marine	The Marine system consists of the open ocean overlying the continental shelf and its associated high-energy coastline.
Estuarine	The Estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The Estuarine system includes both estuaries and lagoons.
Riverine	The Riverine system includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, emergent vegetation, emergent mosses, or lichens. (2) habitats with water containing ocean-derived salts of 0.5 ppt or greater
Lacustrine	The Lacustrine system includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergent, emergent mosses or lichens with 30 percent or greater aerial coverage (3) total area of at least 8 hectares (20 acres). The Lacustrine system includes permanently flooded lakes and reservoirs, intermittent lakes, and tidal lakes with ocean derived salinities below 0.5 ppt.
Palustrine	The Palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ppt. The Palustrine system was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie.

Appendix D

Constructed Stormwater Pond and Reference Wetland Ohio Rapid Assessment Method Score Sheets

Site ID: POND-3093	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: <0.1 acres (0 pts)
Total: 0

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Very Narrow. Buffers average <32 ft (0 pts)
2b. Surrounding land use: High. Urban, industrial, open pasture, row cropping, mining, construction. (1 pt)
Total: 1

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: <15.7 inches (1 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 7

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor (1 pt)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 3

Metric 5. Special Wetlands
Category 1 wetland. Based off narrative rating (-10 pts)
Total: -10

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 1 Shrub: Forest: Mudflats: Open Water: Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Moderate 25-75% cover (-3 pts)
6d. Microtopography

Site ID: POND-3093	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: Standing dead debris: Amphibian breeding pools:
Total: 0

Quantatative Rating Score Summary	
Metric 1: Size	0 / 6
Metric 2. Buffers and surrounding land use	1 / 14
Metric 3. Hydrology	7 / 30
Metric 4. Habitat	3 / 20
Metric 5. Special Wetland Communities	-10 / 10
Metric 6. Plant communities, interspersion and microtopography	0 / 20
TOTAL SCORE:	1 / 100

Field Photos:

Site ID: POND-3096	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.1 to <0.3 acres (1 pt)
Total: 1

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Wide. Buffers average >164 (7 pts)
2b. Surrounding land use: Moderately High. Residential, fenced pasture, park, conservative tillage, new fallow field. (3 pts)
Total: 10

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: <15.7 inches (1 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 7

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor to Fair (2 pts)
4c. Habitat Alterations: Recovering (3 pts)
Other Habitat Disturbances:
Total: 6

Metric 5. Special Wetlands
Category 1 wetland. Based off narrative rating (-10 pts)
Total: -10

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 1 Shrub: Forest: Mudflats: Open Water: Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Extensive >75% cover (-5 pts)
6d. Microtopography

Site ID: POND-3096	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: Standing dead debris: Amphibian breeding pools:
Total: 0

Quantatative Rating Score Summary	
Metric 1: Size	1 / 6
Metric 2. Buffers and surrounding land use	10 / 14
Metric 3. Hydrology	7 / 30
Metric 4. Habitat	6 / 20
Metric 5. Special Wetland Communities	-10 / 10
Metric 6. Plant communities, interspersion and microtopography	0 / 20
TOTAL SCORE:	14 / 100

Field Photos:

Site ID: POND-3095	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.1 to <0.3 acres (1 pt)
Total: 1

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Medium. Buffers average 82 to <164 ft (4 pts)
2b. Surrounding land use: Moderately High. Residential, fenced pasture, park, conservative tillage, new fallow field. (3 pts)
Total: 7

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: <15.7 inches (1 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Regularly inundated or saturated (3 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 6

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor to Fair (2 pts)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 4

Metric 5. Special Wetlands
Category 1 wetland. Based off narrative rating (-10 pts)
Total: -10

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 1 Shrub: Forest: Mudflats: Open Water: Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Extensive >75% cover (-5 pts)
6d. Microtopography

Site ID: POND-3095	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: 1 Standing dead debris: Amphibian breeding pools:
Total: 0

Quantatative Rating Score Summary	
Metric 1: Size	1 / 6
Metric 2. Buffers and surrounding land use	7 / 14
Metric 3. Hydrology	6 / 30
Metric 4. Habitat	4 / 20
Metric 5. Special Wetland Communities	-10 / 10
Metric 6. Plant communities, interspersion and microtopography	0 / 20
TOTAL SCORE:	8 / 100

Field Photos:

Site ID: POND-3094	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.1 to <0.3 acres (1 pt)
Total: 1

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Medium. Buffers average 82 to <164 ft (4 pts)
2b. Surrounding land use: Moderately High. Residential, fenced pasture, park, conservative tillage, new fallow field. (3 pts)
Total: 7

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: <15.7 inches (1 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Regularly inundated or saturated (3 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 6

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor to Fair (2 pts)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 4

Metric 5. Special Wetlands
Category 1 wetland. Based off narrative rating (-10 pts)
Total: -10

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 1 Shrub: Forest: Mudflats: Open Water: Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Extensive >75% cover (-5 pts)
6d. Microtopography

Site ID: POND-3094	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: 1 Standing dead debris: Amphibian breeding pools:
Total: 0

Quantatative Rating Score Summary	
Metric 1: Size	1 / 6
Metric 2. Buffers and surrounding land use	7 / 14
Metric 3. Hydrology	6 / 30
Metric 4. Habitat	4 / 20
Metric 5. Special Wetland Communities	-10 / 10
Metric 6. Plant communities, interspersion and microtopography	0 / 20
TOTAL SCORE:	8 / 100

Field Photos:

Site ID: POND-3097	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.1 to <0.3 acres (1 pt)
Total: 1

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Medium. Buffers average 82 to <164 ft (4 pts)
2b. Surrounding land use: High. Urban, industrial, open pasture, row cropping, mining, construction. (1 pt)
Total: 5

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: <15.7 inches (1 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed:
Total: 8

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor to Fair (2 pts)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 4

Metric 5. Special Wetlands
Category 1 wetland. Based off narrative rating (-10 pts)
Total: -10

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 1 Shrub: Forest: Mudflats: Open Water: Other:
6b. Horizontal Interspersion (above view): Low (1 pt)
6c. Invasive Plant Score: Extensive >75% cover (-5 pts)
6d. Microtopography

Site ID: POND-3097	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: 1 Standing dead debris: Amphibian breeding pools:
Total: 0

Quantatative Rating Score Summary	
Metric 1: Size	1 / 6
Metric 2. Buffers and surrounding land use	5 / 14
Metric 3. Hydrology	8 / 30
Metric 4. Habitat	4 / 20
Metric 5. Special Wetland Communities	-10 / 10
Metric 6. Plant communities, interspersion and microtopography	0 / 20
TOTAL SCORE:	8 / 100

Field Photos:



Site ID: POND-3092	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.3 to <3 acres (2 pts)
Total: 2

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Narrow. Buffers average 32 to 82 ft (1 pt)
2b. Surrounding land use: Moderately High. Residential, fenced pasture, park, conservative tillage, new fallow field. (3 pts)
Total: 4

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: <15.7 inches (1 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Regularly inundated or saturated (3 pts)
3e. Modifications to Hydrologic Regime: Recovering (3 pts)
Disturbances observed:
Total: 8

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recovering (2 pts)
4b. Habitat Development: Poor to Fair (2 pts)
4c. Habitat Alterations: Recovering (3 pts)
Other Habitat Disturbances:
Total: 7

Metric 5. Special Wetlands
Category 1 wetland. Based off narrative rating (-10 pts)
Total: -10

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 1 Shrub: Forest: Mudflats: Open Water: Other:
6b. Horizontal Interspersion (above view): Low (1 pt)
6c. Invasive Plant Score: Extensive >75% cover (-5 pts)
6d. Microtopography

Site ID: POND-3092	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: 1 Coarse woody debris: 2 Standing dead debris: Amphibian breeding pools:
Total: 0

Quantatative Rating Score Summary	
Metric 1: Size	2 / 6
Metric 2. Buffers and surrounding land use	4 / 14
Metric 3. Hydrology	8 / 30
Metric 4. Habitat	7 / 20
Metric 5. Special Wetland Communities	-10 / 10
Metric 6. Plant communities, interspersion and microtopography	0 / 20
TOTAL SCORE:	11 / 100

Field Photos:

Site ID: POND-3089	Rater: David Binger	Date: Mar 7, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: <0.1 acres (0 pts)
Total: 0

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Narrow. Buffers average 32 to <82 (1 pt)
2b. Surrounding land use: Moderately High. Residential, fenced pasture, park, conservative tillage, new fallow field. (3 pts)
Total: 4

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: <15.7 inches (1 pts)
3c. Hydrological Connectivity: Part of riparian or upland corridor (1 pt)
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 8

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor to Fair (2 pts)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 4

Metric 5. Special Wetlands
Category 1 wetland. Based off narrative rating (-10 pts)
Total: -10

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 2 Shrub: Forest: Mudflats: Open Water: Other:
6b. Horizontal Interspersion (above view): Low (1 pt)
6c. Invasive Plant Score: Extensive >75% cover (-5 pts)
6d. Microtopography

Site ID: POND-3089	Rater: David Binger	Date: Mar 7, 2020

Vegetated hummucks / tussucks: Coarse woody debris: Standing dead debris: Amphibian breeding pools: 1
Total: 0

Quantatative Rating Score Summary	
Metric 1: Size	0 / 6
Metric 2. Buffers and surrounding land use	4 / 14
Metric 3. Hydrology	8 / 30
Metric 4. Habitat	4 / 20
Metric 5. Special Wetland Communities	-10 / 10
Metric 6. Plant communities, interspersion and microtopography	0 / 20
TOTAL SCORE:	6 / 100

Field Photos:



Site ID: RW-1	Rater: David Binger	Date: Mar 22, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.3 to <3 acres (2 pts)
Total: 2

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Wide. Buffers average 164 ft or more (7 pts)
2b. Surrounding land use: Very Low. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7 pts)
Total: 14

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts), Seasonal or intermittent surface water (3 pts)
3b. Water Depth: <15.7 inches (1 pts)
3c. Hydrological Connectivity: Part of riparian or upland corridor (1 pt), 100 year floodplain (1 pt), Between stream/lake and other human use (1 pt)
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: None or none apparent (12 pts)
Disturbances observed:
Total: 24

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: None or none apparent (4 pts)
4b. Habitat Development: Moderately Good (4 pts)
4c. Habitat Alterations: None or none apparent (9 pts)
Other Habitat Disturbances:
Total: 17

Metric 5. Special Wetlands
Mature Forested (5 pts)
Total: 5

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 1 Shrub: 2 Forest: 2 Mudflats: 1 Open Water: Other:
6b. Horizontal Interspersion (above view): Moderately High (4 pts)
6c. Invasive Plant Score: Absent (1 pt)

Site ID: RW-1	Rater: David Binger	Date: Mar 22, 2020

6d. Microtopography
Vegetated hummucks / tussucks: 1
Coarse woody debris: 3
Standing dead debris: 3
Amphibian breeding pools:

Total: 18

Quantatative Rating Score Summary	
Metric 1: Size	2 / 6
Metric 2. Buffers and surrounding land use	14 / 14
Metric 3. Hydrology	24 / 30
Metric 4. Habitat	18 / 20
Metric 5. Special Wetland Communities	5 / 10
Metric 6. Plant communities, interspersion and microtopography	17 / 20
TOTAL SCORE:	80 / 100

Field Photos:

Site ID: RW-2	Rater: David Binger	Date: Mar 22, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 3 to <10 acres (3 pts)
Total: 3

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Wide. Buffers average 164 ft or more (7 pts)
2b. Surrounding land use: Very Low. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7 pts)
Total: 14

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts), Seasonal or intermittent surface water (3 pts)
3b. Water Depth: >27.6 inches (3 pts)
3c. Hydrological Connectivity: Part of riparian or upland corridor (1 pt), 100-year floodplain (1 pt), Between stream/lake and other human use (1 pt)
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: None or none apparent (12 pts)
Disturbances observed:
Total: 26

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: None or none apparent (4 pts)
4b. Habitat Development: Good (5 pts)
4c. Habitat Alterations: None or none apparent (9 pts)
Other Habitat Disturbances:
Total: 18

Metric 5. Special Wetlands
Mature Forested (5 pts)
Total: 5

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: 2 Emergent: 1 Shrub: 2 Forest: 2 Mudflats: Open Water: 2 Other:
6b. Horizontal Interspersion (above view): Moderately Low (2 pts)
6c. Invasive Plant Score: Sparse 5-25% cover (-1 pt)

Site ID: RW-2	Rater: David Binger	Date: Mar 22, 2020

6d. Microtopography Vegetated hummucks / tussucks: 1 Coarse woody debris: 3 Standing dead debris: 2 Amphibian breeding pools: 1
Total: 17

Quantatative Rating Score Summary	
Metric 1: Size	3 / 6
Metric 2. Buffers and surrounding land use	14 / 14
Metric 3. Hydrology	26 / 30
Metric 4. Habitat	18 / 20
Metric 5. Special Wetland Communities	5 / 10
Metric 6. Plant communities, interspersion and microtopography	17 / 20
TOTAL SCORE:	83 / 100

Field Photos:

Site ID: POND-3091	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 3 to <10 acres (3 pts)
Total: 3

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Medium. Buffers average 82 to <164 ft (4 pts)
2b. Surrounding land use: High. Urban, industrial, open pasture, row cropping, mining, construction. (1 pt)
Total: 5

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: >27.6 inches (3 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 9

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor (1 pt)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 3

Metric 5. Special Wetlands
Total: 0

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: Shrub: Forest: Mudflats: Open Water: 2 Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Absent (1 pt)
6d. Microtopography

Site ID: POND-3091	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: Standing dead debris: Amphibian breeding pools:
Total: 3

Quantatative Rating Score Summary	
Metric 1: Size	3 / 6
Metric 2. Buffers and surrounding land use	5 / 14
Metric 3. Hydrology	9 / 30
Metric 4. Habitat	3 / 20
Metric 5. Special Wetland Communities	0 / 10
Metric 6. Plant communities, interspersion and microtopography	3 / 20
TOTAL SCORE:	23 / 100

Field Photos:

Site ID: POND-1697	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.3 to <3 acres (2 pts)
Total: 2

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Narrow. Buffers average 32 to 82 ft (1 pt)
2b. Surrounding land use: Moderately High. Residential, fenced pasture, park, conservative tillage, new fallow field. (3 pts)
Total: 4

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: >27.6 inches (3 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 9

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor (1 pt)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 3

Metric 5. Special Wetlands
Total: 0

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: 1 Emergent: Shrub: Forest: Mudflats: Open Water: 1 Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Absent (1 pt)
6d. Microtopography

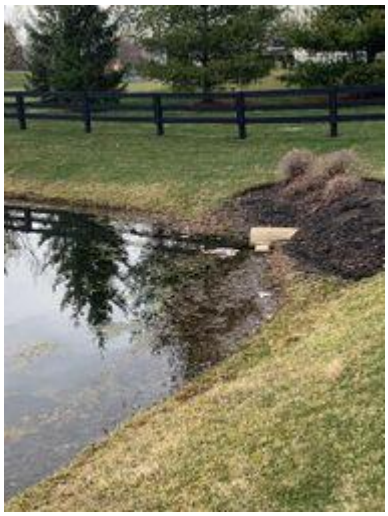
Site ID: POND-1697	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: Standing dead debris: Amphibian breeding pools:
Total: 3

Quantatative Rating Score Summary	
Metric 1: Size	2 / 6
Metric 2. Buffers and surrounding land use	4 / 14
Metric 3. Hydrology	9 / 30
Metric 4. Habitat	3 / 20
Metric 5. Special Wetland Communities	0 / 10
Metric 6. Plant communities, interspersion and microtopography	3 / 20
TOTAL SCORE:	21 / 100

Field Photos:





Site ID: POND-439	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.3 to <3 acres (2 pts)
Total: 2

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Medium. Buffers average 82 to <164 ft (4 pts)
2b. Surrounding land use: High. Urban, industrial, open pasture, row cropping, mining, construction. (1 pt)
Total: 5

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: <15.7 inches (1 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Regularly inundated or saturated (3 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 7

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor to Fair (2 pts)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 4

Metric 5. Special Wetlands
Total: 0

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 2 Shrub: Forest: Mudflats: Open Water: Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Moderate <75% and >25% (-3 pts)
6d. Microtopography

Site ID: POND-439	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: 1 Standing dead debris: Amphibian breeding pools:
Total: 3

Quantatative Rating Score Summary	
Metric 1: Size	2 / 6
Metric 2. Buffers and surrounding land use	5 / 14
Metric 3. Hydrology	7 / 30
Metric 4. Habitat	4 / 20
Metric 5. Special Wetland Communities	0 / 10
Metric 6. Plant communities, interspersion and microtopography	3 / 20
TOTAL SCORE:	21 / 100

Field Photos:



Site ID: POND-3090	Rater: David Binger	Date: Mar 7, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.1 to <0.3 acres (1 pt)
Total: 1

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Narrow. Buffers average 32 to <82 (1 pt)
2b. Surrounding land use: High. Urban, industrial, open pasture, row cropping, mining, construction. (1 pt)
Total: 2

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: >27.6 inches (3 pts)
3c. Hydrological Connectivity: Part of riparian or upland corridor (1 pt)
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 10

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor to Fair (2 pts)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 4

Metric 5. Special Wetlands
Total: 0

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 2 Shrub: Forest: Mudflats: Open Water: Other:
6b. Horizontal Interspersion (above view): Low (1 pt)
6c. Invasive Plant Score: Moderate 25-75% cover (-3 pts)
6d. Microtopography

Site ID: POND-3090	Rater: David Binger	Date: Mar 7, 2020

Vegetated hummucks / tussucks: Coarse woody debris: 1 Standing dead debris: Amphibian breeding pools: 1
Total: 1

Quantatative Rating Score Summary	
Metric 1: Size	1 / 6
Metric 2. Buffers and surrounding land use	2 / 14
Metric 3. Hydrology	10 / 30
Metric 4. Habitat	4 / 20
Metric 5. Special Wetland Communities	0 / 10
Metric 6. Plant communities, interspersion and microtopography	1 / 20
TOTAL SCORE:	18 / 100

Field Photos:



Site ID: POND-127	Rater: David Binger	Date: Mar 7, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.3 to <3 acres (2 pts)
Total: 2

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Narrow. Buffers average 32 to 82 ft (1 pt)
2b. Surrounding land use: Moderately High. Residential, fenced pasture, park, conservative tillage, new fallow field. (3 pts)
Total: 4

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: >27.6 inches (3 pts)
3c. Hydrological Connectivity: Part of riparian or upland corridor (1 pt)
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 10

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor to Fair (2 pts)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 4

Metric 5. Special Wetlands
Total: 0

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: 1 Shrub: Forest: Mudflats: Open Water: 2 Other: Muskrat / Bull frogs present
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Nearly absent <5% cover (0 pts)
6d. Microtopography

Site ID: POND-127	Rater: David Binger	Date: Mar 7, 2020

Vegetated hummucks / tussucks: Coarse woody debris: 1 Standing dead debris: 1 Amphibian breeding pools: 2
Total: 5

Quantatative Rating Score Summary	
Metric 1: Size	2 / 6
Metric 2. Buffers and surrounding land use	4 / 14
Metric 3. Hydrology	10 / 30
Metric 4. Habitat	4 / 20
Metric 5. Special Wetland Communities	0 / 10
Metric 6. Plant communities, interspersion and microtopography	5 / 20
TOTAL SCORE:	25 / 100

Field Photos:



Site ID: POND-796	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.3 to <3 acres (2 pts)
Total: 2

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Very Narrow. Buffers average <32 ft (0 pts)
2b. Surrounding land use: High. Urban, industrial, open pasture, row cropping, mining, construction. (1 pt)
Total: 1

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: >27.6 inches (3 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 9

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor (1 pt)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 3

Metric 5. Special Wetlands
Total: 0

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: Shrub: Forest: Mudflats: Open Water: 1 Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Absent (1 pt)
6d. Microtopography

Site ID: POND-796	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: Standing dead debris: Amphibian breeding pools:
Total: 2

Quantatative Rating Score Summary	
Metric 1: Size	2 / 6
Metric 2. Buffers and surrounding land use	1 / 14
Metric 3. Hydrology	9 / 30
Metric 4. Habitat	3 / 20
Metric 5. Special Wetland Communities	0 / 10
Metric 6. Plant communities, interspersion and microtopography	2 / 20
TOTAL SCORE:	17 / 100

Field Photos:

Site ID: POND-1997	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 3 to <10 acres (3 pts)
Total: 3

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Narrow. Buffers average 32 to <82 (1 pt)
2b. Surrounding land use: High. Urban, industrial, open pasture, row cropping, mining, construction. (1 pt)
Total: 2

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: >27.6 inches (3 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 8

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor (1 pt)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 3

Metric 5. Special Wetlands
Total: 0

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: Emergent: Shrub: Forest: Mudflats: Open Water: 2 Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Absent (1 pt)
6d. Microtopography

Site ID: POND-1997	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: Standing dead debris: Amphibian breeding pools:
Total: 3

Quantatative Rating Score Summary	
Metric 1: Size	3 / 6
Metric 2. Buffers and surrounding land use	2 / 14
Metric 3. Hydrology	8 / 30
Metric 4. Habitat	3 / 20
Metric 5. Special Wetland Communities	0 / 10
Metric 6. Plant communities, interspersion and microtopography	3 / 20
TOTAL SCORE:	19 / 100

Field Photos:

Site ID: POND-2015	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.3 to <3 acres (2 pts)
Total: 2

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Narrow. Buffers average 32 to 82 ft (1 pt)
2b. Surrounding land use: High. Urban, industrial, open pasture, row cropping, mining, construction. (1 pt)
Total: 2

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: >27.6 inches (3 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 10

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor (1 pt)
4c. Habitat Alterations: Recovering (2 pts)
Other Habitat Disturbances:
Total: 4

Metric 5. Special Wetlands
Total: 0

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: 1 Emergent: Shrub: Forest: Mudflats: Open Water: 1 Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Absent (1 pt)
6d. Microtopography

Site ID: POND-2015	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: Standing dead debris: Amphibian breeding pools:
Total: 2

Quantatative Rating Score Summary	
Metric 1: Size	2 / 6
Metric 2. Buffers and surrounding land use	2 / 14
Metric 3. Hydrology	10 / 30
Metric 4. Habitat	4 / 20
Metric 5. Special Wetland Communities	0 / 10
Metric 6. Plant communities, interspersion and microtopography	2 / 20
TOTAL SCORE:	20 / 100

Field Photos:

Site ID: POND-1686	Rater: David Binger	Date: Mar 15, 2020

Ohio Rapid Assessment Method for Wetlands v. 5.0 Quantitative Rating Field Form

Survey123 Developed By: David Binger – Montana State University

Metric 1. Wetland Area
Wetland Area: 0.3 to <3 acres (2 pts)
Total: 2

Metric 2. Upland Buffers and Surrounding Land Use
2a. Upland Buffers: Narrow. Buffers average 32 to 82 ft (1 pt)
2b. Surrounding land use: Moderately High. Residential, fenced pasture, park, conservative tillage, new fallow field. (3 pts)
Total: 4

Metric 3. Hydrology
3a. Sources of Water: Precipiation (1 pts)
3b. Water Depth: >27.6 inches (3 pts)
3c. Hydrological Connectivity:
3d. Duration Inundation or Saturation: Semi- to permanently inundated or saturated (4 pts)
3e. Modifications to Hydrologic Regime: Recent or no recovery (1 pt)
Disturbances observed: Stormwater Input
Total: 9

Metric 4. Habitat Alteration and Development
4a. Substrate Disturbances: Recent or no recovery (1 pt)
4b. Habitat Development: Poor (1 pt)
4c. Habitat Alterations: Recent or no recovery (1 pt)
Other Habitat Disturbances:
Total: 3

Metric 5. Special Wetlands
Total: 0

Metric 6. Plant Communities, Interspersion and Microtopography
6a. Wetland Vegetation Communities Aquatic bed: 1 Emergent: Shrub: Forest: Mudflats: Open Water: 1 Other:
6b. Horizontal Interspersion (above view): None (0 pts)
6c. Invasive Plant Score: Absent (1 pt)
6d. Microtopography

Site ID: POND-1686	Rater: David Binger	Date: Mar 15, 2020

Vegetated hummucks / tussucks: Coarse woody debris: Standing dead debris: Amphibian breeding pools:
Total: 3

Quantatative Rating Score Summary	
Metric 1: Size	2 / 6
Metric 2. Buffers and surrounding land use	4 / 14
Metric 3. Hydrology	9 / 30
Metric 4. Habitat	3 / 20
Metric 5. Special Wetland Communities	0 / 10
Metric 6. Plant communities, interspersion and microtopography	3 / 20
TOTAL SCORE:	21 / 100

Field Photos: